

A feasibility assessment of the application of environmental valuation methods to Rand Water open space

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By

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A. DECLARATION



I declare that this dissertation entitled “A feasibility assessment of the application of environmental valuation methods to Rand Water open space” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature: _____

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(Rinus Boucher, student number: 36678201)

B. ACKNOWLEDGEMENTS

I would first and foremost like to thank God, my Heavenly Father, for granting me the opportunity, courage and tenacity to pursue this research project. The moments of doubt, uncertainty and lack of confidence were overcome by the abundance of His grace and mercy. My wife provided invaluable support to me where I often had to prioritise my studies over husbandly duties. A recent question in desperation from my wife of "*When will I have my husband back?!*" convincingly proclaims the impact of my absence. To Meg-Teagan and Jodi, thank you for allowing Daddy his extended time in the study when you'd rather have preferred me to chase you around the home with imminent tickles or simply spend relaxed time exploring new places where fun can be found. Daddy will make it up to you...

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C. ABSTRACT

Rand Water contracted UNISA to develop a monetary valuation method for its open spaces and their inherent ecological functions. This study began by reviewing existing contemporary definitions of open space in South Africa and then identifying their key characteristics. The research project then looked at the economic contribution that open spaces make to the economy as a basis for environmental valuation. By determining the economic value of open spaces, decision makers can be informed about the importance of open space provision, preservation and maintenance.

The project applied the participatory action research method which requires the active participation of focus groups. The focus groups consisted of Rand Water employees who deal with open spaces in their respective areas of work. During the literature review and problem formulation the various limitations of environmental valuation methods became evident. It became apparent that the development of new valuation methods would not be possible before existing valuation methods had been tested to see if they could feasibly be applied to open space in the Rand Water context. A literature review also determined that open space valuation studies in South Africa are very limited, which made it difficult to formulate a localised context. It was furthermore found that environmental valuers prefer to use the contingent valuation, travel cost and hedonic pricing methods. These methods rely on revealed and stated preferences of open space users to infer an economic value for an open space. Access to Rand Water's open spaces is largely limited owing to strict access control. The excludability of open space users therefore hampers the generation of sufficient data to apply revealed and stated preference valuation methods. On the basis of this finding, it was decided to eliminate the contingent valuation and travel cost methods from this study.

It was decided to apply the constraint composition theory, under the grounded theory model, to study the constraints or moderators which could affect the feasibility of environmental valuation application to Rand Water open spaces. Four moderators were then identified which could influence the outcome of the feasibility assessment. These are the limitations of the methods, the limitations of the legal framework, the limitations of the user and the limitations of the study area.

It was found that the limitations of the methods were a moderator owing to their inherent data requirements. The only suitable valuation methods

were found to be market based as they were not influenced by the excludability factor. These methods include the replacement cost, damage cost avoided, restoration cost and defensive expenditure valuation methods. The focus group was introduced to each method by participating in a method application exercise. Questionnaires regarding each method were completed to test variables.

The legal framework was found not to be a moderator since even though there are limited direct provisions in legislation to mandate environmental valuation, there are legal principles which require economic impacts to be measured and damage to the environment to be estimated. These principles in themselves have supported litigation cases and the mere admission of environmental value estimates in court as evidence and support to a case therefore sets the required legal precedence and mandates further application.

The user was found not to be a moderator. Feedback from the focus groups as well as an environmental resource economics workshop held at the Gauteng Department of Agriculture, Conservation and Environment showed that users understood environmental valuation principles, their benefits and limitations. With training, environmental scientists can apply these methods.

The study area was found to be a moderator. The limited access for potential open space users, limited harvesting, limited agriculture and limited open space categories result in limited values that can be measured.

In conclusion, it was found that not all environmental valuation methods can be applied to Rand Water open space owing to inherent limitations of the methods and the study area. Only market-based methods were found to be suitable for use on Rand Water open space. Notwithstanding the limitations of the methods and study area, which restrict the ability of valuers to obtain a total economic value for Rand Water open space, the available suite of methods can provide an indicator of value for environmental goods and services that flow from the utility's open spaces. It was concluded that the application of environmental valuation methods to Rand Water open space is feasible within the context of the identified limitations.

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G. GLOSSARY

Active recreation: Refers to organised and guided recreation activities which require the active participation of an individual, are often in a team environment and may have elements of competition but exclude organised competitive sport. This includes ball games, swimming and the performing arts (Edginton, Hanson, Edginton & Hudson, 1998:7; Shivers & Hjelte, 1973:41).

Bioregion: A bioregion, sometimes called an ecoregion, is a relatively large area of land or water that contains a geographically distinct assemblage of natural communities (WWF, 2008).

Carbon sequestration (fixing): A process whereby atmospheric CO₂ is captured and stored in complex and stable organic or mineral compounds – sometimes referred to as carbon sinks - through various biochemical or geochemical mechanisms (GreenFacts, 2008).

Clean Development Mechanism: A process established under the Kyoto Protocol which allows developed nations to offset their carbon emissions by investing in carbon reducing projects in developing countries (Perman, Ma, McGilvray & Common, 2003:420; Department of Minerals and Energy, 2007).

Conservation Plan 2 (C-Plan 2): The Gauteng Department of Agriculture, Conservation and Environment's C-Plan focuses on the mapping and management of biodiversity priority areas within Gauteng. The C-Plan includes protected areas, irreplaceable and important sites owing to the presence of Red Data species, endemic species and potential habitat for these species to occur (GDACE, 2005).

Consumptive use value: This value is obtained from the economic benefits associated with the direct harvesting of goods from an open space (Turpie, Joubert, Van Zyl, Harding & Leiman, 2001:12).

Contingent valuation method (CVM): A valuation method that uses a hypothetical scenario put to respondents, which tests their willingness to pay or willingness to accept compensation for this scenario and projects the median results over the relevant population to obtain a value (Perman *et al.*, 2003:420).

Damage cost avoided method: A valuation method that uses the damage cost avoided of a defined area, owing to the presence of a particular environmental function, as a proxy for value of this function (King & Mazzotta, 2006:1).

Defensive expenditure method: A valuation method that uses the cost of maintaining an environmental function to prevent damage or degradation as a proxy for value (Turpie *et al.*, 2001:18).

Economic value: This is an estimate of the sum of consumer surplus plus producer surplus, less any costs associated with the good or service being consumed or used, expressed in monetary terms. The International Valuation Standards Committee (2001:85) states that value is not a fact but an estimate of the most likely price that will be paid for a good or service. Environmental goods and services also have an economic value despite market failure (King & Mazzotta, 2006:1; Hornby, 1995:1319).

Empirical: Based on observation or experiment and not on theory (Hornby, 1995:377).

Environmental goods: These are tangible goods or items which are collected or harvested from the environment for consumption and include flowers, firewood, plants, water and reeds (Turpie *et al.*, 2001:16).

Environmental impact assessment (EIA): The environmental impact assessment process as outlined in the Environmental Impact Assessment Regulations under the National Environmental Management Act 107 of 1998.

Environmental law: Body of legislation consisting of complex and interrelating statutes, common law, treaties, conventions, regulations and policies with the objective of protecting the environment from human activities which may endanger, impact or affect it in a negative way (Barrow, 2006:126-127; also refer to Lazarus, 2004:1-3).

Environmental resource economics: The study of the interrelationship between economics and the environment (Perman *et al.*, 2003:8).

Environmental services (also ecosystem services): Refers to the beneficial outcomes, for the natural environment or people, which result from ecosystem functions. Some examples of ecosystem services are support of the food chain and the provision of clean water or scenic views (King & Mazzotta, 2006:1).

Environmental valuation: The process of determining the flow of economic benefits or detriments from environmental goods and services (Perman *et al.*, 2003:10-11; Turpie *et al.*, 2001:15).

Environmental value: The estimated monetary benefit or detriment obtained from the consumption of environmental goods and services by society (Turpie *et al.*, 2001:11).

Epistemology: Refers to the science of knowledge; how and to what extent the student obtains it (London University, 2005).

Excludability: Refers to whether agents can be prevented from consuming (Perman *et al.*, 2003:126).

Existence value: The comfortable knowledge of the existence of a resource (Perman *et al.*, 2003:402).

GDACE: Gauteng Department of Agriculture, Conservation and Environment.

Grounded theory research: The inductive discovery of theory grounded in systematically analysed data (Haig, 1995:1).

Hedonic pricing method: A valuation method that measures the positive (or negative) effects an environmental service has on property prices and uses the measured premium of the total affected area as a proxy for value (Turpie *et al.*, 2001:19;Perman *et al.*, 2003:435-436).

Indirect use value: The economic benefits that society obtains from the ecological services and functions that open spaces provide (Turpie *et al.*, 2001:12).

Inductive: Sometimes used as 'inductive reasoning'; a method of logical reasoning that obtains or discovers general laws from particular facts or examples (Hornby, 1995:607).

Local Agenda 21: A programme that provides a framework for implementing sustainable development at local level – first described in Agenda 21, the global action plan for sustainability agreed at the United Nations Conference on Environment and Development in 1992 (the Rio Earth Summit) (Australian Government Department of the Environment and Heritage, 2005).

Market failure: The inability of a market system to attach an appropriate value to a good or service owing to numerous factors (Perman *et al.*, 2003:124-126).

Metropolitan/Municipal Open Space System (MOSS): An information system for a particular municipal area concerning its open space network and related attributes (see Chittenden, Nicks, De Villiers & Cape Metropolitan Council, 2000; Environmental Branch Development and Planning Service Unit, 1999).

Moderator: A variable which acts as a constraint on the problem solution (Haig, 1995:2; Gen, 2004:56-59 within the context of constraint composition theory).

Multidisciplinary: The combination of many academic approaches, fields, or methods applied to a problem to achieve a reliable and holistic solution (Wordinfo, 2008).

Non-consumptive use value: A value that is obtained from the use of an open space that does not involve harvesting or collecting of any goods (Turpie *et al.*, 2001:12).

Ontology: The empirical view (empiricism) of ontology describes it as a branch of thought concerned with the observation of the nature of existence and evaluation thereof in relation to facts (Hornby, 1995:810; Scribner, 1999).

Open space: Various contemporary definitions discussed in section 1.2.1.

Option value: The value that people place on reserving the option to use a resource in the future (Perman *et al.*, 2003:402).

Participatory action research (PAR): A systematic enquiry that is collective, collaborative, self-reflective, critical and undertaken by the participants of the enquiry. The goals of this research are the understanding of practice and the articulation of rationale or philosophy of practice in order to improve practice (McCutcheon & Jung, 1990:148).

Passive recreation: Refers to self-directed and unstructured recreation activities performed by the individual at free will. These include walking, hiking, visiting botanical gardens, reading and fishing (Edginton *et al.*, 1998:7; Shivers & Hjelte, 1973:41).

Precautionary principle: Refers to proactive planning to ensure that preventative action is taken in the face of uncertainty, the burden of proof is shifted to the proponents of a development and a wide range of alternatives are explored to attempt avoiding unwanted impacts, and to increase public participation in decision making (Barrow, 2006:33).

Property valuation: Refers to the estimation of the market value of a property by property valuers (IVSC, 2001:29-30, 34).

Rand Water: The water utility company responsible for supplying bulk water to municipalities, mines and industry in Gauteng and portions of the North West, Mpumalanga and Free State provinces.

Recreation: Refers to a worthwhile, socially accepted leisure experience that provides immediate and inherent satisfaction to the individual who voluntarily participates in an activity (Edginton *et al.*, 1998:7).

Relevance rating: An assessment of the applicability of methods to the Rand Water operations and its principal mandate of water provision and conservation (deduced by the researcher from the project brief and context of this research project).

Replacement (substitute) cost method: A valuation method that uses the cost of replacing an environmental service with an artificial one which replicates that function and uses this cost as a proxy for value (King & Mazzotta, 2006:1; Turpie *et al.*, 2001:18).

Restoration cost method: A valuation method that uses the cost of restoring an environmental function back to its original and pristine state as a proxy for value (King & Mazzotta, 2006:1).

Suitability rating: An assessment of the applicability of methods to Rand Water's unique open spaces.

Sustainable development: Development that has integrated social, economic and environmental factors into planning, implementation and decision making to ensure that it serves present and future generations (Holm Jordaan Group & Strategic Environmental Focus, 2005:ix).

Travel cost method (TCM): A valuation method that uses the travel and subsistence expenses people incur to get to and experience a recreation amenity, as a proxy for value (Perman *et al.*, 2003:411).

Urban edge: A proverbial line that determines the outer limit of permissible urban development and based on numerous criteria such as municipal boundaries, geophysical properties of an area, water bodies, land ownership, and the presence and availability of municipal infrastructure and services (Western Cape Department of Environmental Affairs and Development Planning, 2005:8).

User: The person who, in the context of this study, will apply the environmental valuation methods to determine the economic value of an open space.

Use value: A value that people place on the direct or indirect use of an environmental good or service (Perman *et al.*, 2003:402; Turpie *et al.*, 2001:12).

Valuer: A person registered with the South African Council for the Property Valuers Profession as required by the Property Valuers Profession Act 47 of 2000.

H. ABBREVIATIONS

| | |
|----------|---------------------------------------------------------------------------------------------------------|
| CDM | Clean Development Mechanism |
| CER | Certified emission reduction |
| C-Plan 2 | Conservation Plan 2 |
| CVM | Contingent valuation method |
| DMOSS | Durban Metropolitan Open Space System |
| DOE | Designated operational entity |
| EIA | Environmental impact assessment |
| EMF | Environmental management framework |
| ERE | Environmental resource economics |
| GDACE | Gauteng Department of Agriculture, Conservation and Environment |
| GDP | Gross domestic product |
| GNP | Gross national product |
| GPI | Genuine progress indicator |
| HPM | Hedonic pricing method |
| IAP | Interested and affected party |
| ISEW | Index of sustainable economic welfare |
| IVSC | International Valuation Standards Committee |
| IUCN | World Conservation Union |
| MOSS | Metropolitan/Municipal Open Space System |
| NDP | National domestic product |
| NEMA | National Environmental Management Act 107 of 1998 |
| NYC | New York City |
| PAR | Participatory action research |
| SACPV | South African Council for the Property Valuers Profession |
| SATAM | South African tree appraisal method |
| SEA | Strategic environmental assessment |
| SEEA | United Nations <i>Handbook of national accounting: Integrated environmental and economic accounting</i> |
| SNA | Standard national account |
| TCM | Travel cost method |
| TIES | The International Ecotourism Society |
| UN | United Nations |
| UNCED | United Nations Conference on Environment and Development |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNISA | University of South Africa |
| WSSD | World Summit on Sustainable Development |
| WTA | Willingness to accept [compensation] |
| WTP | Willingness to pay |

I. KEYWORDS

Environmental law; environmental valuation; open space valuation; environmental resource economics; environmental valuation methods

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CHAPTER 1: RESEARCH BACKGROUND

1.1 Background

Rand Water was established in 1903 and has supplied Gauteng and its cities with bulk water since then (Rand Water, n.d.). The Rand Water Board was given legal authority for the exploitation of water, could raise loans and arrange for their repayment, as well as implement tariffs for the sale of water (Rand Water, n.d.). Vast expanses of pipelines, servitudes, water purification plants, pump stations and water towers make up the infrastructure of Rand Water. There is employee housing with sport and recreation facilities located at some of its larger operations, such as the Zuikerbosch water treatment plant. The property portfolio of Rand Water is extensive considering the servitudes, staff housing and recreational facilities that support its operations. During 2007, Rand Water distributed a total of 963 965 megalitres of water to its customers (Rand Water, n.d). It has, in addition to its mandate to provide potable water, diversified into other areas to meet its responsibilities towards the communities it serves.

These activities include (Rand Water, n.d.):

- “Assisting local authorities and consumers to reduce communities’ water costs by fixing leaks in old or damaged infrastructure and promoting water-saving devices such as dual-flush toilets and aerated showerheads.
- Safeguarding future supply through monitoring the environment and managing the catchment area through projects which improve the quality and quantity of raw water sources. This includes removing ‘thirsty’ alien plants, rehabilitating wetlands, controlling pollution and reducing erosion. In this manner securing water quality for human consumption.
- Helping improve delivery of water and sanitation services by working with various tertiary education bodies to train Local Authorities officials in the skills needed for successful public and private partnerships.”

From these activities it is evident that Rand Water is committed to environmental stewardship and research and development.

Rand Water is similar to other government utilities in being under pressure to provide goods and services at an affordable rate and of regulated quality. This means that there is a constant review of operational costs with reference to its core functions as an efficiency sustenance exercise. Rand Water owns several portions of land as part of its estates portfolio and is responsible for their management and maintenance. However, the question may therefore be asked whether these open spaces perform a function of any economic value that can be aligned with or complement Rand Water's core business. If these open spaces are not of economic value, it would not be strategically sensible to retain them as non-performing assets. However, decisions should not be made purely on the market value of the property, but also need to include environmental values. If the economic value of these open spaces could be calculated to include the total economic value of all environmental goods and services that proceed from the open spaces, and not just the property market value, this would enable informed decisions to be made that would more likely be in favour of their retention.

Rand Water therefore contracted the University of South Africa (UNISA), through a tender process, to develop a valuation method for its private open space network (annexure D). This study aims to review existing environmental valuation methods to establish the most applicable methods within the Rand Water context and make recommendations for further research with regard to the refinement of the methods. The study examines the current definitions of open space and the challenges faced by open spaces, and explore the possible interventions that environmental valuation can provide. This forms part of an MSc research project focused on refining these 'applicable methods' through a process of field trials guided by the participatory action research methodology. The project also aims to establish the feasibility of the application of environmental valuation methods to the Rand Water open space network, which will suggest possible areas of further research and method development.

The Rand Water context and its terms of reference for this study has formed the basis of selecting and, where possible, developing applicable valuation methods.

The terms of reference are as follows:

- The research aims to develop an applicable environmental valuation method or to refine existing methods that could determine an economic value of open space and its ecosystem services within the Rand Water property portfolio.

- Such a method should be accessible in terms of ease of use. The majority of environmental valuation methods have been developed within the economics fraternity, and the application of these methods is to a large degree reliant on an understanding of economics and related theory (Perman *et al.*, 2003:xiv). The researcher takes the precautionary standpoint that environmental science students are in general not exposed at length to resource economics as subject matter. Ease of use also relates to the availability of required data, which is needed for the application of the valuation method to ensure credibility of results. Extensive surveys can be costly and time-consuming. The valuation methodology package should therefore already have data available to the practitioner, and calculation could be aided by computer software to ensure cost- and time-effective production of valuation results. The valuation method must be able to assess social value and environmental services, such as wetland functions, as required by the original research tender (annexure D).

In order to determine the context of Rand Water open space, employees from Rand Water were requested to provide feedback to certain questions (see section 4.5). Based on the outcome of these questionnaires, the following context can be delineated for Rand Water open space:

- Land with limited public accessibility and land with restricted access that may only be used for recreation and leisure activities by Rand Water employees. The exceptions are limited to non-process related land that functions as natural or undeveloped open space and where access control is not critical.
- Land on which public harvesting of natural resources (wood, plants, fruit, flowers and animals) on these open spaces is mostly prohibited, but uncontrolled harvesting still occurs on some sites.
- Land on which commercial agriculture, including crop production and grazing, is limited to a few exceptions.

1.2 Introduction to the importance of open space

1.2.1 Defining open space

It is important to have a sound understanding of the term 'open space' and what it encompasses in the context of this study. A review of South African definitions is necessary before any particular definition is adopted.

- Mogale City Urban Open Space Project (Mogale City Local Municipality, 2003):

“Any undeveloped vegetated land within and beyond the urban edge, belonging to any of the following six open space categories: ecological, social, institutional, heritage, agricultural and prospective (degraded land).”

- Cape MOSS (Chittenden, Nicks, De Villiers & Cape Metropolitan Council, 2000):

“Open space is principally the unbuilt component inside the urban edge, that serves a variety of purposes and functions.”

- Durban Metropolitan/Municipal Open Space System (MOSS) (Environmental Branch Development and Planning Service Unit, 1999):

Two types of open space were identified for the Durban MOSS:

Urban open spaces

“... the human made or legally designated places and areas within the Durban Metropolitan Area (DMA) that are developed for community use. They include parks, sports fields, agricultural fields, streets, town squares, road reserves, servitudes for services such as electricity transmission line, dams, private gardens.”

Natural open spaces

“... the remaining undisturbed natural and undeveloped areas within the DMA. They are the areas that contain the core terrestrial, freshwater, estuarine and marine ecosystems. These ecosystems include land cover types such as grasslands, forests, beaches, estuaries, rivers, wetlands.”

Instead of drafting a new definition of open space, the available definitions will be summarised to capture the key characteristics of open space that will contextualise it for this environmental valuation study. Open space is therefore regarded as the following:

- Public or private land within or outside the ‘urban edge’ that is mostly vegetated and may contain water bodies such as rivers, dams, wetlands or estuaries.

- Land that is undeveloped and in a natural state or has been landscaped to function as an aesthetic area and/or recreational facility and/or sporting facility.
- Land that is purposefully and in most cases legally set aside for conservation or zoned as ‘open space’, ‘agricultural’ land or ‘undetermined’.

These criteria may not be all-encompassing and may not be suitable for all scenarios, but nonetheless set a reference framework for this study.

1.2.2 The open space ‘crisis’

Open space in South Africa is increasingly under pressure as urban areas expand and densify (see figure 1.1) (Holm Jordaan Group & Strategic Environmental Focus, 2005:1, 14-18, Department of Environmental Affairs and Tourism, 2006:110, 247-248, Environmental Branch Development and Planning Service Unit, 1999:11). Open space plays an important role in a developing country such as South Africa. Reality, however, dictates that housing and basic infrastructure provisions are higher priorities in the context of limited resources (Department of Environmental Affairs and Tourism, 2006:xviii; National Treasury, 2007:43; Van Zyl, Leiman & Jansen, 2004:31). The general understanding among environmentalists and parks managers is that open space is necessary for the long-term sustainability of cities (Turpie *et al.*, 2001:85; Department of Environmental Affairs and Tourism, 2006:247; Saayman, 1997:77; also see Bates & Santerre, 2001; Geoghegan, 2002, and Swanwick, Dunnet & Woolley, 2003).

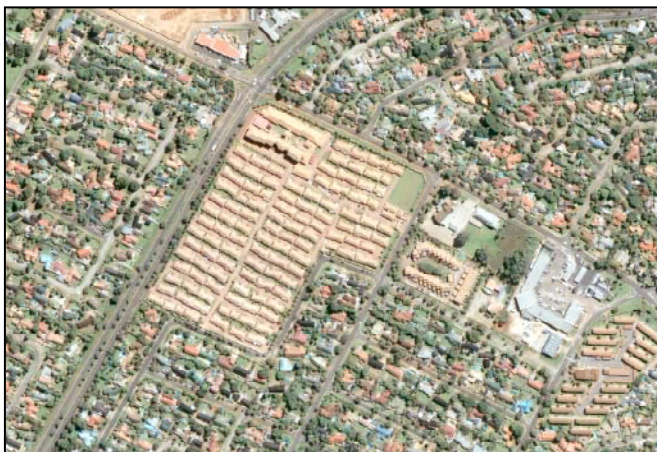


Figure 1.1 Urban densification with little provision for open space (Mogale City Local Municipality, 2007)

The benefits of open spaces have been well researched and include the following in the urban context (Fausold, 1999:307-320; Holm Jordaan Group & Strategic Environmental Focus, 2005:7; Naidoo, 2003:2-11; PricewaterhouseCoopers, 2003:4):

- Open space offers opportunities for active and passive recreation, which in turn reduces destructive and antisocial behaviour, builds family cohesiveness, promotes good psychological and physical well-being, and produces 'upstream' savings in health services owing to increased physical activity through recreation.
- Open space and recreation facilities are significant economic generators as they promote spending on leisure travel, sport and recreation equipment, draw tourism and act as employment generators.
- Open space is often a place of learning, especially where the natural environment is introduced in an interactive manner, and it enhances people's understanding of their natural environment and environmental issues (see figure 1.2).
- Open space maintains ecosystems and preserves biodiversity, protects endangered fauna and flora species, and provides ecosystem services such as clean water and air.



Figure 1.2 Open spaces provide opportunities for environmental education

While most of these benefits appear obvious and necessary for sustainable development, the question has to be asked whether current management practice recognises these benefits.

A number of metropolitan and larger local municipalities now have open space planning regimes in place, such as a MOSS and open space framework, which inform planners of the status of open space in terms of size, connectivity, quantity and relationship with surrounding land uses (Chittenden *et al.*, 2000; Environmental Branch Development and Planning Service Unit, 1999; Strategic Environmental Focus, 2003; Holm Jordaan & Strategic Environmental Focus, 2005; Department of Environmental Affairs and Tourism, 2006:110, 247-248). These planning instruments have not always been present in South Africa and were mostly initiated through Local Agenda 21, after the United Nations Conference on Sustainable Development held in Rio de Janeiro in 1992 (Environmental Branch Development and Planning Service Unit, 1999).

South Africa's open space coverage standards have lagged behind international averages in that the former Transvaal province proposed 1.2 ha per 1 000 population according to the City of Tshwane Metropolitan Municipality's open space framework (Holm Jordaan & Strategic Environmental Focus, 2005:66), whereas international standards for open space coverage range from 6 to 8 ha per 1 000 (Harnick, 2000). Depending on the density of an urban population, the international open space coverage standards translated into approximately 10% of a city in the 1960s (Doell, 1963:22), while it is currently at 14%, according to Harnick (2000). An increase in the open space coverage standards has been evident over the past five decades since Doell (1963:19) stated that the standard at that time was coverage of 7 acres (2.8 ha) per 1 000 population for American cities. The current average, according to Harnick (2000), is 6.8 ha per 1 000 population. These targets include social and ecological open space. It makes sense to provide social open space on the basis of an area-per-population standard, but the same rule cannot be justified for ecological open space. The question may then be asked whether ecological open space allocation should not rather be based on criteria such as ecological processes, species diversity and sensitivity of ecosystem functions, which after a thorough assessment can be expressed in percentage sustainable representation per bioregion. This presents opportunities for further research.

The World Conservation Union (IUCN) set an international conservation target of 10% in February 1992 at the IVth World Congress on National Parks and Protected Areas in Caracas (UN Department of Economic and Social

Affairs, 2004). It was later realised that such a target would conserve only an estimated 50% of species (GDACE, 2005). The IUCN has therefore set a new target to stop all loss of biodiversity by 2010 in Europe (Göteborg European Council, 2001), which means that each country has to adjust its conservation targets to its specific bioregion characteristics instead of a one-size-fits-all target, to prevent any further biodiversity loss.

The Gauteng Department of Agriculture, Conservation and Environment (GDACE) has set itself conservation targets of more than 30% since less than 1% of Gauteng, within the urban edge, is currently formally conserved (GDACE, 2005). These targets are set to influence both open space provision in Gauteng at local government level and privately owned land. Land use applications reviewed through the environmental impact assessment (EIA) process will be subject to decision-making tools such as the Conservation Plan 2 (C-Plan 2 hereafter) to ensure that conservation targets are reached, with specific reference to ecological open space.

The fact that allocation of open space targets and standards has increased over time means that knowledge about the implications of development impacts and lack of open space provision has increased. There are, however, a number of challenges that need to be considered, which are likely to impact on the allocation of open space and its quality in Gauteng.

The incidence of crime and perceptions of it are influencing people's willingness to use open spaces for recreation. Properties located close to open spaces pay a higher premium on household insurance owing to the risk perception (Holtmann & Jansen Van Vuuren, 2007:8). Crime may be a motivator for municipalities to sell open spaces. Fencing and controlled access, security lighting and integrated land uses are often viable solutions to crime in parks and need to be explored before the irreversible sale and development of open space is considered.

South Africa's previous government planned and enforced segregated communities, where people of colour were disadvantaged in the provision of basic services (see Blacks Urban Areas Act 21 of 1923, Black Administration Act 38 of 1927, Blacks (Urban Areas) Consolidation Act 25 of 1945, Group Areas Act 41 of 1950, Black Laws Amendment Act 54 of 1952, Blacks Resettlement Act 19 of 1954, Group Areas Act 36 of 1966, Blacks (Urban Areas) Amendment Act 97 of 1978). The provision of open space in these former affected townships was also inadequate and was generally characterised by sparsely allocated small park stands within dense residential developments (Greater Johannesburg Metropolitan Council,

1999). South African local government is now challenged to provide sufficient open spaces for these communities.

The question may be asked how these problems relate to the Rand Water context. Rand Water's open space contributes to the total open space stock of Gauteng. Any shortage of open space and threats to the sustainable management and expansion of the open space network of the province therefore has a direct bearing on how Rand Water views and manages its open space resources. This context will also assist with the valuing of the Rand Water open space stock.

1.2.3 Environmental valuation as a management intervention

Sustainability is both an ecological and an economic problem. In the early 1980s it was realised that for science to make any progress with regard to the understanding of sustainable development, an integrated and interdisciplinary approach would be needed (Perman *et al.*, 2003:8). Economists realised that economic development and welfare were dependent on the availability of resources and the ability of the environment to sustain human existence. Environmentalists realised that poverty, in the absence of welfare, was an environmentally destructive socio-economic problem that could to some extent be addressed by economic instruments (Dasgupta, 1997:18).

With these realisations, environmental resource economics developed as an economics discipline aiming at obtaining economic efficiency and optimality as key ingredients for sustainability (Perman *et al.*, 2003:3). This is evident in that the majority of research work in this field is performed by economists (compare Gen, 2004:xvi; Perman *et al.*, 2003:399; Alberini, Kanninen & Carson, 1997; Bates & Santerre, 2001; Bowes & Loomis, 1980; Hanemann, 1994). It was within this economics frame of reference that it was recognised that environmental resources were abused and neglected because market systems failed to attach appropriate economic values to these resources (Gen, 2004:8). This market failure was a result of poorly defined property rights, such as clean air (if nobody owns it, everybody can abuse it), failure to cost external effects or consequences of development on the environment, and failure to recognise environmental services and goods as an input in production (Perman *et al.*, 2003:124-126).

The realisation that markets had failed to attach an economic value to such resources or external effects led to the development of environmental

valuation methods (Gen, 2004:8-9). The fact that these resources had no price did not mean that they had no value. Perman *et al.* (2003:11) argue that if well-being is affected by the presence or absence of a resource, then it must have a value, whether positive or negative.

Environmental valuation techniques have not been without controversy, as questions of ethics, validity and accuracy often emerge in the literature (Perman *et al.*, 2003:399; De Witt & Blignaut, 2006:4). Gen (2004:xviii) poses the question whether utilitarian ethics should be allowed to influence environmental policy. Non-economists reason that decisions about the future of environmental resources should not be based on monetary values, as attached values would only reflect society's current understanding of their importance (Perman *et al.*, 2003:399). A case in point is the severe destruction of wetlands over the past century; only recently has their importance been realised (Barbier, Acreman & Knowler, 1997:4-7). Such valuations may therefore discount the expectation of future growth in knowledge relevant to the implications of development (Perman *et al.*, 2003:402). This brings to the fore the importance of the precautionary principle when evaluating environmental resources, and the fact that decisions about their future should be based on a suite of factors and not just monetary value alone (Barrow, 2006:32-33).

In a recent study done to determine the value of grasslands in South Africa, De Witt and Blignaut (2006:4) caution that environmental valuation is not an elementary calculation that will produce stable, absolute values that can be traded off against development. They argue that economic valuation is not an absolute science, but is rather reductionistic and overlooks the value of a system in its totality.

The economic component of environmental considerations remains an important factor, despite the shortcomings in environmental valuation studies. Subsection 2(4)(i) of the National Environmental Management Act (NEMA) 107 of 1998 states as follows: "The social, **economic** and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment."

It should be realised that environmental valuation is a fairly new and rapidly expanding field (Perman *et al.*, 2003:399). The identification of many of the shortcomings in the methods has resulted in improvement and refinement (Gen, 2004:14, 17, 47, 53; Perman *et al.*, 2003:434-435; Kask & Maani,

1992; Malpezzi, 2002; Brown, Ethridge & Don, 1995). The results obtained from valuation studies are used as a guide to inform decisions and can be a valuable educational tool to inform decision makers about the 'value' of the natural environment (Perman *et al.*, 2003:399). Decisions about the future of open spaces and ecosystems should not be based solely on the results of a valuation, but should consider social, economic and environmental factors as given in the national environmental management principles of NEMA.

1.2.4 The economic contribution of open spaces

Open spaces exhibit specific beneficial characteristics which make them economically valuable within the urban context. In the current research the following characteristics have been identified by the researcher through literature reviews and personal experience as either influencing various markets or making contributions to the economy:

1.2.4.1 Influence on property values

Frederick Law Olmstead, Jr. – famous landscape architect responsible for the design of Central Park in New York – stated:

“...it has been established that a well-located school and play ground, or even a site for the same,...adds to the value of all the remaining land in the territory to be served by the school more than the value of all the remaining land in the residential area which it serves than the value of the land withdrawn to create it” (as cited in Weiss, 1987)

Properties in close proximity to open spaces of good state and reputation can have a premium over similar properties that are not in close proximity to these open spaces (Van Zyl, Leiman & Jansen, 2004:10-13). People desire to have a view over a golf course or beach, or have access to a well-kept park (see figure 1.3). This desire to benefit from these environmental services increases the demand for these properties, which naturally results in an escalation in their value. A possible negative aspect of this market trend is that these properties become exclusive, and only benefit wealthier families.



Figure 1.3 Prime locations for residential property are in demand and result in higher prices (Proplan Consulting Engineers, 2005)

Poorly maintained open spaces can also adversely affect surrounding property values (Turpie *et al.*, 2001:65). Similarly, crime associated with open spaces, especially in the South African context, can also negatively impact on property values.

1.2.4.2 Influence on property taxes as a result of open spaces' impact on property value

Van Zyl *et al.* (2004:8) postulate that an increase in property values owing to proximity to an open space could have a bearing on the property tax a municipality charges on those benefiting properties. This suggests that if a municipality can improve the condition of open spaces in terms of maintenance and safety, it could partially recover these costs from higher property taxes. United States Treasury regulation (section 14(h)(3)(I)) recognises that such premium on property value could affect tax liability and makes provision for exemptions where owners have contributed to the open space by means of a land donation or by restricting development on the open space (Fausold, 1999:309).

Van Zyl *et al.* (2004:31) conclude in their study of the cost and benefits of urban river and wetland rehabilitation projects that unfortunately the current municipal finance system does not realise potential tax revenue obtainable from open spaces. This therefore leaves an opportunity for further research

and possible fiscal policy reform that would unlock environmental funding mechanisms.

1.2.4.3 Spending patterns directly influenced by the use of urban open space

People spend money on travel costs and sometimes accommodation to make use of open spaces (Edginton *et al.*, 1998:100-101). Fishermen purchase fishing gear and angling licences in order to enjoy this recreational activity in open spaces. Hiking shoes and outdoor clothing are needed to enjoy nature trails. In addition, activities such as wildlife and nature photography, mountain biking, 4x4 outings, mountaineering, birding and skateboarding require specialised equipment. All these purchases generate substantial revenues for manufacturers and they can partially or wholly be attributed to use in open spaces. Harms (1994), as cited by Fausold (1999:316), states that tourism and leisure activities account for 7% of global trade in goods and services, which generates \$195 billion per annum. These figures can be used as a proxy to estimate the economic contribution of open spaces to the economy.

1.2.4.4 Carbon sequestration

According to the BBC News (2008), the carbon trading market reached a value of \$64 billion in 2007. The Kyoto Protocol makes provision for forests with a high carbon sequestering potential to be registered as carbon sinks under its Clean Development Mechanism (CDM) (Cacho, 2006:1). Once this is approved, the project can sell certified emission reductions (CERs) and thus generate revenue.

There are restrictions, however, which are discussed in section 2.2.6.1 in more detail. A carbon sink project which includes forests and vegetation must ensure that the sequestered carbon stock remains intact. These projects also consist of several hundred hectares to make them economically feasible, considering that they need to show at great expense that they are reducing carbon emissions and maintaining these levels (Cacho, 2006:2; Laurance, 2007:20-24).

The Clean Development Mechanism (CDM) has been the catalyst to consider the value of carbon fixing vegetation. While it is recognised that this

mechanism has several weaknesses and may exclude important greening and conservation initiatives, it nonetheless sets the pace for further research and refinement to give recognition and wider inclusion for carbon sequestering conservation projects (Laurance, 2007:20-24). The urgency of climate change is evident and open spaces with their vegetation can be a significant contributor to offset carbon emissions. Once this is properly recognised and included in the net of CERs, it could form a further basis to value the carbon sequestering services of open spaces.

1.2.4.5 Supplementation of engineered infrastructure

Fausold (1999:311) argues that the value of environmental services is infinite since human life would not be possible without them. It could be possible to determine damages if these services were discontinued in localised settings or to calculate the cost of public expenditure to construct infrastructure to replace these services (Fausold, 1999:311). These estimated expenses would then serve as a proxy for the value of environmental services.

Barbier *et al.* (1997:15) explain that wetlands offer the following important environmental services:

- Nutrient retention
- Flood control
- Storm protection
- Groundwater recharge
- External ecosystem support
- Microclimatic stabilisation
- Shoreline stabilisation, etc.

According to Harris (1992:5-8), trees provide the following environmental services:

- Microclimate enhancement
- Air purification
- Noise reduction
- Erosion control

All these services are essential as they supplement urban infrastructure and can on this basis be valued.

1.2.4.6 Direct contribution towards ecotourism

According to The International Ecotourism Society (TIES), tourism accounts for up to 10% of the global gross domestic product (GDP) and sustains 230 million jobs (TIES, 2006:2). In more than 150 countries tourism is one of the top five export earners (TIES, 2006:2). Ecotourism constitutes 10% of these figures (Fausold, 1999:316).

Open spaces such as botanical gardens, conservancies and heritage attractions therefore make significant contributions to the local economy (see figure 1.4). It is possible to calculate these economic contributions and use them as a proxy to value these open spaces.

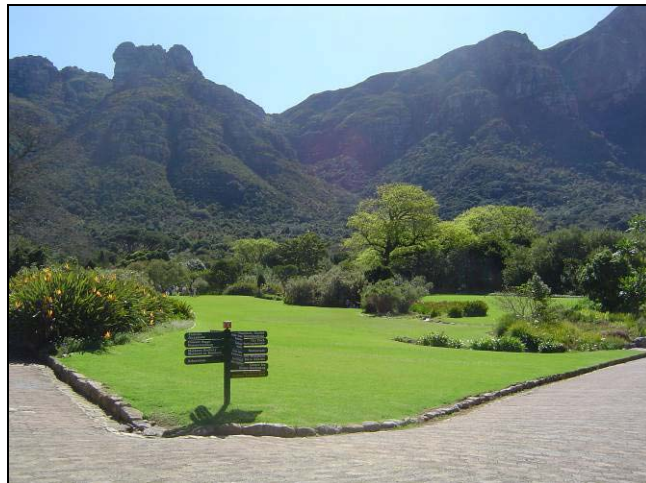


Figure 1.4 Kirstenbosch Botanical Gardens as an ecotourism site

1.2.4.7 Savings in the health costs of a community

Open spaces encourage participation in active and passive recreation activities by providing opportunities in the form of playing fields, walking trails, cycle tracks and swimming areas. Naidoo (2003:6) highlights several diseases that are related to and aggravated by inactivity, such as coronary heart disease, non-insulin dependent diabetes, stroke, breast cancer, colon cancer and depression. These could be managed effectively by increasing physical activity. Naidoo continues by pointing out that the actual costs to the national health system of Australia caused by these lifestyle diseases amounted to (Australian) \$377 million per annum. The potential savings in health care costs become evident when governments invest with renewed

vigour in parks and recreation facilities. It is possible to determine by means of a survey how many people are using open spaces for physical activity and count these as people at reduced risk of lifestyle diseases and also as savings to the national health care system. These savings can be used as a proxy to determine the value of open spaces.

1.2.4.8 Influence on human psychology, which affects productivity and therefore profitability

Recreation and leisure activities have a positive influence on human psychology and well-being (Edginton *et al.*, 1992:10-11). They relieve stress, promote fitness and lead to satisfaction (Farrel & Lundegren, 1983:33-36). Naidoo (2003:7) points out that the provision of quality park and recreation as well as physical activity programmes resulted in increased employee productivity, reduced absenteeism, better employee relations, improved health and morale and reduced accidents among 60% of companies surveyed in Canada.

Increased productivity and reduced absenteeism result in improved revenue and reduced costs which, if properly attributed, could place a value on these park and recreation facilities.

1.2.4.9 Savings in power consumption

Harris (1992:5) points out that a study in New York found that a 30-hectare plot of trees resulted in a 1.3 °C lower temperature for the surroundings compared to the rest of the city. Trees reduce the effects of solar radiation by absorbing sunlight and reducing ambient temperatures through transpiration (Harris, 1992:4). Trees also provide shade to buildings during hot summer days and allow sunlight through during winter months in the case of deciduous trees. Vegetation furthermore reduces wind speeds and the wind chill factor (Harris, 1992:5). Heating and cooling cost savings for buildings can be quantified and, where relevant, be attributed to open spaces and trees.

1.2.4.10 Economical benefits of open spaces used as community food gardens or where urban forest produce is harvested

Community food gardens are now considered an international phenomenon as communities can produce their own food while they also serve as a leisure and recreational opportunity (Ferris, Norman & Sempik, 2001:506). With the global increase in oil prices the price of food has also increased. The production of food is dependent on fossil fuel driven cultivation machinery, while food also needs to be transported to various urban centres. It is therefore foreseen that the trend of localised food production in open spaces and commonages will increase as an alternative and sustainable means for food security (see section II(6)(h), WSSD: Johannesburg Plan of Implementation, 2002).



Figure 1.5 Community food garden on a public open space in Kagiso, Mogale City (Mogale City Local Municipality, 2007)

Localised food production ensures a lower input cost and therefore affordability. This method of urban agriculture is also carbon neutral as it depends very little on fossil fuel to produce and transport. Open spaces can therefore be valued for their contribution to food security and energy savings (see figure 1.5).

1.2.4.11 Positive influence of urban open spaces on social behaviour

Open spaces that offer leisure and recreation opportunities can have a positive effect on a community's social behaviour. Edginton *et al.* (1992:10)

point out that participation in leisure and recreation can aid personal development, social bonding, physical development, sense of achievement and self-worth, problem solving, spiritual development and mental health. These benefits therefore discourage antisocial behaviour such as crime, vandalism and substance abuse (Ferris *et al.*, 2001:564). The mere provision of an open space may not in itself address antisocial problems, but will require the development of recreation programmes and therapeutic recreation interventions to optimise use of open spaces (Edginton *et al.*, 1992:87, 89-90).

The cost of crime, vandalism and other forms of antisocial behaviour has a negative impact on a local economy. The efficiency of recreation programmes as part of the open space service can be measured based on social behaviour changes and their economic benefits can be determined.

1.2.4.12 Secondary industries or small, medium and micro enterprises dependent on urban open spaces

Business can be reliant on open spaces in several ways. The ice-cream vendor in the park selling to parents and children uses this place of social gathering as a marketing opportunity. Artists often gather in parks where they sell paintings, indigenous crafts, or merely perform live music to collect donations. More formal enterprises include tourist operators and adventure sport companies that may rent boats, offer abseiling, or hiking excursions. Other enterprises may even profit from the produce of open spaces such as entrepreneurial food gardens, small-scale fishing, firewood collection and collection of berries, mushrooms, truffles and nuts (Ferris *et al.*, 2001:563) (see figure 1.6).

All these enterprises are dependent on open spaces to ensure livelihoods. The economic contribution of open spaces to these enterprises can be valued.



Figure 1.6 Punting on the river Cam in Cambridge City, England

1.2.4.13 Biodiversity and habitat status

The national biodiversity assessment (Driver *et al.*, 2005:xi) shows that 34% of South Africa's 440 ecosystems are threatened. The report states that 5% are critically endangered, 13% are endangered and 16% are vulnerable. Open space offers the opportunity to preserve sensitive environments for the benefit of future generations (Department of Environmental Affairs and Tourism, 2006:248). The preservation of biodiversity ensures that the ecosystem functions and goods are maintained in good order (Driver *et al.*, 2005:2). It is these ecosystem functions which support human survival and which hold the key to scientific discoveries, such as cures for diseases. The economic value of biodiversity and its support of ecosystem functions are indispensable for sustainable development.

1.3 Problem statement

Central to the purpose of this study is adherence to the terms of reference set by Rand Water (see annexure D). From these terms of reference a **problem statement** can be delineated which guides the research project:

- Considering the challenges faced by Rand Water regarding the future of its open space network, and subsequently that of Gauteng, are open spaces an asset or a liability?
- Do we need to dispose of open spaces to make way for seemingly advantageous urban development that will bring with it job creation and economic growth?

- Or are there perhaps some intrinsic values and economic benefits of open spaces that society is ignorantly discounting?

To answer the first question, there needs to be a measure in place to determine on which side of the economic scale an open space will be placed.

- How do we then measure the economic value of an open space to determine whether it is indeed an asset or liability?
- What environmental valuation methods are available to determine these values, whether negative or positive?
- If such valuation methods are available, what criteria are used to determine where and how they should be applied?
- Who is legally mandated to apply these methods?

These questions need to be answered with specific reference to the Rand Water case as the Rand Water open space network is the focus area of the study. It should be noted here that this research does not attempt to value land, but focuses on determining the value of the benefits associated with open spaces. These benefits, or environmental goods and services, are generally non-tradable assets, yet they may offer economic benefit to Rand Water and surrounding communities.

In summary, the **problem statement** can be delineated and defined as follows:

How can the economic value of Rand Water's open spaces best be determined, considering the limitations of the methods, the legal framework, the user and the study area?

The intrinsic value of open spaces may be intuitively obvious to the environmentalist while valuation methods may not accurately confirm such values. It is then important that the limitations of these valuation methods be clearly outlined as well in order to avoid exaggerated expectations.

1.4 Justification for research

Why is there then a need to determine the value of open spaces? Managers of open spaces believe that these amenities and their inherent ecological functions are essential for sustainable urban living (Turpie *et al.*, 2001:85; Department of Environmental Affairs and Tourism, 2006:247; Saayman, 1997:77; also see Bates & Santerre, 2001; Geoghegan, 2002; and

Swanwick, Dunnet & Woolley, 2003). On the downside, however, these facilities are competing for resources with other essential services, and are often plagued by crime, poor maintenance and illegal dumping (Swanwick *et al.*, 2003:94; Madumo, 2008). In considering the latter, it seems that open space is a liability rather than an asset (see Young, 1994:10). If this is true, then municipalities and entities, for example Rand Water, Eskom and Transnet, should rather sell their open spaces and focus on their core services.

It is, however, known through many years of extensive research that open spaces provide valuable ecological benefits, recreation and entrepreneurial opportunities (Department of Environmental Affairs and Tourism, 2006:248; Ferris *et al.*, 2001:563; Edginton *et al.*, 1998:10). It is also often the experience of park managers that these benefits do not suffice when negotiating for increased budgets or at least to maintain existing budgets to retain and maintain open spaces (Garvin, 1999:7). These arguments for a better maintained and preserved open space network are not presented in terms of fiscal benefits that would otherwise convince policy and decision makers. When the maintenance budget or existence of open spaces is challenged on the grounds of fiscal reform or cost benefit analysis, the open space manager needs to present a counterargument that is also based on fiscal terms, and that indeed shows financial benefits that would classify the open spaces as an asset.

A pilot study undertaken as part of the current research on the potential economic contribution of open spaces delineated the following contributing factors:

- Influence on property values
- Influence on property taxes as a result of impact on property value
- Spending patterns directly influenced by the use of urban open spaces (transport costs to and from facility, entrance charges, rental income)
- Carbon sequestration
- Cost benefits of green infrastructure in urban open spaces as their properties supplement engineered infrastructure such as storm water, waste water, soil stabilisation and removal of pollutants from soils, water and air
- Direct contribution to ecotourism
- Savings in the health costs of a community owing to cleaner air and recreation opportunities which encourage active and healthier lifestyles
- Influence on human psychology which affects productivity and therefore profitability

- Savings in power consumption as a result of reduced solar radiation
- Economical benefits of open spaces used as community food gardens or where urban forest produce is harvested
- Positive influence of urban open spaces on social behaviour where family cohesiveness, recreation, team sport etc. are antagonistic towards antisocial behaviour such as crime; the reduction in crime has a positive economic benefit and it also encourages investment in these neighbourhoods
- Secondary industries or small, medium and micro enterprises are dependent on urban open spaces and they contribute to GDP
- Biodiversity and unique habitats that provide opportunities for further research and conservation

The reality of climate change, for instance, was an inconvenient development for a few decades for many decision makers. However, the implications of procrastination have been clearly calculated in economic terms, backed by convincing scientific work (Lazarus, 2004:236, Barrow, 2006:275). It is now evident that more governments are prescribing to at least a cautious, but rather pertinent action to ameliorate climate change (Barrow, 2006:275).

Presenting economic arguments for conserving ecosystem functions is arguably the preferred modus operandi when these natural assets are at stake. Reviewing environmental valuation methods and refining them for Rand Water's application will provide the necessary methods to formulate such economic arguments. The current research project can therefore play a valuable role in assisting Rand Water to make a presentable case for preserving its open space network and maintaining existing budgets to maintain open spaces.

A literature review also found that very limited research work has been done in South Africa to determine the economic value of open space (see section 2.3.2). Valuation studies often focus on one particular method owing to time and budget constraints and do not take a holistic view of all methods in order to obtain the total economic value of open spaces (see table 2.7). On this basis further research was required that would take into account all available valuation methods and assess their suitability in the Rand Water context.

1.5 Research purpose and hypotheses

The purpose of this study is to gain insight and to establish a methodology relevant to the determination of the economic value of open space within the

Rand Water context. This required an assessment of available valuation methods through the participatory action research approach using focus groups, case studies and survey methods for data collection (Steeple, 2004; Herr & Anderson, 2005:76). In fulfilment of the requirements of the contracted research, the study introduces environmental valuation to Rand Water and provides guidance as to how it can best be applied to its open spaces.

The research project identifies gaps within the current available methods that are not addressing Rand Water's needs and makes recommendations for further research. This research project also relies on literature which has explored the dynamics of method reliability and accuracy and makes cautionary recommendations to Rand Water.

The research hypotheses for this study are stated as follows:

H₀: If certain available environmental valuation methods are assessed for applicability to Rand Water open spaces, and are subject to potential moderators, then it will not be possible to determine a specific/exact value expressed in monetary terms - no significant relationship between available environmental valuation methods and Rand Water open space can be shown.

H₁: If certain available environmental valuation methods are assessed for applicability to Rand Water open spaces, and are subject to potential moderators, then it will be possible to determine a specific/exact value expressed in monetary terms - a significant relationship between available environmental valuation methods and Rand Water open space can be shown.

To answer the applicability question – with applicability being the dependent variable - moderating variables that can tip the scale to proving either the H₀ or H₁ must be reviewed. Applicability for the purpose of the study can be described as the scenario where enough environmental valuation methods can be applied by enough users (valuers) to determine the respective values of enough open space categories. The “What is enough?” question was answered by participants in the action research method. Therefore:

Potential moderator 1: Limitation of methods

H₁: Inherent limitations of valuation methods is a moderator (not all available valuation methods can be applied to Rand Water open spaces owing to inherent limitations).

H₂: Inherent limitations of valuation methods is not a moderator (all available valuation methods can be applied to Rand Water open spaces without having inherent limitations).

This test will review available environmental valuation methods to determine whether they have inherent limitations in terms of accuracy, scope of functionality, and dependency on specific and limited data that could affect their suitability in the Rand Water context.

Potential moderator 2: Limitation of legal framework

H₁: The national and international legal framework is a moderator (the national and international legal framework is a limiting factor with regard to application of valuation methods).

H₂: The national and international legal framework is not a moderator (the national and international legal framework is not a limiting factor with regard to the application of valuation methods).

This test will mostly be a review of national and international legislative frameworks to determine whether these provide a mandate to apply environmental valuation, who the mandate is given to and under what circumstances the mandate is given. It will also determine whether there are any legal impediments regarding its application. This test is thought necessary as the property valuation profession is operating within strict legal and ethical frameworks, while the economist is guided by sound theory to infer economic value of resources, often with far-reaching effects. This study does not wish to promote a methodology that is not supported by national and international legislation and economic best practice.

Potential moderator 3: Limitations of user

H₁: The user of the valuation technique is a moderator (the user of the valuation technique can be a limiting factor when applying the valuation methods).

H₂: The user of the valuation technique is not a moderator (the user of the valuation technique will not be a limitation when applying the valuation methods).

Existing literature indicates that the majority of environmental valuation studies are performed by economists (compare Gen, 2004:xvi; Perman *et al.*, 2003:399; Alberini *et al.*, 1997; Bates & Santerre, 2001; Bowes & Loomis, 1980; Hanemann, 1994). Some methods are complex and the user's experience and qualifications, which are independent variables, can affect the user's ability to apply these methods successfully. It is not the intention of this study to measure the independent variables that affect the user's ability, but to rather take a qualitative approach and measure the user's opinion of his or her personal ability, ease of use and understanding of the methods. The only independent variable that will be tested is relevance of methods to the user's area of work. The user's area of work is linked to his or her experience and qualifications, which therefore relate to the limitations of the user. An irrelevant method would require experience and skill which a user may not necessarily have, whereas a relevant method relates to the user's area of work and the user's ability (experience and qualifications) can relate to its methodology. Relevance to the user's area of work is therefore an independent variable, which reveals user limitation.

Potential moderator 4: Limitations of study area

H₁: The Rand Water study area is a moderator (the Rand Water study area can be a limiting factor when applying the valuation methods).

H₂: The Rand Water study area is not a moderator (the Rand Water study area will not be a limitation when applying the valuation methods).

The total economic value of open spaces consists of various values. Certain valuation methods are designed to determine specific values. It is possible that Rand Water's open spaces do not represent all of these values and certain methods may therefore not be applicable. In this case the presence or absence of these values will be the independent variable.

CHAPTER 2: LITERATURE REVIEW

2.1 Review and application of available environmental valuation methods

This section provides an introduction to environmental valuation. It aims to highlight the characteristics of each method, the environmental values the method is best designed to assess, as well as the most common limitations associated with these methods.

2.1.1 Total economic value

It is necessary to understand the various values that comprise the total economic value of an open space and its ecosystem functions before the methods that value them are discussed. Figure 2.1 gives a breakdown of the various values associated with open spaces.

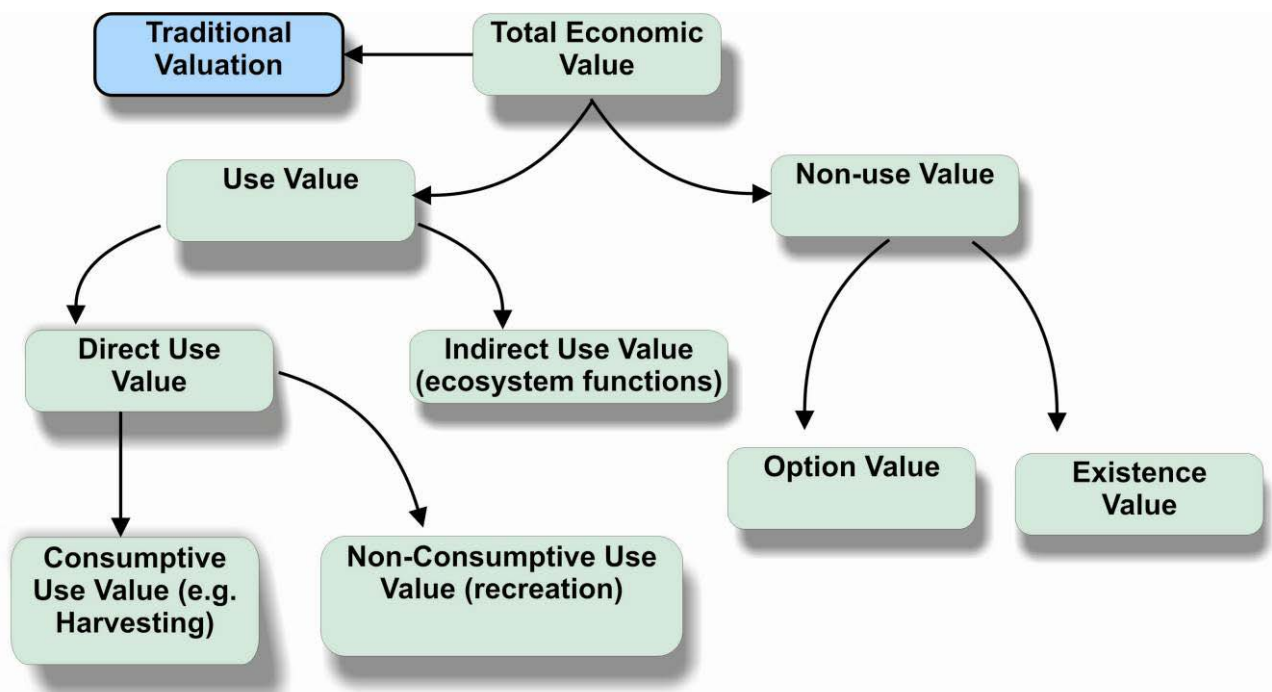


Figure 2.1 Conventional classification of the values of environmental amenities (adapted from Turpie *et al.*, 2001:11)

Ecosystems and open spaces differ from each other in terms of size, quality and types of ecological services and functions. Not all the various values are applicable to each and every open space or environmental resource. A protected wetland may, for instance, permit the use of canoes (non-

consumptive) but not any harvesting (consumptive). In some cases the value may be so insignificant that it is not feasible to perform a valuation on it (Turpie *et al.*, 2001:12). The valuer needs to use his or her own discretion, sometimes aided by various experts, when evaluating an open space to determine which values are relevant (Turpie *et al.*, 2001:85).

2.1.2 Traditional valuation

Municipalities may occasionally be faced with the decision to sell open space. This may be because a developer has approached the municipality and indicated a willingness to purchase. The municipality's response to such an offer will depend on the policies, strategies and by-laws in place relating to open space management. A property valuation is required in the event that a municipality decides to sell open space. A property valuer, normally a municipal official, performs a valuation. Factors such as availability of services, accessibility, improvements to the property, zoning and size, and regional sales data are used to obtain a value (IVSC, 2001:29). This often results in a very low monetary valuation for the open space in relation to, say, residential or business property, because of the absence of installed services, the need to change the zoning, the need to do a township establishment, and the need to follow the EIA process. The traditional property valuation method does not consider value-adding factors such as the flow of environmental services including water purification, climate amelioration, nutrient cycling, carbon sequestration and biodiversity sustenance, and therefore overlooks potentially value-adding benefits (IVSC, 2001:34).

The purchaser would in most cases transform the open space and would not be willing to pay for 'benefits' lost to society. If the benefits that an open space provides to the larger community were factored into its price, then it is most likely that no sale would be concluded and the open space would be preserved for the community who benefits from its services. This approach would also warrant that the purchaser pay for the loss of these services provided to a community, where a sale is approved and proceeds, or alternatively stated: that the cost of the loss be compensated for in the price.

Fortunately the development or transformation of open spaces is a listed activity (activity number 20) in terms of sections 24 and 24 D of NEMA 107 of 1998. The sale and development of open space will be more difficult with these regulations in place.

Professional property valuers are not trained to recognise environmental goods and services in the holistic value of a property (IVSC, 2001:267). Research and development into open space valuation may therefore present an opportunity for the integration of environmental valuation methods in the property valuation profession, which will certainly give more recognition to the importance of environmental goods and services.

2.1.3 Use values

2.1.3.1 Consumptive use value

This value is obtained from the economic benefits associated with the direct harvesting of goods from a portion of land, while these goods may not necessarily pass through a market system (Lindenmayer & Burgman, 2005:9; Markandya, 2005:20). This may include a wide variety of goods such as building material, food, flowers and medicinal plants (Turpie *et al.*, 2001:12). This value is not constant as it is affected by the market value of the harvested goods and the ability of the open space to supply the goods in a sustainable stream. This method is mostly applied to renewable resources or biotic populations that can regenerate, such as fauna and flora. Goods such as minerals are non-renewable and harvesting them is not a desirable or sustainable practice in open spaces. They are therefore excluded for the purpose of this study. Harvesting of minerals in open spaces is in most cases an illegal activity prohibited by municipal by-laws. The value of mineral stock in an open space would only be considered during a cost benefit analysis where mining is considered as an alternative use.

If the sustainability threshold is exceeded, then the volume of goods and flow of services supplied declines and consequently so does their value (Perman *et al.*, 2003:18). It is therefore important to ensure that the consumptive use value is not based on volumes that are not sustainably harvested, which would give inflated values at first but would be likely to depreciate over a short space of time. Sustainable harvesting, however, gives realistic values which appreciate in time provided the market demand remains constant (see Yamauchi, Matsumiya & Iwasa, 2007:139-148). The question the valuer should ask is whether the level of current use is affecting future availability. The resource can be used indefinitely if harvest is equal to or less than the natural reproduction rate, and if the ecological systems that support reproduction are preserved (Perman *et al.*, 2003:18).

Consumptive use value is applicable only where goods are legally harvested, such as communal land where harvesting rights are granted. A nature

reserve will most often not permit harvesting, and a consumptive use value will not be applicable. The production function method is used to gauge consumptive use value (see section [2.1.5.1a](#)).

2.1.3.2 Non-consumptive use value

Non-consumptive use value implies, as the name suggests, that the value is obtained from the use of an open space that does not involve harvesting or collecting any goods (Turpie *et al.*, 2001:12). Activities such as recreational use and tourism add value to an open space as people are willing to spend money to use these recreation opportunities. People spend money on travelling costs to get to these open spaces, food and beverages and sometimes accommodation (see section [2.1.5.2a](#)). If not well managed, non-consumptive use can have a negative impact on the use value. An example is the value of a wilderness area, which lies in the perceived absence of people and the sense of exclusivity, for which people are willing to pay a premium (Perman *et al.*, 2003:127). Such an area would not be a great escape if it were crowded and noisy. Overuse could also directly impact on the quality of the facility through abuse of the amenity infrastructure, trampling of pathways and unmanageable littering. This overuse would result in a depreciation of the open space's non-consumptive use value. This value is also often reflected in nearby property prices and is alternatively referred to as hedonic value or pricing (see section [2.1.5.2b](#)).

2.1.3.3 Indirect use value

Indirect use value is the economic benefits that urban society obtains from the environmental services that open spaces provide (Turpie *et al.*, 2001). These functions may include those shown in table 2.1.

Table 2.1: Environmental services and functions that open spaces may provide

- | | |
|---------------------------------|---------------------------------------|
| • Water supply and purification | • Climate amelioration |
| • Sound and nuisance control | • Flood and erosion control |
| • Carbon sequestration | • Soil formation and nutrient cycling |
| • Pollination | • Refuges for biodiversity |

(Adapted from Turpie *et al.*, 2001:12)

The challenge in obtaining a value for these ecological services is that they are communal and free from market influences (Duraiappah, 2006:6-7). There are, however, indirect methods which can be used to determine a value for ecological services. A change in the quality of an environmental service, such as increased air pollution, reduces property values of the affected area, while improvement results in an appreciation of the property values (Van Zyl *et al.*, 2004:16-17; Perman *et al.*, 2003:435). These changes can be measured to value the impact of the change.

The cost of replacing an ecological service with an artificial substitute can also be used as a proxy to infer a value for it (see section [2.1.5.1b](#)). A wetland has water purification and storm water retention properties which can be substituted by engineering infrastructure such as water purification plants and storm water retention systems. The cost of developing infrastructure to treat and manage the same quantity of water as the wetland would serve as the value indicator.

2.1.4 Non-use values: Option and existence values

Option value refers to the value that people place on reserving the option to use a resource in the future (Turpie *et al.*, 2001:12; Markandya, 2005:20). This is normally expressed as a person's or community's willingness to pay (WTP) to guarantee the availability of the open space for future use (Perman *et al.*, 2003:402). There is also the quasi-option value which is expressed as a person's WTP to avoid the irreversible loss of an open space or ecological service, considering the risk that the advancement of knowledge could in future prove that such loss had been catastrophic and ill-informed (Perman *et al.*, 2003:402). An example would be the relative ignorance 50 years ago concerning the implications of wetland destruction, which led to the loss of a significant number of wetlands (Barbier *et al.*, 1997:4-7). This has resulted in the adoption of the precautionary principle whenever the holistic impact of a particular action is unknown (Lindenmayer & Burgman, 2005:404). This could alternatively be expressed as a person's WTP to avoid unknown risks. With option and quasi-option use value there is no certainty or there is incomplete knowledge about the future conditions of an open space or ecological service (Perman *et al.*, 2003:402).

The comfortable knowledge of the existence of a resource can be referred to as existence value (Perman *et al.*, 2003:402). Contribution to the conservation of far-off places such as rainforests or palaeontologically

important sites could be measured to determine this value. This value, however, need not be applicable to far-off resources only, as WTP for the conservation of any resource could be interpreted as existence value. Unlike option and quasi-option value, there is complete certainty with existence value about the future conditions of an open space and ecological services (Perman *et al.*, 2003:402).

A farm portion with unique landscape and biodiversity features in close proximity to urban development can have the option to be developed as a residential township or to be preserved as a protected nature reserve. The value attached to the property will remain an option value until it is formally protected, whereafter it will assume an existence value. Once it is legally protected, alternative options are restricted by legislation.

2.1.5 Valuation methods

Methods employed in previous studies for the valuation of open spaces and ecosystems are the same methods generally applied to value environmental resources. These methods can be broadly divided into three categories, namely market value approaches, surrogate market approaches and simulated market approaches (Turpie *et al.*, 2001:16).

Market value approaches use market-related pricing of goods and services used to establish a value, for example based on the net value of harvested cut flowers (Turpie *et al.*, 2001:16). The market value approach may apply to use and non-use values. There may, for example, be an option on a particular portion of land to harvest wild flowers and this “option value” can be determined by using a market value approach based on the market value of the wild flowers in question.

Surrogate market approaches, also referred to as revealed preference approaches, examine the economic trends in a particular situation and how an environmental resource influences these trends (Markandya, 2005:24, 33; Turpie *et al.*, 2001:19). A well-maintained and attractive open space will positively influence property values, which are then translated into a net benefit or premium and ultimately expressed as a value. In contrast, a poorly maintained open space will adversely affect property values and could be seen as a cost to the property market for not maintaining the open space in good order.

Stated preference approaches, also referred to as simulated or constructed market approaches, use surveys or questionnaires to obtain the perceived

value or 'willingness to pay' for a service or amenity or to conserve a particular area (Turpie *et al.*, 2001:20; Barbier *et al.*, 1997:Appendix 3). Mean values are then calculated from these surveys and multiplied by the number of affected households to obtain a value. This method is also valuable to test open space user responses to hypothetical scenarios such as the possible sale of parkland or the impact of maintenance standards and crime on usage and ultimately value.

2.1.5.1 Market value approaches

Market value approaches use market-related pricing of goods and services used to establish a value, for example based on the net value of harvested cut flowers (Turpie *et al.*, 2001:16). It uses prices of goods and services found on the open market and that are similar to the environmental goods and services to determine an economic value for the environmental resource. The following represent the most common market-based valuation methods:

a) Production function approach

This method is used to determine the net annual value of goods and services produced by an open space or ecosystem (Lindenmayer & Burgman, 2005:9; Markandya, 2005:20). It therefore values the consumptive use of open space goods.

The annual use value = $Q \times (P - C)$, where Q is the quantity of goods produced, P is the market price at which the goods are sold, and C is the cost of harvesting, processing, transporting and marketing the goods (Turpie *et al.*, 2001:17). A net present value of the open space is then obtained by converting the annual use value (annual use = $Q \times (P - C)$) into a rand value per hectare (R/ha) (Turpie *et al.*, 2001:17). Therefore, if the total annual use value of an open space is, say, R350 000 from flower harvesting and the property measures 10 ha, then the net present value would be R35 000 per ha.

This valuation method may not be applied often in the valuation of open spaces since the harvesting of fauna and flora is often prohibited by municipal by-laws, except for fishing in certain locations (Provincial Gazette Extraordinary, 2007:126-127). It would be unethical to attach a use value to an open space based on products which have been obtained illegally. It

would be the same as saying that the Kruger National Park is worth x based on the street value of its elephant tusks and rhino horns, while it is illegal to trade in these products. Numerous indigenous plant species are under threat owing to unscrupulous harvesting for medicinal use (Department of Environmental Affairs and Tourism, 2006:109). This valuation method could become valuable if the free-for-all situation were changed into a sustainable harvesting programme that is monitored.

The market value approach is also used to value agricultural or forestry land in support of normal property valuation techniques and this is where the method originated (IVSC, 2001:38).

b) Restoration cost and replacement cost method

This method is usually used to value ecosystem functions and departs from the hypothesis that the value of the ecosystem is equal to its replacement cost or restoration cost (Sundberg, 2004:19; Turpie *et al.*, 2001:18). The replacement cost refers to the replacement of ecosystem functions with artificial structures and systems that will replicate the ecosystem function, such as water purification and retention (Sundberg, 2004:19; Turpie *et al.*, 2001:18). However, not all ecosystems can realistically be replaced or replicated by artificial structures and systems, making use of this method rather limited (Sundberg, 2004:20). An approach with the replacement cost method for wetlands would be to obtain engineering costs for the construction of water purification plants per megalitre of treating capacity and to use the total water treatment output of the wetland over a certain period to obtain a value for the ecological function.

Use of the restoration cost method could be based on a hypothetical scenario postulating that the environmental service has been lost or damaged and needs to be restored through rehabilitation practice, which is difficult to calculate (Turpie *et al.*, 2001:18; United Nations, European Commission, International Monetary Fund, Organisation for Economic Cooperation and Development, World Bank, 2003:257). The restoration cost method is sometimes used in lawsuits to determine actual damage caused by illegal activities or negligence, or to determine the negative environmental economic implications of a current production method (King & Mazzotta, 2006:1).

The restoration cost method could employ landscape development costs including earthworks, irrigation, soft and hard landscape materials, and

design and project management costs as a proxy for the value of developed open spaces. The application of the restoration cost method in valuing natural areas is far more complicated, as the restoration of sensitive environments to their original status, for example fynbos vegetation, wetlands or Bankenveld, is extremely difficult if not impossible at present. A number of species cannot be commercially cultivated and re-established in an area, for example the common sugarbush tree or *Protea caffra*. The restoration cost method would therefore be difficult to apply as the costs of complete restoration are unknown. It could be advisable to use the cost to restore an area as close as possible to its original status so that natural systems can continue with the restoration process. One could then attempt to value the 'benefits lost over time' where there is no alternative to an incomplete restoration. This could include the loss of benefits over time up to the estimated point of complete restoration. Lost benefits could include reduced levels of biodiversity, reduced visitation rates and reduced efficiency in water and air purification. The lost benefits approach would most likely employ methods such as damage cost avoided, and replacement cost methods to form a multi-tier valuation approach with the restoration cost method.

c) Damage costs avoided

Wetlands play an important role in flood attenuation because of their good water retention capacity (Barbier *et al.*, 1997:3). The absence of wetlands in a catchment system increases the risk of flash floods and resultant flooding of adjacent properties (Barbier *et al.*, 1997:57). It is possible, with the assistance of hydrologists for instance, to delineate the areas along a watercourse that would be affected by floods if no wetland were present. The possible damages, linked to a probability analysis, are then calculated based on the value of affected infrastructure within the demarcated flood zone. This probable damage cost or reparation cost is then assumed to be the measure of value (Turpie *et al.*, 2001:18).

The damage cost avoided method is normally used to argue for the retention of certain ecosystems and their beneficial functions that support human settlements (see Badola & Hussain, 2005).

d) Defensive expenditure method

The defensive expenditure method uses the cost of preventing damage or improving the environment as opposed to the cost of repairing damage or face environmental deterioration as a proxy for value (Turpie *et al.*, 2001:18; Sundberg, 2004:18). The control of alien invaders, for instance on agricultural land, ensures that the land remains productive and economically active. The cost of removing invaders and regular follow-up programmes to minimise regrowth is, for example, compared to the net benefits of a programme such as increased water resource availability and biodiversity preservation. If the programme's economic benefits outweigh the input costs, then it has a positive value. The defensive expenditure method is based on this relationship between expenditures on an item or programme, and positive changes in the quality of the environment (Sundberg, 2004:19). This method is often used in cost benefit analysis (Sundberg, 2004:11). The maintenance of coastal wetlands and estuaries has also proven effective in controlling the force of tidal waves and storms to prevent damage to infrastructure, and this damage avoidance cost is used as a proxy for value (Turpie *et al.*, 2001:18; also see Badola & Hussain, 2005).

2.1.5.2 Surrogate market/revealed preference approaches

These methods depend on information from individual consumption or purchasing behaviour occurring in markets related or similar to the environmental resource under scrutiny (Kontoleon, Macrory & Swanson, 2002:182). These similar markets are also referred to as surrogate markets as they serve as value proxies for environmental goods and services.

a) Travel cost method

The travel cost method (TCM) is used primarily to value recreational and tourism attractions that are visited frequently (Markandya, 2005:37). Data obtained from this method can be helpful to determine what visitors would be willing to pay as an entrance fee, based on the visitors' consumer surplus (Turpie *et al.*, 2001:19). The method therefore values non-consumptive use of an open space. It is based on the idea that the value visitors place on environmental amenity services is reflected in their willingness to spend money to experience these services (Perman *et al.*, 2003:411; Markandya, 2005:37). People spend money on transport to get to the facility, refreshments, time and often entrance fees. These costs are then used as

proxy to determine value and therefore reveal spending patterns which are influenced by an attraction such as a park. A substantial amount of data is needed to obtain objective surveys, which include the number of visitors, distance travelled, mode of transport, socio-economic background, time spent at site and value of visitor's time (Perman *et al.*, 2003:411-420; Turpie *et al.*, 2001:19). The TCM does entail some limitations and controversies, as pointed out by Turpie *et al.* (2001:19) and Perman *et al.* (2003:415-417), which need to be kept in mind when considering its application:

- One question is whether the opportunity cost of recreational time should be considered at all – in other words, whether the time spent on recreation should be valued against time that could alternatively have been spent on work or business.
- Visitors to these amenities and attractions often do not travel specifically to visit these locations, but their journey forms part of a number of visits to multiple locations. This makes the travel cost method somewhat more complex to use. The apportionment of travel costs to each trip is not feasible, and the responses of respondents who visited more than the study area during the survey should be removed from the survey.
- Other visitors that live close-by may have travelled by foot or bicycle, which requires more extensive questionnaires to determine the value placed on the amenity by visitors. These values have probably been captured in adjacent properties, and the hedonic pricing method is then needed to determine this. If hedonic pricing is also used on the same environmental resource, then visitors from surveyed properties should be excluded from the TCM survey to avoid overestimation.

b) Hedonic pricing

Property prices are often positively affected by the presence of green open spaces, lakes and areas with attractive natural scenery (Van Zyl *et al.*, 2004:10-13). The hedonic pricing method (HPM) calculates the value added to private property owing to the presence of an open space and uses this value to determine the total value of an open space. This calculation is based on the estimated increase in property value (often given by estate agents and sales data) owing to the presence of an open space. The estimated increase is then averaged and multiplied by the number of the relevant properties (Van Zyl *et al.*, 2004:16-18; also see Shultz & King, 2001, and Geoghegan, 2002).

As an example, a park positively influences approximately 420 property values by 8%. The mean property value for the area is R1 000 000 per property. A premium of approximately R80 000 per property is calculated and multiplied by 420 properties, which gives a total value of R33 600 000.

This method is difficult to apply in areas where there is a limited market for properties, such as informal housing and other low income areas, or in rural areas where open space is more abundant and less of a value-adding factor.

2.1.5.3 Simulated market/stated preference approaches: The contingent valuation (CVM) method

This method tests people's WTP for the use or presence of an open space or their willingness to accept (WTA) compensation for the loss of an open space (Markandya, 2005:37; Turpie *et al.*, 2001:20; Perman *et al.*, 2003:420). It is sometimes referred to as a stated preference method, whereas methods such as the TCM and hedonic valuation methods are revealed preference methods (Perman *et al.*, 2003:420). It is called contingent valuation because the valuation is contingent on a hypothetical scenario put to respondents (Perman *et al.*, 2003:420). This is normally determined through interviews and using open-ended questions, referendums, dichotomous choices (yes or no), bidding games, trade-off games, ranking techniques, costless choice options or the priority evaluator technique (Turpie *et al.*, 2001:20). The survey is also dependent on socio-economic data to construct a demand curve for net social values (Perman *et al.*, 2003:424; Turpie *et al.*, 2001:20).

The survey questionnaire should present, by way of a programme or policy, ways to improve or protect an environmental asset from a clearly defined environmental impact. Respondents are then asked about their WTP for such a programme or policy. The payment vehicle is normally presented as some sort of tax payment and the respondent 'votes' either for or against it. This form of survey is sometimes named a referendum model (Perman *et al.*, 2003:424). The respondent's WTP is tested by offering a choice of amounts that he or she would be willing to pay. The respondent then responds with a yes or no answer (dichotomous choice format). It is also important that the survey make provision for respondents to indicate that where the stated amounts are not within their WTP or where they are objecting to the payment vehicle, their 'no' vote is correctly interpreted (Perman *et al.*, 2003:425).

This method is subject to several biases that make its application controversial and subject to criticism. Some of biases are the following (Perman *et al.*, 2003:424-435; Turpie *et al.*, 2001:20; Markandya, 2005:39; also see Gen, 2004):

- Strategic biases whereby respondents believe they could influence decisions by overestimating or underestimating WTP
- Embedded biases whereby respondents do not give realistic answers in relation to their current financial constraints, budgets and needs
- Interviewer bias, information bias, starting-point bias and hypothetical bias, which can influence the respondent's answers and subsequently the results of the survey

The biases can be largely eliminated if the survey design is done correctly and tested before implementation (Gen, 2004:37).

In a CVM survey, the median is normally used to calculate total WTP as it is less affected by outliers (Perman *et al.*, 2003:425). The total WTP is the median figure multiplied by the size of the relevant population.

The method bases its findings on hypothetical questions instead of observed, actual, behaviour (Perman *et al.*, 2003:420). It is also very costly and time-consuming to execute as it requires several interviewers, detailed and tested site-specific surveys, data enumerators and statisticians (Turpie *et al.*, 2001:20). The method is criticised for having been formulated solely for developed or First World economies, with the assumption of generally well-educated respondents, and its subsequent (perceived) irrelevance in developing or Third World applications (Turpie *et al.*, 2001:20). If the survey is not well designed it can produce insensitivities in terms of price and scope. Price insensitivity relates to WTP which statistically appears not to be influenced by the income levels of respondents, and scope sensitivity relates to statistical insensitivity to differing conservation targets hypothetically presented to respondents (Perman *et al.*, 2003:427, 429). An example of price insensitivity is where respondents' WTP does not appear to be influenced by their household income, whereas in practice it should be. An example of scope insensitivity is where respondents' WTP does not change where different conservation targets are presented, e.g. 1 000 ha, 2 000 ha or 5 000 ha set aside for conservation, whereas in practice there should be a correlation.

Past experience has shown that respondents generally protest against WTA, as they refuse to accept any compensation for stated loss of a public good,

and they would rather pay for its preservation, hence the predominant use of WTP (Perman *et al.*, 2003:429). Socio-economic factors, education levels and moral values differ in developing countries, and these respondents may be more inclined to WTA than WTP. The question may also be asked whether it would be morally and ethically correct for a generation to accept compensation for the loss of an environmental good or service on behalf of future generations that are excluded from that decision and future benefits from the resource.

Respondents may also deny responsibility for conservation and generally vote 'no' for any WTP as they believe it to be a function of the state, for which they are already taxed (Perman *et al.*, 2003:31). They may also feel that environmental problems should be the responsibility of those who caused them, or that those who stand to benefit the most from an environmental improvement should pay for it (Perman *et al.*, 2003:31). The CVM assumes that the respondent has some sort of responsibility towards the environment and therefore asks WTP questions. This may not, however, always be legally and constitutionally enforceable, especially with site-specific problems. The survey design needs to explore these dynamics and this should include briefing the respondent on his or her obligations, if any. It may be that a respondent has no obligation to the problem but would feel morally obliged to make a contribution (Perman *et al.*, 2003:431-432).

CVM offers the benefit of valuing both use and non-use values, while the other instruments available can value only use value. CVM has also been granted admissible by US courts, with the Exxon Valdez oil spill case being particularly well known (Perman *et al.*, 2003:434).

2.1.5.4 Which environmental values need to be assessed?

Environmental amenities may not always have all the values represented. It is therefore important to determine which values are applicable and then which valuation method is most appropriate to determine the value (see table 2.2). It may also be true that a particular value is not prominent enough to justify its valuation, considering factors such as budget and time restrictions.

The types of values were discussed in sections 2.1.1-2.1.4. Table 2.2 below shows the ability of each valuation method to determine a specific value, where \checkmark indicates suitable, \surd less suitable and X not suitable.

Table 2.2: Environmental values and applicable methods used to determine valuation

| Type of Value | Valuation Methods | | | | | | |
|----------------------------|---------------------|-----------------------------|---------------------|-----------------------|-------------|-----------------|----------------------|
| | Production function | Restoration and replacement | Damage cost avoided | Defensive expenditure | Travel Cost | Hedonic pricing | Contingent valuation |
| Consumptive use | √√ | √ | √ | √ | √ | √ | √√ |
| Non-consumptive use | √ | √ | √ | √ | √√ | √√ | √√ |
| Indirect use | X | √√ | √√ | √√ | X | √√ | √ |
| Option and existence value | X | X | X | X | X | X | √√ |

(Adapted from Turpie *et al.*, 2001:15)

2.1.5.5 Application of the environmental valuation methods

a) Production function approach

The production function approach, as stated earlier in section 2.1.5.1a, simply entails calculating the annual use value = $Q \times (P - C)$, where Q is the quantity of goods produced, P is the market price at which the goods are sold, and C is the cost of harvesting, processing, transporting and marketing the goods. A net present value of the open space is then obtained by converting the annual use value into a rand value per hectare.

This method requires the following data:

- i) The size of the environmental amenity in hectares
- ii) The products harvested
- iii) The quantity of products harvested over time
- iv) The market value or price of the products
- v) The cost of harvesting the products

b) Restoration and replacement cost

King and Mazzotta (2006:1) as well as Sundberg (2004:20) propose the following process (adapted):

Before any costing is done, it is necessary to assess the environmental service that is provided in terms of the following:

- i) The types of services provided (i.e. water purification, erosion control)
- ii) How the services are provided (water retention through wetland vegetation)
- iii) To whom they are provided (residential area x)
- iv) The measured levels at which the services are provided (2 megalitres per day)

The second step is to identify the least expensive alternative means of providing the identified service or services to the designated area. The third step is to determine the cost of the alternative means of providing the service(s). Finally it is necessary to determine whether the public would be willing to accept the substitute or replacement service in place of the ecosystem service.

c) Damage cost avoided

The initial step of the damage cost avoided method also requires a thorough assessment of the services provided, as described in 2.1.5.5b.

The second step is to estimate the potential physical damage to property, either annually or over a realistic period. The final step is to calculate either the rand value of potential property damage, or the amount that people spend to prevent this damage (King & Mazzotta, 2006:1).

d) Defensive expenditure method

This method is simply the costing of existing programmes aimed at sustaining the integrity of an environmental service or avoiding damages.

e) TCM

Turpie *et al.* (2001:47-57) and Perman *et al.* (2003:413-414) outline the TCM as follows:

Zonal boundaries are drawn up with each zone representing an average distance from the environmental amenity (see Perman *et al.*, 2003:413). Automobile Association (AA) tariffs or South African Revenue Services (SARS) tariffs based on a vehicle's capacity can be used to determine a cost per kilometre. The travel cost per kilometre is multiplied by the distance travelled to give a total travel cost per respondent.

The analyst then estimates a demand curve by determining the relationship between visitation rate and travel costs per zone. The statistical or functional form of the demand curve is chosen on the basis of best fit and applied to the data. This could either be linear, semilog or loglinear (Turpie *et al.*, 2001:48). The demand curve explains the change in visitation numbers as the cost of travelling in relation to distance increases or decreases. Price is therefore a dependent variable. Factors such as income level may to a lesser degree also be a dependent variable, and factors such as race may be statistically independent of the visitation rates (Turpie *et al.*, 2001:48).

Consumer surplus is then calculated for visitors from each zone. It is the difference between the market price of a commodity, say R1,00, and what an individual is prepared to pay, say R3,00, with a resulting surplus of R2,00. In the TCM application, consumer surplus simply means the difference between what the person has paid in travel cost to visit the amenity and the cut-off point where no more visits are likely (see Perman *et al.*, 2003:414). This cut-off point is where it simply becomes too expensive to travel to the amenity. The surplus is therefore the additional travelling cost (distance, time and mode of transport cost) a visitor is willing to pay to visit the amenity up to the point of resistance. The consumer surplus is a handy indicator where access fees are under consideration. Suppose a game reserve needs to increase entrance fees, but does not wish to do so to the extent that visitation numbers will be severely compromised. The consumer surplus will then in such a case give a good indication up to what point entrance fees can be increased where it will simply become too expensive to visit the reserve.

The consumer surplus for each zone is then added up to give the total use value.

f) HPM

This method is dependent on sales data of properties in the survey area or, if this is not available, on the input of experienced estate agents or property valuers.

Van Zyl *et al.* (2004) explain that sales data is used to determine the premium, if any, on property values owing to close proximity to an attractive environmental amenity. Some of the benefits that properties get from this close proximity are easy access to recreational opportunities, scenic views and sometimes serenity. These benefits contribute to property demand and the subsequent rise in values.

The average price of properties located in the area but not directly next to or close to the environmental amenity is calculated using sales data or inputs from estate agents. The premium (or discount) is then calculated for properties located next to or in close proximity to the environmental amenity by comparing their sales data with the average of the area. Supposing the average for the area is R1 000 000 per property, and the average value of properties that seem to benefit from proximity to the environmental amenity is R1 150 000; then the average premium is 15%. See table 2.3 for a basic illustration of hedonic pricing.

The influence of the environmental amenity on property value is the total premium multiplied by the total number of properties.

Table 2.3: Property price increase owing to proximity to environmental amenity

| Number of Affected Properties | Average Value of Affected Properties | Total Value of Affected Properties | Premium | Value owing to Environmental Amenity |
|--------------------------------------|---------------------------------------------|-------------------------------------------|----------------|---------------------------------------------|
| 31 | R1 150 000 | R36 650 000 | 15% | R4 650 000 |

(Adapted from Van Zyl *et al.*, 2004:18)

g) CVM

CVM elicits people's WTP for an environmental programme in a constructed hypothetical scenario. It therefore requires the development of a questionnaire.

The following describes a scenario and presents an example of a CVM questionnaire based on it. This questionnaire must be done face to face with the respondent by trained interviewers.

The Mogale City Local Municipality and private individuals own land towards the west of the Walter Sisulu Botanical Gardens. It has been realised that this land contains unique biodiversity and geological features worthy of conservation. However, the land is under development pressure and these unique features may be lost if no intervention takes place. This land also forms part of the hunting ground of the Botanical Gardens' resident pair of Black Eagles. The Municipality, in partnership with the South African National Biodiversity Institute, wishes to purchase the remaining portions of land worthy of conservation but is in need of a one-off dedicated tax contribution to make possible the purchasing of land, erection of game fencing and launch of conservation programmes. The purpose of this questionnaire is for you to vote on your willingness to contribute and the amount you wish to contribute. It is important to note that the tax contribution is voluntary and will exclusively be applied for the purposes stated above.

The median total WTP is then calculated and multiplied by the total relevant population. This will present the economic value of the environmental amenity (Perman *et al.*, 2003:425).

2.2 In search of a legal mandate to apply environmental valuation methods to environmental resources

2.2.1 Introduction

As stated in the research **hypotheses** under section 1.5, this study does not wish to promote a methodology that is not supported by national and international legislation and environmental valuation best practice. This section of the literature review aims to find a legal mandate for the application of environmental valuation. The need to do this was identified by Mr Andre Kruger during a workshop on 22 November 2006, who is co-supervisor to this research project and whose expertise in property valuation has been invaluable.

This assessment had to look at environmental valuation on a national and international scale to determine what form of legal rights, mandate or restrictions existed which governed environmental valuation application. Environmental resources economics and its valuation methodologies have a much larger application than just open space valuation, and a broad assessment was necessary to obtain a better understanding of the inherent legalities of their application. The assessment to find a legal mandate would not have been possible if the focus was specifically on open space valuation. Section 2.3.2 highlights the limited availability of literature that deals exclusively with open space valuation. If a legal mandate exists, whether by international treaty or national legislation, then this could be disseminated to open space valuation, as the overarching principles and need to value the environment are the same.

The methodology followed in searching for a legal mandate for environmental valuation includes the following study focus areas:

- A brief review of jurisprudence, and its role in the evolution of environmental law
- The interrelationship between environmental law and economics
- The development of environmental valuation in the economics field
- The role of market failure in supporting the need for environmental valuation
- The application of environmental valuation in litigation and tort law
- International accounting guidelines for environmental valuation

- International treaties and agreements that support environmental valuation
- Synergies and differences between property valuation and environmental valuation
- South African legislation and environmental valuation

The literature review attempted to extract specific provisions or at least principles that would support environmental valuation and that could be inferred as a legal mandate.

2.2.2 The law and environmental economics interface

A brief review of jurisprudence is considered necessary within the context of environmental resource economics to show the interrelationship between these disciplines and how support is given to the concept of environmental valuation. One of the theoretical components of the philosophy of law or jurisprudence is the study of natural law and how it influenced modern legislative frameworks (Himma, 2006). Natural law is the generally accepted concept (with exceptions) that our society is governed by inflexible natural precepts and that our laws should be in synchrony with it (D'Entrèves, 1951:17). This underpins the naturalist's school of thought that human civilisation with its morals, politics, philosophies and laws operate within a framework of universal morals and it is not a separate entity (Cornell Law School, 2006). Environmental resource economics (ERE), which forms the basis of this study, is rooted in the understanding that the global economy operates within the same natural environment (Perman *et al.*, 2003:17). The natural environment sustains life and provides the resources which feed the global economy. The synonymy therefore lies in the fact that each system, whether law or economics, has its roots in universal natural principles and precepts. It is through human advancement that these orders have been revealed to form the philosophical basis of our societal hierarchies and legislative arrangements.

Natural law does not refer to the law of physics or environmental law, but is rather a moral guide for the law making process (D'Entrèves, 1951:10). Thomas Hobbes, English philosopher, established that natural law is “a precept, discovered by reason, by which a man is forbidden to do that which is destructive of his life, or takes away the means of preserving the same; and to omit that by which he thinks it may best be preserved” (Hobbes, 1651:chapter xiv). He also said that natural law consists of principles which aim to promote and preserve human happiness, peace and well-being.

The founding principles of natural law are evidently and naturally humanitarian or anthropocentric in their focus. Their integration can be seen from Roman law to the present Statute of the International Court of Justice (Stanford Encyclopedia of Philosophy, 2007). It forms the basis of the preservation of human well-being.

The same principles can be observed in the development of environmental law (Lazarus, 2004:48). These principles do not grant rights to the environment in its exclusivity, but rather affirm people's rights in relation to the environment (Kibel, 1999:150-151). The realisation in the mid-twentieth century that environmental degradation has dire consequences for humanity and future generations, and that it potentially contravenes principles of natural law, brought about international agreements concerned with the protection of the global environment (Barrow, 2006:132; Department of Environmental Affairs and Tourism, 2006:4). Some of the more significant treaties were formulated at the 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, and include the United Nations Framework Convention on Climate Change (UNFCCC or FCCC).

These treaties subsequently influenced the evolution of environmental legislation on a global scale, including South Africa (Department of Environmental Affairs and Tourism, 2006:xviii). The inclusion of these environmental principles in the South African Constitution 108 of 1996, when it was written in the early 1990s, is particularly evident in the well-known section 24 in that *“every person has the right (a) to an environment that is not harmful to their health and wellbeing; and (b) and that everybody has a right to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures”*. Note that the focus is on the right of *“every person”*, implying an anthropocentric point of departure. The Constitution gave impetus to the development of the NEMA 107 of 1998, which is widely applied in dealing with environmental matters.

Although environmental degradation is often ascribed to human economic activity, environmental law does not stand opposed to economic activity. It generally rather aims to regulate and guide economic activity towards a sustainable development path (Driesen, 2003:13). This is based on the concept that the environment has no value outside human activity and would also explain why current environmental legislation does not grant the environment any rights *per se*, but rather protects human rights in relation to the environment (HSBC Institute of the Environment and the Economy,

2005). Judge Weeramantry's opinion in the *Danube River* case held before the International Court of Justice in 1997 supports this precept. The Judge held that "the protection of the environment is a vital part of contemporary human rights doctrine, for it is the *sine qua non* for numerous human rights such as the right to health and the right to health itself". He concluded that "environmental rights are human rights" and that "there is a duty lying upon all members of the community to preserve the integrity and purity of the environment" (cited by Kibel, 1999:150-151). It can be deduced from this that these rights are conditional to an obligation or responsibility and that they are not absolute. With an increase in environmental degradation and in global populations and with the limited resources, it is possible that these human rights may be limited in time to come, while the proverbial scale of justice may shift from an anthropocentric to ecocentric focus (Kibel, 1999:xxi; also see Snauwaert, 1996). As unpredictable as the future may seem, the increase in global environmental consciousness is certain, which may bring about the realisation that "our future depends not so much on our ability to alter nature to accommodate society, but on our ability to alter society to accommodate nature" as stated by Kibel (1999:xxi).

Any phenomena have no value in the absence of a conscious being that may appreciate it. In other words 'value' is only real when there is someone to appreciate it. Humans value environmental resources that sustain economic activity; they value environmental systems which sustain the supply of food, energy, medicine, water and clean air; they value biodiversity which may hold the key to treatment of future ailments and scientific discoveries; and they value the intrinsic, constructive psychological effects the environment has on humans. The realisation of these values over the past century has had its inroads in the evolution of environmental law (Barrow, 2006:126, 132). Environmental laws were needed to protect these values from being diluted by abuse and misuse through human activity. As science came to a better understanding of the value of the environment in relation to human well-being and survival, so the environmentally conscious part of society has endeavoured to ensure its protection.

Perman *et al.* (2003:11) assert that if human well-being is affected by the presence or absence of a resource, then it must have [economic] value, whether positive or negative. While the importance of the environment in terms of sustaining life is recognised by the scientific community, global economies fail to attach an appropriate monetary value to it (Beder, 2000:6; Sundberg, 2004:7; Markandya, 2005:19). It was realised since the Bruntland Commission report that for science and economics to make any progress in

understanding sustainable development, an integrated and interdisciplinary approach would be needed (Beder, 2000:5; Perman *et al.*, 2003:8).

The realisation that markets had failed to attach a value to environmental resources led to the development of valuation methods (Sundberg, 2004:7). Economists could make a case for the sustainable use of the environment if its value could be measured and expressed in fiscal terms. This required the natural environment to be treated as an asset and resource the same as labour and capital (Beder, 2000:5).

This section of the literature review will seek to find a legal mandate for the application of environmental valuation. This task is embarked upon with reservation, considering that ERE and environmental law are subjects that are still evolving while attempting to address many shortcomings (Barrow, 2006:90). It has been established that law develops reactively to problems, resulting in a delay between need and implementation (Barrow, 2006:126). Kibel (1999:xx-xxi) supports this concern by drawing on the inspirational 1991 lecture of Charles Wilkinson at Willamette Law School. Wilkinson was addressing students about western water law, while he tactically integrated aspects of Native American folklore, geological history and the impact of water projects on culture and values to reveal the failure of law. Wilkinson stated that the “language of law as we know it is too small to talk about these issues. We need to create a new language for the law, one that is big enough to confront the resource issues that face us now”.

2.2.3 Market failure

Environmental valuation has developed with a fair amount of scepticism concerning its accuracy in determining real value (Gen, 2004:xv-xviii). The idea of putting a price on environmental services and goods is often thought of as misconceived and inherently flawed (Kontoleon *et al.*, 2002:186; Perman *et al.*, 2003:399). There are also concerns among environmentalists that economics should not be used as an instrument to solve environmental problems while it is at the centre of all these problems. An example is the *pareto optimum* theorem of welfare economics developed by Vilfredo Pareto in 1897 (Perman *et al.*, 2003:7), which acts as a natural control instrument over environmental resource exploitation when a state of economic efficiency exists. This *pareto optimum* theorem or ‘the invisible hand’ of the economy, as it is often referred to, has constantly failed in reality as there is never a state of economic efficiency (Barrow, 2006:93).

Given the difficulty at valuing the environment, it is perhaps unfair to criticise its attempt and its intent. Few economists agreed before the 1980s that the earth was finite and thus encouraged ongoing growth and expansion (Barrow, 2006:94). One environmentalist has, however, ingeniously stated that “*growth for the sake of growth is the ideology of the cancer cell*” (Barrow, 2006:96). Regardless of the controversy and debate around environmental valuation, economists agree that the market has failed to appropriately value the environment and that it has discounted or failed to cost the future implications of environmental degradation (Gen, 2004:8-9; Markandya, 2005:19). Environmental valuation is an attempt to correct market failure and this has opened the door for several applications.

One critical aspect of market failure is that the economy fails to value the externalities of production or consumption. According to Perman *et al.* (2003:134) “*an external effect, or externality, is said to occur when the production or consumption decisions of one agent have an impact on the utility or profit of another agent in an unintended way, and when no compensation/payment is made by the generator of the impact to the affected party*”. This external effect could be pollution, noise, overextraction of a resource, destruction or degradation of one resource because of use of another, for example the destruction of biodiversity because of unsustainable forestry (Markandya, 2005:19). Environmental valuation is used in EIAs and cost benefit analysis to determine the cost implications of such externalities on external parties (Beder, 2000:8; Kontoleon *et al.*, 2002:189, 190). The cost could either be negligible, which means the project is highly viable, or there could be some external cost for which the producer needs to compensate the affected party. The cost could also be so high that the whole project becomes infeasible. Failure to cost or value externalities can lead to litigation as affected parties attempt to claim for damages. When an industry costs these externalities and compensates for them in its overall production cost, then the production externality is internalised (Perman *et al.*, 2003:124-125).

Another aspect of market failure is that property rights for certain environmental resources are poorly defined (Beder, 2000:6; Perman *et al.*, 2003:125). Nobody owns the atmosphere and industries have for many years released their waste gases and smoke without considering the impacts of this on the human collective (Markandya, 2005:19-20). Similarly, the ocean has been subjected to overfishing and environmentally degrading methods of fishing (Kibel, 1999:118-119). These practices often take place in international waters where there is limited control and poorly defined ownership (Perman *et al.*, 2003:25). Since nobody owns the international

waters, it is generally a 'free for all' situation. The sovereign right to profit of international fishing companies is currently not contingent on any responsibility to the international community, but it is protected by international trade agreements. This does not screen produce from unsustainable practices (Kibel, 1999:150; Driesen, 2003:35). Kibel (1999:150) points out that nations that accelerate global warming, deforestation and species extinction, and occasionally deny human rights, are still welcomed in trade agreements. International law is currently challenged to transform these open access resources to a common property resource or international commonage (Perman *et al.*, 2003:126; Kibel, 1999:149-152).

A third aspect of market failure is where the economy does not recognise environmental services and goods as an input in production (bees pollinate crops; clean water is used from rivers to support industries; birds control pests on certain crops) (Kasina, 2007:101). Capital and labour are the basic recognised and accounted inputs in production. Resources such as clean water and air and the environmental services which sustain their supply, though essential in production, are often not valued as an input and this may cause industries to abuse the flow of such 'free' production inputs. The presence of natural elements in the work environment, such as parks, gardens or even office plants, may have a positive effect on human psychological satisfaction, which in turn may improve productivity of workers (Perman *et al.*, 2003:474; Naidoo, 2003:7). Although a production input such as human psychological satisfaction may not be essential in production, clean water and air often are. Economists recognise that production and consumption cannot be sustained indefinitely when a non-renewable resource is essential in the production function (Perman *et al.*, 2003:475). The value of ocean fish is only the cost associated with fishing and marketing the processed fish and does not include ecological functions of the ocean which produced the fish. If these ecological functions were properly valued, then capital could be raised through green taxes, for instance, to ensure that fishing operations are done in an environmentally sustainable manner.

New York City (NYC) relies on the proper functioning of ecosystems in its watersheds to ensure the provision of clean potable water to the city. The city has saved several billion dollars by purchasing land and establishing partnerships with private land owners within the watershed, instead of constructing artificial water treatment plants and pumping stations (New York Water Supply Watersheds, 2007). Today these forests with their micro-organisms and fountains in the watershed, supply New York with clean water, which is today recognised as the largest unfiltered surface water

supply in the world (New York Water Supply Watersheds, 2007). This was made possible because the ecosystem functions in the NYC watershed were valued as an input into the production of the city's clean potable water and a portion of the water sales revenue is used to maintain and expand the NYC watershed property estate (New York Water Supply Watersheds, 2007).

Market failures result in unsustainable economic development as civilisations are discounting the externalities of their 'progress'. The unsustainable mining and harvesting of natural resources will have an economic boom effect until the sustainability threshold is crossed and a decline in availability is observed (Barrow, 2006:97). In an attempt to show the linkages between the environment and the economy and the dependency of the economy on the health of the environment, accounting procedures have been developed which treat the environment as natural capital and attempt to measure its depletion or enhancement (Barrow, 2006:96). Environmental accounting can be applied at a global, national or corporate level and is useful to determine the stocks of resources and value of environmental goods and services. These accounts will inform decision makers about the state of a resource and whether it is utilised optimally or excessively (Perman *et al.*, 2003:628). Environmental accounting systems may also provide information as to what percentage of profit needs to be set aside for maintaining the resource, purchasing cleaner production technologies, and setting aside rehabilitation funds.

2.2.4 Application of environmental valuation in damage claims

Environmental valuation is particularly useful in the event of environmental damage caused by illegal activities. Common law allows for civil action to be taken, under *delictual* liability and specifically the *Aquilian* action as a remedy for wrongs to interests of substance (Bouwer & Gaum, 2000:147). It is necessary under the *Aquilian* action to show that the defendant acted wrongfully and there was culpable conduct, which caused patrimonial loss. This action would require a wrongful act/omission (pollution, poaching), fault (intentional [*dolus*] or negligence [*culpa*]), causation (an act on a preconceived plan of the defendant to cause harm to the environment) and patrimonial loss (irreparable damage to an ecosystem) (Bouwer & Gaum, 2000:147). Environmental valuation methods can be used to determine the value of the loss, damages suffered in terms of health or lost productivity of an ecosystem or determine the cost of repairing such damage. A court of law may use studies to determine fines, settlements or asset attachment orders (Perman *et al.*, 2003:400; Kontoleon *et al.*, 2002:191). The Exxon Valdez oil

spill along the cost of Alaska required the use of preference-based (CVM) environmental valuation methods to determine the damage costs payable to the US government. This resulted in a damage settlement of \$2.75 billion (Perman *et al.*, 2003:423).

Debates concerning the measurement of damage assessment claims are still prevalent in literature as validity, accuracy and costs of the surveys vs. actual damage that has occurred is questioned (Kontoleon *et al.*, 2002:191). Concerns regarding the compatibility of valuations and specifically preference-based approaches with tort law damage calculation are also of concern as the application of *ex post facto* valuations of damage can be embedded with emotional 'moral duty' biases (Cummings & Harrison, 1994:1; Kontoleon *et al.*, 2002:192). The assumption is therefore that the value of the environment would be lower before the damage occurrence than values obtained on an *ex post facto* basis. It is argued that this can be resolved by making use of environmental scientists to determine restoration costs instead of the citizen's jury or a preference-based approach (Kontoleon *et al.*, 2002:192).

Damage claims have the role of compensating victims who suffered loss and also to serve as a deterrence to the potential wrongdoer. It is therefore important that valuation methods measure as accurately as possible the full extent of the damage by taking into consideration all benefits or values lost so that an award fully compensates in monetised terms for the loss. In practice this is not always achievable owing to cost, time and method limitations. However, despite the imprecise values obtained and limitations of valuation methods, it is argued that this is the only available approach at present to assess environmental damage and could also account for their acceptance in damage claims (Rutherford, Knetsch & Brown, 1998:51; Kontoleon *et al.*, 2002:193-194). The fact that environmental valuation methods can play a compensatory and deterrent role in damage claims makes them compatible with tort law principles (Kontoleon *et al.*, 2002:193-200).

2.2.5 International guidelines for environmental valuation

The United Nations *Handbook of national accounting: Integrated environmental and economic accounting* (commonly referred to as SEEA), provides a framework for analysing the environment's contribution to the economy and measures the impact of the economy on the environment in a more holistic sense than GDP or gross national product (GNP) indicators

(United Nations, European Commission..., 2003:1). GDP and GNP are concerned with measuring the affluence or welfare of a nation. GDP is obtained by adding together the total incomes earned of persons or total output sold by firms in the economy, or by adding up the total expenditure of firms on capital (Department of Environmental Affairs and Tourism, 2006:356). GDP, however, fails to account for depreciation of environmental assets (Perman *et al.*, 2003:641; Dasgupta, 1997:6). Environmental accounting aims to complement GDP indicators (see Pulselli, Ciampalini, Tiezzi & Zappia, 2006:271-281). Economists interested in measuring genuine progress in relation to the sustainability of economies concede that national domestic product (NDP) and GDP are not satisfactory measurements. To prove this, several studies have been conducted where an actual index of sustainable economic welfare (ISEW) or genuine progress indicator (GPI) is developed and compared to the traditional GDP, GNP or NDP (Perman *et al.*, 2003:649; also see Silva, 2000:4). Figure 2.2 shows the results of such a study done in the UK.

The calculation of ISEW takes into consideration, among other things, personal consumption expenditure, distributional inequity, value of transport infrastructure, commuting costs, value of public health and education, cost of vehicle accidents, noise, air and water pollution costs, cost of wetland loss, cost of farmland loss, estimate cost of non-renewable resource depletion and cost of long-term environmental damage (Perman *et al.*, 2003:649). While this methodology may be preferable from a sustainability perspective, it challenges conventional thought on economic growth (see Silva, 2000:4). Debt as a percentage of the GDP of a country plays a pertinent role in its credit rating (UNFCCC, 2008:12). The credit rating of a country is used by investors as a risk indicator to determine the level of risk they would be exposed to should they choose to invest in that country. For obvious reasons, if methodologies such as ISEW are standardised as an economic performance indicator, it could have a significant impact on the future risk rating of a national economy. While GDP may indicate economic boom, ISEW may indicate a looming decline, and therefore an investment risk (see figure 2.2). This may be one of the reasons why these indicators are not more broadly applied, as they reveal an uncomfortable trend. It reminds one of Al Gore's documentary "An Inconvenient Truth" (Gore, 2006). The interpretation of the many scientific studies on global warming, biodiversity loss, pollution and assessment of economic sustainability is inconvenient information to many economies. Gore states in his documentary that "ultimately this is not so much a political issue as it is a moral issue", highlighting the need for global policy change.

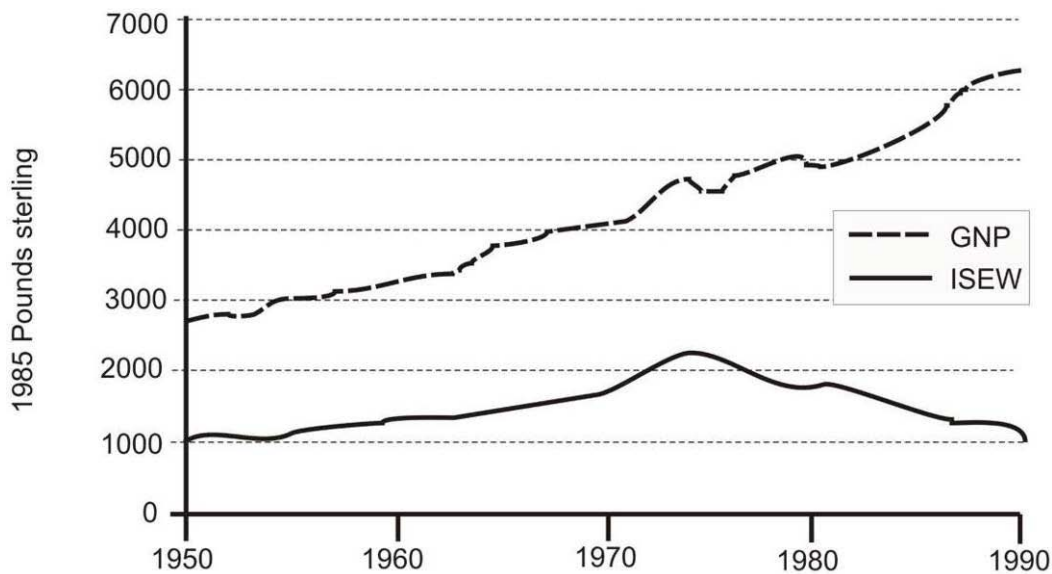


Figure 2.2 Index of sustainable economic welfare for the UK (Perman *et al.*, 2003:648)

National environmental accounting has been adopted by numerous nations in an attempt to account for the state of the nation's environmental assets. Australia, Canada, Denmark, England, Norway, France, Japan, the USA and the Netherlands are among the nations that have developed state-of-the-environment accounts (Barrow, 2006:97). The SEEA classifies natural resources, land and surface water and ecosystems as assets of the economy (see table 2.4) and sets about procedures for enumerating the causes of change in these environmental stock levels so that opening and closing balances can be reconciled at the end of each fiscal year (United Nations, European Commission..., 2003:257).

Environmental accounting will not be possible without environmental valuation methods. The collective asset values described in the SEEA can only be extrapolated by first valuing the various environmental assets and then combining the value of the natural asset with the value of the produced and financial asset already included in the standard national accounts (SNAs) of a nation (United Nations, European Commission..., 2003:11). The SEEA is essentially a subaccount or satellite account of the SNA.

Table 2.4 SEEA asset classification

| |
|----------------------------------------------------------------------------------------------|
| EA.1 Natural resources |
| EA.11 Mineral and energy resources (cubic metres, tonnes, tonnes of oil equivalents, joules) |
| EA.12 Soil resources (cubic metres, tonnes) |
| EA.13 Water resources (cubic metres) |
| EA.14 Biological resources |
| EA.141 Timber resources (cubic metres) |
| EA.142 Crop and plant resources, other than timber (cubic metres, tonnes, number) |
| EA.143 Aquatic resources (tonnes, number) |
| EA.144 Animal resources, other than aquatic (number) |
| EA.2 Land and surface water (hectares) |
| EA.21 Land underlying buildings and structures |
| EA.22 Agricultural land and associated surface water |
| EA.23 Wooded land and associated surface water |
| EA.24 Major water bodies |
| EA.25 Other land |
| EA.3 Ecosystems |
| EA.31 Terrestrial ecosystems |
| EA.32 Aquatic ecosystems |
| EA.33 Atmospheric systems |
| Memorandum items: Intangible assets related to environmental issues (extended SNA codes) |
| AN.1121 Mineral exploration |
| AN.2221 Transferable licenses and concessions for the exploitation of natural resources |
| AN.2222 Tradable permits allowing the emission of residuals |
| AN.2223 Other intangible non-produced environmental assets |

(United Nations, European Commission..., 2003:252)

While more countries now acknowledge the need to account for natural resource depletion, and for valuing these resources to obtain a more objective and holistic state-of-the-environment account balance sheet, the challenge associated with measuring environmental asset depreciation and value is a real restrictive factor (Perman *et al.*, 2003:627-628). The need to treat natural resources the same as human-made capital is a generally accepted principle. It is, however, difficult to measure the depreciation and value of environmental benefits that do not produce directly observable monetised flows into the economy, such as fresh air, lakes and oceans

where there is no exclusive property rights. The exploitation of open access resources does not produce economic data which can be used to calculate depreciation. There are no incentives or legal obligations for private firms to value these resources in the context of quality, availability and depletion (Perman *et al.*, 2003:641).

The difficulty, and sometimes controversy, in the application of environmental valuation methods is evident in environmental accounting as well. Some of the methods have very limited coverage as they are limited to use on a few subset of values. Most of these methods have also been specifically adapted for use on environmental resources and the values are therefore not compatible with the valuation principles used in national accounts. The risk of double counting the same flow of benefits is apparent when using multiple valuation methods and the valuer therefore needs to be aware of this. The use of multiple valuation methods is nonetheless encouraged to cover as many of the values as possible (United Nations, European Commission..., 2003:412-413).

The valuation of environmental goods and services is a growing discipline in economic sciences (Gen, 2004:3). The value of these methods is recognised more widely now than ever before, especially in the context of dwindling biodiversity, climate change, environmental pollution and urban development challenges (Perman *et al.*, 2003:10-11; Markandya, 2005:19-20). While a number of environmental features, such as corral reefs or distant lakes or forests, may not appear to be contributing to the global economy, a cautious approach must be taken in recognising that humanity's knowledge about the natural environment is largely limited. To decide that the loss of any species or ecosystem is of no consequence to humanity may prove to be disastrous. This is clearly where decision makers need to adopt the precautionary principle so that preventative action is taken in the face of uncertainty (Barrow, 2006:33, Lindenmayer & Burgman, 2005:404). There is uncertainty about the future pharmaceutical value of unexplored species, and about the complete role of biodiversity in the fine balance of ecological processes. There is also uncertainty about the possible economic value of these undefined and undiscovered benefits. Carbon sequestering ecological processes is perhaps one of the most discounted environmental benefits at present when the inherent risks of global warming and subsequent climate change are considered. Whilst scientists are globally in agreement about the reality of climate change, as observed, multinational companies are continuing to exploit natural forests (Laurance, 2007:20-24). Companies also focus their technological developments on the reliance on crude oil and coal as finite energy sources, while doing so under the protection of international

trade agreements. Governments that are treaty to international trade agreements may not impose sanctions on countries that are clearly using environmentally destructive production methods (Kibel, 1999:150; Driesen, 2003:35). While certain international trade signatories may object to import controls that are based on 'dirty' production technologies, the fact that less regulatory demanding countries can produce at lower cost is often overlooked. In the absence of air pollution controls and water effluent standards, production is obviously cheaper (Lazarus, 2004:146). Cheaper production is often at the cost of biodiversity, human health and the global climate (Silva, 2000:4). This happens where the cost of the externalities of production has been discounted and where environmental services and goods as inputs in production are not recognised. There is therefore a firm global case for environmental valuation to ensure that these discrepancies are identified and accounted for in production costs.

2.2.6 Influence of international environmental agreements on implementation of environmental valuation

2.2.6.1 Kyoto Protocol

In the context of global warming and associated climate change, the environmental service of carbon sequestration is becoming critical. Plants perform the carbon sequestering function by absorbing carbon dioxide and, through the process of photosynthesis, converting it into organic compounds where the plant in turn releases oxygen into the atmosphere (Reyneke, Coetzer & Grobbelaar, 1987:41). The rate of carbon gas release into the atmosphere as a result of human activity has, however, exceeded the natural assimilative capacity of the environment to sequester it into organic compounds. The natural consequence is an increased atmospheric concentration of carbon dioxide (Perman *et al.*, 2003:544; Driesen, 2003:85, 131). Carbon dioxide as well as other hydrocarbons released into the atmosphere act as greenhouse gases by trapping solar radiation, which effectively results in global warming (Department of Environmental Affairs and Tourism, 2006:216). Global warming causes the gradual melting of polar ice sheets and glaciers, which is now evident and observed in Antarctica as well as Iceland and the North Pole (BBC News, 2005; Handwerk, 2004).

The ice reserve held in the polar regions, with the assistance of gravity, performs the important function of regulating ocean currents, as it causes warm tropical water to cool and sink to the bottom of the ocean to become

cold water ocean currents (Gribbin, 2001:3). This whole oceanic current system ensures the rotation of ocean water past continents, assists in global temperature regulation and also aids the development of high and low pressure atmospheric systems, which in turn support the transfer of moist ocean air onto land to produce rain (Gribbin, 2001:3; also see Encyclopaedia Britannica, 2008:33). The melting of ice in polar regions is at present threatening the functioning of ocean currents, which in turn could affect rainfall patterns (European Space Agency, 2005). While scientists are attempting to predict the extent of future climate change, the exact changes are still uncertain at present (Department of Environmental Affairs and Tourism, 2006:219). What is certain is the consensus of scientists on the reality of global warming (Driesen, 2003:131).

An international attempt at reducing and stabilising global carbon dioxide (CO₂) emissions was marked by the UNFCCC, which was signed by participants at the UNCED in 1992 (UNFCCC, 2008). Signatories to the agreement committed themselves to reducing their respective countries' CO₂ emissions to 1990 levels by 2000 (UNFCCC, 2008). The UNFCCC subsequently set the pace for the following 1997 Kyoto Conference during which specific emission targets and carbon trading standards were set (UNFCCC, 2008). Although the United States - being under pressure from its industries - did not sign the Kyoto Protocol, a number of its states did set specific carbon reduction strategies in place, with California being the trendsetter (Driesen, 2003:120). Certain industries in the United States as well as Europe and Asia started participating in emissions trading systems, and more specifically the CDM of the Kyoto Protocol.

Emission trading is an economic incentive for industries and nations to reduce their carbon emission (Perman *et al.*, 2003:336). The system is an evolution of the typical command and control approach used to regulate pollution in the past (Driesen, 2003:58). It is essentially an economic instrument that enables companies to sell their excess allocated and permitted quota of emissions (otherwise known as carbon credits; one credit equals one ton of CO₂), if they do not use it, to companies that exceed their quota (Driesen, 2003:59). Some companies have made substantial investments in cleaner production technologies and are therefore able to reduce their emissions, while others may be using old and inefficient technologies and therefore have to pay for the right to pollute. Emissions trading therefore encourages industry to reduce its emissions.

Nations that became signatories to the Kyoto Protocol agreed to specific national emission targets (Department of Environmental Affairs and Tourism,

2006:225-226). This binding agreement had to be cascaded down to industries and a national cap or limit was therefore placed on the volume of emissions the industry may emit (Perman *et al.*, 2003:334-335). The more an economy develops, the more the demand for carbon credits will grow and the more expensive the right to pollute will become. It may initially have been more feasible to purchase credits, but as the carbon credit price increases, the more feasible cleaner production technologies become. Some emission trading schemes also require that a portion of the carbon credits be retired in every trade transaction so that the volume of available national credits decreases over time (Macalister, 2007). Essentially this results in lowering the national emissions cap and increasing carbon credit prices (Macalister, 2007). Governments also permit the donation of carbon credits to non-profit organisations which may be tax deductible (Grant Thornton, n.d.). Carbon credits, like shares, are recognised as assets and are accounted for in the balance sheet of a company.

Nations that are able to reduce their emissions below the cap set by the Kyoto Protocol can also trade these carbon credits with other nations (Perman *et al.*, 2003:335). The CDM allows industrialised countries to invest in emission reducing projects in developing countries, where these projects would be too costly in their own countries (Perman *et al.*, 2003:336; Cacho, 2006:1). The industrialised country may only invest in a project that would not ordinarily have occurred in the developing country and is referred to as the additionality criterion (Department of Minerals and Energy, 2007). These project methodologies are approved and monitored by the CDM Executive Board as well as an independent third-party agency, which is referred to as the designated operational entity (DOE) (Department of Minerals and Energy, 2007). The DOE needs to ensure that the project remains sustainable and that emission reductions remain constant. The CDM Executive Board will then issue CERs once it is satisfied that the project complies with its requirements (UNFCCC, 2008; Cacho, 2006:8). The company that has funded the CDM project can then use the CER as an alternative to purchasing carbon credits (UNFCCC, 2008).

The Kyoto Protocol with its carbon trading system has now made it possible to place an economic value on the reduction of or right to emit a specified volume of carbon. This effectively allows economists to value emission reduction technologies in that they would bring about CERs and hence free carbon credits which may be traded. These options should be dependent on a cost benefit analysis to compare costs of purchasing credits versus purchasing emission reduction technologies. The emissions cap will ensure

that the price of credits escalates and emission reductions become economically more desirable.

Green carbon sink projects, including mainly forest preservation, are to a limited degree registered as CDM projects owing to the risks involved and the less permanent state of the carbon fixing (Laurance, 2007:22). It is argued that forests may be subject to drought, fires and diseases which may threaten their carbon reserve (Cacho, 2006:9). The CDM nonetheless allows registration of certain green sink projects. In this case it would be possible to use the value of the CERs as a proxy to value the forest's carbon sequestering function. In this case the international agreements related to climate change have made it possible for the economic valuation of environmental services. While there are still numerous loopholes and discrepancies in the CDM system (Januário, 2007:73), it nonetheless sets the pace for future improved trading systems that would place a greater value on the carbon sequestering ability of natural vegetation. These systems may open more funding opportunities for conservation and urban greening programmes. Environmentalists, however, caution that carbon sink projects should not be funded alone on the basis that they permit ongoing and increased levels of carbon emissions of industrialised nations, in that they "buy their way out" (Laurance, 2007:20-21). These projects should instead be funded on the basis of protecting their existing environmental services and carbon sinks, while industrialised nations should continue to reduce local emissions and implement cleaner production technologies and efficiencies.

2.2.6.2 The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)

The Ramsar Convention has been established as an international treaty for the conservation and sustainable utilisation of important wetlands (De Groot, Stuip, Finlayson & Davidson, 2006:1). This follows the Convention on Wetlands of International Importance especially as Waterfowl Habitat held in Ramsar, Iran, in 1971 (Ramsar Information Paper No. 2, 2007:1). It is regarded as one of the first modern international treaties dealing with conservation and the wise use of the environment (Barbier *et al.*, 1997:7).

It is widely accepted that wetlands are among the most productive ecosystems supporting millions of people with food and ecological services (Barbier *et al.*, 1997:3; Ramsar Information Paper No. 1, 2007:2). Wetlands are generally considered as biodiversity hotspots owing to the great variety of birds, plants, fish, insects and mammals they support. They are also often a haven for biologists who study the many intricacies and interactions

between species (Ramsar Information Paper No. 2, 2007:2; Barbier *et al.*, 1997:3; De Groot *et al.*, 2006:iv; Department of Environmental Affairs and Tourism, 2006:120). Wetlands also perform important indirect services to people in that they purify water from dissolved solids and nitrogen, minimise the impact of flood water by reducing the flow rate of water and retaining it and reduce wave energy along coastal regions, thus limiting storm damage (Barbier *et al.*, 1997:20; De Groot *et al.*, 2006:19).

These benefits were not, however, always understood and wetlands have suffered extensive destruction to make way for agriculture, housing and industry (De Groot *et al.*, 2006:4). Delmar Blasco, Secretary General of the Ramsar Convention Bureau, states that wetlands have often been regarded as wastelands, which were seen as breeding sites for vermin (Barbier *et al.*, 1997:vii-viii). Some of the destructive alterations responsible for the high percentage of global wetland loss include water extraction, channelling, or damming, as well as peat mining (Barbier *et al.*, 1997:6).

The Ramsar Convention, which enabled international cooperation on wetland conservation, was established when it was realised that global waterfowl numbers were declining at an unprecedented rate (Barbier *et al.*, 1997:6). The Convention has since commissioned several research projects on the functioning and importance of wetlands, which allowed for the broadening of the terms of reference of the agreements and general understanding among signatories of the importance of wetlands (Ramsar Information Paper No. 2, 2007:5). According to Barbier *et al.* (1997:7-8), signatories to the Convention agree to undertake four main activities and obligations:

- Signatories must nominate wetlands for inclusion in the 'List of Wetlands of International Importance' and ensure that their ecological footprint is maintained.
- Signatories must develop national wetland policies, ensure that wetland conservation is included within their national land-use planning, develop integrated catchment management plans and adopt and apply the guidelines for implementation of the Wise Use Concept, which amounts to the sustainable utilisation of wetlands for the benefit of communities while ensuring the integrity of the ecosystem functions and their biodiversity properties.
- Signatories must promote the conservation of wetlands in their area of jurisdiction by establishing nature reserves and by promoting training in wetland research, management and wardening.

- Signatories must engage with other contracting parties about possible transfrontier wetlands, shared water systems, shared species and development aid for wetland projects.

(Also see Ramsar Information Paper No. 2, 2007:2-5)

The Ramsar Convention recognises that wetlands have great value but that these values are competing with conflicting economic uses, such as peat mining and property development (De Groot *et al.*, 2006:3; Barbier *et al.*, 1997:18-19). The value of wetlands had to be shown to be greater than other competing uses for conservation to be realised. The Conference of the Parties to the Convention on Wetlands therefore agreed in Brisbane, Australia, in March 1996 on a strategic plan (1997-2002) that would initiate the economic valuation of wetlands (Barbier *et al.*, 1997:vii, 21). Specific research was therefore commissioned in the fields of environmental valuation to bring to fulfilment the operational objectives of the strategic plan, which include the policy guide on “Economic valuation of wetlands” by Barbier *et al.* (1997), and the technical guide on “Valuing wetlands” by De Groot *et al.* (2006). Nations that are therefore treaty to the Ramsar Convention are assisted in fulfilling their mandate and obligations by being provided with a framework for valuing wetlands as a decision support tool. The legitimacy of the treaty and its subsequent mandates is clear and provides sufficient legal impetus to consider environmental valuation in policy formulation, EIAs and management plans related to wetland conservation.

2.2.7 Synergies and differences between property valuation and environmental resource valuation

The International Valuation Standards Committee (IVSC), formerly known as the International Assets Valuation Standards Committee, was established in 1981. This committee aims to (IVSC, 2001:3):

- i) “Formulate and publish, in the public interest, valuation standards for property valuation and to promote their worldwide acceptance and;
- ii) Harmonize standards among the world’s States and to identify and make disclosure of differences in statements and/or applications of standards as they occur.”

Through negotiations, the IVSC has managed, with some exceptions, to ensure a common international agreement regarding the fundamentals of

valuation (IVSC, 2001:3). The valuation profession abides by these fundamental principles and uses them to guide the valuation of fixed and movable assets, whether it is plant and equipment, businesses or real estate (IVSC, 2001:15). The concepts and principles of valuation are a broad subject and this study will therefore only focus on property valuation in an attempt to find synergies and differences between it and valuation of environmental goods and services. Environmental benefits originate and flow from property. Perman *et al.* (2003:10, 124-125) wonder whether it should therefore be considered as a value-adding component to that property. In practice it may not be that simple since the benefit of environmental goods and services may accrue not only to the property owner, but to the public surrounding such property (Lazarus, 2004:26). In some cases the property owner may receive little financial benefit from these services, while they are essential for the livelihood and well-being of surrounding communities. Perman *et al.* (2003:125) explain that there are no property rights in flow resources, as they cannot be contained exclusively for private use. For example, the presence of a wetland on a property where the owner resides may not benefit much, but its functioning is critical for the supply of environmental services such as clean water, storm water regulation and biodiversity sanctuary to communities downstream. Environmental legislation may protect the wetland and therefore restrict the potential utility of the land in question (see NEMA, section 2(4)(r)), which in turn may have a negative impact on the property's market value. These value impacts may, on the other hand, be offset by property rate discounts and exemptions as an incentive to preserve the site (see section 17(1)(e) of the Local Government: Municipal Property Rates Act 6 of 2004).

The traditional economic value-adding components to real estate include its general uniqueness, durability, location, relative limited supply and the available options of specific uses of a given site to its owner (IVSC, 2001:29). The IVSC supports the private rights concept associated with property ownership, which is an entitlement to the interests in what is owned (IVSC, 2001:30). The IVSC, however, does not show that it recognises communal rights to benefits flowing from private property. Communal benefits flowing from private property has therefore little bearing on its market value. It is only the rights to benefits which are vested in private property ownership that have a bearing on the relevant property's market value (IVSC, 2001:29). The economic concept of value is a direct reflection of a market's assessment of the benefits that accrue to the one who owns the property (IVSC, 2001:34). Even though a community may benefit from a flow of environmental goods and services from private property, it seldom pays for these benefits (Perman *et al.*, 2003:10). The owner of the property is not benefiting financially from

the provision of the services to surrounding communities, but often takes responsibility for its upkeep and maintenance (Lazarus, 2004:26). These benefits may include water purification, underground water reserve replenishment, a beautiful view, air quality amelioration, climate amelioration and biodiversity reserve for a variety of beneficial plant and animal species. These are benefits protected under the constitutional rights of communities (section 24 of the Constitution of 1996), and are protected through environmental legislation (NEMA 107 of 1998). The rights of the community to the flow of such services may to a certain extent limit the rights of the owner from whose property these services flow (Lazarus, 2004:28).

It is therefore preferable that the economic value of property and of environmental goods and services be separated during the valuation process as they are not always compatible and interrelated. The determination of market value is often more straightforward than valuing environmental goods and services. Real estate valuation relies on market trends, and property cost and pricing data to arrive at a market value (IVSC, 2001:34-35). Environmental goods and services, on the other hand, are in most cases not traded on the open market and the lack of market-based value proxies means that the number of assumptions about their value increases (IVSC, 2001:109).

The differing levels of expertise required for valuing real estate and the environment is also a factor that makes integration difficult. See table 2.5 for a comparison between real estate valuation and environmental valuation. Valuers are rarely qualified to recognise environmental goods and services and primarily focus on valuing real estate, businesses, plant and equipment (IVSC, 2001:267). Environmental goods and services are mostly valued by economists with the participation of environmental scientists becoming more prominent (compare Gen, 2004:xvi; Perman *et al.*, 2003:399; Alberini *et al.*, 1997; Bates & Santerre, 2001; Bowes & Loomis, 1980; Hanemann, 1994). The IVSC (2001:268) recognises environmental factors as “influences external to the property being valued, which may have a positive effect, negative effect or no effect at all on the property’s value”. Valuers are therefore encouraged to make use of the services of specialists where they believe environmental factors to have an effect on property value (IVSC, 2001:270-271). An interesting observation with regard to the International Valuation Standards is that they provide guidance notes (International Valuation Guidance Note Number 7) (IVSC, 2001:267) on the negative impact pollution, hazardous and toxic substances have on private property, but fail to provide any guidance on the identification of key environmental benefits and their influence on property value. This could effectively result in

the discounting of important environmental goods and services, the deterioration of which may have adverse effects on property value.

Table 2.5 A comparison between real estate valuation and environmental valuation

| Property Valuation | Environmental Valuation |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Primarily values real estate/immovable property | Primarily values the flow of goods and services from the environment |
| Focuses on the economic benefit accruing to the private property owner | Focuses on the economic benefit/detriment accruing to the receiving/affected community |
| Mostly uses market trends in immovable property cost and pricing, and few assumptions to infer value | Relies on non-market values, value proxies and a greater number of assumptions to infer value |
| Performed by professional valuers | Performed by economists and to a limited degree some environmental scientists |
| Valuation of immovable property is regulated by Property Valuers Profession Act 47 of 2000 | Valuation of environmental goods and services is not regulated at present |
| Seldom recognises the economic relevance of the environment for sustaining property value | Primarily aims to attach greater recognition to the environment as an economic contributor so that it may be protected and preserved to ensure economic sustainability |
| Environmental factors can influence property value, but are seldom taken into consideration during the property valuation process | Immovable property value only has an influence in hedonic valuation methods (property values are used as a proxy to value the environment, for example the influence a park has on surrounding property values) |

2.2.8 South African legislation and environmental valuation

2.2.8.1 Property Valuers Profession Act 47 of 2000

The Property Valuers Profession Act provides for the registration of practising property valuers and of the profession through the South African Council for the Property Valuers Profession (SACPV). The SACPV constantly evaluates required qualifications and accredits them accordingly, ensuring that property valuers adhere to national and international best practice and ethics. Section 19(2) provides that a person may not practise property valuation unless that person is registered in a relevant category of practice by the SACPV.

It is therefore clear that only property valuers may value immovable property for the purposes of financing, establishing property rates, insurance or determination of a reasonable price for the purposes of auctioning. Environmental valuation may not attempt to attach a market value to any property based on the presence of certain environmental goods and services. Environmental valuation may instead identify the environmental goods and services present and value the economic benefit of the flow of these goods and services to beneficiaries. It is then the prerogative of a property valuer to assess, with environmental sciences support, the identified flow of environmental goods and services to determine whether they could have any effect on the value of immovable property. The purpose of environmental valuation is not to influence property value, but rather to identify the economic benefits produced by the environment so that more informed decisions can be made about its utilisation.

2.2.8.2 National Environmental Management Act 107 of 1998

Subsection 2(4)(i) of the NEMA states as follows: “The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.”

Environmental valuation not only determines the economic value of the environment, but can also predict the economic impact the loss of environmental goods and services has on an economy (Perman *et al.*, 2003:399-400). It is often used in cost benefit analysis when considering the implications of development versus those of not developing (Perman *et al.*,

2003:399; Lazarus, 2004:27). This is therefore becoming a valuable instrument during the EIA process, as it allows for a more objective analysis of the real economic impact of a project. EIAs, unfortunately, do not always value the external effects a particular application has on the environment and therefore cannot require an applicant to internalise this cost in the overall economic feasibility assessment of the project. As an example, a mining company has determined that the establishment of a coal mine in a particular area is feasible based on the quality of the coal reserves and limited excavation costs, and has considered the cost of rehabilitation in its feasibility studies. The EIA, however, finds that there is a substantial risk of acid mine water decanting into an important water compartment. The implications of allowing the pollution would result in the non-usability of the water reserve for potable use and irrigation, which would sterilise thousands of hectares of agriculturally active land. This in turn would impact on job opportunities and local food security. The cost of establishing a water purification plant is then considered as an alternative, but it is soon realised that such a plant would have to be operational for many decades after the closure of the mine. The external costs of this project have been determined and the project is therefore regarded as infeasible.

Unfortunately even though NEMA requires independent consultants to perform the EIA (section 24(7)(d)), the consultancy is judged based on its track record of successful environmental authorisations, the same way a lawyer is chosen for successful cases. Naturally this places the consultancy under pressure to allow a level of compromise and bias, as its business depends on it (Beder, 1993:28-30; Rubinson, 2007:196-197, 200). The result is then that the environmental consultant may propose mitigation measures or alternative production methods to make a case for authorisation, or where information is withheld, which in retrospect may not have been the best development option (Beder, 1993:28-30; Rubinson, 2007:200). The use of environmental valuation of project externalities may produce non-supporting results. This information may therefore derail a project. The accuracy of the results may also be controversial, considering that it is a developing science. These factors will hamper the application of environmental valuation in the EIA process.

NEMA requires the assessment of the economic impact of activities, whether positive or negative, to allow competent authorities to make more informed decisions concerning each activity. There is unfortunately limited expertise in the field of environmental valuation (see section 2.3.2), while it is quite often an expensive exercise (Turpie *et al.*, 2001:85). Environmental valuation methods cannot be applied for every activity and the environmental

consultant as well as the relevant and competent authority must provide guidance as to which projects will require the application of environmental valuation. Environmental valuation is a fairly new and developing science (Perman *et al.*, 2003:399). It is envisaged that its application will only become more common practice in environmental management applications if the accuracy of the valuation methodology is refined, if environmental legislation gives it more prominence and if more environmentalists are trained in its application. NEMA is not specific as to which activities will require assessment of economic impacts and is generally silent on the application of environmental valuation methods. It does, however, lay the basic integrated environmental management principles for assessing possible economic impacts, although only applied on a limited and discretionary basis in practice (NEMA: Chapter 1).

2.3 Identification of gaps within available literature

The review of available literature revealed several areas that have not been sufficiently addressed to assist this research project. These gaps allow for the identification of further research opportunities, while they also presented challenges to this research project. Among the key gaps identified are the limited range of available methods and lack of attempts to broaden and refine these methods, the limited area of application and limited research on achieving wider areas of application, and the limited research on the use of available methods on valuing open spaces.

2.3.1 Limited range and area of application of methods

The review of the available methods showed that each method has its own specific data requirements. The availability of data is dependent on the type of environmental good being assessed and the impact of its excludability to users of the environmental good. An environmental good or service can be a public or private good. One distinguishing characteristic to determine whether a good or service is public or private, to varying degrees, is excludability (Perman *et al.*, 2003:126). This means that a person can be excluded from enjoying an environmental benefit, because access to it is restricted in terms of property rights or legislation. This is particularly relevant to Rand Water, as some of its properties have strict access control in place and are therefore off limits to the general public. This characteristic of these properties is assessed against the data requirements of valuation methods to determine if it will have an impact on method applicability.

Table 2.6 Required data for the successful use of valuation methods

| Valuation Method | Required Data | Impact of Excludability |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Production function approach | <ul style="list-style-type: none"> • The size of the environmental amenity in ha • The products harvested • The quantity of products harvested over time • The market value or price of the products • The cost of harvesting the products | Goods need to be accessible for harvesting and marketing, otherwise no data is obtainable |
| Restoration or replacement cost method | <ul style="list-style-type: none"> • The types of services provided • How the services are provided • To whom they are provided • The measured levels at which the services are provided • Replacement or substitution and values | Excludability is not a critical factor |
| Damage cost avoided method | <ul style="list-style-type: none"> • The types of services provided • How the services are provided • To whom they are provided • The measured levels at which the services are provided • Rand value of potential property damage, or the amount spent to avoid such damage | Excludability is not a critical factor |

| | | |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Defensive expenditure | <ul style="list-style-type: none"> • Cost of programme vs. • Cost of not having the programme | Excludability is not a critical factor |
| Travel cost method | <ul style="list-style-type: none"> • Number of visitors over a given period • Distance travelled • Travel modes used • Purpose of travel • Preferred recreation options of user • Income group • Cost of travel mode per kilometre | Site needs to be accessible for public recreational use, otherwise it will not be visited, and no data will be generated |
| Hedonic pricing | <ul style="list-style-type: none"> • Number of marketable properties benefiting from open space • Average value of properties in area • Value of properties directly benefiting from open space | Adjacent property owners need to have access to benefits of open spaces (view, recreational use) to show economic benefit and produce data |
| Contingent valuation | <ul style="list-style-type: none"> • Total WTP or WTA from a representative sample of population benefiting from open space | Respondents need to have access or otherwise have knowledge of the open space to enable them to show a WTP or WTA |

Another aspect which limits the application of the methods is that each method has a limited range of values it can determine (see figure 2.1 and table 2.2). It is only the CVM which is recognised as determining the total economic value of an open space.

It is with these limitations in mind that current literature reveals a preference for the use of the HPM, CVM and TCM for valuing open spaces, provided excludability is not a factor. This can be seen in the results obtained from an article search performed for ["economic value+ "open spaces"] and ["valuation method" + "open space"] in Google Scholar on 4 and 5 March 2008. The first 20 research articles from accredited journals that used

valuation methods on open spaces were assessed to determine which methods were most commonly used. The results are tabulated as follows:

| Author/s | CVM | HPM | TCM | Replacement Cost | Other |
|--------------------------------------------------------|------------|------------|------------|-------------------------|--------------|
| Edwards-Jones, Edwards-Jones & Mitchell (1995) | 1 | 0 | 0 | 0 | 0 |
| Blaine, Lichtkoppler & Stanbro (2003) | 1 | 0 | 0 | 0 | 0 |
| Garcia & Riera (2003) | 1 | 0 | 0 | 0 | 0 |
| Wolf. 2003 | 1 | 0 | 0 | 0 | 0 |
| Loomis, Traynor & Brown (1997) | 1 | 0 | 0 | 0 | 0 |
| Champ, Flores, Brown & Chivers (2002) | 1 | 0 | 0 | 0 | 0 |
| Halstead, Luloff & Stevens (1992) | 1 | 0 | 0 | 0 | 0 |
| Breffle, Morey & Lodder (1998) | 1 | 0 | 0 | 0 | 0 |
| Bates & Santerre (2001) | 1 | 0 | 0 | 0 | 0 |
| Shultz & King (2001) | 0 | 1 | 0 | 0 | 0 |
| Tyrväinen & Väänänen (1998) | 1 | 0 | 0 | 0 | 0 |
| Geoghegan (2002) | 0 | 1 | 0 | 0 | 0 |
| McConnel & Walls (2005) | 1 | 1 | 0 | 0 | 0 |
| Hokao, Iamtrakul & Teknomo (2005) | 0 | 0 | 1 | 0 | 0 |
| Gen (2004) | 1 | 1 | 1 | 0 | 0 |
| Tajima (2003) | 0 | 1 | 0 | 0 | 0 |
| Lupi (1991) | 0 | 1 | 0 | 0 | 0 |
| Crompton & Nicholls (2005) | 0 | 1 | 0 | 0 | 0 |
| Loomis, Rameker & Seidi (2004) | 0 | 1 | 0 | 0 | 0 |
| Mansfield, Pattanayak, McDow, McDonald & Halpin (2005) | 0 | 1 | 0 | 0 | 0 |
| Total frequency of use | 12 | 9 | 2 | 0 | 0 |

The assessment used in table 2.7 is not comprehensive but gives a good overview of the most frequently used and preferred environmental valuation methods. Based on this assessment, 52.18% of environmental valuation studies performed on urban open spaces use the contingent valuation

method, 39.13% use hedonic pricing while only 8.69% use the travel cost method. See figure 2.3 below:

Open Space Valuation Studies

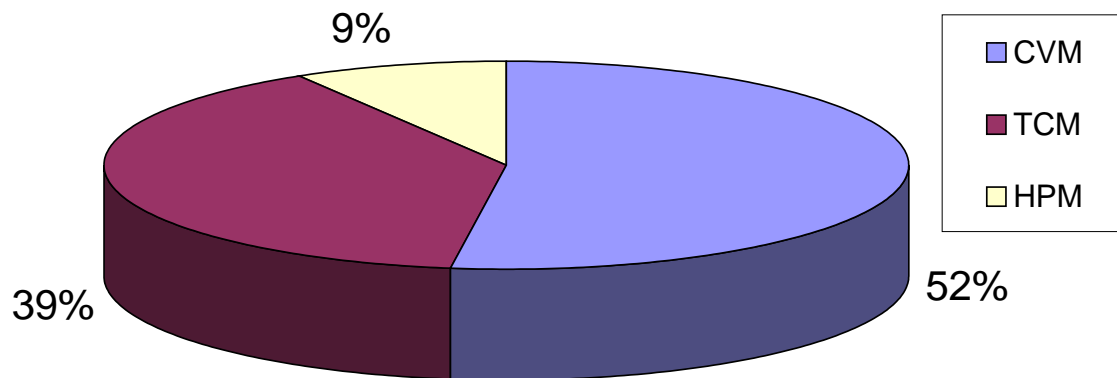


Figure 2.3 Valuation methods most commonly used in open space valuation studies

None of the articles revealed the use of any other environmental valuation method. A more comprehensive literature review may reveal the occasional use of other valuation methods; however, these may not represent such a significant frequency of use compared to CVM, HPM and the TCM. Perman *et al.* (2003:411) also confirm that these three techniques are the most frequently used. A study by Gen (2004:84-102) as shown in figure 2.4 also reveals a method preference in the same order. CVM and HPM are relatively simple valuation methods, and they are also adept at considering a wider range of environmental values so that total environmental value can be determined. The volume of available studies on these preferred techniques makes it therefore also easier for students of environmental valuation to adapt them for their own research.

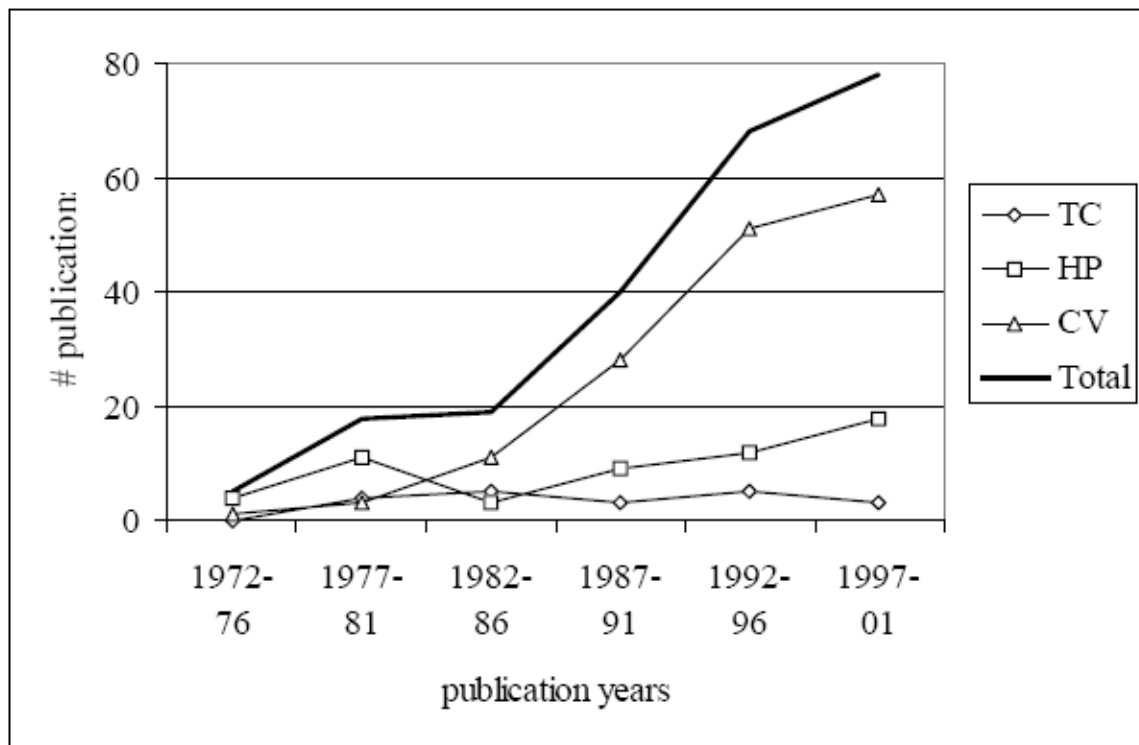


Figure 2.4 Valuation methods used by publication year (Gen, 2004:102)
 TC = Travel cost; HP = Hedonic pricing; CV = Contingent valuation

The literature review did not reveal any attempts at developing new environmental valuation methods. Rather, studies focused on improving existing methods, especially CVM (Perman *et al.*, 2003:426-435). The current suite of environmental valuation methods is therefore limited.

2.3.2 Limited use of valuation on open spaces

A search was performed on Google Scholar on 11 March 2008 for articles in accredited journals that used or discussed each of the three preferred methods. Each article was then assessed to determine whether the method was applied to public open space or other environmental goods. The assessment was limited to the first 20 articles found per method. The tabulated results can be seen in annexures A, B and C. Of the 20 articles on CVM, only 2 articles (10% of the articles) described applying CVM to open spaces. The article assessment for TCM revealed only 4 articles (20% of the articles) where open spaces were valued. HPM was used in only 2 of the articles (10% of the articles) where open spaces were valued. These results reveal that urban open space valuation only comprises a small component of the number of research articles dealing with environmental valuation. The

implications are that research on open space valuation has to rely on a very limited availability of literature to establish best practice and currently accepted valuation theory. See figure 2.5 below.

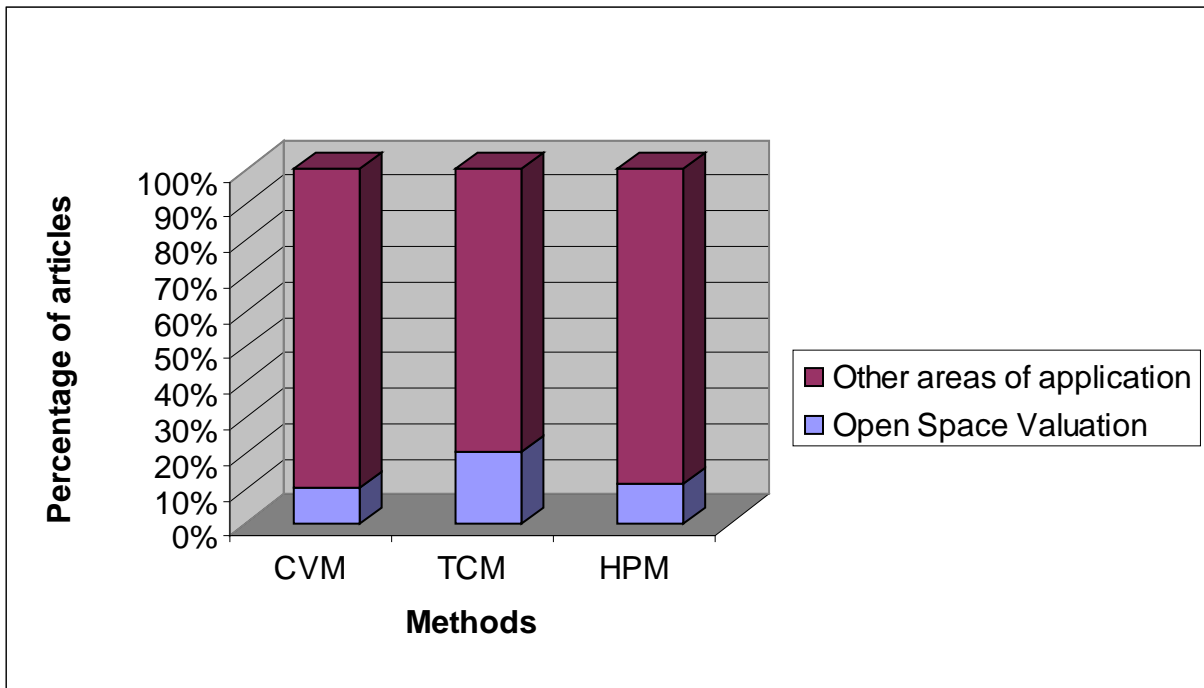


Figure 2.5 Results of an assessment of the frequency of application of valuation methods to urban open spaces

A further interesting fact noted was that the majority of the assessed articles focused on method refinement and review and not so much on valuation studies of the environment. 85% of the articles on CVM were concerned with method refinement and review, while only 15% looked into actual application of environmental valuation. With TCM, 55% of the articles were concerned with method refinement and review, while 45% looked into the actual application of environmental valuation. Articles on HPM, however, revealed that 25% were concerned with method refinement and review, 35% focused on environmental valuation, 30% focused on valuing products and services other than the environment, and 10% focused on both method refinement and environmental valuation. See figure 2.6 below.

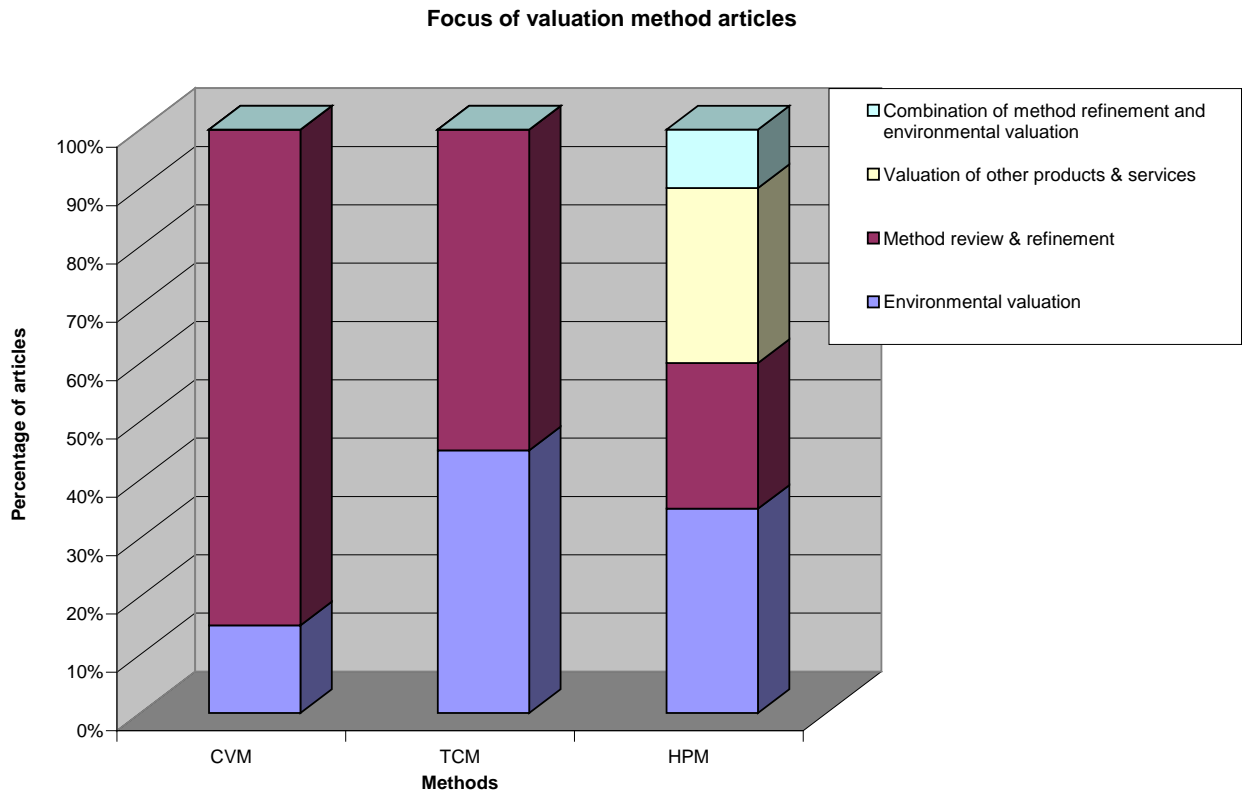


Figure 2.6 Results of an assessment of the focus of research articles dealing with the CVM, TCM and HPM valuation methods

The evident research focus on method refinement and review indicates that these methods have inherent properties that make errors and statistical biases probable. Several application frameworks have been suggested for each of these methods to overcome errors and bias. Current literature furthermore does not suggest a uniform method that will suit all applications. What is evident is that methods need to be adjusted for each area of application so that the valuer takes into consideration site-specific requirements.

None of the 80 articles assessed during the literature review of section 2.3 originates from South Africa. There is currently very limited work available on urban open space valuation in South Africa. Known pieces of literature include the work of Turpie *et al.* (2001), Van Zyl and Leiman (2003) and Van Zyl *et al.* (2004). This therefore presents a very limited South African frame of reference for this study.

Articles reviewed show that current methods do not determine the value of the environment in relation to community health, carbon sequestration, productivity, power savings and biodiversity.

CHAPTER 3: METHODOLOGY

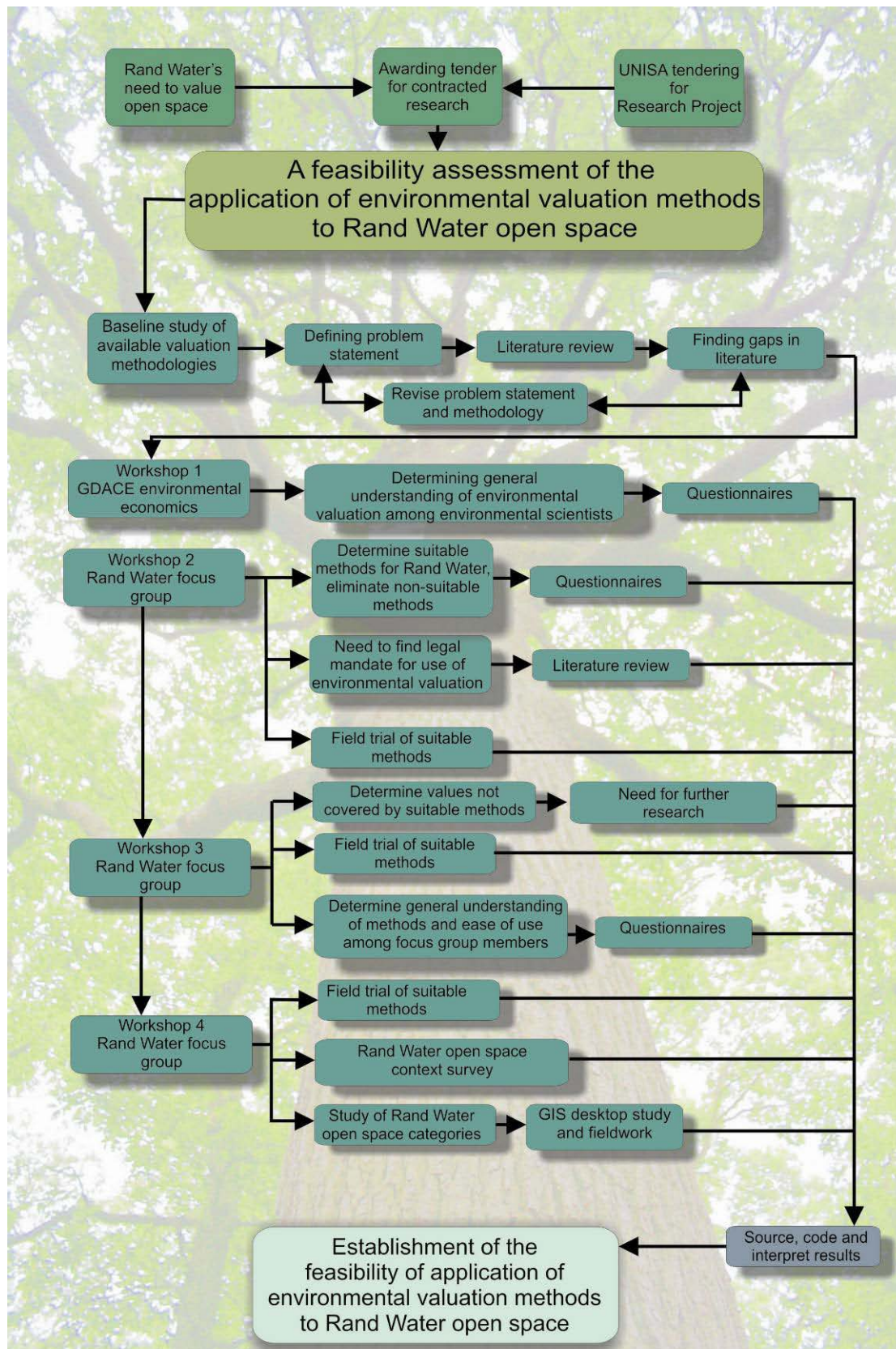


Figure 3.1 Research flow chart

3.1 Introduction

This chapter presents an overview of the research methodology followed to determine the feasibility of the application of environmental valuation techniques to Rand Water open space. A baseline study of literature was performed to enable the formulation of a **problem statement** and subsequent **hypotheses**. From the outset it was decided to apply the participative action research (PAR) model owing to the benefits of collaboration and input of a multidisciplinary project team.

PAR will be discussed in more detail in this chapter, followed by the method of data collection, questionnaire design, workshop observations and group composition. Testing of data, validity and reliability testing will also be discussed.

3.2 The research process

3.2.1 Methodology

Rand Water contracted UNISA through tender to develop a valuation methodology for its open space network. The initial intention of the research project was to develop a valuation method that takes into consideration all the value aspects that are ascribed to open spaces. To this effect this following model was suggested in the research proposal as a means to determine total economic value of open spaces:

Open space value = $\sum v$ (Author's interpretation)

Where v includes the following variable values:

v_1 = *influence on property values*

v_2 = *influence on property taxes as a result of their impact on property value*

v_3 = *spending patterns directly influenced by the use of urban open spaces*

v_4 = *carbon sequestration*

v_5 = *cost benefits of green infrastructure in urban open spaces as their properties supplement engineered infrastructure (storm water management, water retention and filtration; soil preservation etc.)*

v_6 = *direct contribution to ecotourism*

v_7 = *savings in the health costs of a community (participation in active recreation, dust and pollution control)*

v_8 = *influence on human psychology which affects productivity and therefore profitability*

- v_9 = savings in power consumption
- v_{10} = economical benefits of open spaces used as community food gardens or where urban forest produce is harvested
- v_{11} = positive influence of urban open spaces on social behaviour
- v_{12} = secondary industries or small, medium and micro enterprises dependent on urban open spaces and their contribution to GDP
- v_{13} = biodiversity and habitat status
- v_x = other factors

(Source: Author's interpretation)

However, further literature review revealed the conventional classification of environmental values (see figure 2.1). It was then decided to abandon this model and adopt the conventional classification even though the values presented in the open space value = $\sum v$ model are compatible with the conventional classification model. This research did not aim to develop an alternative or amended value classification system as opposed to the commonly applied classification model used within ERE.

The literature review also showed that several valuation methods already existed which could determine the economic value of most of the v -values:

Table 3.1 Applicable valuation methods for determining the economic value of various benefits associated with open space

| v-values | Applicable Method |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| v_1 = influence on property values | Hedonic pricing |
| v_2 = influence on property taxes as a result of their impact on property value | Hedonic pricing Cost benefit analysis |
| v_3 = spending patterns directly influenced by the use of urban open spaces | Travel cost method |
| v_4 = carbon sequestration | Clean Development Mechanism |
| v_5 = cost benefits of green infrastructure in urban open spaces as their properties supplement engineered infrastructure (storm water management, water retention and filtration; soil preservation etc.) | Replacement cost method Restoration cost method Damage cost avoided method |
| v_6 = direct contribution to ecotourism | Travel cost method Contingent valuation method |
| v_7 = savings in the health costs of a community (participation in active recreation, dust and pollution control) | Cost benefit analysis |

| | |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| v_8 = <i>influence on human psychology which affects productivity and therefore profitability</i> | Cost benefit analysis Contingent valuation method |
| v_9 = <i>savings in power consumption</i> | Cost benefit analysis |
| | |
| v_{10} = <i>economical benefits of open spaces used as community food gardens or where urban forest produce is harvested</i> | Production function approach |
| v_{11} = <i>positive influence of urban open spaces on social behaviour</i> | Contingent valuation method Cost benefit analysis |
| v_{12} = <i>secondary industries or small, medium and micro enterprises dependent on urban open spaces and their contribution to GDP</i> | Contingent valuation method Cost benefit analysis Production function approach |
| v_{13} = <i>Biodiversity and habitat status</i> | Contingent valuation method Travel cost method |

It was decided on this basis that this research should rather focus on the available environmental valuation methods than to develop any new methods (see figure 3.2 as adapted from Turpie *et al.*, 2001:11). The synthesis of new valuation methods was not achievable as there are too many questions (see table 3.1) for a single research project to answer. When research articles were reviewed (see table 2.7 and section 3.2.1-3.2.2), it was also evident that researchers primarily focus their work on single methods. While the research project group recognised the role of environmental valuation in environmental management, the research enquiry had to remain within the field of environmental sciences. The research project had to view environmental valuation from an environmental sciences perspective even though it had a multidisciplinary dimension.

The available methods would be tested within the Rand Water context and the most appropriate methods would be refined where possible for Rand Water's use. An assessment of the available methods revealed that not all methods would be suitable for the Rand Water context, which naturally also excluded the valuation of certain environmental benefits. It became apparent that the remaining suite of valuation methods would not be able to determine total economic value.

In an effort to resolve this problem the research project team agreed on 20 July 2006 that the research should investigate the possibility of adjusting the South African tree appraisal method (SATAM) for application in valuing open spaces. SATAM was also a research project commissioned by Rand Water to value trees and considers a wide range of factors to determine the total

economic value of a tree. The method takes into consideration the tree species, historical, cultural or genetic conservation value, condition of tree, visual tree defects and an impairment factor. These factors are expressed in a percentage, based on the assessment of each of the factors. A monetary value is then obtained by multiplying the basic tree cost by the percentage score of each of these factors (Marx, 2005:223). This method was considered as a possible solution to obtaining the total economic value of an open space, as all the factors influencing an open space could be rated and scored, which could then be factored into a single formula. SATAM uses a basic tree cost as a monetary factor in its formula, but it was difficult to determine a single basic open space value that would not contravene economic theory or property valuation regulations. This challenge is discussed further in detail in chapter 5, section 5.1.3.

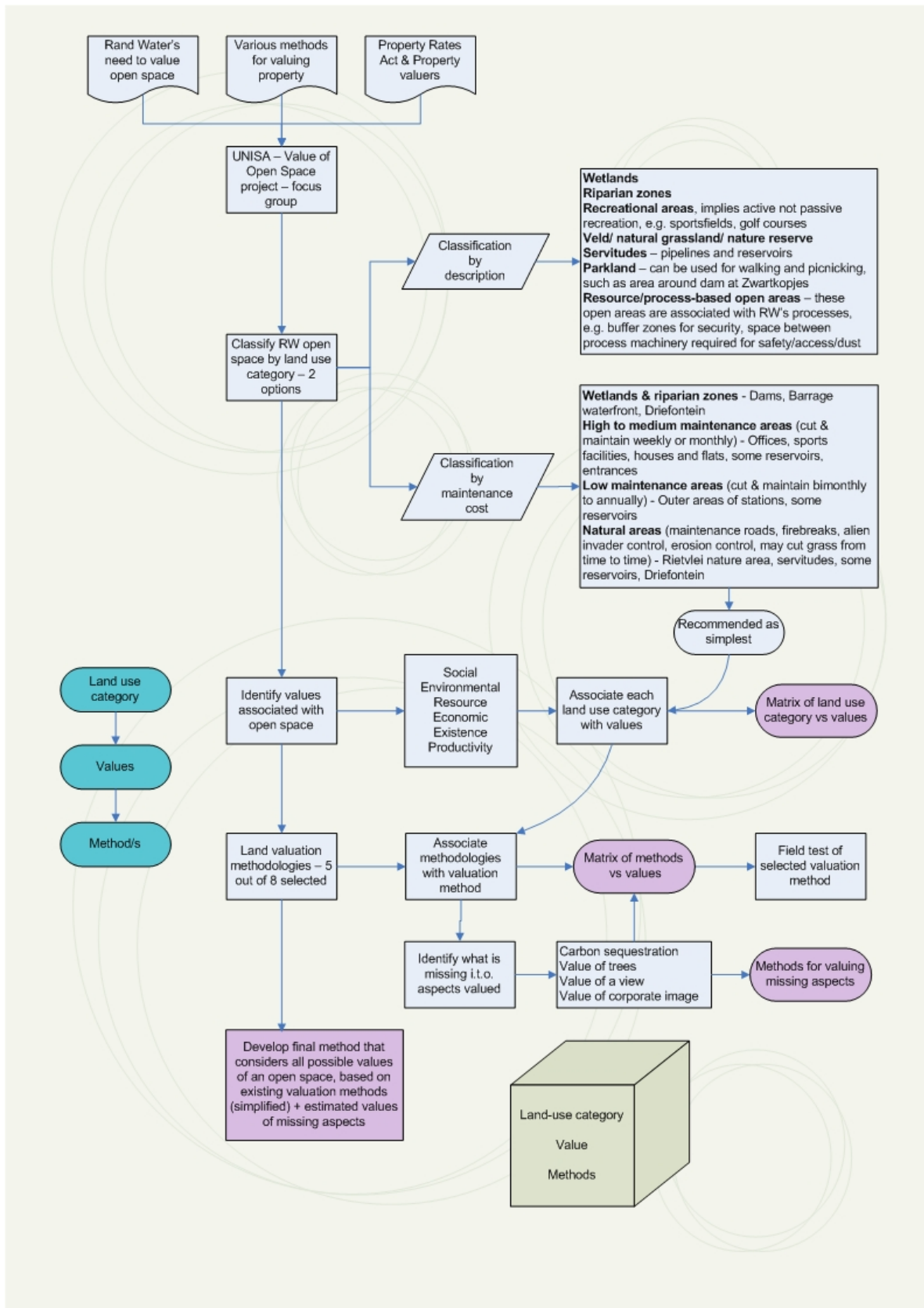


Figure 3.2 Initial research flow chart drafted by Megan Taylor (Rand Water, 2006)

During a workshop held on 22 November 2006, Andre Kruger (Senior Lecturer in Property Valuation at the University of Johannesburg) raised a concern about the valuing of open spaces, as this could possibly overextend the property valuation profession's mandate or that of the environmental scientist. The research project group identified this as a valid concern and further research was required to find a legal mandate to value the environment. The research was to determine what national and international legislation is regulating the valuation of the environment, which profession may perform valuation studies, and what the role of property valuation in valuing the environment is. A literature review was conducted to find answers to these questions during most of 2007.

With the range of challenges the research project team encountered and identified regarding the valuation of Rand Water open space, it was decided to focus the efforts of the research more towards a feasibility assessment than pioneering the development of new valuation methods. The initial topic of the research project was changed from "A Methodology for the Value Estimation of Urban Open Space in Gauteng" to "A feasibility assessment of the application of environmental valuation methods to Rand Water open space". The research **problem statement** and **hypotheses** were therefore designed around the problem of feasibility of the application of environmental valuation techniques to Rand Water open space.

The research design process as outlined above was influenced largely by the input of the research project team, which consisted of the researcher, Rand Water representatives, supervisor and co-supervisors from UNISA as well as a Property Valuation lecturer. The process was also influenced by a focus group consisting of open space managers and technical staff within Rand Water. This process of collaboration and consultation is based on the PAR model. The multidisciplinary nature of this research project required the input from industry experts through regular interaction and PAR subsequently provided the framework for this approach.

Action research is an approach or methodology which enables researchers and their participants to learn from each other through a cycle of planning, action, observation and reflection (Steeple, 2004). Action research is an orientation to enquiry, facilitating an interpretive means of reporting in which the existence of practitioners as real-life participants in the research is acknowledged (Steeple, 2004). It is designed to be responsive to real practitioner needs and concerns, and is therefore 'real-life' application. It allows each participant to reflect critically on his or her own practices and learn in the process as new methods are explored and tested. All participants

are therefore trying new concepts and methods out in practice while their experiences are recorded and used as a basis for review. This allows the different areas of knowledge and experiences to merge together to form new visions, knowledge and action (Rasmussen, 2005). Marx (2005:34) provides a simplified but effective definition of PAR as “learning by doing”.

This research method therefore aims to produce knowledge and action that is useful to the participants. One of the most commonly known methods associated with PAR is a SWOT analysis (Rasmussen, 2005). This entails the identification of internal strengths and weaknesses and external opportunities and threats with obvious reference to the research subject. The researcher therefore does not stand alone in a ‘first person’ presentation but is dependent on the input of a number of participants.

Collaboration with others who have a share in the problem being studied is central to the success of PAR (Herr & Anderson, 2005:4). In this research project Rand Water practitioners formed part of the research design and collaborated in the process to ensure that the content was representative of the Rand Water context and that the outcome was relevant. Herr and Anderson (2005:4) state that the nature of dissertations discourages collaborative work. The PAR process ensures that the dissertation is a living document during the research process, which is constantly assessed, updated and amended as participants learn more and change their perception of the problem and solution. This was the exact experience of this research project in that goalposts were shifted as the research team understood the problem better. The PAR definition of McCutcheon and Jung (1990:148) fits the process followed in this research project well:

“[PAR is a] systematic enquiry that is collective, collaborative, self-reflective, critical, and undertaken by the participants of the enquiry. The goals of such research are the understanding of practice and the articulation of rationale or philosophy of practice in order to improve practice.”

To state this process in the Rand Water context one could say that the threat to its open space network required a solution of which economic value assertion was seen as a possible change agent. UNISA was contracted to facilitate a research project as an ‘outsider’ in collaboration with Rand Water ‘insiders’ (see PAR positionality continuum according to Herr and Anderson, 2005:38). A participative process of enquiry and model testing was embarked upon to test the feasibility of the environmental valuation approach as a solution to Rand Water’s problem. This process would assist in answering the epistemological question of “How do we know that the value of

Rand Water's open spaces can be determined?" The practical feasibility assessment would provide this knowledge.

The epistemological question furthermore requires that the relationship of the researcher to the knowledge be stated. The researcher comes from the horticulture, open space and recreation management, and environmental management fields. He has been departmental head of a parks and cemeteries department in a local municipality for over five years. During this time the question of the economic value of open space in the urban environment became more prominent in the context of limited resource allocation, sale of open spaces and socio-economic threats. The researcher does not have any formal training in ERE. Although environmental valuation may be considered to be under the custodianship of the economic sciences, the researcher believes that an environmental sciences perspective of environmental valuation studies is necessary. It is therefore the view of the researcher that this knowledge should be more accessible to environmental scientists and this research project aims to demystify environmental valuation and lay a foundation for further research enquiry in the environmental sciences field. It also became evident that very little work has been done in South Africa compared to the rest of the world to advance the field of environmental valuation and specifically its application to open spaces (see section 2.3.2, also Gen, 2004:93). The researcher therefore believes that this research project is needed and desirable.

The ontological question (empirical) of "what is the role of value determination for Rand Water open space?" is largely answered by the literature review, which gives a perspective of existing knowledge. Literature clearly indicates the function and benefits of environmental valuation and the objectives it aims to achieve, which could be applicable to the Rand Water context as well.

Herr and Anderson (2005:71) point out that action research is similar to grounded theory research in that it is data driven rather than theory driven. The theory is grounded in systematically gathered and analysed data. The **hypothesis** of a research project applying grounded theory is developed and deduced from initial data analysis. According to Haig (1995:1), research enquiry starts with an ill-structured problem which is refined during the data collection, coding and analysing cycles. The data therefore suggests a theory. Haig (1995:2) postulates that "*grounded theory is reconstructed as a problem-oriented effort in which theories are abductively generated from robust data patterns, elaborated through the construction of plausible*

models, and justified in terms of their explanatory coherence". It allows inference of the best explanation of a problem.

In formulating research questions and hypotheses for this research project, the constraint-composition theory under the grounded theory research model was applied (see Haig, 1995:2). Constraint-composition asserts that a problem includes all constraints on its solution, along with the demand that the solution be found. The research problem and hypotheses of this research project include moderators or variables, which were found during systematic data collection and the reflection stages of the PAR cycles. These moderators therefore function as the constraints on the problem solution, in fulfilment of the constraint-composition theory (see Gen, 2004:56-59; also Kontoleon *et al.*, 2002:180 for variations of constraint-composition).

Grounded theory and PAR primarily use qualitative data as these methodologies have been pioneered by and are applied mainly in the social sciences field (Haig, 1995:1). This research project is rooted in the environmental sciences field with a component of economic science. It is therefore inevitable that the data would be of both a qualitative (verbal) and quantitative (numerical and statistical) nature. Data collected during this research project was mostly qualitative.

In conclusion, Argyris *et al.* (1985, as quoted by Herr & Anderson, 2005:14) explain that "*the goal of action science is the generation of knowledge that is useful, valid, descriptive of the world, and informative of how we might change it*". This encapsulates the content of this research dissertation.

3.2.2 Data collection design

Qualitative and quantitative data were collected in a collaborative manner, since the PAR model was applied. Focus group and project group members were helpful in providing various literature sources. Data sources varied from textbooks, research articles and websites as well as collecting data through practical applications and questionnaires. In collecting data, the researcher aimed to establish a baseline of existing environmental valuation methods, to assess the application to Rand Water open space from a feasibility perspective, and to make recommendations regarding the best valuation practice for Rand Water.

The occurrence of an evolving methodology is a virtual given with PAR (Herr & Anderson, 2005:76). The scope of data gathering has broadened from the

outset while perceptions and preconceived ideas of how one will achieve a functional valuation model have been challenged. A particular difficulty came with the research project group's frame of reference, which is bias towards environmental sciences. This research project is rooted in the economics field which none of the research group could claim extensive knowledge of. The collection of data therefore required first an understanding of the data so that only relevant information could be extracted. The economic theory which supports ERE can become complex and the extent to which this data would be included or excluded without compromising the validity of the research project had to be decided.

Baseline knowledge about the economic value of open spaces was obtained through internet searches. Initial searches only revealed limited resources, which did not provide a full perspective of the available environmental valuation methodologies and related theory. It was only until the work of Turpie *et al.* (2001) was found, which provided a comprehensive overview of the available methods, that a better understanding of the research field was achieved. The work of Turpie *et al.* (2001) set the framework for further literature studies. Further reading of ERE textbooks, especially by Perman *et al.* (2003), laid the foundation for a better understanding of the subject matter. Electronic searches then proved more successful once the prominent keywords within the relevant literature became apparent. It was then clear what information was needed. Keywords and phrases used in the searches included value of parks/open spaces, valuation of parks/open spaces, environmental valuation methods, environmental resource economics, economic benefits of open spaces/parks, environmental values, contingent valuation method, travel cost method, replacement cost method, restoration cost method, hedonic pricing method, environmental psychology, environmental law, and property valuation.

Complementary research was performed to find a legal mandate for the application of environmental valuation methods. This was based mostly on a literature review. International environmental treaties, international best practice and law, the property valuers profession, national environmental legislation and court cases seemed from the start to be the most likely sources of finding a legal mandate, which then formed the focus of this study area.

SATAM as developed by Marx (2005) was assessed to determine its suitability to value open spaces. Principles of environmental valuation and economic theory were used to perform a critical and comparative

assessment of currently used environmental valuation methods and a hypothetically adjusted SATAM.

A comparative methodology was used to further establish a baseline understanding of environmental valuation application within the South African context. Open-ended questions relating to the benefits and challenges of environmental valuation were presented to GDACE and Rand Water employees to test common and diverse preferences, attitudes and perceptions.

The most prominent valuation methods were identified and explained through presentations to the project group and participants. Methods were then assessed to determine what kind of data and procedures each method required in order to be properly applied. Based on the required data and procedures, participants rated the relevance of the methods to determine suitability within the Rand Water context. This allowed the elimination of certain less applicable methods. The suite of applicable methods was then subjected to various field trials where participants could see how the methods worked and provide comments on their relevance, user friendliness and ease of use. Rand Water's most prominent open space categories were then identified and a method selection matrix was developed to allow for the selection of the most appropriate method/s for each open space scenario.

3.2.2.1 Development of questionnaires and method trials

Questionnaires were designed around findings from the literature review. The questionnaires also followed the requirements of the research **problem statement**, which had to consider the feasibility of application of environmental valuation methods to Rand Water open spaces. There are four moderating factors which could affect proving the feasibility **hypothesis**, including:

- Limitations of the valuation methods
- Limitations of the legal framework
- Limitations of the user
- Limitations of the study area

The limitations of the legal framework were assessed through a literature review. The determination of the limitations of the methods, user and study area was, however, dependent on data obtained from questionnaires and geographic information system (GIS) data. The questionnaires therefore had

to be designed to obtain data from open space practitioners and technical staff in Rand Water. Participants first had to be familiarised with the methods for them to answer some of the questions related to the limitation of methods to avoid fictitious constructs (Mouton, 2001:103). Practical application of the methods was essential to ensure that data obtained from the questionnaires was valid.

Questions were designed to avoid any form of bias or ambiguity. They were limited to multichoice ratings to simplify statistical analysis, except where opinions were solicited. The Rand Water context was a key factor when questionnaires were designed and the data had to specifically address this focus area.

3.2.2.2 Observations at workshops

The value of the PAR method became apparent during the workshops held. Participants were able to ask questions about the methods and express their opinions and concerns. These observations were recorded and specific notes were made of valid concerns and practical suggestions, which influenced the design of the research project. This feedback also provided a good overview of the effectiveness of the research project and whether it met the requirements of Rand Water.

3.2.2.3 Project group and participants

The project group consisted of the following members:

| | |
|------------------------|------------------------------|
| Prof. Richard Hendrick | (UNISA supervisor) |
| Mr Isaac Rampedi | (UNISA co-supervisor) |
| Mr Andre Kruger | (University of Johannesburg) |
| Mrs Megan Taylor | (Rand Water) |
| Mr Leslie Hoy | (Rand Water) |
| Mr Rinus Bouwer | (Student) |

The project group was formed from key stakeholders from UNISA and Rand Water. Andre Kruger was co-opted because of his academic background in property valuations which allowed him to give a valuable perspective to the research project. This group monitored the research project and provided direction in terms of research design, objectives and problem solving. Workshops were arranged with the GDACE as well as Rand Water, during

which presentations were made and questionnaires distributed. Participants became aware of the benefits of environmental valuation and in turn provided valuable feedback to the research project.

The participants in the workshops were limited to employees of Rand Water and GDACE. The sample drawn from Rand Water employees represented technical employees who dealt with properties, infrastructure, environmental management and open space management. The selection of this group was done by the Environmental Services unit of Rand Water. These participants were employees that would be most likely to apply the valuation methods or assess the economic value of the Rand Water open spaces, as they had access to these properties. The sampling of participants from other sectors was considered, but the project group felt that since the valuation methods would specifically be developed for Rand Water's application, participants should be familiar with the Rand Water open space context. This context refers to the limitation of open space uses, extent of the open space network, excludability factor, open space categories and specific needs of Rand Water with regard to open space valuation. Participants in the workshops from both GDACE and Rand Water were sampled based on their expertise and area of work which could benefit from environmental valuation (see sections 4.3.2.1 and 4.3.2.2 as well as annexures E-H). Participants from GDACE attended a workshop on ERE and completed questionnaires on their understanding of the subject matter and how it could be applied in their field of expertise. The Rand Water workshops focused more on field trials, where hypothetical scenarios were sketched which required the use of environmental valuation to provide a solution. Certain assumptions were allowed as not all data was immediately available, and participants then agreed on variables. Formulae were designed within an Excel spreadsheet which was jointly completed by participants. Participants then assessed the various methods. Data obtained from completed questionnaires was compared and analysed statistically.

3.2.2.4 Testing the data

Questionnaires were circulated to the project group prior to completion to obtain collaborative input. Results from completed questionnaires were tabulated and assessed. The deviation in data was used as an indicator for reliability and validity. The results from the questionnaires were again presented to participants in follow-up workshops where comments were solicited regarding the validity of the results.

The presentations made at each workshop attempted to give an overview of the methods and theory of environmental valuation. This set the basis on which participants understood the nature of the subject and questions related to it. It was obvious then that these presentations needed to be objective and informative as they could influence the way participants responded to questions. The presentations were also circulated to the research project group for collaborative input prior to any presentations taking place. Each method was explained in the presentations and before it was tested. The results of the method tests were presented and explained to the participants. After the method was tested, an informal discussion followed where participants gave feedback regarding the method. This feedback was noted to make further recommendations to the application of the methods. The questions were furthermore analysed for difficulty and distracters (in the use of multiple-choice questions).

3.2.2.5 Reliability of data

According to Rudner and Schafer (2001), “reliability is the extent to which the measurements resulting from a test are the result of characteristics of those being measured”. The National Academy for Academic Leadership (Gardiner, 2007) defines reliability as “the capacity of an assessment method to perform in a consistent, stable fashion during successive uses. Reliability is a prerequisite for validity. An unreliable indicator cannot produce trustworthy results”.

The consistency of results was tested from the tabulated results to determine reliability. Questionnaires were also distributed again to smaller groups after some time had elapsed to determine if similar results were obtained. If the results showed limited deviation, then the data was considered reliable.

Results from tests and questionnaires were also compared with observations from previous studies where such data was available.

3.2.2.6 Validity

Herr and Anderson (2005:55) propose five validity criteria for PAR:

Table 3.2 Herr and Anderson’s validity criteria for PAR

| Goals of Action Research | Quality/Validity Criteria |
|------------------------------------------------------|--------------------------------------|
| 1) The generation of new knowledge | Dialogic and process validity |
| 2) The achievement of action-oriented outcomes | Outcome validity |
| 3) The education of both researcher and participants | Catalytic validity |
| 4) Results that are relevant to the local setting | Democratic validity |
| 5) A sound and appropriate research methodology | Process validity |

Dialogic validity refers to the monitoring of research quality by means of peer review (Herr & Anderson, 2005:57). The research project outcomes were regularly referred to the project group for review and comment. Articles that were compiled from the research project were also submitted for review by independent reviewers that were assigned by the editors of the journals in question.

Process validity refers to the manner in which problems are defined and solved to allow for ongoing learning of the individual or system (Herr & Anderson, 2005:55). This research project faced several difficulties during problem formulation and methodology design which necessitated reflective cycles of review and adjustment. To this extent there was ongoing problematisation of the study area and the methodology which was designed to interrogate it. The project group learned from the outset about the complexities of environmental valuation and allowed this new frame of reference to suggest a change from a valuation method development approach to a valuation method assessment. Assumptions about the problem definition were changed over time as knowledge increased. The process was one that encouraged learning of both the individual and system for it to be true to the intent and purpose of PAR.

Outcome validity within the PAR context refers to the extent to which actions occur to resolve the problem identified by the study (Herr &

Anderson, 2005:55). It can also be described as the scenario where quality action follows on quality data. **Outcome validity** is achieved by the unambiguous interpretation of sufficient data to either prove or disprove the stated **hypothesis** and **subhypothesis**. The **outcome validity** scenario would be where Rand Water is informed, based on sufficient findings, whether the application of environmental valuation methods meets or does not meet the feasibility criteria. The resulting action would be a decision to either use existing valuation methods to value Rand Water open space or to support further research in developing new methods that can overcome identified gaps.

Catalytic validity, according to Lather (1986, as quoted by Herr & Anderson, 2005:56) is “the degree to which the research process reorients, focuses, and energizes participants toward knowing reality in order to transform it”. There was a deepened understanding of environmental valuation during the research project which resulted in a changing of perspectives and adjusting of an understanding of the research problem. This again highlights the transformative potential of PAR (Herr & Anderson, 2005:57).

Democratic validity refers to the extent of participation of all interested parties that may have an interest in the research problem. Rand Water assisted to ensure that employees who had an interest in open space management were present during focus group meetings. All questionnaires and methods of enquiry were submitted to Rand Water for input before actual implementation. Results from questionnaires were also submitted to Rand Water. Quarterly meetings were held with the research project team to discuss progress and the way forward with pressing problems and challenges.

CHAPTER 4: RESULTS

This chapter presents the results obtained from different methods of enquiry. The enquiry methods were designed to test the four identified moderators that would ultimately prove or disprove the main **hypothesis**. The research method employed, as stated in chapter 3, follows the participatory action research approach. PAR is mostly qualitative in nature as it relies on opinions and interpretations of participants in the research project. This research project aims to provide an environmental valuation solution to the Rand Water Environmental Services unit and it was therefore imperative that the end user was actively involved in the development of a solution.

The results reflect the opinions, ratings and scores given by research participants concerning the relevance, ease of use, availability of data, among other things, of the available environmental valuation methods. The results obtained are used to determine how feasible the application of the various methods is in the Rand Water context and furthermore, to customise the most appropriate methods and present them in a user-friendly field guide for use by Rand Water employees.

4.1 Testing limitations of the valuation methods

Each of the valuation methods has its specific area of application and is somewhat limited in wider applications. Some of the methods are outright unsuitable for application at Rand Water and were eliminated from the start based on consensus reached by the research project team.

The production function approach was eliminated as there are limited opportunities for harvesting natural goods from Rand Water's open spaces. Rand Water's infrastructure is listed as National Key Points with resultant high security and access control levels. This inaccessibility limits harvesting and therefore the feasible application of the production function approach. The presence or not of harvestable goods is irrelevant because of this factor.

Limited accessibility also affects the application of the TCM as well as the CVM, as both methods are applied mostly where there are accessible environmental and recreational services and infrastructure. Both methods also rely on high open space user numbers to obtain representative interviewees, which is also unlikely in the Rand Water case. CVMs often use

taxes as a payment vehicle to determine WTP. Rand Water cannot implement taxes in any form as it is not a statutory revenue collector. Rand Water's recreation facilities are used mainly by its employees who often stay in close proximity to these facilities. This results in insignificant travel costs when applying the TCM.

As part of the PAR approach, a meeting was held on 22 November 2006 where selected Rand Water employees were asked to assist with the selection of appropriate valuation methods for the utility's open spaces. Participants were given an overview presentation on the values associated with open space and the methods used to value it. They were also offered an opportunity to apply the restoration cost method to an open space located at the Rand Water Estates Nursery, for them to become familiar with the application of the methods.

Some of the general conditions needed for the successful application of the methods were converted into a questionnaire that would enable the selection of the most appropriate methods. Within the context of Rand Water's open space, respondents reviewed these criteria and answered Yes, Maybe/sometimes or No. One point was allocated for a Yes answer, 0.5 points for a Maybe/sometimes answer and 0 points for a No answer. The results for each answer were added up, then divided by the number of questions for each method and percentage suitability was allocated. Twelve respondents completed the questionnaire.

The results of these questionnaires are presented as follows:

4.1.1 Replacement cost method

| General condition or criteria to be met | Choose an appropriate answer and mark with X | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|----|
| | Yes | Maybe/ Sometimes | No |
| Is there an environmental service such as water purification, nutrient cycling, carbon sequestration, and water storage and storm water attenuation? | 12 | 0 | 0 |
| Can this environmental service be readily quantified? i.e. volumes of water purified, volumes of carbon sequestered, volumes of water stored, metric volume of soil preserved. | 6 | 4 | 2 |

| | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| Can this environmental service be replaced or replicated with engineering infrastructure such as a water purification plant to purify water or storm water infrastructure to manage surface water runoff? | 6 | 5 | 1 |
| Are there costing guidelines available for such engineering infrastructure? i.e. Professional Institutes, Project Costing Guidelines. | 6 | 3 | 3 |

The replacement cost method received a rated suitability of 74% based on the assessed results. Rand Water has some wetland areas within its open space network and this method is particularly applicable for use on wetlands and waterways, which is perhaps the reason for its reasonably high suitability score.

4.1.2 Restoration cost method

| General condition or criteria to be met | Choose an appropriate answer and mark with X | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|----|
| | Yes | Maybe/ Sometimes | No |
| Can this open space, park or ecosystem function be restored to its original state or as close to its original state as possible if it is hypothetically lost by either pollution or illegal development? | 8 | 3 | 1 |
| Can the status of the environmental service be determined, prior to the impact? i.e. species diversity, ecosystem functions etc. In other words are there records of the ecosystem functions, park infrastructure and bio-diversity of all Rand Water open spaces? | 5 | 4 | 3 |
| Are there costing guidelines available for such restoration/rehabilitation work? i.e. landscape contractor costs, plant material and/or specialist studies. | 10 | 1 | 1 |

The restoration cost method is relatively easy to apply and is perhaps closer to what horticulturists and estate managers may apply in their work

environments, as it is essentially based on project costing. This method was also applied in a practical session prior to the completion of this questionnaire, which may have contributed to the relatively high suitability rating of 75%.

4.1.3 Damage cost avoided

| General condition or criteria to be met | Choose an appropriate answer and mark with X | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|----|
| | Yes | Maybe/ Sometimes | No |
| Is there any property, infrastructure, natural resource or quality of life (health) that will suffer measurable and likely damage if the environmental service discontinues? i.e. deterioration of water quality on health and tourism value, increase in peak storm water volumes that causes flooding, air quality reduction impacting on health. | 10 | 1 | 1 |
| Can the probability of such damage be determined? | 9 | 3 | 0 |
| Can the extent of such probable damage be quantified? | 4 | 7 | 1 |

With a suitability rating of 79% it is evident that respondents were of the view that the Rand Water open spaces and ecological services perform an important damage avoidance function. One has to view Rand Water open spaces in relation to their core function, which is to provide water, and how these open spaces and their inherent ecological services contribute to the protection and maintenance of this key infrastructure. The many wetlands and open spaces act as a buffer between Rand Water operations and surrounding land uses. The absence of these buffers may also increase the risk of probable damage should there be floods or infrastructure failure.

4.1.4 Defensive expenditure method

| General condition or criteria to be met | Choose an appropriate answer and mark with X | | |
|-----------------------------------------|----------------------------------------------|--------|----|
| | Yes | Maybe/ | No |

| | | Sometimes | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----------|---|
| Are there any proactive measures to sustain the ability of an environmental resource to prevent any damage? i.e. an alien invader eradication programme to avoid erosion and sustenance of agricultural potential or estuary maintenance to avoid storm damage, or fire control? | 12 | 0 | 0 |
| Is the cost of such proactive measures available? | 7 | 3 | 2 |

Respondents all agreed that there were programmes in place to maintain the integrity of Rand Water's open spaces, its environmental services and its operations. Rand Water supports eradication programmes as part of the Work for Water programme, which aims to reduce alien plant invaders from water catchment and river areas. These programmes can be valued against the cost or consequences of not controlling these plants within the context of South Africa as a water scarce country. The Water Wise gardening campaign of Rand Water can also be valued using the same method. A suitability rating of 85% was calculated.

4.1.5 Hedonic pricing

| General condition or criteria to be met | Choose an appropriate answer and mark with X | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|----|
| | Yes | Maybe/ Sometimes | No |
| Are there any properties in close proximity to the environmental resource that may benefit from it in terms of view, serenity, recreation and leisure activities? | 9 | 2 | 1 |
| Is the environmental resource in question relatively unique and in relative short supply? In other words is there a demand for such environmental resource in the survey area to the extent that it influences property values? | 4 | 7 | 1 |
| Are the properties that may be benefiting from such environmental resource relatively | 1 | 9 | 2 |

| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| tradable on the open market and in relative demand? | | | |
| Are there any sales statistics that can be analysed, or property valuers, or experienced estate agents that can be interviewed regarding the affected properties? | 5 | 4 | 3 |

The HPM only achieved a suitability rating of 50%. Although most respondents agreed that there were properties in close proximity to environmental resources that may benefit from them, it was clear that they may not necessarily affect property values. The reason for this is evident in the questionnaire results where benefiting properties are mostly those located within Rand Water's estates, which, being staff housing and workplaces, are not tradable on the open market. This method may therefore only be applicable where surrounding private properties benefit from the Rand Water open space in terms of a view or its non-consumptive and indirect use values.

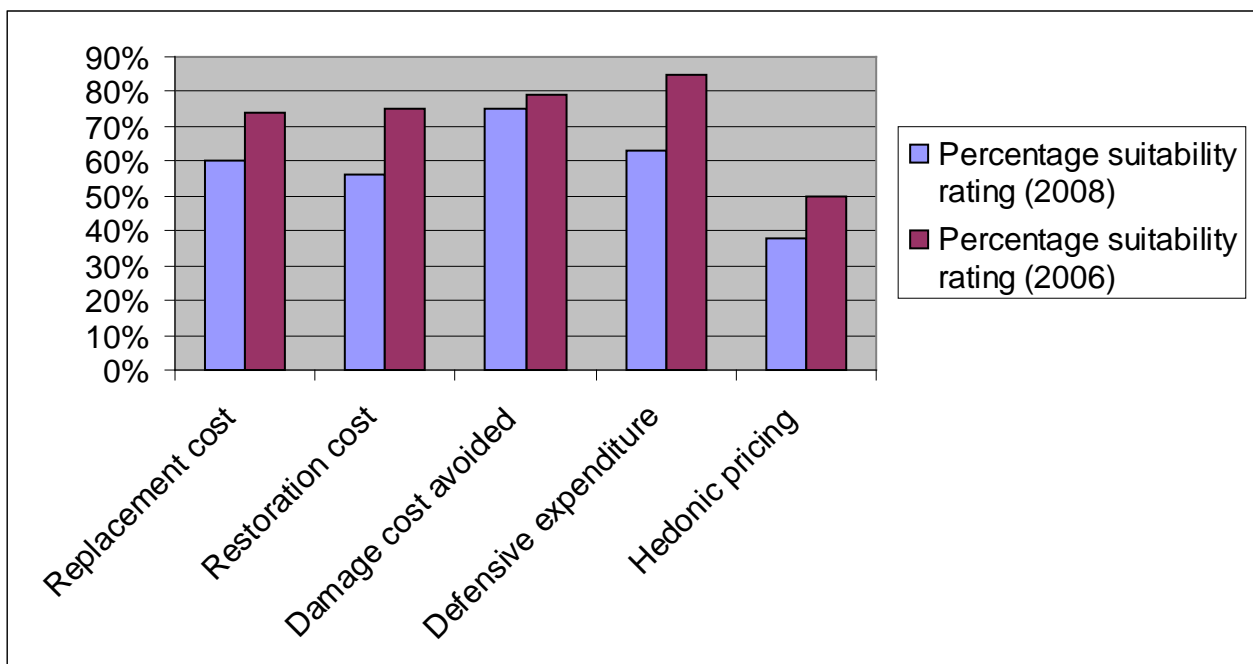


Figure 4.1 Percentage suitability rating for the application of valuation methods to Rand Water's open space

Figure 4.1 shows the results of a feasibility assessment conducted in 2006 and 2008. The 2006 results are presented in 4.1.1 to 4.1.5 and were

gathered from 12 participants. It was decided to repeat this feasibility assessment questionnaire among Rand Water staff to test the reliability of data. A smaller sample, which consisted of 6 participants, was requested to complete the questionnaires. It is evident from the results that the 2008 assessment produced lower feasibility ratings than the 2006 assessment. These results will be discussed further in chapter 5.

4.2 Testing limitations of the legal framework

See section 2.2 for results of the tested limitations of the legal framework since this survey was largely a literature review. These results are discussed in section 5.2.

4.3 Testing limitations of the user

Environmental valuation is a subject of ERE. This research project aims to make these valuation techniques accessible to the Rand Water end-user. During the testing of methods at workshops, participants were asked about the applicability and ease of use of the methods. These results are used to determine the users' own perceived limitations with regard to the use of these methods.

During an early phase of the research project GDACE appointed Mr Hugo van Zyl and Dr Jane Turpie to present a three-day course on ERE, from 22-24 March 2006. GDACE invited the researcher, Prof. Richard Hendrick (UNISA), Mr Isaac Rampedi (UNISA) and Mr Leslie Hoy (Rand Water) to the course. This presented an opportunity to assess course participants' understanding of ERE, and how they perceived it to be relevant in their field of work. Open-ended questions were used for this assessment and results were analysed using the constant comparative method. This approach requires the coding of results to enable a comparison between emerging themes and to allow an interpretation of results. In this case similar responses were categorised by means of colour coding. The frequency of similar responses was then expressed as a percentage of the total number of respondents. The results from this survey are given under section 4.3.2.

4.3.1 Assessment of results for user limitation with regard to various methods

Participants from Rand Water were asked during each workshop about the applicability and ease of use of the various methods. These questions and results of the questionnaire are given as follows:

4.3.1.1 Defensive expenditure method

- a) How relevant do you think this method is to the Rand Water operations?

| | |
|--------------------------|---|
| Highly relevant | 5 |
| Relevant | 1 |
| Only to a limited degree | 3 |
| Totally irrelevant | 0 |

In order to obtain a mean rating for each of the questions, a score has been allocated for each answer. 'Totally irrelevant' scored 0, 'Only to a limited degree' scored 33, 'Relevant' scored 66, and 'Highly relevant' scored 100. The mean score was then calculated to determine the applicable answer for each question. A score of 0-25% would be regarded as 'Totally irrelevant'; 26-50% would be 'Only to a limited degree'; 51-75% would be 'Relevant'; and 76-100% would be 'Highly relevant'. The same calculation is applied to the remaining questions of section 4.3.1.

In this case a score of 74% shows that Rand Water employees regarded the defensive expenditure method as highly relevant to Rand Water operations.

- b) How relevant would this method be in your area of work?

| | |
|--------------------------|---|
| Highly relevant | 2 |
| Relevant | 4 |
| Only to a limited degree | 2 |
| Totally irrelevant | 1 |

A score of 58% shows that a limited number of Rand Water employees found this method relevant in their day-to-day work. This method was rated as relevant.

- c) Would you consider the method easy to use once all the relevant data has been obtained?

| | |
|-------------------------|---|
| Very easy | 1 |
| Easy | 4 |
| Somewhat challenging | 4 |
| I did not understand it | |

With a score of 55% the method was rated as mostly easy with a degree of difficulty by Rand Water participants.

- d) Would it be difficult for you to obtain data for this method, considering budget, time, IT and human resource constraints?

| | |
|--------------------------------------------------|---|
| Not at all, data is available now | 2 |
| The data can be obtained with limited difficulty | 7 |
| It would be difficult to obtain this data | |
| Impossible to obtain this data | |

Rand Water employees indicated that the data for this method could be obtained with limited difficulty. A score of 73% was obtained.

- e) Do you think this method would provide any substantive case for preserving Rand Water Open Spaces?

| | |
|--------------------------|---|
| Most definitely | 3 |
| Yes, in some cases | 5 |
| Only to a limited degree | 1 |
| No, lets scrap it | |

A score of 73% indicates that this method would in some cases provide a substantive case for preserving Rand Water open spaces.

4.3.1.2 Damage cost avoided method

- a) How relevant do you think this method is to the Rand Water operations?

| | |
|--------------------------|---|
| Highly relevant | 5 |
| Relevant | 3 |
| Only to a limited degree | 1 |
| Totally irrelevant | |

With a score of 81% it is clear that Rand Water employees regarded the damage cost avoided method as highly relevant.

- b) How relevant would this method be in your area of work?

| | |
|--------------------------|---|
| Highly relevant | 4 |
| Relevant | 3 |
| Only to a limited degree | 1 |
| Totally irrelevant | 1 |

A score of 70% shows that employees regarded this method as relevant in their area of work.

- c) Would you consider the method easy to use once all the relevant data has been obtained?

| | |
|-------------------------|---|
| Very easy | |
| Easy | 5 |
| Somewhat challenging | 4 |
| I did not understand it | |

The damage cost avoided method was rated as easy with a score of 51%.

- d) Would it be difficult for you to obtain data for this method, considering budget, time, IT and human resource constraints?

| | |
|--------------------------------------------------|---|
| Not at all, data is available now | 3 |
| The data can be obtained with limited difficulty | 4 |

| | |
|-------------------------------------------|---|
| It would be difficult to obtain this data | 2 |
| Impossible to obtain this data | |

Rand Water employees indicated with a score of 70% that data could be obtained with limited difficulty.

- e) Do you think this method would provide any substantive case for preserving Rand Water Open Spaces?

| | |
|--------------------------|---|
| Most definitely | 5 |
| Yes, in some cases | 4 |
| Only to a limited degree | |
| No, lets scrap it | |

With a score of 85% this method could most definitely provide a substantive case for preserving Rand Water open spaces.

4.3.1.3 Replacement cost method

- a) How relevant do you think this method is to the Rand Water operations?

| | |
|--------------------------|---|
| Highly relevant | 6 |
| Relevant | 1 |
| Only to a limited degree | 3 |
| Totally irrelevant | |

A score of 77% indicates that Rand Water employees found this method highly relevant.

- b) How relevant would this method be in your area of work?

| | |
|--------------------------|---|
| Highly relevant | 5 |
| Relevant | 4 |
| Only to a limited degree | 1 |
| Totally irrelevant | |

With a rating of 80% Rand Water employees considered the replacement cost method highly relevant in their specific areas of work.

- c) Would you consider the method easy to use once all the relevant data has been obtained?

| | |
|-------------------------|---|
| Very easy | 1 |
| Easy | 3 |
| Somewhat challenging | 6 |
| I did not understand it | |

A score of 50% indicate that Rand Water employees found the method somewhat challenging to apply.

- d) Would it be difficult for you to obtain data for this method, considering budget, time, IT and human resource constraints?

| | |
|--------------------------------------------------|---|
| Not at all, data is available now | |
| The data can be obtained with limited difficulty | 9 |
| It would be difficult to obtain this data | 1 |
| Impossible to obtain this data | |

A score of 63% shows that Rand Water employees could obtain data with limited difficulty.

- e) Do you think this method would provide any substantive case for preserving Rand Water Open Spaces?

| | |
|--------------------------|---|
| Most definitely | 3 |
| Yes, in some cases | 7 |
| Only to a limited degree | |
| No, lets scrap it | |

Rand Water employees found that this method would most definitely provide a substantive case for preserving Rand Water open spaces. A score of 76% was obtained.

4.3.1.4 Restoration cost method

- a) How relevant do you think this method is to the Rand Water operations?

| | |
|--------------------------|---|
| Highly relevant | 6 |
| Relevant | 2 |
| Only to a limited degree | 2 |
| Totally irrelevant | |

The restoration cost method was considered highly relevant in Rand Water operations with a score of 80%.

- b) How relevant would this method be in your area of work?

| | |
|--------------------------|---|
| Highly relevant | 6 |
| Relevant | 2 |
| Only to a limited degree | 2 |
| Totally irrelevant | |

Rand Water employees also believed that this method was highly relevant in their areas of work. A relevance rating of 80% was obtained.

- c) Would you consider the method easy to use once all the relevant data has been obtained?

| | |
|-------------------------|---|
| Very easy | |
| Easy | 7 |
| Somewhat challenging | 3 |
| I did not understand it | |

A score of 56% indicates that Rand Water employees considered the method easy to use.

- d) Would it be difficult for you to obtain data for this method, considering budget, time, IT and human resource constraints?

| | |
|-----------------------------------|---|
| Not at all, data is available now | 1 |
| The data can be | 8 |

| | |
|-------------------------------------------|---|
| obtained with limited difficulty | |
| It would be difficult to obtain this data | 1 |
| Impossible to obtain this data | |

Participants indicated that data could be obtained with limited difficulty with a score of 66%.

- e) Do you think this method would provide any substantive case for preserving Rand Water Open Spaces?

| | |
|--------------------------|---|
| Most definitely | 3 |
| Yes, in some cases | 6 |
| Only to a limited degree | 1 |
| No, lets scrap it | |

Participants indicated that this method could in some cases provide a substantive case for preserving Rand Water open spaces, with a score of 73%.

4.3.1.5 Hedonic pricing method

- a) How relevant do you think this method is to the Rand Water operations?

| | |
|--------------------------|---|
| Highly relevant | 1 |
| Relevant | 2 |
| Only to a limited degree | 6 |
| Totally irrelevant | 1 |

Rand Water employees considered the HPM to be relevant only to a limited degree, with a score of 43%.

- b) How relevant would this method be in your area of work?

| | |
|--------------------------|---|
| Highly relevant | |
| Relevant | 4 |
| Only to a limited degree | 5 |

| | |
|--------------------|---|
| Totally irrelevant | 1 |
|--------------------|---|

Individual participants also regarded the method to be relevant to a limited degree in their specific areas of work, with a score of 43%.

- c) Would you consider the method easy to use once all the relevant data has been obtained?

| | |
|-------------------------|---|
| Very easy | 2 |
| Easy | 3 |
| Somewhat challenging | 5 |
| I did not understand it | |

A score of 56% shows that participants regarded the method as relatively easy.

- d) Would it be difficult for you to obtain data for this method, considering budget, time, IT and human resource constraints?

| | |
|--------------------------------------------------|---|
| Not at all, data is available now | |
| The data can be obtained with limited difficulty | 7 |
| It would be difficult to obtain this data | 3 |
| Impossible to obtain this data | |

Participants indicated with a score of 56% that data could be obtained with limited difficulty.

- e) Do you think this method would provide any substantive case for preserving Rand Water Open Spaces?

| | |
|--------------------------|---|
| Most definitely | 1 |
| Yes, in some cases | 3 |
| Only to a limited degree | 5 |
| No, lets scrap it | 1 |

A score of 46% indicates that the HPM could only to a limited degree provide a case for preserving Rand Water open spaces.

4.3.2 Assessment of results for user limitation with regard to ERE and environmental valuation

As stated in section 4.3, the following results were obtained from an ERE workshop held at the Provincial Department of Agriculture, Conservation and Environment from 22-24 March 2006. The same questionnaire was repeated at a Rand Water focus group workshop held on 11 July 2008 and the results are presented under 4.3.2.2.

4.3.2.1 Results of GDACE workshop

| Question 1 Briefly mention field of expertise. | |
|------------------------------------------------|------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | Resource Economist + Ecologist |
| 2 | Environmental Economics |
| 3 | Town Planning & Environmental Management |
| 4 | Waste, pollution and environment |
| 5 | Chemistry & Business leadership |
| 6 | Faunal specialist: Ornithology, herpetology |
| 7 | Evaluating EIA's |
| 8 | Environmental Management |
| 9 | Terrestrial ecology |
| 10 | Psychology, public participation |
| 11 | Road safety & education, public relations, geography & environmental studies |
| 12 | Environmental Management: Industrial & Air Quality |
| 13 | Land use planner - soil classification; agricultural engineering |
| 14 | Environmental Management - horticulture |
| 15 | Horticulture |
| 16 | Environmental Management and town planning |
| 17 | Environmental Management |

Of the 17 respondents, 13 (76%) came from an environmental or natural sciences background, 2 (12%) from economic sciences, and 2 (12%) from social sciences. The participants were therefore largely from an environmental management field.

| Question 2 How can environmental resource economics help you in your field of expertise and what opportunities are there for its application? | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | I practice ERE (environmental resource economics) in a variety of decision making contexts (environmental planning, water allocation, EIA, natural resource management) |
| 2 | Assists in integrating environment in economic decision making which tends to dominate considerations in gov. decisions |
| 3 | Broadening scope of evaluating impact of development on natural resources; could form part of evaluation in EIA decision making |
| 4 | Alternatives for appropriate land use , or; appropriate land use technologies |
| 5 | Assist in guidelines to consultants providing resource evaluation; assist with EIA decision making ; assist with selecting best development option |
| 6 | Provide counter argument to prevailing sentiment that development is beneficial to society opposed to conservation; economic arguments will not always help conserve sensitive ecosystems and alternative approaches to the economic argument must be developed |
| 7 | It will assist in decision making and to convince developers to look at the bigger picture |
| 8 | ERE will be required occasionally to verify matters in IEM and EIA fields; ERE has substantial application in climate change mitigation and adaptation, emissions trading, ecosystem services; ERE could assist in motivating environmentally responsible tourism developments |
| 9 | ERE can help to justify the use of resources in competing for budget with other land uses perceived to be more profitable; economical analysis is necessary to correctly appreciate and validate wild species and their ecosystems |
| 10 | Not sure that it can; my primary concern with ERE is that it operates in the dominant paradigm rather than challenging it, i.e. something only has value if a monetary value can be attached to it. We need to find new ways to work with the marginalised and poor |
| 11 | Opportunities exist with interaction with municipality for implementation of spatial development frameworks w.r.t. establishment of protected areas |
| 12 | ERE can be used to determine saturation point for development of certain industries such as filling stations |
| 13 | Protection of high potential agricultural soil – giving it an option |

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| | value when dealing with developers |
| 14 | Protection of property and resources; obtaining funds from developers to compensate for loss of environment; compensation to landowners in cases of expropriation; motivation for funds to maintain the environment |
| 15 | To determine the value of the environment we live in; to resolve many questions raised by the decision makers, IAP's |
| 16 | If a tool is available to assist in the valuing of the environment opposed to development it would help with sustainable development |
| 17 | Indicating the value of environmental areas in a very well understood language (money); In certain ecosystems the cost of losing the ecosystem can be demonstrated; motivation for conservation can be supported by monetary figures; value of open space can be more than property value, taking into consideration indirect values. |

Six respondents felt that ERE can assist with decision making (35%), and six respondents indicated that it can provide alternative options to development on sensitive environments or justify the allocation of resources to protect the environment (35%). ERE can also support sustainable development initiatives (47%) according to eight respondents such as:

- Motivating environmentally responsible tourism
- Determining saturation point of certain industries
- Protecting high potential agricultural land
- Determining fines based on loss through developments
- Determining what the cost of losing an ecosystem would be if development proceeds

Two of the respondents (12%) cautioned that ERE may not always be appropriate to support decision making about the environment as it is based on the 'dominant paradigm'.

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| Question 3 What would you say are the benefits of obtaining an economic value for urban open spaces and ecosystems? | |
| Answer No. | Answer |
| 1 | Justification of maintaining open space, and determination of optimal amount of open space |
| 2 | Creates awareness; allows for better more holistic analysis |

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| 3 | Place open space on equal footing with other economic land uses; facilitate building of an argument towards protection/ creation of open spaces among competing land uses |
| 4 | To enable decision making for planning |
| 5 | Guide EIA decision making; Tool for encouraging tourism; aid in balance between conservation and development; people will have similar mindsets in discussing options around urban open spaces and eco-systems |
| 6 | Provide counter argument to prevailing sentiment that development is beneficial to society opposed to conservation |
| 7 | This will increase their protection |
| 8 | Providing counter arguments centering on development value. Can offer practical value to property valuation situations |
| 9 | It is only a benefit if the economical value can be proven to be more valuable than competing land uses that are proven threats to natural landscapes; lower economical values will lower the status of open spaces; economical values can enhance greater realism and honesty regarding zoning and use of natural landscapes |
| 10 | In light of my previous comment – not much |
| 11 | Long term sustainability objectives; most appropriate land use initiatives; the curbing of unscrupulous developers i.r.t. lifestyle estates. |
| 12 | Increased open spaces |
| 13 | Awareness of the potential before it is lost developers and uniformed open space users. |
| 14 | Protection of these open spaces; increasing the profile of open spaces |
| 15 | Making economic sense of the environment; giving a value indicator for developed open spaces |
| 16 | Assists with valuing available resources to guide forward planning. What land needs to be retained for open space and what can be developed. |
| 17 | It raises awareness among decision makers and communities; indicates direct and indirect costs of developments in certain areas; the values can be used to motivate for conservation; monetary values are well understood by all. |

Ten (58%) of the respondents indicated that by valuing open spaces and ecosystems, awareness or their profile could be raised about their importance, and that it could provide a counterargument for more open space provision. Nine respondents (53%) also indicated that it could assist in obtaining the correct balance between open spaces and development, and

also increase protection and provision of open space. Three respondents (17%) indicated that it supported decision making and future planning. One (7%) respondent indicated that it would only be of use if the environment could be proven to be more valuable than competing land uses.

| Question 4 What would you say are the challenges and constraints that could halt the implementation of a valuation system in environmental resource management? | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | Incorporating valuation in environmental resource management is increasingly being embraced. Expertise is scarce but funding is available |
| 2 | Lack of funding, lack of political will, lack of awareness of the potential of the discipline, low skill levels/ training availability |
| 3 | Limited research into the field, hence body of knowledge in defence of the approach; new field will not find favour in world dominated by financial returns as unit of success |
| 4 | Knowledge of discipline; demands to address equity |
| 5 | Buy-in from developers; buy-in from political leaders whose mandate is to deliver on growth objectives; the validation of tools for valuing resources; lack of forum to discuss and agree on methodology; lack of case studies that demonstrate success of these systems, especially in SA context. |
| 6 | Lack of key documents on the value of ecosystem services; convincing stakeholders and to consider long term benefits of conservation over immediate financial incentives associated with development; certain species and ecosystems have no direct benefit to humans in terms of current understanding |
| 7 | General understanding of the concept by developers and consultants |
| 8 | Valuation of non-consumptive uses and non-use value is far from practical, and this skews all valuations toward pure economic value; educating a wide range of role players in the application of the system; understanding the relationship between ERE and other forms of environmental assessment |
| 9 | To prove that protected areas /natural landscapes are more valuable than transformed, developed land; how do we price the 'wildness' of species?; how do we price the natural species assemblages of a natural undisturbed habitat?; to allocate value to something that has no direct benefit to human society; society does not normally allocate real economic value to undeveloped land but |

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| | only to its potential; cultural value systems difficult to change |
| 10 | Succumbing to the dominant paradigm! |
| 11 | Different approaches in the three tier government system; lack of resources at local government; variation at provincial level w.r.t. environmental resource requirements; property developers. |
| 12 | Political buy-in |
| 13 | The price as measured by non environmentally friendly people |
| 14 | If the broader industry does not agree on a valuation system; buy-in of politicians and management; lack of policies or legislation that support the system; lack of training of those who implement the system; lack of will by implementers to pursue the system |
| 15 | Dissemination of the outcome of the project to the people; testing the valuation method and credibility of the system and perceptions of decision maker; legislating the valuation system for adoption in government. |
| 16 | Not answered |
| 17 | Lack of information on costing of biodiversity; lack of awareness of role of certain ecosystems; cost of obtaining a valuation for a site; time involved in preparing a valuation; buy-in from decision makers. |

One (6%) respondent indicated that valuation in environmental resource management was increasingly being embraced and that funding was available. Twelve (70%) of the respondents indicated that skills, information, knowledge and support systems for implementation of environmental valuation were lacking. Seven (41%) of the respondents indicated that buy-in from decision makers (politicians and management) would be a challenge. Nine (53%) of the respondents revealed some scepticism towards the workability of environmental valuation. The concerns include:

- Credibility of the methods in real life
- That there would not be a broad acceptance of the methodology
- Environmental valuation is applied by non-environmentally friendly people (economists?)
- Varying standards and methodologies in government
- Difficulty in valuing the environment

Three (17%) of the respondents indicated that funding and resources would be a challenge.

Question 5 Policy and regulatory provisions can enable the implementation of environmental resource economics in decision making. What provisions or

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| | amendments, if any, are needed (with reference to EIA regulations, incentives for conservation practice, green taxes, tradable credits) to ensure this? |
| Answer No. | Answer |
| 1 | Little or none. Our policies are excellent and include provision for incentive measures. Just a matter of implementation |
| 2 | Various measures could be considered and researched |
| 3 | Build requirements into the enabling Act; Must be part of EIA submission to motivate a development; train practitioners and assessors in the field |
| 4 | Nil; authorities to be provided with guidelines for incorporating in scoping reports |
| 5 | Need to include in regulations the need for valuation with guidelines; tradable credits mechanism should be considered for waste reduction/ re-use/ cleaner technology and included in waste legislation |
| 6 | Inclusion into the EIA process of an economic audit of current and future ecosystem services and option values associated with 'green fields' especially outside urban edge and in sensitive habitats within urban edge. These values should be compared with the perceived benefits of the proposed development |
| 7 | Add section in EIA evaluation checklist of authorities which indicates that this has been done; the different alternatives proposed in EIA should be evaluated by ERE |
| 8 | Setting up of an administrative system that can cope with trading; providing guidelines for the application of ERE |
| 9 | Not answered |
| 10 | Not sure |
| 11 | Not answered |
| 12 | Developers must pay levies to compensate for environmental degradation in the form of bio-diversity offsets. |
| 13 | Legislation governing subdivision and change of land-use |
| 14 | EIA's needs to indicate the total environmental loss should the development go ahead; needs to be linked to bigger picture. |
| 15 | EIA to look into the reality of sustainability of development in the context of ecosystems. EIA to focus on intrinsic value and ethics arguments on environmental degradation |
| 16 | Not answered |
| 17 | Valuation of certain ecosystems e.g. wetlands should be mandatory; the costs of rehab should be looked into before gets go- |

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| | ahead – look at listed activities; Local Government should be legally obliged to undertake SEA's and EMF's to obtain development thresholds in all areas. |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

Six (35%) of the respondents proposed an amendment to the EIA regulations of NEMA to enable the implementation of environmental valuation. Four (23%) of the respondents proposed an amendment of the EIA review guidelines and criteria (EIA checklists) as used by authorities and consultants. Six (35%) of the respondents suggested specific legislative amendments that could ensure improved environmental management:

- A tradable credit system should be developed to encourage waste reduction, reuse and implementation of cleaner production technologies.
- A carbon trading mechanism for South Africa should be set up.
- Legislation dealing with rezoning and subdivision should be amended.

Two (12%) respondents indicated that there was no need to amend legislation. Three (17%) of the respondents did not answer the question.

| Question 6 Do you have any remark or suggestions as input in this research project and perhaps what research is needed to assist you with your environmental management mandate? | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | No |
| 2 | No |
| 3 | Review enabling legislation with a view of identifying leverage points; what will be required to ensure that valuation is built into land use decisions |
| 4 | Case studies e.g. review decisions of authorities |
| 5 | Develop clear criteria for environmental valuation; actual case studies that are SA specific and show the benefits to community, growth and environment; research must be linked to policy transformation in line with requirements of SA legislation |
| 6 | Value of ecosystem services need to be investigated and processes developed to assess novel scenarios in a consistent and defensible manner |
| 7 | No |
| 8 | ERE must never be perceived as the ultimate solution. It is a very small part of IEM and has enormous potential to be used to the |

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| | detriment of the environment. Research should therefore focus on how and where it will be appropriate to use valuation |
| 9 | I need a pricing system for natural resources. The game industry is hiding their statistics and profits to avoid tax. We need economical parameters to properly validate this industry |
| 10 | None |
| 11 | The establishment of the Dinokeng tourism project |
| 12 | Mining impacts and bio-diversity offsets. |
| 13 | Can assist with spatial information – zonation of high potential soil |
| 14 | Practical application; easy to use; reduced cost i.e. not having to employ 20 experts; simplify the model if possible |
| 15 | None |
| 16 | Valuing future use of high agricultural potential land vs. development potential; Open spaces under pressure to be sold off as it will generate income for municipality and reduce maintenance costs. |
| 17 | What is the cost of lost biodiversity; Cost of red data species lost; In Gauteng grasslands does not have a big visual impact such as a ridge etc. How do we value grasslands? |

Two (12%) of the respondents pointed out that further research was needed into legislation and policy transformation to enable environmental valuation. Five (29%) of the respondents indicated the need to focus on specific case studies to resolve specific problems. Six (35%) of the respondents requested specific research into the refinement of the methodology and also to overcome specific problems related to valuation. Five (29%) of the respondents did not provide input to this question.

4.3.2.2 Results of Rand Water workshop

| Question 1 Briefly mention field of expertise. | |
|------------------------------------------------|--------------------------------------|
| Answer No. | Answer |
| 1 | Environmental Management |
| 2 | Horticulturist |
| 3 | Horticulturist |
| 4 | Environmental Management Systems |
| 5 | Ecology/ Market Research |
| 6 | Maintenance and development of sites |
| 7 | Horticulture |

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| 8 | Horticulture |
| 9 | Marketing & Communication; Research of Waterwise/ conservation |
| 10 | Horticulture |

40% or four of the participants indicated they had expertise in environmental management, ecology or conservation. Two (20%) of the respondents also had market research expertise. 60% or six of participants indicated that their primary field of expertise was horticulture and site maintenance.

| Question 2 How can environmental resource economics help you in your field of expertise and what opportunities are there for its application? | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | Directly relates to my area of work. Opportunity to be pro-active |
| 2 | Legal requirements for preservation of our natural resources, biodiversity and environmental education |
| 3 | Help us manage challenges regarding open space and wetlands |
| 4 | Knowing the value of an ecosystem that is under threat of any development; can provide or assist with decision making on the future of development |
| 5 | Provide a case for conserving an area of land. Justify spending on preventative measures such as firebreaks. |
| 6 | Decisions regarding the allocation of funds for restoration work after activities by other parties; decisions to protect and limit activities and expansion of certain areas |
| 7 | Able to dispute the unnecessary construction on open space |
| 8 | EIA management |
| 9 | Advisory role to decision makers |
| 10 | Planning for maintenance and projects conserving some areas of RW. |

Three of the respondents indicated that ERE enables proactive, preventative and appropriate planning interventions when decisions regarding the environment are concerned. Four respondents indicated that ERE can support decision making and case building. Environmental education and knowledge building was highlighted as important benefits of ERE by two respondents. According to four respondents, ERE can also support conservation and preservation of environmental resources.

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| Question 3 What would you say are the benefits of obtaining an economic |
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| value for urban open spaces and ecosystems? | |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | Not answered |
| 2 | To prevent depletion of our natural resources and destruction of our main source of water supply and indigenous flora |
| 3 | Conserving the environment; open space and wetlands |
| 4 | To be able to replace what is lost or to be able to exercise payment for ecosystem services |
| 5 | Long-term: prevent over development with consequent problems like stormwater runoff and flooding. Create an understanding of the value of natural systems amongst people who are not naturalists |
| 6 | Direct decision makers with financial benefit calculations; giving decision makers comparative cost |
| 7 | Preserving and sustaining open space for present and future generations |
| 8 | Social investment in built-up urban areas- green open space; biodiversity possibilities on open grasslands; recognition of benefits of recreation (stress relieve); parks and gardens enhances the [corporate] image of RW. |
| 9 | Environmental consciousness; corporate responsibility; protection and conservation of land |
| 10 | Not answered |

Three respondents indicated that open space valuation allows preventative and responsive management interventions. Four of the respondents stated that valuation may justify and support conservation initiatives. Four respondents indicated that valuation will raise awareness/consciousness and support decision making. Two respondents also stated that valuation can support corporate social investment and corporate image. One respondent pointed out that valuation may initiate payment vehicles for environmental services, which could include incentives, fines and green taxes.

| Question 4 What would you say are the challenges and constraints that could halt the implementation of a valuation system in environmental resource management? | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Answer No. | Answer |
| 1 | Lack of data |
| 2 | Time; limited resources; lack of participation; lack of expertise. |

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| 3 | Not answered |
| 4 | Knowledge and understanding of the methods; environment and ecosystems are more valuable than in many ways than what human beings can think. |
| 5 | People who are not environmentalists and who do not understand how an ecosystem functions would miss out many environmental services in their valuation |
| 6 | Acceptance of model |
| 7 | Not answered |
| 8 | Management and staff constantly changing; new management do not share the heritage importance of site. |
| 9 | Obtaining required data; human resources; also the accuracy and accreditation of the method. Valuation |
| 10 | Many |

Two of the respondents pointed out that data availability could be a challenge when applying environmental valuation methods. Three respondents stated that human resources and, as a result, limited time may impact on the application of valuation. Lack of knowledge, understanding and expertise were considered limitations by three respondents. Lack of participation, method acceptance and perceived limited support by management were raised by three participants as possible constraints on valuation. One participant pointed out that human knowledge about the environment was limited and this may affect effective valuation. The latter statement supports application of the precautionary principle in environmental valuation.

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| Question 5 Policy and regulatory provisions can enable the implementation of environmental resource economics in decision making. What provisions or amendments, if any, are needed (with reference to EIA regulations, incentives for conservation practice, green taxes, tradable credits) to ensure this? | |
| Answer No. | Answer |
| 1 | Enforcement of consideration of economic aspects & cumulative impacts [of development] |
| 2 | Not answered |
| 3 | Not answered |
| 4 | I think environmental ecosystems should have more protection [from] decisions that encourages [unjustified] development |
| 5 | Including this in EIA's would be useful, as it would hopefully stop |

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| | non-viable developments before they start – it could be a useful toll in the EIA toolbox. |
| 6 | Where developers have the potential to impact on areas or the cumulative impact on areas, the EIA process should include an environmental valuation & comparison for IAP's |
| 7 | Not answered |
| 8 | Reduced tax as rand water pays industrial rates; the value of RW properties have to "green space" |
| 9 | Not answered |
| 10 | Not answered |

Four of the participants felt that that environmental valuation should be enforced as a decision support tool during the EIA process. One respondent pointed out that environmental valuation could support reduced property rates taxes. This, however, is not possible with environmental valuation. The approach should rather be to subdivide Rand Water properties according to usage. Zoned private open space would have a lower property tax rate payable than an industrial zoning. If such open spaces are set aside for conservation, it could have further tax reductions or exemptions in terms of section 17(1)(e) of the Local Government: Municipal Property Rates Act 6 of 2004.

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| Question 6 Do you have any remark or suggestions as input in this research project and perhaps what research is needed to assist you with your environmental management mandate? | |
| Answer No. | Answer |
| 1 | None |
| 2 | None |
| 3 | None |
| 4 | I think ecological valuation is a big gap at the moment and need to be understood. |
| 5 | We need more research on 1) valuing wetlands 2) what environmental services are there? 3) do valuations on selected RW properties, one using well researched variables and the second using guesstimates, to see how accurate a 'quick and dirty' approach will be. |
| 6 | Defining different levels of land maintenance + its relative potential to increase/ decrease land value. |
| 7 | None |

| | |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8 | None |
| 9 | In the guide, real life practical examples should be given and ones applicable to RW. Not only referring to wetlands, use method in more than one example. |
| 10 | None |

One participant highlighted his or her doubts about environmental valuation and stated that it was not well understood. One participant stated that research is needed on wetland valuation, identification of environmental services, and comparison between methods applied with accurate data and methods applied with more assumptions. One respondent identified the need to show the economic impact varying levels of maintenance standards have on open spaces. One responded requested the field guide to show various practical examples of method application so that it could be better understood.

4.4 Testing limitations of the study area

This process involved an analysis of GIS data of the most prominent Rand Water properties (see annexures I-P). The properties surveyed in this process include the larger Rand Water estates where a variety of open space categories are represented. It was decided to exclude servitudes in this survey owing to cost and time limitations. It is also believed that the linear nature of servitudes does not follow any ecological process, while they are also too narrow to provide any valuable corridor for recreation or biodiversity preservation. Servitude soils are disturbed through the laying of underground services, and this allows the encroachment of pioneer plants such as alien invaders. Reseeding with grasses also creates monocultures with limited biodiversity value. These assertions could be confirmed during further research. Smaller properties such as water towers also provide little open space or associated benefits and were therefore also excluded. The mapping was done by the Rand Water Corporate GIS Section and provided to assist this research project. The Corporate GIS Section categorised the open spaces into bowling green, embankment, focal area, general purpose park – grass, parkland, and sport field. It was decided to simplify these categories by grouping bowling green and sport field as sporting facilities; embankment, focal area, general purpose park, parkland and every second month were grouped into parkland ('every second month' refers to the frequency of maintenance); and veld was renamed veld and natural vegetation.

Table 4.1 Area coverage of different open space categories on Rand Water properties

| Rand Water Site | Sporting Facilities | Parkland | Veld & Natural Vegetation | Total m² per Site |
|-----------------------------------|----------------------------|-----------------|--------------------------------------|-------------------------------------|
| Eikenhof | 0 | 15 524.51 | 47 136.78 | 62 661.29 |
| Emhlangeni | 0 | 107 767.30 | 0 | 107 767.30 |
| Mapleton | 0 | 67 768.66 | 0 | 67 768.66 |
| Palmiet | 0 | 145 762.50 | 12 034.06 | 157 796.60 |
| Rietvlei | 0 | 35 653.80 | 0 | 35 653.80 |
| Vereeniging | 8 450.41 | 405 934.28 | 0 | 414 384.70 |
| Zuikerbosch | 31 349.00 | 2 879 519.00 | 1 664 271.80 | 4 575 140.00 |
| Zwartkopjes | 6 885.00 | 562 433.00 | 11 904.00 | 581 222.00 |
| Total m ² per category | 46 684.40 | 4 220 363.05 | 1 735 346.60 | 6 002 394.00 |

From the conducted survey it was established that sporting facilities comprise approximately 1% of the total Rand Water open space portfolio. Veld and natural vegetation comprises 29% of the open space portfolio. Parkland comprises 70% of the open space portfolio, which represents the largest part of the open space portfolio.

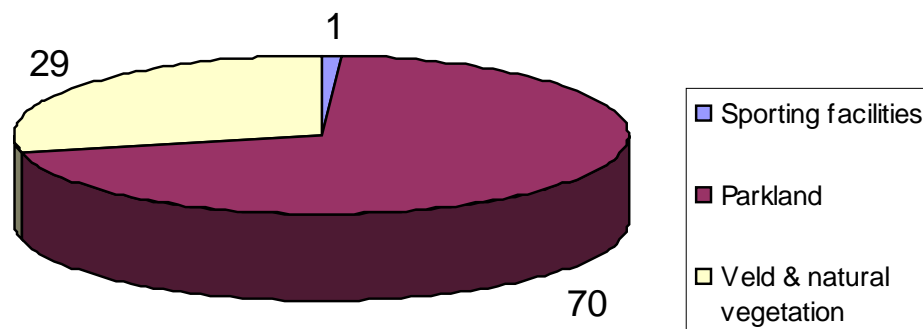


Figure 4.2 Percentage representation of various categories of open space on Rand Water property portfolio as per GIS data

Unfortunately the GIS data did not indicate wetlands or riparian zones and could therefore not be included in this survey. During the Rand Water open space valuation focus group meeting held on 11 July 2008, participants were asked how abundantly each open space category was presented in the Rand Water open space portfolio, with 1 being very few and 10 being abundant. This survey included wetlands and riparian zones.

The results (median) are given as follows:

Table 4.2 Occurrence rating of different open space categories in Rand Water as interpreted by focus group participants

| Open Space Category | Occurrence in Portfolio (rate 1-10) |
|---------------------------------------|-------------------------------------|
| Wetlands | 2 |
| Riparian zones | 1 |
| Sport & recreation facilities | 4 |
| Veld/natural grassland/nature reserve | 8 |
| Parkland | 6 |

If this data is extrapolated to present a percentage representation of each open space category of the total open space portfolio, then the following results are obtained:

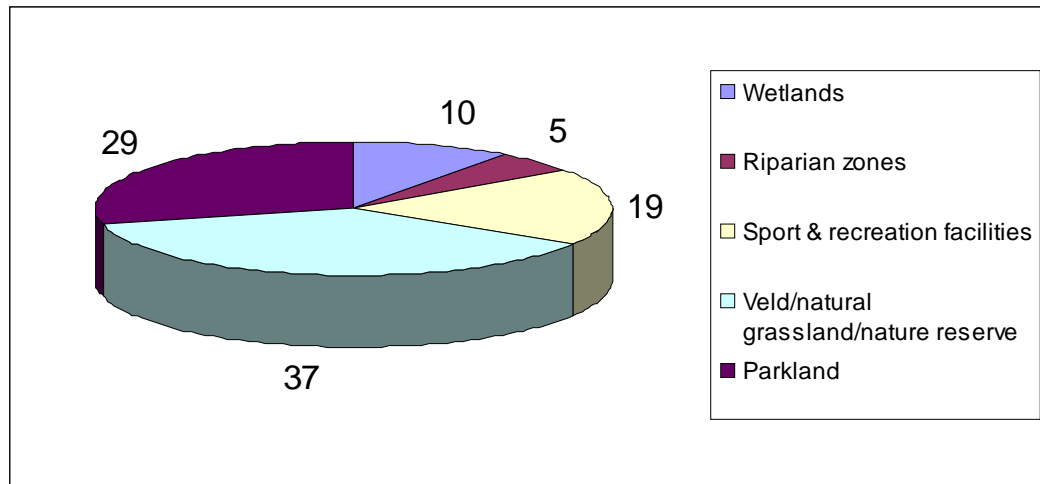


Figure 4.3 Percentage representation of various categories of open space on Rand Water property portfolio as per focus group interpretation (including wetlands and riparian zones)

If wetlands and riparian zones are excluded to allow a comparison between the focus group interpretation and actual GIS data (see figure 4.4), the following results are obtained:

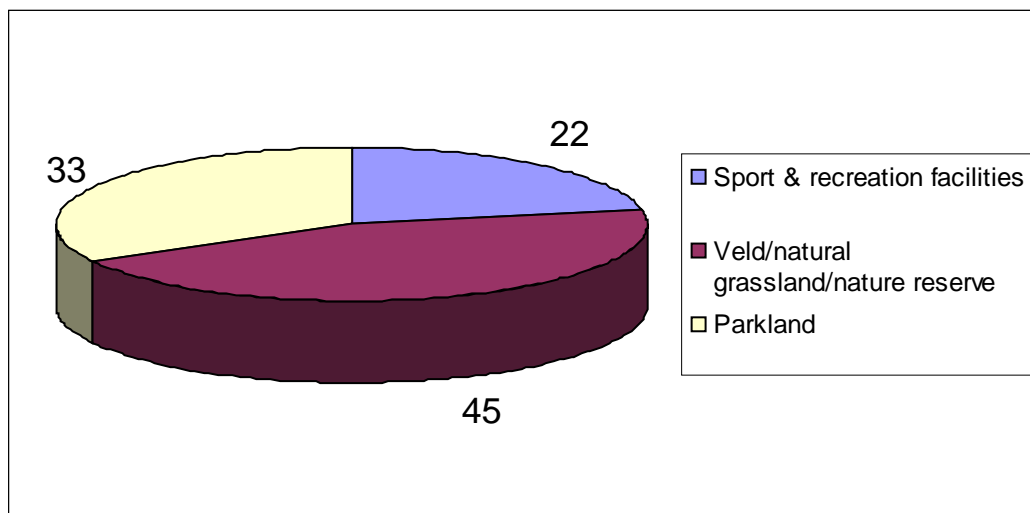


Figure 4.4 Percentage representation of various categories of open space on Rand Water property portfolio as per focus group interpretation (excluding wetlands and riparian zones)

When figure 4.4 is compared to figure 4.2 it is apparent that the majority of focus group participants did not have an accurate interpretation of the representation of the various categories of open space present on Rand Water estates. Three of the participants presented more accurate estimates, but since the median results were used, the remaining ratings caused overestimations.

4.5 Results of an open space context survey for Rand Water

In order to establish a context for Rand Water open spaces, Rand Water employees were asked to answer true or false questions during the July 2008 workshop. The context aims to explain the accessibility and utility of these open spaces, as these factors will have an impact on valuation method selection and limitations on data availability. A total of nine participants completed the questionnaire and the results are as follows:

- a) Rand Water’s open space network consists of land with limited public accessibility and land with restricted access that may only be used for recreation and leisure activities by Rand Water employees.

| | |
|----------------------------|---|
| True | 1 |
| True, with some exceptions | 7 |
| False | 1 |

Respondents were then asked to list the exceptions, if any, or state why they considered the statement to be false:

The following are the verbatim stated exceptions:

- Some areas are not well restricted and are accessed by quad-bikes, dog trainers, anglers, and informal housing.
- Bushwillow Creek is used by homeless people, and cyclists practice in this area.
- Rietvlei area allows school visitations occasionally.
- Jogging and dog training occurs on eastern side of Zwartkopjes.
- Certain sites do allow public visitations subject to the accompaniment of Rand Water officials.
- Zuikerbosch has a caravan park and fishing spots accessible to public and Rand Water employees.

77% of participants pointed out that the statement was true with exceptions as stated above. 11% stated that the statement was true and 11% that it was false. The interpreted context is therefore that the majority of Rand Water's open spaces consist of land with limited public accessibility and land with restricted access that may only be used for recreation and leisure activities by Rand Water employees. The exceptions are limited to non-process related land that functions as natural or undeveloped open space and where access control is not critical.

- b) Public harvesting of natural resources (wood, plants, fruit & flowers, animals) on these open spaces is restricted.

| | |
|----------------------------|---|
| True | 3 |
| True, with some exceptions | 4 |
| False | 2 |

Respondents were then asked to list the exceptions, if any, or state why they considered the statement to be false:

The verbatim stated exceptions are as follows:

- Rand Water owns vast areas of land where access restriction is difficult. Harvesting therefore occurs.
- Medicinal plants are harvested on some of the reservoir sites and unfenced areas (servitudes) even though it's not permitted.
- Natural resources are abused in areas where security and access control is not enforced.
- Harvesting of alien invader wood is permitted by agreement on some servitude sites.

44% of participants stated that the statement was true with some exceptions. 33% stated that the statement was true and 22% that it was false. The interpreted context is therefore that public harvesting of natural resources (wood, plants, fruit and flowers, animals) on these open spaces is mostly prohibited, but uncontrolled harvesting still occurs on some sites.

- c) Commercial agriculture, including crop production and grazing, is not practised on the Rand Water open spaces.

| | |
|------|---|
| True | 5 |
|------|---|

| | |
|----------------------------|---|
| True, with some exceptions | 3 |
| False | 1 |

Respondents were asked to list the exceptions, if any, or indicate why they considered the statement to be false:

The verbatim stated exceptions are listed below:

- There is some occurrence of informal grazing.
- Informal settlement (Valley area) where livestock is kept.
- Grass bales are sold from some sites.
- Farmers occasionally access Rand Water property to allow grazing.

55% of participants stated that the statement was true. 33% stated that the statement was true with exceptions and 11% stated that it was false. The majority of participants were of the opinion that commercial agriculture, including crop production and grazing, was limited to a few exceptions.

This chapter presented the results obtained through various methods of enquiry. The following chapter will analyse and discuss these results.

CHAPTER 5: DISCUSSIONS

5.1 Limitations of the valuation methods

This section has examined the results obtained from various tests to determine what the limitations of the selected methods are. The results will then be used to determine whether the stated **hypotheses** are proven true or false.

5.1.1 Discussion of results from a suitability assessment

A suitability assessment was employed for each method during the year 2006. A suitable method in this context can be defined as a method that is appropriate for application to Rand Water open spaces. The same assessment was repeated during the year 2008. It is clear that the suitability ratings for all methods dropped during the 2008 assessment. Reasons for this could be that the lower number of respondents produced less reliable and consistent results. Another factor which could have resulted in the lower suitability rating is that respondents became more familiar with methods and were better able to relate them to their areas of work. If the latter explanation is accepted, then it can be deduced that the 2008 assessment provides a more realistic suitability rating of the methods. A complication with this assertion, however, is that workshop participants had changed by 56% between 2006 and 2008 (comparison between annexures F and H). The influence of a better understanding of methods in relation to the Rand Water context over time was therefore diminished by the inconsistency of attendance by the same focus group members. This problem was unfortunately a dynamic that was beyond the control of the researcher, since Rand Water employees may have resigned, were promoted or simply may have had commitments on the day of the focus group workshop. This challenge could have been addressed by having all the focus group workshops closer together, and not spread over three years as was the case, although achievement of the latter proposed solution presents several logistical challenges as well. In order to arrive at more realistic suitability ratings, the mean values between the 2006 and 2008 values are used. This approach could therefore compensate for inconsistencies between the two data sets.

5.1.1.1 Defensive expenditure method

A mean suitability rating of 73.5% was calculated. It can therefore be concluded that the defensive expenditure method is regarded as suitable

within the Rand Water context. Rand Water's defensive expenditure on alien eradication produces the benefits of biodiversity conservation, water resource preservation and agricultural resource conservation. The expenditure on these programmes can be used as a proxy to value such resources. If these resources were not considered valuable, then Rand Water would not have allocated resources for their conservation. Rand Water therefore reveals the value of these resources by investing in their conservation. The same can be deduced about Rand Water's investment in wetland conservation, urban greening and Water Wise programmes.

5.1.1.2 Damage cost avoided method

A mean suitability rating of 77% was calculated. This method is commonly applied to wetland and other aquatic systems (see Van Zyl *et al.*, 2004; Barbier *et al.*, 1997:57; Turpie *et al.*, 2001:18). A study of satellite images revealed that Rand Water does not have many wetlands as part of its open space portfolio (see section 4.4). The GIS data also primarily revealed area zoning which excluded wetlands and related aquatic systems. It is, however, important to note that water conservation is a key priority for Rand Water considering its investment in various water preservation initiatives such as Working for Water and Water Wise as well as its representation on the Working for Wetlands programme (Rand Water, n.d.). The damage cost avoided method will be a valuable tool to educate various stakeholders about the importance of wetland functions, especially their ability to prevent flood damage by regulating water flow, and by acting as natural water reservoirs in times of drought. This is central to the elected mandate and priority of a utility that is concerned with the sustainable supply of water to a growing population in a water stressed country.

5.1.1.3 Replacement cost method

The replacement cost method achieved a mean rated suitability of 67% based on the assessed results. The slightly lower score can be attributed to the complex process of obtaining accurate data to satisfy the requirements of the method. The method was nonetheless rated as suitable as, similar to the damage cost avoided method, it can be of educational value. This method shows the value of water purification, water retention and flood attenuation in wetlands by comparing them to expensive man-made structures that are designed to perform the same function. This again relates to Rand Water's educational programmes designed to instil the importance of water conservation within decision makers and the broader community.

5.1.1.4 Restoration cost method

A suitability rating of 65% was achieved. Although the method is simple to apply in that it is merely an exercise of project costing to replace what has or may be lost, it might not be applied frequently in Rand Water. This method can be valuable when damage estimates are needed to prepare for litigation. Rand Water can, however, in its interaction with the green industry present the valuation tool to local authorities or conservation bodies that are faced with the challenge of unauthorised environmental degradation to enforce the 'polluter pays principle'.

5.1.1.5 Hedonic pricing method

The HPM only achieved a mean suitability rating of 44%. A review of GIS data (see annexures I-P) showed limited private residential properties that may benefit from its proximity to Rand Water open spaces. There are therefore limited opportunities for surrounding properties to benefit from a view over Rand Water estates. The presence of industrial-style treatment facilities amidst the open spaces also lessens any perceived aesthetic value that could positively influence property values. The strict access control policies furthermore exclude surrounding property owners from any recreational benefits. These limitations limit the opportunity for Rand Water open spaces to positively influence surrounding private properties. HPM is therefore not considered suitable in the Rand Water context. The method may nonetheless be introduced by Rand Water to municipalities and other stakeholders in urban greening who have public open spaces that are positioned to influence private property values.

5.1.2 Discussion of results relating to relevance, data availability and ability of methods to present a case for open space preservation

This section discusses the results obtained from the focus group workshop held on 11 July 2008. The questionnaires aimed to solicit data about the method relevance, data availability and potential of the methods to present a case for the preservation of open space, which could all be limiting factors in the Rand Water context.

5.1.2.1 Method relevance rating

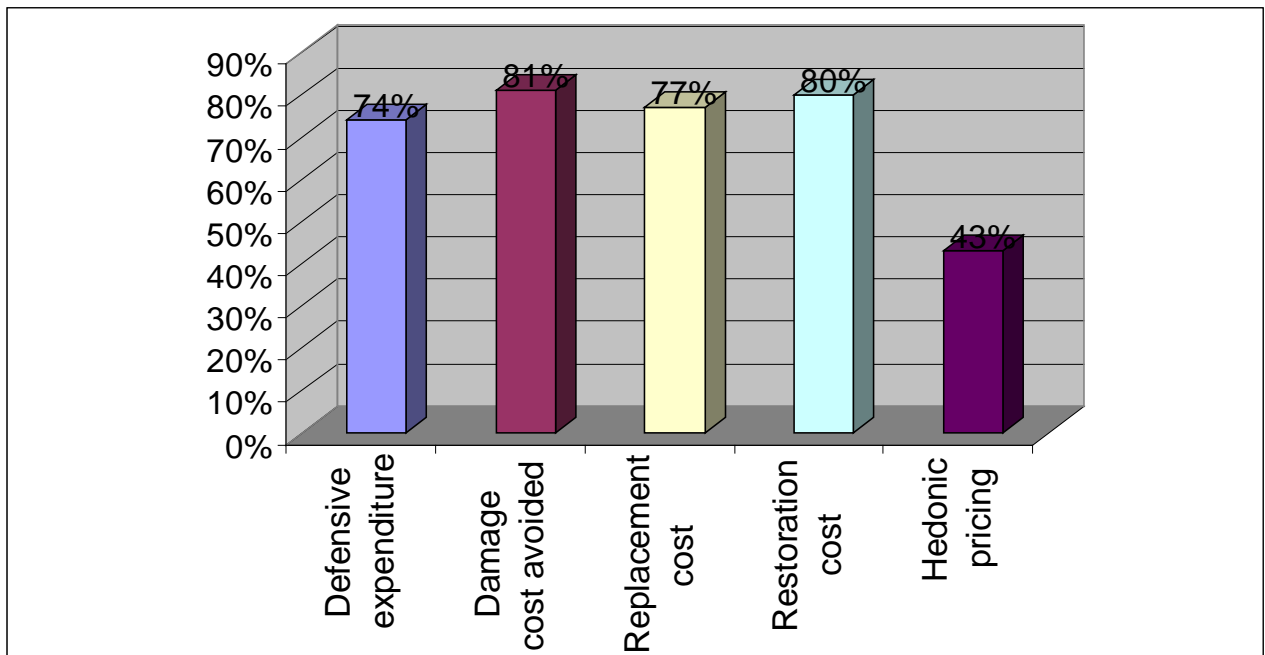


Figure 5.1 Percentage relevance rating of valuation methods to Rand Water's operations

Relevance in this context can be defined as being appropriate in the context of Rand Water's mandate as a water utility company. Relevance here differs from suitability in that it focuses more on applicability of the methods to Rand Water's operations and mandate. Suitability relates to application to Rand Water's open spaces. Rand Water has a variety of departments, operations and functions to support its mandate. It is therefore possible that some environmental valuation methods may be more suitable than others in the context of Rand Water's mandate. Rand Water employees best understand the context of their employer's operations and therefore rated each method in terms of relevance after being introduced to available methods (see section 4.3.1). The above graph (figure 5.1) presents the results of the relevance rating, expressed as a percentage. Most of the methods, except for the HPM, rate favourably in terms of relevance.

5.1.2.2 Data availability score

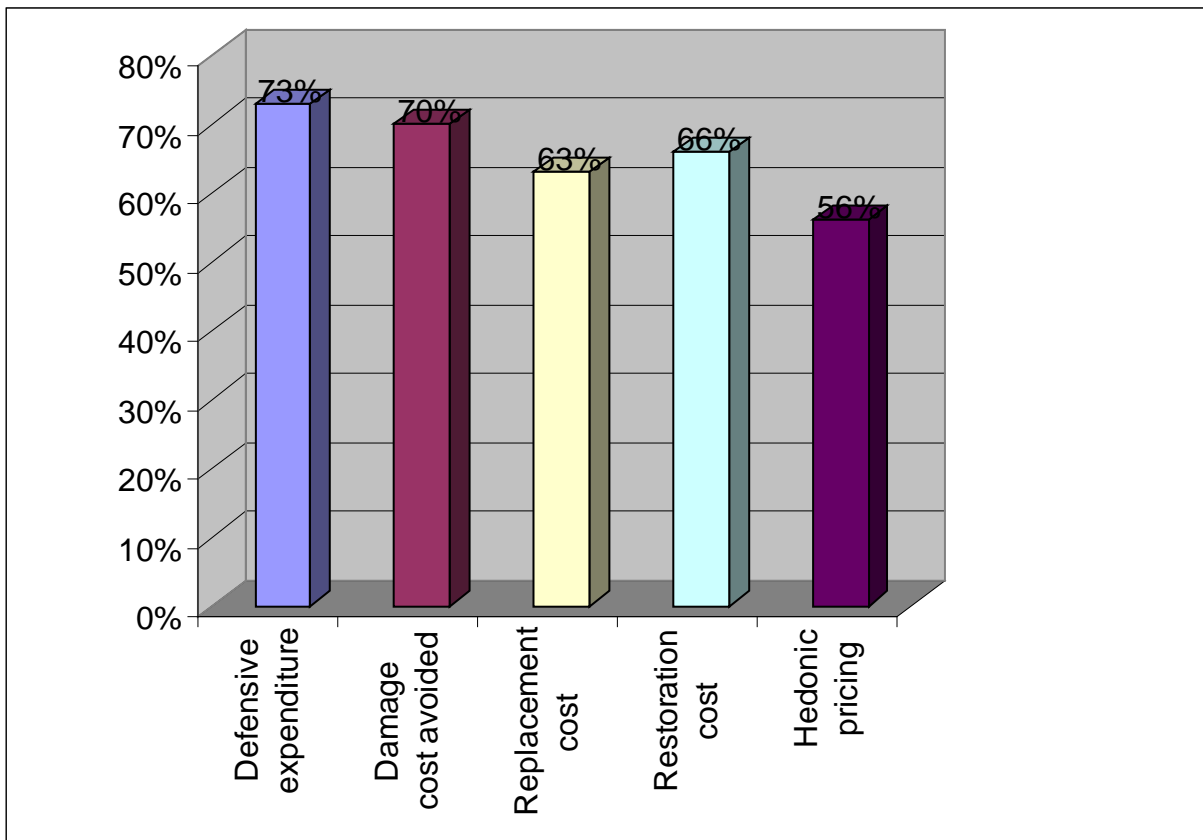


Figure 5.2 Data availability score for each method expressed as a percentage

In order to conduct an environmental valuation exercise the valuer needs access to specific information. The types of information or data requirements vary between methods. Obtaining this data presents obstacles such as time, budget, technical expertise and data ownership, which impact on the ability of the valuer to complete a valuation exercise. Workshop participants were presented with the data requirements for each method and rated the ease of data availability within Rand Water. The replacement cost method scored second lowest (63% as per figure 5.2) owing to the technical data requirements needed in terms of finding appropriate replacement technologies, and comparing the performance of the proxy with that of the environmental service. For this reason the participants stated that the data could be obtained with limited difficulty. The HPM scored the lowest (56% as per figure 5.2) owing to the probable low frequency of application in practice of the method and also because data is 'owned' by estate agents and property valuers outside Rand Water. Access to data may therefore be challenging.

5.1.2.3 Potential of each method to present a case for the preservation of open space

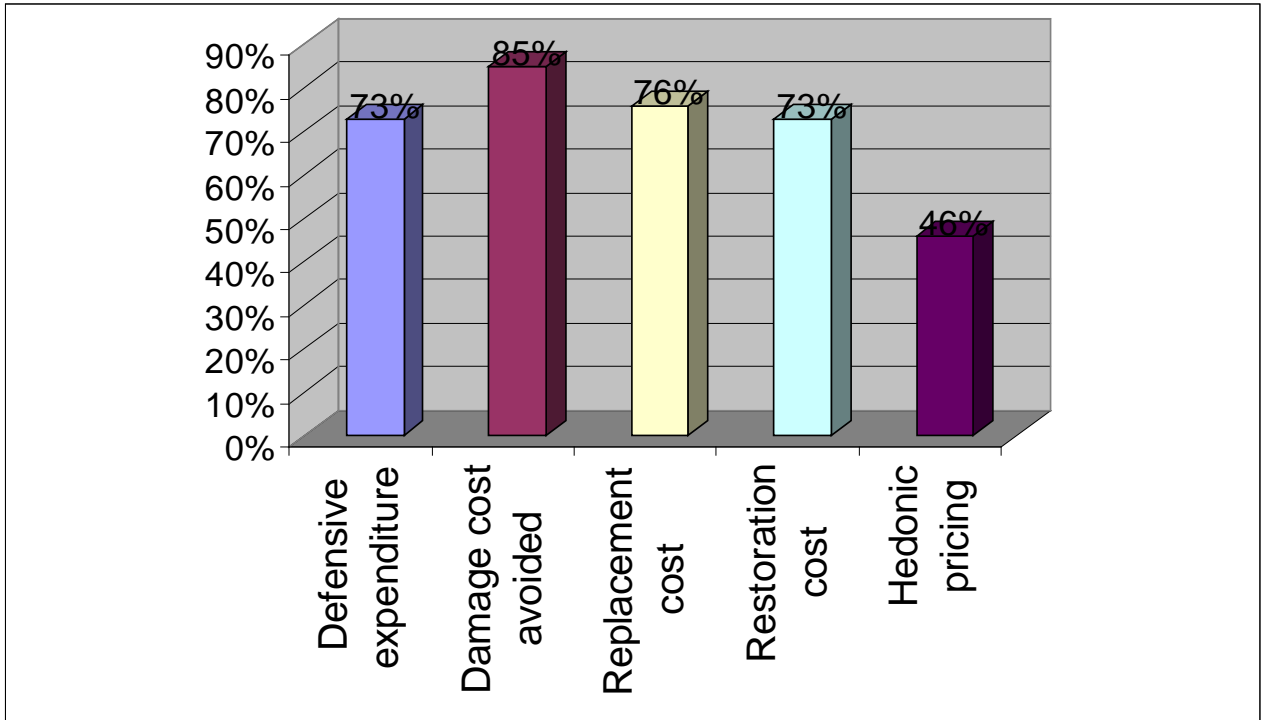


Figure 5.3 Potential of each method to present a case for the preservation of open space, expressed as a percentage

Open spaces and environmental goods and services are valued in order to inform decision makers, change policy and present a case for open space preservation. Discussions in the focus group workshops revealed expressed interest in and enthusiasm for methods such as damage cost avoided and replacement cost method in that these methods have the potential to make a substantive case for conserving specific open spaces (see figure 5.3). On this basis, participants were requested to rate each method's perceived ability to present a case for the preservation of open space in Rand Water. This could also be related to some extent to relevance, as a non-relevant method would not perform well in defending open space preservation in the Rand Water context. The results show that Rand Water employees considered the majority of the methods to have the ability to inform decision makers, change policy and defend open space preservation. The HPM has a limited capacity in this respect as it has a limited scope of application to Rand Water open space.

5.1.3 Discussion of possible adaptation of SATAM into an open space valuation instrument

SATAM has been designed for the valuation of trees within urban areas (Marx, 2005:*abstract*). The method makes use of a replacement tree cost which is obtained by comparing the largest commercially available tree of the same or at least similar species as the tree under evaluation. The replacement tree cost is then subject to value-adding factors obtained from the tree under appraisal, such as height, trunk, circumference and the tree's condition, to arrive at a basic tree cost (see figure 5.4). The basic tree cost is subject to further multiplication factors such as condition rating, amenity appraisal value, environmental contribution and origin/species (Marx, 2005:223).

THE MATHEMATICAL OPERATION FOR SATAM

Client's name: _____

Address: _____

Accurate location detail: _____

Global positioning system (GPS) reading (or Grid Square reading) _____

Appraiser's name: _____

Appraiser's registration number: _____

Date of appraisal: _____

1. **Species** _____
2. **Height** _____ metres
3. **Trunk Circumference** _____ centimetres
4. **Condition appraisal** _____ %
5. **Environmental contribution** _____ %
6. **Amenity appraisal** _____ %
7. **Species / Origin appraisal** _____ %
8. **Replacement Tree Size** (circumference) _____ cm
Replacement tree (Trunk Area) _____ cm^2 TA_R
9. **Replacement Tree Cost** = R _____
10. **Installation Cost** (30% of replacement tree cost) = R _____
11. **Installed Tree Cost** (#9 + #10) = R _____
12. **Unit Tree Cost** (#9 ÷ #8) = R _____ per cm^2
13. **Appraised Trunk Area:** (TA_A or ATA_A ; using the tables 3.2 and 3.3)
= _____ cm^2
14. **Appraised Tree Trunk Increase** (TA_{INCR}) = TA_A or ATA_A _____ cm^2
(#13) - TA_R _____ cm^2 (#8) = _____ cm^2
15. **Basic Tree Cost** = TA_{INCR} (#14) _____ cm^2 x **Unit Tree Cost** (#12)
R _____ per cm^2 + **Installed Tree Cost** (#11) R _____ = R _____
16. **Appraised Value** = **Basic Tree Cost** (#15) R _____ x **Condition rating**
(#4) _____ % x **Environmental contribution** (#5) _____ % x **Amenity appraisal value** (#6) _____ % x **Origin / Species** (#7) _____ %
= R _____
17. Round the **Appraised value** (#18) to the nearest R100 = R _____

Figure 5.4 SATAM worksheet (Marx, 2005:223)

It was initially thought possible to adapt SATAM to value open spaces in that an appraiser could identify factors that add to or detract from the overall open space value and use these as multiplication fractions applied to a basic open space value. These factors can include the variable values stated under section 3.2.1. The immediate question that is posed, which must form the basis of this approach, is what is the base value of an open space. A tree has a basic value as it stands as a marketable product in a nursery, which

consists of production cost, marketing costs and profit margins. As it is planted in a public garden, it grows in size, it has aesthetic appeal, heritage and environmental value, all which contribute to its replacement value. An open space starts out as undeveloped land, which is then often zoned as either public or private open space. The undeveloped land could then remain as such because of its existing amenity value, such as an indigenous forest with a river. Alternatively, the undeveloped land can be landscaped and recreation amenities can be constructed on it. If such an open space is hypothetically placed on the market again, it would at most be valued as undeveloped land with consideration of its potential to be converted into commercially viable land. Zoned open spaces cannot easily be rezoned and developed into other land uses owing to the provisions of sections 24 and 24 D of the NEMA. This regulation therefore further suppresses open space property values owing to the implicit limitation on development options and inherent risk to the purchaser. Can the initial purchase price of the undeveloped land then be used as a base value for an open space? Can factors such as accessibility, location, recreation opportunities and aesthetic appeal be applied as multiplication fractions to the base value of the open space to establish a market value?

To answer these questions it is important to understand that the purpose of environmental valuation is to establish a realistic market value for environmental goods and services that are generally discounted by markets (Gen, 2004:8-9; Markandya, 2005:19). Market value is the most likely price that will be paid for a good or service that is available for purchase (IVSC, 2001:34). Open spaces with their inherent goods and services are generally not traded freely, so environmental valuation methods have to rely on value proxies in the form of revealed preferences, simulated market approaches and market values (see sections 2.1.5.1-2.1.5.2) to obtain a realistic market value of the open space under consideration. Environmental valuation is more concerned with the value of environmental goods and services that emanate from a property or properties than the value of the property itself.

Property valuation may only be performed by a property valuer in terms of section 19(2) of the Property Valuers Profession Act 47 of 2000. The determination of a market value of an open space that is based on an initial purchase price is therefore not permissible by any person other than a property valuer as defined in the said Act. The answer to whether the initial purchase price of the undeveloped land can be used as a base value for an open space is therefore “no” if this approach is applied by any person other than a property valuer. This finding is sufficient therefore to eliminate this

approach from this research project, as it will not be applicable within the Rand Water context.

However, SATAM is still valuable for use in valuing trees in the urban environment. This tree appraisal method could complement the restoration cost method where damage has occurred to trees and claims need to be instituted.

The approach should not be totally disregarded, however, as it may be of value to the property valuation profession. Young (1994:9) states that the market valuation of public sector assets such as open spaces or infrastructural assets is difficult where there is no market for such assets. Public sector assets such as open spaces may need valuation for accounting purposes and a suitable method may be of assistance (Young, 1994:13). Further research into the adaptation of this valuation approach (SATAM) may see a marriage between environmental valuation and property valuation. This would then be a property valuation exercise and not an environmental valuation one. The research may determine whether factors such as accessibility, location, recreation opportunities and aesthetic appeal can be applied as multiplication fractions to the base value of the open space to establish a market value. The market value in this case would focus more on the public utility value of the public asset than its potential selling price. Public utility then includes all the factors that make the asset valuable in its service to the community. The economic value obtained from this valuation exercise will be the price of the public good which, if it is hypothetically sold, would compensate the community for the loss of its utility. This theory may be defensible since it is based on a similar principle of WTA compensation found under the CVM as broadly applied by economists. The development of appropriate market-based proxies for environmental goods and services could possibly be converted into quality/quantity-dependent multiplication fractions and applied to the base value of the open space to arrive at an estimated market value, similar to the SATAM approach. This hypothesised valuation approach will need the scrutiny of the valuation profession before it is embarked upon.

5.1.4 Discussion of moderator hypothesis

It was hypothesised that the inherent limitations of the various environmental valuation methods could potentially be a moderator. The H_{11} and H_2 were delineated as follows:

Potential moderator 1: Limitation of methods

H₁: Inherent limitations of methods is a moderator (not all available valuation methods can be applied to Rand Water open spaces owing to inherent limitations).

H₂: Inherent limitations of valuation methods is not a moderator (all available valuation methods can be applied to Rand Water open spaces without having inherent limitations).

The potential variables tested in terms of method limitations include a suitability assessment, relevance of methods to Rand Water operations, data availability, ability of methods to present a case for open space preservation and finally, potential of SATAM to be adapted for open space valuation.

From the results obtained it was established that the hedonic pricing method was unsuitable (44% rating) and irrelevant (43% rating), its data availability score was the lowest (56%) and its potential to present a case for open space preservation was low (46%). The possible adaptation for SATAM for use on open space valuation in Rand Water was also discarded owing to potential legal limitations. The remaining methods, including defensive expenditure, damage cost avoided, replacement cost and restoration cost methods, meet the criteria of suitability, relevance, data availability and ability to present a case for open space preservation.

The contingent valuation method and travel cost methods were also eliminated from the outset (see section 4.1) based on specific data requirements which could not be met within the Rand Water open space environment.

Based on the outcome of this assessment both revealed preference and stated preference valuation methods have been found unsuitable for application to Rand Water open spaces. The implications of this are that the remaining market-based methods are not able to determine option and existence values and are also ineffective at determining non-use values (see table 2.2; also Kontoleon *et al.*, 2002:182-183). The available suite of suitable valuation methods, which are primarily market based, is therefore unable to determine the total economic value of Rand Water open space.

On the basis of these findings it is concluded that H₁ is shown to be true, considering that not all available valuation methods can be applied to Rand Water open space.

5.2 Limitations of the legal framework

There are currently very few pieces of legislation that provide an unambiguous mandate for determining the value of environmental goods and services in an effort to cost the implications of development impacts. Subsection 2(4)(i) of NEMA requires that “*social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment*”. This nonetheless provides a requirement for the thorough assessment of all aspects of an impact, including economic. Practice, however, shows that few EIAs apply environmental valuation methods (see question 5 under section 4.3.2.1). This can largely be attributed to limited skills in applying environmental valuation, budget and time limitations and controversy surrounding some of the valuation methods.

However, common law does recognise that the environment has value and this can be seen in cases where the cost of environmental damage had to be determined to enable a court to issue fines or settlements. The case of the Exxon Valdez oil spill in Alaska is particularly well known in this regard (Perman *et al.*, 2003:421). It is unfortunate, though, that environmental valuation is only applied once damage has occurred and a case has reached litigation. This reactive response to environmental challenges reveals market failure. The market often fails to attach a value to the external effects and the inherent risks of its economic activities. It is believed that if the Exxon Mobil Oil Company had been proactive, it would have done a risk assessment in which the financial implications of possible spills were considered. Mitigation measures would have been in place and the spill might have been prevented.

The consideration of environmental value is becoming more common practice in international accounting standards. This is observed in the United Nations *Handbook of national accounting: Integrated environmental and economic accounting* (commonly referred to as SEEA). It provides clear guidelines for accounting for the contribution of the environment to the economy and the economic implications of resource depletion and state of the environment.

Furthermore, the Kyoto Protocol as well as the Ramsar Convention pave the way for advancement of environmental valuation methods. The Kyoto Protocol is concerned with the impact of global warming and climate change

and devises trading schemes to reduce and offset carbon emissions. It is foreseen that carbon sequestering technologies and green spaces would be highly valued in future as they ameliorate climate change. Environmental valuation may therefore be applied more readily as emission trading schemes are refined. Valuable work has also been done by the Ramsar Convention in determining the economic value of wetlands, and specific manuals are provided to signatories on how to apply various valuation methods (Barbier, *et al.*, 1997; De Groot, *et al.*, 2006; Ramsar information paper no 1, 2007).

Unfortunately there is no specific assertion in legislation as to which profession is eligible to perform environmental valuation. The property valuation profession does not have the necessary environmental sciences skills to identify environmental goods and services that can make an economic contribution. The environmental scientist may not be sufficiently trained in economics and valuation methods. Environmental valuation is currently predominantly applied by economists who specialise in environmental resource economics. The researcher, however, believes that there is also scope for environmental scientists as well as property valuers to perform environmental valuation, provided that specific training is offered in this respect. It is believed that environmental valuation will become more prominent in the field of environmental management and that this will require some form of regulation as well as some minimum level of qualification. The submission of an environmental valuation in a court of law will at this stage have to be done by an independent, reputable professional or preferably a team of experts across the fields of economics, valuation and environmental sciences, for it to be admissible. However, there are no limitations at this stage as to how Rand Water applies these methods for its own use to inform decisions. The legal factors only need to be considered when Rand Water intends to advise an external party on environmental valuation or where these methods are applied in litigation cases.

5.2.1 Discussion of moderator hypothesis

It was hypothesised that the legal framework could potentially be a moderator. The H_{1_1} and H_2 were delineated as follows:

H_1 : The national and international legal framework is a moderator (the national and international legal framework is a limiting factor with regard to application of valuation methods).

H₂: The national and international legal framework is not a moderator (the national and international legal framework is not a limiting factor with regard to the application of valuation methods).

It can be concluded that even though there are limited direct provisions in legislation to mandate environmental valuation, legal principles require economic impacts to be measured and damages to the environment to be estimated. These principles in themselves have supported litigation cases and the mere admission of environmental value estimates in court as evidence and support to a case therefore sets the required legal precedence and mandates further application.

On the basis of these findings it is concluded that H₂ is shown to be true, considering that there is currently no legal impediment as to who is mandated to perform environmental valuation. There is also sufficient legal precedence to apply environmental valuation and for it to be accepted in a court of law. The national and international legal framework is not a moderator but rather supports environmental valuation.

5.3 Limitations of the user

As discussed under section 1.5, it is not the intention of this study to measure the independent variables that affect the user's ability to apply the methods, but to rather take a qualitative approach and measure the user's opinion of his or her personal ability, ease of use and understanding of the methods. This section will discuss the results obtained from various tests to determine what the limitations of the user are in terms of actual application of the methods. The results will then be used to determine whether the stated **hypothesis** is proven true or false.

5.3.1 Relevance rating of valuation methods to respondents' area of work

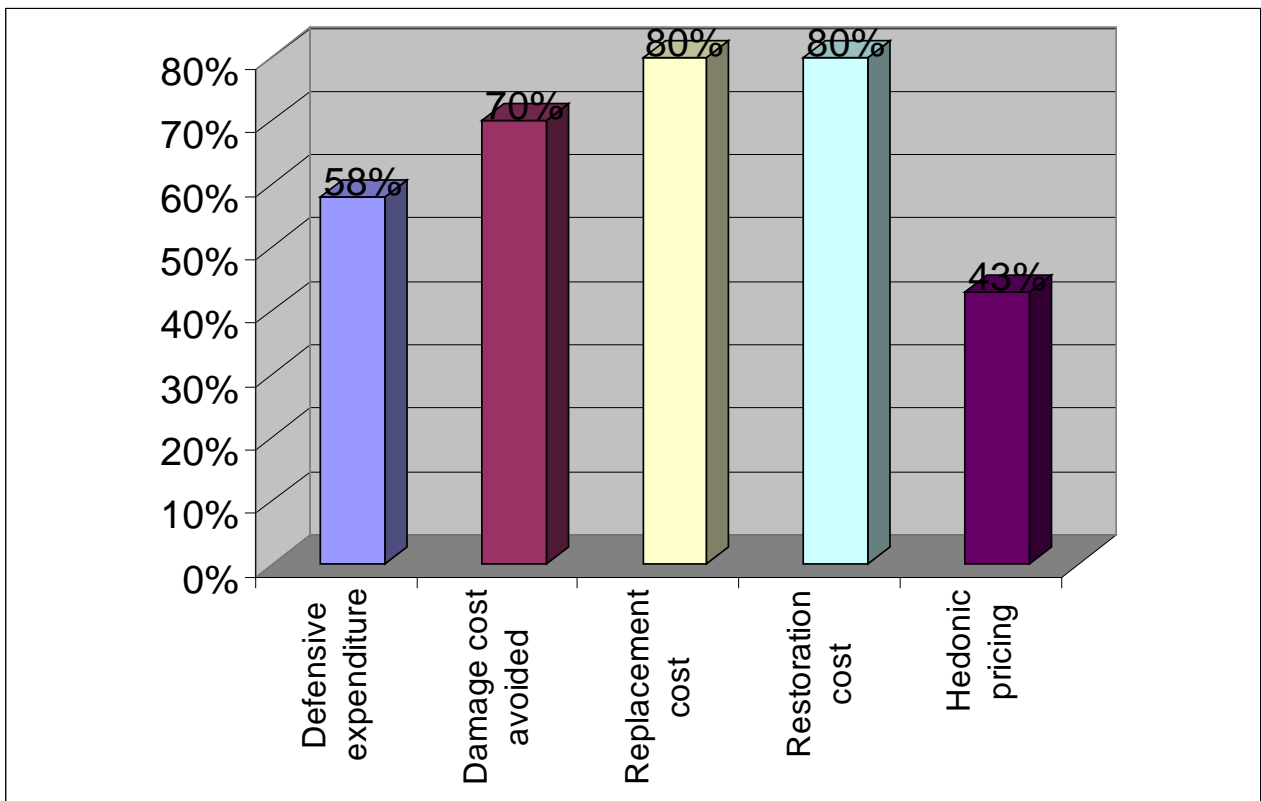


Figure 5.5 Percentage relevance rating of valuation methods to participants' area of work

Rand Water employees operate within different technical environments ranging from engineering, geographic information systems, environmental management, and horticulture. Each of these disciplines may find a particular method relevant to their area of work or totally not applicable. Their ratings are presented in figure 5.5. It is interesting to note that even though the defensive expenditure method may have been rated less relevant by a fair number of respondents (only 58%) in their respective areas of work, they mostly agreed that it is more relevant in the overall open space context of Rand Water (74% - see figure 5.1). This indicates that this method, however relevant, may only be applied by a small number of Rand Water employees. The HPM again scored a low relevance rating.

5.3.2 Ease of use rating for environmental valuation methods

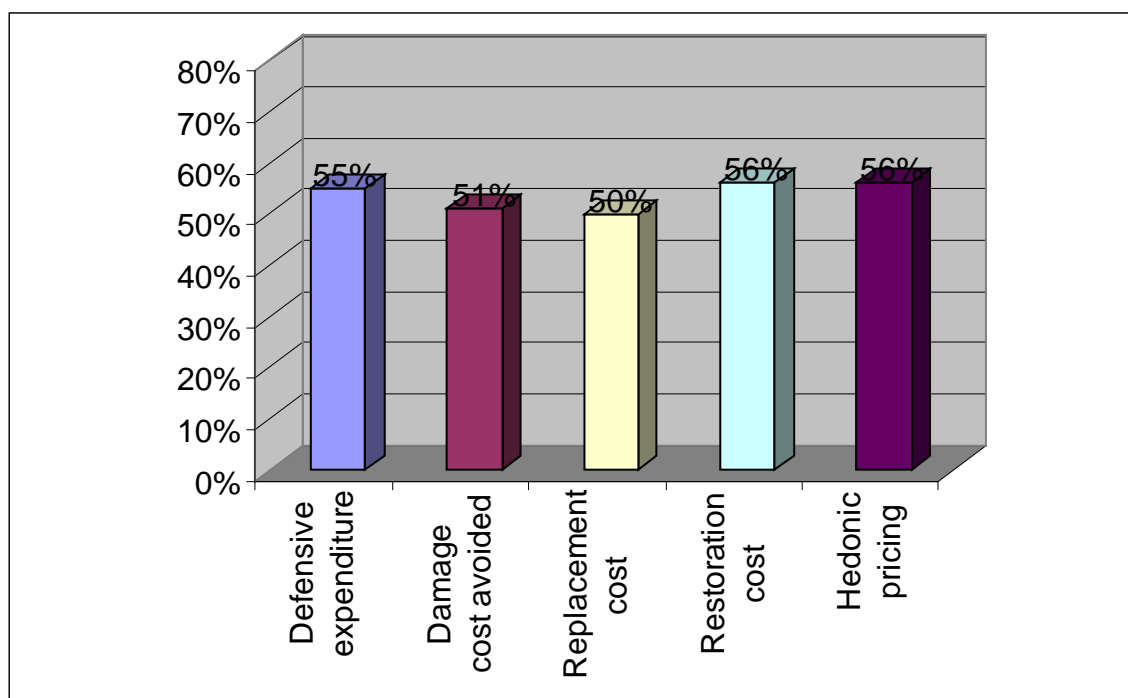


Figure 5.6 Percentage ease of use rating of various methods

This index as shown in figure 5.6 is important as it shows how accessible Rand Water employees considered the methods to be in terms of ease of use. Results could highlight limitations of the user – with user being the Rand Water employee - in applying the methods in practice. The results for all the methods fall within the 50% bracket, which is rated as easy. The results are, however, at the lower end of the ‘easy’ bracket, which represents some level of apprehension about the method application. This can be overcome with training and the introduction of an appropriate field guide.

5.3.3 Discussion of user feedback from the GDACE ERE workshop held on 22-24 March 2006

The results shown under section 4.3.2 present the main themes found in the responses. Some respondents’ answers contained more than one of the main themes identified. The results in section 4.3.2 therefore show the percentage of the respondents that had identified a particular theme. Sections 5.3.3 and 5.3.4 present these results differently by showing the prominence of each theme as a percentage based on its frequency of

occurrence. The percentages may therefore differ from those given under section 4.3.2, except where only one theme per respondent was identified per question. The purpose of this approach is to highlight the respondents' understanding of the key issues pertaining to environmental valuation in an attempt to measure user limitation.

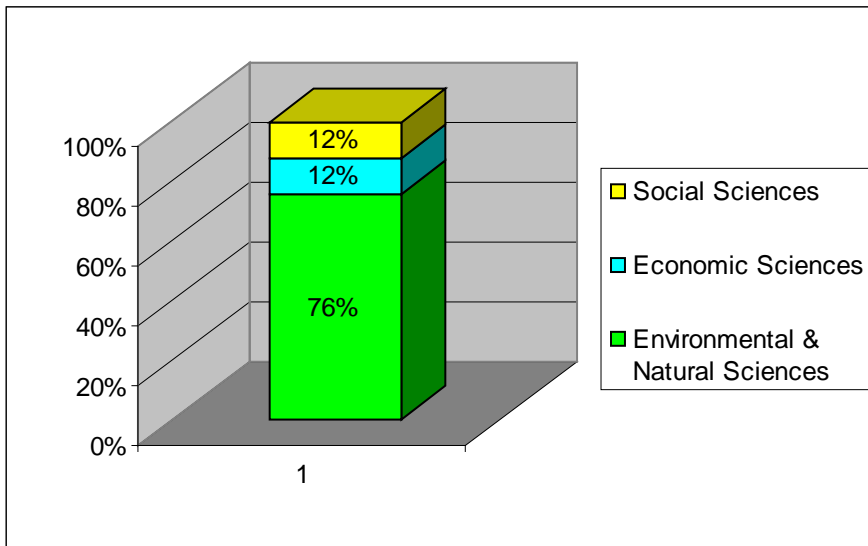


Figure 5.7 Workshop participants' field of expertise profile (GDACE)

Figure 5.7 shows that the majority of respondents came from an environmental management field, which is understandable considering the mandate of GDACE. From this it could be inferred that the remaining responses were strongly influenced by this paradigm or frame of reference.

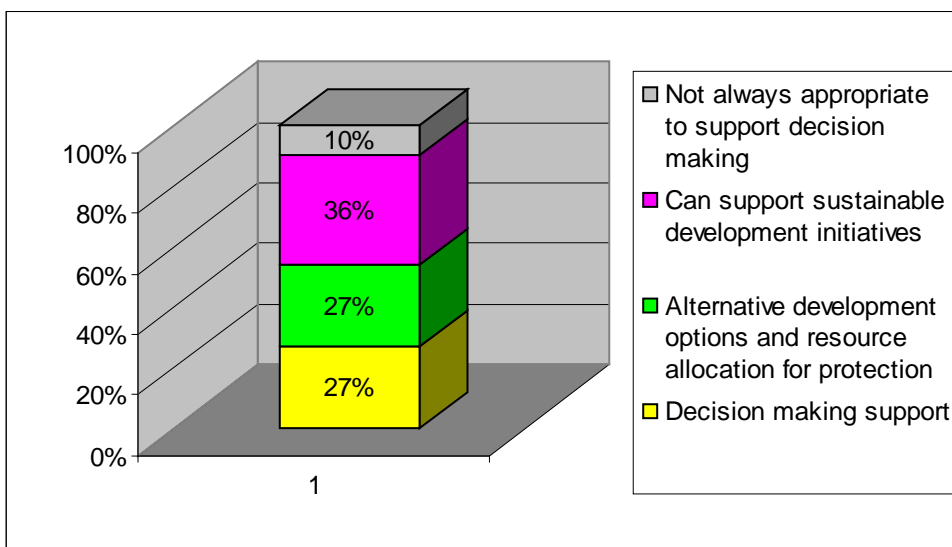


Figure 5.8 Response summary of how environmental valuation can help respondent in his/her field of expertise and opportunities for application (GDACE)

Respondents understood that environmental valuation could function as a decision support tool in that it illustrates the economic importance of the environment, which may assist sustainable development initiatives. The two dominant themes as shown in figure 5.8 support this interpretation.

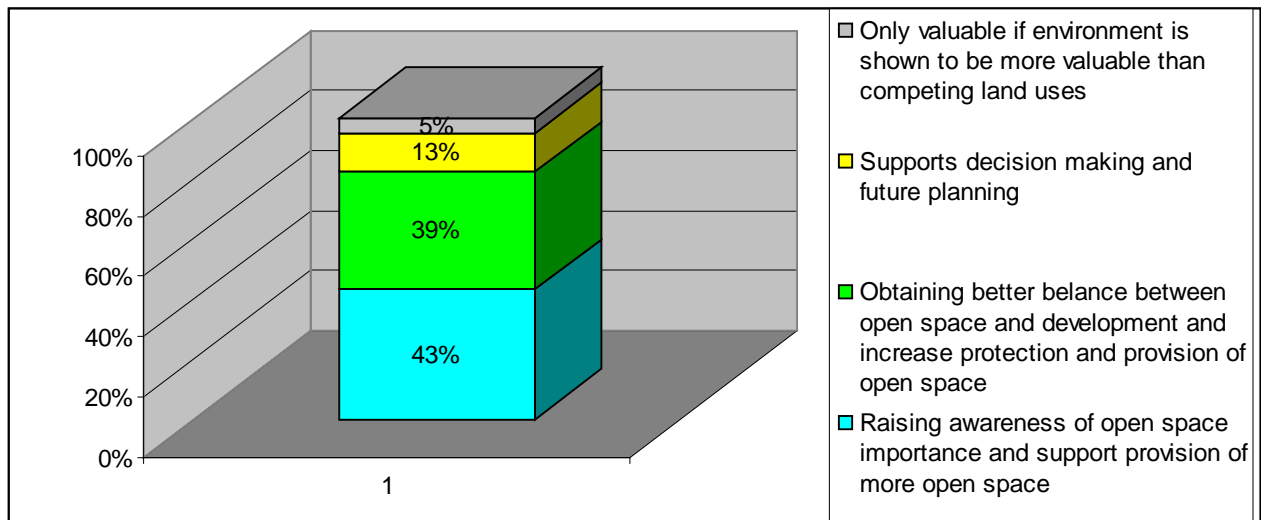


Figure 5.9 Response summary of perceived benefits of obtaining an economic value for urban open spaces and ecosystems (GDACE)

Environmental valuation can assist in obtaining a better balance between open space and development, while also increasing the protection of existing open space. It furthermore assists with raising awareness about the importance of open spaces in the urban environment. Respondents managed to capture these main benefits in their responses.

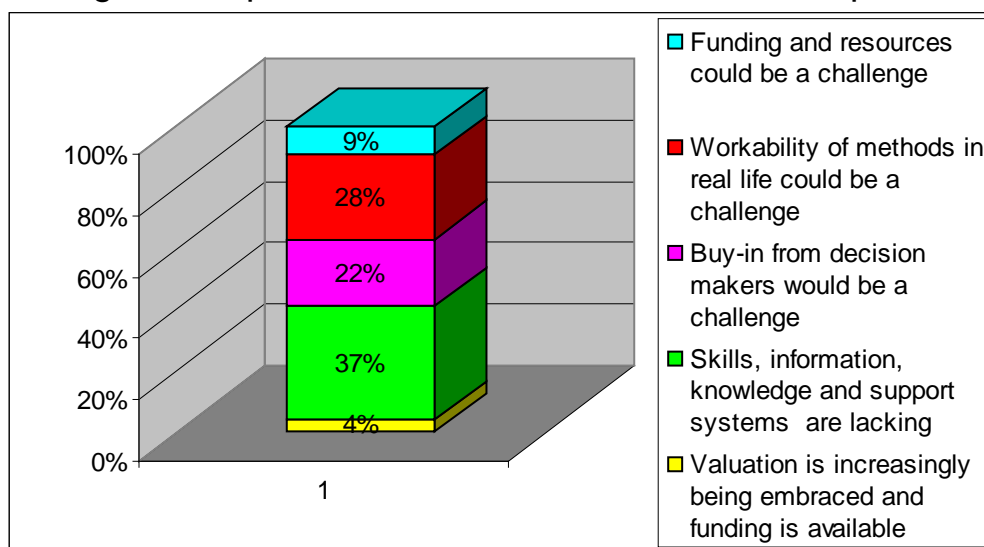


Figure 5.10 Response summary of perceived challenges and constraints that could halt the implementation of environmental valuation (GDACE)

Literature states numerous challenges with regard to the implementation of environmental valuation in practice. The respondents managed to identify the most prominent of these as stated above. They therefore understand the inherent limitations of environmental valuation and real-life obstacles that an environmental valuer may encounter.

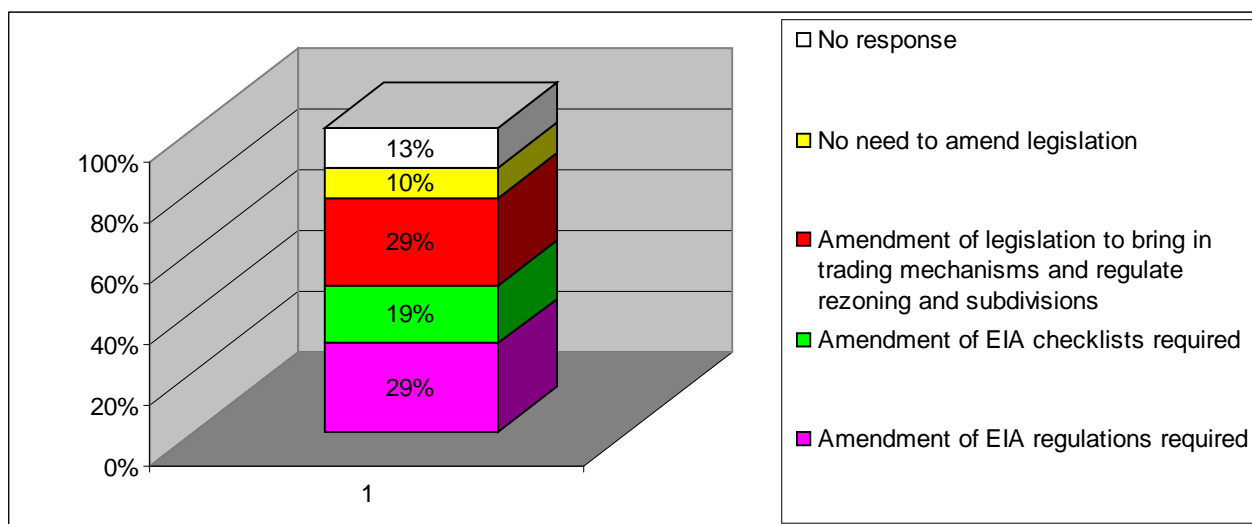


Figure 5.11 Response summary of policy and regulatory provisions needed to enable implementation of environmental valuation (GDACE)

The nature of the respondents' work requires them to review EIAs within the NEMA legal framework. During the workshop respondents saw opportunities for regulatory amendments to allow for the application of environmental valuation. Respondents were therefore able to relate their area of work to these opportunities.

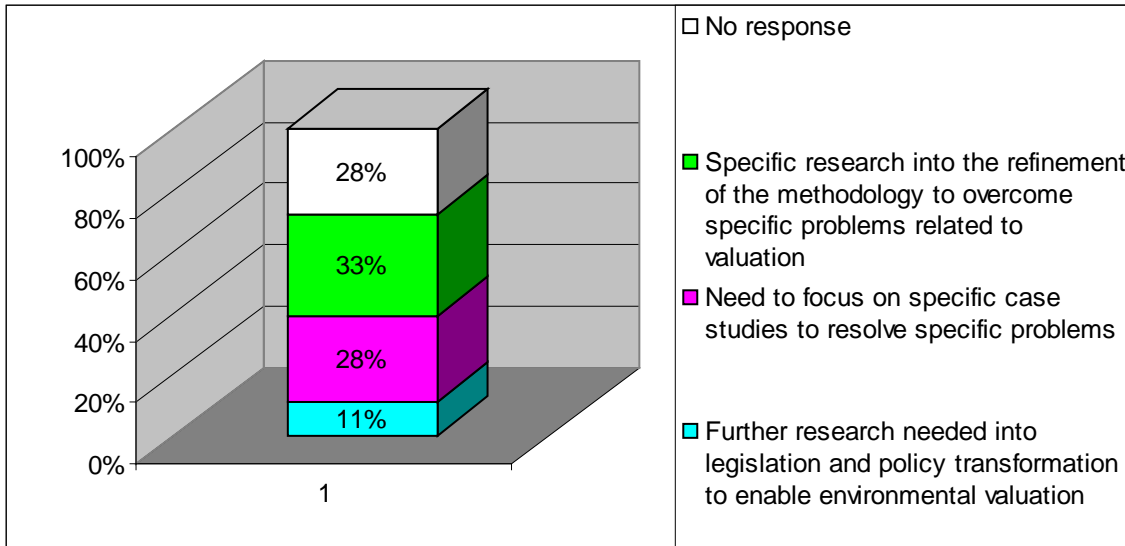


Figure 5.12 Response summary of remarks or suggestions for current and future research (GDACE)

Respondents identified the need for further refinement of valuation methodology, which is also a prominent focus in actual environmental valuation research (see figure 2.6). Respondents also identified the need to focus on specific case studies to resolve specific environmental problems.

In summary, it can be concluded that respondents of the GDACE environmental resource economics workshop displayed a good understanding of the key issues pertaining to the discipline and were able to relate them to their area of work. This can largely be attributed to the good course presentation done by Mr Hugo van Zyl over the three days. This gave respondents a good overview of ERE and environmental valuation. Based on the results it is believed that given sufficient training and exposure to environmental valuation, environmental scientists can apply environmental valuation in practice to support their work.

5.3.4 Discussion of the user feedback from the Rand Water focus group workshop held on 11 July 2008

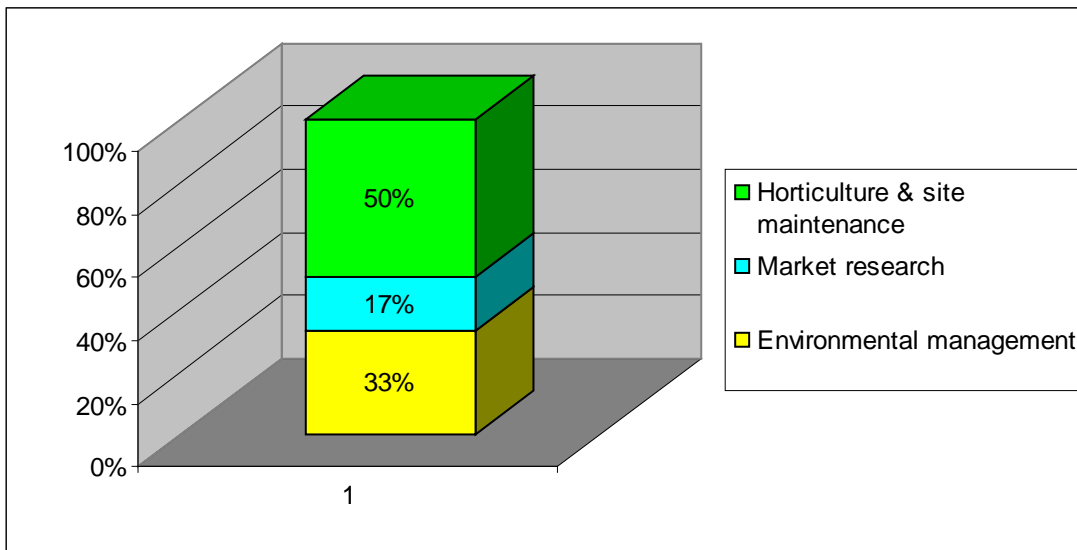


Figure 5.13 Workshop participants' field of expertise profile (Rand Water)

The Rand Water respondents comprised mostly horticulturists and a smaller component of environmental scientists. Responses were therefore influenced by a predominantly horticultural and open space maintenance frame of reference.

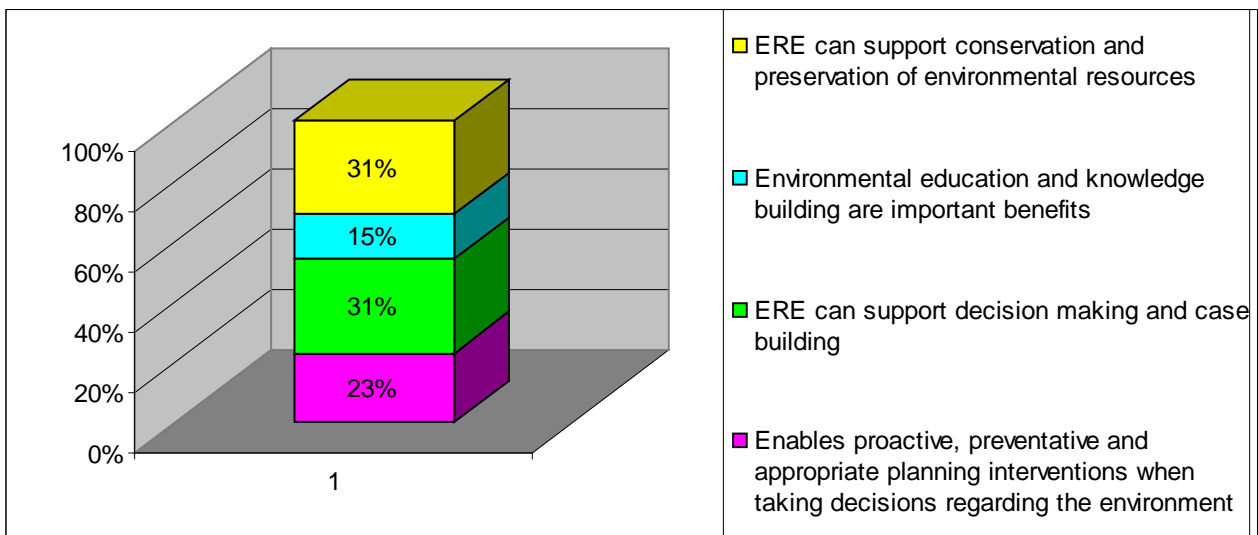


Figure 5.14 Response summary of how environmental valuation can help respondents in their field of expertise and opportunities for application (Rand Water)

Respondents understood that environmental valuation can support conservation and preservation of environmental resources as well as function as a decision support tool. The same themes were also identified in the GDACE ERE workshop. Respondents were therefore able to relate environmental valuation to their area of work.

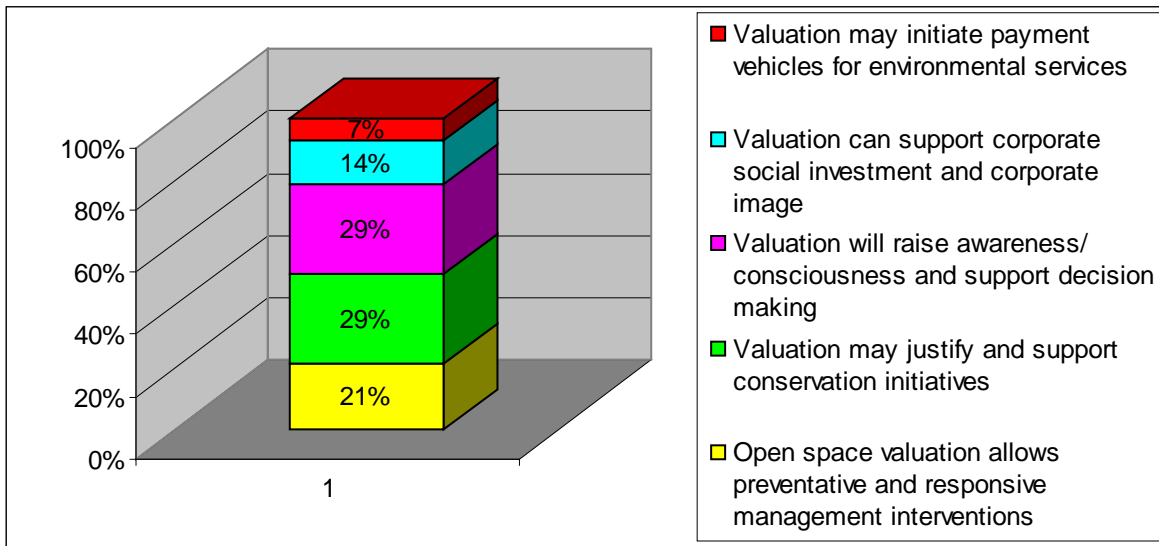


Figure 5.15 Response summary of perceived benefits of obtaining an economic value for urban open spaces and ecosystems

Environmental valuation can assist with justifying and supporting conservation of existing open space. It furthermore assists with raising awareness about the importance of open spaces in the urban environment which will support decision making. Preventative and responsive management support was also identified as a benefit of obtaining an economic value for open spaces. Similar themes were also identified in the GDACE workshop. Respondents were therefore able to identify the key benefits of environmental valuation.

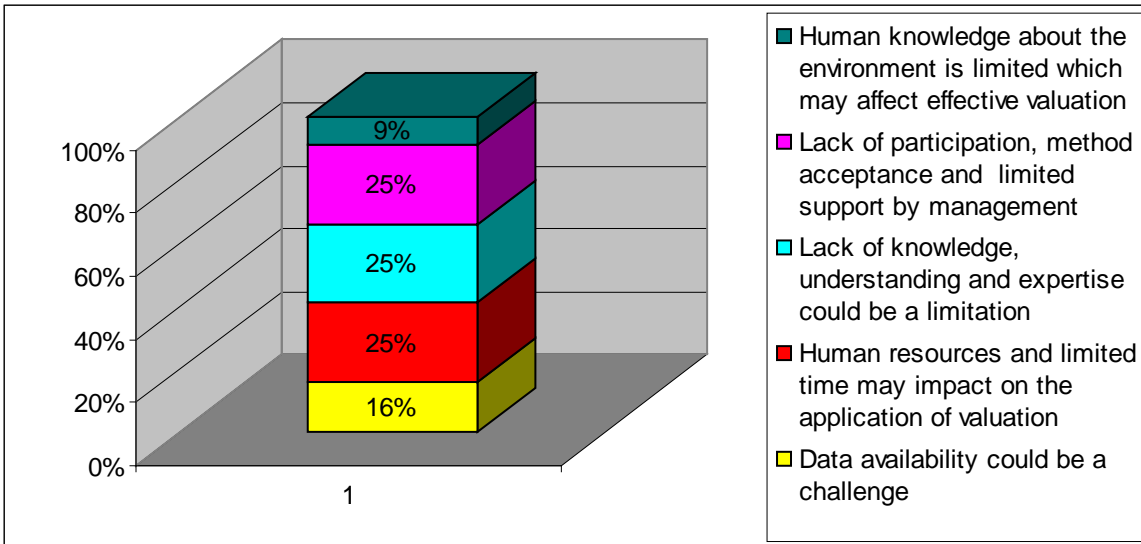


Figure 5.16 Response summary of perceived challenges and constraints that could halt the implementation of environmental valuation (Rand Water)

The respondents managed to identify the most prominent challenges associated with environmental valuation, as did respondents of the GDACE workshop. Respondents therefore understood the inherent limitations of environmental valuation and real-life obstacles that an environmental valuer may encounter.

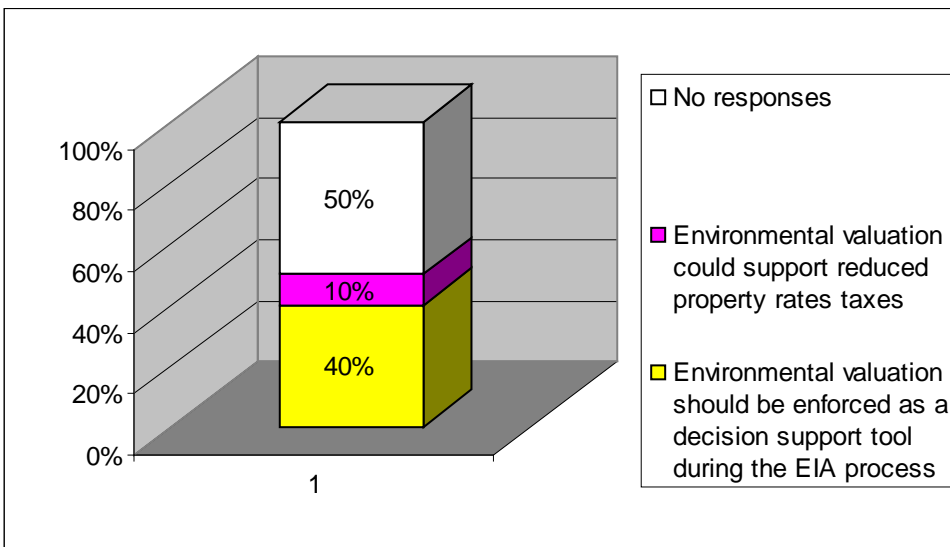


Figure 5.17 Response summary of policy and regulatory provisions needed to enable implementation of environmental valuation (Rand Water)

Half of the respondents did not answer this question. This could possibly be because few of the respondents actually applied environmental legislation in their field of work. The remaining respondents identified the need to apply environmental valuation during EIAs, similar to the GDACE responses.

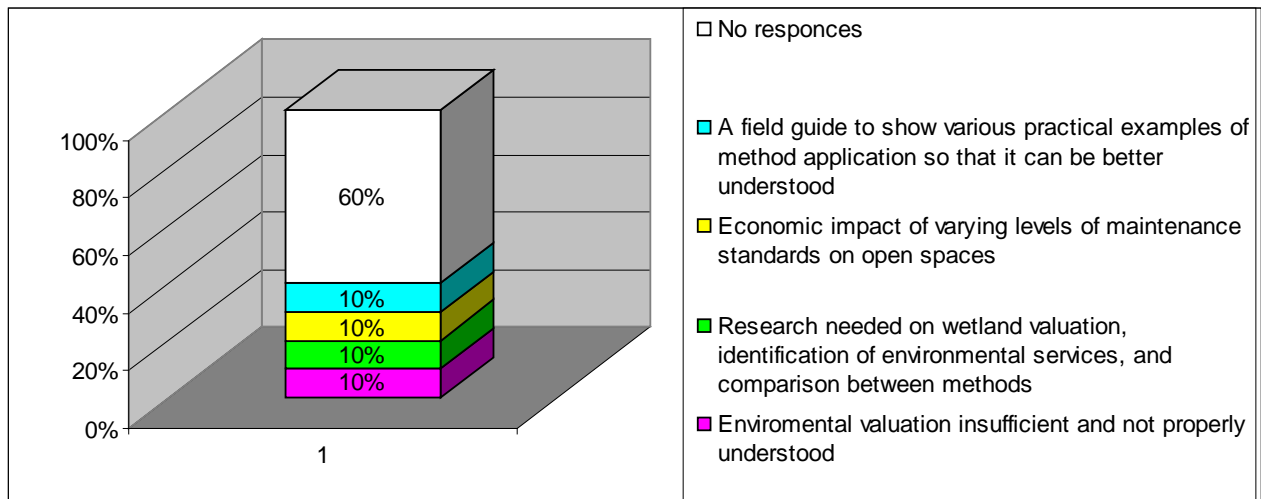


Figure 5.18 Response summary of remarks or suggestions for current and future research (Rand Water)

The majority of respondents did not answer this question. There could be various reasons for this, including no need to provide input, or respondent fatigue.

The Rand Water focus group had a basic introduction to ERE, unlike the GDACE group who received a reasonably good overview of the subject. Despite this difference, respondents from both workshops managed to identify similar key benefits, limitations and opportunities for application of environmental valuation in their respective areas of work. It is clear from the answers that the majority of respondents understood the principles of environmental valuation and could relate them to their field of expertise. As with most open-ended questions, there are minority themes that reveal good insight as well as themes that reveal confusion and misinterpretation of the questions. Predominant themes were nonetheless evident from all the answers from both the GDACE workshop and the Rand Water focus group, which allowed them to be categorised and rated. From these results it can be deduced that environmental scientists, horticulturists and open space managers can, if they receive sufficient training, apply principles of ERE and practise environmental valuation in their respective fields of work.

5.3.5 Discussion of moderator hypothesis

It was hypothesised that the user limitations could potentially be a moderator. The H₁ and H₂ were delineated as follows:

H₁: The user of the valuation technique is a moderator (the user of the valuation technique can be a limiting factor when applying the valuation methods).

H₂: The user of the valuation technique is not a moderator (the user of the valuation technique will not be a limitation when applying the valuation methods).

As seen from figure 5.5, it was found that respondents regarded the majority of the methods relevant in their areas of work. 'Relevance to user's area of work' is an independent variable which relates to user limitation (see section 1.5). Figure 5.6 also shows that respondents regarded all the methods as easy to apply. Sections 5.3.3 and 5.3.4 show that respondents had a good understanding of the limitations, benefits and application of environmental valuation and correlated these to their respective areas of work.

On the basis of these findings it is concluded that H₂ is shown to be true as the user in this specific study is found not to be a moderator. Respondents displayed the necessary understanding of environmental valuation application within their respective areas of work, as well as stated their confidence in using the methods. It should, however, be noted that users will have to receive thorough training in method application to ensure accuracy and **validity** of valuation results. The tests used relied mostly on user feedback, whereas an actual assessment of user fieldwork results may reveal more pronounced user limitations - notwithstanding the potential of proper training. This finding nonetheless shows that environmental valuation should not necessarily be the preserve of economists, but that environmental scientists have the ability to familiarise themselves with it and potentially popularise its application in this field. Qualifying criteria are necessary, which in this case will mean a user needs to have at least a tertiary qualification in environmental sciences with appropriate practical experience and some level of method application training before embarking on an environmental valuation exercise.

5.4 Limitations of the study area

The study area includes all Rand Water owned open spaces. A context survey established that public accessibility to Rand Water properties is limited, harvesting of natural products is restricted and limited commercial agriculture takes place (see section 4.5). The study area therefore does not have any measurable consumptive use value.

Non-consumptive use values such as recreation and ecotourism are measured by means of stated and revealed preference valuation methods. Open space user accessibility is important to enable sufficient data to be generated for the successful application of these methods, as the methods rely exclusively on open space user feedback. Limited public accessibility to or user excludability from the Rand Water open spaces means that the only available approaches (stated and revealed preference) to measure non-consumptive values will not work (see table 2.6 and figure 2.1). Open space user excludability and subsequent elimination of stated and revealed preference approaches means that option and existence values cannot be measured either.

GIS data supplied by the Rand Water Corporate GIS Section did not indicate any wetlands. Annexure L (Palmiet Estate) shows a wetland but it does not appear to be on Rand Water property in terms of the cadastral data. Respondents from the July 2008 focus group meeting did indicate that Rand Water does have wetlands within some of its open spaces. It is therefore assumed that the Corporate GIS data supplied may not be comprehensive and that there are wetlands present, although limited, on Rand Water open space. Damage cost avoided and replacement cost methods are used predominantly to value wetland ecological services (Barbier *et al.*, 1997; Turpie *et al.*, 2001:18; Sundberg, 2004; King & Mazzotta, 2006:1; Badola & Hussain, 2005). The limited distribution of wetlands on Rand Water open space means that these two methods will seldom be applied.

Owing to the limitations of the Rand Water study area, only indirect use values can be determined. The ecohydrological focus of the damage cost avoided and replacement cost methods means that only restoration cost and defensive expenditure methods are available to determine the indirect use values of the remainder of Rand Water's open spaces. This is a very limited suite of environmental valuation methods.

5.4.1 Discussion of moderator hypothesis

It was hypothesised that the study area limitations could potentially be a moderator. The H_{1_1} and H_2 were delineated as follows:

H_1 : The Rand Water study area is a moderator (the Rand Water study area can be a limiting factor when applying the valuation methods).

H_2 : The Rand Water study area is not a moderator (the Rand Water study area will not be a limitation when applying the valuation methods).

GIS data and an open space context survey were used to determine whether the study area contains the activities, open space categories and levels or open space user access needed to calculate the open space total economic value. Open space user excludability is found to be a significant independent variable which affects the ability of environmental valuation methods to determine consumptive and non-consumptive use values as well as option and existence value. This means that the total economic value of Rand Water's open spaces cannot be determined with the currently available environmental valuation methods.

On the basis of these findings it is concluded that H_1 is found to be true as the study area is a moderator. The limited open space user access, limited harvesting, limited agriculture and limited open space categories result in limited values that can be measured.

5.5 Reliability and validity of data

One particular concern regarding reliability from the outset was the small focus group. The focus group varied between 11 and 17 participants. It was observed that the effect of outlier data on mean and median results could increase as the respondent size decreased, which negatively affected the reliability of data (see section 4.4). The focus group consisted of Rand Water employees who dealt directly with Rand Water open spaces and the group size was therefore not very flexible. This dynamic was identified and outlier data was identified where it was deemed to have a negative influence on predominant data trends (see sections 4.4 and 5.1.1). Questions were also explained to respondents to ensure that answers were in response to correctly interpreted questions.

Notwithstanding this dynamic, overall results where duplicate tests were applied showed acceptable levels of reliability. The results from open-ended questions relating to ERE and environmental valuation to GDACE and Rand Water reveal similar themes between the two groups (see sections 4.3.2, 5.3.3 and 5.3.4). The method suitability assessment conducted in 2006 was repeated in 2008. Even though the suitability ratings decreased in 2008, there was limited variation in the trend. The HPM still rated as unsuitable and the remaining methods still rated as suitable (see figure 4.1). Figures 5.1, 5.2 and 5.3 consistently show the failure of the HPM with regard to relevance to Rand Water operations, data availability, and potential of method to present a case for open space preservation. The isolation of this one method in all the surveys also points to a measure of reliability of data and data collection instruments. Specific data trends could also be explained by existing knowledge, which further shows reliability of results (see explanation of results under sections 5.1.2.1, 5.1.2.2 and 5.1.2.3).

Validity was measured in terms of Herr and Anderson's goals of action research and **validity** criteria. **Dialogic validity** was achieved by regularly meeting with the project group, who provided their input into the research dissertation. Submission of articles to scientific journals also provided valuable input from reviewers with regard to content and structure of the research. Input received was incorporated into the dissertation and recommended amendments were effected. Feedback from *Acta academica* regarding the legal framework for environmental valuation provided valuable information for the structure and content of this topic. A submission to *Acta Structilia* was accepted and published in volume 15, number 1 of 2008.

Process validity was achieved by finding and applying a suitable process that would define the problem and mechanisms for its solution. The challenges encountered in finding a means to develop a methodology for the valuation of Rand Water's open space necessitated a review of the **problem statement**. The PhD thesis of Gen (2004) inspired the use of moderator hypotheses as they provided an opportunity to rather investigate the constraints which could affect the application of environmental valuation. Further literature review enabled the researcher to identify this process as constraint composition under the grounded theory methodology. This approach tied in with PAR as the theory development and the constraint composition process follows similar cycles of review and reflection. These cycles of problem formulation ensured that the project group and participants learned while they were engaged in the research process.

Outcome validity was achieved by studying all the possible moderators which could affect the feasible application of environmental valuation methods to Rand Water open space, developing appropriate instruments to measure its effects (within the PAR methodology) and to present the data with interpretations to objectively prove the stated hypotheses. The use of user feedback within a focus group, literature review and GIS data provided the means to do this.

The use of moderator hypotheses allowed the research project to give an accurate reflection of the current reality within Rand Water which affects the application of environmental valuation. While not all methods are applicable within Rand Water, the remaining methods are able to provide an opportunity for valuing open spaces. Focus group feedback revealed enthusiasm about the ability of certain methods to provide a case for open space preservation, while also realising the limitations of other methods. These observations point towards **catalytic validity**.

Democratic validity was achieved through the constitution and participation of the open space valuation focus group and research project group. Review of research progress, challenges and research instruments was important to ensure **democratic validity**. The participation of GDACE in the research process allowed valuable feedback and a means of comparison. The researcher also collaborated with Ms Muriel Bonjean from Oxford University, who was doing research on the value of wetland services using the replacement cost method. This allowed the exchange of data and methodologies. The input of Mr Hugo van Zyl, Environmental Economist, at the beginning of the research project also contributed to broadening the participant base.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions about the results obtained with reference to stated main hypotheses

The main hypotheses were stated as follows:

H_0 : If certain available environmental valuation methods are assessed for applicability to Rand Water open spaces, and are subject to potential moderators, then it will not be possible to determine a specific/exact value expressed in monetary terms - no significant relationship between available environmental valuation methods and Rand Water open space can be shown.

H_1 : If certain available environmental valuation methods are assessed for applicability to Rand Water open spaces, and are subject to potential moderators, then it will be possible to determine a specific/exact value expressed in monetary terms - a significant relationship between available environmental valuation methods and Rand Water open space can be shown.

It was found that revealed and stated preference environmental valuation methods cannot be applied to Rand Water open space owing to inherent limitations of the methods and the study area. Only market-based methods were found to be suitable for use on Rand Water open space. It was also found that the legal framework and the user are not moderators in the application of environmental valuation to Rand Water open space, and would not be moderators for the broader application of environmental valuation to municipal land and other areas of environmental importance either. The user limitation is, however, contingent on appropriate training. Notwithstanding the limitations of the methods and study area, which limit the ability of users to obtain a total economic value for Rand Water open space, the available suite of methods can provide an indicator of value for environmental goods and services that flow from the utility's open spaces.

The travel cost, contingent valuation and hedonic pricing methods were eliminated owing to unsuitability within the Rand Water context. The available suite of methods is also less suitable to determine use, non-use, option and existence values (see table 2.2 and 6.1). The remaining market-based methods are only suitable to value indirect use values such as environmental services (also see table 2.2 and 6.1). The three environmental

valuation methods that were eliminated are the most prominently used methods because of their ability to determine a wider range of environmental values at once (see tables 2.2 and 2.7). The excludability of open space users from Rand Water open spaces was found to be the most significant factor contributing to the elimination of these methods. The restriction of open space access and usage means that potential open space users' stated and revealed preferences cannot be measured (see table 2.6 and Perman *et al.*, 2003:126). If there is limited or no open space access and usage, then limited or no data can be generated that could be applied in environmental valuation methods. The remaining market-based methods are also very specific in their area of application, with the replacement cost and damage cost avoided methods predominantly being applied to value ecohydrological functions (Sundberg, 2004:19; Turpie *et al.*, 2001:18; also see Badola & Hussain, 2005). The composition of Rand Water's open space categories reveals that only a small fraction comprise of wetlands where these methods can be applied.

The restoration cost and defensive expenditure methods were found to be suitable despite the limitations on the application of environmental valuation to Rand Water's open spaces. The replacement cost and damage cost avoided methods could also be applied, though on a very limited scale, to value wetlands within the Rand Water open space portfolio. It is therefore still possible to determine an economic value for Rand Water's open spaces. The method relevance ratings obtained during the survey (see figure 5.1) cannot be discounted as focus group participants were familiar with Rand Water's open space network and its inherent characteristics that make these methods suitable. On the basis of these findings H_1 is found to be true despite the influence of some moderators, as it is still possible to determine an economic value for Rand Water open space. H_0 would have been true if it were not at all possible to value Rand Water's open spaces. It can furthermore be concluded that the application of environmental valuation methods to Rand Water open space is feasible within the context of the identified limitations. Further research is, however, needed to overcome some of these limitations, which will then allow the total economic value of the Rand Water open spaces to be determined.

The available methods will be presented to Rand Water in the form of a field guide to assist prospective environmental valuers in Rand Water to understand the methodology of environmental valuation and to guide the valuation process. The benefits transfer approach may be considered by Rand Water to estimate the economic values of the environmental values that cannot be determined owing to method and area or application

limitations. This approach makes use of the values obtained from other environmental valuation studies and transfers these to similar environmental services as a quick and cost-effective approach. This approach is, however, criticised in literature because of its lack of accuracy in that it generalises environmental values over a broad spectrum of site-specific variables (Barbier *et al.*, 2007:35). Its application should therefore be limited as a last resort and only where indications of economic value are sought in the absence of clear environmental values (United Nations, European Commission..., 2003:463). Presentation of such values should then also be in a format that highlights the limitations of the benefits transfer approach.

Table 6.1 Summary of valuation method feasibility assessment results

| Valuation group | Valuation method | Targeted values | Feasibility notes |
|-----------------------------|------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Market based methods | Production function approach | Consumptive use, Non-consumptive use | Excludability inhibits harvesting from RW open space |
| | Restoration cost method | Consumptive use, Non-consumptive use, indirect use | Found to be suitable |
| | Replacement cost method | Consumptive use, Non-consumptive use, indirect use | Found to be suitable but application limited to ecohydrological functions |
| | Damage cost avoided method | Consumptive use, Non-consumptive use, indirect use | Found to be suitable but application limited to ecohydrological functions |
| | Defensive expenditure method | Consumptive use, Non-consumptive use, indirect use | Found to be suitable |
| Revealed preference methods | TCM | Consumptive use, Non-consumptive use | Excludability limits number of open space users and data required. |
| | HPM | Consumptive use, Non-consumptive use, indirect use | Excludability limits influence of RW open space on private property value |
| Stated preference methods | CVM | Consumptive use, Non-consumptive use, indirect use, option and existence | Excludability limits open space user interest to state a WTP or WTA for a specific scenario, therefore limited data available. |

6.2 Recommendations for future research and actions

Unless a researcher has a thorough understanding of ERE and the various theories and principles that guide it, he or she should not attempt environmental valuation method development. Environmental valuation is still a developing science under scrutiny from economists, environmentalists and lawyers alike. Environmental scientists should rather observe the development of new methods by the economic sciences and wait for such methods to be validated. They can play a valuable role in collaborating with economists to ensure that all value-adding factors of the environment are considered when attempting to determine total economic value. Existing methods can also be tested by environmentalists to determine whether they are suitable to appropriately value an environmental good and service, especially where such methods are applied in a cost benefit analysis, the results of which could influence the outcome of an EIA process. The economist may not be able to identify all possible impacts a proposed development may have on the environment, while the environmental scientist can provide this kind of perspective. Then again, environmental scientists might not be able to translate this impact into economic terms. Environmental valuation may only receive the recognition its potential deserves once a true multidisciplinary approach to its application is considered.

Unfortunately open space user excludability is a significant handicap to the environmental valuer, as shown in previous chapters. Stated and revealed preference valuation methods require open space user feedback. If potential open space users are not permitted on a site owing to private property rights or stringent security measures, they will not value the environmental goods and services on that property. People only value things that positively affect their welfare and well-being. If the private property provides a view or offers benefits downstream, then it could be valued using stated and revealed preference valuation methods. This research project did not find a solution to this problem. It is believed that it cannot be overcome without overestimating or presenting non-market related values. If the 'economic' value is non-market related, it would be irrelevant and of no use. The free market determines the price a good or service should sell at and the same mechanisms are applied in valuing the environment. This problem highlights the limitations of the methods and the effects of market failure. The failure of current methods does not mean that private and secluded open space and its environmental goods and services have no value. The precautionary principle must always be considered in such cases as our knowledge about the environment and its intrinsic values in supporting life and the economy

are not fully understood. Where environmental valuation fails, environmental science principles must prevail. While the economic benefits of recreation and aesthetics could not be valued regarding Rand Water open space, their intrinsic value to its employees who benefit from them could be significant. This research project did not establish how these open space benefits affect job satisfaction, productivity, or corporate image, whereas these factors can have measurable financial impacts. These are opportunities for further research.

The adaptation of SATAM into an environmental valuation method seems plausible from a preliminary assessment, provided that it is applied to public properties that are not traded, such as public open spaces. A property valuation will not take environmental goods and services present on this property into consideration unless it is prone to affect its likely selling price. There is therefore no point in adding such factors to the valuation if the market does not recognise them by means of their revealed preferences. The SATAM model, however, is applicable to public goods that provide a utility value to the community. This method can be adapted to value the utility value of such property for public accounting purposes. This method could be developed as a collaborative research project between economists, property valuers and environmental scientists.

Open space allocation in urban areas has in most cases used an area-per-population standard. Recent findings by the World Conservation Union found that current conservation targets are insufficient to protect the number of threatened ecosystems globally (GDACE, 2005; Göteborg European Council, 2001). While environmental sciences have developed progressively, efforts are still undermined by ill-informed and outdated planning practice. It has therefore become necessary for a percentage of sustainable representation per vulnerable bioregion to be determined to ensure its planned survival into perpetuity. This calls for further research that will challenge the urban open space allocation of area-per-population standard and that will present an appropriate model to find a balance between social and ecological open space. This model will consider the minimum viability levels for species habitats to be self-sustainable and will make recommendations. It is believed that an open space allocation protocol is needed for each bioregion as the ecological processes and species habitat requirements vary from region to region. Such research could nonetheless develop a standard protocol which can be applied over a wide spectrum of bioregions, as long as the variables are identified.

Feedback from respondents highlights the need for methods to be refined for them to be more accurate, but at the same time to be more effective in determining a variety of values. A fair amount of research is currently focusing on method refinement and it is the view of the researcher that this will continue until the problems of cost, time, accuracy and validity are addressed (see figure 2.6). Computer-aided environmental valuation may be the beginning of such a solution, provided it is supported by well-researched value variables and parameters.

Further research into the value of carbon sequestration, biodiversity, health benefits, productivity and energy savings could further diversify the recognised economic value portfolio of the environment. The value of carbon sequestration is directly linked firstly to the value of carbon in carbon trading markets and secondly whether international protocols will recognise carbon sequestration by greening projects as recipients of tradable CERs. The Kyoto Protocol will be replaced in 2012, during which any new agreements could indicate the way forward for valuing carbon sequestration. Biodiversity offers many opportunities for ecotourism, commercial horticulture, pharmaceuticals, and for sustaining environmental goods and services. A literature review did not reveal any specific attempt to obtain the economic benefits of biodiversity, which highlights the need for further research. Open spaces provide recreation opportunities which lead to active lifestyles, act as 'air-conditioners', could contribute to stress relief and to good mental health. All these factors contribute to national health savings. Some research has been done in this field but not enough to become prominent in environmental valuation studies (see Naidoo, 2003:7). Research has established that vegetation can cool buildings during transpiration which reduces the need for air-conditioning. Further research could be conducted into the effectiveness of this, how it can be better employed in building designs and what the economic value of the effective utilisation of this natural process could be.

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Annexure A

Assessment of research articles to determine frequency of application to open space and to determine research focus: contingent valuation method

| No. | Research Article Authors | Application to Open Space (Yes or No) | Research Focus |
|-----|---------------------------------------------------------|---------------------------------------|---------------------|
| 1 | Diamond & Hausman (1994) | No | Method assessment |
| 2 | Hanemann (1984) | No | Method assessment |
| 3 | Hanemann (1994) | No | Environmental value |
| 4 | Hanemann, Loomis & Kanninen (1991) | Yes | Environmental value |
| 5 | Portney (1994) | No | Method assessment |
| 6 | Carson, Mitchell, Hanemann, Kopp, Presser & Ruud (1992) | No | Environmental value |
| 7 | Adamowicz, Boxall, Williams & Louviere (1998) | No | Method assessment |
| 8 | Carson, Flores, Martin & Wright (1996) | No | Method assessment |
| 9 | Hanemann (1989) | No | Method assessment |
| 10 | Cameron & James (1987) | No | Method assessment |
| 11 | McFadden (1994) | No | Method assessment |
| 12 | Carson, Flores & Meade (2001) | No | Method assessment |
| 13 | Cummings & Taylor (1999) | No | Method assessment |
| 14 | Creel, Loomis & Park (1991) | No | Method assessment |
| 15 | Loomis, Paula, Strange, Fausch & Covich (2000) | Yes | Environmental value |
| 16 | Cameron (1992) | No | Method assessment |
| 17 | Cooper (1993) | No | Method assessment |
| 18 | Kristrom (1997) | No | Method assessment |
| 19 | Alberini, Kanninen & Carson (1997) | No | Method assessment |
| 20 | Welsh & Poe (1998) | No | Method assessment |

Annexure B

Assessment of research articles to determine frequency of application to open space and to determine research focus: travel cost method

| No. | Research Article Authors | Application to Open Space (Yes or No) | Research Focus |
|-----|----------------------------------------------|---------------------------------------|---------------------|
| 1 | Randall (1998) | No | Method assessment |
| 2 | Brown & Mendelsohn (1984) | No | Method assessment |
| 3 | Bowes & Loomis (1980) | No | Method assessment |
| 4 | Fix & Loomis (1997) | Yes | Environmental value |
| 5 | Ribaudo & Epp (1984) | Yes | Environmental value |
| 6 | Loomis, Yorizane & Larson (2000) | No | Method assessment |
| 7 | Bishop & Heberlein (1979) | No | Method assessment |
| 8 | Chen, Hong, Liu, Zhang, Hou & Raymond (2004) | Yes | Environmental value |
| 9 | Farber (1988) | Yes | Environmental value |
| 10 | Desvousges, Smith & McGivney (1983) | No | Method assessment |
| 11 | Dobbs (1993) | No | Method assessment |
| 12 | McConnell & Strand (1981) | No | Environmental value |
| 13 | Smith & Kopp (1980) | No | Method assessment |
| 14 | Loomis & Ward (1986) | No | Environmental value |
| 15 | Kling (1997) | No | Method assessment |
| 16 | Clarke (1998) | No | Method assessment |
| 17 | Strong (1983) | No | Method assessment |
| 18 | Common, Bull & Stoeckl (1999) | No | Method assessment |
| 19 | Menkhaus & Lober (1996) | No | Environmental value |
| 20 | Loomis (1986) | No | Environmental value |

Annexure C

Assessment of research articles to determine frequency of application to open space and to determine research focus: hedonic pricing method

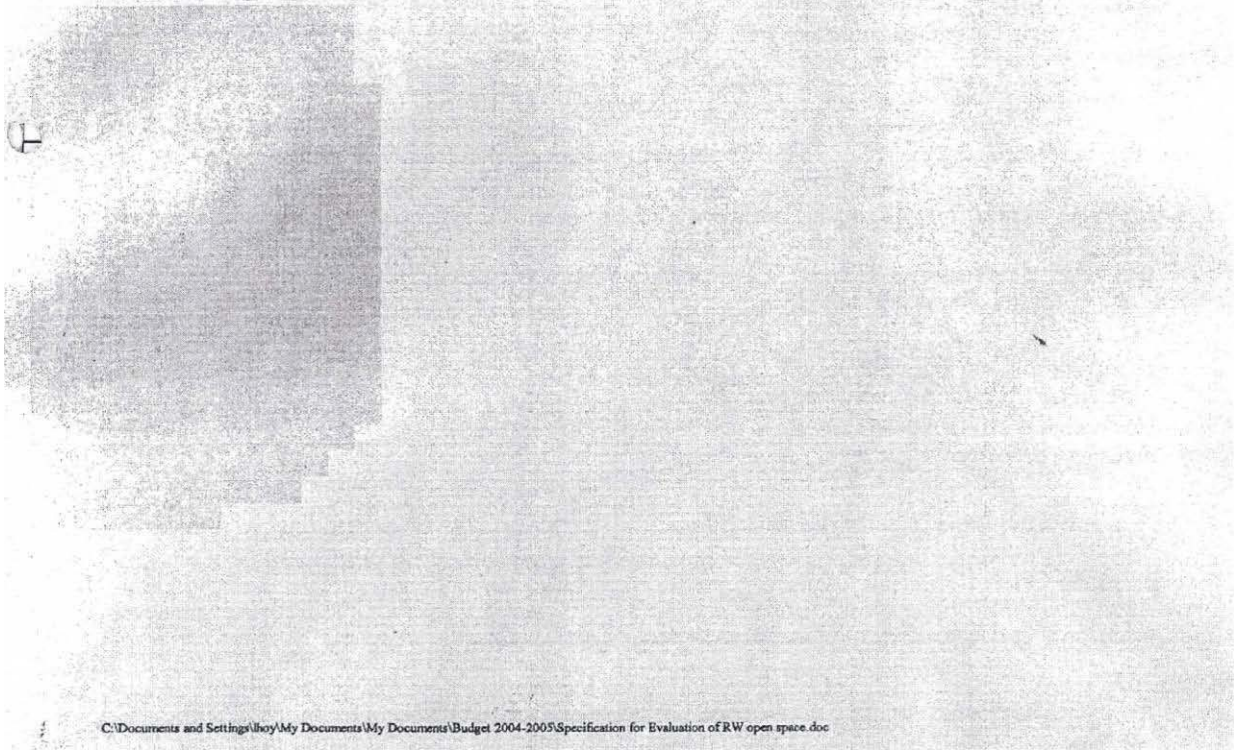
| No. | Research Article Authors | Application to Open Space (Yes or No) | Research Focus |
|-----|-----------------------------------------------|---------------------------------------|-----------------------------------------|
| 1 | Tyrväinen (1997) | Yes | Environmental value |
| 2 | Ready, Berger & Blomquist (1997) | No | Method & Environmental |
| 3 | Kask & Maani (1992) | No | Method assessment |
| 4 | Malpezzi (2002) | No | Method assessment |
| 5 | Le Goffe (2000) | No | Environmental value |
| 6 | Pace (1995) | No | Method assessment |
| 7 | Lake, Lovett, Bateman & Day (2000) | No | Method assessment |
| 8 | Brown, Ethridge & Don (1995) | No | Method assessment |
| 9 | Rehdanz (2006) | No | Environmental value |
| 10 | Abdalla & Ready (2005) | No | Environmental value |
| 11 | Greening, McMahon & Sanstad (1997) | No | Other product |
| 12 | Lake, Lovett, Bateman & Day (2000) | No | Environmental value |
| 13 | Milon, Gressel & Mulkey (1984) | No | Method assessment & environmental value |
| 14 | Tomkovick & Dobie (1995) | No | Other product |
| 15 | Chang (1995) | No | Other product |
| 16 | Richards & Jeffrey (1996) | No | Other product |
| 17 | Geoghegan (2002) | Yes | Environmental value |
| 18 | Coelli, Lloyd-Smith, Morrison & Thomas (1991) | No | Environmental value |
| 19 | Andersson (2005) | No | Other product |
| 20 | Monty & Skidmore (2003) | No | Other product |

Annexure D

Rand Water research tender for the valuation of urban open spaces

1

**Undertake Study to Identify an Appropriate
Methodology to Estimate the Value of Rand Water
Urban Space in the South Africa Context.**



Undertake study to Identify an appropriate Methodology to estimate the value of Rand Water urban space in the South Africa context.

1. Aim:

To identify an appropriate methodology to estimate the value (preferably in financial terms) of urban open space in South Africa, with **particular reference to the possibilities, and method of application for Rand Water.**

2. Background:

Rand Water has many different types of open space. These open spaces are often not appreciated for what they are, the role they play in society, the role they play in the Rand Water work environment and the benefit to current and **future generations of Rand Water staff and Rand Water properties.**

Rand Water is also a large owner of land (about 2000 hectares) mainly in Gauteng which must be managed correctly using the most appropriate technology and information. This situation is true to many areas within South Africa, including Rand Water's direct customers (municipalities) who are tasked to deliver services, including greening activities. Unfortunately they do not always have access to appropriate supporting documentation.

A basic review of literature indicates that there is a good support to justify the value of Urban Open Space. This could be used to the advantage of RW and the environment.

"Evaluation and appraisal provide the primary method of quality control in leisure services. They reveal discrepancies, which once corrected, can result in better services to the public. As a planning tool, evaluation enhances the likelihood of making accurate decisions regarding continuation, expansion, or limitation of services." (Bannon, 1976.)

3. Methodology:

The methodology identified/developed must **be developed for Rand Water properties**, and must also be able to be applied across boundaries, to municipalities, nature areas within any urban situation.

The method itself must establish a baseline through a literature review and visits to different organizations and then through analysis of information find the solutions (detailed more in heading Proposed Outcomes) that can be applied practically in the field at Rand Water.

4. General Information:

The **study must produce practical results** that can be implemented by Rand Water Estates for in-house or for other customer service use.

Where appropriate role players such as SALL, LIA, TIA, IERM etc as well as other industry players (Gov Depts, Eskom etc) should be consulted.

The system must incorporate all necessary and applicable South African and international environmental aspects.

5. Results for Rand Water specifically:

Best practice.

Improve economics reporting of Urban Open Space.

Uniformity of determining values of spaces throughout Rand Water.

Improve long-term viability of sites.

Assist Rand Water Estates to add value to Rand Water.
Allow Estates to assist external customers with this information and approach.

6. Proposed Outcomes:

The **measurable outputs of this project** will need to consist of the development of a series of tools and/or methods for urban open space planning with specific focus to Rand Water. This research project is to be comprised of two distinct components. These two components are an open space site survey phase and an urban open space valuation model where the data is integrated and is expressed in monetary terms. The following outcomes must be achieved by the selected learning institution with this research:

6.1 A range of survey instruments will be needed to be developed to evaluate the Rand Water urban open space resources in terms of:

- a) Phytosociological aspects. (Plant/People-social)
- b) Determine user profile from the community to be served.

These instruments will allow for the categorization of urban open space within a valuation framework. These survey instruments or methods for gathering data in this study may need to include amongst others the following: artifact analysis, content analysis, critical incident method analysis, documentary analysis and field study.

6.2 A Rand Water urban open space valuation model.

The model would need to use several criteria; not just financial but also measure "profits", quantitative as well as qualitative. In short **to measure the cost effectiveness and benefits of the Rand Water urban open space in terms of the impact it has on the localized and broader environment**. It is envisaged that a methodology for value determination will be developed by compiling *inter alia* instruments to measure:

- Influence on Rand Water property values
- Added value of heating, shading, erosion prevention, screening, noise reduction etc
- Added value of O₂, absorption of environmentally unfriendly elements etc.
- Carbon sequestration (information to be obtained from second separate study, but results included in this)
- Cost benefits of green infrastructure on Rand Water urban open spaces as their properties supplement engineered infrastructure (treatment works, offices, pump stations etc)
- Methods of determining value of artifacts and historical "ruins",
- Savings in the health costs of a community,
- Saving in power consumption,
- Value of medicinal plants on sites (especially the RV nature area),
- Positive influence of urban open spaces on social behavior e.g. family, recreation, team sport, anti-crime
- physical value of all plants including those planted and those in natural areas.

The study will exclude the following

- Influence on property taxes as a result of its impact on property value,
- Spending patterns directly influenced by the use of urban open spaces,
- Direct contribution towards eco-tourism,
- Economical benefits of open spaces used as community food gardens or where urban forest produce is harvested

- secondary industries of small, medium and micro-enterprises dependant on urban open spaces and their contribution to GDP

7. Possible additional outcomes:

It is proposed that **possible additional outcomes** could be achieved for the project but this will be dependent on cost estimates.

The institution once completed the study must within the scope of the project and work with Rand Water IT section to produce a computer model that can be used to input and calculate all gathered data from any said project and produce a financial answer relevant to that RW site/park area.

The computer model will need to be

- windows compatible
- agreed to by the Rand Water internal IT Department
- loadable onto more than one computer.

8. To undertake this work, it is required that the learning institution "contractor" be required to:

- a) Be familiar with the broad horticultural industry and industry standards.
- b) Be familiar with processes used to determine unit costs of urban space or have access to this information.
- c) Spend sufficient time understanding Rand Water's processes and sites, as well as consulting with the industry.

The contractor will be required to produce initial results by August 2005 with the final product delivered by no later than April 2007. Final results produced before this would be an advantage to Rand Water and ensure a good working relationship.

9. THRIP/Parallel Funding:

The possibility of **THRIP funding or other parallel funding must be clearly stated** as this will assist in project adjudication.

10. Contractual compliance.

The student/s undertaking the study will be required to enter into a contract together with RW and the learning institution (due to thrip/parralel funding) to ensure that information gathered is NOT used for private gain but for the sole purpose of the joint agreement of RW and the learning institution.

11. Payment:

Due to the fact that THRIP/Parallel funding may be possible or anticipated, payment of funds may be undertaken up front. Financial statements of the project will need to be available for scrutiny and should form part of the greater learning institutions audit process.

12. Quoting for work:

Learning Institutions are required to quote for the work, with submissions by no later than 09 March 2005 at 12h00.

Undertake study to identify an appropriate Methodology to estimate the value of Rand Water urban space , with references to the South African context.

C:\Documents and Settings\lhooy\My Documents\My Documents\Budget 2004-2005\Specification for Evaluation of RW open space.doc

QUOTE :

| Item | Cost to RW Excluding Thrip/ Parallel funding. | V.A.T | Total |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------|----------|
| Undertake desktop literature study, investigations as well as visitations to identified organisations to establish what is currently in place and what is the current gap for Rand Water.(Phase 1) | | | R |
| To undertake various studies and tests to provide formula/methods of determining the value of Rand Water open space in context of the requirement. (Phase2) | | | R |
| To provide information to and work with RW IT section to produce a formula/computer program that will produce the required results. * | | | |
| Rand Water Contingency amount. | | | R |
| TOTAL | | | R |

Note:

*Computer generated model may only be undertaken if available budget allows for this. If sufficient funds are not available, these may be sourced later.

Should Parallel/ Thrip funding not be made available to the institution, that funds will be withdrawn.

Quote valid for 60 days

Name _____ Date _____

Designation: _____

Learning institution : _____

Does the possibility of THRIP/ Parallel funding existing. _____ Yes/No _____

Annexure E

Attendance register for GDACE Environmental resource Economics workshop held from 22-24 March 2006

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|----------------------|----------------------------------|----------------------------------------|
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Annexure F

Attendance register for Rand Water open space valuation focus group meeting held on 22 November 2006

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Annexure G

Attendance register for Rand Water open space valuation focus group meeting held on 14 November 2007

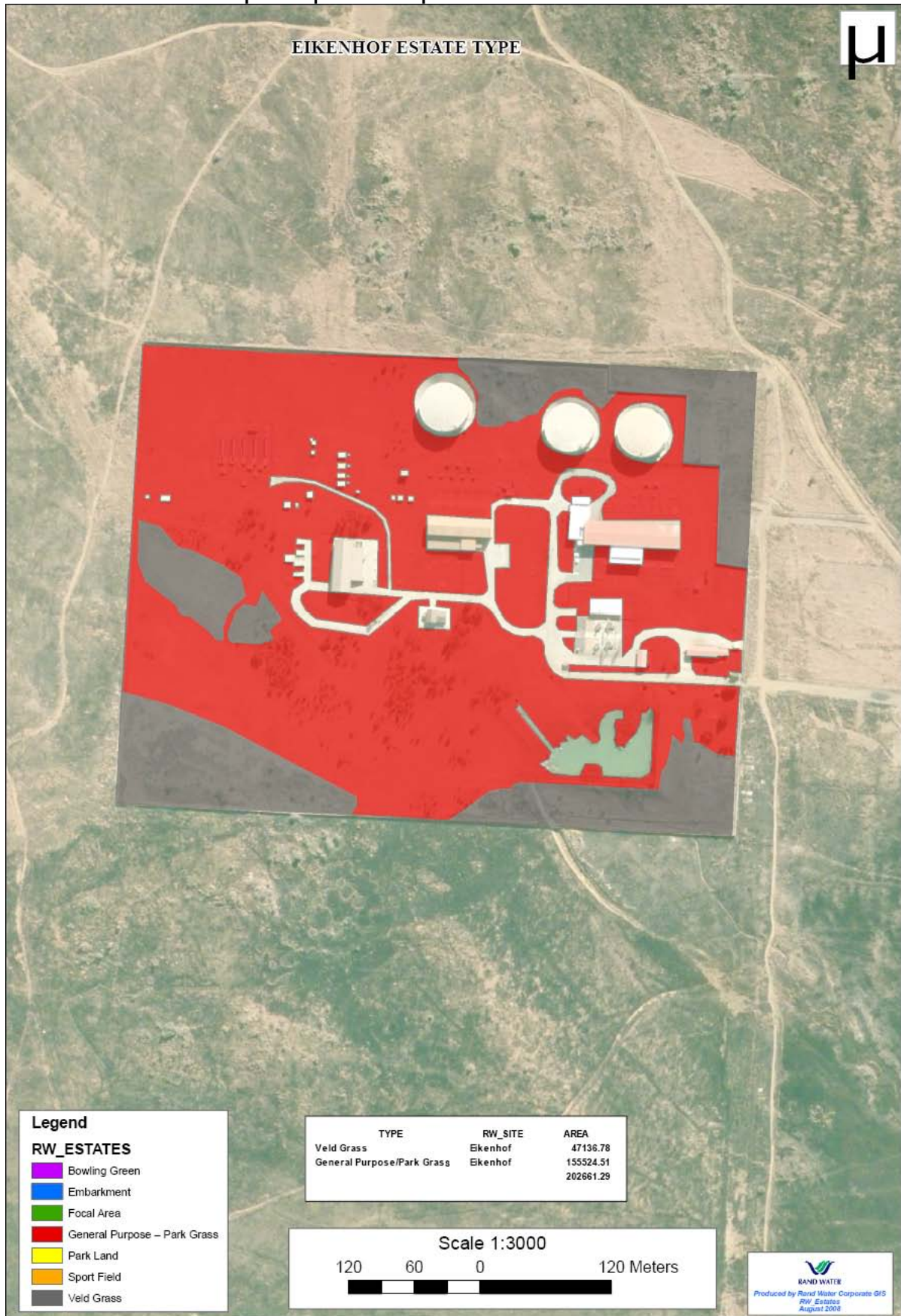
| Name | Organisation | Email |
|--------------|---------------------|-----------------------------|
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Annexure H

Attendance register for Rand Water open space valuation focus group meeting held on 11 July 2008

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Annexure I Open space map for Eikenhof Estate



Annexure J Open space map for Enhlangeni Estate



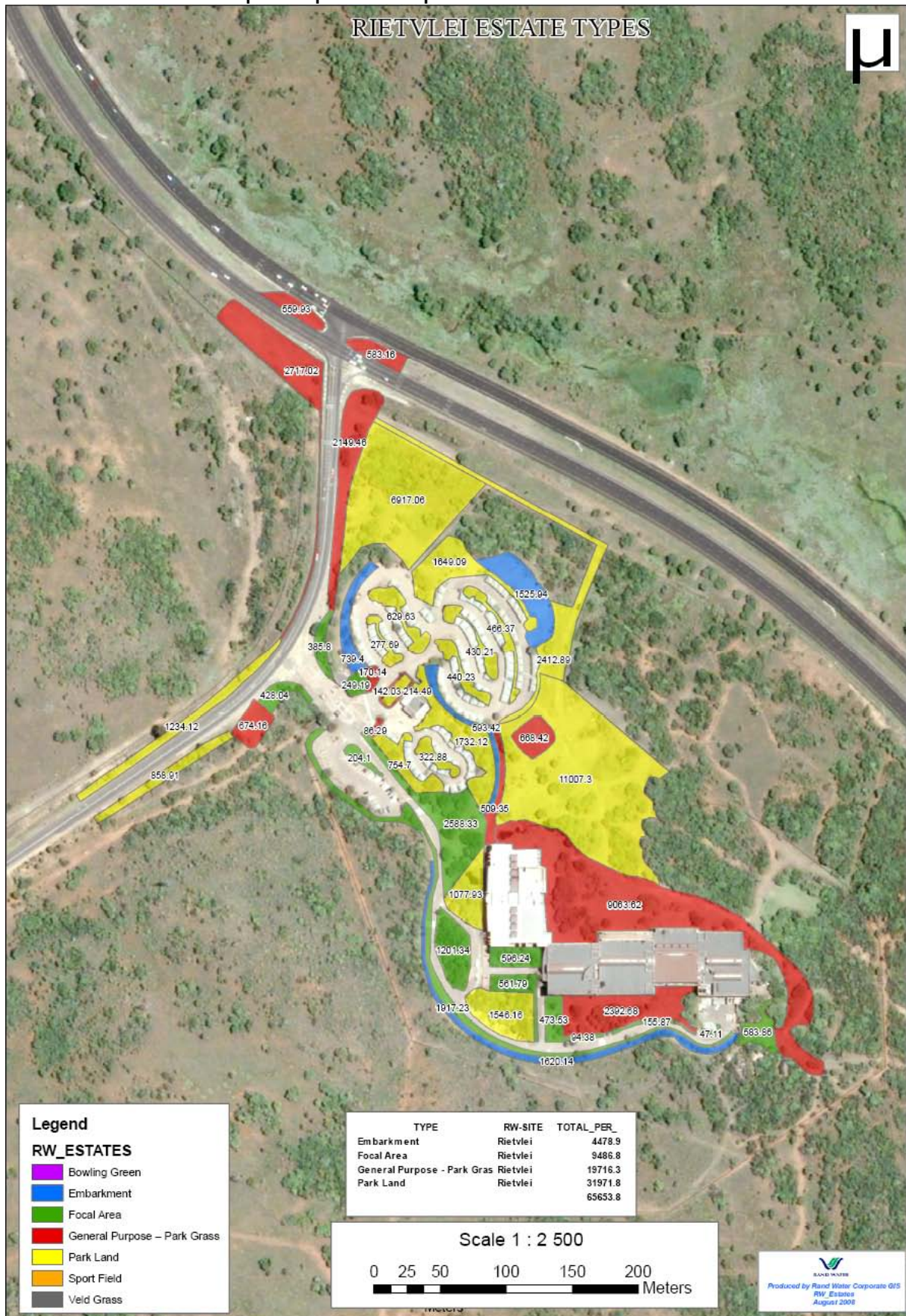
Annexure K Open space map for Mapleton Estate



Annexure L Open space map for Palmiet Estate



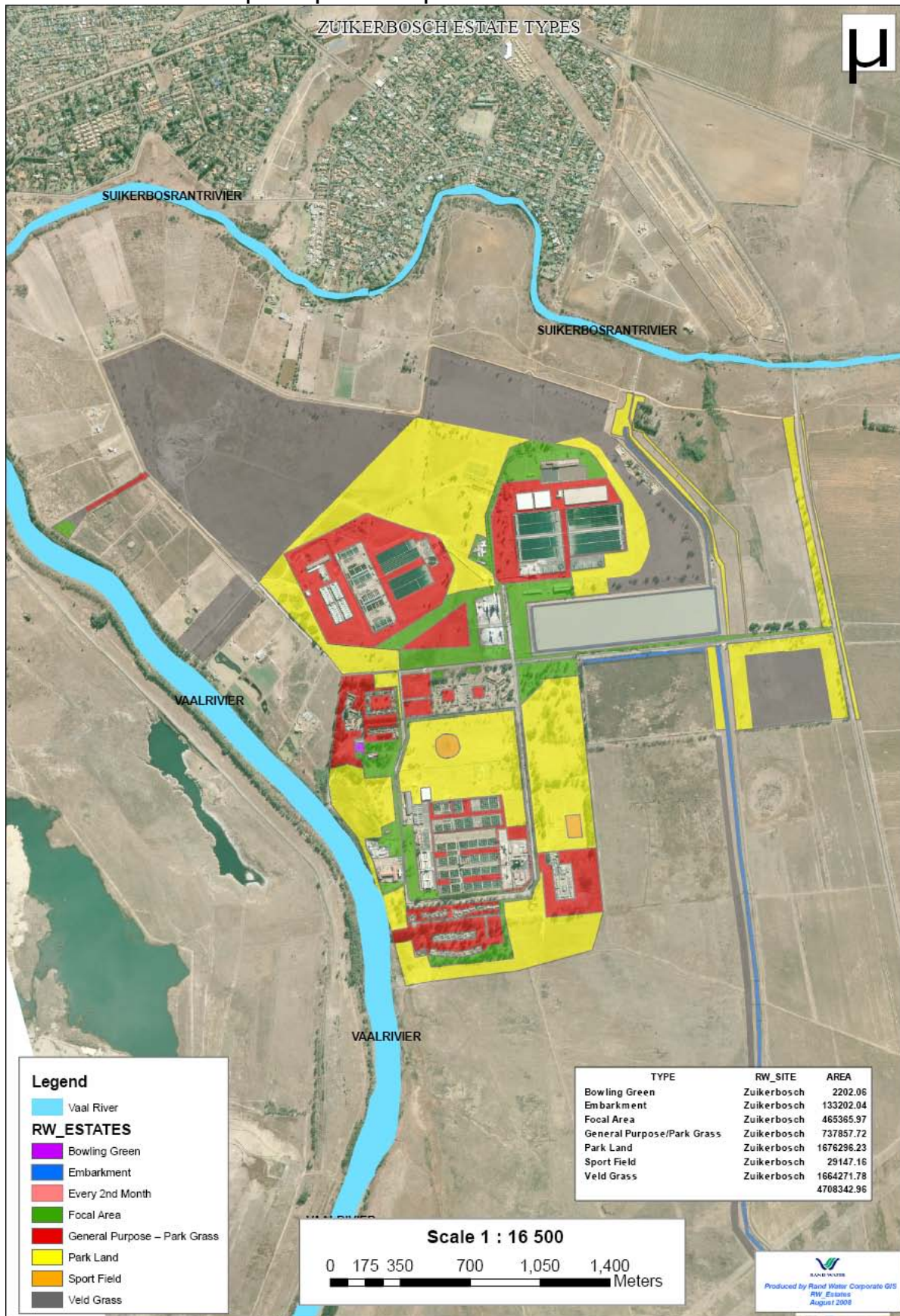
Annexure M Open space map for Rietvlei Estate



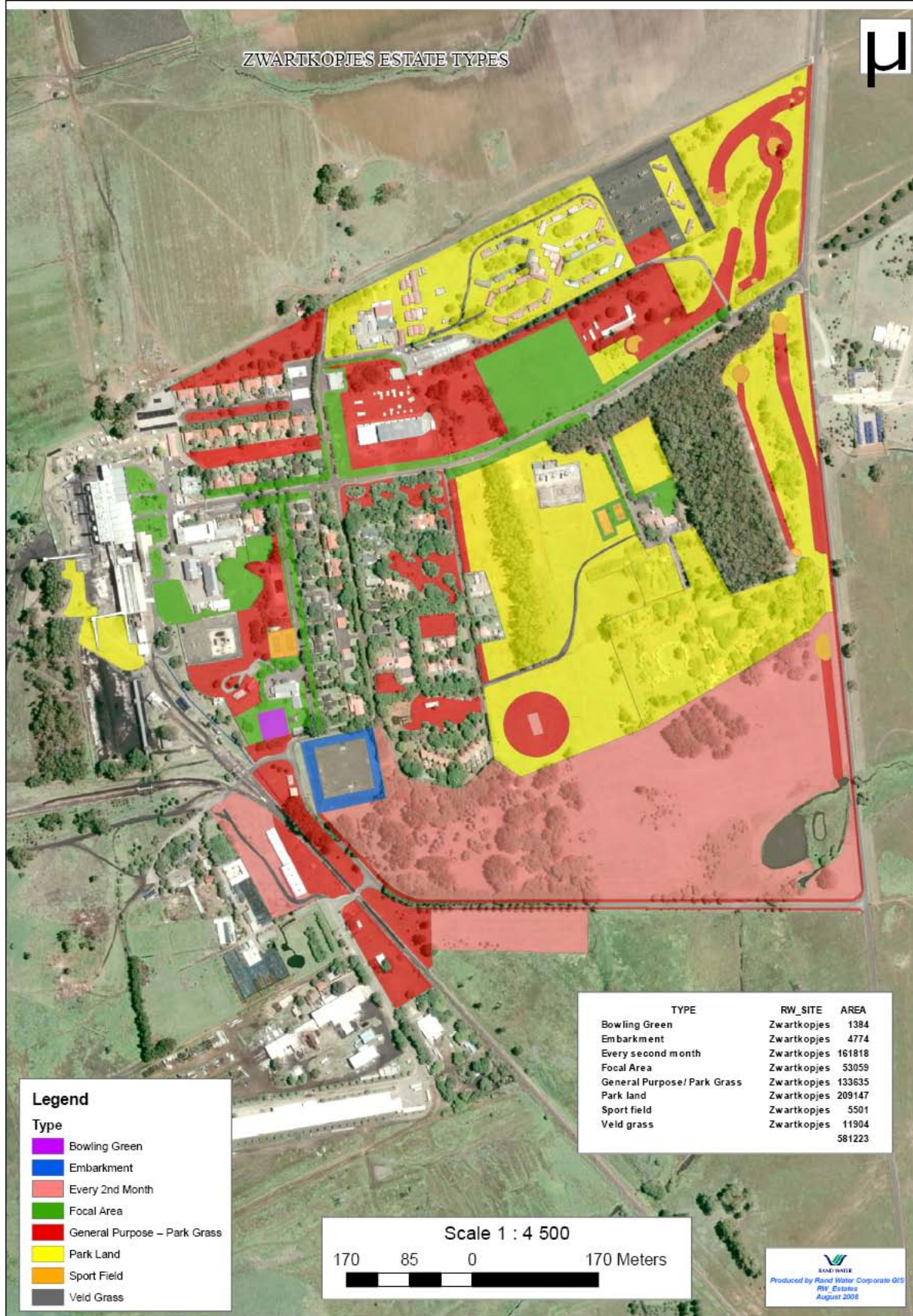
Annexure N Open space map for Vereeniging Estate



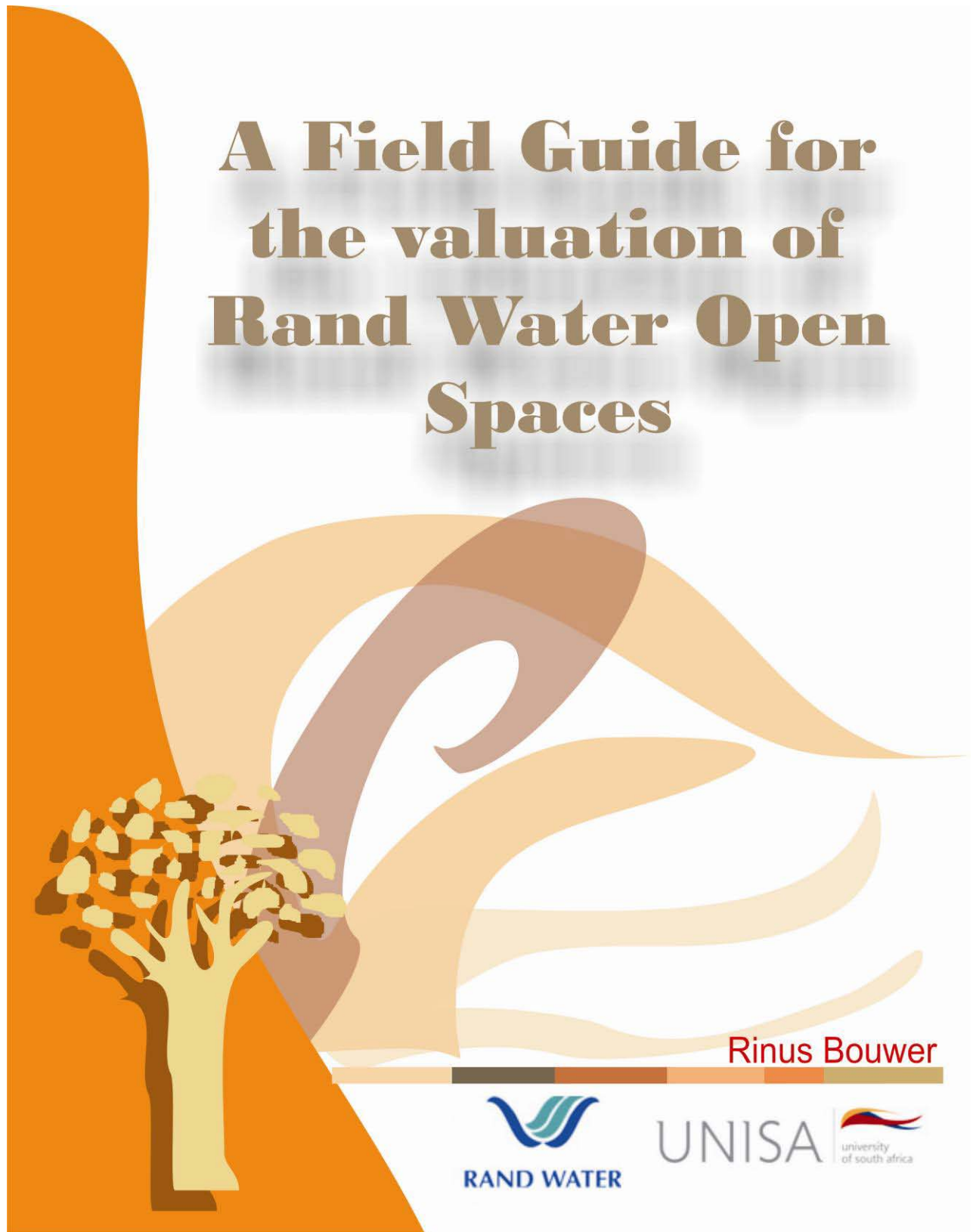
Annexure O Open space map for Zuikerbosch Estate



Annexure P Open space map for Zwartkopjes Estate



A Field Guide for the valuation of Rand Water Open Spaces



Rinus Boucher





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| The Value of Open Space | p5 |
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Value and Method selection flowchart

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Introduction

Rand Water has contracted UNISA to develop a monetary valuation method for its open spaces and its inherent ecological functions. This study began by reviewing existing contemporary definitions for open space in South Africa and then identifies the key characteristics thereof for the purpose of this study. The research project then looked at the economic contribution that open spaces make to the economy as a basis for environmental valuation. By determining the economic value of open spaces decision makers can be informed about the importance of open space provision, preservation and maintenance.

The research project aimed to determine the feasibility of applying environmental valuation methods on Rand Water open space. In order to do this it was necessary to assess the factors or moderators which affected the successful valuation of open spaces in the Rand Water context. These include the limitations of the methods; the limitations of the legal framework; limitations of the valuer; and limitations of the study area.

It was found that the limitations of the methods were a moderator due to their inherent data requirements. The only suitable valuation methods were found to be market based as they were not influenced by the excludability factor. These methods include the Replacement Cost, Damage Cost Avoided, Restoration Cost and Defensive Expenditure valuation methods. The focus group were introduced to each method by participating in a method application exercise. Questionnaires regarding each method were completed to test variables.

The legal framework was found not to be a moderator since even though limited direct provisions exists in legislation to mandate environmental valuation, legal principles exists which require economic impacts to be measured and damages to the environment be estimated. These principles in themselves have supported litigation cases and the mere admission of environmental value estimates in court as evidence and support to a case therefore sets the required legal precedence and mandates further application.

The user was found not to be a moderator. Feedback from the focus group as well as an environmental resource economics workshop held at the Gauteng Department of Agriculture, Conservation and Environment showed that users understood environmental valuation principles, their benefits and limitations. With training environmental scientists can apply these methods.

The study area was found to be a moderator. The limited access for potential open space users, limited harvesting, limited agriculture and limited open space categories results in limited values that can be measured.

It was found that not all environmental valuation methods can be applied on Rand Water open space due to inherent limitations of the methods and the study area. Only market based methods were found to be suitable for use on Rand Water open space. Notwithstanding the limitations of the methods and study area, which limits the ability of valuers to obtain a total economic value for Rand Water open space, the available suite of methods can provide an indicator of value for environmental goods and services that flows from the utility's open spaces. It was concluded that the application of environmental valuation methods on Rand Water open space is feasible within the context of the identified limitations.

The final part of the research project was to develop an environmental valuation field guide that would assist Rand Water employees to determine the value of open spaces and its inherent ecosystem goods and services. This document therefore presents the generally accepted environmental valuation methodology in a practical field guide. It aims to give an overview of environmental valuation theory, the identified values associated with open spaces, and the relevant valuation methods employed to assess these values.

Environmental valuation

Value of open space





The value of open space

Open Spaces exhibit specific beneficial characteristics which make it economically valuable within the urban context. The following characteristics have been identified by the author through literature reviews and personal experience as either influencing various markets or making contributions to the economy:

Influence on property values

Properties in close proximity to open spaces of good state and reputation can have a premium over similar properties that are not in close proximity to such open space (Van Zyl, Leiman, Jansen, 2004:10-13). People desire to have a view over a golf course, beach, or have access to a well kept park. This desire to benefit from such environmental services increases the demand for these properties, which naturally results in an escalation in the value of such properties. A possible negative aspect of this market trend is that such properties become exclusive, which only benefit wealthier families.

Poorly maintained open spaces can also adversely affect surrounding property values (Turpie, *et al.*, 2001:65). Similarly crime associated with open spaces, especially in the South African context can also negatively impact on property values.

Frederick Law Olmstead, Jr. famous landscape architect responsible for the design of Central Park in New York stated:

"...it has been established that a well-located school and play ground, or even a site for the same, ...adds to the value of all the remaining land in the territory to be served by the school more than the value of all the remaining land in the residential area which it serves than the value of the land withdrawn to create it" (as cited in Weiss, 1987)

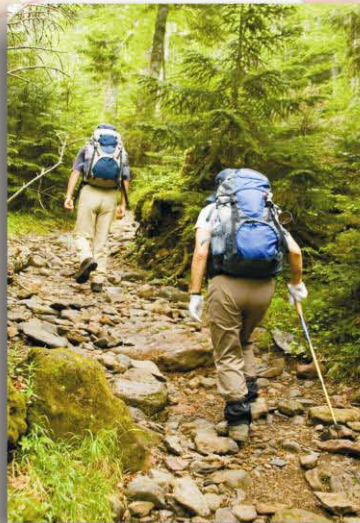
Influence on property taxes as a result of open spaces' impact on property value

Van Zyl (2004:8) postulates that an increase in property values due to its proximity to an open space could have a bearing on the property tax a Municipality charges on such benefiting properties. This suggests that if a Municipality can improve the condition of open spaces in terms of maintenance and safety, it could partially recover such costs from higher property taxes. United States Treasury regulation (Section 14 (h)(3)(l)) recognises that such premium on property value could affect tax liability and makes provision for exemptions where owners have contributed to such open space by means of a land donation or by restricting development on such open space (Fausold, 1999:309).

Van Zyl (2004:31) concludes in his study of the cost and benefits of urban river and wetland rehabilitation projects that unfortunately the current municipal finance system does not realise potential tax revenue obtainable from open spaces. This therefore leaves an opportunity for further research and possible fiscal policy reform that would unlock environmental funding mechanisms.

Spending patterns directly influenced by the use of urban open space

People spend money on travel costs and sometimes accommodation to make use of open spaces (Edginton, *et al.*, 1998:100-101).



Spending on hiking equipment

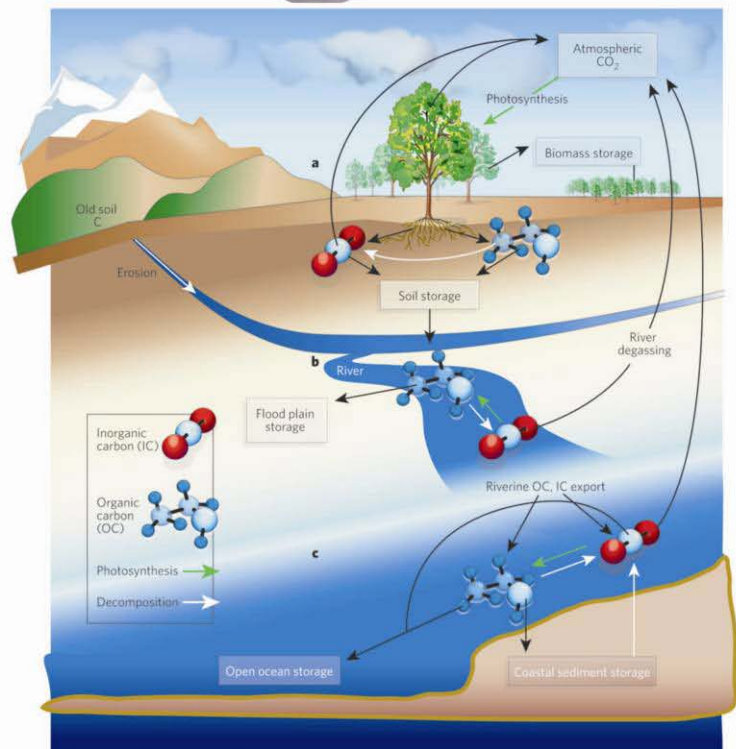
Fishermen purchase fishing gear and angling licences in order to enjoy this recreational activity in open spaces. Hiking shoes and outdoor clothing are needed to enjoy nature trails. In addition, activities such as wildlife and nature photography, mountain biking, 4x4 outings, mountaineering, birding, and skateboarding require specialised equipment. All these purchases generate substantial revenues for manufacturers and it can partially or wholly be attributed to use in open spaces. Harms (1994), as cited by Fausold (1999:316), states that tourism and leisure activities account for 7% of global trade in goods and services, which generates \$195 billion per annum. These figures can be used as proxy to estimate the economic contribution of open spaces to the economy.

Carbon sequestration

According to the BBC news (2008) the Carbon Trading market reached a value of \$64 Billion in 2007. The Kyoto Protocol makes provision for forests with a high carbon sequestering potential to be registered as carbon sinks under its Clean Development Mechanism (Cacho, 2006:1). Once this is approved, the project can sell certified emission reductions (CER's) and thus generate revenue.

A carbon sink project which includes forests and vegetation must ensure that the sequestered carbon stock remains intact. These projects also consist of several hundred hectares to make it economically feasible, considering that it needs to show at great expense that it is reducing carbon emissions and maintaining it (Cacho, 2006:2, Laurance, 2007:20-24).

The Clean Development Mechanism (CDM) has been the catalyst to consider the worth of carbon fixing vegetation. While it is recognised that this mechanism has various weaknesses and may exclude important greening and conservation initiatives, it nonetheless sets the pace for further research and refinement to give recognition and wider inclusion for carbon sequestering conservation projects (Laurance, 2007:20-24). The urgency of climate change is evident and open spaces with its vegetation can be a significant contributor to offset carbon emissions. Once this is properly recognised and included in the net of certified emission reductions, it could form a further basis to value the services of open spaces.



The carbon cycle

www.nature.com/.../n7050/fig_tab/436469a_F1.html

Supplementation of engineered infrastructure

Fausold (1999:311) argues that the value of environmental services is infinite since human life would not be possible without it. It could be possible to determine damages if these services were discontinued in localised settings or to calculate the cost of public expenditure to construct infrastructure to replace these services (Fausold, 1999:311). These estimated expenses would then serve as a proxy for the value of environmental services.

Barbier, *et al.*, (1997:15) states that wetlands offer the following important environmental services:

- Nutrient retention
- Flood control
- Storm protection
- Groundwater recharge
- External ecosystem support
- Micro-climatic stabilisation
- Shoreline stabilisation, etc.

According to Harris (1992:5-8) trees provide the following environmental services:

- Microclimate enhancement
- Air purification
- Noise reduction
- Erosion Control

All these services are essential as it supplements urban infrastructure and can on this basis be valued.



Trees play an important role in climate amelioration



Open spaces assist in flood control



Kirstenbosch botanical gardens attract numerous tourists



Namaqualand is an important South African ecotourism site



Open space encourages active lifestyles

Direct contribution towards ecotourism

According to the International Ecotourism Society (TIES), tourism accounted for up to 10% of the global Gross Domestic Product (GDP) and sustains 230 million jobs (TIES, 2006:2). In more than 150 countries tourism is one of the top five export earners. (TIES, 2006:2). Ecotourism takes up 10% of these figures (Fausold, 1999:316). Open Spaces such as botanical gardens, conservancies and heritage attractions therefore make significant contributions to the local economy (see figure 1.4). It is possible to calculate these economic contributions and use it as proxy to value such open spaces.

Savings in the health costs of a community

Open spaces encourages participation in active and passive recreation activities by providing opportunities in the form of playing fields, walking trails, cycle tracks, and swimming areas. Naidoo (2003:6) highlights that several diseases that are related to and aggravated by inactivity, such as coronary heart disease; non insulin dependent diabetes; stroke; breast cancer; colon cancer and depression, could be effectively managed by increasing physical activity.

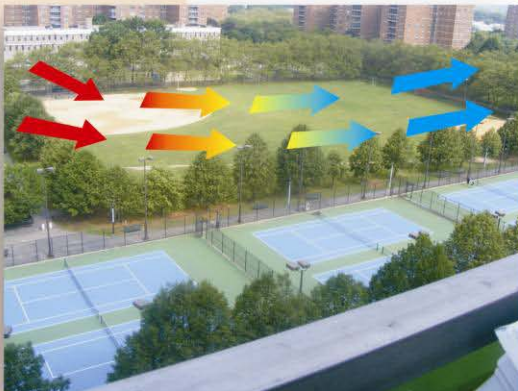
Naidoo (2003:6) highlights that several diseases that are related to and aggravated by inactivity, such as coronary heart disease; non insulin dependent diabetes; stroke; breast cancer; colon cancer and depression, could be effectively managed by increasing physical activity. Naidoo continues to point out that the actual costs to the National Health System of Australia due to these lifestyle diseases amounted to (Australian) \$377 million per annum. The potential savings in health care costs becomes evident when governments invest with a renewed vigour into parks and recreation facilities. It is possible to determine by means of a survey how many people are using open spaces for physical activity and count these as people at reduced risk of lifestyle diseases and also as savings to the national health care system. Such savings can be used as proxy to determine the value of open spaces.



The beauty of the natural environment has a positive influence on human psychological well-being



Central Park in New York performs an important climate amelioration function for the city



Urban vegetation reduces temperatures through evapotranspiration

Influence on the human psychology which affects productivity and in return profitability

Recreation and leisure activities have a positive influence on the human psychology and well-being (Edginton, 1998:10-11). It relieves stress, promotes fitness and leads to satisfaction (Farrel, Lundegren, 1983: 33-36). Naidoo (2003:7) points out that the provision of quality park and recreation as well as physical activity programmes resulted in increased employee productivity, reduced absenteeism, better employee relations, improved health and morale and reduced accidents among 60% of companies surveyed in Canada.

Increased productivity and reduced absenteeism results in improved revenue and reduced costs which, if properly attributed, could place a value on such park and recreation facilities.

Savings in power consumption

Harris (1992:5) points out that a study in New York found that a 30 hectare plot of trees resulted in a 1.3°C lower temperature for the surroundings compared to the rest of the city. Trees reduce the effects of solar radiation by absorbing sunlight and reducing ambient temperatures by transpiration (Harris, 1992:4). Trees also provide shade to buildings during hot summer days and allow sunlight through during winter months in the case of deciduous trees. Vegetation furthermore reduces wind speeds and reduces the wind chill factor (Harris, 1992:5). Heating and cooling cost savings for buildings can be quantified, and where relevant, be attributed to open spaces and trees.



Open spaces provides opportunities for urban agriculture



Urban food security can be achieved through cultivation on un-used open spaces



Valuable crops can be marketed and generate revenue for poor communities

Economical benefits of open spaces used as community food gardens or where urban forest produce is harvested

Community food gardens is now considered an international phenomenon as communities can produce their own food while it also serves as a leisure and recreational opportunity (Ferris, Norman, Sempik, 2001:506). With the global increase in oil prices the price of food has also increased. The production of food is dependent on fossil fuel driven cultivation machinery, while food also needs to be transported to various urban centres. It is therefore foreseen that the trend of localised food production in open spaces and commonages will increase as an alternative and sustainable means for food security (see Section II. (6)(h), WSSD: Johannesburg Plan of Implementation, 2002).

Localised food production ensures a lower input cost and therefore affordability. This method of urban agriculture is also carbon neutral as it depends very little on fossil fuel to produce and transport. Open spaces can therefore be valued for its contribution to food security and energy savings.





Water located in open spaces is an important recreation resource



Recreation from a young age promotes responsible social behaviour



Achievement in recreation activities enhances a person's self worth

Positive influence of urban open spaces on social behaviour

Open spaces that offer leisure and recreation opportunities can have a positive effect on a community's social behaviour. Edginton *et al.* (1998:10) point out that participation in leisure and recreation can aid personal development, social bonding, physical development, sense of achievement and self worth, problem solving, spiritual development and mental health. These benefits therefore discourage anti-social behaviour such as crime, vandalism, substance abuse (Ferris *et al.*, 2001:564). The mere provision of an open space may not in itself address anti-social problems, but will require the development of recreation programmes and therapeutic recreation interventions to optimise use of open spaces (Edginton *et al.*, 1998:87;89-90).

The cost of crime, vandalism and other forms of anti-social behaviour has a negative impact on a local economy. The efficiency of recreation programmes as part of the open space service can be measured based on social behaviour changes and its economic benefits can be determined.



Recreation supports physical development



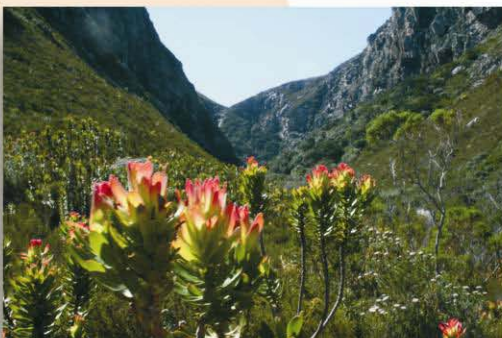
Icecream vendor benefitting from beach visitors



Students at Cambridge University operating punting boats for extra income



Biodiversity sustains ecosystem functions



Open spaces provides opportunities for habitat preservation

Secondary industries or small, medium and micro enterprises dependant on urban open spaces

Business can be reliant on open spaces in several ways. The ice-cream vendor in the park selling to parents and children use this place of social gathering as a marketing opportunity. Artists often gather in parks where they sell paintings, indigenous crafts, or merely perform live music to collect donations. More formal enterprises include tourist operators and adventure sport companies that may rent boats, offer abseiling, or hiking excursions. Other enterprises may even profit from the produce of open spaces such as entrepreneurial food gardens, small scale fishing, fire wood collection, and collection of berries, mushrooms, truffles, and nuts (Ferris *et al.*, 2001:563)(see figure 1.6).

All these enterprises are dependent on open spaces to ensure a livelihood. The economic contribution of open spaces to these enterprises can be valued.

Bio-diversity and habitat status

The National Bio-Diversity Assessment (Driver, *et al.* 2005:xi) shows that thirty four percent of South Africa's 440 ecosystems are threatened. The report states that 5% are critically endangered, 13% are endangered and 16% are vulnerable. Open space offers the opportunity to preserve sensitive environments for the benefit of future generations (Department of Environmental Affairs & Tourism, 2006:248). The preservation of biodiversity ensures that its ecosystem functions and goods are maintained in good order (Driver *et al.*, 2005:2). It is these ecosystem functions which support human survival and which holds the key to scientific discoveries, such as cures for diseases. The economic value of bio-diversity and its support of ecosystem functions are indispensable for sustainable development.

Environmental valuation theory

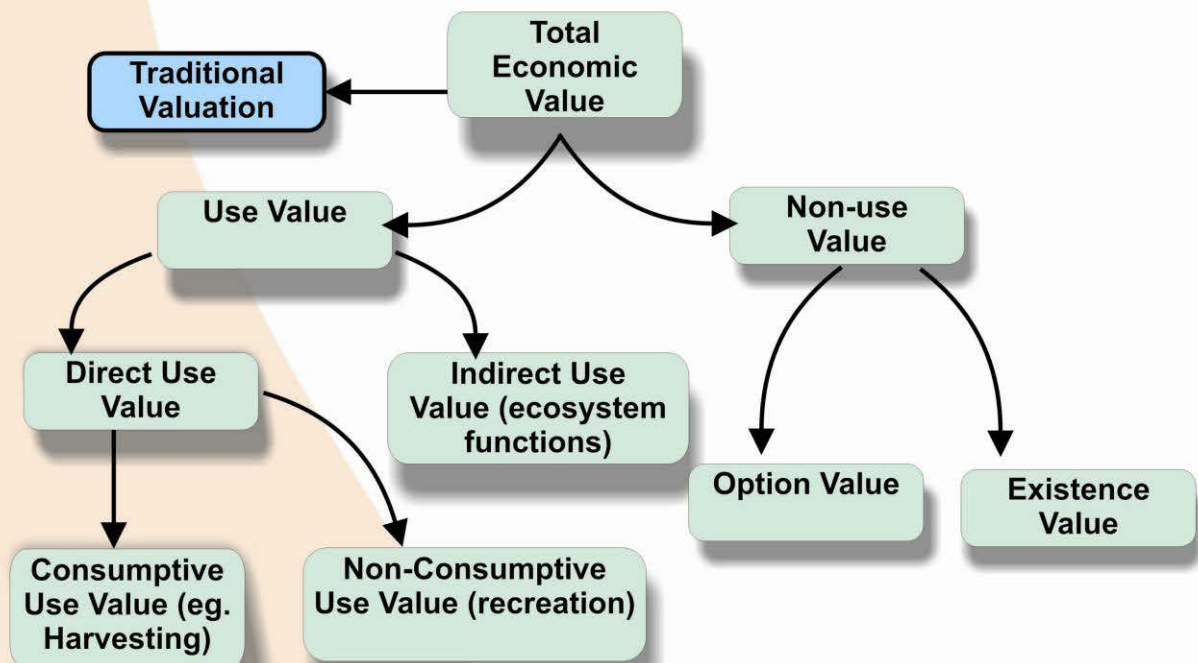
Review and application of available environmental valuation methods

This section provides an introduction to environmental valuation. It aims to highlight the characteristics of each method, the environmental values it is best designed to assess, as well as the most common limitations associated with these methods.

Total economic value

It is necessary to understand the various values that comprise the total economic value of an open space and its ecosystem functions before the methods that value them are discussed. Figure 1 gives a breakdown of the various values associated with open spaces.

Ecosystems and open spaces differ from each other in terms of size, quality and types of ecological services and functions. Not all the various values are applicable to each and every open space or environmental resource. A protected wetland may for instance permit the use of canoes (non-consumptive) but not any harvesting (consumptive). In some cases the value may be of such insignificance that it is not feasible to perform a valuation on it (Turpie, *et al.*, 2001:12). The valuer needs to use his or her own discretion, sometimes aided by various experts, when evaluating an open space to determine which values are relevant (Turpie, *et al.*, 2001:85).



Use values

Consumptive use value

This value is obtained from the economic benefits associated with the direct harvesting of goods from a portion of land, while these goods may not necessarily pass through a market system (Lindenmayer & Burgman, 2005:9; Markandya, 2005:20). This may include a wide variety of goods such as building material, food, flowers and medicinal plants (Turpie *et al.*, 2001:12). This value is not constant as it is affected by the market value of the harvested goods and the ability of the open space to supply the goods in a sustainable stream. This method is mostly applied to renewable resources or biotic populations that can regenerate, such as fauna and flora. Goods such as minerals are non-renewable and harvesting them is not a desirable or sustainable practice in open spaces. They are therefore excluded for the purpose of this study. Harvesting of minerals in open spaces is in most cases an illegal activity prohibited by municipal by-laws. The value of mineral stock in an open space would only be considered during a cost benefit analysis where mining is considered as an alternative use.

If the sustainability threshold is exceeded, then the volume of goods and flow of services supplied declines and consequently so does their value (Perman *et al.*, 2003:18). It is therefore important to ensure that the consumptive use value is not based on volumes that are not sustainably harvested, which would give inflated values at first but would be likely to depreciate over a short space of time. Sustainable harvesting, however, gives realistic values which appreciate in time provided the market demand remains constant (see Yamauchi, Matsumiya & Iwasa, 2007:139-148). The question the valuer should ask is whether the level of current use is affecting future availability. The resource can be used indefinitely if harvest is equal to or less than the natural reproduction rate, and if the ecological systems that support reproduction are preserved (Perman *et al.*, 2003:18).

Consumptive use value is applicable only where goods are legally harvested, such as communal land where harvesting rights are granted. A nature reserve will most often not permit harvesting, and a consumptive use value will not be applicable. The production function method is used to gauge consumptive use value .



Wild berries and mushrooms collected from open spaces

Non-consumptive use value



Kayaking as non-consumptive use



Mountain climbing a form of non-consumptive use of an open space

Non-consumptive use value implies, as the name suggests, that the value is obtained from the use of an open space that does not involve harvesting or collecting any goods (Turpie *et al.*, 2001:12). Activities such as recreational use and tourism add value to an open space as people are willing to spend money to use these recreation opportunities. People spend money on travelling costs to get to these open spaces, food and beverages and sometimes accommodation. If not well managed, non-consumptive use can have a negative impact on the use value. An example is the value of a wilderness area, which lies in the perceived absence of people and the sense of exclusivity, for which people are willing to pay a premium (Perman *et al.*, 2003:127). Such an area would not be a great escape if it were crowded and noisy. Overuse could also directly impact on the quality of the facility through abuse of the amenity infrastructure, trampling of pathways and unmanageable littering. This overuse would result in a depreciation of the open space's non-consumptive use value. This value is also often reflected in nearby property prices and is alternatively referred to as hedonic value or pricing.

Ecotou:

Ecotourism

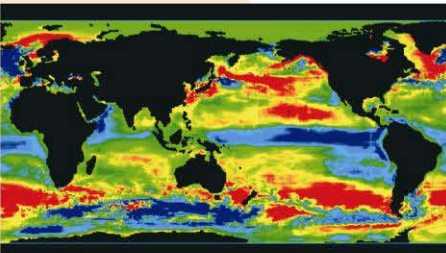
Recreation



Soil formation is an ecosystem function



Pollination is an ecosystem function



Vegetation provides important carbon sequestering functions to counter climate change

Indirect use value

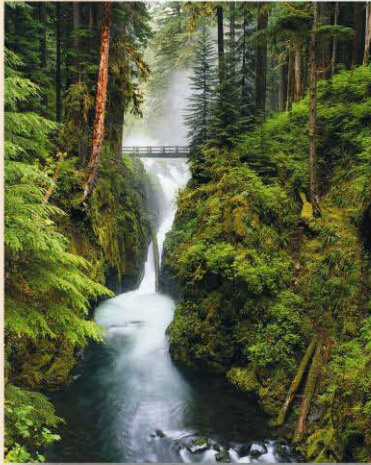
Indirect use value is the economic benefits that urban society obtains from the environmental services that open spaces provide (Turpie *et al.*, 2001). These functions may include the following:

- Water supply and purification
- Sound and nuisance control
- Carbon sequestration
- Pollination
- Climate amelioration
- Flood and erosion control
- Soil and nutrient cycling
- Refuges for biodiversity

The challenge in obtaining a value for these ecological services is that they are communal and free from market influences (Duraiappah, 2006:6-7). There are, however, indirect methods which can be used to determine a value for ecological services. A change in the quality of an environmental service, such as increased air pollution, reduces property values of the affected area, while improvement results in an appreciation of the property values (Van Zyl *et al.*, 2004:16-17; Perman *et al.*, 2003:435). These changes can be measured to value the impact of the change.

The cost of replacing an ecological service with an artificial substitute can also be used as a proxy to infer a value for it. A wetland has water purification and storm water retention properties which can be substituted by engineering infrastructure such as water purification plants and storm water retention systems. The cost of developing infrastructure to treat and manage the same quantity of water as the wetland would serve as the value indicator.

Non-use values: Option and existence values



The beauty of the natural environment is an important existence value for people

Option value refers to the value that people place on reserving the option to use a resource in the future (Turpie *et al.*, 2001:12; Markandya, 2005:20). This is normally expressed as a person's or community's willingness to pay (WTP) to guarantee the availability of the open space for future use (Perman *et al.*, 2003:402). There is also the quasi-option value which is expressed as a person's WTP to avoid the irreversible loss of an open space or ecological service, considering the risk that the advancement of knowledge could in future prove that such loss had been catastrophic and ill-informed (Perman *et al.*, 2003:402). An example would be the relative ignorance 50 years ago concerning the implications of wetland destruction, which led to the loss of a significant number of wetlands (Barbier *et al.*, 1997:4-7). This has resulted in the adoption of the precautionary principle whenever the holistic impact of a particular action is unknown (Lindenmayer & Burgman, 2005:404). This could alternatively be expressed as a person's WTP to avoid unknown risks. With option and quasi-option use value there is no certainty or there is incomplete knowledge about the future conditions of an open space or ecological service (Perman *et al.*, 2003:402).

The comfortable knowledge of the existence of a resource can be referred to as existence value (Perman *et al.*, 2003:402). Contribution to the conservation of far-off places such as rainforests or palaeontologically important sites could be measured to determine this value. This value, however, need not be applicable to far-off resources only, as WTP for the conservation of any resource could be interpreted as existence value. Unlike option and quasi-option value, there is complete certainty with existence value about the future conditions of an open space and ecological services (Perman *et al.*, 2003:402).

A farm portion with unique landscape and biodiversity features in close proximity to urban development can have the option to be developed as a residential township or to be preserved as a protected nature reserve. The value attached to the property will remain an option value until it is formally protected, whereafter it will assume an existence value. Once it is legally protected, alternative options are restricted by legislation.

Valuation methods

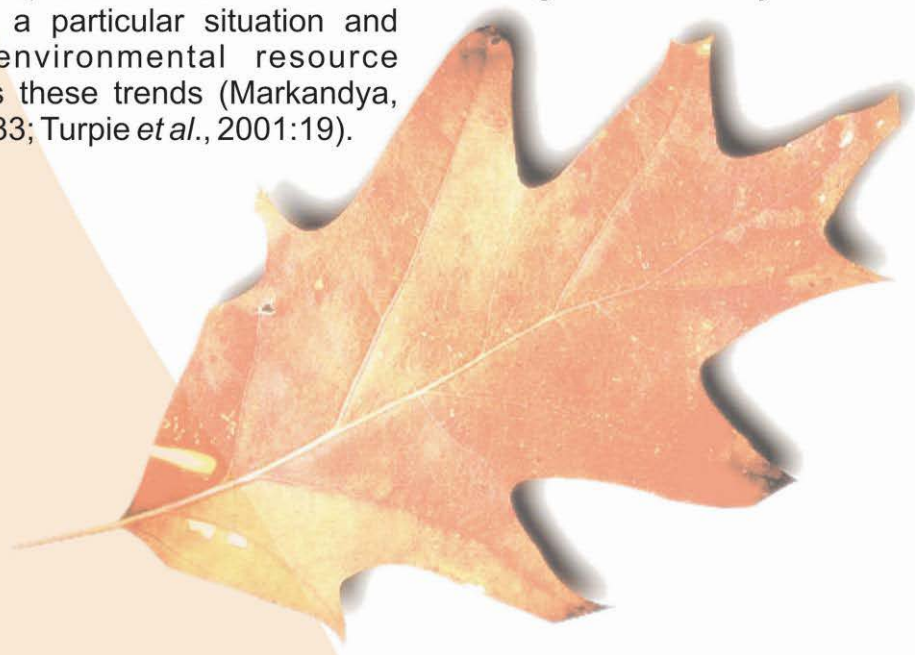
Methods employed in previous studies for the valuation of open spaces and ecosystems are the same methods generally applied to value environmental resources. These methods can be broadly divided into three categories, namely market value approaches, surrogate market approaches and simulated market approaches (Turpie *et al.*, 2001:16).

Market value approaches use market-related pricing of goods and services used to establish a value, for example based on the net value of harvested cut flowers (Turpie *et al.*, 2001:16). The market value approach may apply to use and non-use values. There may, for example, be an option on a particular portion of land to harvest wild flowers and this "option value" can be determined by using a market value approach based on the market value of the wild flowers in question.

Surrogate market approaches, also referred to as revealed preference approaches, examine the economic trends in a particular situation and how an environmental resource influences these trends (Markandya, 2005:24, 33; Turpie *et al.*, 2001:19).

A well-maintained and attractive open space will positively influence property values, which are then translated into a net benefit or premium and ultimately expressed as a value. In contrast, a poorly maintained open space will adversely affect property values and could be seen as a cost to the property market for not maintaining the open space in good order.

Stated preference approaches, also referred to as simulated or constructed market approaches, use surveys or questionnaires to obtain the perceived value or 'willingness to pay' for a service or amenity or to conserve a particular area (Turpie *et al.*, 2001:20; Barbier *et al.*, 1997:Appendix 3). Mean values are then calculated from these surveys and multiplied by the number of affected households to obtain a value. This method is also valuable to test open space user responses to hypothetical scenarios such as the possible sale of parkland or the impact of maintenance standards and crime on usage and ultimately value.



Market value approaches

Market value approaches use market-related pricing of goods and services used to establish a value, for example based on the net value of harvested cut flowers (Turpie *et al.*, 2001:16). It uses prices of goods and services found on the open market and that are similar to the environmental goods and services to determine an economic value for the environmental resource. The following represent the most common market-based valuation methods:

a) Production function approach

This method is used to determine the net annual value of goods and services produced by an open space or ecosystem (Lindenmayer & Burgman, 2005:9; Markandya, 2005:20). It therefore values the consumptive use of open space goods.

The annual use value = $Q \times (P - C)$, where Q is the quantity of goods produced, P is the market price at which the goods are sold, and C is the cost of harvesting, processing, transporting and marketing the goods (Turpie *et al.*, 2001:17). A net present value of the open space is then obtained by converting the annual use value (annual use = $Q \times (P - C)$) into a rand value per hectare (R/ha) (Turpie *et al.*, 2001:17).

Therefore, if the total annual use value of an open space is, say, R350 000 from flower harvesting and the property measures 10 ha, then the net present value would be R35 000 per ha.

This valuation method may not be applied often in the valuation of open spaces since the harvesting of fauna and flora is often prohibited by municipal by-laws, except for fishing in certain locations (Provincial Gazette Extraordinary, 2007:126-127).

The market value approach is also used to value agricultural or forestry land in support of normal property valuation techniques and this is where the method originated (IVSC, 2001:38).

It would be unethical to attach a use value to an open space based on products which have been obtained illegally. It would be the same as saying that the Kruger National Park is worth x based on the street value of its elephant tusks and rhino horns, while it is illegal to trade in these products. Numerous indigenous plant species are under threat owing to unscrupulous harvesting for medicinal use (Department of Environmental Affairs and Tourism, 2006:109). This valuation method could become valuable if the free-for-all situation were changed into a sustainable harvesting programme that is monitored.

Restoration cost and replacement cost method

This method is usually used to value ecosystem functions and departs from the hypothesis that the value of the ecosystem is equal to its replacement cost or restoration cost (Sundberg, 2004:19; Turpie *et al.*, 2001:18). The replacement cost refers to the replacement of ecosystem functions with artificial structures and systems that will replicate the ecosystem function, such as water purification and retention (Sundberg, 2004:19; Turpie *et al.*, 2001:18). However, not all ecosystems can realistically be replaced or replicated by artificial structures and systems, making use of this method rather limited (Sundberg, 2004:20). An approach with the replacement cost method for wetlands would be to obtain engineering costs for the construction of water purification plants per megalitre of treating capacity and to use the total water treatment output of the wetland over a certain period to obtain a value for the ecological function.

Use of the restoration cost method could be based on a hypothetical scenario postulating that the environmental service has been lost or damaged and needs to be restored through rehabilitation practice, which is difficult to calculate (Turpie *et al.*, 2001:18; United Nations, European Commission, International Monetary Fund, Organisation for Economic Cooperation and Development, World Bank, 2003:257). The restoration cost method is sometimes used in lawsuits to determine actual damage caused by illegal activities or negligence, or to determine the negative environmental economic implications of a current production method (King & Mazzotta, 2006:1).



Wetlands provide important water purification and flood water retention functions in the urban environment

The restoration cost method could employ landscape development costs including earthworks, irrigation, soft and hard landscape materials, and design and project management costs as a proxy for the value of developed open spaces. The application of the restoration cost method in valuing natural areas is far more complicated, as the restoration of sensitive environments to their original status, for example fynbos vegetation, wetlands or Bankenveld, is extremely difficult if not impossible at present. A number of species cannot be commercially cultivated and re-established in an area, for example the common sugarbush tree or *Protea caffra*. The restoration cost method would therefore be difficult to apply as the costs of complete restoration are unknown. It could be advisable to use the cost to restore an area as close as possible to its original status so that natural systems can continue with the restoration process. One could then attempt to value the 'benefits lost over time' where there is no alternative to an incomplete restoration. This could include the loss of benefits over time up to the estimated point of complete restoration. Lost benefits could include reduced levels of biodiversity, reduced visitation rates and reduced efficiency in water and air purification. The lost benefits approach would most likely employ methods such as damage cost avoided, and replacement cost methods to form a multi-tier valuation approach with the restoration cost method.

Damage costs avoided

Wetlands play an important role in flood attenuation because of their good water retention capacity (Barbier *et al.*, 1997:3). The absence of wetlands in a catchment system increases the risk of flash floods and resultant flooding of adjacent properties (Barbier *et al.*, 1997:57). It is possible, with the assistance of hydrologists for instance, to delineate the areas along a watercourse that would be affected by floods if no wetland were present. The possible damages, linked to a probability analysis, are then calculated based on the value of affected infrastructure within the demarcated flood zone. This probable damage cost or reparation cost is then assumed to be the measure of value (Turpie *et al.*, 2001:18).

The damage cost avoided method is normally used to argue for the retention of certain ecosystems and their beneficial functions that support human settlements (see Badola & Hussain, 2005).



Some floods can be prevented if ecosystems such as wetlands function properly and are protected in the urban environment

Defensive expenditure method

The defensive expenditure method uses the cost of preventing damage or improving the environment as opposed to the cost of repairing damage or face environmental deterioration as a proxy for value (Turpie *et al.*, 2001:18; Sundberg, 2004:18). The control of alien invaders, for instance on agricultural land, ensures that the land remains productive and economically active. The cost of removing invaders and regular follow-up programmes to minimise regrowth is, for example, compared to the net benefits of a programme such as increased water resource availability and biodiversity preservation. If the programme's economic benefits outweigh the input costs, then it has a positive value. The defensive expenditure method is based on this relationship between expenditures on an item or programme, and positive changes in the quality of the environment (Sundberg, 2004:19). This method is often used in cost benefit analysis (Sundberg, 2004:11). The maintenance of coastal wetlands and estuaries has also proven effective in controlling the force of tidal waves and storms to prevent damage to infrastructure, and this damage avoidance cost is used as a proxy for value (Turpie *et al.*, 2001:18; also see Badola & Hussain, 2005).



Firebreak management is an important form of defensive expenditure to prevent fire damage



Alien invader control is a form of defensive expenditure to prevent loss of water resources and bio-diversity due to weed encroachment.

Surrogate market/revealed preference approaches

These methods depend on information from individual consumption or purchasing behaviour occurring in markets related or similar to the environmental resource under scrutiny (Kontoleon, Macrory & Swanson, 2002:182). These similar markets are also referred to as surrogate markets as they serve as value proxies for environmental goods and services.

Hedonic pricing

Property prices are often positively affected by the presence of green open spaces, lakes and areas with attractive natural scenery (Van Zyl *et al.*, 2004:10-13). The hedonic pricing method (HPM) calculates the value added to private property owing to the presence of an open space and uses this value to determine the total value of an open space. This calculation is based on the estimated increase in property value (often given by estate agents and sales data) owing to the presence of an open space. The estimated increase is then averaged and multiplied by the number of the relevant properties (Van Zyl *et al.*, 2004:16-18; also see Shultz & King, 2001, and Geoghegan, 2002).

As an example, a park positively influences approximately 420 property values by 8%. The mean property value for the area is R1 000 000 per property. A premium of approximately R80 000 per property is calculated and multiplied by 420 properties, which gives a total value of R33 600 000.

This method is difficult to apply in areas where there is a limited market for properties, such as informal housing and other low income areas, or in rural areas where open space is more abundant and less of a value-adding factor.



Views over attractive open spaces can have a positive influence on property value

Stated preference/simulated market approaches: The contingent valuation (CVM) method

This method tests people's WTP for the use or presence of an open space or their willingness to accept (WTA) compensation for the loss of an open space (Markandya, 2005:37; Turpie *et al.*, 2001:20; Perman *et al.*, 2003:420). It is sometimes referred to as a stated preference method, whereas methods such as the TCM and hedonic valuation methods are revealed preference methods (Perman *et al.*, 2003:420). It is called contingent valuation because the valuation is contingent on a hypothetical scenario put to respondents (Perman *et al.*, 2003:420). This is normally determined through interviews and using open-ended questions, referendums, dichotomous choices (yes or no), bidding games, trade-off games, ranking techniques, costless choice options or the priority evaluator technique (Turpie *et al.*, 2001:20). The survey is also dependent on socio-economic data to construct a demand curve for net social values (Perman *et al.*, 2003:424; Turpie *et al.*, 2001:20).

The survey questionnaire should present, by way of a programme or policy, ways to improve or protect an environmental asset from a clearly defined environmental impact. Respondents are then asked about their WTP for such a programme or policy. The payment vehicle is normally presented as some sort of tax payment and the respondent 'votes' either for or against it.

This form of survey is sometimes named a referendum model (Perman *et al.*, 2003:424). The respondent's WTP is tested by offering a choice of amounts that he or she would be willing to pay. The respondent then responds with a yes or no answer (dichotomous choice format). It is also important that the survey make provision for respondents to indicate that where the stated amounts are not within their WTP or where they are objecting to the payment vehicle, their 'no' vote is correctly interpreted (Perman *et al.*, 2003:425).

This method is subject to several biases that make its application controversial and subject to criticism. Some of biases are the following (Perman *et al.*, 2003:424-435; Turpie *et al.*, 2001:20; Markandya, 2005:39; also see Gen, 2004):

- Strategic biases whereby respondents believe they could influence decisions by overestimating or underestimating WTP
- Embedded biases whereby respondents do not give realistic answers in relation to their current financial constraints, budgets and needs
- Interviewer bias, information bias, starting-point bias and hypothetical bias, which can influence the respondent's answers and subsequently the results of the survey

The biases can be largely eliminated if the survey design is done correctly and tested before implementation (Gen, 2004:37).

In a CVM survey, the median is normally used to calculate total WTP as it is less affected by outliers (Perman *et al.*, 2003:425). The total WTP is the median figure multiplied by the size of the relevant population.

The method bases its findings on hypothetical questions instead of observed, actual, behaviour (Perman *et al.*, 2003:420). It is also very costly and time-consuming to execute as it requires several interviewers, detailed and tested site-specific surveys, data enumerators and statisticians (Turpie *et al.*, 2001:20). The method is criticised for having been formulated solely for developed or First World economies, with the assumption of generally well-educated respondents, and its subsequent (perceived) irrelevance in developing or Third World applications (Turpie *et al.*, 2001:20). If the survey is not well designed it can produce insensitivities in terms of price and scope. Price insensitivity relates to WTP which statistically appears not to be influenced by the income levels of respondents, and scope sensitivity relates to statistical insensitivity to differing conservation targets hypothetically presented to respondents (Perman *et al.*, 2003:427, 429).

An example of price insensitivity is where respondents' WTP does not appear to be influenced by their household income, whereas in practice it should be. An example of scope insensitivity is where respondents' WTP does not change where different conservation targets are presented, e.g. 1 000 ha, 2 000 ha or 5 000 ha set aside for conservation, whereas in practice there should be a correlation.

Past experience has shown that respondents generally protest against WTA, as they refuse to accept any compensation for stated loss of a public good, and they would rather pay for its preservation, hence the predominant use of WTP (Perman *et al.*, 2003:429). Socio-economic factors, education levels and moral values differ in developing countries, and these respondents may be more inclined to WTA than WTP. The question may also be asked whether it would be morally and ethically correct for a generation to accept compensation for the loss of an environmental good or service on behalf of future generations that are excluded from that decision and future benefits from the resource.

Respondents may also deny responsibility for conservation and generally vote 'no' for any WTP as they believe it to be a function of the state, for which they are already taxed (Perman *et al.*, 2003:31). They may also feel that environmental problems should be the responsibility of those who caused them, or that those who stand to benefit the most from an environmental improvement should pay for it (Perman *et al.*, 2003:31). The CVM assumes that the respondent has some sort of responsibility towards the environment and therefore asks WTP questions. This may not, however, always be legally and constitutionally enforceable, especially with site-specific problems. The survey design needs to explore these dynamics and this should include briefing the respondent on his or her obligations, if any. It may be that a respondent has no obligation to the problem but would feel morally obliged to make a contribution (Perman *et al.*, 2003:431-432).

CVM offers the benefit of valuing both use and non-use values, while the other instruments available can value only use value. CVM has also been granted admissible by US courts, with the Exxon Valdez oil spill case being particularly well known (Perman *et al.*, 2003:434).



WTA

Willingness to accept

WTP

Willingness to pay

Value and Method Selection Flowchart

The appropriate environmental valuation method or suite of methods is selected once the most important environmental values have been selected. The valuer needs to decide which values are the most significant as it is not always possible to evaluate all values when considering time and budget limitations. An open space may for instance provide the functions of nutrient cycling and soil formation. This function may be important if the open space is used for agriculture where nutrient cycling supports the production of valuable crops, however, in normal open space use this function becomes less significant. The valuer should rather focus on functions which makes the open space important in its context. The valuer should ask what the economic implications would be if such an open space is lost owing to a change in land use. Would there be a loss in bio-diversity, recreation opportunities or would surrounding properties be affected by increased flood waters? Such answers should point the valuer in the right direction. One of the functions of environmental valuation is to measure the effect the environment has on the economy, whether negative or positive. Some environmental functions may be important from an ecological or social perspective but may have little effect on the economy as it has little or no effect on the market. An open space may have a rare field orchid present on it, which is important from an ecological perspective. The presence or absence of such orchid may however have little economic bearing.

If such orchid happens to produce large attractive flowers, such as the *Disa uniflora*, it would be of ecotourism importance. Such orchid, if permitted, could also be harvested for cutflowers and such value can be determined. If it is discovered that such plant holds important pharmaceutical value then it could further have an influence on the economy. A vacant undeveloped open space in the urban context may be a security risk and may therefore have a negative effect on nearby property values. Illegal dumping and invader plant overgrowth may have further negative market influence. Such factors must be taken into consideration when a valuer aims to determine the total economic value of an open space. Not all environmental functions can be valued at present. While urban vegetation may contribute to carbon sequestration, such function hardly qualifies for carbon credits under the current Kyoto protocol. If provisions were however made in the Kyoto protocol to issue carbon credits for such function, it could be valued based on the market value of such carbon credits. A study of literature will however reveal that the issuing of carbon credits to existing vegetation is unlikely due to the additionality criterion and this environmental service may therefore remain discounted.

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For an environmental good or service to be valued it must:

- Influence market behaviour and or;
- Influence asset values and or;
- Protect asset values and or;
- Must have a market value itself and or;
- Be an input in production and or;
- Must have a comparable market proxy

(Author's interpretation)

If the environmental good or service fails to meet these criteria then it would be unlikely for the available environmental valuation methods to value it. The valuer needs to keep this in mind when selecting environmental values that are to be determined to avoid overestimating the ability of existing valuation methods. This may limit environmental valuation exercises to only the most significant environmental goods or services which has a direct influence on human well-being and markets. This factor highlights the limitation of existing environmental valuation methods and also the consideration that environmental values should never be used as the only decision support tool.

Value Identification

This section provides a brief overview of values that may be present in an open space to assist the valuer to use the value and method selection flow chart.

Consumptive use value:

This value refers to environmental goods that are harvested for consumption. The harvesting of wood, medicinal plants, thatch grass, wild flowers, fruit, or the production of food can all be valued based on the market values of such produce.

Non consumptive use value

As the name states, this value includes benefits obtained from an open space which is non-consumptive.

The open space is still used but no harvesting and consumption occurs. This includes recreation activities such as fishing, camping, hiking, cycling, walking, canoeing, picnicking, and playing. It could also include tourism.

Programmes for maintaining ecosystems and biodiversity

This refers to specific maintenance programmes on an open space that serves to protect the integrity of an ecosystem with its goods and services. This may include alien invader control, firebreaks, erosion control, grass cutting, weeding, and irrigation.

It is difficult to estimate what the damage would be of a veld fire as the intensity, likelihood, and distribution are unknown variables. It is also difficult to value biodiversity that may be harmed during a veld fire. Various organizations are willing to spend money to prevent veld fires and this reveals their willingness to pay to preserve the benefits of biodiversity or ecosystem functions. The cost of such firebreak programme can therefore be used as a proxy for the value of the environment that is protected. The same is true of other defensive expenditure programmes.

Flood Control

Wetlands and open spaces in the urban environment prevents flooding and subsequent damages by retaining water and reducing the flow rate of water. If an open space is a recipient of, and discharges water it is likely to regulate water and prevent floods. The expertise of a hydrologist is then required to estimate what the extent of flooding would be if such flood control function is harmed or needs to be replaced.

Soil erosion control

Vegetation performs the important function of mechanically protecting soil from erosion by means of its root systems. This is especially important next to steep embankments where such soil could damage roads and block stormwater drains. Erosion control furthermore sustains soil fertility and therefore future vegetative growth.

Water conservation

Wetlands act as water reservoirs during

dryer periods by holding water water back and slowly releasing it to ensure a constant supply of water. In the absence of a wetland water would run freely out of an area and little ground water recharge occurs. Owing to this mechanism communities and farmers enjoy a constant supply of water. If such wetland is lost it would affect water security and the sustainability of agriculture in the area.

Nuisance control and aesthetics

Dense vegetation can dampen noise, control odours or hide unsightly buildings or activities. This has a positive impact on property values. Aesthetically pleasing open spaces also attract investment as people prefer to stay next to areas with a good view and possibly recreation opportunities.

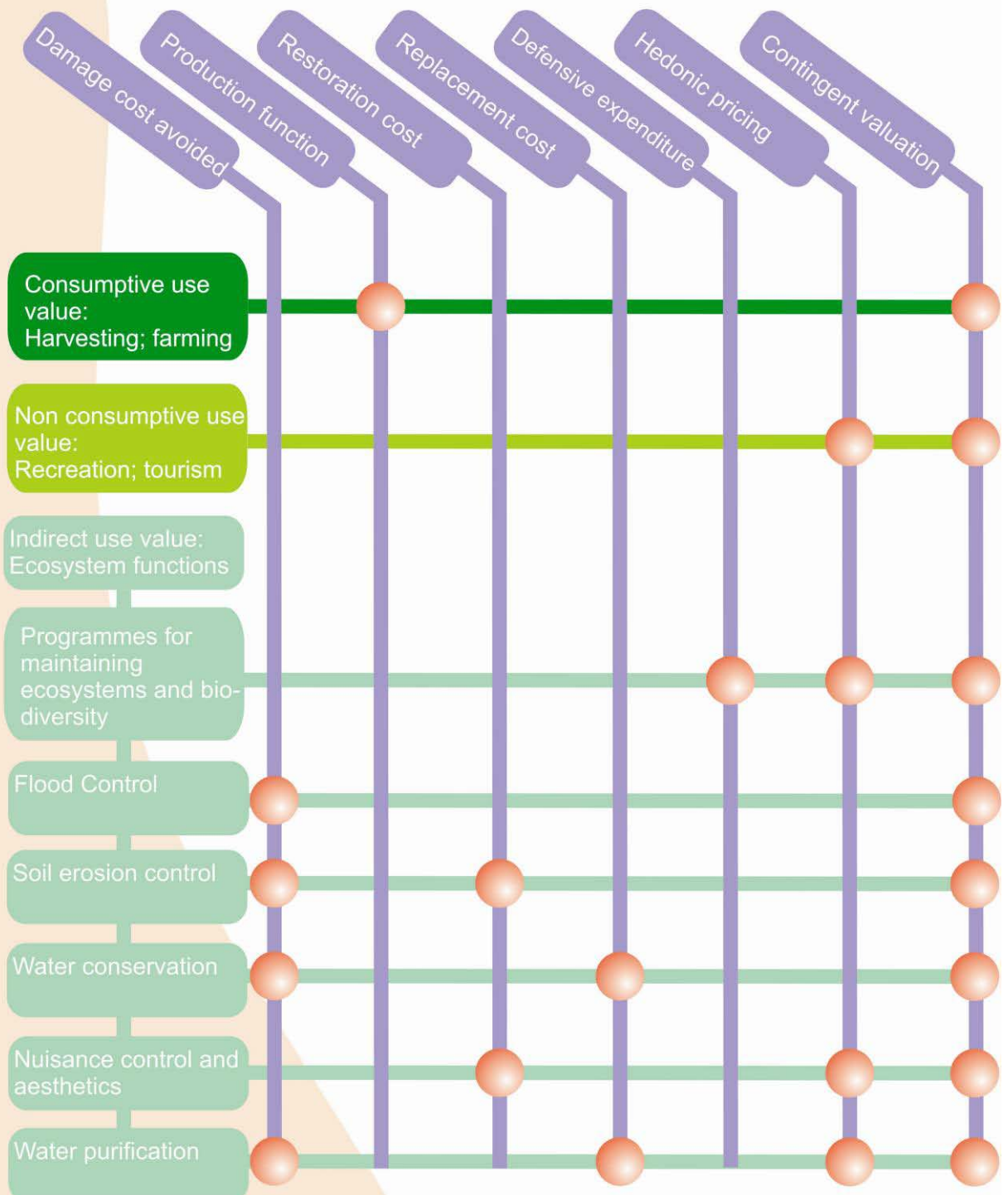
Water purification

Wetlands are known for their ability to purify water. Open spaces that receives runoff water also purifies water as it seeps into the soil and dirt and impurities are trapped by clay and organic particles where micro-organisms can break it down. The extent or effectiveness of such purification can be measured and costed by using artificial systems that does the same filtering, as value proxy.

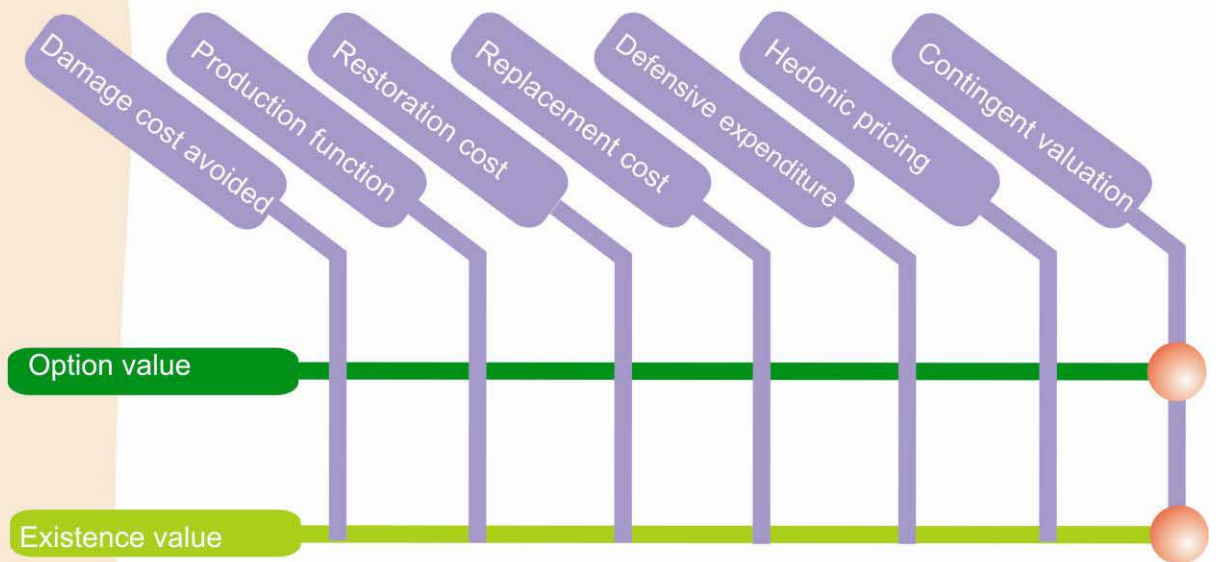
Method selection

Once the relevant values present on an open space have been identified, the valuer can use the value and method selection flow chart on page 31 to identify the relevant valuation method.

Value and method selection flowchart



Value and method selection flowchart continued





Production function approach

The production function approach, as stated earlier in section 2.1.5.1a, simply entails calculating the annual use value = $Q \times (P - C)$, where Q is the quantity of goods produced, P is the market price at which the goods are sold, and C is the cost of harvesting, processing, transporting and marketing the goods. A net present value of the open space is then obtained by converting the annual use value into a rand value per hectare.

This method requires the following data:

- i) The size of the environmental amenity in hectares
- ii) The products harvested
- iii) The quantity of products harvested over time
- iv) The market value or price of the products
- v) The cost of harvesting the products

As an example:

An open space consisting of 100 hectares is used to harvest wild flowers for the cut flower market. A single stem sells for R5.00 at the market. Over the season approximately 200,000 stems are harvested from this open space. The harvesting and marketing costs amounts to R2.00 per stem.

The annual use value is therefore

$200,000 \times (R5.00 - R2.00)$, which equals R600,000. The net present value for the open space per Ha is $R600,000 \div 100\text{Ha}$, which equals R6000 per Ha.

Replacement cost

King and Mazzotta (2006:1) as well as Sundberg (2004:20) propose the following process (adapted):

Before any costing is done, it is necessary to assess the environmental service that is provided in terms of the following:

- i) The types of services provided (i.e. water purification)
- ii) How the services are provided (water treatment through wetland vegetation)
- iii) To whom they are provided (residential area x)
- iv) The measured levels at which the services are provided (2 megalitres per day)

The second step is to identify the least expensive alternative means of providing the identified service or services to the designated area. The third step is to determine the cost of the alternative means of providing the service(s).

Finally it is necessary to determine whether the public would be willing to accept the substitute or replacement service in place of the ecosystem service.

The following validity criteria needs to be considered before commencing with a replacement cost valuation exercise:

A) The human engineered system provides functions that are equivalent in quality and magnitude to the ecosystem service.

B) The human engineered system is the least cost alternative way of replacing the ecosystem service.

C) Individuals in aggregate would in fact be willing to incur these costs if the ecosystem service was no longer available.

(Shabman & Batie, 1978)

In practice it is not always possible to find an exact replacement for an environmental service and it is therefore necessary for the valuer to apply his or her discretion to make assumptions about economies of scale and volume adjustments. In the case of wetland functions the valuer must decide which parameters will be compared for the valuation exercise. Wetlands remove total suspended and total dissolved solids and so does man made water purification plants. This gives a basis for comparison, where the cost of removing these solids from the man made system is used as proxy to value the wetland function.

The following serves as an example of how a replacement cost valuation is done on a wetland using the removal of total suspended solids as value proxy

$$\text{Replacement Cost} = (Wm\ell^D \times 365) \left(\left(\frac{TC^M}{M\ell^D} \right) \left(\frac{WTSS \times 1}{PTSS} \right) \right) ES$$

Where:

$Wm\ell^D$ = Wetland Megaliter of water output per day

TC^M = Plant total treatment cost per megaliter

$M\ell^D$ = Plant megaliter output per day

WTSS = Wetland total suspended solid removal (Mg/ℓ)

PTSS = Plant total suspended solid removal (Mg/ℓ)

ES = Estimated scale of economy expressed in a fraction

The above example uses the cost of total suspended solids removal as the value proxy. The same formula can be adjusted to measure removal of certain chemicals or to value the water storage function of a wetland. The above example only makes use of the cost of the service and not the actual capital costs of the plant. The availability of data will be a significant determinant when choosing the approach in replacement cost valuation.

Restoration Cost Method

The restoration cost method is simply a costing exercise where the cost of restoring and ecosystem or open space is used as proxy for value. This is done with the assumption that an open space is lost due to some disaster and needs to be restored to as near as possible to its original state. This method is valuable in damage cost estimates. These costs may include earth works, soil stabilisation, irrigation, plants, labour costs, professional fees, compost and fertilizer, or civil works.

Damage cost avoided

The initial step of the damage cost avoided method also requires a thorough assessment of the services provided:

- i) The types of services provided (i.e. Storm water protection, erosion control)
- ii) How the services are provided (water retention through wetland vegetation)
- iii) To whom they are provided (residential area x)
- iv) The measured levels at which the services are provided (efficiency at preventing damage)

The second step is to estimate the potential physical damage to property, either annually or over a realistic period if such environmental service is removed. In the case of flood protection provided by wetlands the services of a hydrologist would be needed to estimate the change in water flows during peak water runoff to determine what properties will be at risk of damage.

The final step is to calculate the rand value of potential property damage (King & Mazzotta, 2006:1).



Flood water damage mapping

Defensive expenditure method

This method is simply the costing of existing programmes aimed at sustaining the integrity of an environmental service or avoiding damages. Open spaces may be subject to fires and damages may occur if this risk is not managed. Organisations are therefore willing to spend money to avoid out of control veld fires by preparing fire breaks, cutting grass and removing alien invader plants. These costs reveals the organisation's willingness to pay to avoid damages and also by what amount it values the prevention of veld fires. The same holds true for the maintenance costs of company gardens which reveals how much an organisation values beautiful and attractive parks and gardens. This factor is however dependent on consumer surplus. If it becomes too expensive to maintain these programmes they will be downscaled or discarded.

In this case the company is shown to discount the value of the programme in light of other priorities and as it's consumer surplus is eroded by poor economic conditions.

Programme costs may involve equipment costs, salaries, materials, transports costs, and or facilities. These costs can be found in the budget or financial statements of an organisation and can be reduced to costs per area or hectare by simple calculations which considers frequency of programme interventions and intensity per area.

Hedonic Pricing Method

This method is dependent on sales data of properties in the survey area or, if this is not available, on the input of experienced estate agents or property valuers.

Van Zyl et al. (2004) explain that sales data is used to determine the premium, if any, on property values owing to close proximity to an attractive environmental amenity. Some of the benefits that properties get from this close proximity are easy access to recreational opportunities, scenic views and sometimes serenity. These benefits contribute to property demand and the subsequent rise in values.

The average price of properties located in the area but not directly next to or close to the environmental amenity is calculated using sales data or inputs from estate agents.

The premium (or discount) is then calculated for properties located next to or in close proximity to the environmental amenity by comparing their sales data with the average of the area. Supposing the average for the area is R1 000 000 per property, and the average value of properties that seem to benefit from proximity to the environmental amenity is R1 150 000; then the average premium is 15%.

The influence of the environmental amenity on property value is the total premium multiplied by the total number of properties.

Contingent Valuation Method (CVM)

CVM elicits people's WTP for an environmental programme in a constructed hypothetical scenario. It therefore requires the development of a questionnaire.

The following describes a scenario and presents an example of a CVM questionnaire based on it. This questionnaire must be done face to face with the respondent by trained interviewers.

The Mogale City Local Municipality and private individuals own land towards the west of the Walter Sisulu Botanical Gardens. It has been realised that this land contains unique biodiversity and geological features worthy of conservation. However, the land is under development pressure and these unique features may be lost if no intervention takes place.

This land also forms part of the hunting ground of the Botanical Gardens' resident pair of Black Eagles. The Municipality, in partnership with the South African National Biodiversity Institute, wishes to purchase the remaining portions of land worthy of conservation but is in need of a one-off dedicated tax contribution to make possible the purchasing of land, erection of game fencing and launch of conservation programmes. The purpose of this questionnaire is for you to vote on your willingness to contribute and the amount you wish to contribute. It is important to note that the tax contribution is voluntary and will exclusively be applied for the purposes stated above.

The median total WTP is then calculated and multiplied by the total relevant population. This will present the economic value of the environmental amenity (Perman et al., 2003:425). If the above hypothetical scenario is used and a median willingness of R75 per family is estimated and multiplied by a family population of 150,000 then the environmental value of this area is R11,250,000.

Another example would be where Rand Water wishes to determine the value of its sport and recreation services provided to employees. The following hypothetical scenario is presented to employees:

Rand Water wishes to determine the economic value of its sport and recreation facilities and services provided to employees.

If these facilities and services were not present or available to employees, how much would you be willing to contribute per month to have access to such facilities? See the following options:

A) *I do not wish to contribute*

B) *R50*

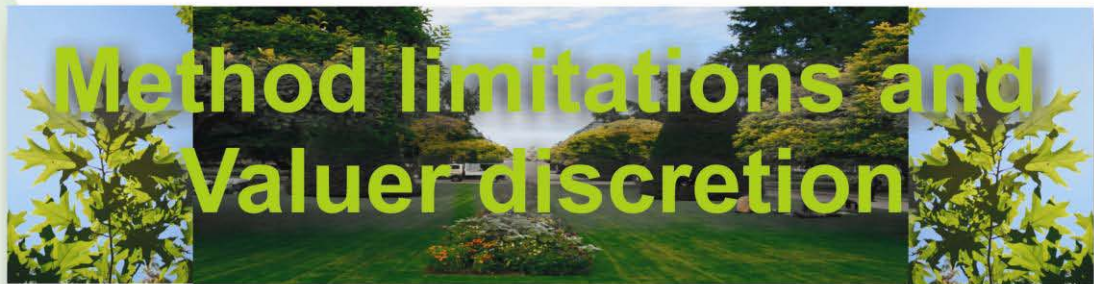
C) *R100*

D) *R150*

E) *Own amount R_____*

If a median monthly payment of R100 is given and there are 300 employees who benefit from these facilities, then a monthly value of R30,000 is calculated or R360,000 per annum.

These questions can be structured and customised to a wide variety of scenarios to value amenities and environmental goods and services. It is up to the valuer to be creative and apply his or her own discretion when formulating a questionnaire.



Method limitations

The following section aims to give the valuer an overview of method limitations in the Rand Water open space context as was found during the research project

Each of the valuation methods has its specific area of application and is somewhat limited in wider applications. Some of the methods are outright unsuitable for application at Rand Water and were eliminated from the start based on consensus reached by the research project team.

The production function approach is less suitable as there are limited opportunities for harvesting natural goods from Rand Water's open spaces. Rand Water's infrastructure is listed as National Key Points with resultant high security and access control levels. This inaccessibility limits harvesting and therefore the feasible application of the production function approach. The presence or not of harvestable goods is irrelevant because of this factor.

Limited accessibility also affects the application of the TCM as well as the CVM, as both methods are applied mostly where there are accessible environmental and recreational services and infrastructure.

Both methods also rely on high open space user numbers to obtain representative interviewees, which is also unlikely in the Rand Water case. CVMs often use taxes as a payment vehicle to determine WTP. Rand Water cannot implement taxes in any form as it is not a statutory revenue collector. Rand Water's recreation facilities are used mainly by its employees who often stay in close proximity to these facilities. This results in insignificant travel costs when applying the TCM.

Replacement cost method

The replacement cost method achieved a mean rated suitability of 67% based on the assessed results. The slightly lower score can be attributed to the complex process of obtaining accurate data to satisfy the requirements of the method. The method was nonetheless rated as suitable as, similar to the damage cost avoided method, it can be of educational value. This method shows the value of water purification, water retention and flood attenuation in wetlands by comparing them to expensive man-made structures that are designed to perform the same function. This again relates to Rand Water's educational programmes designed to instil the importance of water conservation within decision makers and the broader community.

Restoration cost method

A suitability rating of 65% was achieved. Although the method is simple to apply in that it is merely an exercise of project costing to replace what has or may be lost, it might not be applied frequently in Rand Water. This method can be valuable when damage estimates are needed to prepare for litigation. Rand Water can, however, in its interaction with the green industry present the valuation tool to local authorities or conservation bodies that are faced with the challenge of unauthorised environmental degradation to enforce the 'polluter pays principle'.

Defensive expenditure method

A mean suitability rating of 73.5% was calculated. It can therefore be concluded that the defensive expenditure method is regarded as suitable within the Rand Water context. Rand Water's defensive expenditure on alien eradication produces the benefits of biodiversity conservation, water resource preservation and agricultural resource conservation. The expenditure on these programmes can be used as a proxy to value such resources. If these resources were not considered valuable, then Rand Water would not have allocated resources for their conservation. Rand Water therefore reveals the value of these resources by investing in their conservation. The same can be deduced about Rand Water's investment in wetland conservation, urban greening and Water Wise programmes.

Damage cost avoided method

A mean suitability rating of 77% was calculated. This method is commonly applied to wetland and other aquatic systems (see Van Zyl et al., 2004; Barbier et al., 1997:57; Turpie et al., 2001:18). A study of satellite images revealed that Rand Water does not have many wetlands as part of its open space portfolio. The GIS data also primarily revealed area zoning which excluded wetlands and related aquatic systems. It is, however, important to note that water conservation is a key priority for Rand Water considering its investment in various water preservation initiatives such as Working for Water and Water Wise as well as its representation on the Working for Wetlands programme (Rand Water, n.d.). The damage cost avoided method will be a valuable tool to educate various stakeholders about the importance of wetland functions, especially their ability to prevent flood damage by regulating water flow, and by acting as natural water reservoirs in times of drought. This is central to the elected mandate and priority of a utility that is concerned with the sustainable supply of water to a growing population in a water stressed country.

Hedonic pricing method

The HPM only achieved a mean suitability rating of 44%. A review of GIS data showed limited private residential properties that may benefit from its proximity to Rand Water open spaces. There are therefore limited opportunities for surrounding properties to benefit from a view over Rand Water estates.

The presence of industrial-style treatment facilities amidst the open spaces also lessens any perceived aesthetic value that could positively influence property values. The strict access control policies furthermore exclude surrounding property owners from any recreational benefits. These limitations limit the opportunity for Rand Water open spaces to positively influence surrounding private properties. HPM is therefore not considered suitable in the Rand Water context. The method may nonetheless be introduced by Rand Water to municipalities and other stakeholders in urban greening who have public open spaces that are positioned to influence private property values.

Valuer discretion

Environmental valuation is still as developing science where accuracy and methods and even the methodologies are constantly tested and evaluated. There are also so many variations between sites and environmental goods and services that the valuer has to adapt certain valuation methods to meet site and scenario specific requirements. This is especially true for the CVM, damage cost avoided, replacement cost, and defensive expenditure methods. Data availability and data ownership are also important considerations when choosing a method or area of application. It may for instance be too expensive and difficult to measure the removal of certain chemicals by wetlands, and to find a comparative manmade system that does the same. In this case the valuer may have to resort to simpler variables such as total suspended solids removal.

The valuer is encouraged to experiment and to adapt methods to meet specific requirements. Literature has however established certain conditions which need to be satisfied to ensure reliability and validity of results and the valuer needs to be aware of these as stated in previous sections. It should also be noted again that environmental valuation results should be used as a decision making support tool in collaboration with other environmental management instruments and should hardly ever be used as the only reference point when matters concerning the environment is concerned.

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