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Including the economic value of well-functioning urban ecosystems in financial decisions: Evidence from a process in Cape Town

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ABSTRACT

Investing in urban natural assets can leverage relatively high economic value in city economies. It is not only the case for highly developed cities, but could also be the case for rapidly developing cities. This is the key message from a case study for the City of Cape Town in South Africa as presented in this paper. It was calculated that the leverage of municipal expenditure on maintaining and enhancing ecosystems is 1.2–2 times higher than the leverage of all municipal expenditure on the City economy. Investing and maintaining a City's natural assets or ecological infrastructure yields economically valuable services that could prove to be an important driver of value addition in a city's economy. It is conservatively estimated that for the City of Cape Town, natural assets yield a flow of ecosystem services valued in the order of R4 billion per annum, within a range between R2 billion and R6 billion per annum. Most of this value for the City of Cape Town is created through the tourism industry, but recreation in parks, open spaces and beaches, as well as specific industries such as film-making, also benefit substantially from the services provided by well-functioning ecosystems. Buffering services to better cope with natural hazards such as coastal surges, flooding and fires in urban contexts are important services from an insurance perspective. As entities focused on service provision and as enablers of economic growth and development, municipalities in rapidly developing urban centrums have the mandate and must create the opportunity to invest adequately in natural assets to maintain a healthy flow of ecosystem services to the benefit of people living in and visiting their cities.

1. Introduction

Rapid urbanization raises the question of how to provide a continued flow of ecosystem goods and services without negatively affecting underlying stocks of natural capital within the context of increased pressure and density. While most cities import ecosystem goods and services, this is not the only option and this option is increasingly under pressure (Folke et al., 1997). Another option is to maintain and enhance local urban natural capital not only for efficiency, educational and ethical reasons, but also to improve the quality of urban life (Bolund and Hunhammar, 1999).

With an increasing global scarcity of ecosystem goods and services the latter option is becoming more relevant. Especially when a city's socio-economic activities are closely linked to the services provided by its underlying urban natural assets. The City of Cape Town (2455 km^2 in size with 3.7 million people) is one such city. The City of Cape Town is situated in the Cape Floristic Kingdom, a global biodiversity hotspot where natural assets provide a substantial contribution to the regional economy (Turpie et al., 2003).

Earlier economic valuation studies in the City of Cape Town highlighted the economic value of green, open spaces (Turpie et al., 2001); the premium achieved with property in proximity to wetlands (Van Zyl, 2007; Van Zyl and Leiman, 2001); and direct use values from agricultural production in a city wetland (Lannas and Turpie, 2009). Furthermore, Ballance et al. (2000) used the travel cost method to estimate the recreational use value of ten beaches along the Cape Peninsula. These studies highlighted the economic importance of certain natural assets and ecosystem

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services, but have not yet been integrated into an argument aimed at financial decision-makers to invest in the City of Cape Town's urban natural assets. This paper presents the results of a project that was intended to fill this gap, as reported in De Wit et al. (2009).

The key challenge is that information about the value of underlying urban natural assets is not generally included in the financial decision-making processes, leading to weakly informed decisions regarding budget allocations to departments that manage natural assets and the flow of ecosystem goods and services. There are two main reasons for this. The first reason is that it is often implicitly assumed that urban natural assets will continue to provide a healthy flow of goods and services to its inhabitants and visitors and that no specific intervention is required. This is evident through low budgets to urban environmental management. It is a strong assumption to make and one that needs to be questioned within the context of rapid urbanization and a global declining flow of ecosystem services. The second reason is that investments in natural assets are not seen to yield adequate returns, while investment in other infrastructure and services such as housing and education yields visibly higher returns to the urban economy.

In this paper we present an argument for increased investment in urban natural capital. Using a case study of the City of Cape Town, South Africa, we argue that investments in urban natural capital are increasingly needed to repair, maintain and enhance the flow of ecosystems goods and services to people living in and visiting cities. We also argue that investment in urban natural capital, at least for the City of Cape Town, yields higher economic benefits than the overall municipal expenditure in the urban economy. Furthermore, this paper presents the point that results can be significantly enhanced through the use of a participatory process that includes both financial and environmental decision-makers.

We used accepted methods to estimate the economic value of ecosystem goods and services. In the design of the project we recognized the need to move away from technocratic solutions and the importance of including financial and environmental decision-makers in the City of Cape Town in a process of selecting and prioritizing key ecosystem services and key users. A six-step process methodology is presented in this paper, including a participatory process with the aim to identify and prioritize valuable ecosystem goods and services as well as focusing on how to select and use economic valuation techniques. Although the monetary valuation results were important to the project on which this paper is based, their estimation did not require particularly novel techniques and they are not the focus of this paper.

2. Methods

2.1. Six-step process methodology

The integrative and practical focus of the study required a methodology that included both process design and the use of economic valuation techniques. We used a conceptual model of natural assets yielding a flow of ecosystems goods and services (EGS) as applied earlier in the Millennium Ecosystem Assessment (2005). We further developed this conceptual model to include a participatory process with key decision-makers focused on the selection and prioritization of ecosystem goods and services within the context of the City of Cape Town. The methodology was tested and reduced to six generic steps as illustrated in Fig. 1. These steps are very similar to those developed independently in the TEEB process (Hussain et al. 2012), although some important nuances exist. Both the specification of policy and management issues and the need for assessment (TEEB, step 1) as well as the integration of valuation outcomes into business case (TEEB, step 5) were part of the Cape Town study, but are not explicitly stated in the process methodology specified here. The focus was more on the detail in and process followed for the identification and prioritization of EGS (TEEB, step 2); namely what EGS are available, what the users are, how EGS related to development objectives, how EGS can be influenced by management and what the risks are to sustainable flows of EGS. Each of these steps is now introduced in more detail.

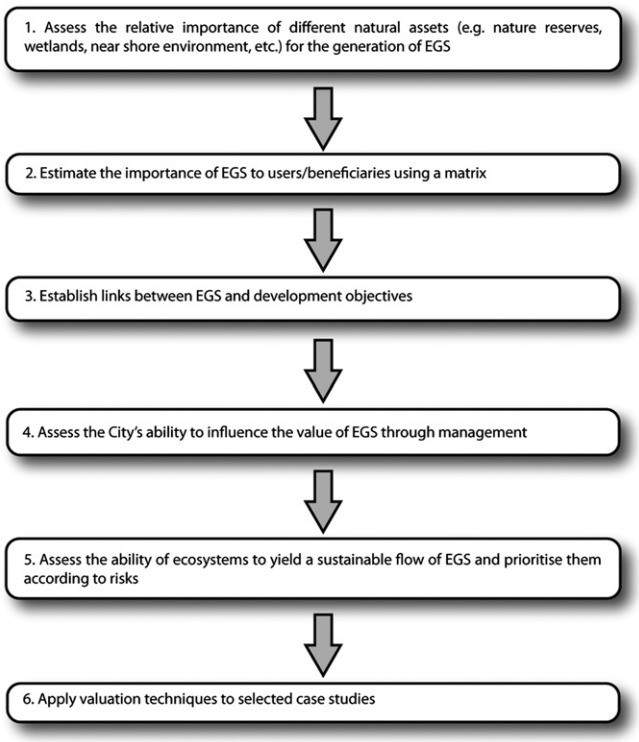

Fig. 1. Six-step valuation methodology.
Source: Own.

First, the natural assets of the City can be divided into different categories that, in turn, yield different flows of EGS. A basic understanding of the relationships between natural assets and EGS flows is needed in order to appreciate which ones are important in the generation of different EGS and to prioritize underlying assets for investment. Table 1 outlines the broad categories of natural assets used to categorize the sources of EGS and may differ per City. The three basic categories are biota (fauna and flora) and soils, the water environment and the atmosphere, and provide the first level of basic categorization. Biota (fauna and flora) and soils are further divided into natural areas and reserves, municipal parks, sports grounds, agricultural lands and vacant land. The water environment category is divided into watercourses, wetlands and dams (aquatic environments), and the near-shore coast (marine environments).

Second, the number of beneficiaries, as well as the estimated value for each of the EGS to these beneficiaries, will determine what the highest ranked values are likely to be. It is, therefore, critical to consider who the users or beneficiaries of EGS in a particular context are, and the relative importance of these EGS to different users. In order to choose appropriate user categories, high-level distinctions were made between local users and regional, national and international users. Among the local users, further distinctions were made, namely residents, key commercial groups and key public bodies (see also Eftec, 2006). The categorization of users and beneficiaries of EGS can be further developed for any local urban context. This step can be particularly useful if distributional aspects are important and the needs and values of certain beneficiary groups require prioritization.

Table 1
Broad categories of natural assets.

Relative importance of natural assets as sources of EGS							
Biota (fauna and flora) and soils					Water environment		Atmosphere
Natural areas & reserves	Municipal parks	Sports grounds	Agricultural lands	Vacant land	Watercourses, wetlands and dams	Near-shore coast	

Third, although awareness is growing with regard to the broad links between natural assets and economic development outcomes, there is a need to better understand and spell out these links when considering the value of natural assets. This is especially relevant when budget allocations are informed by the strategic objectives of a city's development plan, which often have no specific high-level allocation to any specific environmental category. Failure to link investment in natural assets and the flow of EGS to desired developmental outcomes reduce the probability of increased budget allocations for investment in natural capital. Taking cognizance of these outcomes can also increase the chances that more socially equitable outcomes are taken into account in assessment as desired development outcomes generally do or should address the need for social redress.

Fourth, the previous steps in the methodology do not make a distinction between natural assets and EGS flows on the basis of their ownership status or the level of control that the City has over them. This is, however, an important factor as some assets and flows may be almost completely under the control of the City, be shared with other institutions and groups, or fall completely outside of the City's control. The assets and flows completely outside of the City's control may have high value, but will generally be less important when motivating for an increased allocation of financial resources. Ranking or screening EGS according to the City's ability to maintain or expand natural assets and the flow of EGS is thus an important step before devoting further resources to the valuation of EGS or developing a business case.

Fifth, ranking EGS according to the level of ecological and socio-economic risks it faces is an important step before devoting resources to valuation. Certain environments are likely to be more vulnerable to habitat loss and degradation and faces greater ecological risks. These are the environments where thresholds are important and exceeding these thresholds would have particularly onerous consequences in both ecological and socio-economic terms. For example, if a river system experiences effective ecological collapse owing to pollution, species can be lost and health hazards can emerge, followed by associated ecological and socio-economic costs. The natural assets that could be on the brink of disaster and those that are associated with higher risks and potential impacts need to be given priority in assessment.

Sixth, it is only after key EGS have been prioritized using the preceding steps, that further assessments using economic valuation techniques are appropriate. Such valuation studies should focus not only on the benefits of preserving or maintaining natural assets and flows, but also on the reduced costs (or savings) of mitigation flowing from a more pro-active management of a city's natural assets and EGS. For example, if an urban wetland is not properly managed and it loses its functions, the costs of alternative technologies to (partially) substitute such functions can be substantial. It must further be noted that the opportunity cost of losing natural assets and flows may appear incrementally small at first, but will generally increase rapidly with increased scarcity.

2.2. Participatory appraisal with city line function managers and senior staff

A structured questionnaire comprising open-ended questions was compiled and used for interviewing key City of Cape Town line function people in order to understand what they consider to be (a) the functions performed by the City's natural areas, (b) the goods and services yielded, and (c) the beneficiaries of these goods and services. In developing the questions for the interviews, we adopted the conceptual framework of De Groot et al. (2002), which provides a framework for integrated assessment and valuation of ecosystem functions, goods and services. Apart from these three key questions (functions, goods and services, and users) there was also a second set of questions which were intended to more closely establish the beneficiaries or users of the City's natural and semi-natural environments and to describe the threats and uncertainties facing the natural capital base of the City.

In a subsequent workshop, the prioritization of EGS in the City of Cape Town was done in a facilitated setting with invited line function managers and senior staff representing all functions related to the management of ecosystem goods and services. This included those involved in the management of environmental resources, parks, tourism, heritage, sports and recreation, waste-water, storm-water, solid waste and spatial planning. Four focus groups were randomly identified with 4–6 people in each group. Participants were asked to identify, score and briefly motivate what, in their view, the most important linkages are between all identified EGS in the City and:

- beneficiaries,
- the achievement of development objectives,
- the City's environmental mandate and ability to influence, and
- ecological and socio-economic risks.

After a brief introduction, the focus group discussions were limited to 15 min per topic after which focus groups reported back to others. The feedback was summarized for the benefit of the entire group and used as an input to further off-line analysis and ranking.

2.3. Economic valuation techniques

The theory and application of economic valuation techniques have been discussed in detail before and will not be repeated here (Blignaut and Lumby, 2004). From the viewpoint of an urban manager it is more relevant to know how to select an appropriate valuation technique. A sound approach is to first categorize values based on the nature and availability of prices (Blignaut and Lumby, 2004). The following five categories are distinguished: market prices, shadow prices, direct proxies, indirect proxies, or no proxies at all. The options in choosing valuation techniques based on these categories are broadly as follows:

- If efficient market prices are available, change in productivity techniques are preferable.
- If non-distorted (efficient) market prices are not available, surrogate market approaches (such as the travel cost and hedonic pricing methods) are used.
- When market prices are not available but direct (efficient) proxies are, a variety of assumed preference techniques (such as replacement cost, cost of illness, opportunity cost or dose

response methods) or other benefit transfer methods (BMTs) are applicable.
- When indirect proxies are available, revealed preference methods (such as the travel cost and hedonic pricing methods) are appropriate.
- Finally, if no market prices or proxies are available, non-market methods (such as contingent valuation or choice modeling approaches) may be used.

It is often necessary to use a combination of these economic valuation techniques rather than a single one to value environmental benefits. Some techniques lend themselves more readily for use in combination with other techniques. Once a technique is selected based on the availability of data, and the issues of compatibility with other techniques are investigated, a number of failsafe principles need to be applied (Pagiola et al., 2004). For example, a technique may be compatible with other techniques, but if they value the same thing in different ways double counting may occur. Also, while a technique might be easy to apply in practice, the results of certain valuation studies may not be readily transferable to a local context. The given context of a study is important for all valuation studies. It might also be appropriate, in certain instances, to control for income differentials between groups. Otherwise the results could suggest that poorer people value the environment less, which is clearly not an accurate interpretation.

Economic valuation techniques cannot be applied indiscriminately to every situation. Every case has a unique problem statement and the techniques that are used need to be broad enough to fit different types of problem. Some techniques are also more suitable for the valuation of certain goods and services than others. It addition, it was thought important that the City of Cape Town's decision-makers received not only the results of the application of a set of valuation techniques, but also practical experience in and guidance on how to broadly approach the economic valuation of ecosystem goods and services.

Choosing suitable valuation techniques started with the consideration of the importance rankings given to the different EGS categories through the participatory process. Through the use of rankings in particular, this process made it clear where the bulk of EGS values were likely to be found. Based on the nature of the prioritized EGS, appropriate valuation techniques could be chosen. The valuation required a combination of limited primary valuation techniques and benefits transfer estimates based on previous valuation studies. The use of previous studies from the City of Cape Town only, as opposed to other locations, increased confidence levels in the results. Valuation techniques applied and the level of detail possible for each EGS varied. Some services are relatively well understood and best valued on a city-wide scale while others lacked adequate data for average values across the City, but could nevertheless be illustrated using case studies of individual sites. This was a particularly useful tool in attempting to convey important concepts to decision-makers such as the potentially significantly higher costs of inaction in dealing with severely degraded environments. It enriched valuation and allowed for the presentation of both city-wide value averages and instructive individual cases.

3. Results

3.1. Participatory process and valuation techniques chosen

The consultative process was designed to assist in the development of an inventory of goods and services flowing from the natural capital of the City of Cape Town. From the interview process with City line function departments it was reinforced that the challenge is how to present to policy-makers and decision-makers the fact that if natural/semi-natural assets are not maintained the benefits from environmental goods services will decline over time. This decline will have the effect of threatening certain industries in the City and also the social wellbeing of the city's residents. Conversely, if natural assets are maintained and used more effectively, they will continue to perform a wide range of functions and their associated goods and services will continue to flow.

The five services that were ranked by the City of Cape Town's decision-makers during the participatory process as the highest relative importance for valuation are the following:

- Natural hazard regulation: buffering ecosystems (e.g. reefs and kelp can reduce the impact of storms and large waves);
- Recreation and tourism: people often choose sites based on the natural or cultivated characteristics of an area;
- Water purification and waste treatment, assimilation: ecosystems can cause impurities but also help filter out and decompose organic wastes;
- Space for biota: regulation of habitat and space;
- Esthetic values and sense of place: esthetic values are reflected in support for parks, scenic drives and housing locations.

Table 2 outlines which valuation techniques were used for each EGS category including brief points on why they were favored and descriptions of key elements of their application. Given the focus of this article and limited space available, more detail is given for those applications that yielded higher values. In order to ensure comprehensive valuation, a number of techniques were employed including damage costs avoided, preventative expenditures, clean-up costs, travel costs, donor funding proxies, benefits transfer (which drew on studies that used travel costs, hedonic valuation and contingent valuation) and estimates of increased economic activity in key sectors that could be ascribed to natural assets (e.g. the film and advertising industry). With regard to why certain valuation techniques were chosen, it is worth noting that study resource and data limitations played a key role in dictating what was possible. This necessitated a more 'opportunistic' approach grounded in the reality of having to make do with limited resources and data, a situation that familiar to most practitioners particularly in developing country contexts.

3.2. Economic value of ecosystems[1]

The economic valuation estimates in this paper show that the City of Cape Town's natural assets provide important flows of value. These values flow to a wide range of beneficiaries including tourists and residents visiting natural recreational areas such as parks, lakes and beaches; people living in areas prone to flooding, fire and coastal storm surges; as well as entrepreneurs and business owners involved in economic activities such as film-making and advertising. Many other groups were identified, but in consultation with City managers we focused on those who are perceived to be the main beneficiaries. This range of estimates should be treated as conservative given the number of important values that could be quantified in monetary terms. Given the nature of what was required, the valuation exercise focused on generating aggregated values for the City as a whole whilst clearly indicating beneficiary groups. Beyond this, it did not include any specific adjustments to values on the basis of income levels

[1] For a more comprehensive discussion on economic values generated, the interested reader is referred to De Wit et al. (2009).

Table 2
Valuation techniques used.
Source: Based on De Wit et al (2009).

EGS category	Valuation techniques used
Natural hazard regulation	Estimate of the cost of damages avoided to land, homes and infrastructure from natural assets buffering fires, flooding and storm surges.Estimates of the costs associated with additional preventative management measures necessitated by the weakened buffering capacity of ecosystems (i.e. fire protection, flood management and storm surge management).
Recreation and tourism	For tourism value, travel costs supplemented by estimates of the entry fees paid by tourist visiting the most popular natural attractions (e.g. Table Mountain, Cape Point, Boulders Penguin Colony, Silvermine Reserve, Tokai Forest, etc.). Steps used: (1) Estimate the total travel costs (i.e. transport costs) associated with all tourist trips that include the City of Cape Town in their itinerary using tourism authority data.[a] (2) Isolate the relative prominence or weight of the City of Cape Town in the travel decision of tourists including the City in their travel itineraries using the results of existing tourism surveys. (3) Isolate the relative prominence or weight of the City of Cape Town's natural assets in the travel decision of tourists coming to the City using the results of existing tourism surveys which included questions regarding the importance of natural assets in the experience of tourists. (4) Add entry fees paid by tourists to access key natural areas to their travel costs. Budget constraints meant that it was not possible to also survey tourists' willingness to pay for entry to other areas where no entry fees were due. This was not considered a source of significant value under-estimation given the likely magnitude of such values relative to overall transport costs. For recreational value to local residents, benefits transfer from previous valuation studies in the City of Cape Town (Turpie et al. (2001) for green open spaces, Ballance et al. (2000) for popular beaches and Donaldson (2009) for Table Mountain National Park sites) adjusted for population growth and increased travel costs.
Water purification and waste treatment, assimilation	Illustrative examples of the clean-up costs required to restore selected urban wetlands back to proper functioning, thereby avoiding the risk of significantly more costly repairs should ecosystems collapse. It was recognized that this approach does not pretend to generate an overall value for the entire City.
Space for biota/biodiversity value	Foreign donor funding of conservation used as a tentative proxy. View taken that it is very difficult to isolate or compartmentalize biodiversity in valuation making it best to recognize it as a critical umbrella service without which most other EGS would diminish or may even become unavailable.
Esthetic values and sense of place	Qualitative discussion of enhanced health and wellbeing associated with natural assets. Qualitative discussion of the significant contribution of natural assets to the City's brand and an enhanced business environment. Estimate of the proportion of overall expenditure in the film and advertising industry that can be attributed to the contribution of natural assets which play a critical role in providing settings. Sourced total expenditure on film and advertising in Cape Town and surveyed major film and advertising industry role players to elicit a range of estimates for how much natural assets contribute to the package of advantages that draw productions and their associated spending to Cape Town. Property value enhancement estimates based on benefits transfer from Van Zyl et al. (2004) and Standish et al. (2004) both of which investigated the impacts of natural assets on property values in Cape Town.

Note: we considered the use of total tourist expenditure as a proxy for value (as opposed to only transport and entry fee expenditure), but decided against its use as it is a less accurate reflection of willingness to pay and is likely to result in the over-estimation of value.

or other distributional considerations. This does not imply that these are not potentially important for other valuation exercises with different goals.

Table 3 provides the estimates and discusses the individual values that make up the estimated value of natural assets that have been quantified in the City of Cape Town providing examples of selected key calculations used. It shows that tourism and recreation values are responsible for the largest portion of overall values, as one may expect in a city with high levels of nature-based tourism and recreation opportunities. Regulating services such as natural hazard regulation and waste assimilation also feature prominently although accurate value estimates are hampered by limited accurate information on linkages between natural assets and these services. It is clear that the City of Cape Town's natural assets play a leading role in building its brand and attracting skills. Specific industries such as film-making and advertising continue to rely on nature for attracting business to the City and the natural esthetic and lifestyle possibilities are strongly reflected in significant property values premiums.

Based only on the prioritized services that could be confidently quantified, total values associated with the City of Cape Town's natural assets were estimated at between R1.51 billion and R3.9 billion per annum. It was recognized that this range of estimates are conservative given the number of important values that could not be quantified in monetary terms. In addition, most value streams have significant room for improvement. For instance, the availability of areas for the recreational use of natural assets is still severely limited particularly in lower income areas resulting in low values at present. Given the many services not valued in monetary terms and the conservative approach to valuation we have followed, a 30% adjustment to the prioritized values and consequently, a realistic baseline benefit range of between R2 billion to R6 billion per annum was used (Table 4).

The flow of these values needs to be protected and enhanced to create additional value to the economy and employment. Current expenditure on the environment by the municipality is estimated at R370 million per annum on operations and R110 million per annum on capital investments. This falls within a range of 2% to 2.5% of total expenditure. It is estimated that the value leveraged by this expenditure is higher than what is achieved by total municipal expenditure. For every R1 spent by the municipality in 2008/9 approximately R7.30 of value added was generated in the City of Cape Town's economy. For every R1 of expenditure on the environment by the municipality almost R8.30 of ecosystem goods and services were generated when a flow of R4 billion per annum is used. This is a conservative estimate and the ratio can be as high as R13.50 when a flow of R6 billion per annum is used. This means that the leverage of municipal expenditure on the environmental sector is considerably higher, that is between 1.2 and 2 times than that of total municipal expenditure on the City of Cape Town's economy.

4. Discussion

The multi-faceted valuation required for Cape Town presented a number of challenges most of which revolved around resource

Table 3
Estimated economic values per EGS category.
Source: *Based on* De Wit et al. (2009).

Environmental goods and services categories	Estimated value and other indicators of value
Tourism	Natural assets are the City of Cape Town's key offering to attract tourists. Total tourism value associated with natural assets: R965 million to R2.95 billion per annum (R847 million to R2.805 million for travel costs plus R118 million to R145 million for entrance fees)
Recreation	Local recreational values for local green open spaces, Table Mountain National Park sites, Kirstenbosch Botanical Gardens and local beaches: R407 million to R494 million per annum. Significant additional value creation possible when considering the limited availability of areas for recreation (particularly in lower income areas) and current resources for management
Globally important biodiversity	Donor funding of R225 million over seven years has flowed into the region in recognition of the international importance of its biodiversity – it can easily be argued that the City of Cape Town is one of the most important cities in the world from a biodiversity conservation perspective.
Natural hazard regulation	Natural hazards are associated with significant damage and management costs, some of which could be avoided with the optimal management of natural assets as buffers. Combined total values of between R4.6 million and R60.4 million per annum for natural assets in natural hazard regulation for all three natural hazards (i.e. wildfires, floods and storm surges). For example, damage costs from flooding estimated as follows: (1) Used City GIS database to estimate the total number and value of properties within the 1 in 100 year flood line. (2) Estimated potential likely damages to all properties and structures in the event of a 1 in 100 years flood at R545 million (this translates to around R5.45 million per annum spread over 100 years)
Water purification and waste treatment, assimilation	The natural environment needs to be properly managed and maintained in order for the purification and absorption services that flow from it to be optimized and to remain free. For example, among many potential cases, the need to dredge the particularly heavily polluted Zeekoevlei Wetland for R60–R70 million represents the minimum clean-up costs needed for the vlei to function normally (i.e. balance waste assimilation, ecosystem functioning, esthetics and recreation) and avoid collapse.
Esthetic and sense of place related values	Growing empirical evidence shows that natural and green spaces play an important role in improving health and wellbeing in cities. Key leaders in the City of Cape Town recognize that its natural assets give it a strategic advantage and help to attract skilled entrepreneurs and others that drive economic development The City of Cape Town's efforts towards creating a winning brand are strongly linked to its natural assets and have borne fruit in the form of awards that help to attract more opportunities. The City of Cape Town's many and varied natural assets are a key driver of the film and advertising industry. The extensive opportunities are valued at between R133 million and R398 million per annum. The City of Cape Town boasts some of the most sought after property largely because of its natural assets. At a site-specific scale, rehabilitation and restoration projects have created significant values with benefits exceeding costs by a factor of four in some cases

Table 4
Estimated total quantified economic values per EGS category.
Source: *Based on* De Wit et al. (2009).

Value category	Estimate of value (2008 R millions)		
	Low	Medium	High
Tourism	965	1829	2948
Recreation	408	449	494
Natural hazard regulation	5	18	60
Esthetic values captured by the film industry	133	265	398
Other (30% adjustment)	453	1024	1950
Total	**1963**	**3586**	**5850**

and data availability as is often the case for valuations. Fortunately, however, the exercise was greatly assisted by the presence of existing valuation studies, other useful survey data (such as that for tourist preferences with regard to natural areas) along with the willing participation of key City officials. This allowed for a valuation that drew on a number of individual techniques and sources with high levels of input by City managers allowing for increased confidence in results.

It is clear that the economic value of well-maintained and healthy ecosystems in the City of Cape Town is substantial. A realistic baseline value of between R2 billion and R6 billion per annum equates to approximately 10%–25% of the total annual municipal budget. These services are essentially provided for free by nature and would incur substantial additional financial costs if not well maintained.

However, the argument for investment in urban natural assets goes further than preventative maintenance. Investment in urban natural assets create economic value added by (i) supporting socio-economic activities such as tourism and recreation, and creative industries such as film-making and advertisement, (ii) creating a premium for property values and (iii) creating buffer services to natural events such as coastal surges, flooding and wildfires. There are even indications that investment in urban natural assets may create economic value added that is higher than value added achieved by alternative municipal investments in the urban economy under certain conditions. The validity of such a statement needs to be further tested across other municipalities as well before firm conclusions can be drawn.

The benefits of investing in natural assets do not neatly flow back to the investor, but owing to the public or quasi-public good nature of many natural assets, is dispersed among many beneficiaries. This would not be a problem in a situation where municipalities do not have budget constraints to act in the public interest, but it is a real issue in rapidly urbanizing and developing cities, including the City of Cape Town, where most revenue is generated within the city itself and by way of national grants (Swilling and De Wit, 2010). There is a case to be made to create revenue streams from those who benefit from increased investment in ecosystem goods and services, both inhabitants and visitors to a city. The challenge, however, is to design economic policy instruments that capture this value in a context where the perception is that such services are provided for free, and the expectation is that this will be provided for free in the future.

To take the continued flow of EGS for granted when urban natural assets are increasingly under pressure is a foolish and short-sighted strategy. With rapid urbanization, municipal budgets will

have to start reflecting the current and future value of healthy urban natural assets and the resulting sustainable flow of EGS to inhabitants and visitors of cities.

In order to do this the value of urban natural capital and flow of EGS need to be communicated in the financial language of budget processes. This is only a start though, as better financial information on the value of urban natural assets is not the only factor for success. The involvement of managers from the financial department of the City of Cape Town throughout the participation process proved to be beneficial to form a better understanding of its budget cycles and develop a more focused argument for measurable, financial indicators. The valuation of ecosystems in financial terms is one more concrete way to signal the importance of a well-functioning urban ecosystem to the local economy. Whether budgeting will eventually be impacted depend on the development strategy, and thus also the financial strategy, that the City of Cape Town is adopting.

A better understanding of the budget processes, the objectives of actors in such processes, as well as insights in how to effectively communicate arguments are all highlighted as fruitful areas of further study. It must also be noted that specific investments in maintaining, conserving and/or restoring natural areas would have to be evaluated in a more detailed framework that includes the social costs, benefits and risks over time of such interventions.

The assessment process in itself contributed to interdepartmental linkages between City line managers and senior staff and a foundation for further work on environmental fiscal reform in the City, points highlighted by subsequent work documented in Robrecht et al. (2012) and in a compendium of urban case studies published by UN Habitat (2012).

5. Conclusion

The City of Cape Town is positioning itself as a global player with a relatively well-diversified economy that includes significant tourism, trade and services sectors. The business community aspires to a city of inspiration and innovation, a city that is both green and beautiful. The City of Cape Town's leadership is focused on providing an enabling environment for growth and development through, for instance, effective service delivery. In this regard, the Mayor is on record stating that he wants to see an increase in the rate of capital investment in the City of Cape Town to spur infrastructure-led economic growth.

Contrary to commonly held misconceptions, none of these visions and objectives compete with investments in the City of Cape Town's natural environment. This research has shown that investing and maintaining the City of Cape Town's natural assets or ecological infrastructure, yields highly valuable services which provide the backbone for value addition and employment in its economy. In addition, investment helps to manage the significant socio-economic risks associated with degradation and neglect of natural assets. It has an important role to play as both a cost control measure and an enabler of economic growth and development in keeping with the mandate of the municipality.

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References

Ballance, A., Ryan, P.G., Turpie, J.K., 2000. How much is a clean beach worth? The impact of litter on beach users in the Cape Peninsula, South Africa. South African Journal of Science 96, 210–213.

Blignaut, J.N., Lumby, A., 2004. Economic valuation. In: Blignaut, J.N., De Wit, M.P. (Eds.), Sustainable Options: Economic Development Lessons From Applied Environmental and Resource Economics in South Africa. UCT Press, Cape Town.

Bolund, P., Hunhammar, S., 1999. Ecosystem services in urban areas. Ecological Economics 29 (2), 293–301.

De Wit, M.P., Van Zyl, H., Crookes, D.J., Blignaut, J.N., Jayiya, T., Goiset, V., Mahumani, B.K., 2009. Investing in natural assets. a business case for the environment in the city of Cape Town. Report prepared for the City of Cape Town, Cape Town, South Africa, 18 August. Available from: 〈http://www.capetown.gov.za/en/EnvironmentalResourceManagement/projects/Pages/EnvironmentalResourceEconomics.aspx〉.

De Groot, R.S., Wilson, M.A., Boumans, R.M.J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393–408.

Donaldson, R., 2009. Table Mountain National Park visitor and user survey 2007–2008: summary of combined summer, autumn, winter and spring results. Report to TMNP (SANParks) by the Centre for Geographical Analysis at the University of Stellenbosch, Stellenbosch, South Africa.

Eftec, 2006. Valuing our natural environment. Report prepared for Department for Environment, Food and Rural Affairs, United Kingdom.

Folke, C., Jansson, A., Larsson, J., Costanza, R., 1997. Ecosystem appropriation by cities. AMBIO: A Journal of the Human Environment 26 (3), 167–172.

Hussain, S., Wittmer, H., Berghofer, A., Gundimeda, H., 2012. Conceptual frameworks for considering the benefits of nature. In: Wittmer, H., Gundimeda (Eds.), The Economics of Ecosystems and Biodiversity in Local and Regional Policy and Management, (Eds.) Earthscan, London and Washington DC.

Lannas, K.S.M., Turpie, J., 2009. Valuing the provisioning services of wetlands: contrasting a rural wetland in Lesotho with a peri-urban wetland in South Africa. Ecology and Society 14 (2), 1–18.

Millennium ecosystem assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Pagiola, S, Von Ritter, K., Bishop, J., 2004. Assessing the economic value of ecosystem conservation. The World Bank Environment Department, Environment Department Paper no.101. World Bank, Washington, DC.

Robrecht, H., Lorena, L., Muhlmann, P., Mader, A., Calcaterra, E., Nel, J., Hammerl, M., Moola, F., Ludlow, D., Wackernagel, M., Teller, A., de Wit, M., van Zyl, H., Berghofer, A., 2012. Ecosystem services in cities and public management. In: wittmer, H, Gundimeda (Eds.), The Economics of Ecosystems and Biodiversity in Local and Regional Policy and Management. Earthscan, London and Washington, DC.

Standish, B., Boting, A., Van Zyl, H.W., Leiman, A., Turpie, J.K., 2004. The economic contribution of Table Mountain National Park. Report to South African National Parks, Cape Town, South Africa.

Swilling, M., De Wit, M.P., 2010. Municipal services, service delivery and prospects for sustainable resource use in Cape Town. In: swilling, M. (Ed.), Sustaining Cape Town. Imagine a livable City. Sun Media, Stellenbosch.

Turpie, J.K., Joubert, A.R., Van Zyl, H., Harding, B., Leiman, A., 2001. Valuation of open space in the Cape Metropolitan Area. Report to the City of Cape Town, Cape Town, South Africa.

Turpie, J.K., Heydenrych, B.J., Lamberth, S.J., 2003. Economic value of terrestrial and marine biodiversity in the Cape Floristic Region: implications for defining effective and socially optimal conservation strategies. Biological Conservation 112, 233–251.

UN Habitat, 2012. Urban patterns for a green economy working with nature. UN Habitat, Nairobi.

Van Zyl, H. and Leiman, A., 2001. Case studies using revealed preference methods II: estimating the property value of open space using the hedonic valuation method. In: Turpie, et al. (Eds.). Valuation of Open Space in the Cape Metropolitan Area. Report to the City of Cape Town, Cape Town, South Africa.

Van Zyl, H.W., Leiman, A., Jansen, A., 2004. The costs and benefits of urban river and wetland rehabilitation projects with specific reference to their implications for municipal finance: case studies in Cape Town. Water Research Commission Report no. K8/564. Water Research Commission, Pretoria, South Africa.

Van Zyl, H.W., 2007. Property price approaches to the valuation of urban wetlands: theoretical considerations and policy implications. Ph.D. Thesis. School of Economics, University of Cape Town, Cape Town.