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Mapping and valuation of South Africa's ecosystem services: A local perspective

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ABSTRACT

We used locally-sourced and other relevant information to value ecosystem services provided by South Africa's terrestrial, freshwater and estuarine habitats. Our preliminary estimates suggest that these are worth at least R275 billion per annum to South Africans. Notwithstanding benefits to the rest of the world, natural systems provide a major source of direct income to poor households, and generate significant value in the economy through tourism and property markets, as well as providing considerable non-market benefits. Higher values correspond both to areas of higher biomass, which have higher capacity to supply ecosystem services, and areas of higher population densities, which generate demand as well as threats. The value of regulating services is higher for natural systems closer to population centres. Amenity values are highest in cities and protected areas, with the fragmented green open space areas within cities have among the highest values per ha. Even if the gaps are taken into account, our estimates are far lower than estimates based on average global values, but are likely to be more accurate, relevant and tractable to policymakers. Nevertheless, some services have large global values, the recognition of which is important in developing strategies for financing biodiversity conservation.

1. Introduction

The need to find an optimal balance between conservation and development is increasingly evident, especially in developing countries such as South Africa, where addressing widespread poverty is a priority, and where ecosystems and their biodiversity face escalating threats from land transformation, hydrological alteration, pollution, overexploitation, invasive alien species and climate change. The valuation and mapping of ecosystem services can inform policy by elucidating the role of natural capital in contributing to development objectives, highlighting natural areas of importance for service provision, facilitating the evaluation of alternative locations for project action, and providing better justification for public spending on conservation and restoration efforts (van Jaarsveld et al., 2005).

The valuation of ecosystem services has proliferated since the early 1990s. While most studies focus on single services at a local scale (Turner et al., 2003), these can be used in conjunction with spatial data to develop regional, national or even global estimates. Since Costanza et al.'s (1997)'s estimate of the value of the world's ecosystem servicesin , extrapolated from the few studies available at the time, the execution and scaling up of valuation studies has been significantly improved by advances in satellite data, geographic information systems and models. This has allowed for more accurate means of transferring values, taking geographic variation into account (e.g. Troy and Wilson, 2006; Egoh et al., 2008; Naidoo et al., 2008; UK NEA, 2011). These advances are motivated by growing recognition of the importance of valuing natural systems at a national scale (e.g. CBD Aichi targets) and their incorporation into national accounting systems (UN-SEEA, 2012).

Much of the work carried out to date relies on the increasing pool of estimates from valuation studies around the world, much of which is collated in global databases. These have been particularly valuable in extrapolating values to areas for which estimates are relatively scarce, notably developing countries. However, the reliability and policy relevance of such estimates might be limited. We argue that “local is *lekker*[1]”, in that it may often be more useful to apply (scarce) local

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[1] A South African expression translating to “local is good”.best".

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Table 1
Provisioning, cultural and regulating services included and not included in this study. Note that the provision of mineral resources, water and abiotic energy were not considered as ecosystem services.

Category	Services	Brief explanation	Included
Provisioning services	Livestock fodder	Supply of grazing used as an input to free-ranging livestock and game farming	Yes
	Harvested renewable resources	Raw materials, biofuel, wild foods. wild medicines and ornamental products (e.g. flowers) harvested for use or sale	Yes
	Genetic resources, biological compounds	The value of exploration for genetic varieties etc. that are used in agriculture, horticulture, medicine etc.	*No*
Cultural services	Amenity values (aesthetic, recreation)	The value derived from viewing or using nature for relaxation, exercise, spiritual enjoyment etc.	Yes
	Cultural and religious value	The significance of nature in cultural and religious beliefs and activities	*No*
	Existence and bequest (non-use) values	The value derived from the knowledge that wild nature exists and that it can be enjoyed by future generations	Yes
	Scientific and educational value	The value derived from understanding nature and potential lessons etc, including from armchair appreciation of nature (e.g. watching documentaries)	*No*
Regulating services	Carbon storage	Maintenance of carbon stored in plants and soil, rather than allowing their release into the atmosphere leading to climate change damages	Yes
	Regulation of local climate	Reduction of urban heat island effects or wind by natural vegetation	*No*
	Pollination	Pollination of crops by wild pollinators, improving crop yields, saving managed pollination costs	Yes
	Control of pests and pathogens	Control of pest populations by wild animal populations, reducing losses or prevention costs, or avoidance of the proliferation of pests or pathogens by maintaining healthy ecosystems e.g. black fly*, malaria	Part*
	Maintaining soil fertility	Replenishment of fertile soils by flooding	*No*
	Critical habitats/refugia	The role played by critical habitats such as breeding areas, nursery areas or seasonal watering areas, for the maintenance or productivity of broader-scale populations that have value elsewhere, e.g. the value of estuaries for marine fisheries	Yes
	Control of erosion and sedimentation	Prevention of soil loss by vegetative cover and the prevention of sedimentation by eroded sediments through trapping by vegetation and wetlands.	Yes
	Flow regulation	Flood attenuation by vegetated areas and wetlands; and groundwater recharge and the maintenance of low flows through infiltration facilitated by vegetative cover	Yes
	Coastal storm protection	Attenuation of wave energy by natural barriers such as dunes and mangroves, avoiding damages	*No*
	Water quality amelioration	Avoided treatment costs and downstream ES losses through removal of elevated nutrients, suspended sediments and pathogens generated by human activities.	Yes
	Air quality amelioration	Health costs avoided through removal of particulate matter by vegetation, particularly in urban areas	*No*

value estimates than using international estimates that may not be reliably transferable to local contexts. Furthermore, while international values may be useful to inform strategies for financing biodiversity conservation to improve global welfare, local values are more important for optimizing allocations from a national welfare perspective, and are therefore more likely to have traction with policy-makers.

In this study, we provide preliminary estimates of the value of South Africa's untransformed terrestrial, aquatic and estuarine ecosystems to South Africans, using locally-relevant data, and taking spatial variation in ecosystem system characteristics and demand into account as far as possible. In addition to highlighting the patterns of value and their implications, we draw attention to data gaps and areas for further research, and discuss the discrepancies with international estimates.

2. Data and methods

2.1. Valuation framework and scope

Environmental valuation began with the notion of estimating changes in total economic value (direct, indirect, option and non-use values, Pearce and Turner, 1990) obtained from environmental assets as a result of changes in environmental characteristics. The concept of ecosystem services developed later, and along with it, the idea of trying to put a value on natural capital (e.g. Costanza et al., 1997), rather than valuing marginal changes. The development of a standardized approach to classify and value ecosystem services is considered critical to informing sustainable development policy but remains a serious challenge (UN, 2012). This is partly because most benefits derived from ecosystems are the result of a combination of labour and man-made capital as well as natural inputs (Boyd and Banzhaf, 2007; Landers and Nahlik, 2013), which makes it difficult to attribute value to nature.

The concept of ecosystem services was introduced to make the point that nature should also be recognized as a valuable form of capital that contributes to economic production and human wellbeing. The original concept saw ecosystems providing “goods”, such as fish, and “services”, such as water quality amelioration, which provided inputs to or saved on the costs of production. This concept was further clarified by Barbier (1994), who recognized that ecosystems also have “attributes”, such as beauty, rarity or diversity, that generate spiritual, educational, cultural and recreational values. Goods, services and attributes were essentially re-categorized as provisioning, regulating and cultural services by the Millennium Ecosystem Assessment framework document (2005), which also recognized a fourth category of supporting services, comprising the underlying processes which maintain conditions for life on Earth. The Common International Classification of Ecosystem Services (CICES; Haines-Young and Potschin, 2013) has reverted to three main groups (“provisioning”, “regulation and maintenance” and “cultural”), but retains these underlying functions and broadens the concept of ecosystem services to include crop and livestock production and their co-benefits such as draught power, as well as abiotic energy sources such as wind and tidal energy production. There are also other changes such as inclusion of water storage (including by reservoirs) and water purification as a provisioning service. This study follows the more traditional frameworks, but ignoring the supporting services of the MEA to avoid double-counting.

In this study, we focussed our assessment on the direct and indirect use values of the provisioning, regulating and cultural services provided by remaining natural terrestrial, freshwater and estuarine ecosystems in their current condition. These areas represent 85% of South Africa's land area, most of which is under private or communal rangelands, private wildlife-based land uses or state-owned protected areas, including urban green open space areas and beaches. The assessment did not include the value of cropland or plantations, which make up 13% of the country and contribute 2% to GDP (DAFF, 2017). Rather, it sought to value what might be lost when natural systems are