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Achieving the national development agenda and the Sustainable Development Goals (SDGs) through investment in ecological infrastructure: A case study of South Africa

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ABSTRACT

Ecological infrastructure (EI) refers to ecosystems that deliver services to society, functioning as a nature-based equivalent of, or complement to, built infrastructure. EI is critical for socio-economic development, supporting a suite of development imperatives at local, national and international scales. This paper presents the myriad of ways that EI supports sustainable development, using South Africa and the South African National Development Plan as a case study, linking to the Sustainable Development Goals on a global level. We show the need for EI across numerous development and sustainability issues, including food security, water provision, and poverty alleviation.

A strategic and multi-sectoral approach to EI investment is essential for allocating scarce public and private resources for achieving economic and social-ecological priorities. Opportunities to unlock investment in EI, both internationally and on the national level, are identified. This includes leveraging private sector investment into landscape management and integrating the costs of managing EI into public sectors that benefit directly from ecosystem services, such as the water sector and infrastructure development. Additionally, investing in EI also aligns well with international development and climate change funds. Investment in EI from a range of innovative sources supports global and national development, while complementing other development investments.

1. Introduction

1.1. Defining investment in ecological infrastructure

Ecosystem services, or the benefits ecosystems provide to people, is well documented (Costanza et al., 1997; Daily, 1997; Millennium Ecosystem Assessment, 2005; Sukhdev and Kumar, 2010). Over the past decade, there has been a vast increase in research efforts to study ecosystem services, including a new journal dedicated to the subject (Costanza and Kubiszewski, 2012). The concept of ecological infrastructure (EI) builds further on this work by explicitly focusing on the tangible asset base from which specific ecosystem services are derived. Through its formulation as "naturally functioning ecosystems that produce and deliver valuable services to people" (SANBI, 2013; Jewitt et al., 2016), EI is put forward as the nature-based equivalent of built infrastructure (Cumming et al., 2014), that can support, sustain, or in some cases substitute built infrastructure. This language highlights that the services supporting human well-being and socio-economic development do not originate solely from built infrastructure. The term ecological infrastructure specifically distinguishes natural ecosystems from other 'green infrastructure' (e.g. European Commission, 2013), such as permeable pavements, rooftop gardens and sustainable energy production. In some cases (e.g. UNEP, 2014), EI is synonymous with green infrastructure, whereas in others (e.g. European Commission, 2013) it is one element of a more widely encompassing definition that also includes infrastructure not made up

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Table 1
The sustainable development goals and South Africa's National Development Plan focus areas.

Sustainable Development Goal (SDG)	South Africa National Development Plan (NDP) Focus Areas
1. End poverty in all its forms everywhere	Chapter 3: Economy and Employment Chapter 6: Inclusive rural economy Chapter 11: Social protection
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Chapter 4: Economic infrastructure Chapter 5: Environmental Sustainability and Resilience Chapter 6: Inclusive rural economy
3. Ensure healthy lives and promote well-being for all at all ages	Chapter 5: Environmental Sustainability and Resilience
4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all	Chapter 9: Improving education, training and innovation
5. Achieve gender equality and empower all women and girls	Chapter 6: Inclusive rural economy
6. Ensure availability and sustainable management of water and sanitation for all	Chapter 4: Economic infrastructure
7. Ensure access to affordable, reliable, sustainable, and modern energy for all	Chapter 4: Economic infrastructure
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Chapter 3: Economy and Employment
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Chapter 4: Economic infrastructure
10. Reduce inequality within and among countries	Central theme of the NDP
11. Make cities and human settlements inclusive, safe, resilient and sustainable	Chapter 4: Economic infrastructure Chapter 5: Environmental Sustainability and Resilience
12. Ensure sustainable consumption and production Patterns	Chapter 4: Economic infrastructure Chapter 5: Environmental Sustainability and Resilience Chapter 6: Inclusive rural economy Chapter 8: Human settlements
13. Take urgent action to combat climate change and its impacts	Chapter 4: Economic infrastructure
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Chapter 5: Environmental Sustainability and Resilience
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	Chapter 5: Environmental Sustainability and Resilience
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Chapter 11: Social protection
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development	Chapter 7: Positioning South Africa in the World

of functioning ecosystems. The terms natural infrastructure (Wilson and Browning, 2012) and EI appear to be broadly synonymous.

Invoking the analogy of ecosystems providing benefits to people as a form of infrastructure also helps to make an argument that, just as built infrastructure requires investment, so does EI. Where built infrastructure requires an initial capital investment followed by on-going investment in operations and maintenance, the same is true for EI (Cumming et al., 2014). In the case of EI, initial investment may be in the form of rehabilitation where degradation has taken place, or the formal protection of EI under pressure of land use change. Maintenance involves the implementation of management actions required to keep healthy ecosystems in a good condition or maintain rehabilitated ecosystems in the desired state. In some cases it may simply require leaving the EI untouched (Kubiszewski et al., 2013). In some cases, the cost of investing in EI carries an opportunity cost, where the choice to invest in EI is a choice to not invest in another land use which could bring with it other benefits (Cumming et al., 2014).

In South Africa, a country with a strong development agenda, there is increasing understanding of the role EI and built infrastructure enable growth and development (Dini et al., 2016; Maze and river , 2016), as in many other countries. While a development agenda may increase the potential risk of degradation of the natural environment, it also creates opportunities to demonstrate how the rehabilitation and maintenance of EI can provide a complementary mechanism for contributing to development objectives. This approach demonstrates that nature and development need not be mutually exclusive, as is frequently perceived (Daly, 2008). In the case of water, there is growing global recognition of the role of EI in supplementing, sustaining, and, in some cases, substituting built infrastructure (Carse, 2012; UNEP, 2014; Palmer et al., 2015). For example, in many major cities in the United States, including New York and Boston, have conserved and rehabilitating forests upstream of the cities as a means of protecting the watershed and, hence, the ecosystem services of clean water flowing into the cities (Postel and Thompson, 2005).

Drawing attention to the need for investment in EI is important, as there has been a tendency to overlook the services provided, their value

to people, and the need for ongoing investment to ensure the continued flow of these services (Wilson and Browning, 2012). This stems from the fact that EI often provides public goods and services (Kubiszewski et al., 2010), and markets for these types of ecosystem services do not exist (Gómez-Baggethun et al., 2010). This results in the value of these services seldom being expressed in monetary terms or captured in market transactions (Costanza et al., 2014). Investment in EI does not need to rely on a market-based approach that entails the existence of a pricing mechanism (Farley et al., 2013; Costanza et al., 2011). Attempts at establishing payment for ecosystem services (PES) schemes have met with resistance in many countries, at least partly due to the public good nature of the services being provided (Farley et al., 2010; Bullock et al., 2011; Cumming et al., 2014). In contrast, a public sector focussed discourse of investing in EI has proven to be more successful in many countries, including Costa Rica, Mexico, and South Africa (McAfee and Shapiro, 2010; Arriagada et al., 2012). For example, the National Water Resources Strategy (Department of Water Affairs, 2013) in South Africa, explicitly recognises the value of EI for water security. Specifically, it articulates policy objectives focused on investment in the rehabilitation and maintenance of water-related ecosystems, particularly in strategic water source areas. Strategic water source areas in South Africa make up 8% of the collective surface area of South Africa and neighbouring countries Lesotho and Swaziland, while contributing 50% of the mean annual runoff of these three countries (Nel et al., 2013)). The National Water Resource Strategy goes on to highlight water use charges set by the Department of Water and Sanitation as the primary mechanism for funding these investments.

1.2. The Sustainable Development Goals and South Africa's development agenda

As part of its post-2015 development agenda, the United Nations (UN) has facilitated the development of the Sustainable Development Goals (SDGs) (United Nations, 2015). Unlike their predecessors, the Millennium Development Goals (MDGs), these goals address more than just poverty alleviation but focus on overall human and ecosystem well-being. Achieving this requires addressing the three dimensions of sustainable development (social, economic, and environmental) in an integrated and synergistic way (Costanza et al., 2016), as seen in Table 1. The SDGs are aimed at and were signed off by all nations, both developed and developing, including South Africa.

With 17 goals, 169 targets, and over 300 indicators proposed, the SDGs provide diluted guidance at best. South Africa's National Development Plan (NDP) 2030 maps out more specific development priorities for the country (National Planning Commission, 2013). The NDP, developed before the SDGs were finalised, sets out a visionary and holistic approach to sustainable development. It defines national development priorities and provides the foundation for South Africa achieving the SDGs. The NDP also influences annual resource allocation for the government's spending until 2030. Given scarce public resources, these investments should generate a high return in terms of social, economic, and environmental values and should maximize synergies across multiple development goals.

The NDP proposes a multi-dimensional framework for addressing the principal challenges of poverty and inequality in South Africa. The NDP highlights ten critical actions, namely:

1. A social contract to reduce poverty and inequality, and raise employment and investment.
2. A strategy to address poverty and its impacts by broadening access to employment, strengthening the social wage, improving public transport and raising rural incomes.
3. Steps by the state to professionalise the public service, strengthen accountability, improve coordination and prosecute corruption.
4. Boost private investment in labour intensive areas, competitiveness and exports, with adjustments to lower the risk of hiring younger workers.
5. An education accountability chain, with lines of responsibility from state to classroom.
6. Phase in national health insurance, with a focus on upgrading public health facilities, producing more health professionals and reducing the relative cost of private health care.
7. Public infrastructure investment at 10% of gross domestic product (GDP), financed through tariffs, public-private partnerships, taxes and loans and focused on transport, energy and water.
8. Interventions to ensure environmental sustainability and resilience to future shocks
9. New spatial norms and standards – densifying cities, improving transport, locating jobs where people live, upgrading informal settlement and fixing housing market gaps.
10. Reduce crime by strengthening criminal justice and improving community environments.

The SDGs are consistent with South Africa's development objectives in a number of ways. Both the SDGs and the NDP place poverty reduction at the centre and aim to address job creation, inequality, water security, food security, climate change, disaster risk reduction, infrastructure development, human settlements, and health issues, as well as the sustainable use and conservation of biodiversity (Table 1). Investing in EI directly supports achieving the SDGs, and therefore addressing South Africa's development agenda.

2. Ecological infrastructure addressing South African development agenda and SDGs globally

Investing in EI addresses key priorities identified in the NDP in South Africa, and supports the attainment of many of the SDGs globally. Inclusive approaches towards managing EI involving local and national stakeholders from public and private agencies can promote active citizenry, ensure gender equality, build capacity, and create employment while also maintaining and enhancing ecosystems for providing water, disaster risk reduction, and a healthy environment to local communities, cities, and businesses. Cross-sectoral and multi-stakeholder approaches towards environmental stewardship are also important for addressing conflicts and trade-offs in resource use and adapting to climate change impacts (Gregory et al., 2012). Fig. 1 below demonstrates how investing in EI supports the achievement of a range of SDG outcomes.

Functioning EI provides ecosystem services that contribute to poverty alleviation (SDG 1) (Daw et al., 2011; Ferraro and Hanauer, 2014), food security (SDG 2) (Bommarco et al., 2013), health and well-being (SDG 3) (Summers et al., 2012), and helps to reduce inequality (SDG 10) (McAfee and Shapiro, 2010). Studies on the livelihood benefits of wetlands, for example, have shown that on average a 1 km^2 wetland provides natural resources for local communities worth USD$211 per household per year – over six times more than annual average cash incomes of the area – as well as being culturally important (Adekola et al., 2008).[1] Livelihood benefits from rural wetlands in Lesotho are found to be in the region of USD$203/ha/yr, and more than USD$1,570/ha/yr from urban wetlands in Cape Town (Lannas and Trupie, 2009). Natural resources harvested from woodland areas and are also crucial for poor communities (Twine et al., 2003) Harvesting of non-timber forest products (NTFP's) in natural areas within rural and urban areas contributes approximately 20% to poor community's household income (Shackleton et al., 2007, 2016; Davenport et al., 2012). Access to fuel wood is of particular importance (Shackleton et al., 2007). NTFP provision in Southern Africa are valued

[1] All monetary values originally in South African Rand (ZAR) were converted to USD at the average midpoint rate for 2014, 10.84:1.

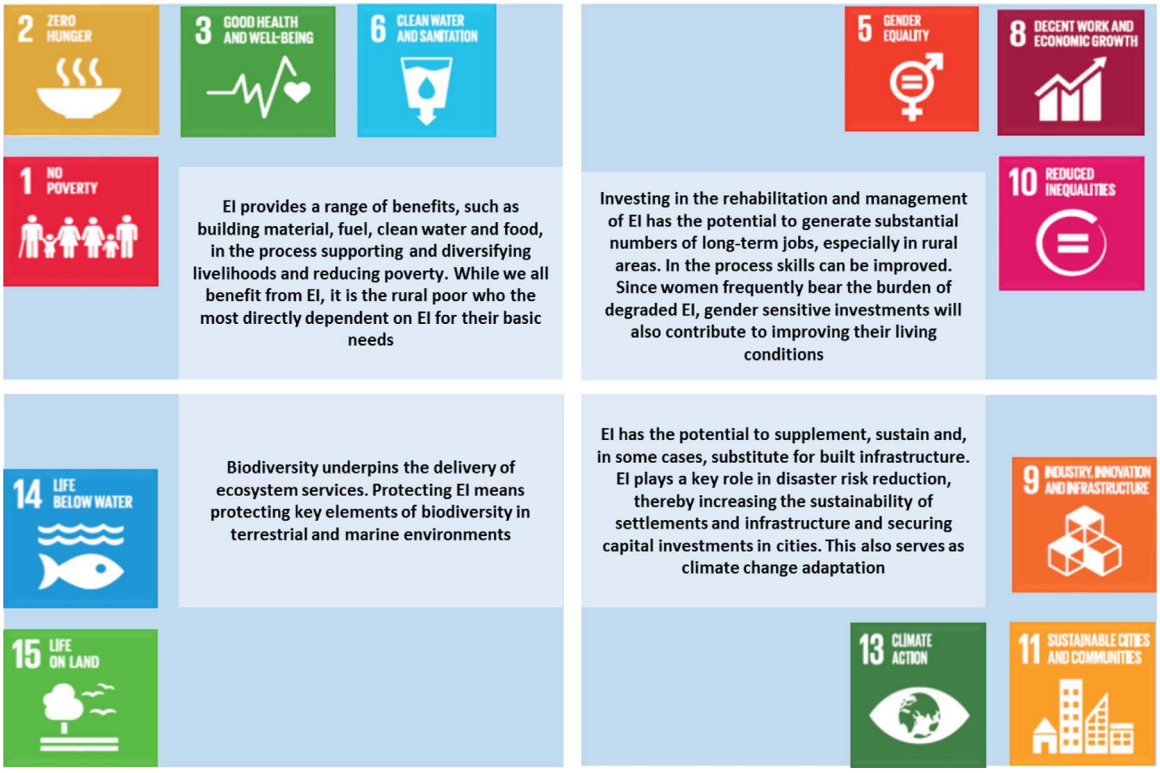

Fig. 1. Investing in ecological infrastructure supports a range of the SDG targets.

at USD$75–100 per ha and is comparable to returns from forestry and cattle ranching (Shackleton et al., 2007). Collection of natural resources also play a crucial role as safety nets or a coping mechanisms during times of vulnerability or disaster (Shackleton and Shackleton, 2004; Paumgarten and Shackleton, 2011). Investing in EI in areas where natural resources can act as safety nets are particularly important in countries like South Africa where unemployment is high and HIV/AIDS is rampant (Shackleton et al., 2008). Reliance on NTFPs in Zimbabwe, for example, is highly comparable to South Africa (Campbell et al., 1997). They are also important in most developing countries, such as Cameroon (Ambrose-Oji, 2003), Vietnam (Quang and Anh, 2006) and Brazil (Pattanayak and Sills, 2001) as well as many developed countries such as wild berry and mushroom use and sale in Finland (Richards and Saastamoinen, 2010; Laird et al., 2011).

In the commercial agricultural sector, natural rangelands in South Africa's grassland biome are worth over USD$77,300/ha/yr and contribute significantly to the country's dairy and beef sector (Blignaut et al., 2008). Intact rangelands for grazing are important for local poverty alleviation in rural areas as well as being culturally important in South Africa (Shackleton et al., 2008). Promoting natural habitats in agricultural landscapes also supports pollination and natural pest control (Foley et al., 2011). In the Western Cape region, the deciduous fruit industry receives annual pollination services from wild insects worth between USD$29–185 million annually (Allsopp et al., 2008). Promoting raptor populations by building nesting boxes or maintaining natural areas on farms aids considerably in pest control. Savings due to natural pest control are estimated at USD$230/ha/yr to the wine industry in New Zealand and have been shown to be twice as effective as other control methods for reducing cape gerbil (*Tatera afra*) numbers on grain farms in the Western Cape, South Africa (Potter, 2004; Kross et al., 2011).

The act of restoring EI to a functional state is a job creation activity, which can support economic growth and full and productive employment (SDG 8) (Plieninger et al., 2013). For example, the Working for Water (WfW) programme employs on average 9,000 people/yr in clearing invasive plants to improve the supply of ecosystem services. Due to its successes in reducing poverty and improving ecosystem service supply, this program has grown from supporting ten projects in South Africa with an annual budget of USD$2.3 million in 1995, to over 300 projects with an annual budget of USD$139 million in 2015 (van Wilgen and Wannenburgh, 2016). South Africa's Natural Resource Management (NRM) programmes, including WfW, strive to address gender equality (SDG 5), with approximately 50% of the jobs created between 2012 and 2015 going to women (Kahn in person comm., 2016). This job creation programme, combining work with skills development, also aims to reduce inequality within the country (SDG 10). This program in South Africa is has become globally acclaimed, providing other countries a potential framework.

Ecological tourism is a useful mechanism to promote sustainable development by providing employment and thus acting as a poverty alleviation mechanism while promoting biodiversity conservation (Tapela and Omara-Ojungu, 1999; Spenceley and Goodwin, 2007; Snyman, 2012). Snyman (2012) shows that on average, each staff member in the tourism industry supports four to seven dependents in rural areas of low employment, and wages are used within these communities, furthering employment and development through the multiplier effect. Private eco-tourism in the Eastern Cape of South Africa has increased employment by a factor of 3.5 (from 179 to 623 people), and has quintupled average salaries from around USD$715/yr to USD$4,064/yr (Sims-Castley et al., 2005). EI for ecotourism is also important for the local economies of other countries such as Costa Rica, Kenya, and others across the world (Weaver, 1999)

The availability of clean water (SDG 6) is supported by healthy catchments and wetlands. Wetlands have been shown to remove toxic acid mine drainage contamination from water in the Witwatersrand (Coetzee et al., 2002; Tutu et al., 2008). In the Hennops river, Gauteng province, a wetland was seen to substantially reduce water toxicity, with reductions in nitrogen, phosphorus, ammonia, calcium magnesium, and pH resulting from sewage, agricultural and industrial waste, and improve flora and fauna health (Oberholster et al., 2008). Wetlands in the Zambezi basin of Southern Africa are estimated to

provide water purification services valued between USD$1.6 million/yr and USD$18.4 million/yr and carbon sequestration valued at USD$8 and 64 mil/yr (Schuyt, 2005). Restoring degraded wetlands was suggested to further improve water quality downstream, which is used for drinking water in Pretoria (Oberholster et al., 2008). In Sweden wetlands are important for removing agricultural waste and can reduce total abatement costs by 30% (Byström, 1999). Furthermore, in storm prone areas of the world, wetlands are extremely important for reducing the effects of storm surges and attenuate waves thus protecting costa areas from damage (Costanza et al., 2008; Barbier et al., 2013).

Baseflow and yield of water are also impacted by the state of EI. Invasive alien trees in the upper reaches of South Africa's rivers reduce water yield by 695 million m^3/yr and if not managed could eventually increase to 2700 million m^3/yr (Cullis et al., 2007). This results in annual losses of between USD$50–$194 million/yr in the ten large catchments in South Africa and could potentially reach up to USD$889 million/yr (Blignaut et al., 2008). Invasive trees in the Kogelberg area use on average 347 m^3/ha/yr, which reduces water supply to Cape Town by 30% (Le Maitre et al., 1996). Therefore, programs like WfW are an extremely important form of investment into sustaining EI.

Built infrastructure and human settlements (SDG 9 and SDG 11) are made more resilient to the impacts of natural disasters, which are exacerbated by climate change (SDG 13), when protected by EI. EI is often hybridised with built infrastructure to provide multi-functionality and aid the usefulness and operation of built infrastructure (Ahern, 2013). Numerous tactics have need used in different regions of the world, such as diverting built storm water drainage systems though wetlands to slow flow and purify water (Ahern, 2013). Investment in EI (through retaining natural areas and sustainable farming) to secure water supply to the Panama Canal is crucial to ensure this global transport point remains usable (Carse, 2012). A constructed 0.44 ha vegetation wetland on the Lourens river, South Africa, removed all pesticides and insecticides, reduced suspended solids, orthophosphate and nitrate from agricultural waste water, and reduce water toxicity by 89% downstream (Schulz and Peall, 2001). In urban areas EI also provides a number of cultural ecosystem services important for sustaining human well-being (Shackleton et al., 2016).

In 2000, large-scale floods in Nzhelele, South Africa, resulted in significant social, environmental, and economic damage to the area. In response, rural and commercial farmers invested in improving river bank stability, broadened crop varieties to protect against total crop failure, and promoted the protection of natural vegetation to reduce the effects of natural disasters (Vermaak and van Niekerk, 2004). The impacts of these floods raised awareness for the need to prevent overgrazing and encourage sustainable land practices to reduce flood risk. In South Africa's Eden District, various drivers (including climate change, invasive species, urban development, and land use change) are enhancing natural disasters in the area (Nel et al., 2014). This results in increased fire intensities, flooding, and water scarcity. Invasive species reduce water flow by half during times of drought and more than double fire intensity (Nel et al., 2014). Clearing them would significantly reduce these disasters. Restoring degraded lands by removing invasive species is expected to reduce flood events by 16% in the area. Restoring sand dunes, which are often destroyed due to construction of houses, was identified as extremely important for reducing the effects of sea storm waves on built infrastructure, such as roads, pipelines and power lines (Nel et al., 2014). Investment in EI in other regions of the world is also important to prevent natural disasters, such as mangroves acting as storm protectors along coastal areas (Badola and Hussain, 2005).

EI also contributes to climate change mitigation. The city of Durban, South Africa, has committed itself to a community reforestation project (Roberts, 2010). This aims to improve carbon sequestration to mitigate the effects of climate change, as well as provide adaptation benefits by reducing the effects of land degradation, stabilising catchment areas for flood prevention, and improving the flow of provisioning ecosystem services that can act as safety nets to local livelihoods (Roberts, 2010). In addition, it provides employment to tree growers. This project has planted over 82,000 trees on 64 ha of old degraded sugarcane fields and a further 586 ha will be planted to stabilise a land fill area and reduce negative effects of pollution and degradation (Roberts, 2010). Planting of *Portulacaria afa* (Spekboom) is highly beneficial to restoring degraded rangelands in the Eastern Cape, by improving grazing potential, biodiversity, water infiltration, and soil stability, thus reducing the risks associated with droughts and desertification. It is also highly beneficial for carbon sequestration (Mills and Cowling, 2006). As mentioned above, mangrove forests are crucial for mitigate the effects of storm surges on coastal areas around the world (Badola and Hussain, 2005).

Finally, the protection and sustainable use of biodiversity, marine and terrestrial (SDG 14 and SDG 15), is synonymous with the protection and sustainable use of EI, employing the same conservation mechanisms and programmes of work (Cumming et al., 2014).

3. Opportunities for enabling investment in EI

While mobilising resources for investing in EI in South Africa, two points should be kept in mind. Firstly, with EI providing clear supportive functions to sectors other than the biodiversity sector, resources should be sought for investing in EI from those sectors. For example, raising finance from Official Development Assistance (ODA) not targeted specifically at biodiversity conservation; debt-for-nature swaps and the South African water sector. These examples are outlined below.

Secondly, a significant component of EI is a public good that provides services to the broader society at local community, sub-national, national or international scales. For this reason, a purely market-based approach to seeking additional resources does not make sense in the South African context, as has been found to be the case in other contexts around the world (Costanza et al., 2011, Cumming et al., 2014; Farley et al., 2015). It therefore follows that opportunities for public sector resources should be sought out. However, as shown by (McCarthy et al., 2012; Waldron et al., 2013), public resources have proven to be insufficient in achieving biodiversity and ecosystem services related goals such as the Aichi targets under the CBD. This makes mobilising resources that combine public and private sector desirable. Two examples of programmes that leverage public and private sector resources are outlined in this section: the Land User Incentives element of the Natural Resource Management programme and the biodiversity stewardship programme. Additionally, funding for investment in EI, particularly in developing nations, such as South Africa, needs to be sourced both internally (locally) and externally (international) as benefits streams from investment into EI have global implications.

3.1. International finance: ODA

A large part of international finance in South Africa, and many other developing nations, comes through Official Development Assistance (ODA). According to the World Bank, South Africa received ODA worth USD$1.29 billion in 2013, around 0.4% of the Gross National Income. 'Mixed' ODA funds, targeting biodiversity as well as other sustainable development objectives, have been shown to be worth nearly three quarters of total biodiversity related ODA globally, with strict biodiversity projects making up the remaining quarter (Miller, 2014).

International climate change funding for both mitigation and adaptation can be accessed for investment in EI. The Global Environment Fund (GEF), for example, manages three funds that focus on climate change adaptation – the Least Developed Countries Fund and the Special Climate Change Fund under the UN Framework

Convention on Climate Change (UNFCCC) and the Adaptation Fund under the UNFCCC's Kyoto Protocol. The first two both have focal areas that can include ecosystem management. The third, Adaptation Fund, is strongly driven by country-level strategies, simply requiring EI to be included in national climate change strategies, which South Africa has done.

3.2. International finance: Debt-for-nature swaps

Debt-for-nature swaps or debt-for-development swaps can be a way of mobilizing public and private finance through a cancellation or restructuring of debts (Berensmann, 2007). A creditor, e.g. a government of a donor country, can agree to cancel debts under the condition, that the debtor (e.g. a country) reinvests the equivalent amount into initiatives for sustainable development. Alternatively, debt can be restructured rather than cancelled (for example through lower interest rates). The freed capital from this restructuring of debt can then be invested in conservation and sustainable development. This can be done on national or sub-national scales. For example, the Government of Seychelles recently restructured US$ 29.6 million of debt with the freed capital financing the creation of marine protected areas the size of Germany (The Nature Conservancy, 2016). In the case of the a local scale project aiming to avoid deforestation in the Coffee Forest in El Salvador, coffee farmers pay back parts of their debt in form of carbon credits to a bank that is a partner in the project (CCB, 2008). Farmers pay their debt in form of an ecosystem service (carbon sequestration) which they provide by leaving more shade trees in the coffee farms. Furthermore, the forests and coffee farms of the project area are important for maintaining the water supply to a large part of the country's population. Hence the project is securing multiple benefits for multiple stakeholders – typical characteristic of EI.

3.3. The National Water Pricing Strategy and National Water Resources Strategy

The water sector is heavily dependent on well-functioning EI, from high altitude catchments acting as water sources, to coastal settlements dealing with pollution and flow regulation challenges (Le Maitre et al., 1996; Schulz and Peall, 2001; Coetzee et al., 2002; Schuyt, 2005; Cullis et al., 2007; Blignaut et al., 2008; Oberholster et al., 2008; Tutu et al., 2008; Ahern, 2013).

The Pricing Strategy for Water Use Charges, administered by Department of Water and Sanitation (DWS), is potentially a significant source of funding for investing in water-related EI. The current strategy makes provision for a component of the revenue generated from the sale of raw water by DWS to be invested in the clearing of invasive alien plants (IAPs) that impact water resources. The current version of the revised strategy (yet to be promulgated) expands this provision beyond IAP clearing to include "maintenance and restoration of ecosystems to improve water resources". The Pricing Strategy presents the opportunity of including in the water price an amount that is earmarked for investment in management and restoration of freshwater ecosystems with a view to improving water resource outcomes for water users. This strategy is a mechanism for long-term sustainable financing of water-related EI within South Africa.

3.4. Natural Resource Management and Land User Incentives

South Africa's Natural Resource Management (NRM) programmes are designed to address both poverty alleviation and job creation while restoring ecosystem function and the flow of ecosystem services (van Wilgen and Wannenburgh, 2016). Arguably the most well-known of these programmes is the Working for Water programme, which aims to clear invasive alien plants that have a negative impact on water resources. Another programme, Working for Wetlands, focuses on rehabilitating, conserving, and supporting the sustainable use of wetlands. The NRM programmes obtain their funds from the national fiscus. In the financial year 2015/16, the total allocation from national Treasury was USD$170 million.

The Land User Incentives model for the NRM programme aims to leverage private sector funds into the implementation of the NRM programmes. This model works by the Department of Environmental Affairs, in which the NRM programmes are housed, inviting tenders from the private sector as well as other public entities to implement NRM projects in discrete areas across the country. A set of criteria is used to award the work to a bidder, based on financial, social, and ecological criteria. The winning bidder implements the project, with support from the state budget. Initial estimates show that this model has been able to shift around 30% of the total cost of project implementation onto the private sector (C. Marais, in person comm. 2016).

Of the total budget allocation for the NRM programmes in 2015/16, 16% of the budget was spent on the land user incentives model, only one year into the testing of this model (C. Marais in person comm., 2016). This growth is expected to continue, with more emphasis being placed on the Land User Incentives model within the NRM programmes. In addition to increasing the state investment in the LUI model, efforts are underway to increase the relative amount of private sector investment in each LUI project.

3.5. Biodiversity stewardship programmes

The biodiversity stewardship programmes operating in South Africa offer an opportunity to leverage significant private sector investment into EI protection and rehabilitation. The programmes, implemented by provincial government conservation agencies, often with assistance from NGO's, partner with willing landowners in areas of high biodiversity importance. The programmes offer a suite of agreements, ranging from non-binding agreements, to short-term contract agreements, to long-term formal protected areas. In all cases, the landowner is responsible for the management of the land. In cases where a protected area is established, the land is subject to the same restrictions and degree of protection of a state owned and managed protected area (Cumming et al., 2015).

Securing and managing EI within biodiversity stewardship agreements can generate substantial savings to the national fiscus, while ensuring the provision of ecosystem services. A recent study shows that the biodiversity stewardship model of establishing a protected area is 70–400 times less costly to the state than the alternative model of land purchase. Once established, the ongoing management of the land is 4–17 times less costly to the state than managing biodiversity on their own protected areas (Cumming et al., 2015).

In addition, the biodiversity stewardship model can secure other state investments in the landscape. For example, NRM work conducted on the land often requires follow-up work once the initial investment has been spent on the land, such as removing emerging seedlings after the more mature invasive alien trees have been removed. Under the pervasive NRM model, the state programme conducts two follow-ups, after which this work becomes the responsibility of the landowner. Without repeated follow-ups, the initial investment is not only wasted, but the environmental degradation may be worse than it was before the work began. The NRM programmes have faced a real challenge in ensuring landowners take on the follow-up work. However, if the land owner has entered into a biodiversity stewardship agreement, they will be bound to ongoing management of the land, thereby ensuring the initial state investment in the land is not wasted. This speaks not only to the benefit of the biodiversity stewardship programme, but also the value of the NRM programmes in prioritising, *ceteris paribus*, land under a biodiversity stewardship agreement over land under no agreement, in order to secure the state investment (Cumming et al., 2015).

Despite the substantial cost savings for the state, a major barrier to

the biodiversity stewardship programmes growing across the country is a lack of state investment in the programmes. In order to leverage more private sector investment into EI, a state investment orders of magnitude smaller is required. In addition to this, increased support from NGOs can bolster the work done by conservation agencies in these programmes.

4. Conclusion

Achieving the SDGs is a challenge for all countries, with no one country excelling in the achievement of all SDGs (Kroll, 2015). There is value in all countries learning from each, other striving to apply important lessons within unique country contexts. Drawing on a number of case studies particular in South Africa, this article illustrates the value of investment in EI for reaching national development goals and the SDGs. New sources of EI investment, and the expansion of existing sources, are critical in meeting national and international development goals over the next few decades. This paper highlights various potential sources of funds to invest in EI to reach these policy targets, although many more may exist. While some of these sources are unique to South Africa, most are applicable to other developing countries. This includes raising funds from both local and international funding sources as well as from the public and private sector. We highlight two important considerations when investing in EI. Firstly, funding should be sought from various sources since the benefit of investing in EI extend to different sectors. Secondly, given the public good nature of EI, funding for EI will frequently draw on the public funding, or blended public and private sector funding.

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