Environmental and resource economics in South Africa: Status quo and lessons for developing countries

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We review the potential contributions of environmental and resource economics (ERE) to the achievement of sustainable development in developing countries; and highlight the limitations associated with applying ERE within a developing-country context, using examples from South Africa. We find that ERE has much to offer in helping to overcome the challenges associated with sustainable development in developing countries, but that the developing-country context needs to be taken into account before applying tools and methods that were designed with the developed-country context in mind. In particular, the unique and often complex socioecological context of developing countries needs to be considered and integrated into policy and management prescriptions.

Key words: environmental and resource economics, sustainable development, developing countries, market-based instruments

Introduction

All nations face the challenge of simultaneously meeting two imperatives: developing their economies to meet the needs of their people, and ensuring that the productivity and viability of the underlying ecosystems and ecosystem services are maintained at healthy levels over time. Essentially, these imperatives are enshrined in the concept of sustainable development, which is commonly defined as 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'[1]

From an economic perspective, sustainable development requires that social welfare (well-being) is at least maintained over time. One way of interpreting this is in terms of maintaining the stock of productive capital upon which social welfare depends,[2–4] which includes human capital (intangible skills and knowledge) and natural capital (ecological systems and natural resource deposits), as well as manufactured capital (tangible produced assets). Under the *weak* definition of sustainability, the different forms of capital are assumed to be substitutable, and sustainable development simply requires maintaining the *total* stock of capital. Thus, welfare can be sustained even while natural capital is depleted, so long as this is compensated for through an increase in other forms of capital. By contrast, *strong* sustainability recognises that natural capital is not readily substitutable with other forms of capital, and requires that the stock of natural capital is maintained in its own right.[2–5] A compromise may be to allow some substitution between different forms of capital, so long as some minimum, core stock of critical natural capital is maintained.[6]

Achieving sustainable development requires recognition of the inter-dependencies between the natural environment, economic stability and social well-being. Environmental and resource economics (ERE) is a sub-discipline of economics that explicitly recognises these inter-dependencies and has developed a variety of tools and methods for addressing the inevitable trade-offs and challenges that must be faced in the pursuit of sustainable development. It therefore seems capable of offering much in terms of advancing sustainable development, particularly in developing countries, where these trade-offs and challenges are particularly pronounced. However, there are also a number of limitations to the application of ERE, particularly in the developing-country context.

This paper aims to review the potential contributions of ERE to the achievement of sustainable development in developing countries, as well as to highlight some of the limitations associated with applying ERE in a developing country context, using examples from South Africa. The paper concludes with lessons for developing countries with regards to undertaking ERE research, applying ERE tools and methods, and providing appropriate advice to policy and decision makers for the advancement of sustainability.

The South African context

The challenges associated with sustainable development are particularly difficult in developing countries, where complex trade-offs between economic, social and environmental objectives must often be made. In South Africa, for example, many people are simultaneously faced with poverty, degraded environments and limited access to safe drinking water and sanitation;[7,8] unemployment is at least 25% and may be as high as 45%;[9] the incidence of diseases such as HIV/AIDS and malaria is high and increasing;[10,11] and socioeconomic systems are heavily reliant upon the natural resource base, and therefore vulnerable to global change.[12] South Africa therefore faces a desperate need for rapid social and economic development in order to achieve the Millennium Development Goals. Consequently, South African decision makers have tended to prioritise social and economic development agendas, often at the expense of environmental integrity. For example, the Accelerated Shared Growth Initiative for South Africa (ASGISA) of 2006, the overarching macroeconomic framework guiding all policy development in South Africa until 2014, explicitly makes environmental goals subordinate to its sociopolitical and economic goals of halving unemployment (to below 15%) and poverty (to less than one-sixth of households) by 2014. It aims to achieve this through the promotion of continuous economic growth at an average 5% per year.[13]

The effects on the natural resource base of this bias towards the attainment of socioeconomic goals are being increasingly recognised. For example, the average South African's 'ecological footprint,' which measures demand on the biosphere in terms of the area of biologically productive land and sea required to provide the necessary resources for economic activities and to absorb wastes, was estimated in 2003 to be 2.8 global hectares (gha), which is 0.6 gha greater than the world average and 1.6 gha greater than that of the average person in the rest of Africa.[14] Furthermore, in terms of the environmental sustainability index,

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which benchmarks the ability of nations to protect the environment over the next several decades based on 21 indicators of environmental sustainability, South Africa ranked 93rd out of 146 countries around the world in 2005, and 20th out of the 40 New Partnership for Africa's Development (NEPAD) countries included in the survey.[15] Finally, South Africa's adjusted net savings, a proxy for genuine savings (an indicator of weak sustainability),[16] has averaged 5% of gross domestic product (GDP) since 1986,[17] but this value excludes most types of pollution damage, as well as water, biodiversity and soil depletion, and therefore overstates actual genuine savings.[5] It is therefore likely that South Africa's actual genuine savings is below 5%, and possibly even negative, which would indicate that South Africa is not even achieving weak sustainability.

These and other indicators are increasingly helping decision makers to recognise the dependence of society upon nature and the importance of maintaining a healthy ecosystem capable of providing the goods and services necessary for a prosperous society. In response to this improved understanding, and to meet its obligations under Agenda 21[18] and the Johannesburg Plan of Implementation,[19] the South African government released its 'National Framework for Sustainable Development in South Africa' in June 2007.[20] This strategy identified five priority areas for strategic intervention based on analyses of trends in South Africa's natural, economic and social (including governance) capital, namely: enhancing systems for integrated planning and implementation; sustainable use of ecosystems; investing in sustainable economic development and infrastructure; creating sustainable human settlements and responding appropriately to emerging human development, economic and environmental challenges.[20] The implementation of such interventions requires decision making and action, and these decisions will often require that complex trade-offs are made between economic, social and environmental objectives. As described below, ERE is well suited to the resolution of precisely these types of trade-offs,[21,22] and therefore to assist in addressing the challenges presented by the need for sustainable development.

Environmental resource economics and sustainable development

Environmental and resource economics is concerned with the interactions between the economic system and the natural environment in which it is embedded. While other branches of economics, such as ecological economics, institutional economics and evolutionary economics, are also concerned with the natural environment, environmental economics focuses specifically on the way in which the economic system draws on the natural environment for raw material inputs to production and consumption, and the way in which it releases the byproducts of such economic activity back into the environment.[23] It can therefore contribute to policy and decision making regarding the allocation and management of land, water and energy resources, as well as the management of air and water pollution and solid waste, in order to meet social, economic and environmental goals. Furthermore, the importance of ERE analysis at the macroeconomic level, such as in green accounting and sustainability assessment, is also increasingly being recognised.[2,3,16,24,25]

Modern ERE, which arose in the 1960s, is rooted in neoclassical welfare economics, which holds that individuals obtain utility (satisfaction or 'happiness') from consumption of goods and services, and that social welfare is a function of individual utility. It assumes that the aim of the economy is to maximise social welfare through an 'efficient' allocation of resources, which can best be achieved by allowing the market to act as an allocation system. Market prices reflect the relative value (and scarcity) of goods and services, and individuals make decisions based on market prices so as to maximise individual utility. Given the satisfaction of a number of conditions regarding the functioning of markets, and thus regarding market prices, it is argued that the outcome of these individual decisions will ensure that social welfare is also maximised. For example, well-defined property rights must be in place, and prices for goods and services must adequately reflect all benefits and costs associated with their production and consumption. In addition, there must be a large number of willing buyers and sellers with complete information.

Environmental and resource economics departs from its neoclassical roots, however, in arguing that these conditions rarely hold in reality (i.e. markets often fail to efficiently allocate resources), such that some form of government intervention is often required.[26–29] In particular, property rights over natural resources are often absent or inadequate, making them vulnerable to overexploitation and depletion,[30] while prices often fail to adequately reflect the full social costs and benefits associated with particular goods or services, owing to the existence of externalities and/or public goods (defined in next paragraph), implying that individual decisions based on these prices will not be good for society as a whole.

Externalities refer to the side effects (positive or negative) of economic activity (production or consumption) that are not incurred directly by those participating in the activity, but are instead borne by society and/or future generations. Pollution is an example of a negative externality that is not taken into account by the relevant decision makers (private costs will be too low relative to social costs). This omission provides incentives for environmentally-damaging behaviour, in that a greater amount of the activity generating the pollution will be undertaken relative to the socially-optimal amount.[5] On the other hand, the market will tend to undersupply positive externalities, such as the catchment services (e.g. fresh water and flood control) associated with appropriate upstream land-use practices.

Public goods (or services) have the characteristics of non-excludability (people who do not pay to use the good or service cannot be excluded from using it) and non-rivalry (one person's use of the good or service does not diminish the extent to which it can be used by others). Markets do not automatically provide the right type and quantity of public goods, because, in the absence of public policy, there are limited or no returns to private investors for doing so.[31] Many, if not most, environmental goods and services are public goods, implying that markets will undersupply environmental goods and services (such as clean air and water).

Mechanisms developed within the field of ERE to address market failures focus on the creation of institutions for assigning and enforcing property rights to natural resources (so that the owners of such rights have incentives to manage the resources sustainably),[28] and on the use of market-based policy instruments (such as taxes and emissions trading), to ensure that producers and consumers pay for (internalise) the external costs of their activities, which should reduce pollution and lead to more efficient resource allocations.[29,32,33] Another market-based instrument that is gaining prominence internationally is payments for ecosystem services (PES), which aims to provide incentives for the provision of positive externalities, such as payments for catchment protection services.[34–36] In addition, environmental and resource economists have developed a suite of economic-valuation tools, which can provide valuable information regarding the monetary value of ecosystem goods and services in cases where market prices are missing or inadequate, thereby over-

coming problems of lack of information associated with missing markets and/or the existence of externalities.[37–40] By overcoming market failures and promoting both economic efficiency and environmental protection, economic-valuation tools, property rights and market-based policy instruments can, in principle, assist in overcoming conflicts between environmental and economic objectives, and therefore play a potentially important role in the pursuit of sustainable development, particularly in developing-country contexts.

Furthermore, the potential role of ERE in the assessment of progress toward sustainable development is also increasingly being recognised.[2,3,16,24,25] Indicators for assessing sustainable development fall into two broad categories, namely biophysical measures (generally based on a strong definition of sustainability, such as the ecological footprint and environmental sustainability index) and economic measures (generally based on the weak definition of sustainability, such as various measures of green domestic/national product, genuine savings and inclusive wealth).[16,41] Economic indicators of sustainability generally require some valuation of environmental stocks or flows in monetary terms.[41] As mentioned above, ERE has developed a variety of economic-valuation tools, which are able to value physical units in monetary terms,[37–40] and therefore has an important role to play in sustainability assessment.

Finally, Burns *et al.*[42] argue that research and development undertaken in South Africa should be underpinned by the principles of sustainability science, such as transdisciplinarity, which goes beyond interdisciplinarity (integration between scientific disciplines) to incorporate, among other things, improved integration between science and policy. Given its inherently interdisciplinary nature (in particular, its ability to integrate natural and social sciences), ERE has great potential to achieve true transdisciplinarity, and efforts are already being made in this direction, even in South Africa.[43] Furthermore, ERE has developed a wide variety of tools that explicitly aim to integrate information from a wide variety of disciplines and present it in a way that is comprehensible to decision makers, thereby potentially improving the link between science and policy. It can therefore play an important role in the advancement of sustainability science, and, by implication, sustainable development.

Environmental and resource economics in developing countries: the case of South Africa

The potential contributions of ERE were recognised in South Africa in the 1990s, when, in response to growing international environmental awareness and increased recognition of the ability of market-based instruments to alleviate environmental problems in developed countries, the Department of Environmental Affairs and Tourism commissioned a series of investigations into the use of market-based instruments for addressing environmental problems in South Africa.[44–47]

These initiatives have continued into the new millennium, with the national treasury commissioning investigations into environmental fiscal reform, specifically investigating the role that environmentally-related taxes and charges could play in supporting sustainable development in South Africa.[48] Furthermore, the Department of Water Affairs and Forestry has established a pricing strategy for raw water use charges, and is investigating fiscal instruments, such as a charge system for discharge of waste into water bodies[49] and for the clearing of invasive alien plants.[50] Other areas of influence include contributions to the 1998 National Water Act,[51] the 2000 Coastal White Paper,[52] and the 2004 Biodiversity Act;[53] as well as influencing the thinking of large municipalities such as eThekwini and Cape Town.[54,55]

Parallel to these public sector initiatives, South African academic and research institutions have increased teaching and research in ERE, which is reflected in the growing number of ERE students and courses (at least at the undergraduate level) offered by universities, and of publications in which ERE has been applied to inform and evaluate environmental policy and management since 1990.[56,57]

Environmental resource economics research initiatives in South Africa are solution driven and have tended to focus on seven main environmental-economic problems: the impacts and control of invasive alien plants; ecosystem services, primarily biodiversity, carbon sequestration, water resources management and tourism; livelihoods and poverty; pollution and waste; climate change mitigation and adaptation (including energy and food security); agriculture and forestry; and natural capital restoration. To inform these efforts, substantial progress has also been made in terms of the valuation and mapping of ecosystem services,[56,59] the impact on values of changes in ecosystem quality,[60] and the integration of this understanding into conservation and development planning.[59]

Some examples of South African applications of the ERE market-based policy tools referred to above include the creation of property rights to water resources, taxes and charges in the field of solid waste management, and attempts at developing various payments for ecosystem services schemes. These examples, and some of the problems encountered, are discussed briefly below.

First, prior to the 1998 National Water Act,[51] the right to use water was tied to land ownership. After 1998, however, land- and water-use rights were separated,[61] making it possible to sell water-use rights without selling the land. In effect, this made landowners custodians of water quality for downstream users and reinforced 'water quality' as one of the primary determinants of the value of water.[62] Initially, no official system was put in place to facilitate trading, which resulted in high transaction costs and low market activity. However, various water management reforms have since been put in place, including the decentralisation of management, allocation of water-use rights, and development of administrative and monitoring capacity to facilitate and develop a water market, which is now active at water user association level.[63]

A potentially negative consequence of leaving water allocation to the market is that water-use rights will tend to be allocated to the highest bidder. In general, the highest bidders are those users who derive the most utility per unit of water. Given that high-value users are mostly situated in urban (particularly metropolitan) areas, the long-term result would be the continual reallocation of water-use rights from rural to urban areas. This could have disastrous long-term implications for development, as increased urbanisation, resulting from rural landscapes and livelihoods becoming degraded, would exacerbate the existing urbanisation problem.[64]

Second, a number of market-based indicators have been used in the field of solid waste management in South Africa, with the purpose of reducing waste generation and diverting waste from landfills to recycling. For example, there is a national product tax on plastic shopping bags, which aims to reduce consumption of such bags and raise revenues for recycling them. Similarly, there is a proposed levy on tyres and potential for the expansion of product taxes to such items as packaging, batteries and electronic equipment.[48] There are also a number of deposit-refund schemes for glass and plastic beverage containers. Again, these can potentially be expanded to include other products.[48]

However, instruments aimed at reducing disposal to landfill will only be effective if a viable alternative is available; that is, if there are well-functioning markets for recycling. Furthermore, the most effective market-based indicators for reducing disposal to landfill are likely to involve quantity-based charging for waste management services at the municipal level. Interviews with municipal waste management departments have highlighted that there is currently insufficient capacity for implementation of such instruments at the municipal level in South Africa.[65] Although there is a growing awareness of, and interest in, the potential of these instruments, a number of fundamentals need to be in place before such instruments can be implemented; including enactment of the Waste Management Bill, stricter enforcement of existing policy instruments, political will, education and awareness, development of capacity and infrastructure, development of viable recycling markets, and improved waste licensing and data.[65]

A third example is the growing interest in and attempts at implementing PES schemes in southern and South Africa. A PES scheme can be defined as a 'voluntary, conditional agreement between at least one 'seller' and one 'buyer' over a well-defined environmental service or a land use presumed to produce that service.'[34] A recently completed South African inventory lists eight PES schemes at various stages of implementation.[66] Three of the most recent are:

(i) The Maloti-Drakensberg Transfrontier Project, which identified a strategy for developing incentives for land users to enhance the supply of environmental goods and services;[67]
(ii) Government initiatives, such as the Working for Water programme, which is a poverty relief public works programme that creates jobs and economic empowerment through funding of invasive alien plant clearing operations in order to address the problem of scarce water resources, and which had its origins in early ERE research in South Africa on the cost of fynbos degradation resulting from invasive alien plants;[68] and
(iii) The natural-capital restoration project in the Baviaanskloof area of the Eastern Cape, which focuses on restoring degraded landscapes by planting indigenous thicket vegetation (spekboom, *Portulacaria afra*). The potential for PES lies in spekboom's ability to sequester and store substantial quantities of additional carbon in both the soil and biomass.[69] The social, biophysical and economic assessments are in an advanced stage and strategies are being developed for mainstreaming ecosystem services (and PES) into the management and planning of the area.[70,71]

Most of these efforts have involved detailed baseline assessments and model development; but only a few, mostly those within the Working for Water program, have entailed actual financial transfers, and even then the structure and practice of these schemes falls short of the theoretically ideal definition of PES. The reasons for the inability thus far of PES schemes to take hold are consistent with experiences throughout the world (and particularly in developing countries). Payments for ecosystem services schemes require well-defined, tradable commodities as proxies for environmental services that can be cost-effectively measured and monitored; well-functioning, enforceable and transparent institutions and governance systems; a flexible mix of market, cooperative and regulatory arrangements; and a mechanism for ensuring that the benefits and costs of PES are equitably distributed.[36,72] It is in developing innovative ways of overcoming these barriers that the ERE research community in South Africa is focusing much of its efforts, and where valuable contributions to ERE research will be made.

Challenges and lessons for developing countries

Some of the challenges facing ERE in South Africa, and therefore limiting its progress, include:

(i) The young nature of the discipline in South Africa, together with the shortage of skilled ERE practitioners;
(ii) A shortage of high-quality ERE postgraduate programmes and supervisors at South African universities, such that graduates in ERE pursue their training and interests overseas;
(iii) Although ERE research has been relatively well funded by the South African government, the environment in general faces competition with other sectors (such as health and education) for limited funding; and
(iv) Capability and capacity constraints within government departments, research councils and academic institutions, combined with increasing demands on these limited resources (with the result that many highly-qualified and experienced environmental economists are 'lost' to private consulting).

These challenges limit the capacity of ERE researchers in South Africa to contribute to theoretical research in particular, as the urgency of environmental problems and development needs makes theoretical research a 'luxury' when immediate policy and development decisions need to be evaluated and trade-offs assessed, while the 'contract' nature of research funding (short-term and output-driven) often precludes theoretical research. In addition, there is a lack of strong university-based ERE groups; instead, specific recommendations are championed by isolated individuals, although the recently established Environmental Policy Research Group Unit at the University of Cape Town should help improve this situation. Consequently, the tendency in South Africa is for ERE practitioners to focus more on application of theory, tools and methods developed elsewhere in order to inform policy and decision making, rather than on critiquing and developing the theory itself.

However, ERE theory, tools and methods have predominately been advanced in developed countries, and are often incompatible with developing-country contexts. The substantial socioeconomic and environmental differences between developed and developing countries, means that tools and methods developed by environmental and resource economists in developed countries cannot easily be transferred to developing-country contexts without considering the unique circumstances of the latter. These differences will influence the assumptions upon which policy recommendations are based. Simply using the same assumptions that were valid in developed countries for developing countries could lead to inappropriate recommendations with regard to policy and resource management, with potentially severe negative consequences.

For example, market-based instruments have proved to be relatively effective in managing pollution and waste in many developed nations, and are often promoted as the answer to environmental problems in developing countries. However, these should not be seen as a panacea that can be applied in all contexts.[36,73] The use of such instruments requires well-functioning markets, secure property rights, an effective legal system, well-developed administrative capacity, political will and good governance—which are often, and to varying degrees, lacking in developing countries.[74–76] Thus, these limitations must be taken into account in the selection, design and implementation of such instruments, and not just acknowledged as constraints. For example, there may be a need to focus initially on building institutional capacity. Furthermore, some instruments may be simpler to implement and administer than others, and policy could be designed in such a way that instruments are implemented

incrementally, beginning with relatively simple instruments and becoming increasingly sophisticated as institutional capacity grows. In the control of air pollution, for example, Russell and Vaughan[76] recommend starting with a technology standard, which requires relatively little monitoring capacity, followed by a technology-based discharge standard as institutional capacity grows, and finally converting these non-marketable discharge permits into marketable permits as part of a full-blown emissions trading scheme. More research is therefore needed to determine the best way of developing and strengthening institutional capacity, and of designing instruments that take developing-country contexts into account.

Conclusion

The challenge for ERE in developing countries is to account for the developing country context (history, culture, institutions, etc.) when applying its tools and methods. In particular, the unique and often complex socioecological context of developing countries needs to be more thoroughly integrated with policy and management prescriptions. Realising the potential of ERE tools and methods to make a positive impact on sustainable development in developing countries therefore requires that they are adapted through research and stakeholder consultation processes that are sensitive to the institutional limitations, cultural practices, social goals and ecological pressures of developing countries.

Another critical challenge is to address the capacity limitations referred to above. This will require developing and implementing a plan for building ERE research and development capabilities and capacity in developing countries. In South Africa, for example, a Department of Science and Technology project currently underway at the Council for Scientific and Industrial Research aims to develop a plan for building research capacity in the economics of global change and sustainability.

There is therefore substantial scope for critique and innovation of the theory, methods and models of ERE as they apply to the developing-country context. Environmental resource economics has the potential to contribute to natural resource management as well as both microeconomic and macroeconomic policy making, and can also contribute to improved integration between natural and social sciences, and between science and policy in general. It therefore has the potential to support decision makers in dealing with the complex trade-offs with which they are often faced. If applied in a way that takes the context into account, ERE can therefore contribute much to the advancement of sustainable development in developing countries.

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