Second Economy Strategy:
Addressing Inequality and Economic Marginalisation

Making Markets work for People and the Environment: Employment Creation from Payment for Eco-Systems Services

Combating environmental degradation and poverty on a single budget while delivering real services to real people

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EXECUTIVE SUMMARY

We conducted a partial sectoral analysis of the market for ecosystem goods and services in South Africa by doing the following:

- We mapped the areas of high ecosystem productivity and poverty. By overlaying the two datasets, we identified the priority areas for developing markets for ecosystem goods and services.
- We estimated the potential size of the ecosystem market.
- We developed a potential institutional mechanism through which the value of such a market could be unlocked.

The development of markets for ecosystems goods and services is an increasingly important issue in the face of environmental degradation and increasing pressures on remaining natural capital. What are the implications of natural capital being increasingly scarce? Firstly, the value increases. The value of land and natural resources and the production of ecosystem goods and services are becoming precious commodities implying that those who currently have access or tenure over them are holders of an asset of which the value is set to rise. This has an impact on the political economy of managing natural resources. But, as will be shown, those who stand to gain from this new economy, though it will require a concerted and focussed effort, are the marginalised and the poor. As the value of natural capital increases, so will the value of the land and the ability of the landowners/users to seek environmental and economic justice also increase, for instance. Secondly, as the value of natural capital increases, so does the need to invest in natural capital, the limiting factor, to protect the capital base and compensate the owners of the resource for their custodianship. Thirdly, this unique juncture in time, with natural capital becoming increasingly the limiting factor and therefore the valuable asset, implies the opportunity for the development of new markets – markets for commodities that never before existed. These new markets are likely to give rise to new social constructs, a new vocabulary and a new paradigm concerning development. Sustainable development is no longer a nice-to-have, it is now essential for progress. Fourthly, the establishment of these new markets carry in and with it the opportunity, if well-conceived, to address poverty and stimulate economic development and growth in ways unknown before. We have to, however, caution that if this process is not well-managed, as financial capital follows value – i.e. natural capital – so does the opportunities to further exploit and marginalise the poor and economically vulnerable. While the impending increase in value of

land and natural resources can be the greatest single factor in catapulting the poor from oblivion to a position of meaningful participation in the economy, one should guard against this blessing becoming a curse.

We identified large parts of the Eastern Cape, KwaZulu-Natal, Mpumalanga and the Limpopo Province as priority areas for the development of markets for ecosystems. It is in these areas where ecosystem productivity is high and poverty rife. While it was not a consideration in this study, it is interesting to note the high degree of overlap between the areas of high priority from a market for ecosystem goods and services perspective and those of biodiversity importance.

Is the development of such a market viable and does it offer sufficient scale to justify further consideration and investigation? While the supply of the services originates mainly from those municipalities that offer significant ecosystem services and which are generally poor, the demand for ecosystem services is in the cities. Those on the demand-side and those on the supply-side are therefore geographically apart, yet it is in this that the market for ecosystem services can act as a bridge to enable the development of new market opportunities for those who are currently "un-marketed" – those operating in the second economy. While there is evidence of such an emerging market at various places, it is very far from its potential and it is highly unlikely that the market will achieve its full potential without a concerted effort. If one only focuses on energy, water and carbon, it is clear that the potential market size is substantial, as can be seen in Table I. We focus on energy, water and carbon since they could be considered umbrella services. The are easily understood, in high demand, does have market prices associated with them, and by effectively managing them one is likely to address a range of other conservation and economic objectives simultaneously.

Table I: Summary: Potential size of the energy, water and carbon markets

	Market size: Rmillion/year[7]	Number of person-years
Energy: Biomass gasification[1]	3,550	42,000–50,000
Energy: Biogas: LPG replacement[2]	1,182	45,000
Energy: Biogas: Fuelwood replacement[3]	325	31,000
Water: At current levels of infestation[4]	526–2,594	The same as for biomass gasification
Water: At future levels of infestation[5]	1,953–9,626	
Carbon sequestation[6]	8,978	240,634

Notes:

1 Refers to the process whereby all forms of woody biomass are being gasified in a biomass gasifier. The gas produced is then used to generate electricity using a generator.

2 Most organic material such as manures and agriculture residuals can, once placed in a digester, produce biogas which can be used as an energy source to replace, among other things, the need for liquid petroleum gas (LPG), a high-value commercials energy carrier.

3 Biogas can also successfully be used to replace the need for firewood and reduce the rate of reforestation, as well as the time spent on collecting firewood. Biogas is also a much cleaner and healthier energy carrier than wood.
4 Refers to the value of the water consumed by invasive alien plants species at current rates of infestation. By value is meant the economic value, i.e. the value of the water through the economic value chain and not the price of water.
5 Refers to the value of water consumed by invasive alien plant species in future if left uncontrolled at today's economic values.
6 Refers to the potential value of degraded and intact natural capital to sequester carbon. Varying sequestration rates for both the level of degradation and the vegetation type has been used.
7 For an explanation how these numbers were derived, please consider the main text.

The most challenging component concerning the development of this market is not to prove value, nor to convince the people to participate, but it will be and is an institutional issue. We suggest the development of a payment for ecosystem services facilitation agent, as a private sector entity, but in close conjunction with government. Such a relationship could be, but is not limited to, one that constitutes a public-private partnership. Important, however, is that the agency will have to liaise with local communities, through existing structures such as the Community Works Programme or others, the government and the buyers of the services. This is done to bundle the services together and in so-doing reduce the transaction cost of the trade.

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GLOSSARY

(Mostly derived from:

Aronson, J., Milton, S and Blignaut, J. 2007. *Restoring natural capital: Science, business and practise.* Washington DC.: Island Press.)

Alien species: Fungi, plants or animals that is not native to the country or region in which they are introduced or naturalized. See also invasive alien plant.

Biodiversity: The diversity of life at genetic, species, community, ecosystem and biome levels.

Bush encroachment: Indigenous woody plant species that invades the territory of other species or that are becoming denser not allowing other species to co-exist.

Carbon sequestration: A concept that refers to capturing carbon and keeping it from entering the atmosphere for some period under a greenhouse gas reduction program. Carbon is sequestered in carbon sinks such as forests, soils or oceans.

Cost-benefit analysis: An economic technique applied to public decision-making that attempts to quantify, in monetary terms, the advantages (benefits) and disadvantages (costs) associated with a particular policy in a comparative way.

Cost-benefit ratio: A discounted measure of project worth which implies the present worth of the cost stream divided by the present worth of the benefit stream. When the cost-benefit ratio is used, the selection criterion is to accept all independent projects with a ratio of 1 or less when discounted at a suitable discount rate, most often the opportunity cost of capital (see opportunity cost).

Degradation: A persistent loss in the capacity of ecosystems to deliver ecosystem goods and services.

Direct use value: The direct or extractive and consumptive use of natural biota includes wood for construction and timber as well as for energy purposes, medicinal products, edible fruit, herbs and vegetables as well as thatch and the value of livestock and the hunting of game.

Discount rate: The interest rate at which an agent discounts future events, preferably in a multi-period model. Often denoted as “r”. A present-oriented (or short-term orientated) agent discounts the future heavily, yielding a high discount rate.

Discounting: A method used to determine the monetary value today of a project’s future costs and benefits by weighting monetary values that occur in the future by a value less than 1 (the discount rate).

Disturbance: Natural or anthropogenic events or activities that *significantly* change the structure, content and/or function of ecosystems. Can lead to *degradation.*

Ecology: The study of factors determining the abundance and distribution of plant, animal, fungal and microbial species, including the interaction of all such organisms with one another and with their physical environment.

Ecosystem goods and services: The conditions and processes through which natural ecosystems sustain and fulfil human and other forms of life. Examples include the delivery of fuelwood (goods), the provisioning of clean water, climate maintenance (carbon sequestration), crop pollination, and fulfilment of human cultural, spiritual, and intellectual needs (services). Also known as *Environmental services*.

Ecosystem: The complex of living organisms, and their associated non-living environment, interacting as an ecological unit.

Gross Domestic Product (GDP): The value of the flow of domestic goods and services produced by an economy over a period of time, e.g., one year.

Invasive alien plant: Invasive plants are non-indigenous (introduced) naturalized plant species that produce reproductive offspring in very large numbers and thus have the potential to spread over a large area and to disrupt processes of native ecosystems.

Macroeconomics: The branch of economic theory concerned with the economy as a whole. It deals with large aggregates such as total output, rather than with the behaviour of individual consumers and firms.

Marginal analysis: An analytical technique that focuses on incremental changes in total values, such as the last unit of a good consumed, or the increase in total cost.

Marginal benefit: The increase in total benefit consequential to a one-unit increase in the production of a good.

Marginal cost: The increase in total cost consequential to a one-unit increase in the production of a good.

Market failure: A situation in which the behaviour of optimising agents in a market would not produce optimal allocation due to market inadequacies. Sources of market failures are, among others, monopolies or oligopolies, producers that have incentives to under-produce and to price above marginal cost, which then provides consumers with incentives to buy less than the optimal allocation and externalities.

Natural capital: The stock of physical and biological natural resources that consist of renewable natural capital (living species and ecosystems), non-renewable natural capital (sub-soil assets, e.g., petroleum, coal, diamonds, etc.), replenishable natural capital (e.g., the atmosphere, potable water, fertile soils), and cultivated natural capital (e.g., crops and forest plantations).

Opportunity cost: The cost of sacrificing the next best alternative or the income forfeited as a result of a decision in favour of one option rather than another.

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MAKING MARKETS WORK FOR PEOPLE AND THE ENVIRONMENT

COMBATING POVERTY AND ENVIRONMENTAL DEGRADATION ON A SINGLE BUDGET WHILE DELIVERING REAL SERVICES TO REAL PEOPLE

1 INTRODUCTION

More and more, the complementary factor in short supply (the limiting factor to development) is remaining natural capital, not manmade capital as it used to be. For example, populations of fish, not fishing boats, limit fish catch worldwide. Economic logic says to invest in the limiting factor. That logic has not changed, but the identity of the limiting factor has.

Herman Daly (personal communication) cited in Aronson, Blignaut, Milton and Clewell (2006)

In this report we:

- **map the environment services sector geographically and identify the priority areas,**
- **conduct a sector analysis and provide a partial estimate of its size, and**
- **assess the barriers to developing this market and develop strategies to overcome these.**

Herman Daly, in the above quote, eloquently articulates the fact that the context and content of economic development globally, but also in South Africa, has reached a new juncture – a juncture that has never before even been considered. This juncture pertains to the access and the distribution of natural resources that will increasingly limit economic development. Previously land, water, mineral resources and other forms of natural capital used to be readily available – these did not pose any supply constraint. Economic theory and development models therefore, by and large, do not take these forms of supply constraint into account. This has to change. Climate change and human migration to urban centres are also exacerbating the situation. Has this situation of resource constraints been an unknown and unforeseen development? The answer to this question is, unfortunately but not surprisingly, no – please refer to Box 1 for an exposition based on the 150-year-old concept known as the Jevons Paradox.

What are the implications of natural capital being increasingly scarce? Firstly, its value is set to increase. Access to and ownership of natural capital is no longer a coincidental luxury or redundant resource. The value of land and natural resources and the production of ecosystem goods and services are becoming precious commodities implying that those who currently have access or tenure over them are holders of an asset that's value is set to rise. This has an impact on the political economy of managing natural resources. But, as will be shown here, those who stand to gain from this new economy are the marginalised and the poor. As the value of natural capital increases, so will the value of the land and the ability of the landowners/users to seek environmental and economic justice. Secondly, as the value of natural capital increases, so does the need to invest in natural capital, the limiting factor, to protect the capital base and to compensate the owners of the resource for their custodianship. Thirdly, this unique juncture in time with natural capital becoming increasingly the limiting and therefore the valuable asset implies the opportunity for the development of new markets – markets for commodities that never existed before. These markets are likely to give rise to new social constructs, a new vocabulary and a new paradigm concerning development. Sustainable development is no longer a nice to have, it is now essential for progress. Fourthly, the establishment of these new markets carry in and with it the opportunity, if well-conceived, to address poverty and stimulate economic development and growth in ways unknown before. There is, however, a caution. As financial capital follows value, i.e. natural capital, so does the opportunities to further exploit and marginalise the poor and economically vulnerable if this process is not well-managed. While the impending increase in value of land and natural resources can be the greatest single factor in catapulting the poor from oblivion to a position of meaningful participation in the economy, one should guard that this blessing does not become a curse. Unfortunately, this is possible if not managed properly, as is indicated clearly in the literature concerning mineral wealth (Auty and Mikesell 1998).

Box 1: The Jevons paradox

Back in 1865, in his book *The Coal Question,* William Jevons stated that total consumption of a resource could sometimes increase, rather than decrease, as improvements in technology increase resource use efficiency. This counter-intuitive relationship is known today as the Jevons paradox. Efficiency improvements, instead of reducing the demand for a resource, reduce its relative price in comparison to its output, which in turn increases the overall demand. This increase in demand could be so significant that it offsets the reduction in the per unit consumption of the resource due to the efficiency improvement. Jevons applied his theory to England's coal consumption. Coal consumption increased substantially with the invention of James Watt's improved steam engine of 1784. Coal became a much more efficient and effective source of power generation, which lead to the overall increase in coal consumption despite the fact that the coal requirement per application fell. The Jevons paradox explains much of what is happening today. Whereas it is a widely held belief that technology improvements will circumvent further environmental degradation, they can do so only at the margin. This means that technology may reduce individual resource requirements per unit of output, but that in turn stimulates an increase in demand for those very same resources! Combine this "perverse" efficiency-effect with the demands of 6.5billion people rather than the mere one billion we were at the turn of the 18th century, and the Jevons paradox takes on a completely new, and altogether devastating dimension.
(Source: Blignaut et al. In prep.)

Box 2: Ecosystems their functions and contribution to well-being:

Functions:
- Provisioning: food, fresh water and fibre
- Cultural: such as aesthetic, religious and/or spiritual)
- Regulating: climate, water purification, disease management and water flows
- Supporting: Soil formation & primary production

Contribution to well-being:
- Security: Risk mitigation (floods & disease etc.)
- Materials: Food and water and resources
- Health: Strength, emotional well-being
- Relations: Social cohesion and mutual respect

(Source: Adapted from MA 2005)

What then is natural capital? Natural capital can be defined as "an economic metaphor for the stock of physical and biological natural resources" where physical includes chemical resources such a natural gas and petroleum, as they occur in natural and managed landscapes, and from which flow natural, or ecosystem, goods and services (Aronson et al. 2007: 4–5). Natural capital can be grouped into four types: renewable, i.e., living species and ecosystems; non-renewable, i.e., fossil fuels and minerals; replenishable, i.e., the atmosphere, potable water and arable soils; and cultivated, i.e., crop lands, and forest plantations (Rees 1995; MA 2005). The collection of these types of natural capital forms ecosystems at various scales, namely local, landscape, national, regional, continental and global scale, and then there is the marine ecosystem as well. See Box 2 for a quick reflection on ecosystems' functions – we return to this topic in Section 2. It should be made clear, however, that we do not focus on all the categories of natural capital here, but only on the services which intact natural capital provides and which degraded landscapes can provide after a process of restoration.

A consequence of not recognising natural capital's importance to economic development is that there is no direct incentive for people to manage the natural capital they might have access to, prudently. Natural capital's value is not reflected in the value of any commodity one buys. A classic example of this is water. Water in and by itself is free of charge, and there is no payment or contribution to the owners of the land where this resource originates from. Economically speaking, natural capital's rent is zero. This is depicted in the complex and sophisticated water tariff structure, yet the system is purely aimed towards cost recovery (see Box 3). The current system does not make any provision for compensating, or provide an incentive for, good land use management. This is despite the fact that such good land

Box 3: The water tariff structure

Tier 1: Raw water charge payable by registered water abstractors such as water utilities, farmers and large industrial users to DWAF based on the cost to store and transfer the raw water. There exist large variations in this charge since it is linked to the cost and age of the infrastructure serving the abstractor. This charge includes a water resource management charge to pay for the administrative component of the local water management system - currently the local DWAF offices, but in future the Catchment Management Agencies.

Tier 2: The water tariff payable by municipalities and bulk users for potable water delivered by utilities.

Tier 3: The water tariff payable by the end consumer of potable water such as households.

Tier 4: Waste water discharge charge system which is a payment to DWAF by treatment works for returning weaker quality water into the natural ecosystem than what was abstracted.

use management is directly linked, through the functioning of ecosystems, to the stable and high quality flow of water. So what is wrong? Those enjoying the benefits of the ecosystem functions do not pay for its upkeep. This implies a situation of what could be termed ecological free-riders, mostly those in urban areas. Conversely, the people and the natural infrastructure providing the ecosystem services are not compensated for doing so and, hence, there is no incentive to manage the system properly. This constitutes a real threat to the way in which the resource is being managed. Concurrently, however, it also offers the opportunity to intervene and rectify this injustice and inequity. **Natural capital should also be considered as infrastructure providing a storage and supply function as is the built capital – providing this function cheaper and more efficiently than the built environment (MDTP 2008). It is therefore worth paying for. How should this happen? One way of doing it is by instituting a market and payments for ecosystem services.**

2 PAYMENTS FOR ECOSYSTEM SERVICES

2.1 Ecosystem services

There is a long list of ecosystem goods and services and these can be classified in various ways, as can be observed in Daily (1997), Costanza et al. (1997) and the MA (2005). In Table 1, we reproduce the typology of ecosystem services according to De Groot et al. (2002).

Table 1: Functions, goods and services of natural and semi-natural ecosystems

	FUNCTIONS	ECOSYSTEM PROCESSES & COMPONENTS	GOODS AND SERVICES (examples)
	Regulation Functions	***Maintenance of essential ecological processes and life support systems***	
1	Gas regulation	Role of ecosystems in bio-geochemical cycles (e.g. CO_2/O_2 balance, ozone layer, etc.)	UVb-protection by O_3 (preventing disease) Maintenance of (good) air quality Influence on climate (see also function 2.)
2	Climate regulation	Influence of land cover and biol. mediated processes (e.g. DMS-production) on climate	Maintenance of a favourable climate (temp, precipitation, etc.) for, for example, human habitation, health, cultivation
3	Disturbance prevention	Influence of ecosystem structure on dampening env. disturbances	Storm protection (e.g. by coral reefs) Flood prevention (e.g. by wetlands and forests)
4	Water regulation	Role of land cover in regulating runoff & river discharge	Drainage and natural irrigation Medium for transport
5	Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers)	Provision of water for consumptive use (e.g. drinking, irrigation and industrial use)
6	Soil retention	Role of vegetation root matrix and soil biota in soil retention	Maintenance of arable land Prevention of damage from erosion/siltation
7	Soil formation	Weathering of rock, accumulation of organic matter	Maintenance of productivity on arable land Maintenance of natural productive soils
8	Nutrient regulation	Role of biota in storage and re-cycling of nutrients (e.g. N,P&S)	Maintenance of healthy soils and productive ecosystems
9	Waste treatment	Role of vegetation & biota in removal or breakdown of xenic nutrients and compounds	Pollution control/detoxification Filtering of dust particles Abatement of noise pollution
10	Pollination	Role of biota in movement of floral gametes	Pollination of wild plant species Pollination of crops
11	Biological control	Population control through trophic-dynamic relations	Control of pests and diseases Reduction of herbivory (crop damage)
	Habitat Functions	***Providing habitat (suitable living space) for wild plant and animal species***	
12	Refugium function	Suitable living space for wild plants and animals	Maintenance of biological & genetic diversity (and thus the basis for most other functions)
13	Nursery Function	Suitable reproduction habitat	Maintenance of commercially harvested species
	Production Functions	***Provision of natural resources***	
14	Food	Conversion of solar energy into edible plants and animals	Hunting, gathering of fish, game, fruits, etc. Small-scale subsistence farming & aquaculture
15	Raw materials	Conversion of solar energy into biomass for human construction and other uses	Building & Manufacturing (e.g. lumber, skins) Fuel and energy (e.g. fuel wood, organic matter) Fodder and fertilizer (e.g. krill, leaves, litter).
16	Genetic resources	Genetic material and evolution in wild plants and animals	Improve crop resistance to pathogens & pests Other applications (e.g. health care)
17	Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Drugs and pharmaceuticals; Chemical models & tools; Test- and essay organisms
18	Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	Resources for fashion, handicraft, jewelry, pets, worship, decoration & souvenirs (e.g. furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)
	Information Functions	***Providing opportunities for cognitive development***	
19	Aesthetic information	Attractive landscape features	Enjoyment of scenery (scenic roads, housing, etc.)
20	Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for eco-tourism, outdoor sports, etc.
21	Cultural & artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting, folklore, national symbols, architect, advertising, etc.
22	Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features)
23	Science & Education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, etc. Use of nature for scientific research

Source: De Groot et al. (2002)

As indicated in Table 1, ecosystems' contribution to the economy and human well-being is wide-spread and extensive. It is therefore about time to get serious concerning restoring and maintaining such ecosystems and the natural capital that supports it (Blignaut and Aronson 2008). Boxes 4 and 5 illustrate the importance of natural capital and its ensuing ecosystem flows within both an urban and agriculture context.

Box 4: The value of ecosystem goods and services in the eThekwini municipality

eThekwini municipality has some 105 000ha of natural areas producing ecosystem goods and services. These natural areas include rivers, wetlands, woodlands, estuaries, near shore ocean, grasslands, forests and mangroves.

The presence of these functioning ecosystems either complements the municipality's services sector, or in many cases, provides an alternative for especially the un-serviced households. Ecosystems in urban environments, by providing ecosystem goods and services, achieve the following two key objectives:

- To help meet basic needs, and
- To free up finances for investment into communities that have neither engineered nor natural services, such as the urban poor.

To illustrate this point, one can turn the issue upside down by asking what the potential costs of not having a functional natural environment in the city would be. For example, consider the following:

- What would it cost the municipality to supply all rural households with piped water?
- What would the costs to the households be as a result of greater incidence of disease (medical costs, lost productivity costs) resulting from the use of polluted water?
- What would it cost the city to supply all rural and urban households with reticulated sewerage systems?
- What would it cost rural households to build with only commercially available building materials?
- What would it cost the city to have to generate new jobs in only the manufacturing sector (while the cheaper jobs in tourism and agriculture would be forgone)?
- What would it cost the city's tourism sector if the sea was brown and polluted for extensive periods of the year (already Umgeni estuary is only safe for recreation for approximately 60 days a year)?

The estimated value of these and similar services supplied by the natural capital is R5.2billion, while the total metro budget is R17billion. In other words, eThekwini gains an additional third of their services by having access to ecosystem goods and services.

(Source: eThekwini Municipality Environmental Services Management Plan 2001).

Box 5: The link between ecosystems and agriculture production systems

A substantial part of South Africa's natural resources is in the hands of private landowners: of the almost 82% of land in South Africa classified as farmland (potentially arable and grazing land), approximately 67% is regarded as being in the hands of commercial and small-scale agriculture (Directorate: Agricultural Statistics of the National Department of Agriculture 2002). On the one hand the agricultural sector is dependent on natural resources for its income, but on the other hand it is also a custodian of the goods and services provided by these resources.

Estimations of monetary benefits of selected ecosystem goods and services provide an indication of the value thereof for the agricultural sector. For instance, the contribution of wild pollinators to the Western Cape deciduous fruit industry is estimated at between R331 and R2,096million (Allsopp et al. 2008). At the same time the value of natural grazing for livestock in the grasslands biome in South Africa has been estimated at R8 172/km^2, and that of grazing for commercial, subsistence and wildlife purposes in the savanna biome at R3 600/km^2, R2 308/km^2 and R1 982/km^2 respectively (Du Plessis and Reyers, in progress; De Wit and Scholes, in progress). The natural amenity benefit provided by agricultural and natural landscapes (for tourism purposes for instance) has been estimated at between R376/km^2 and R2 943/km^2 (Turpie et al. 2003; Cooperative of Independent Consultants 2006).

At present there are few incentives to manage agricultural land for the long-term benefit of society and future generations, but strong incentives to cultivate and exploit it for short-term gain by private landowners (short-term private benefits leading to long-term public costs). Forces such as climate change and drastic changes in the agricultural sector since 1994, intermingled with political and economic uncertainty (due to market liberalisations and land reform in particular) exacerbate the situation. An expanding population who are predominantly situated in the urban areas of the country places additional pressure on natural resources and in some instances the agricultural sector is already competing with urban areas for scarce resources such as water. In 2000, the Department of Water Affairs and Forestry (DWAF) put South Africa's total reliable surface water supply at 13 226million m^3, but in the same year, water use in the country was estimated at 13 041million m^3, meaning that only 186million m^3, or 1.4% of the supply, remained unused. In addition, from 1995 to 2000, approximately 84% of the increase in total water consumption of all sectors could be attributed to irrigation agriculture (Department of Water Affairs and Forestry 2004; Statistics South Africa 2006), while 12 of the 19 water catchments in South Africa have recorded water deficits. This leaves this sector in a vulnerable position, especially when predictions of higher temperatures and lower rainfall due to climate change are taken into account.

There are, however, a few cases in which farmers and corporate agriculture have engaged willingly in projects to protect and conserve natural resources, such as the Wine and Biodiversity Initiative among wine producers in the Western Cape and nationwide LandCare projects in partnership with the Department of Agriculture, as well as a commitment towards "best management practice" guidelines in certain industries (e.g. potatoes). Many farmers have embarked on the rehabilitation of degraded land as they realise the importance of this natural resource for themselves and future generations, but these costs are astronomical and the market for ecosystem goods and services is limited or non-existent (rehabilitation of Karooveld can cost anything from R200 to R20 000/ha) (Cupido 2005; Esler and Kellner 2001). Here the draft Revenue Laws Amendment Bill published for comment by National Treasury in August 2008, where an amendment was proposed to create a mechanism to make environmental maintenance and rehabilitation expenses as well as the loss of right of use of land related to biodiversity conservation and management income tax deductible, is a step in the right direction (Minister of Finance 2008). The Conservation of Agricultural Resources Act (CARA, Act no. 43 of 1983), which provides a legal framework for the conservation of agricultural resources has a substantial role to play in leveraging funds towards the market for ecosystem goods and services by bringing involved parties together. CARA's objectives of maintaining the production potential of land, the prevention and rehabilitation of soil erosion, as well as the protection of water resources and eradication of IAPs dovetail well with the objective of making markets work for the people and the environment. The loss of water resulting from IAPs in the fynbos biome, for instance, has been estimated at R684million (Turpie et al. 2003).

In conclusion, the main driver of incentives remains money, as agriculture is essentially a business like any other. Agricultural landowners (private or communal) have a considerable role to play in restoring and maintaining our natural capital, but up to now there has been little incentive for them to incur private costs for the benefit of the greater public. For this reason, the creation of incentives for sound land management practices and the creation of markets for ecosystem goods and services are required if the agricultural sector is expected to remain a major employer and generator of income in the economy.

Is it essential, or at all possible, to develop a market for this entire suite of services? Fortunately, the answer is no. We can, and have to, focus. We turn to this next.

2.2 Umbrella services and payment systems[11]

As will be indicated in Section 3, the areas of high ecosystem goods and services provision in South Africa are also the areas that are enshrined in pockets of poverty that, incidentally, are also very important from a biodiversity perspective. A system that therefore encourages the conservation of mountain catchment areas for water supply, for example, will also make an important contribution to poverty alleviation, habitat maintenance and biodiversity conservation. In this way water provision, for one, could be seen as an "umbrella service" in that initiatives taken to preserve this service would also lead to the conservation of biodiversity and other ecosystem services. Another umbrella service is carbon sequestration. The high-biomass areas suitable for carbon sequestration through restoration of high-biomass indigenous vegetation types are often geographically separate from the low-biomass (grassy) mountainous areas that are important for water provision, but the principle remains the same. The restoration and management of natural capital of any of these umbrella services would imply the provision of various other – let's call it auxiliary – services while providing employment and capacity-building opportunities essential to development in the process. In this way people who are economically marginalised can offer, perhaps for the first time, a very valuable and in some instances an invaluable service to the economy. The market has come to the people.

The role of umbrella services in the development of the market cannot be overstated. This is since it is well-known that ecosystems generate numerous services, such as nutrient cycling, provision of refugia, etc. (Costanza et al. 1997; De Groot et al. 2002, MA 2005). Some of these services are inherently more marketable than others. The marketability lies in the tangibility or measurability of the service and, in the context of payments for ecosystem services (PES), the ability to prove that changes in management lead to changes in the output of economically valuable services. Indeed, in PES systems around the world, it has been found that most examples are for a few main commodities, particularly carbon, water, productive potential, biodiversity and landscape beauty, with markets for carbon sequestration and hydrological services being dominant (Landell-Mills and Porras 2002; Pagiola and Platais 2007). Among these commodities Pagiola and Platais (2007) concur with the observations above that water services have the most potential for application of the PES approach as water users (1) are easy to identify; (2) receive clear, well-defined benefits; and (3) often already have financing mechanisms

[11] This section is largely based on Turpie et al. (2008a).

– none of which is true for biodiversity, for example. Carbon is somewhere in between. In particular, there are tight overall limits on the emission reduction credits that can be generated by land use-based activities under the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change (UNFCCC) and very restrictive rules on eligibility and methodologies, while the voluntary ('retail') market, though more flexible than the CDM market, tends to pay less.

Marketing the hydrological and climate regulation functions of ecosystem restoration projects has many advantages. These projects are well-understood by the broad populace, they are the easiest to execute and it is more likely to find willing-buyer and willing-seller combinations. The positive externalities of these projects, such as biodiversity conservation, protection of endemic fauna and flora, nutrient recycling, etc., are therefore "un-priced" coincidental positive externalities or benefits. However, if these benefits are clearly identified, the restoration activity (and the subsequent management of the restored site) could sell at a premium over projects where these positive externalities are not clearly identified or not present. In this way, hydrological and climate regulation restoration programmes (i.e. ecological restoration programmes) become an umbrella for the bundling of various ecosystem services. This implies, however, that hydrologists (including water engineers), ecologists and economists will have to work together and find a common language for the subject matter to proceed (see Box 6).

Box 6: Getting hydrologists, ecologists and economists to talk to one another

Arguably the single, most challenging obstacle to overcome in establishing a payment for ecosystem services system is the search for a common currency among ecologists, hydrologists and economists. The need for such a common currency arises from the fact that it is necessary to link the stated hydrological responses (i.e. changes in baseflows, stormflows and sediment yields) to a measurable land use management change that has a measurable impact on an ecological indicator. These linkages are required in order to develop a payment mechanism which enables compensation to participants based on measurement of an ecological indicator which reflects a change in land use and associated improvements in hydrological responses. The cost of the land use management change must then be compared to the benefits of such a change for society at large in order to establish the economic viability of such an intervention.

We identified basal/vegetation cover as an outcome of management that can be measured and which is directly linked to the effectiveness of management and, importantly, is also a direct driver of hydrological processes.
(Source: Adapted from MDTP 2008).

The way for introducing PES as a broad-scale conservation tool for achieving both biodiversity conservation and ecosystem service delivery has been paved by the development and evolution of the Working for Water, Working for Wetlands, Working on Fire and Working for Woodland programmes. Indeed, conservation planners in South Africa are currently looking to PES as potentially playing a major role in realising conservation initiatives. These include the Cape Action Plan for the Environment (CAPE), which has an ambitious conservation plan for the Cape Floristic Region (Cowling et al. 2003), and the Maloti-Drakensberg Transfrontier Project, which embarks on a conservation plan for the Drakensberg and Maloti Mountains of South Africa and Lesotho (MDTP 2008). Invasive alien plant management is seen as one activity among other natural resource management activities that could constitute the supply side of the PES market in South Africa. The other activities will include the restoration of wetland and riparian (or river fronts or edges) and natural resource use management; integrated grazing and land use regimes; and an integrated veld and forest fire management regime.

PES can be viewed as an opportunity to:

i) Compensate land owners for supplying ecosystem goods and services;
ii) Provide sustainable financing of the publicly and privately owned protected areas, or leveraging the management costs of these conservation areas into perpetuity; and
iii) Provide an incentive for private and communal land owners to engage in biodiversity conservation in order to meet conservation targets that cannot be reached by the protected area systems.

Is PES a new idea that will fade away over time? Not unless most of the international scholars are completely wrong regarding this topic. An entire issue of the high standing international journal *Environmental Development Economics* (June 2008, Vol 13, Part 3) was devoted to the topic of payments for ecosystem services. A special issue of the journal *Ecological Economics* (January 2008, Vol 65) focused only on payments for watershed services. The current buoyancy of the voluntary market for carbon sequestration and the development a various standards is a further proof that the concept of payments for ecosystem services is here to stay.

3 WHERE PEOPLE LIVE AND NATURE WORKS: MAPPING SOUTH AFRICA'S MAIN ECOSYSTEM SERVICES

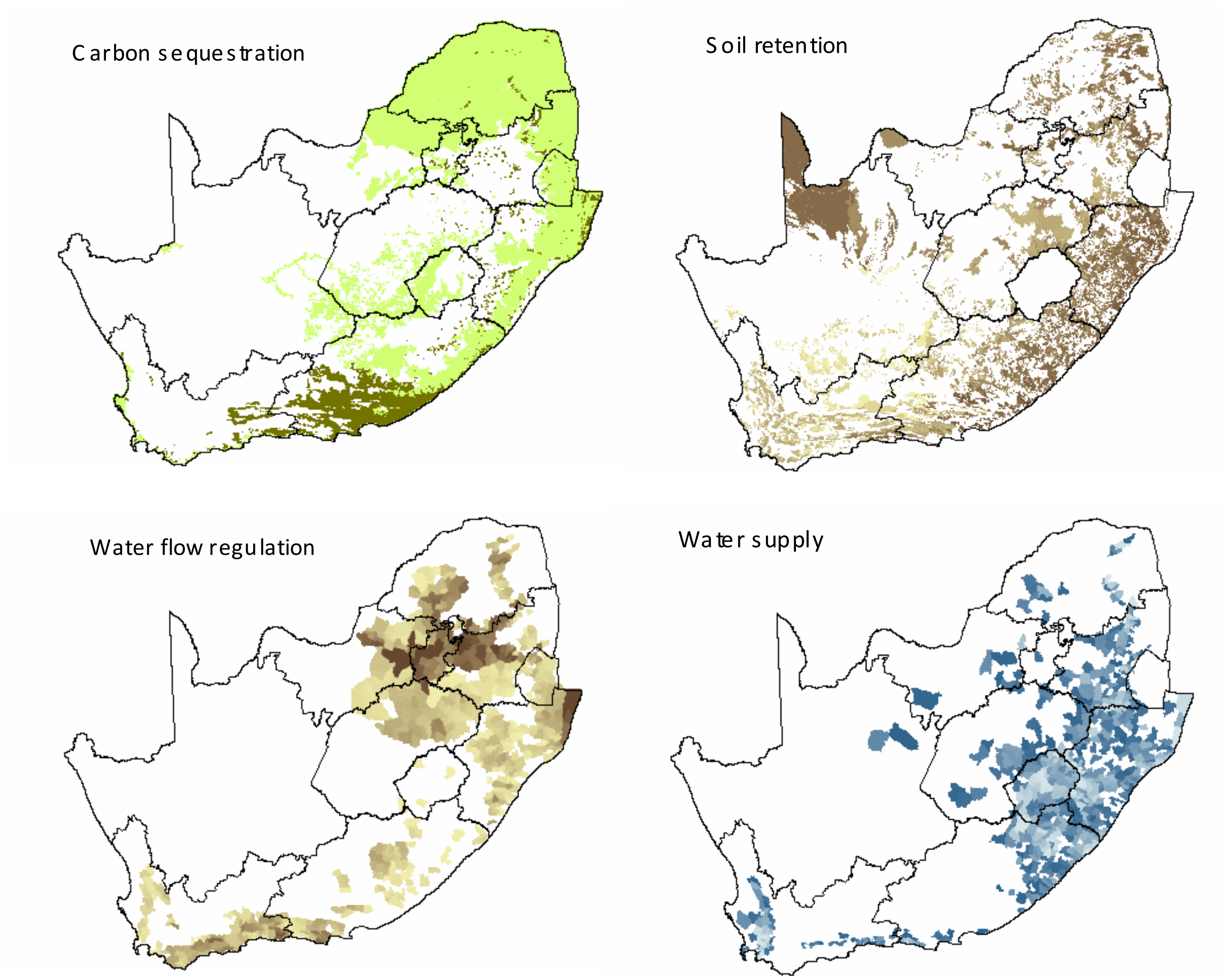
As noted earlier, the development of markets and payment systems for ecosystem goods and services are no longer a novelty, and in this section we will map the ecosystem service factories geographically or spatially to identify the priority areas for intervention. By identifying the priority areas, one can focus on the development of such a market in those areas where it makes the most sense. This means the introduction of such a payment system in areas which are home to both highly productive ecosystems and people who will benefit most from the introduction of such a system. We, therefore, map South Africa's ecosystem goods and services sector in combination with income on a municipality level. We will now discuss the mapping method.

We mapped four key ecosystem services based on data from Egoh et al. (2008), namely carbon sequestration, surface water supply, water flow regulation and soil retention (see Map 1). While three of the four services mentioned are self-explanatory, soil retention deserves an explanatory note. Soil retention itself is an in situ service and hardly sellable, while the reduction of sediments in water is an ex situ service and sellable. From a market perspective we are interested in the extent to which soil retention reduces sediment in water.

The selection of the four ecosystem services was based on national importance and data availability. The production level of each ecosystem service was scored from 0 (area of no to low production) to 100 (areas of highest production in the country) and the data was then summarised for each district municipality (based on the median score of each ecosystem service production). It was necessary to map the production levels of each ecosystem service separately as their geographic distribution differs. For example, important areas for water flow regulation, concentrated in the central highveld, are different from areas important for surface water supply (see Map 1). Map 1 provides a bird's-eye view of where South Africa's ecosystem service factories are. It should be noted that:

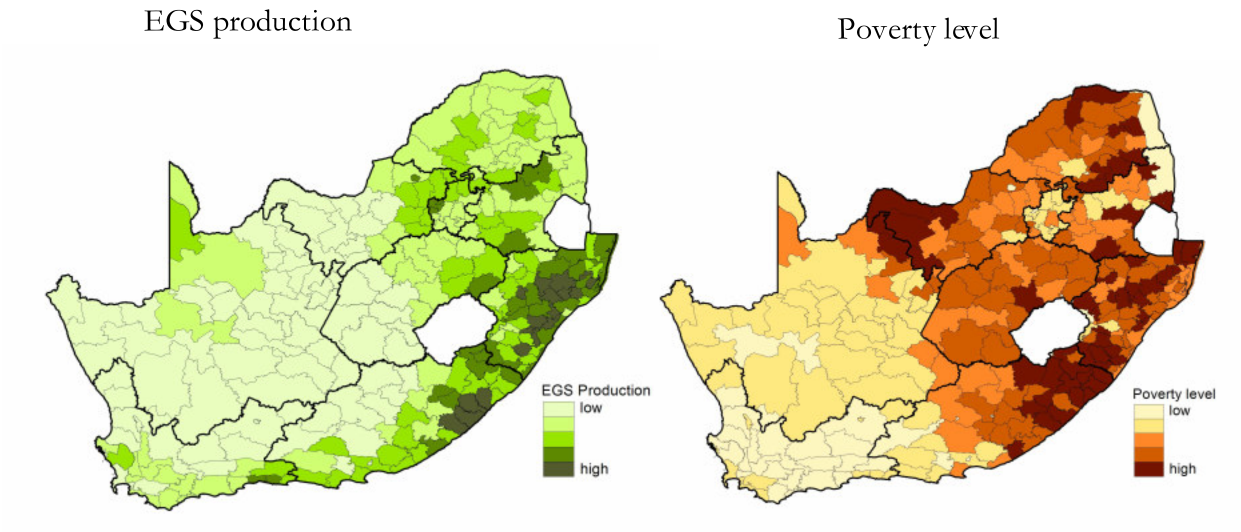
- carbon sequestration is defined as the vegetation potential to store carbon above and below ground and the map is derived from Driver et al. (2005)

- soil retention is defined as the ability of natural vegetation to curb erosion by holding onto soil and the map is derived from Egoh et al. (2008),
- water flow regulation represents the storage component of water services and is defined as the contribution of groundwater to base flow per quaternary contribution; the map is derived from Egoh et al. (2008) based on data from DWAF (2005), and
- water supply is defined as the total water yield from a quaternary catchment, including surface and subsurface flow, and the map is derived from Schulze (1997).



Map 1: South Africa's ecosystem service factories. The darker the colour the higher the ecosystem service potential.
Sources: Derived from Schulze (1997), DWAF (2005), Egoh et al. (2008)

The ecosystems services represented in Map 1 can be combined and superimposed onto the municipal boundaries of South Africa. This can also be done with regard to poverty in order to identify the areas in which it makes most sense to develop a market for ecosystem goods and services. We therefore identified geographic priority areas for intervention by combining the distribution of the ecosystem service factories in the country with poverty levels as well as population density. We calculated the overall ecosystem service level of municipalities by summing the score of the four individual ecosystem services (see Map 2a). Thereafter, we mapped poverty levels per municipality based on the census data (Statistics South Africa 2004). We used the percentage of households with an annual income of less than R4 800 as a measure of poverty level and we defined municipalities with high poverty level where this percentage exceeded 40% (see Map 2b). We also calculated population density per municipality (based on the number of households) and defined municipalities with high population density where it exceeded $20/km^2$.



Map 2: Ecosystem service production and poverty on a municipal level.
Sources: Egoh et al. (2008), Statistics SA (2004)

Based on the above analysis, we identified three priority clusters (summarised in Table 2) according to the distribution of ecosystem service factories, poverty levels and population density. Essentially this implies combining the information on Map 2 to identify the key priority areas for developing a market for ecosystem goods and services in South Africa. These areas have high ecosystem productivity and high poverty, as reflected in Map 3a (the information from Map 3a is summarised and tabulated in Table 3). Interestingly, the areas identified as ecosystem factories and as key priority areas for developing a market correspond very well with areas of high biodiversity importance (see Map 3b).

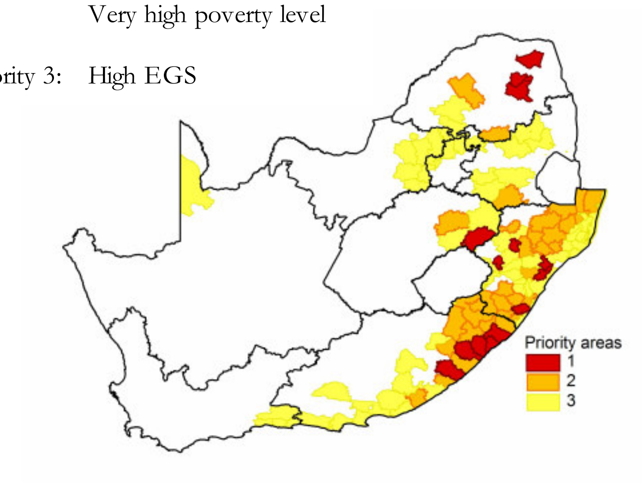
Table 2: Compiling the priority areas for intervention

Priority cluster	Ecosystem service Score	Poverty level	Population density
1	>= 75	High	High
2	>= 75	High	
3	>= 75		

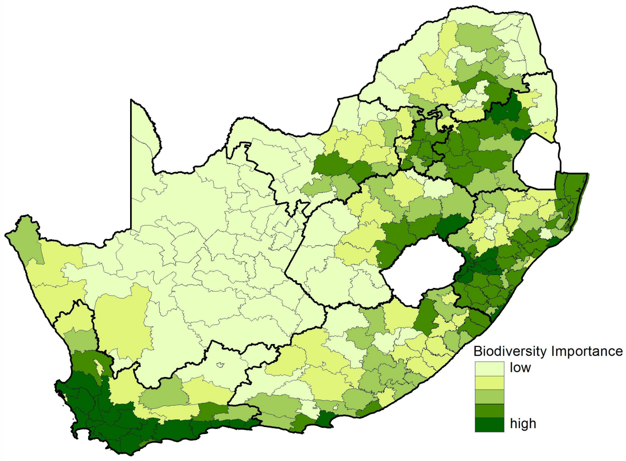
Priority 1: Very high EGS
Very high poverty level
High population density

Priority 2: Very high EGS
Very high poverty level

Priority 3: High EGS



Areas of high biodiversity importance



Map 3: Geographic priority areas for developing and ecosystem goods and services market and areas of high biodiversity significance.

Source: Egoh et al. (2008)

Table 3: Geographic priority areas for developing a market for ecosystem services

		Priority 1	Priority 2	Priority 3	Total
Number of municipalities		14	33	68	115
Number of poor households		360,000	470,000	960,000	1,800,000
Mean % poor households		48%	47%	26%	35%
Ecosystem level (Score)		158 Very high	141 Very high	123 High	132 High
EGS (no of municipalities)[1]		Carbon: 11 Water: 10 Soil: 9	Carbon: 18 Water: 22 Soil: 22	Carbon: 34 Water: 35 Soil: 33	Carbon: 63 Water: 67 Soil: 64
Major Provinces[2]	KZN	5	19	24	48
	EC	5	10	12	27
	MP			9	10
	NW				7
	GP				6
	LIM	3			7

Source: Own analysis.

Notes:

1: This indicates which EGS has high production level and the respective number of municipalities, e.g. out of the 14 municipalities forming Priority 1, 11 have high carbon storage potential.

2: This is a breakdown of each priority cluster per province (most significant one indicated only), e.g. out of the 14 municipalities in Priority 1, 5 are in KZN, 5 in EC, and 3 in LIM.

From the above information it is evident that the key priority areas for the development of a market for ecosystem services are in the Eastern Cape and in KwaZulu-Natal as well as in Mpumalanga and Limpopo provinces. These are the provinces generating most of the country's ecosystem services, but where poverty is the most prevalent.

It is ironic that the poorest of the poor are to be the stewards of some of the most valuable assets in South Africa.

In the past the poor has managed these valuable – and even invaluable – assets to the benefit of all; not enjoying any return on their labour. They were effectively subsidising the affluent.

Now is the time to make the asset base work for them.

4 PAYMENTS FOR ECOSYSTEM GOODS AND SERVICES: SCOPE OF THE MARKET

4.1 Case study 1: Renewable energy

4.1.1 Energy utilising invasive alien plant species and bush encroachment

South Africa is currently in the grip of arguably its most serious energy crisis. Not just because of load shedding, but because a large part of the country's population does not have access to electricity and has to rely on expensive alternatives such as paraffin, liquid petroleum gas (LPG), charcoal and fuel wood. While paraffin, LPG and charcoal are expensive and have negative impacts on people's respiratory systems, the collection of fuel wood is an arduous task mainly carried out by the most marginalised – women and children. This task also has detrimental impacts on the natural environment and biodiversity where indigenous woody species are harvested in an unsustainable manner. In one such case, such harvesting of fuel wood has lead to the introduction of a restoration programme (ARISE) in Giyani and Port St John (commenced in 2004) (Blignaut and Van Aarde 2007). It has now (2008) been complemented with a similar project in the Sekhukhune District of the Limpopo province. Restoration, irrespective of its importance and no matter how essential, only treats a symptom. The cause remains the demand for energy.

The lack of affordable and sustainable energy in rural areas is, however, not a challenge that cannot be overcame. South Africa has a significant amount of (woody) invasive alien resources and, to go with it, a bush encroachment problem. Combined, as is evident in Table 4, these two aspects total almost 114million tons of realistically harvestable biomass. It should be noted that for bush encroachment we only considered 20% to be realistically harvestable and for invasive alien species between 10% and 80% depending the landscape in which they occur. These estimates are based on Working for Water's experience of the past decade as to what is attainable from a technical clearing perspective.

Table 4: Realistically harvestable and utilisable biomass from (woody) invasive alien resources and bush encroachment

Province	Bush encroachment (ha)	Realistic % cleared	Biomass yield t/ha	Harvestable Volumes (t)	Invasive alien plants (condensed ha)	Realistic % cleared	Biomass yield t/ha	Harvestable Volumes (t)	Preliminary estimate of total utilisable biomass
Eastern Cape	4,198,321	20%	15	12,594,963	136,132	70%	106	10,118,787	22,713,750
Free State	707,398	20%	15	2,122,194	22,981	80%	22	410,662	2,532,856
Gauteng	-	0%	-	-	12,379	30%	96	355,418	355,418
KwaZulu-Natal	1,031,633	20%	20	4,126,532	275,948	10%	106	2,930,199	7,056,731
Mpumalanga	1,169,318	50%	20	11,693,180	166,634	10%	106	1,769,430	13,462,610
North-West	5,513,532	20%	20	22,054,128	50,609	30%	32	484,489	22,538,617
Northern Cape	6,273,493	20%	15	18,820,479	149,487	30%	22	1,001,752	19,822,231
Limpopo	3,230,227	20%	20	12,920,908	236,715	30%	96	6,796,179	19,717,087
Western Cape	-	0%	-	-	563,490	15%	64	5,393,102	5,393,102
TOTAL	**22,123,922**			**84,332,384**	**1,614,376**			**29,260,018**	**113,592,402**

Sources:

Invasive alien plants: Versfeld et al. 1998;
Bush encroachment: Hoffman & Ashwell (2001) magisterial districts where bush encroachment was considered a Priority 1.

Note:

The extent of utilisable areas was based on the general nature of the landscape in the respective provinces. The Eastern and Western Cape was extrapolated from areas surveyed on the Eastern Cape coastal plains, the Aghulhas plains and West Coast plains while the estimates for Limpopo, North-West and Free State were verified using recent management assessments of the provinces. Low levels of invasive alien plant accessibility were allocated to Mpumalanga and KwaZulu-Natal because of the mountainous nature of invasions by utilisable species such as Eucalyptus and Australian Acacias.

To clear the woody invasive alien species and the bush encroachment over a 15 year cycle will cost between R1,8 and R2,2billion per annum, as is evident in Table 5, and it will generate between 42 000 and 50 000 person-years in terms of job opportunities.

Table 5: Cost of clearing invasive aliens and bush encroachment over a 15 year cycle in Rmillion under different cost estimates

	Cost of clearing woody invasive alien species			Bush encroachment		
	Low cost scenario	**Mean costs scenario**	**High cost scenario**	**Low cost scenario**	**Mean costs scenario**	**High cost scenario**
Eastern Cape	62	68	75	190	209	230
Free State	10	11	13	32	35	39
Gauteng	6	6	7	-	-	-
KwaZulu-Natal	125	138	151	47	51	57
Mpumalanga	76	83	91	133	146	160
North-West	23	25	28	250	275	302
Northern Cape	68	75	82	284	313	344
Limpopo	107	118	130	146	161	177
Western Cape	255	281	309	-	-	-
TOTAL	**732**	**805**	**886**	**1,082**	**1,191**	**1,310**
Person-years	**16,941**	**18,635**	**20,499**	**25,057**	**27,563**	**30,319**

Note: The figures above are based on the extent of invasive alien plants as estimated by Versfeld 1998. Unfortunately the revised estimates of the total extent of invasive alien plants in South Africa will only be available in December 2008. In comparison with the above estimates Common Ground et al. (2003) estimated that to get invasive alien plants under control by 2020 an annual budget of R1,65billion is needed. This estimate, however, did not take into account the impact of biological control and other initiatives like value added industries and legal incentives and disincentives.

Should biomass from accessible areas be utilised to generate electricity using biomass gasification, it is possible to install a variety of small (2MW–10MW) systems with a total installed capacity of 720MW. It should be noted that the limiting factors to the size of the power plant are the realistically reliable size of the feedstock and the distance the feedstock has to be transported to get to the power plant. Power plants erected too far from the point of demand for the electricity is also likely to lead to unwanted transmission or distribution losses. South Africa suffers from a lack of working examples, however. There is one small non-functional system near Fort Hare, but there is no feedstock supply or management agreement to this unit that was financed by Eskom. This raises the issue about management. Capital without management is, by and large, wasted capital. Technically the system can work, but it requires a programme and concerted effort to allow the development of the required management personnel.

Should one be able to manage for the above technical aspects that will influence the systems' efficiency and cost-effectiveness, then one can commence to calculate its economic potential. If these systems function 75% of the time generating electricity at 65c/kWh they will generate electricity with an annual turnover of R3,5billion (see Table 6) if the proceeds from the sale of carbon credits are included. While the capital expenditure (unit cost) of a biomass gasification unit is approximately R12million/MW, which is about 50% of the capital expenditure of a coal-fired power station, the cost of harvesting, extracting and transporting the biomass is expensive and time-consuming. These activities, however, have the potential of generating the number of jobs mentioned above. It is hence possible to utilise the existing biomass of problem species to generate electricity, reducing the need for the use of expensive and unhealthy alternatives and generate income and business opportunities in rural areas at the same time. While the harvest of the biomass in question is in progress various forms of "energy farming" could commence to ensure a long-term and sustainable operation of the electricity plants.

Table 6: Key information concerning the generation of electricity from available biomass

	Preliminary estimate of total utilisable biomass: t	Biomass per year over 15 years: t	Installed capacity[1]: MW	Electricity generated at 75% op. time: MWh	Value of electricity at 65c/kWh: Rmil	Value of carbon sales at R100/tCO_2 Rmil	Total value Rmil
Eastern Cape	22,713,750	1,514,250	144	946,406	615	95	710
Free State	2,532,856	168,857	16	105,536	69	11	79
Gauteng	355,418	23,695	2	14,809	10	1	11
KwaZulu-Natal	7,056,731	470,449	45	294,030	191	29	221
Mpumalanga	13,462,610	897,507	85	560,942	365	56	421
North-West	22,538,617	1,502,574	143	939,109	610	94	704
Northern Cape	19,822,231	1,321,482	126	825,926	537	83	619
Limpopo	19,717,087	1,314,472	125	821,545	534	82	616
Western Cape	5,393,102	359,540	34	224,713	146	22	169
TOTAL	**113,592,402**	**7,572,827**	**720**	**4,733,017**	**3,076**	**473**	**3,550**

Notes:

1 Installed capacity refers to the total electricity generation capacity, or the size of the power plant, that could be erected as a result of the available biomass.

The generation of electricity from biomass can be augmented with biogas from manures. This is the topic of the following section.

4.1.2 Energy utilising biogas produced from cattle manure

Biogas is a renewable fuel derived from the anaerobic digestion of biodegradable matter, including animal manure. Biogas largely comprises methane (CH_4), a combustible gas, but also contains a large proportion (about 35–40% by volume) of carbon dioxide (CO_2), a heavier and non-combustible gas, plus some fraction of hydrogen sulphide (H_2S). While biogas can be used successfully in most applications designed for LPG, methane (or enriched biogas) can be used in all such applications.

> **Box 7: A village-scale application of biogas**
> Using only the night-time manure of 600 head of cattle that are kraaled overnight in a typical village, will produce 120m^3 of biogas per day. This feedstock volume is sufficient to produce 48kg of methane. This compressed and scrubbed biogas is equivalent to 48kg LPG/day, or 17,5 tons of LPG/annum. At a calorific value of 50MJ/kg, 17,5 tons of bottled biogas is equivalent to 875GJ. At 3 600MJ/MWh the 875GJ/annum of energy is equivalent to 243MWh/annum. Over, for example, 5 years (2008–2013) this results in an avoided fossil fuel use of 1 217MWh.
>
> A feasibility assessment is currently (Oct. 2008) ongoing to consider the replacement of the Kruger National Park's LPG requirement with scrubbed biogas produced in adjacent communities.

In rural communities biogas produced from the overnight manure of corralled cattle is ideal for use in thermal applications such as cooking. This will significantly reduce the use of firewood and increase the quality of life of especially women and children who are generally tasked to collect the wood. It is also a much cleaner burning form of energy than wood or coal, and much safer than other forms of energy, such as paraffin. Should the biogas be scrubbed and compressed it can be used to power generators, or be sold to commercial agents to replace LPG or any other fuel (see Box 7 for more details).

The same provinces identified in Section 3 as ecosystem provision priority areas are also technically the most suited for the production of biogas.

Biogas production – which is labour intensive – can be produced locally wherever animal manure and agriculture residuals are available, but the provinces most suited are the Eastern Cape, KwaZulu-Natal and Limpopo (Austin and Blignaut 2008).

One village-scale biogas production and bottling facility will contribute to rural development in the following ways:

- It will create approximately 50 months of local labour during construction.
- It will create approximately 10 permanent, full-time local jobs during operation.
- It will reduce CO_2-emissions depending on the application of the biogas and the source of energy it will be replacing.
- It will create opportunities for development of local businesses, for example in transport, irrigated agricultural and selling the residual from the biogas production process as fertiliser.
- It will provide training to the operators of the biogas bottling installations.
- It will give rise to environmental awareness and safety campaigns for the communities at large.

The scope of such a programme is quite significant. There are 5.5million cattle grazing on communal land, which is a third of SA's total stock. If only 50% of the cattle is considered, their manure will be sufficient to run over 4,500 biogas bottling installations with a combined turnover of R1,182million/a. Operating these installations will create 45,000 permanent rural jobs, avoid at least 135,000 tons of CO_2-emissions per year, and generate a profit of R234million per year. This energy translates to approximately 4million GJ or 1 100GWh/annum of electricity generation.

Changing gears, if the manure is not bottled and sold commercially, it still has incredible potential as an energy carrier for domestic purposes. In the recently completed national biogas feasibility assessment (Austin and Blignaut 2008), the following key observations were made:

- There are (conservatively) 310 000 households (9.5% of SA's rural households) that show the technical viability to participate in a rural biogas programme.

- If one assumes that the 310 000 households use biogas for their entire energy demand, the equivalent value in electricity replacement cost (not paying for electricity that constitutes an outflow or leakage of money from the 2nd to the 1st economy) is approximately R325million.
- The province in which this programme will make most sense is the Eastern Cape, which has a 26% financial IRR and an economic IRR of 77%.
- Key stakeholders for the programme include the DME, DTI, AsgiSA, the National Development Agency (NDA) and the Umsobomvu Youth Fund.

> Access to energy from a renewable source using appropriate technologies is a first and critical step towards unlocking the potential of our people,
> **while removing one of the key drivers of ecosystem degradation.**

- Implementing the programme presents an opportunity to co-ordinate various rural developmental programmes under one banner and, as a result, harmonise different public funding streams in capital and operational subsidies.

While it is fully appreciated that introducing a biogas system will imply a change of manure management, in addition to a programme in capacity building, biogas has proven to be utterly successful in places like Nepal, Vietnam and India. Also in South Africa there are pockets where biogas is being utilised in both urban/commercial set-ups (such as where restaurants uses biogas to cook with using food leftovers) and rural/domestic conditions, such as in Richmond (KZN) and Gawula near Giyani (Limpopo Province). An important consideration is that with all change, the change in manure management system will also have to be managed, but, based on all the interviews conducted during the national biogas feasibility assessment (Austin and Blignaut 2008) people are willing to participate in such a national biogas as programme if offered the opportunity. Currently a feasibility assessment is ongoing to determine the possibility of replacing Kruger National Park's LPG requirement with biogas produced by communities in adjacent villages (Box 7). This feasibility assessment entails the development of a business case for such a programme, but in and by itself there is no working example of such in the country yet.

4.2 Case study 2: Water

South Africa is an arid country with an average rainfall of approximately 450mm/year which is just more than half of the global average of 860mm/year. The eastern parts of the country are wetter while large areas of the Northern Cape, Free State and North-West provinces are dry. It is anticipated that this gradient will be exacerbated through climate change. This implies more serious and more frequent droughts in the west, and more frequent floods in the east. Therefore, water management from both an access and availability perspective as well as from a risk mitigation view, is likely to become more important. Strategic decisions concerning adaptation have to be taken now. We can wait no longer.

The importance of taking strategic action is further emphasised by the fact that many water catchments are already under serious stress, even to the point of being over-subscribed or developed and in a deficit. In the past, water managers used an intricate system of inter-basin water transfer schemes to transfer water. We do not have many of those options available any longer, yet the country has to develop, which necessitates water. Both the ground and the surface water in the northern parts of the country, for example, such as the Limpopo, Inkomati, Upper Vaal, and Lower Vaal systems are nearly fully developed and over-exploitation already occurs. In 2000, the demand for water outstripped the available supply in 10 of the 19 water management areas of the country. Shortfalls were present in Limpopo (23) (million m^3/yr), Levuhu/Letaba (36), Olifants (194), Inkomati (258), Thukela (103), Mvoti-Umzimkulu (241), Lower Orange (9), Gouritz (63), Olifants/Doring (35) and Berg (5) water management areas (DWAF 2004). While there were still options for new augmentation schemes in some of these catchments others, for example, the Olifants, Inkomati and Berg are already impacting negatively on the environmental reserve. Irrespective whether there is still "undeveloped" water available in a system or not, land use management in the catchment must be taken into account as the development of water infrastructure is very expensive. If the inflow to water infrastructure is not optimised, it will impact negatively on the viability of such infrastructure. Furthermore, a large percentage of surface water extraction is still run-of-river (riparian extraction with no formal storage facilities). Land that is allowed to become invaded by alien plants is the best known example of a management practice that impacts on the way in which water is being released. Other practices include the transformation and degradation of wetlands, overgrazing, and short and unsustainable veld fire regimes which lead to sheet and donga erosion. Because of reduced basal cover in especially Karoo, grassland and savannah systems, flood flow increases while low flows decrease. This has significant implications especially for people dependent on run-of-river extraction. Furthermore, sediments as a result of erosion events silt up storage facilities. This has clearly been shown in the Maloti-Drakensberg payments for ecosystem services study (also see Boxes 12 and 13).

As mentioned though, the impacts of invasive alien plants on water resources are the best known. Cullis et al. (2007) estimated that invasive alien trees in our watersheds (mountain catchments) and riparian areas reduce utilisable water (yield) by 695million m^3/yr or 4.1% and if left unchecked this can increase to 2,724million m^3/yr or 16.1% of registered water use (see Table 7). The estimated reduction in yield due to invasive alien trees in the water management areas with shortfalls is shown in the table below.

Table 7: Impact of invasive alien plant species on water provision, and its economic loss

Water Management Area	Shortfall in 2000	Current losses due to invasive alien trees	Potential future losses due to invasive alien trees	Economic value of water currently lost, in Rmil, at various marginal use values			Potential future loss in the economic value of the water, in Rmil, at various marginal use values		
	Million m^3	Million m^3 & the % of the losses to the shortfall in parenthesis	Million m^3 & the % of the losses to the shortfall in parenthesis	R1.4/m^3	R3.29/m^3	R6.9/m^3	R1.4/m^3	R3.29/m^3	R6.9/m^3
Limpopo	23	18 (78)	63 (274)	25	59	124	88	207	435
Levuhu/Letaba	36	11 (31)	67 (186)	15	36	76	94	220	462
Olifants	194	69 (36)	133 (69)	97	227	476	186	438	918
Inkomati	258	49 (19)	166 (64)	69	161	338	232	546	1,145
Thukela	103	48 (47)	261 (253)	67	158	331	365	859	1,801
Mvoti-Umzimkulu	241	126 (52)	420 (174)	176	415	869	588	1,382	2,898
Lower Orange	9	8 (89)	88 (978)	11	26	55	123	290	607
Gouritz	63	23 (37)	79 (125)	32	76	159	111	260	545
Olifants-Doring	35	5 (14)	52 (149)	7	16	35	73	171	359
Berg	5	19 (380)	66 (1320)	27	63	131	92	217	455
Total	**967**	**376 (39)**	**1,395 (144)**	**526**	**1,237**	**2,594**	**1,953**	**4,590**	**9,626**

Source: Cullins et al. 2007, MDTP 2008, and own analysis

From the above it is clear that the control of invasive alien trees in watersheds and riparian areas has the potential to significantly impact on the viability of water in stressed catchments by reducing the current shortfall by about 40%. In cases like the Olifants, Inkomati and Berg systems, the clearing of current invasions can restore the very important environmental reserve. Depending on the use of the water and the marginal value applied, such as a low R1,40/m^3 for agricultural use to a high of R6,90/m^3 for residential and high value added industries (MDTP 2008), the economic value of the water we're currently losing in mountain catchments and riparian zones only, and only in these 10 stressed water catchments, are between R526million and R2,6billion per annum. Should the spread of the invasive aliens not be controlled, the impact on the economy is likely to be between R1,95billion and R9,6billion.

Given the strategic importance of the resource, the investment in natural capital, the investment in water catchment management by the clearing of invasive aliens in this instance, cannot be overemphasised. Also see Boxes 8 and 9 for practical case studies currently ongoing where the private sector is already investing in water and what the cost is of not doing so from a water treatment plant's perspective. The value of intact aquatic ecosystems on the livelihoods of people is also illustrated in Box 10.

Box 8: Investing in water: The market is open and active

The current water pricing strategy states that: *... cost of control of certain IAP's may be charged to affected water users. ... The resultant additional water after taking the ecological reserve and reducing over allocation into account may be allocated to sectors that financially participated in the clearing project* (DWAF 2007). Since 1998 DWAF has recovered some clearing costs from existing government water schemes but until now no new allocations have been made as a result of the clearing of invasive alien trees. There is however two projects currently being negotiated where the yield as a result of invasive alien plant clearing will be allocated to the users. The first being the Blue Ridge Mine that needs 1.27million m^3/yr for their mining activities in Olifants water management area in Limpopo. They had a choice between buying water from agricultural users and paying for the clearing of invasive alien trees. They decided on the latter and are currently negotiating with DWAF about the clearing costs and the issuing of a water license. The second being De Hoek Farm in the Berg River in the Western Cape which has a similar goal but they want to use the water for fruit production. De Hoek also needs more than 1million m^3/yr and, in the process, are also developing a joint venture with the local Saron community. Like Blue Ridge Mine, they are also currently negotiating with DWAF about the clearing cost and issuing of a water use license.

Other opportunities exist for the private sector to become engaged in "Water farming" through, for example, their corporate social investments. This is especially attractive for large and more water intensive companies. Internationally the concept of carbon neutral operations by large companies is nothing new. This means that these companies invest in activities that will either sequester or reduce carbon emissions equal to the amount that they emit. South African Breweries has recently decided to invest in projects that will release water into the natural system equal to the water used by their breweries in Cape Town and Port Elizabeth. The idea is to clear invasive alien trees in the Kouga catchment in the case of Port Elizabeth and on Table Mountain in the case of the Newlands brewery resulting in an increase in stream flow equal to the volumes of water used by these breweries (Nel et al. in press). The difference between the water neutral initiative and the Blue Ridge and De Hoek examples discussed above is that the increased runoff will not be allocated for consumptive use but released back into the system to sustain natural processes.

Box 9: The cost of losing ecosystem functioning on a water purification plant

The Vöelvlei Dam in the Kleinberg River, a subcatchment of the Berg river system, has major challenges with the productivity of their water purification plant. During the last number of years the Cape Town City Council, the management authority responsible for the operations and maintenance of the dam, has noted a decline in water quality. Of particular concern is nutrification and to some extent siltation. These water quality issues have lead to a reduction in production and consequently the output of the Vöelvlei water purification plant. The plant has the potential to purify 273 000m^3/day, but is currently only able to purify 120 000m^3/day, a reduction of 56% or losses of 55 845million m^3/yr. This reduction, and the ensuing economic and financial cost, could have been averted if the ecosystem was still healthy and fulfilling its function.

One of the major negative impacts on water quality in the catchment is the degradation of riparian zones and wetlands. Nearly all the rivers contain invasive alien plant species with densities in excess of 75%. Furthermore, unsustainable farming practices in the catchment, such as cultivation in the floodplain, further negatively impact on water quality. These farming practices have lead to the fact that the majority of wetlands has either been destroyed or is highly degraded (De Roubaix & Viljoen 2008). The natural ecosystem can no longer fulfill its water purification function. One algal bloom, for instance, costs R3,5million to treat while the additional chemicals cost around R1,2million per year. If one assumes only one algal bloom per year the total cost to the water user is R4,7 per year – this is only the direct financial cost not taking into the account the loss in output as mentioned above. For a total of around R15million over a 12 year period and a maximum annual investment of around R1,7million, the functioning of the catchment can be restored with significant impacts on the water quality. If this means the algal blooms can be reduced to one only second or third year and the water purification costs are reduced by 20%, it will lead to a reduction in operation costs of around R2million per annum.

Over and above purification costs is the threat of waterweeds. Waterweeds have major implications for water infrastructure and more specifically pumps and pipelines. It is a well-known fact that waterweeds are more aggressive in water with high nutrient levels. Nutrient levels in catchments are largely dependent on a few activities namely point source pollution from industrial activities, poor purification of domestic and industrial water causing highly nutrified return flows and non-point source pollution due to unsustainable land management practices. Only a combination of the three will ensure optimum water quality in our reservoirs. Improved watershed services can therefore make a significant impact on the cost of water services to the user.

Box 10: Value of water for people and environment

Aquatic ecosystems generate numerous ecosystem services that are valuable to a range of different kinds of stakeholders. In poor rural areas, populations tend to concentrate around rivers and wetlands – people depend on these assets for grazing, agriculture and the harvesting of natural resources for food, medicine and raw materials. These resources can provide up to a quarter of household income in some areas (see Figure a below). However, the monetary value of harvested wetland resources still undervalues these resources, as it does not reflect its importance in terms of reducing risk, such as in times of drought, or as a safety-net to families that have suffered shocks such as job losses. These are crucial functions in countries where governments provide very little in terms of social welfare, including South Africa, where the provisioning services of aquatic ecosystems are estimated to be in the order of R1.8billion per year (Turpie et al. 2008b).

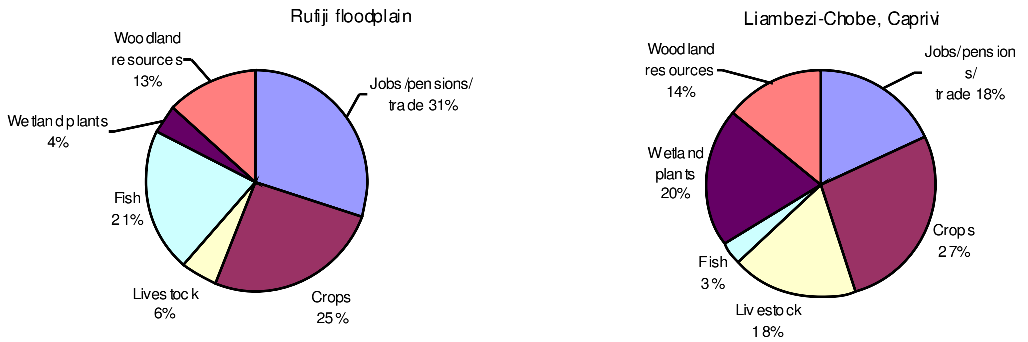


Figure a: Percentage contribution of different sources of income to overall household income on the Rufiji floodplain, Tanzania (livestock = goats and chickens) and next to Lake Liambezi, Namibia (livestock = cattle). (Turpie & Barnes 2003)

Aquatic ecosystems also provide a range of regulating services, including flow regulation and water purification. Wetlands, in particular, attenuate flood waters so that they are less destructive downstream, and by holding water in storage, they increase infiltration into groundwater aquifers and treat organic and inorganic pollutants. River flows also dilute pollutants that would otherwise render water unsafe for consumption and recreation. While the quantification of these services is still generally hampered by lack of biophysical understanding and data, numerous studies have highlighted the enormous value that some aquatic ecosystems have in terms of the regulating services they provide. In South Africa, the regulating services of rivers and wetlands are estimated to be in the region of billions of rands (Turpie et al. 2008b).

Aquatic ecosystems are also particularly valuable in terms of the attributes they contain which provide cultural services in the form of cultural, spiritual, scientific, educational and recreational value. While some of the more intangible values are difficult to express in monetary terms, the recreational value of aquatic ecosystems is manifest in the enormous tourism and property value that can be attributed to them.

The output and value of aquatic ecosystem services are affected by their health, which in turn, is affected by the quantity and quality of water flows into these ecosystems. Many economic activities thus impact on the ability of aquatic ecosystems to deliver these services. These include activities that intercept stream flow, such as plantation forestry, and activities that modify return flows, such as dry land agriculture (which yields pollutants) and hydropower generation (which changes flow patterns and volumes). Thus, actions that sustain freshwater inflows to aquatic ecosystems can generate significant value downstream.

4.3 Case study 3: Carbon sequestration

The carbon sequestration market concerning the reduction of emissions from degradation and deforestation is notoriously difficult to access given the incredibly stringent requirements to prevent abuse and ensure additionality. As a consequence the voluntary market in this sector is very buoyant and offers considerable potential to reduce poverty while simultaneously aiming to sequestering carbon. The voluntary market is also considering soil carbon and sequestration of carbon and/or the avoidance of degradation and carbon leakage from other than the so-called forests – aspects which the formal market is unlikely to approve in the near future. So, how big is the potential market in South Africa?

Based on the 2001 land cover data, we distinguished between degraded areas and natural areas by both biome and province. We assumed, for the restoration effort of degraded land, that it will cost R10,000/ha and that management (after restoration) will cost R70/ha and are based on MDTP (2008). Assuming that a person-day cost R150 and that there are 200 person-days a year, it is possible to determine the number of person-years such a programme can create. We assumed that only 50% of the potential programme can be realised, i.e. only 50% of the land owners will sign up to such a programme, and that the carbon from degraded areas can be sold at R60/t and the carbon from natural areas for R100/t. We vary the carbon sequestration capacity (tCO_2/ha) per biome and province based on inputs from specialists. The results of this analysis are depicted in Table 8.

Table 8: South Africa's carbon sequestration potential

	Degraded	Natural	Total	Total rest. cost	Rest: Jobs	Mngm cost	Mngm: Jobs	CO_2 seques-tration
	Ha	Ha	Ha	Rmil	Person-years	Rmil	Person-years	Rmil
Eastern Cape	1,211,183	14,202,949	15,414,132	12,112	403,728	1,079	35,966	1,508
Free State	185,698	9,204,346	9,390,044	1,857	61,899	657	21,910	356
Gauteng	11,473	969,158	980,631	115	3,824	69	2,288	118
KwaZulu-Natal	830,713	6,008,777	6,839,490	8,307	276,904	479	15,959	1,493
Limpopo	1,333,933	9,182,926	10,516,859	13,339	444,644	736	24,539	2,433
Mpumalanga	142,105	5,333,435	5,475,540	1,421	47,368	383	12,776	641
Northern Cape	653,919	35,548,505	36,202,424	6,539	217,973	2,534	84,472	1,067
North-West	789,150	7,117,220	7,906,370	7,892	263,050	553	18,448	764
Western Cape	120,746	10,282,432	10,403,178	1,207	40,249	728	24,274	598
Total	**5,278,920**	**97,849,748**	**103,128,668**	**52,789**	**1,759,640**	**7,219**	**240,634**	**8,978**

From Table 8 it is evident that a potential market of approximately R9billion per year can be established generating a potential 240 000 person-years of job opportunities for management only and more than a million person-years of restoration opportunities. Can a carbon trading system work in rural areas and in villages? Can this system contribute towards well-being, conservation and improved resource management? We think yes, but it will imply the participation of the respective land-owners to the programme. These questions are explored in more depth in Boxes 11 and 12.

Box 11: Making carbon credits work for people and the environment

NOVA, based at the Theology Department of the University of Pretoria, aims to bridge the gap between services and products provided by outside institutions to poor households and the perceptions and responses of those households. One of its focus areas is energy, and one of its projects is the Basa Magogo method of igniting a coal-fired stove. This method entails preparing fire in a drum by igniting it from the top. Top-down ignition, rather than the conventional method of burning coal from the bottom-up, produces more useful heat from the same mass of coal and thus consumes up to 50% less coal. The method works in stoves and braziers and reduces the particles emitted from the source by more than 80% compared to the conventional method.

Participating communities were identified in terms of their large or common usage of coal for meeting their basic energy consumption requirements. Mixed teams (youth and women) of demonstrators or fieldworkers were selected through existing local community structures, e.g. through churches, NGOs, local municipality/councillors databases, etc. After about a week's training, which includes practical demonstrations on the Basa Magogo method, they were deployed to conduct demonstrations in houses and public spaces accessible to the general public. Before they begin their work, they enter into a contract or agreement with Nova, defining the terms and conditions of the work. They are provided with all working apparatus and apparels needed, are given transport fees and are remunerated appropriately at the end of the month or week. Recognition certificates are given to all the fieldworkers at the end of the project for the training they did and involvement in the air quality control exercise.

Benefits
The benefits demonstrated by these projects can be summarised as follows:

- **Household level**
  - Reduction in domestic energy cost
  - Increase in expendable income per household
  - Reduction in health risk due to exposure to air pollution
- **Regional level**
  - Reduction in health care cost
  - Reduction in solid waste
  - Improvement in visibility
- **National and global level**
  - An increase of the Human Development Index
  - Reduction in greenhouse gas emissions

Through verifications by a third party, Nova's methodology quantifies the reduction in greenhouse gas emissions by changing the way the people operate their stoves. The reduction in greenhouse gasses is then sold onto the international market – which, in turn, is paying for the project. The multi-faceted benefit of this exercise is both measurable and direct, improving the welfare and health, social outlook and economic returns for the poor communities in taking responsibility for their surroundings. This approach will ultimately lead to a reduction in the demand for fuel in rural areas which could lend itself to the establishment of a Reduced Emissions from Deforestation and Degradation (REDD) project.

Acknowledgement
This extract is from a report and information written by Prof. Attie van Niekerk and Dr Christiaan Pauw in Feb 2008 on *Implementation Of The Basa Magogo Method Of Igniting Coal In Low-Income Households In South Africa* and Thami Klassen's involvement and report in designing and leading an Air Quality Control project in Middleburg.

Box 12: Stopping the leaks: Managing systems to serve the people

Recent research in the Maloti-Drakensberg shows that robust vegetation cover in the upper catchments – through maintaining the recommended cattle carrying capacity and by burning the mountain grasslands in the spring every second year – can enhance water infiltration, reduce flooding, increase carbon sequestration and reduce sediment yields by:

- reducing summer stormflows by up to 40%,
- increasing winter baseflows by an additional 13million m^3 and 4million m^3 in the upper uThukela and upper Umzimvubu catchments respectively,
- reducing annual sediment yields by 1.3million m^3 and 5million m^3 in the upper uThukela and upper Umzimvubu rivers respectively, and
- sequestering 134 000tons and 334 000tons of carbon per year in the upper uThukela and upper Umzimvubu catchments respectively.

In essence, good land use practice in high rainfall mountain areas is good for water security, carbon sequestration and other ecosystem services. The following services have high value, and can be traded:

- additional and more regular water supply for users – improving assurance of supply and adding value to both reticulated and raw water users,
- reduced sedimentation of water infrastructure and river ecosystems which reduces water storage and abstraction costs – thereby making cost savings,
- additional carbon sequestration which is tradable, and which also improves grassland productivity, and
- a range of other ecosystem services which are also enhanced by this action such as reduced flooding, improved water quality, improved fishing, biodiversity conservation and improved grazing. These are economically beneficial to society but as yet cannot be traded in this location.

Importantly the management costs are 20% of the direct value of tradable benefits at the most, making this a financially attractive option. Improved management and rehabilitation will also result in 1 800 restoration jobs in the first 7 years, with some 500 permanent jobs.
(Source: MDTP 2008)

4.4 Bundling: The optimisation goal

Restoring and managing natural capital, within a developing context such as many rural areas in South Africa, also has to be considered as an economic development strategy. Economic development and conservation concerns, here represented by the need to do restoration and the management thereof, has to be – and is – complementary. What does this imply from an economic development perspective? It is only when there is mutually beneficial and productive trade between people and nations that economies can develop and grow sustainably. What, then, can South Africa sell to the developed world? And how can South Africa sell it in a way that adds value to both the buyer and the seller? Here we argue that by investing in the global 'limiting factor' to economic development – natural capital – it will be possible for both the developed world, and large multi-national companies based there to honour, enact, and benefit from the basic quid pro quo-principle underlying all mutually beneficial trade.

To be effective we also need to be aware of the interconnectedness among socio-ecological systems, linking economic development, the protection of biodiversity, the fight to slow or halt desertification, and/or mitigation of anthropogenic climate change. The restoration of natural capital and the maintenance thereof can provide important contributions to all of these major challenges at once. This is perhaps best understood by citing the three international Conventions (the 'three Cs') that emerged from the 1992 Rio de Janeiro World Summit on Sustainable Development: The United Nations Framework Convention on Climate Change (http://unfccc.int/), The Convention on Biodiversity (http://www.cbd.int/), and the Convention to Combat Desertification (http://www.unccd.int/). The 'three Cs' are intimately interlinked and should be seen as a cluster, or package (http://ahjwg.chem.unep.ch/). Pursuing any one of the three in isolation can, perhaps, yield x amount of results, while working on all three simultaneously should lead to x^2 or even x^{10} results (see Figure 1)! All three will certainly require investments in time, energy and financing to succeed. These investments include improved science-based knowledge of open, nested ecological systems, improved management tools and techniques, an appropriately oriented policy environment at national and international levels (relating for example to taxes and subsidies), and sufficiently developed institutions to implement the project or programme. Indeed, holistic ecological restoration (Clewell and Aronson 2007) offers a unique opportunity for the 'three Cs' to converge and be mutually reinforced by such a strategic alliance – a subject we will return to in the following section. It is noteworthy that striving to simultaneously address the objectives of these three conventions would take us a long way forward in contributing and ultimately achieving the United Nations' Millennium Development Goals to overcome poverty on a global scale (http://www.un.org/millenniumgoals). These goals – the so-called MDGs – is a set of development indicators agreed to by all countries and the world's leading development institutions, and forms a unifying factor among all the ongoing development efforts with the aim to halve poverty by 2015.

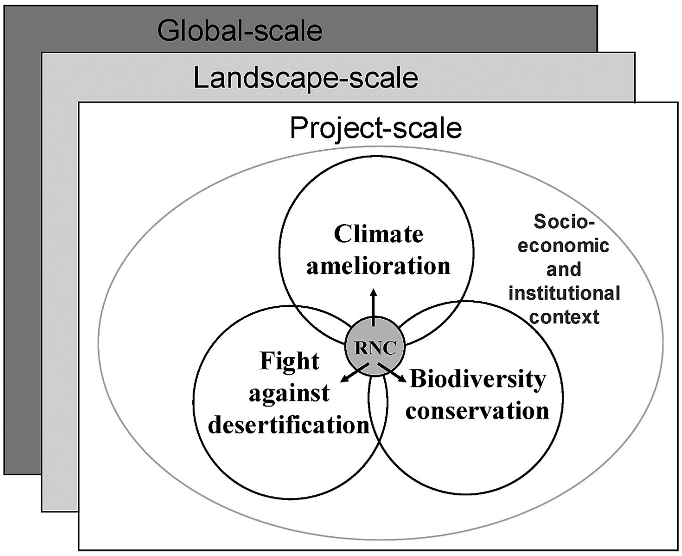


Figure 1: Bundling of services: Achieving multiple objectives simultaneously
Schematic diagram relating objectives and strategies for ecological restoration in terms of the three Conventions of the 1992 Rio Summit as motivations in a purely conceptual space at different scales, embedded in different socio-economic and institutional contexts. The three arrows converging on a central area marked RNC in the center of the figure indicate the need for integration and synergy among activities that relate to the 'three Cs'. The three conventions are obviously not the same in nature or in scope. The fact that all three are depicted by circles is merely for purposes of presentation.
Source: Blignaut et al. 2008b.

Box 13: The value of bundling services together: The case of Ukhombe village, KwaZulu-Natal

Using the land for one service has a very different value to using the land for a suite of services. In general, farmers tend to maximise their use of one service, such as grazing, to ensure that they earn the greatest private benefit. However, this maximised private use frequently generates costs to society, as the public goods and services supplied by land are diminished. Consequently, maximised private exploitation of natural assets results in a net loss to the greater society. In communal grazing lands across South Africa this process tends to dominate, with society bearing the long-term costs of poor water supply, sedimentation of dams, global warming, and a less attractive tourism asset, while there is a 30% increase in returns from cattle in the short-term. See the table below for a representation of the difference in cattle returns per hectare for cattle farming at optimal vs. excessive stocking rates.

If society is willing to pay for a land use system that prevents the dis-services of excessive cattle stocking, then a more optimal solution is possible – the farmers get greater returns, while the society experiences less costs. In Ukhombe, a communal farming in area in the KZN Drakensberg, research has shown that if the cattle farming practices are changed from the prevailing over-stocking and over-burning regimes to a land management system of the recommended stocking rates and burning regime, then it is possible to generate a range of additional beneficial ecosystem services. The research also showed that for a common set of management actions, four high-value ecosystem services could be delivered – winter water, sediment reduction, carbon sequestration and attractive tourism assets. Should a market be developed for these services, then the reduction in private returns experienced by reducing stocking rates and burning every second year, some R22 per hectare, would be offset by an additional income of R180. Importantly, the more services traded, the greater the incentive to manage cattle at the recommended stock capacity. In summary, maximising returns from the land by using only one ecosystem good – cattle forage – has significantly lower returns than using the land optimally for a suite of services.

Annual Returns to Ukhombe Land Owners R/ha/a – with cattle weaners						
Land use	**Water**	**Sediment**	**Carbon**	**Cattle**	**Tourism**	**Combined**
Recommended stocking rate, with appropriate biennial burning	R24.78	R38.64	R62.88	R61.42	R76.00	**R263.72**
Excessive stocking rate, with annual burning	0	0	0	R83.46	0	**R83.46**

By optimising the use of the land to generate a suite of services on a sustained basis, a land owner could generate 3.2 times more returns (benefits less costs) when compared to a single maximised use, provided a market for these additional services is available. For the Ukhombe community, the current benefits of cattle farming result in an annual income of R234 000. If a bundle of services was to be traded, this could increase to R738 000 per year.

The challenge, however, is to engage land-owners into this programme and that will and can only take place if the obvious value in changing land use can be converted into real financial benefits. Indicating potential does not automatically implies a transaction. The transaction has to be developed through a concerted effort.
Source: MDTP 2008.

One example of a case of the value of bundling services together is presented in Box 13 and concerns the Ukhombe village in KwaZulu-Natal. A further, yet hypothetical, example is the management of the communal land around Bushbuckridge. This could, theoretically, be integrated with the Kruger National Park and managed no different from the other contract parks around the Kruger National Park offering top-end accommodation. The area could be managed in such a manner that still allows for the direct access to and the sustainable harvest of resources such as thatch and the hunting of game based on a sustainable off-take basis. The results of this analysis are presented in Table 9 and Figure 2. It clearly indicates that the value of the land, and the possible return from it, is considerably higher (up to R5 000/ha) than what is currently possible under conventional land use options.

Table 9: Comparison of the total economic value of The Kruger National Park land under conservation, with communally-owned land (BBR) under subsistence management and following restoration of natural capital.

Function										
	Rooibosveld (8% of KNP)		**BBR (Actual)**		**BBR potential (Cattle)**		**BBR potential (Tourism)**		**BBR diff (R/ha)**	
Tourism	162904	0.00	184301	0	184301	0	184301	646.48	0	646.48
Existence & option values	162904	0.00	184301	0	184301	0	184301	400.25	0	400.25
Total non-consumptive		**0.00**	184301	**0**	184301	**0**	184301	**1046.73**	**0**	**1046.73**
Honey	162904	0.00	184301	0	184301	30.00	184301	30.00	30.00	30.00
Carbon sequestration	162904	440.00	184301	0	184301	440.00	184301	440.00	440.00	440.00
Total Indirect Consumptive		**440.00**		**0**		**470.00**		**470.00**	**470.00**	**470.00**
Fuelwood	162904	0	184301	161.85	184301	124.76	184301	124.76	-37.09	-37.09
Timber	162904	0	184301	75.91	184301	85.82	184301	85.82	9.91	9.91
Crafts	162904	0	184301	6.92	184301	1830.72	184301	1830.72	1823.81	1823.81
Medicinal	162904	0	184301	134.29	184301	1680.37	184301	1680.37	1546.08	1546.08
Edible fruit, herbs and vegetables	162904	0	184301	260.90	184301	53.87	184301	53.87	-207.03	-207.03
Thatch	162904	0	184301	196.96	184301	21.00	184301	21.00	-175.96	-175.96
Livestock	162904	0	184301	263.61	184301	143.20	184301	0.00	-120.41	-263.61
Wild animals	162904	0	184301	0	184301	0	184301	307.96	0	307.96
Other	162904	0	184301	41.86	184301	0	184301	0.00	-41.86	-41.86
Total Direct Consumptive		**0**		**1142.31**		**3939.75**		**4104.51**	**2797.44**	**2962.20**
Function: Grand total	162904	**440.00**	184301	**1142.31**	184301	**4409.75**	184301	**5621.24**	**3267.44**	**4478.93**

Source: Blignaut and Loxton 2007.

Note: BBR = Bushbuckridge

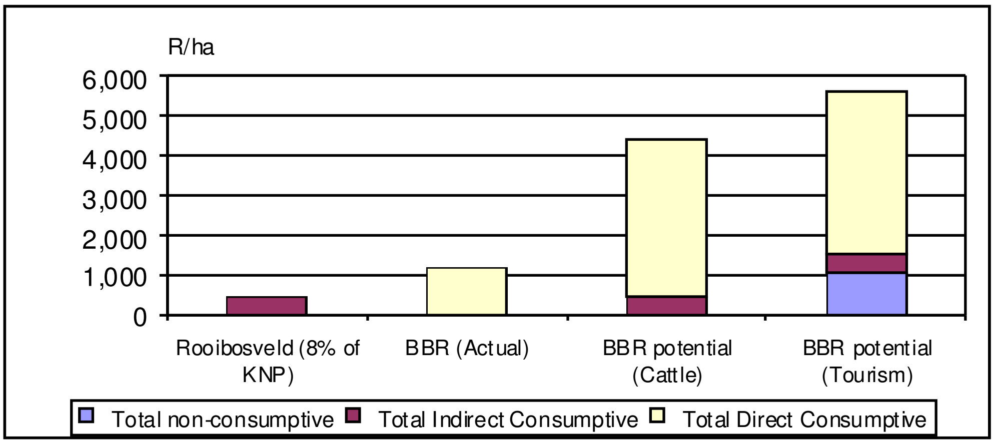


Figure 2: Different values for various land use options surrounding the Kruger National Park.

Source: Blignaut and Loxton 2007.

5 UNLOCKING THE POTENTIAL: DEVELOPING THE MARKET

From Section 3 we know which municipal areas are the areas of priority for establishing a market for ecosystem goods and services. It is those municipalities which offers significant ecosystem services, and which are generally poor. The demand for ecosystem services is in the cities. It is the urbanites who require water and energy, and who have the responsibility to offset their large carbon footprints. Those on the demand side and those on the supply side are therefore geographically apart, yet it is in this where the market for ecosystem services can act as a bridge and enable the development of new market opportunities for those who are currently "un-marketed" – those operating in the second economy.

As was evident from the numerous boxes and the examples provided, the establishment of such a market for ecosystem services is not new. There are various, albeit small-scale, trades occurring. This market, however, is very far from its potential and it is highly unlikely that it will achieve such without a concerted effort. From Section 4, only focussing on energy, water and carbon, it is clear that the potential market size is substantial, as can be seen in Table 10. This partial analysis of the market estimates its size, conservatively, as approximately R17billion/per year with the potential to generate 350 000 person-years of employment opportunities.

Table 10: Summary: Potential size of the energy, water and carbon markets

	Market size: Rmillion/year[7]	Number of person-years
Energy: Biomass gasification[1]	3,550	42,000–50,000
Energy: Biogas: LPG replacement[2]	1,182	45,000
Energy: Biogas: Fuelwood replacement[3]	325	31,000
Water: At current levels of infestation[4]	526–2,594	The same as for biomass gasification
Water: At future levels of infestation[5]	1,953–9,626	
Carbon sequestation[6]	8,978	240,634

Notes:

1 Refers to the process whereby all forms of woody biomass are being gasified in a biomass gasifier. The gas produced is then used to generate electricity using a generator.

2 Most organic material such as manures and agriculture residuals can, once placed in a digester, produce biogas which can be used as an energy source to replace, among other things, the need for liquid petroleum gas (LPG), a high-value commercials energy carrier.

3 Biogas can also successfully be used to replace the need for firewood and reduce the rate of reforestation, as well as the time spent on collecting firewood. Biogas is also a much cleaner and healthier energy carrier than wood.

4 Refers to the value of the water consumed by invasive alien plants species at current rates of infestation. By value is meant the economic value, i.e. the value of the water through the economic value chain and not the price of water.
5 Refers to the value of water consumed by invasive alien plant species in future if left uncontrolled at today's economic values.
6 Refers to the potential value of degraded and intact natural capital to sequester carbon. Varying sequestration rates for both the level of degradation and the vegetation type has been used.
7 For an explanation how these numbers were derived, please consider the main text.

Ho do we get the money to where it matters: paying the right people to do the right jobs in the right way, regularly and properly?

Important to consider when contemplating markets for ecosystem goods and services is that the products and the goods and services might vary considerably. If one takes water, for example, there are three distinctly different market possibilities. They are:

1) The Blue Ridge Mine option (Box 8):
The equation is simple: No water = no mine since there is no surplus water in the system. The cheapest additional source of water is the clearing of invasive aliens. This is a private initiative to pay people to do the work, but brokered and wheeled by and through DWAF. Approval; that is mandatory according to the National Water Act since only DWAF can award water use licences. The mine essentially bought registered water use licences by paying for the clearing of IAPs.

2) The SA Breweries option (Box 8):
Water neutral scheme – SAB calculated their water footprint and they pay for the clearing of invasive aliens through their corporate social investment fund. They are essentially buying goodwill and public relations through the clearing of IAPs.

3) The general water user option:
Pay for water at the pipe as a result of the removal of invasive aliens, essentially paying a raw water charge, but the water users are unattached to the actual water source. At the moment the water users are only paying for water delivery services through the built environment, and the land owners and natural capital are subsidising them. If we add the charge for management of the catchment, they will pay for the services natural capital and the stewards of the land are providing as well. The water user will then, for example, pay for the clearing of invasive aliens and restoration.

In all three cases, the people buying the water actually have not paid for the water per se. They bought a service that varied across the three cases, linked to a single activity or cost item – the clearing of invasive alien plants.

To mainstream this market – and to unlock the value of natural capital – we have to consider economic development;

it is trade, not aid, which matters.

To make this market work, however, we need new market structures and institutions.

One plausible institutional system that can work for "farming with ecosystem goods and services" is a system comparable to an out-growers system, as it has become known and demonstrated in the sugar cane and forestry sectors (see Box 14). This system could be adapted to work for ecosystems as well through what has become know as the Community Works Programme (CWP). Communities could be contracted to provide ecosystem services with the CWP as the local implementing agencies. The system, however, needs an overarching payments broker or facilitating agency that can bundle the services and the areas and optimise the trade (see Figure 3). Whereas the Catchment Management Agencies (CMAs) could fulfil the role of broker for water in future (or the regional DWAF offices while the CMAs are being established), a dedicated facilitation agency for carbon and the other services would be required to liaise with the various CWPs.

Box 14: What can we learn from industry: The out-growers programme

The timber and cane sugar industries have both successfully established small-scale out-grower schemes that generate large volumes of produce within the industry. These two industries have shown that with the right support and incentives, developing farmers can respond to the market and in so-doing improve rural livelihoods.

The two industries are successful in that both the seller (the farmers) and the buyer (the mill owners) are incentivised to make the market work and to secure a sustainable supply of material. The returns are attractive for both parties, and they cooperate in establishing, maintaining and harvesting the crops. Importantly, the buyers play a very active role in promoting efficient farmers by:

- guaranteeing to buy the produce at the market price,
- supplying the technical and material inputs to the farmers that will result in the volumes desired by the industry,
- reducing the risks associated with long-term crops such as timber, by providing financial advances on the final sale of produce,
- reducing the financial risks to farmers by supplying the necessary materials such as seedlings etc., and
- ensuring that efficient transport is on hand to move the produce to the mills.

This shows that small-scale developing farmers can engage with sophisticated markets, producing the right products at the right time. In a similar vein, with the right investment from ecosystem services buyers, rural land owners could meet the supply requirements, thereby providing opportunity for a vibrant ecosystem services market in rural South Africa.

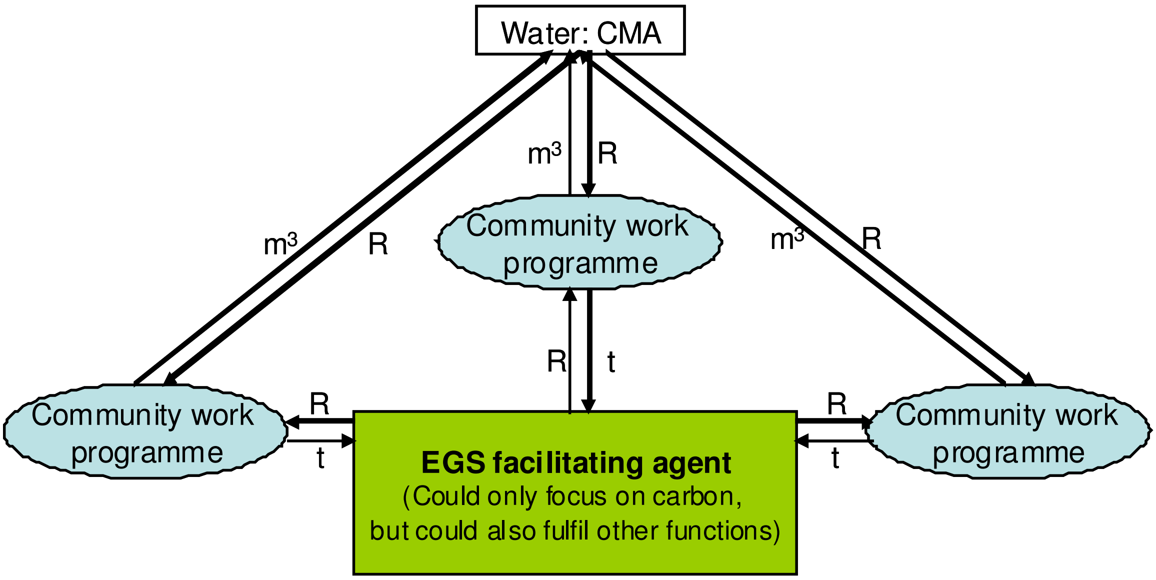


Figure 3: A possible institutional and market design for the development of a payment system for ecosystem services.

The whole purpose of developing a payments facilitating agency would be the re-development of social capital where that has become fragmented in the past. It would therefore make sense that government has to pay for the establishment cost of such an agency. The transaction cost of setting up such an agency is likely to be an insurmountable barrier to entry. Other barriers to entry include:

- Monitoring and evaluation certification, not unlike that of the global carbon standards;
- Local-level as well as agency-level capacities which include a thorough understanding of the market;
- Entitlements and title deeds to the returns of the trade;
- Mechanisms to convert the benefits of the services, which are in the public domain, to private benefits;
- Potential role-confusion among CMAs/Irrigation boards/NGOs/Conservation agencies during the process of market development;
- Highly successful extended public works programme which could lead to the crowding out of the market – leading to a notion that government will step in and maintain all ecosystem goods and services;
- Incomplete knowledge and information gaps – it is interesting to note that many international PES cases are based on much more rigorous science than what is seemingly required here; and
- Unattractiveness in the carbon market – given South Africa's arid nature.

Actions that are required to get the market and the facilitation agency established include the following:

- The provision of incentives to actually trade and to develop the market;
- Institutional design – an initial attempt has been made, but this has to be followed-up with a specific business plan by the agency responsible for this task;
- The clarification of the roles of the CMAs, and NGOs – which will require a huge co-ordination and management role by the facilitation agency;
- The identification and development of a pilot site, and
- The development of monitoring and evaluation protocols and plans.

In accordance with the suggestions made here, Box 15 applies these principles in a concrete example as discussed and suggested after concluding the Maloti-Drakensberg project. In this case the multiple contractors could be perceived as the CWP that are being contracted by the PES implementing agency to do the work.

Box 15: Developing the market for ecosystem goods and services in the Maloti-Drakensberg:

The eco-hydrological economic model shows that it is financially feasible and economically beneficial to trade baseflow augmentation, sediment reduction and carbon sequestration from areas of high rainfall in the Maloti-Drakensberg. Importantly, the feasibility shows that the financial benefits are variable but generally positive, and the impacts on jobs will be significant. Clearly, it is worthwhile for suppliers of ecosystem services – the mountain communities and the potential ecosystem users (the water consumers and high volume carbon producers) – to engage in a mutually beneficial trade. Furthermore, both sectors have expressed a desire to trade, based on the evidence of the current research undertaken.

So the question then arises, how can trade be facilitated? In essence, an enabling environment or a supportive platform needs to be established for an emerging PES trade to develop in an optimal way benefiting both the participants and society itself.

The concept of trading ecosystem services is new, but rapidly developing worldwide. Markets are evolving in mostly water, carbon and biodiversity sectors. However, due to the non-existence of this current market in the uThukela and Umzimvubu catchments, transactions costs are likely to be high in the start up phase. So a facilitating or implementing agent is required. The key requirements of a PES implementing agency would be to:

- Work with potential buyers
  - Identify the funding sources
  - Negotiate the prices and payment terms
  - Negotiate service criteria and indicators
- Work with potential suppliers
  - Package the services to be supplied
  - Negotiate prices
  - Distribute the funds
- Generally
  - Coordinate implementation activities
  - Monitor and evaluate delivery
  - Market the opportunities
  - Provide scientific oversight

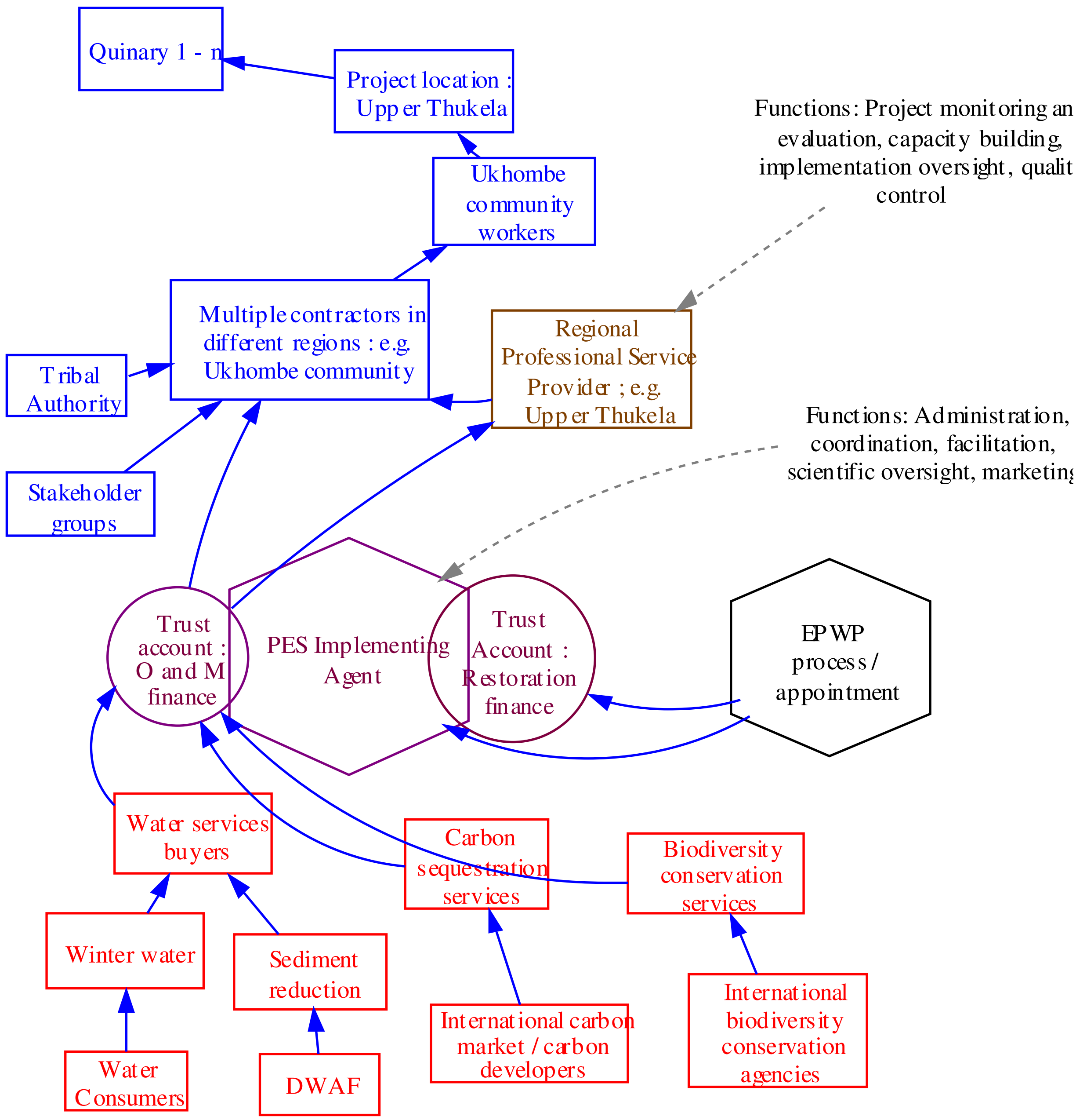
Basically, an effective project implementation and market development service provider is required to facilitate trade. However, as the trade deals with a nationally strategic resource – water – and the producers are generally vulnerable, and the trade process as yet undeveloped, the stability of the trade is unknown. The development of a risky trade in a strategic resource involving vulnerable people, and consequently the failure of the trade to develop optimally, can have significant implications for national water users, supplier households, and associated economies. In addition, the improvement of the mountain ecosystems will have a major positive impact on grassland productivity and river productivity, thereby stimulating all other associated economic activities. For example, improving grasslands will enhance cattle production, thatch production, medicinal plants, scenic beauty and tourism. Improved rivers will generate a fly-fishing industry (as seen in places like Dullstroom), water recreation opportunities, improved water quality, reduced siltation of water storage and abstraction infrastructure, as well as enhance pollution dilution and reduce flood damage. Society at large benefits from such a trade, while the buyers and sellers benefit too.

It can be argued then, given the importance of the market and the broader societal benefits, that government oversight and support to the developing market is desirable and necessary. We propose that government funds a PES implementing agency that will unlock a market for ecosystem services. In order to build on the concept of using the market to supply ecosystem services, we further suggest that the services for implementing a PES system be put out to tender, encouraging efficiency while limiting the burden on the tax payer. It would also be preferable to include an incentive mechanism, one that encourages the PES implementing agency to continue to build the market, and thereby the jobs and other public benefits.

While there is a market to pay for the management of mountain ecosystems (as management is relatively cheap and the returns good for society) by charging the users, there is a large restoration effort required that in most cases cannot be paid for by water charges, as the magnitude of degradation to repair is too large. Here there is a key role for the Extended Public Works Programme, where public works pays for restoration, while the management thereafter is funded by the user. In other words, the government pays for capital infrastructure restoration, or natural capital restoration, and the consumer pays for the management of the natural capital. Again, this justifies the need for some government involvement in the market.

An additional motivation for a public-private partnership in implementing a PES system is that the returns to management are small compared to urban incomes but significant compared to rural incomes. The implications of this are that a small expenditure in the rural setting will make a large impact on welfare. However, an agency that was funded by charging a commission on the trade would need to extract a relatively large percentage of the income, significantly reducing the benefits to rural households. Hence, the argument that a EPWP funded agency could do the facilitation and administration as a public benefit action, while the incomes received from consumers could be directly passed on to the producers, thereby eliminating the need for an expensive middleman. In this way, expensive start up transaction costs are borne by the RSA taxpayer as the benefits of a new industry and trade creates large positive externalities for broader society. Furthermore, an effective implementation system will attract other trade options, such as carbon and biodiversity. This arrangement is illustrated in the diagram below.

Box 15: Another view about developing the market for ecosystem goods and services (cont.)



We propose that in this developing trade scenario, an 'anchor tenant' be secured, such as DWAF or National Treasury, who have a track record of innovative public works programmes. Such an institution could then with public finances, support the establishment of a market with viable institutions. Once such institutions are in place, transactions for other services, such as carbon sequestration and biodiversity conservation, can efficiently be made.

Importantly, the policy and legal environment is conducive to such a trade system. Not only does the Water Pricing Strategy make provision for charging for ecosystem services, but it also makes provision for agencies (such as the TCTA) to supply water to DWAF.

In summary, a PES trade facilitating agency incorporating a public-private sector partnership in some form, could be a suitable vehicle for establishing an emerging market for ecosystem services, where high value resources need to be strategically managed, and vulnerable communities of suppliers need to be guarded against market failure or large price fluctuations. A public-private partnership could significantly reduce the degree of risk for all trade participants, ensuring greater buy-in and greater benefits to RSA as a whole.
(Source: MDTP 2008.)

6 CONCLUSION

Here it has been indicated that South Africa has a few very distinct ecosystem goods and services "factories" referring to those areas with high ecosystem productivity. Once the information of the spatial distribution of the ecosystem goods and services factories are overlaid with areas of deep poverty, key priority areas for the development of a market for ecosystem goods and services are identified. These are areas in the Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo provinces.

This partial analysis of the market estimates its size, conservatively, at approximately R17billion/per year with the potential to generate 350 000 person-years of employment opportunities. While this potential budget is only about 25% of that of the social welfare budget, it is 2,500% that of the South African National Parks Board. Investing in natural capital in the ways proposed here will inject cash into the conservation sector unknown before.

The challenge, however, is to develop an appropriate and adequate institutional framework for the development of this market. We suggest the development of a payment for ecosystem services facilitation agent, as a private sector entity but in close conjunction with government. Such a relationship could be, but is not necessary, one that constitutes a public-private partnership. Important, however, is that the agency will have to liaise with both local communities, through existing structures such as the Community Works Programme or others, the government and the buyers of the services. This is done to bundle the services together and in so-doing reduce the transaction cost of the trade.

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