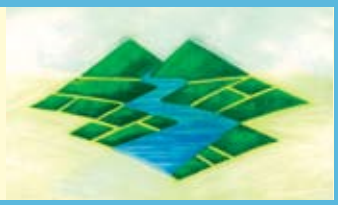
Developing markets for watershed services and improved livelihoods



Fair deals for watershed services in South Africa

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First published by the International Institute for Environment and Development (UK) in 2008

ISBN: 978-1-84369-651-3 ISSN: 1605-1017

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A catalogue record for this book is available from the British Library

Citation: King *et al.* 2008. *Fair deals for watershed services in South Africa*. Natural Resource Issues No. 12. International Institute for Environment and Development. London, UK.

Design by: Eileen Higgins, email: eileen@eh-design.co.uk
Printed by: Russell Press, UK on 80% recycled paper

Contents

Acknowledgements

The contributions of the following people to the overall delivery and lessons learned in the project are acknowledged:

Pete Ashton, Fritz Bekker, James Blignaut, Arthur Chapman, Marius Claasen, Thomas Gyedu-Ababio, Hanlie Hattingh, Margot Herling, Christo Marais, James Mayers, Pat Manders, Carmel Mbizvo, Nancy Moilwa, Elizabeth Muller, Rob Palmer, Gavin Quibell, Robyn Steyn, Mark Surmon, Tony Turton, J.A. Van Heerden and Alet Visser.

Acronyms and abbreviations

ANC	African National Congress
AWARD	Association for Water and Rural Development
CMA	Catchment management agency
CSIR	Council for Scientific and Industrial Research
DBSA	The Development Bank of Southern Africa
DFID	UK Department for International Development
DWAF	Department of Water Affairs and Forestry
ES	Environmental service
GDP	Gross domestic product
GGP	Gross geographic product
IIED	International Institute for Environment and Development
IPCC	Inter-Governmental Panel for Climate Change
NGO	Non-governmental organisation
NWA	National Water Act
PCPS	Payments for catchment protection services
PES	Payments for ecosystem services
PWS	Payments for watershed services
RSA	Republic of South Africa
SANBI	South African National Biodiversity Institute
SANParks	South Africa National Parks
UNDP	United Nations Development Programme
WfW	Working for Water Programme
WMA	Water management area
WUA	Water user association

Executive summary

In most parts of South Africa, water is scarce and droughts are a regular feature. Under most climate change scenarios, water is likely to become scarcer and extreme events (ie. droughts and floods) more frequent and possibly more intense. In some regions, the lack of water is already becoming a constraint to the economic development that is so badly needed in a country that is still addressing the legacy of apartheid.

Over the last decade, most of the legislation governing land, water and natural resources in South Africa has been revised. Importantly, the Constitution specifically recognises sustainable development and the need for a healthy environment for the benefit of current and future generations of South Africans. The 1998 *National Water Act* provides a comprehensive overhaul of nearly all aspects of water management in South Africa. It specifically makes provision for meeting basic human needs and safeguarding the ecological integrity of rivers and also recognises that South Africa's international obligations must be met.

Most governments – recognising the close relationship between land use and the quality and quantity of both surface and ground water – have in the past tried to influence land-use decisions through regulation. Typically, important parts of catchments were protected, while land use in other parts of the catchment was controlled through various forms of legislation. Regulatory mechanisms have generally failed to control land use, and water quality in particular has suffered. In the last decade, an approach in which stewards of ecosystems are rewarded has gained increasing recognition and interest amongst conservation and development experts. In watershed management, payments for good stewardship are generally made by downstream users of water to upstream land managers. The applicability of payments for watershed services (PWS) – or payments for catchment protection services (PCPS) as they are know as in South Africa – to developing countries has been accelerated by their successful application, amongst others, in Costa Rica, New York, and the Vittel Valley, France.

In South Africa, controlling the spread of alien invasive species is a major challenge. It is currently estimated that 1.7 million hectares are covered by invasive species and that their removal would free up about 3.3 million m^3 of water annually. The government's Working for Water (WfW) Programme is one type of PCPS – albeit publicly funded. WfW uses long-term unemployed persons, mainly from rural areas, to remove invasive alien species from catchments to reduce their negative impact on surface water.

A diagnostic report on payments for catchment protection services that immediately preceded the project identified that the precedent set by Working for Water and the wholesale legislative changes created interesting but untested opportunities for the

development of privately led payments for catchment protection services. The subsequent project 'Developing markets for watershed protection services and improved livelihoods' was jointly implemented in South Africa by the International Institute for Environment and Development (IIED) and the Council for Scientific and Industrial Research (CSIR) and was funded by the UK government's Department for International Development (DFID). The project's objective was to facilitate the payments for catchment protection services that contributed towards poverty alleviation.

After a national review of potential sites, the upper Ga-Selati sub-catchment and five sites in the Sabi Sand catchment were identified as action-learning sites. These catchments are situated within the Oliphants and Sabie Sand river catchments respectively; the Oliphants and Sabie Sand catchments share a number of important characteristics in that:

- they are both large catchments;
- they both rise in the highveld of South Africa and flow eastwards through the lowveld into the Kruger National Park and on into Mozambique;
- they both have similar wealth gradients, where the bulk of economic activity is located in the upper catchment;
- they both have large rural populations residing in marginal agricultural areas (legacies of the apartheid system and the creation of nominally independent homelands) and which engage in a range of agro-pastoral activities as well as harvesting timber and non-timber forest products from the natural vegetation;
- they both have high rates of soil erosion;
- water demand more often than not exceeds water supply, and as a result there are limited dry-season flows in the lower reaches of both rivers. This is exacerbated during droughts.

Further local partnerships were developed with Clean Stream Environmental Services (upper Ga-Selati sub-catchment) and Nepid Consultants (Sabie Sand catchment) as site-level partners. Site-level activities were supported by a range of local to national studies that provided important baseline information and analyses (See Appendix One). At a national level, the project was guided by a multi-stakeholder committee that included representatives from the Department of Water Affairs and Forestry (DWAF).

In the Ga-Selati sub-catchment, as in the Olifants catchment generally, the core problem was identified as reduced stream flow. Site investigation in the upper Ga-Selati sub-catchment identified the spread of alien invasive species, off-take of water for irrigation, and highly wasteful irrigation technologies as the main causes of reduced stream flow. Although the Sabie Sand catchment has similar problems at a macro level, a range of specific site-level problems that dealt with both water quality (at Sabie town and Hazyview town) and quantity (in the Peebles Valley and the Sabie Sand Game Reserve) were identified. A livelihoods analysis in the Olifants catchment

highlighted the high rates of unemployment and the pervasive nature of poverty in the catchment. It concluded that poverty in the area was directly linked to the homeland policies under apartheid since much of the area lay within the former Lebowa Homeland.

Within the time frame of the project, it was not possible to facilitate payments for catchment protection services in either the upper Ga-Selati sub-catchment or the selected sites in the Sabie Sand catchment. The project made most progress in upper Ga-Selati sub-catchment, where a cost-effectiveness analysis indicated that improving the transport and storage of water in the Ga-Selati Irrigation Scheme would be the most cost-effective intervention within the upper sub-catchment under a payment for catchment protection services approach. Conversely, removing the alien invasive species from the grasslands of the upper sub-catchment was the most expensive option. However, for the horticultural farmers in the upper sub-catchment who were facing acute water problems, all the identified options were cheaper and therefore more cost-effective than harnessing underground water resources.

Although the project did not facilitate any payment mechanisms between the buyers and sellers of catchment protection services, the process, the baseline studies and the analyses conducted as part of the project provided six important lessons. These are:

1. Within South Africa, PCPS alone are unlikely to have substantial impacts on poverty and the livelihoods of poor people: poverty in the north-eastern communal lands of South Africa is largely a function of the structural inequality resulting from 60 years of apartheid. This is exacerbated by the lack of livelihood assets such as skills and information (human capital), poor infrastructure in terms of service delivery and road infrastructure (physical capital), and an absolute lack of financial means (financial capital). People living in the area generally have precarious livelihoods and are extremely vulnerable to external threats such as extreme climatic events.

2. The current water, land and environmental legislation is both enabling and constraining the development of PCPS in South Africa: the current legislative environment presents both opportunities and challenges for any PCPS scheme. On the one hand South Africa's water and environmental legislation is so comprehensive that key land-use changes needed to improve ecosystem services are often already required by law. On the other hand it is clear that implementing these progressive legal frameworks is – and will continue to be – a major challenge.

3. Secure land and water rights are critical for the development of effective PCPS in South Africa: South Africa is still in a period of legal and policy transition in which the government is working to address the inequalities perpetrated during the apartheid era. In particular, land is being restituted and redistributed. (In the upper Ga-Selati sub-catchment, land redistribution was the dominant concern amongst

potential buyers of watershed services and the primary impediment to implementing PCPS.) Similarly rights to, and over, water are being radically overhauled. The above-mentioned reasons for the current insecurity over land and water rights are expected to have important – but generally positive and long-lasting – impacts on livelihoods. The authors of this paper believe that until rights are secure and the uncertainties and tensions abate, opportunities to develop PCPS are likely to be limited.

4. Stable institutional organisational frameworks are critical for the development of PCPS in South Africa: as part of the changes in water and land tenure, the government of South Africa is also transforming water management institutions and processes. In future, 19 catchment management agencies (CMAs) will manage water in the country. During the project only three CMAs had been established but none was fully functional and effective. This meant that for both the Olifants catchment and the Sabie Sand catchment, there was no established organisation to act as an intermediary in transactions, or to fulfil the role of arbiter between the competing water users.

5. The Working for Water Programme (WfW) can inform and transform into privately-led PCPS: the government of South Africa buys catchment protection services through the Working for Water Programme (WfW) – an expanded public works programme whose core activity is the control of water-intensive alien invasive species in upper catchments and riverine areas. Currently there is little incentive for privately-funded PCPS when WfW can be involved for free. However, the precedent/example that has been set by WfW – namely that clearing alien invasive species is good for water supplies – is an important one. Currently, a major constraint to privately funded invasive alien species clearing programmes is the cost. For example, initial clearing costs can be as much as R7,000 per hectare (depending on species, location and density); follow-up visits are required every one to three years at a cost of approximately R50/ha (depending on regeneration rates) and will have to continue for anything up to 30 years (depending on the size of the seed banks).

6. South Africa possesses a unique body of information, knowledge and skills that can facilitate the development of both government- and private sector-led PCPS: South Africa possesses a unique pool and combination of hydrological information and skills (e.g., hydrological modelling) that is not found anywhere else in Africa. These have been used effectively to develop and implement the government's Working for Water and other similar programmes. The precedent set by WfW, the widespread understanding of land-use/water relationships, and the hydrological skills and information that currently exist (together with the models that are being developed under WfW) provide South Africa with an excellent platform for the development of privately funded PCPS. Their widespread adoption will depend on reducing many of the transaction costs.

1 Introduction

1.1 Background

Thirteen years after the end of apartheid, South Africa continues to face a number of challenges including: water stress; the impacts of diseases such as malaria, TB and the HIV/AIDS pandemic; poverty; high unemployment (about 30 per cent), and rising demands to address its huge social and economic disparities[1] (Ashton, 2007). Factors adding to the complexity of these challenges for decision-makers and policy-makers are the powerful global processes and trends of climate change, globalisation and rising oil prices (Perrings 2007). Climate change scenarios, for example, predict a more variable, but drier and hotter South Africa (Schultze 2005; Hewitson and Crane, 2006). This will have severe impacts on already overstretched water resources (Ashton 2007; Ashton *et al.* 2008). For some sectors of the economy (such as mining) water scarcity may well limit economic growth and development (Falkenmark 1994). Since Independence, nearly all South African policy and legislation has been reviewed and revised, including legislation pertaining to land, water and natural resources. This has repercussions for land and water users in all spheres of life (Quibell and Steyn 2005).

Within the international arena new options for the management of natural resources are being developed, with particular emphasis on incentives rather than regulatory approaches (Engel *et al.* 2008). Payments for ecosystem services (PES) are one kind of incentive mechanism that deals particularly with cases of market failure (Engel *et al.* 2008). PES include payments designed for biodiversity protection, carbon sequestration, landscape beauty and catchment protection, and watershed management (Landell-Mills and Porras 2002). However, our collective understanding of the impacts of implementing these mechanisms on factors such as rural livelihoods, their income distribution effects and long-term environmental sustainability, is still very limited (Landell-Mills and Porras 2002), particularly within developing country contexts.

To investigate these issues, the International Institute for Environment and Development (IIED) coordinated a three-year global research project funded by the UK Department for International Development (DFID) called 'Developing markets for watershed protection services and improved livelihoods'. This project was designed specifically to investigate the opportunities for improved livelihoods and land management through payments for catchment protection. South Africa was

1. South Africa has a highly skewed economy, with a Gini coefficient of 0.77 (Statistics South Africa 2001).

selected as one of four country project sites due to its progressive legal and policy reforms, for example the *National Water Act* of 1998. This report presents the results from the two South Africa action-learning sites on the Ga-Selati, Sabie and Sand rivers[2] and associated project activities.

1.2 Payments for ecosystem services

Many ecosystems are being degraded because there are few, if any, incentives to maintain them (Bond and Mayers forthcoming). In the past, governments in both developed and developing countries have relied on legal and other statutory instruments to control land use by farmers and developers. The results of these legal approaches to land management have been mixed, with unprecedented changes in land use from natural habitat to agriculture and settlement over the last 50 years (Adams and Jeanrenaud 2008; IPCC 2000). More recently, innovative market-based approaches have been experimented with to create incentives (financial and otherwise) for appropriate land management and the protection of ecosystems to sustain the provision of ecosystem goods and services. Common examples of these market-based approaches include payments for ecosystem services (PES) and environmentally related taxes and charges. Costa Rica's experience with PES and the catchment management by New York City to ensure fresh water provision are often cited as successful examples (Pagiola 2008; Appleton 2002).

It is argued that payments for ecosystem services can be more economically efficient and more environmentally effective (ie. sustainable) than other incentive-based approaches because they create a direct relationship between the supplier and the buyer of the service (Engel *et al.* 2008). Creating incentives for land management has been done in the past and there is considerable experience from community-based natural resource management, particularly in southern Africa (Frost and Bond 2008). Payments for ecosystem services are different to other incentive-based or -led mechanisms, because they are:

1. A *voluntary* transaction in which
2. a *well-defined environmental service* (ES) (or a land use likely to secure that service)
3. is being purchased by at least one *ES buyer*
4. from at least one *ES provider*
5. if, and only if, the ES provider ensures the supply of the ES (ie. there is *conditionality*).

(Source: Wunder 2005)

2. In this report a 'catchment' defines the area that collects and channels water. A 'watershed' is regarded as the high-lying boundary that separates one catchment from another.

A global review of PES recommended cautious optimism with respect to their efficacy, but highlighted the uncertainty surrounding the equity of the impacts on livelihoods, particularly for poorer sectors of society (Landell-Mills and Porras 2002). For example, payments for catchment protection services (PCPS) can make a direct contribution to the livelihoods of residents in a catchment or river basin. Conversely, there are fears that the changes in land management upon which regular contingent payments will depend may exacerbate or marginalise the poorest inhabitants in a catchment (ibid) if not implemented and managed appropriately.

A necessary – but not sufficient – condition for a successful catchment payment mechanism is that it must provide the buyer with greater economic benefits than the total cost of the payments made (Engel *et al.* 2008). For the supplier of the service, the payments must exceed the costs of changes in land management required to guarantee that ecosystem service. This needs to take place in an environment that minimises the transaction costs (Landell-Mills and Porras 2002).

1.3 The project's approach

Based on an action-learning approach, the project sought actively to engage in the process of developing payments for catchment protection services (PCPS) to develop real time and context-specific lessons (Bond and Mayers forthcoming).

The South African component of the project was coordinated by the Council for Scientific and Industrial Research (CSIR). In consultation with its partners, CSIR selected pilot sites within larger catchments, identified local facilitators, and provided a range of technical support to the project. A multi-stakeholder advisory group guided the project. The overall lessons from it were shared in two seminars with key stakeholders[3] while the supporting research and investigations are documented in 11 working papers (see Appendix One).

- **The purpose of the project** was to increase the collective understanding of 'payments for ecosystem services' and their potential to facilitate the provision of catchment protection services, and to improve livelihoods by designing and employing PES where and when appropriate (King and Bond 2005).

- **The specific goal of this project** was to promote the maintenance of catchment protection services that underpin local livelihoods in South Africa.

3. The first seminar, a national workshop with invited participants from DWAF, SANBI, SANParks, CSIR, UNDP, DBSA and private environmental consultants, was held at the CSIR's convention centre in March, 2006. The second seminar, to the Environmental Policy Committee of the Chamber of Mines of South Africa, was held at the Chamber of Mines in March, 2007.

- The **specific outputs** were:

  Output 1: National learning group for markets for watershed services established and supported.
  Output 2: Key constraints and opportunities for the development of market-based mechanisms for watershed services identified, analysed and documented for six selected sites.
  Output 3: Pilot markets and/or market-based mechanisms in selected watersheds in South Africa are enabled and their impact on poverty monitored.
  Output 4: Lessons learned from action-learning analysed.

1.4 Structure of this report

This report is divided into five sections, structured as follows:

Section 1 provides a general introduction to the concept of payments for ecosystem services and the broader vision of this project team;

Section 2 presents an overview of the national context of the project;

Section 3 defines the project approach for South Africa;

Section 4 presents an overview of the two selected water management areas;

Section 5 outlines the lessons learned from the project and some key conclusions.

2 Water and land management in South Africa

2.1 Introduction

The abolition of apartheid in South Africa has stimulated wholesale change in nearly every aspect of society. For example, there has been widespread revision of legislation to the extent that South Africa is one of the few countries to have the concept of sustainable development enshrined in its constitution (Republic of South Africa 1996). This section provides a brief review of the relevant legal and policy changes since 1994 and the biophysical, economic and social contexts in which the project was implemented.

2.2 The legislative setting

South Africa's legal framework is now based on the notion of 'justice for all', thereby removing the inequities of the apartheid system. The South African Constitution explicitly recognises the importance of land, natural resources and sustainable development (Republic of South Africa 1996) by emphasising the need for a healthy environment that is protected for the benefit of present and future generations. Specifically, the Constitution requires legislative and other measures to 'secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development'. Until 1998, water rights and land ownership were closely related, with landholders having strong riparian rights to water. In 1998, the *National Water Act* was passed (Act No. 36 of 1998, Republic of South Africa 1998). Under the Act, water resources are now managed as a national asset by the Department of Water Affairs and Forestry (DWAF). The Act cancelled all riparian rights to water and separated land ownership from water ownership (DWAF 1997). Riparian rights have now been replaced by licences for prescribed water uses (DWAF 1998).

In future, DWAF will delegate responsibility for local water resource management issues to 19 catchment management agencies (CMAs). These decentralised CMAs will work with local water user associations (WUAs) to ensure effective and efficient management of water resources and delivery of water services. While these institutions are being set up over the next several years, the Department of Water Affairs and Forestry will act on their behalf.[4]

4. Quibell (2007) documents the challenges in operationalising the new legislation. He argues that converting policy into practice has been limited by both financial and human resources. As a result, while South Africa has a model legal and policy framework, changes on the ground have been very slow.

In the context of PCPS, the Act makes three explicit statutory provisions. These are the quantities of water that are required: 1) to meet the basic needs of people (the 'Basic Human Needs Reserve'); 2) to sustain the integrity of aquatic ecosystems (the 'Ecological Reserve'); and 3) to meet international obligations in rivers shared with neighbouring countries. These are the only quantities of water that are specified in law and are regarded as inviolate (DWAF 1997; 1999; 2005). The *National Water Act* also defines 11 additional water uses (Box 1) that can only be made once the Basic Human Needs Reserve, the Ecological Reserve and international obligations have been met.

Box 1

The 11 uses of water defined by the *National Water Act* (1998)

1. Taking water from the resource.
2. Storing water.
3. Impeding or diverting the flow (of a river or stream).
4. Engaging in Streamflow Reduction Activities (potentially any land-based activity that could reduce river flows [S36]).
5. Engaging in a Controlled Activity (potentially any land-based activity that could reduce or degrade water quality [S37 (1) and 38 (1)].
6. Discharging waste (solid or liquid) into the water resource.
7. Disposing of solid or liquid waste in a manner that could affect the water resource (e.g., through inappropriate location of a solid waste disposal facility).
8. Disposing of heated water.
9. Altering the bed, banks, course or characteristics of a watercourse.
10. Removing or discharging of underground water.
11. Using water for recreational purposes.

The characteristics of the 1998 *National Water Act* that make it truly holistic in nature and put it at the forefront of international water policy are that it revokes riparian rights, it adopts a wide definition of water uses, and it devolves water management responsibilities to local CMAs (Quibell 2007). Importantly, the legislation 'recognises the "true" economic value of water and therefore water-resource protection activities should focus on maintaining vital ecological functions and the "*silent services*" these functions provide' (ibid). The new legislation does allow for the creation of incentive-based mechanisms such as markets as long as these do not serve to create or entrench inequities in society (Quibell and Steyn 2005). This broad-based approach to water use (specifically the 'Human Needs' and 'Ecological' reserves) has, however, limited the opportunities to use payment mechanisms to address land use management problems in catchments (ibid).

Prior to 1994, South Africa legislated against the ownership of land by black South Africans (Bradstock 2005). This meant that by the late 1980s, 50,000 commercial white farmers owned 90 per cent of the agricultural land (Mbongwa *et al.* 1996). Black South Africans were essentially confined to a dispersed network of nominally

independent homelands. In 1994, the African National Congress (ANC) outlined a land redistribution and restitution programme (ANC 1994). This land reform programme, alongside other water reform processes, is continuously being implemented across South Africa and is leading to dramatic changes in rural communities and economies.

The combined effects of these land and water reforms are creating considerable insecurity within the commercial farming sector in South Africa. As commercial farmers are an obvious provider and/or user of watershed services, this insecurity could hinder all efforts at establishing a system of payments for catchment services (Quibell and Steyn 2005).

2.3 The economic setting

South Africa is regarded as a middle-income country with an emerging market economy. The gross domestic product (GDP) of the country in 2004 was US$553.2 billion and the average per capital income was US$12,000 (CIA 2006). The South African economy has also been growing at a reasonably strong rate of between 4 and 5 per cent per year since 2002, as measured by annual changes in its GDP (although the first quarter real GDP growth rate for 2008 was down to 2.1 per cent). The country also has well-developed financial, legal, communications, energy, mining and transport sectors. These measures of the economy growth belie the fact that poverty is pervasive, unemployment rates are high, and income distribution remains highly skewed. In 2001, for example, approximately 57 per cent of individuals in South Africa were living below the income poverty line and 29 per cent of the population was unemployed (Whiteford 2004). The level of unemployment has, however, come down since 2001 and is currently around 23 per cent (Stats SA 2008). Income distribution in South Africa remains highly skewed as reflected in the Gini coefficient value of 0.685 in 2006 (van der Berg *et al.* 2005). Thus the bottom 10 per cent of South African households earns 1.4 per cent of the income and the top 10 per cent of households earns 44.7 per cent of income (CIA 2006). This inequality is not limited to financial resources but also relates to education and skills and is one of the key drivers of unemployment in South Africa. Therefore, despite the many positive factors characterising South Africa's development and enormous political goodwill, many challenges remain.

There are also important regional disparities in the distribution of wealth within catchments that have implications for the development of PCPS. The generic payments for ecosystem services model is based on the assumption that buyers of a watershed service operate at the lower end of the catchment (ie. downstream) while the suppliers of services are relatively poorer upland farmers (Engel *et al.* 2008; Wunder 2005). In South Africa the wealth gradient is generally reversed

with the highest concentrations of wealth located along the central plateau due to mining, associated industrial activities, and agriculture. This wealth gradient does therefore limit the opportunities for the conventional model used for PCPS.

2.4 The biophysical setting and water management

In many parts of South Africa water is scarce. The national average annual rainfall is approximately 497 mm – well below the world average of 860 mm. Rainfall is also very unevenly distributed. Approximately 21 per cent of the country receives less than 200 mm of rainfall annually while 65 per cent of the country receives less than 500 mm per year. Drought is a regular occurrence for most farmers. As a result of the country's topography and rainfall, approximately 60 per cent of river flows are derived from less than 20 per cent of the land area (Basson *et al.* 1997).

South Africa's water sector is often likened to a large-scale plumbing system. This is because of the intricate network of inter-basin transfer schemes and multiple sources of supply such as surface water runoff from rainfall, ground water, and the re-use of effluent returned to public streams and water imports from other countries (DWAF 1986; King 2002). Assuming only marginal increases in supply and an increase in demand from 13,280 million cubic metres per annum (m^3/a) in 2000 to 17,248 million m^3/a in 2025, there will be a water deficit of approximately 1,788 million m^3/a by 2025 (DWAF 2002). This will be most acute in the northern, south-western and central regions (Basson *et al.* 1997).

Climate change scenarios predict that the western parts of the country will become drier and the eastern parts wetter (Hewitson and Crane 2006). Climate change and assumed economic growth will increase the pressure on water resources, especially for water-intensive activities such as mining and power generation. The limits on water are likely to be a major constraint on future economic growth (Scholes and Biggs 2004).

2.5 The relationship between land use and water

Water scarcity and the strategic economic importance of water have meant that current and previous South African governments have invested considerable resources in research and developing hydrological monitoring and modelling capabilities. In part this has been necessary to support the complex and multi-faceted approach to water supply and demand management in South Africa. In comparison with many other countries in the region, South Africa has accurate time-series hydrological data, excellent catchment and water models, as well as many skilled personnel such as hydrologists and water engineers (Turpie *et al.* 2008).

South African governments have invested substantial resources in storing and moving water

South Africa possesses good scientific information on the linkages between land-use changes and water quantity, particularly for the primary agricultural crops, grasses and invasive alien plants. One example of how this type of information is being used is the Working for Water (WfW) Programme (Marais *et al.* 2004), which focuses on removing alien invasive plant species that use large volumes of water in order to reduce water use and improve stream flows in catchments. However, if the concept of payments for activities that lead to increased stream flows and improved water quality (ie. ecosystem services) is to be taken beyond the 'Working for Water' example, water resource managers, the users of water, and communities (as the land managers) will need to enter a relatively new arena where they can test fresh opportunities and explore alternative land-use options.

2.6 The status of PCPS in South Africa

Payments for catchment protection services in South Africa have been developed primarily through the government's Working for Water (WfW) Programme. WfW was launched in 1995 as a response to chronic unemployment in rural areas combined with the threat posed by alien invasive species to scarce water resources

and the biodiversity of riparian habitats and the montane grasslands in which many of South Africa's rivers rise (Marais *et al.* 2004). Politically, WfW could not have been developed without demonstrating a strong poverty alleviation dimension (Woodworth 2006). Since the creation of the WfW the government has developed complementary programmes that also focus on poverty alleviation, biodiversity conservation and water provision, such as Working for Fire, Working for Woodlands and Working for Wetlands (Woodworth 2006).

The scale of the challenge posed by alien invasive species and their impact on water supply and biodiversity in South Africa is substantial. The estimated area covered by alien invasive species exceeds 1.7 million hectares. The estimated incremental water use is 3.3 million cubic metres, which is about 7 per cent of the mean annual runoff. The problem, however, is not evenly distributed across South Africa. Four catchments, the Namaqualand Coast (91 per cent of runoff), Western Cape (31 per cent of runoff), the Bushmans–Alexandria Coast (42 per cent of runoff) and the Port Elizabeth Coast (27 per cent of runoff) are particularly badly affected (Turpie *et al.* 2008).

There is general consensus that WfW has been a major success in terms of restoring water supplies in areas heavily infested by alien invasive species (see Turpie *et al.* 2008). Broad estimates are that 1 million hectares of land have been cleared since its inception, with a total saving of 46 million cubic metres of water. In the process the programme has created thousands[5] of jobs, provided training and skills, and has also been used as an entry point for HIV/AIDS awareness programmes.

The WfW Programme dominates most land–water issues in South Africa. One of the major challenges facing the programme is to develop privately funded PCPS that are not reliant on government funding. Small initiatives are being developed outside the WfW framework. The Trans Caledon Tunnel Authority, for example, is implementing the Berg Water Project and has contracted WfW for three years to clear 13,200 hectares of alien invasive species. Another example is the George City Municipality, which has committed SAR400,000 a year for three years to clear alien species in nearby catchments (Turpie *et al.* 2008; Blignaut 2008).

5. In 2000 the WfW Programme provided employment for 24,000 previously unemployed people, 52 per cent of whom were women (Milton *et al.* 2003).

3 Action-learning and the South African project's catchments and sites

3.1 Introduction

The international project 'Developing markets for watershed protection services and improved livelihoods' was implemented in five countries and in selected island states in the Caribbean. Additional action-learning sites were identified in India (3), Indonesia (2) the Caribbean (2), and Bolivia (1).[6] The project also facilitated diagnostic studies on the potential for pro-poor payments for catchment protection services in Bolivia and China.

In South Africa the implementation phase of the project built on the country-level diagnostic study commissioned by IIED (see King *et al.* 2003). At the time, the diagnostic concluded that:

- no markets for watershed protection services currently exist in South Africa;
- good opportunities exist where markets could be established and managed by catchment management agencies;
- a research initiative should focus on determining the feasibility and viability of watershed protection services markets rather than the actual establishment of fully functioning watershed protection services markets;
- a critical issue is: who pays for ecosystem services?
- a clearer understanding of the nature and mechanisms of potential markets needs to be established, including the associated transaction costs.

3.2 The project methodology

The international project coordinated by IIED was based on an action-learning approach. Central to the methodology is the notion that the participants and stakeholders make interventions and then take time to reflect on the process, to question, and to seek to understand lessons learned (Dick 1997). A common approach to the project's action-learning approach was developed by IIED and the country partners (see Box 2).

6. *Fair Deals for Watershed Services* (Bond and Mayers forthcoming) is a summary and analysis of the lessons learned from the project. Individual country reports are also available at www.iied.org

Box 2

The common approach to the project by IIED and partners

The common approach in the action-learning countries included:

1. **Core research team:** a lead partner institution, well placed in terms of track record, contacts, field connections, interest and capability, convened a small team in each country.
2. **Site selection:** the diagnostic studies enabled potential sites to be identified and preference criteria were used by each research team to select the case study areas from the larger pool of sites.
3. **Baseline studies:** at most of the selected sites baseline studies on livelihoods, land use and hydrology were undertaken. The purpose of these studies was to identify the livelihoods challenges and opportunities, document current land use, and identify the core problems and potential interventions.
4. **Learning groups:** an essential component of action-learning as a methodology is that the participants and stakeholders take time to reflect on the process, to question, and to seek to understand lessons learned (Dick 1997). In each country, IIED and partners constituted learning groups that typically comprised a range of stakeholders from government, civil society and, where possible, the private sector.
5. **Applied research and analysis:** to support both the site-level and learning group work, the research teams identified key issues and problems that needed to be addressed. Typically this led to the development of short commissioned reports.

Source: Bond and Mayers forthcoming

The Council for Scientific and Industrial Research (CSIR) was the coordinating partner for the action-learning phase of the project in South Africa. To facilitate the site-level work, the CSIR formed partnerships with Clean Stream Environmental Services (the implementing partner for the Ga-Selati catchment) and Nepid Consultants (the implementing partner in the Sabie Sand catchment). The role of these two partners was to establish stakeholder processes in the selected sites and facilitate discussions, negotiations, and the dissemination of information. The ultimate aim was to develop each project to a stage where actual payments could be made between buyers and sellers of catchment protection services. Because of its diverse range of expertise, CSIR was also responsible for carrying out many baseline studies, applied research and analyses. These supporting documents have been published as a series of working papers.[7]

A project advisory team was also established consisting of representatives from DFID, the Department of Water Affairs and Forestry, the site-level consultants and CSIR. The team advised on the implementation of the project.

7. The working papers 1–11 are available from the project website. A summary of the working papers is presented in Appendix One.

Table 1

The project goal, purpose and outputs for South Africa	
Project Goal	Promote the maintenance of watershed services that improve local livelihoods in South Africa.
Project Purpose	By June 2006, payments for identified watershed services that support local livelihoods towards poverty eradication in South Africa are understood and implemented at selected sites.
Project Outputs	
Output One	Best practice for pro-poor payments for watershed services established, documented and communicated to key stakeholders in South Africa.
Output Two	Baseline information, key constraints and opportunities for the development of payments for watershed services identified, analysed and documented.
Output Three	Pro-poor payments for watershed services tested in two selected pilot sites.
Output Four	Effective project management established and maintained.

3.3 Selecting the project sites

The project sites were selected using a three-step process. The first step involved a national (countrywide) review of potential sites that could be used to evaluate whether 'payments for catchment protection services' could be implemented effectively (Claasen *et al.* 2005). In the second step a suite of criteria was used to narrow the options down to six potential catchments. The selection criteria included the administrative capacity of the catchment, the priority of the catchment in terms of water development, the levels of water stress, the levels of institutional support, the degree of poverty, land-use activities, and the availability of hydrological information. The most important criterion was that there were potential buyers and sellers of catchment protection services (King *et al.* 2003).

Box 3

Shortlist of catchments in which there was thought to be the potential to develop PCPS

- **Olifants catchment;**
- **Sabie Sand catchment;**
- **Upper Vaal catchment – specifically the Klip River;**
- **Mhlatuze catchment;**
- **St. Lucia Wetland;**
- **Levuvhu/Letaba catchment – with a focus on the Levuvhu sub-catchment.**

For each catchment, the project conducted a feasibility study that considered:

- hydrological features;
- land tenure and ownership systems;
- identified groups of poor and marginalised communities;
- the presence and implications of power imbalances;
- land-use practices; and
- economic features and their implications at sub-national and national levels.

On the basis of these criteria and practical considerations (such as physical accessibility and the costs of transport) two areas were selected. The first was the upper Ga-Selati sub-catchment in the Olifants Water Management Area while the second consisted of five sites on the Sabie and Sand rivers in the Sabie Sand Water Management Area. The process of identifying and selecting these two areas took about 15 months (between February 2004 and June 2005), which considerably reduced the time available to the project partners to research, design and test pro-poor payments for catchment protection services at these sites.

Box 4

A summary of common water sector definitions

Water management area (WMA)

The *National Water Act* (NWA) of 1998 requires that a National Water Resource Strategy be developed to 'provide the framework for the protection, use, development, conservation, management and control of water resources for the country as a whole. The Strategy also provides the framework within which water will be managed at regional or catchment level, in defined water management areas.'

Catchment management agency (CMA)

The *National Water Act* of 1998 requires that catchment management agencies are progressively established by the Minister for the 'purpose of delegating water resource management to the regional or catchment level (Water Management Area level) and to involve local communities, within the framework of the national water resource strategy'. The exact nature of representation on CMAs, as well as their structure, functions and responsibilities, is currently being finalised. However, the NWA implicitly requires that the CMAs adopt unique, imperative and valuable organisational forms focused on facilitating integration and cooperation between the many state and other organisations that are responsible for biosphere-related matters in order to achieve their goals (Dent 2007). The NWA also stipulates 'fair representation for all sectors' on these CMAs.

Water user association (WUA)

Water user associations are co-operative associations of individual water users operating at restricted localised levels who wish to undertake water-related activities for their mutual benefit. Unlike catchment management agencies, the primary purpose of WUAs is not water management. A water user association may, however, exercise management powers and duties only if, and to the extent, these have been assigned or delegated to it. The Minister establishes and disestablishes water user associations according to procedures set out in Chapter 8 of the NWA. Existing irrigation boards, subterranean water control boards and water boards established for stock watering purposes will continue in operation until they are restructured as water user associations.

Clearing alien invasive species in the Legalametse Nature Reserve by the Working for Water Programme

3.4 Overviews of the Olifants and Sabie Sand catchments

The two catchments chosen for the project were in the Olifants catchment and the Sabie Sand catchment.[8] A brief overview of the biophysical, social, economic and administrative contexts of these catchments is outlined below.

3.4.1 The Olifants catchment

The Olifants River rises in the highveld[9] of South Africa near Trichardt and Secunda, about 65 km south-east of Johannesburg. The river drops from an altitude of about 1,580 m to approximately 150 m above sea level at the point which it crosses the South African border into Mozambique. The total area of the catchment within South Africa is over 54,000 km^2.

8. Note that the catchment in this respect is limited to that portion that lies within South Africa.
9. 'Highveld' – a high plateau summer-rainfall grassland in South Africa, generally between 1,200 m and 1,800 m above sea level. These grasslands are maintained by fire and frost in the dry winter and mostly used for extensive pastoral activities or maize cultivation. 'Lowveld – a lower and hotter region (specifically referring to South Africa's eastern border region) that is not intensely cultivated, is subtropical in nature with savannah vegetation characteristics, and is susceptible to long dry seasons of about eight months, including winter. Wildlife reserves are emblematic of this part of the country.

Table 2

Land use in the Olifants catchment

Land use	Area (km²)	per cent of total
Forest and woodland	11, 266	21
Unimproved grassland/veld in good condition	11, 220	21
Agriculture: dryland commercial	8, 146	15
Thicket/bushveld	7, 134	13
Protected nature reserves*	6, 990	13
Forest and woodland: degraded	3, 917	7
Agriculture: dryland subsistence	2, 265	4
Agriculture: irrigated commercial	1, 035	2
Urban	1, 035	2
Plantations: eucalyptus	824	2
Thicket/bushveld: degraded	730	1
Total	**54,562**	

* Elements of forest and woodland, unimproved grassland, and thicket/bushveld are included in the land use 'Protected nature reserves'.
Source: CSIR 2003

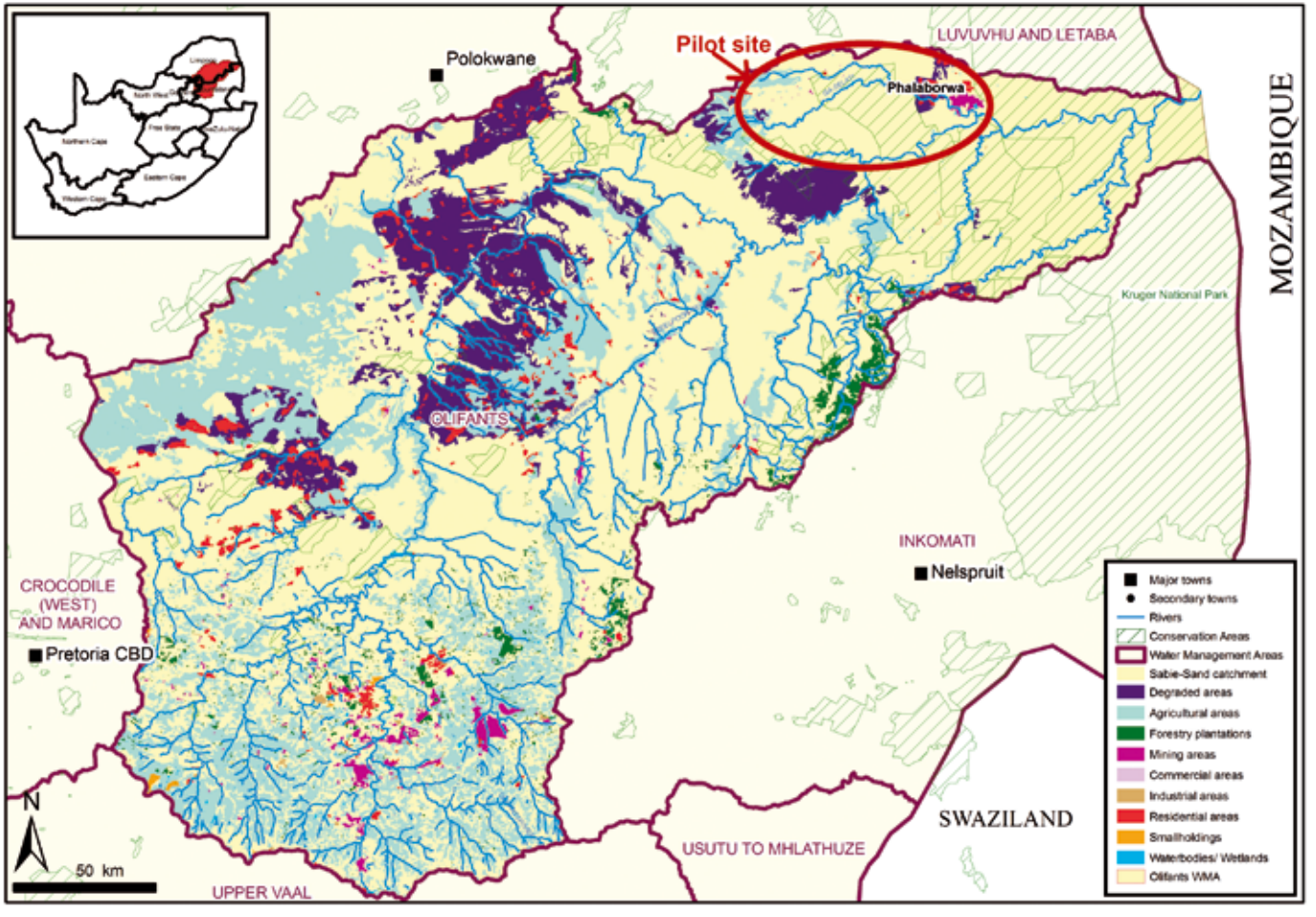
The Olifants catchment is economically diverse, with activities including mining, power generation, metallurgical industries, irrigation, dryland and subsistence agriculture, and eco-tourism. An estimated 5 per cent of South Africa's gross domestic product (GDP) is generated in the region and the contributing sectors to gross geographic product (GGP) are mining (22 per cent), manufacturing (18 per cent), electricity (15 per cent), government (16 per cent); and agriculture (7 per cent). These figures clearly indicate that the mining and agriculture sectors are the prominent land and water users in the WMA. The mining sector is supported by the mineral-rich environment that encompasses coal, copper, chrome, platinum, vanadium and phosphorus. Agriculture is prominent because of the good dryland- and livestock-farming conditions in the area, as well as the extensive irrigation infrastructure that has been developed over time. Other types of farming, such as trout and game, are increasingly being developed and support the successful and growing tourism industry in the area (DWAF 2004).

The catchment itself can be is divided into four distinct sub-areas: the Upper Olifants, Middle Olifants, Steelpoort and the Lower Olifants. These are described in turn below.

The **Upper Olifants Sub-Area** lies in the economic heart of South Africa. It is characterised by the large urban areas of Witbank and Middelburg with their

Figure 1

Map of the Olifants Water Management Area showing the towns, major tributaries and the extent of different types of land use in the catchment



associated mining and industrial enterprises. In the area below the Loskop Dam there are large areas of commercial, irrigated agriculture. It is estimated that 80 per cent of the population of the catchment lives in the Upper Olifants Sub-Area. The water required for irrigation represents 57 per cent of the total water requirements in the catchment (DWAF 2004). Water for thermal power stations represents a further 19 per cent of the total water requirements of the catchment. The balance of the water is used for urban, industrial and mining purposes (DWAF 2004).

The **Middle Olifants Sub-Area** lies largely in the former homeland of Lebowa. The limited water infrastructure, poor soil quality, and subsistence-type agriculture mean that per capita water use in this region is low (DWAF 2004). Water for domestic use is either collected from communal standpipes or abstracted directly from the Olifants River and its tributaries. The high population density, limited soil conservation practices, and the highly erodible soils mean that the middle section of the catchment is a major source of silt in the river (DWAF 2004).

In the **Steelpoort Sub-Area** section of the catchment, the government of South Africa has recently approved the construction of the De Hoop Dam. The water from the dam will be largely used to supply the rapidly growing mining sector and to meet the associated industrial and domestic growth in the area (Hendricks 2008).

Most of the land in the **Lower Olifants Sub-Area** is unsettled and set aside as protected areas, conservation areas and wildlife reserves; either in the form of privately owned wildlife farms or the state-managed Kruger National Park. Phalaborwa town, on the edge of the Kruger National Park, is another mining and industrial centre. Water is supplied to the town by the Lepelle Water Board from the Phalaborwa Barrage.

Box 5

Land tenure and land-use issues in the Sekhukhuneland (Middle Olifants Sub-Area)

Within this section of the catchment, land rights are a key issue and are a contributing factor to inappropriate land- and water-management practices, leading to high levels of erosion and silt in the river. For example:

- **women, and in particular unmarried women, have no land rights;**
- **there is tension between traditional authorities and local government over issues of development and the allocation of land;**
- **there are boundary and land disputes as a result of the illegitimate 1993 land transfers to tribal authorities;**
- **traditional chiefs still charge levies for land allocations and natural resource utilisation;**
- **rural people are still threatened with evictions by traditional chiefs.**

Source: Sekhukhuneland Ad Hoc Committee on Land (2003)

Table 3

Water balances for the Olifants catchment for the year 2000 (actual) and 2025 (predicted)

Catchment	Water volumes per unit time (million cubic metres per year)				
	Reliable reserve / yield	Transfers in	Transfers out	Total local requirements	Water available/ (shortfall)
Olifants (2000)	609	172	8	965	(192)
Olifants (2025)	630	210	7	1,070	(241)

Source: DWAF 2002

The poor water quality in the Olifants River is a result of pollutants from the mining, industrial and agricultural activities in the Upper, Middle and Steelpoort sub-area sections of the catchment (Basson *et al.* 1997). This is compounded by seepage and discharges of untreated and inadequately treated domestic sewage from poor sanitation facilities largely from the Middle Sub-Area of the catchment. The impact of the high loads of suspended sediment carried by the Olifants River is particularly evident at the Phalaborwa Barrage, whose capacity has been severely reduced by siltation. The quality of the aquatic habitat along the Olifants River in the Kruger National Park is adversely affected by sediment, high concentrations of dissolved salts, and reduced in-stream flows (Pollard *et al.* 2003).

Currently, the DWAF is responsible for managing the water resources of the catchment, including management of major infrastructure. However, the *National Water Act* (Act 36 of 1998) requires that the responsibilities for water management are transferred to catchment management agencies (CMAs). The processes of setting up the new CMAs and devolving power to them are under way. It is envisaged that under the new CMAs, water user associations will take increasing responsibility for localised management of irrigation infrastructure, while water boards and local governments will be responsible for the provision of domestic water supply. Key stakeholders in the Olifants catchment include: The Lepelle Water Board, the Olifants River Forum, the Ba-Phalaborwa Environmental Forum, DWAF, the provincial departments of environment and water affairs, owners of private nature reserves, SANParks (Kruger National Park), mines (Palabora Mining Company, Foskor), the relevant municipalities (such as the Sekhukhune Cross Boundary District Municipality), community members, community-based organisations, and non-governmental organisations operating in the area.

3.4.2 The Sabie Sand catchment

The Sabie Sand catchment is part of the Inkomati Water Management Area, which is situated in the north-eastern part of South Africa (Figure 2). The Sabie River, of which the Sand River is a tributary, flows through the Kruger National Park into the Corumana Dam immediately downstream of the border between South Africa and Mozambique.

Land use in the upper Sabie Sand catchment is characterised by extensive commercial forestry plantations and irrigated agriculture. In the lower catchment, wildlife is the main land use both on private land and in the Kruger National Park. In the middle section there are large areas of densely settled communal lands (Pollard *et al.* 2003). Erosion from this section of the catchment is increasing sediment loads – particularly in the Sand River. Sedimentation in the lower section of the river is a growing problem.

Even though there is erosion and sedimentation in the Sand River, the Sabie Sand catchment is considered to be one of the most ecologically sound catchments in South Africa (Pollard *et al.* 2003). The key problem in the catchment is over-abstraction, especially in the dry seasons and in periods of below-average rainfall. The demands of forestry, irrigated agriculture, and abstraction for urban use and to meet international obligations to Mozambique, mean that there is limited flow in the dry season and that during droughts there is insufficient water in the river to meet stakeholders' needs.

Table 4 **Land use in the Sabie Sand catchment**

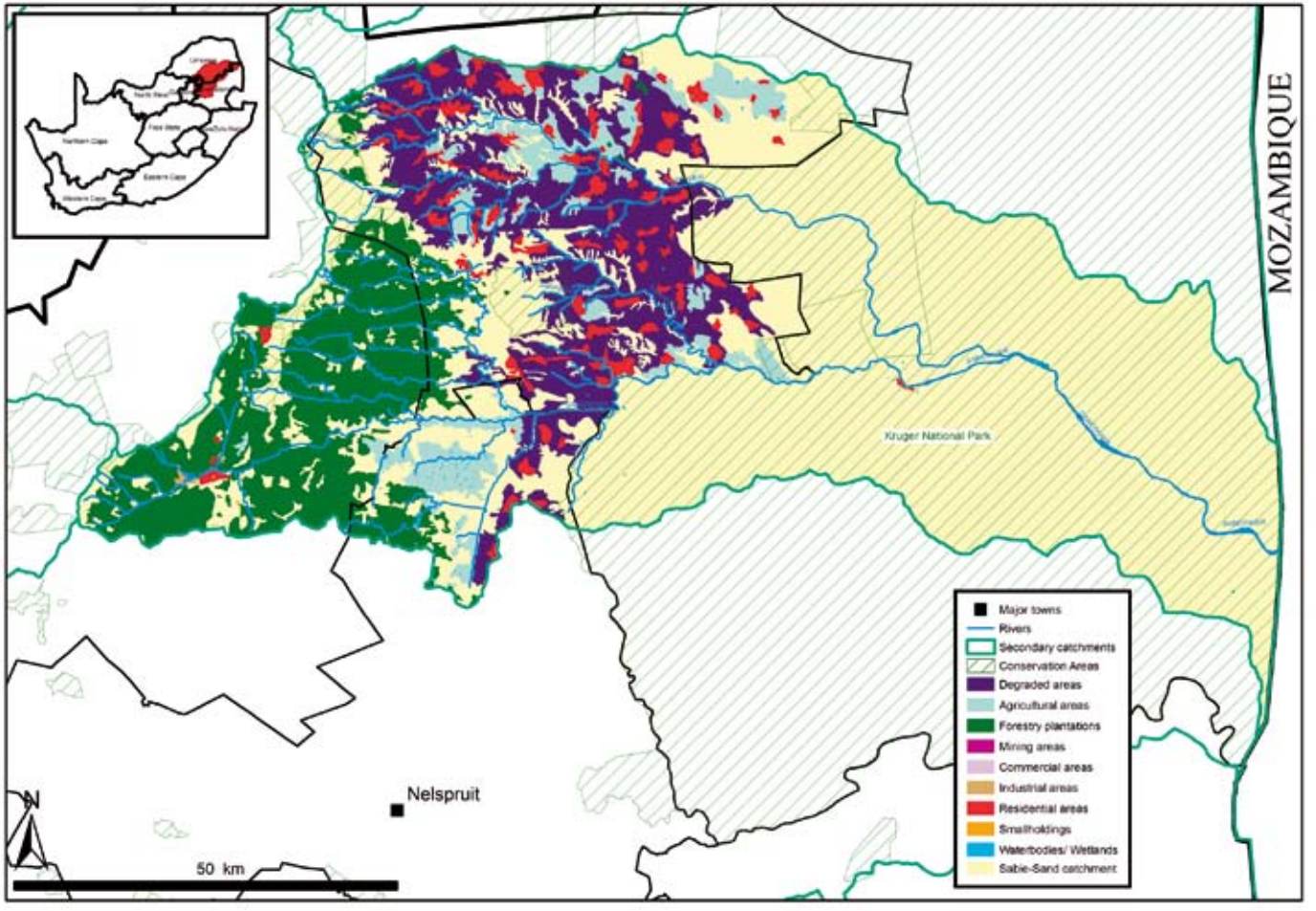
Land use	Area (km²)	Area (per cent)
Irrigated agriculture	126	2
Forestry (plantation and indigenous forests)	898	12
Rural settlements	335	4
Wildlife	6,272	82
Total	**7,631**	**100**

Source: DWAF 2003

Land ownership in the catchment varies from privately owned lands in the upper reaches, through communally owned land in the middle section, to a combination of private and state-owned land in the lower reaches (Pollard *et al.* 2003). The communal lands in the middle section are part of the former KaNgwane, Gazankulu and Lebowa homelands. It is estimated that 66 per cent of the population of the catchment (± 620,000) live in communal lands, where population densities vary between 150 and 300 persons per square kilometre (Pollard *et al.* 2003). The largest settlement is called Bushbuckridge (DWAF 2004).

Figure 2

Map of the Sabie Sand catchment area showing administrative boundaries, major towns, tributary rivers and the extent of different types of land use in the catchment



The residents of the communal lands rely on subsistence agriculture and natural resource usage for their livelihoods. Household income is supplemented by cash from urban remittances and state pensions. Only 6 per cent of the local cash economy is generated by agriculture. The direct-use values of the livestock, agricultural produce, and resources harvested directly from nature are high and account for more than 50 per cent of the total livelihood streams (Pollard *et al.* 2003). Agriculture consists of maize cultivation at the homestead or in demarcated fields adjacent to the villages, intercropped with fruit trees and vegetables; land that is not converted to agriculture is used for the environmental goods and services it produces (e.g., grazing, wood fuel, medicine, poles, etc) (Pollard *et al.* 2003). Although woodlands are highly degraded they provide an important source of wood fuel both as an enterprise and used directly by households.

The main water users are the private and public conservation areas (ie. the 'Ecological Reserve'), afforestation and agriculture (Table 5). Currently, the domestic sector uses the least water but this will change as the government fulfils its constitutional obligation of providing all households with sufficient water to meet World Health Organisation minimum daily requirements.

Table 5 **Water balances for the Sabie Sand catchment for the year 2000 (actual) and 2025 (predicted)**

Catchment	Water volumes per unit time (million cubic metres per year)				
	Reliable reserve / yield	Transfers in	Transfers out	Total local requirements	Water available/ (shortfall)
Sabie Sand (2000)	95	0	0	117	(22)
Sabie Sand (2025)	159*	0	0	141	18

* Yield increases by 2025 as a result of the commissioning of the Injaka Dam in 2001.
Source: DWAF 2003

The key stakeholders in the Sabie Sand catchment consist of conservation authorities (private and state), commercial farmers, forestry companies, national and provincial government departments, municipalities, research organisations (e.g. the Wits Rural Facility), traditional authorities, community-based organisations, and an array of NGOs – for example the Association for Water and Rural Development (AWARD), an NGO based at the Wits Rural Facility near Acornhoek in the Sand River catchment. According to AWARD there are seven functional traditional authorities in the Sand River catchment. The structures of these and other forms of authority in the area are, however, unclear.

Situation at Phalaborwa Bridge

In the communal areas there is an ongoing tension between the residents and authorities due to the resentment over previous perceived injustices perpetrated in the name of conservation initiatives. Current and future land and water conservation initiatives are still constrained by this history (Pollard *et al.* 2003). Equally, there is tension between the modern political administrative system and traditional leadership. Thus, while land is nominally under communal ownership, there is a *de facto* open access to resources as the residents view most resources as a public asset that can be used for personal gain (Pollard *et al.* 2003).

3.5 Common characteristics of the two catchments and the potential for payments for catchment protection services

The Olifants and the Sabie Sand catchments share a number of important characteristics:

- they are both large catchments;
- they both rise in the highveld of South Africa and flow eastwards through the lowveld into the Kruger National Park and on into Mozambique;
- they both have large rural populations residing in marginal agricultural areas (legacies of the apartheid system and the creation of nominally independent

homelands) and which engage in a range of agro-pastoral activities as well as harvesting timber and non-timber forest products from the natural vegetation;
- they both have high rates of soil erosion;
- they have similar wealth gradients, where the bulk of economic activity is located in the upper catchment;
- water demand more often than not exceeds water supply, and as a result there are limited dry-season flows in the lower reaches of both rivers. This is exacerbated during droughts;
- changing land and water rights are causing substantial uncertainty and insecurity to all land and water users across the entire country. The causes of these uncertainties and insecurities are reforms to water and land regulations and the legislation that defines and enforces property rights, and the government's efforts at land restitution and redistribution.

For the purposes of testing payments for catchment protection services, sites were selected at sub-catchment level. In the Olifants catchment, the upper Ga-Selati sub-catchment was identified as an appropriate site because of the impact of acute water shortages on a range of downstream water users including existing and proposed mining developments and the Kruger National Park, privately owned game farms, and Mozambique – even though the *National Water Act* provides for both an 'Ecological Reserve' and 'international obligations' (Scholes and Biggs 2004). In the Sabie Sand catchment, five potential sites were identified for the development of payments for catchment protection services. These were: Peebles Valley, Sabie town, the Hazyview area, the Sand River and the Venus Plantation/ Sandton Bird Club.

4 Facilitating catchment protection services in the upper Ga-Selati, and Sabie and Sand rivers

4.1 Introduction

The upper Ga-Selati sub-catchment within the Lower Olifants Sub-Area was selected as an appropriate site to investigate the feasibility of implementing payments for catchment protection services because:

- It is characterised by very high and increasing upstream and downstream demands for water and is faced with a continually decreasing and unreliable supply due to inefficient water use and inappropriate land management, particularly along the upstream reaches.

- Extensive commercial plantations and stands of invasive alien plants exist in the headwaters and riparian zones in the upper reaches of the sub-catchment, which reduce stream flows draining the Olifants catchment.

- There exist clearly defined alternative technologies and land-use options for upstream landowners (potential sellers) to adopt that could alleviate much of the water quality and water flow problems for downstream users.

- There are many downstream water users (intensive irrigated agriculture, extensive rural settlements, towns, conservation areas, industry and mining) that could benefit from additional water runoff.

- It is a complex social and ecological system characterised by: extreme inequalities between upstream, poor, rural communities and downstream private industries and mines; insecure property rights and land tenure due to redistribution/restitution claims being lodged by local communities for large tracts of land that are in various stages of settlement; and diverse stakeholders, land-use types and topographies.

- It is representative of many catchments in South Africa, making the lessons learned in this study applicable to others.

In the Sabie Sand catchment, five sites were selected. These were:
1. Peebles Valley in the upper North Sand River;
2. Sabie town on the Sabie River;
3. Hazyview on the Sabie River;
4. The Sand River;
5. The Venus Plantation/Sandton Bird Club, on the Mac-Mac tributary.

These were selected as possible sites for implementing payments for catchment services because each of them potentially had the following attributes:

- clearly defined objectives for payments for catchment services – the buyers should know what they are paying for, and the sellers should know what services they are providing;
- poor communities whose livelihoods could be improved by payments for catchment services;
- capable buyers who are willing and able to make payments;
- measurable outputs so that the benefits of the service provision are clear to both buyers and sellers of the catchment services;
- political support for transactions at all levels of government, improving the chances of success;
- quality of communications: high-quality communications amongst the participants is vital to success; and
- large scale: the scale of the operation should be large enough to ensure tangible improvements in livelihoods but small enough to ensure effective arrangements and maximise the understanding of cause and effect.

(Source: Palmer *et al.* 2005)

The selected sites are described in detail below.

4.2 The Ga-Selati River

The Ga-Selati River is a tributary of the Olifants River. The river rises in the Legalameetse Nature Reserve at an altitude of 1,600 m, joining the Olifants on the boundary of Kruger National Park approximately 90 km later, just below Phalaborwa (Figure 3). The first 3 to 5 km of the river, below the Legalameetse Nature Reserve, flow through montane forest in the mountain uplands and then drop 800 m to the 'lowveld', which is a relatively flat and low-lying savannah (500–600 m above sea level). Along this stretch of the river, the water is heavily utilised by local communities and for irrigated agriculture. Thereafter, the river drops another 500 m over the next 90 km to its confluence with the larger Olifants River at the Phalaborwa Copper Mine. The increasing demands for water along the mid-section of the river by rural communities and agriculture has resulted in less water being available for other downstream users, notably private game farms and tourist activities (particularly the Kruger National Park), and as a means to dilute polluted seepage water from the large mining operations at the town of Phalaborwa.

Within the Ga-Selati poverty is endemic within the area of the former Lebowa homeland. The livelihood strategies and outcomes of households in these villages are very similar to those of communities in former homelands throughout South Africa. Poverty is pervasive and the isolated location of these villages limits employment opportunities to work on commercial farms in the district. Wages on commercial farms are low and relatively large households often depend on a single wage combined with state pensions and/or child support grants. As a result, household income is seldom sufficient to cover food expenses.

Service provision in these villages is relatively good. The majority of households have access to a tap within 200 m of their plots. Provision was made for electricity to these villages but the high costs of using electricity in the home, such as installation of wiring and purchase of electrical implements, result in the majority of households still using wood collected from the communal area for cooking and heating. Candles are generally used for lighting. Sanitation facilities are sub-standard, with rudimentary pit latrines the most common sanitation facility used. Households do not pay for services such as water and sewerage.

In general, the communal areas of the catchment are highly degraded. The area is semi-arid and cultivation is limited. Cattle graze and roam freely on the communal land, contributing to environmental degradation. Households are dependent on natural resources for wood (as a fuel source for heating and cooking), for livestock grazing and as a source of food. Many households collect food from the veld. Respondents of the livelihood survey report that they mostly collect dry wood from the veld for firewood. However, stakeholders report large-scale tree felling by some community members in the Legalameetse Nature Reserve and it is therefore doubtful whether the available natural resource provides sufficient dry wood to meet the future needs of the entire population of the communal area.

Over time, and across the entire upper Ga-Selati sub-catchment, water quality and water supply have become critical issues. The demand for water in the catchment from agriculture, mining and industry exceeds the natural supply capabilities of the catchment and means that a substantial volume of water has to be transferred into the catchment on an annual basis. The projected demand for water in the catchment shows that even with increased transfers into it, the water deficit will increase to 241 million cubic metres by 2025. In fact, the present situation has become so bad that, during the dry season, the traditionally perennial Olifants River stops flowing. This has prompted the DWAF to propose changing its status from a perennial to seasonal river.

Figure 3

Land use in the upper Ga-Selati sub-catchment

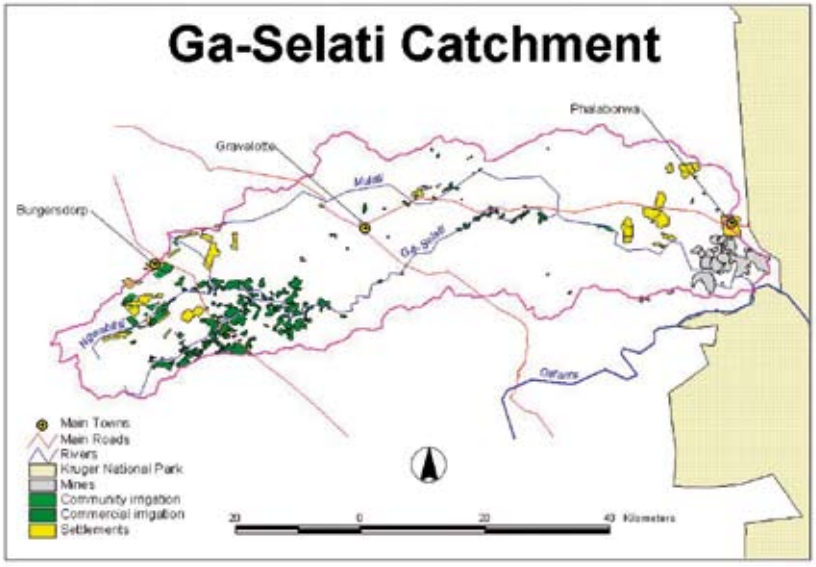
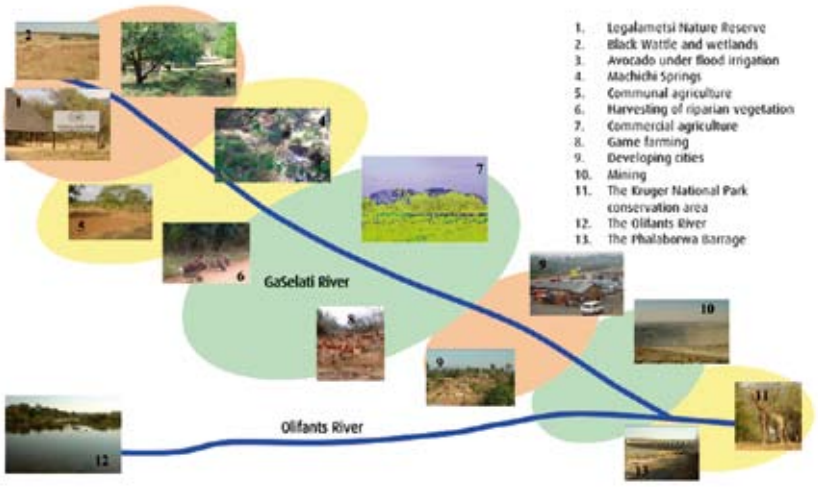


Figure 4

Illustrated examples of key land uses along the Ga-Selati River



4.2.1 Key land-use and water-use issues in the upper Ga-Selati sub-catchment

Current and projected water balances for the Olifants catchment indicate that the river is already over-drawn and will be further over-drawn by 2025 (DWAF 2002 and Table 3). The initial hydrological review of the Ga-Selati River identified a number of water- and land-use activities relying on, and having substantial impacts on, the quantities of water in the sub-catchment (Chapman 2006). These activities include:

- **Alien invasive species in the Legalameetse Nature Reserve:** the indigenous vegetation of the Legalameetse Nature Reserve is mountain grassland (Chapman 2006). This is gradually being replaced with a dense cover of black wattle (*Acacia mearnsii*) trees spreading from the water-courses. In South Africa the black wattle is classified as an alien invasive species due to its capacity for aggressive encroachment into other ecosystems and the substantial quantities of water that it uses (see Turpie *et al.* 2008). This change in land use is having a substantial and important impact on the stream flow of the river. This is being compounded by the damage to grasslands and wetlands by illegal grazing within the protected area.

- **The government irrigation scheme in the Legalameetse Nature Reserve:** within the Legalameetse Nature Reserve is a government managed 10 hectare avocado orchard, which is really an anachronism of past land uses and policies. The orchard was established approximately 60 years ago and is irrigated by an ingenious but very inefficient series of gravity-fed unlined channels that provide flood irrigation to the trees on a continuous basis at a rate of 1,166 m^3 per day. The environmental engineering consultancy firm, Rural Integrated Engineering, was employed to assess the irrigation system and determined that: 1) the current irrigation system is highly inefficient; and 2) based on the age of the trees, the location of the orchard, and the limited technical support, the orchard is probably not economically viable.

- **Diversion of water from the Machichi Springs to commercial farms and clearing of riverine forests**: below the Legalameetse Nature Reserve is a pristine area called the Machichi Springs that feeds water into the river and through afro-montane riverine forests. The area has significant spiritual value for the local communities in the region and is used for annual circumcision ceremonies. The water from the springs is currently being diverted for irrigation on the nearest commercial farm[10] and the riverine forests are being harvested for wood fuel and to allow cultivation.

10. This irrigation system and the irrigation system in the avocado orchard were designed by the same water engineer in the late 1940s (Fritz Bekker pers. comm.).

- **Increasing sinking and use of boreholes by farmers downstream of the Machichi Springs:** at the base of the escarpment, immediately below the Machichi Springs, there are several commercial horticulture farms, which depend on stream flows for their drip-irrigation systems. However, due to declining water quantities in the upper Ga-Selati River, these farmers are increasingly relying on borehole water. Further downstream of the Machichi Springs, and also dependent upon water flows in the Ga-Selati River, are commercial game farms and nature reserves. These farmers are increasingly being forced to rely on borehole water as they experience almost no river flows for significant periods yet their businesses and property values depend on assured water supplies.

- **The Phalaborwa Barrage and water extraction for mining, industry and urban uses:** the Ga-Selati River then flows into the Olifants River where water is stored by the Phalaborwa Barrage, which is managed by the Lepelle Water Board. Water users located in the vicinity of the barrage, such as the Palabora Mining Company, Foskor and the Ba-Phalaborwa Municipality, rely on water from the barrage for all their activities. However, the Lepelle Water Board reports that it has experienced extreme problems in meeting its water supply and water quality objectives due to the siltation of the Phalaborwa Barrage and the growing demand for water. Siltation of the barrage occurs because of the continual erosion in the middle reaches of the Olifants River and the effective capacity of the Phalaborwa Barrage has been, and continues to be, severely reduced.[11] The only effective way to increase the capacity of the barrage is to remove accumulated sediments through scouring at peak flow.

- **Water quality and quantity for maintaining ecological integrity in the Kruger National Park:** after the barrage, the Olifants River continues to flow into the Kruger National Park and then into Mozambique. The ecological functioning of much of the park is reliant on stable water supplies and water of good quality. Yet South African National Parks (SANParks) is concerned about the quality of the water flowing in the lower reaches of the Olifants River – provided by releases from the Phalaborwa Barrage and flows in the Ga-Selati River – as well as the declining volumes of water that are unable to meet the 'Ecological Reserve' requirements within the Kruger National Park. Water quality deterioration becomes particularly marked when the barrage is 'scoured' to remove accumulated sediments and increase its capacity. SANParks has frequently reported ecological damage (e.g. extensive fish kills) in the Kruger section of the Olifants River and is also concerned about water volumes that are 'lost' (to Mozambique) in the process of scouring the barrage.

11. Currently it is estimated that the barrage is operating at 30 per cent of capacity.

4.2.2 Assessment of the potential for payments for catchment protection services along the Ga-Selati River

The initial review of the Ga-Selati River identified the challenges listed above as well as a set of potential solutions encompassing a range of catchment protection activities (Table 6). It was initially thought that efforts should focus on facilitating payments from the mining and industrial sectors in Phalaborwa to the Legalameetse Nature Reserve for land-use and water-use changes that would lead to substantial improvements in the quantity and quality of downstream flows. Some of the catchment protection activities identified included: removing alien invasive species, closing or modifying the irrigated avocado orchard, and protecting the Machichi Springs. It was determined that all of these could lead to substantial increases of flow in the Ga-Selati River that would alleviate some of the water problems at Phalaborwa and within the Kruger National Park (Chapman 2006). Since many of the changes would have taken place in a protected area, the challenge was to identify mechanisms that addressed the core objective of the project, namely to develop pro-poor payments for catchment protection services.

Table 6 **Potential buyers and sellers of catchment protection services along the Ga-Selati River**

1	Phalaborwa stakeholders; Kruger National Park	Working for Water (WfW); local communities	Removal of alien invasive plants in Legalameetse.	Improved water quantity during peak flow and over the dry season.
2	Phalaborwa stakeholders; Kruger National Park	Local communities	Removal of the avocado orchard under flood irrigation in Legalameetse.	Improved water quantity during peak flow and over the dry season.
3	Phalaborwa stakeholders; Kruger National Park	Local communities	Maintaining the avocado orchard but improving the irrigation system in Legalameetse.	Improved water quantity during peak flow and over the dry season.
4	Provincial parks; commercial irrigation farmers; mines; Kruger National Park	Local communities	Protection of Machichi Springs	Improved water quantity during peak flow and over the dry season.
5	Commercial irrigation farmers; mines; municipalities	Local communities	Improved farming practices of subsistence agriculture.	Improved water quantity during peak flow and over the dry season.

The initial expectations that the stakeholders in the Phalaborwa area would be interested in a 'payments for catchment protection services' scheme were dashed when an informal survey found at least 17 unplanned barrages and weirs along the Ga-Selati River between the base of the escarpment and the Phalaborwa Barrage (Bekker 2005 personal communication). The presence of the illegal weirs and barrages meant that the additional water made available from the catchment protection activities would be captured and stored by the illegal dams and weirs and insufficient water would be available to change the dry-season stream flow at Phalaborwa.

In addition to the practical difficulties of increasing stream flow at the lower end of the Ga-Selati River were two other problems, both created by the 1996 *National Water Act* (see the legal and policy review by Quibell and Steyn 2005). The first problem was that even if the Phalaborwa stakeholders did pay for catchment protection services, they were not automatically entitled to the additional water made available.[12] The second problem raised was that SANParks (representing the Kruger National Park) was unlikely to be a buyer of catchment protection services because its right to water was legally enshrined in the 'Ecological Reserve'.

Due to these limiting factors, the unmanageably large size of the original site, and the uncertainties associated with the complex social and ecological system, it was decided to focus the study at a smaller scale and to limit the attempts to implementing PES to the upper Ga-Selati River sub-catchment. Consequently, the project facilitators evaluated the potential of the commercial horticulture farmers, immediately downstream of the Legalameetse Nature Reserve, as possible buyers of catchment protection services. Efforts were focused here because interviews with these farmers indicated that they were increasingly worried about the declining water quality and flows for irrigation and were investing in boreholes to ensure water supply.

The hydrological studies of the upper Ga-Selati sub-catchment determined the potential water savings that could be made by removing alien invasive species, clearing the avocado orchard, and improving irrigation efficiency, as well as the storage and transport of water (Chapman 2006; Rural Integrated Engineering 2006).

The hydrological survey estimated that clearing $\pm$ 850 ha of black wattle from the Legalameetse Nature Reserve could immediately save approximately 1.6 million cubic metres of water per annum (approximately 18 per cent of baseline flows).

12. Since these investigations, a precedent has been set elsewhere in South Africa where a mining company (Blue Ridge Mining) has agreed to pay for the removal of alien invasive species and has been allocated the theoretical increase in water that this generated (Christo Marais 2006 pers. comm.; Blignaut 2008).

Table 7

Summary of water use and potential water savings after interventions in the upper Ga-Selati sub-catchment

Description	Baseline or current use (million m3/yr)	New practice estimated use (million m^3/yr)	Estimated savings by use (million m^3/yr)
Alien invasive plants	1.6	0.0	1.6
Legalameetse avocado orchard	0.3	0.0	0.3
Inefficient irrigation	7.1	0.0	7.1
Increased irrigation uses[1]	0.0	7.1	-7.1
Evaporation (river and riparian vegetation) [2]	0.5	1.0	-0.5
Total use	9.5	8.1	1.4
Total available	9,0	9,0	
Deficit / surplus	- 0.5	0.9	

1. There is an assumption that the water saved by increasing the efficiency of reticulation will be used to expand production through an increase in the area under irrigation.
2. Evaporation takes place from the river and riparian vegetation. This evaporative demand (which currently exceeds supply) must be supplied before any additional water can reach its beneficiaries downstream.
Source: Adapted from Chapman 2006

However, if left unchecked, the expansion of the wattle invasion could use up to 3.7 million cubic metres (approximately 41 per cent of baseline flows) in 10 years' time. In other words, if left unchecked, the spread of black wattle could result in the upper Ga-Selati River drying up (Chapman 2006).

The survey also estimated that approximately 300,000 m^3 of water was being abstracted annually to irrigate the avocado orchard. Because of the age of the trees and the low productivity of the orchard it is likely that current beneficiaries could be easily compensated if it was no longer irrigated or removed.

The total losses from inefficient irrigation infrastructure and practices of the farmers in the area of the Machichi Springs was estimated to be approximately 7.1 million cubic metres per annum (approximately 79 per cent of baseline flows) (Table 7). These losses are caused by leaks from the poorly maintained infrastructure (built in the 1930s), the failure to return over-flow to the Ga-Selati River, unlined reed-filled dams, and long stretches of unlined canals (Rural Integrated Engineering 2006). The hydrological survey assumed, however, that any savings in water would be immediately utilised by increases in the area under irrigation.

4.2.3 Building a business case for payments for catchment protection services at the Ga-Selati site

Payments for catchment protection services (PCPS) are only an efficient and viable option if there is a clear and compelling financial case for both the buyers and the sellers of the service (Bond and Mayers forthcoming; Wunder 2008; Pagiola *et al.* 2002). This means that:

- The cost of the payments to the buyer must be less than the total cost of the current and undesirable situation.

- The cost of implementing catchment protection activities to the seller (including opportunity cost of the land) must be less than the payments received.[13]

It is therefore necessary to understand the incentives driving stakeholder behaviour before any progress can be made in developing the Ga-Selati site into an action-learning 'payment for catchment protection services' scheme. To do this the team prepared a cost-effectiveness analysis of the options to assess the financial opportunities for both the buyers and the sellers of the identified services. The analysis used the hydrological evidence and current market prices, supplemented with additional information (see Wise and Musango 2006).

Table 8 **Options considered in cost-effectiveness analysis**

Scenario	Land use change option	Additional water due to changes in land use/technology (m^3/ha/yr)
A1	Eradicate black wattle.	1,875–4,500
B1	Remove avocado orchard and stop diverting water from river, saving 85 per cent of the water.	29,400
B2	Rehabilitating the existing irrigation system, saving 54 per cent of water.	18,800
B3	Upgrade the irrigation system.	25,500
E1	Improving the transport and storage of water in the Ga-Selati Irrigation Scheme.	4,560–6,387

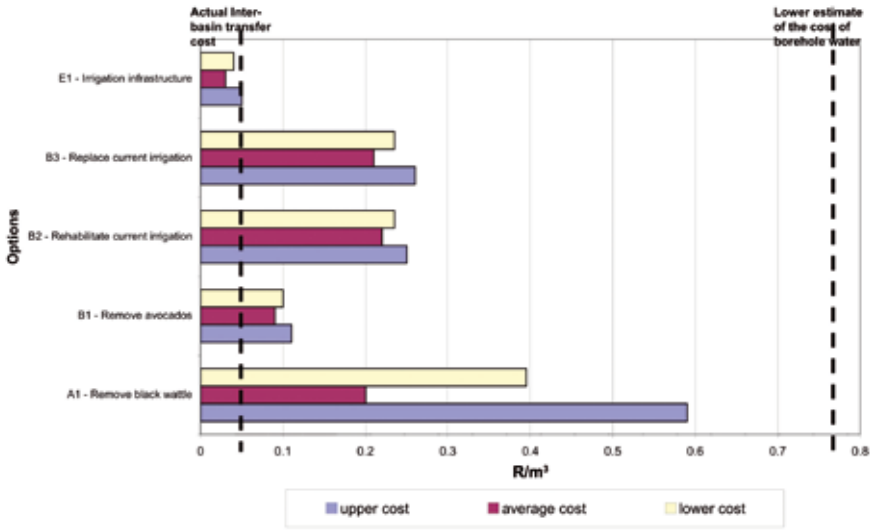
Source: adapted from Wise and Musango 2006[14]

13. Although Jack *et al.* (2008) point out that the aversion of landholders to risk is an important factor influencing seller participation: 'If poor landholders are more risk-averse, then they may demand greater compensation to switch to unfamiliar land uses. On the other hand, the payments under a PES program may be relatively certain compared with other income.'
14. Note: the full report of Wise and Musango provides additional options that were not considered during the action-learning phase.

Because of the range of estimates of water saved and the variable costs of the intervention, the analysis produced a range of break-even costs that a potential buyer of watershed services would need to pay per cubic metre of water saved.

Figure 5

Comparison of five potential landuse and water interventions and the cost of inter-basin transfers and borehole water



The cost-effectiveness of the options depends on two key variables:

- The cost of making the land-use or technological change.
- The volume of water saved.

Of the options, the most cost-effective intervention was Option E – improving the transport and storage of water in the Ga-Selati Irrigation Scheme. In contrast, the most expensive option was the upper estimate for the removal of the black wattle (Figure 5). However, developing catchment protection services are not the only options available to the water users along the Ga-Selati River. Their options include: drilling boreholes to access ground water, re-cycling, or – as in the case of the Lepelle Water Board – buying water through inter-basin transfers[15] (Wise and Musango 2006) However, these options are not available to all water users in the catchment due to their geographical location within the catchment. For example, the farmers in the upper Ga-Selati sub-catchment who need more water are limited to drilling boreholes.

15. The Lepelle Water Board has the option of buying water from either the Vaal, Inkomati or Maputo catchments for R0.0483 m^{-3}.

For the horticulture farmers in the upper Ga-Selati sub-catchment, all of the options considered are more cost-effective than the alternative – which is drilling, equipping and pumping water from boreholes, and which is estimated to cost between R0.76 and R3.30 per cubic metre of water. However, as noted earlier, at the time these options were being developed there was no guarantee that the water saved from any of the interventions would actually accrue to the stakeholder paying the costs.

The analysis is also revealing in terms of the potential volume of water that could be saved. It is very clear that in the upper Ga-Selati sub-catchment the biggest saving of water comes from upgrading irrigation technology or re-allocating water used for irrigation rather than changing land use. In a typically complex catchment this is contrary to much of the literature, which argues that removing alien invasive species leads to the greatest and most substantial improvements in stream and groundwater flows (Le Maitre *et al.* 2000; Dye and Jarmain 2004; Diederichs *et al.* 2004). In South Africa, the government – through the Working for Water Programme – is also responsible for the removal of alien invasive species.[16]

4.2.4 Assessing the options for the farmers in the upper Ga-Selati sub-catchment

All the options considered by the cost-effectiveness analysis are potentially financially viable to the farmers in the upper Ga-Selati sub-catchment as the costs of implementing the changes are less than the cost of their main alternative – sinking and pumping from boreholes (see Figure 5). The potential buyers of PCPS at Phalaborwa have more options, including buying water through inter-basin transfers at rates that are less than the costs of the water saved from land-use changes. However, this is a temporary solution as additional water is often not available and will become scarcer as demand continues to grow.

Despite the positive outcome to the analysis, no further progress was made in developing PCPS in the upper Ga-Selati sub-catchment. The issues that prevented further progress included:

- **Ongoing uncertainty about land tenure:** while CSIR and the local facilitator were working towards the development of a pilot PCPS, the process of land redistribution and land restitution was ongoing. This process became the priority for the farmers and the administrators responsible for the upper Ga-Selati sub-catchment as it directly affected their businesses and lifestyles. The current water shortages (with their potential to increase further) were considered long-term

16. Operationally it is unclear how effective the WfW Programme has been in the Ga-Selati. During a field visit a WfW team was removing *Lantana camara* and *Chromolaena* but leaving the black wattle in place.

problems that could be addressed if, and only if, farmers were still on their land at some point in the future.

- **Legal constraints to payments for catchment protection services:** sustainable development is one of the pillars of the South African Constitution (Republic of South Africa 1996). The South Africa *National Water Act* of 1998 is widely considered to contain some of the most innovative water legislation in the world. Two provisions in the Act, namely the provision of the 'Ecological Reserve' and the fact that water belongs to the state and can only be used under specific conditions, are constraints to the development of PCPS as potential solutions to land-use change problems.

- **Changes in the administration of water:** the management of water resources in South Africa is in a state of transition (Quibell 2007). Although the Olifants River will soon be managed by the Olifants Catchment Management Agency, it had not been established and hence did not have effective control over the water in the Ga-Selati River during the project cycle.

- **Time constraints:** it is estimated that the process of identifying and then beginning to develop PCPS in the upper Ga-Selati sub-catchment has cost between R275,000 and R300,000. The work was conducted as part of a time-bound international project and there was no further funding for the process of facilitating the actual implementation of a PCPS scheme in the upper Ga-Selati sub-catchment.

4.2.5 Potential for pro-poor payments for catchment protection services in the upper Ga-Selati sub-catchment

Given the limited progress the project made at the Ga-Selati site, it is only possible to hypothesise on the potential of PCPSs to reduce poverty. The livelihood survey of people resident in the upper Ga-Selati sub-catchment concluded that many of the residents of the area face pervasive poverty (Visser *et al.* 2005). The origins are primarily historical as the catchment was part of the Lebowa Homeland. Within the upper catchment there are very limited opportunities. The major source of employment is either on commercial farms or the Phalaborwa Mining Complex.

The distribution of the settlement in the catchment is essential to understanding the opportunities for pro-poor PCPS. The Ga-Selati River rises in a protected area in which no permanent human settlements are permitted. In this case the land manager is the Limpopo Province Local Government (Conservation Board). Outside of the protected area the major opportunities for saving water are made by changing the way water is transported, stored and used by commercial farmers.

Again, even if payments for PCPS were to be developed – assuming that land ownership remained constant – they would certainly not be pro-poor. Within the upper Ga-Selati sub-catchment the only real option for improving livelihoods through PCPS would be through employment opportunities. However, as the WfW Programme is already active in the area, it is not clear whether there would be any additional net benefits and to whom they would accrue.

Land redistribution and restitution have been identified as constraints to the development of PCPS. For the residents of the upper Ga-Selati sub-catchment, especially the residents of the peri-urban sites of Calais and Balloon, the opportunity to access land presents them with the best opportunity to improve their livelihoods. During the project's work in the region, a claim by the Sekororo community was approved in which 895 households were granted rights on one of the commercial farms in the upper Ga-Selati sub-catchment. Creating an enabling environment that will allow communities to regain land lost during the apartheid era is clearly the priority in terms of addressing poverty in the region.

4.3 The Sabie Sand catchment

The Sabie River rises in the escarpment of the Drakensberg Mountains and flows eastwards through privately owned farm land, then through densely settled communal land, before flowing into the Kruger National Park. On leaving South Africa, the Sabie River flows into the Corumana Dam in Mozambique. Mean annual flows are approximately 866 million m^3/annum. Being in a summer rainfall area, about 60 per cent of annual flow takes place in the late summer months of January, February and March. Runoff variability is high, with a standard deviation of about 330 and a coefficient of variation of 490. Kurtosis (skewness) of the distribution of flows is also high, with a very few floods strongly influencing the flow record. Cyclone Eline[17] brought heavy rainfall to the region in February 2000 and the monthly mean flow was exceeded 90 times. However, during drought years, river flows can decline to less than a tenth of the monthly mean, as they did during the drought of 1983.

The Sand River drainage begins in the Mpumalanga Drakensberg (longitude 30° 55′, latitude 25° 38′), flowing immediately off the steep escarpment in a south-easterly direction onto the foothill slopes where the Bushbuckridge settlement, communal land and defunct irrigation scheme are located. Further downriver it enters the Sabie Sand Game Reserve and then joins the Sabie River in the Kruger National Park. The upper reaches of the catchment have a mean annual rainfall of between 1,000 and 1,800 mm/yr, which is considered high in South Africa. This high rainfall zone, however, only occupies 10 per cent of the total Sand River catchment area.

17. See http://en.wikipedia.org/wiki/Cyclone_Eline

The Sand River has a mean annual average flow of about 79 million m^3 per year as measured by Weir X3H008 in the lower catchment (Chapman 2007). However, inter- and intra-seasonal flows are highly variable and depend on rainfall. Flooding is also an important factor, for example during February 2000 when river flow reached 1,589 million cubic metres which is easily ten times the highest previous peak flow. During the dry season, the maintenance of base-flow in the upper parts of the Sand River is important for ensuring security of water supply to the people in the lower parts of the catchment.

4.3.1 Key land-use and water-use issues in the Sabie Sand catchment

The key issues impacting on water availability in the catchment are:

- The commercial plantations of exotic species (pine and eucalyptus) planted in the upper catchment and non-commercial alien invasive species. The combined impact of these two land uses on water flows is estimated at nearly 30 million cubic metres per annum.

- The inefficient and poorly maintained irrigation schemes in the lower catchment (Chapman 2007). It is estimated that nearly 80 million cubic metres of the 118 cubic metres of average annual river flow are diverted for agricultural purposes using this inefficient irrigation infrastructure.

If a theoretical water budget is constructed for the Sabie Sand catchment it shows that it is in deficit by nearly 27 million cubic metres annually. The implications of this are that, once the basic human needs are met, the balance of the water is taken from the 'Ecological Reserve'.

Three interventions in the catchment could lead to considerable savings of water, if this was the sole objective of catchment management. These are:

- removal of commercial forestry and re-establishment of montane grasslands;
- removal of alien invasive species;
- upgrading and rehabilitation of irrigation schemes.

If these changes were made – together with the assumptions that indigenous woodlots were established for fuel wood and the water for basic human needs remained constant – the catchment could save nearly 73 million cubic metres of water annually, thus ensuring that the basic human needs and ecological reserve were met even in years of low rainfall (Chapman 2007) (Table 9).

Table 9

Summary of baseline water use and potential water savings for the Sand Irrigation Scheme after interventions

Catchment utility	Baseline current use (million m^3/yr)	New practice estimated use (million m^3/yr)	Estimated savings by use (million m^3/yr)
Plantation forests	24.4	0.0	24.4
Indigenous forests	0.0	20.0[18]	-20.0
Compensatory woodlots	0.0	4.5	-4.5
Alien invading plants	5.0	0	5.0
Irrigation systems	79.9	12.3	67.6
Basic human needs	5.9	5.9	0
Ecological reserve	29.5	29.5	0
Total demand	**144.7**	**72.2**	
Natural flow (input)	**118.0**	**118**	
Net water available	**-26.7**	**45.8**	

Source: Chapman 2007

4.3.2 Assessment of the potential for payments for catchment protection services in the Sabie Sand catchment

As mentioned previously, it was deemed unfeasible to consider implementing payments for catchment protection services at catchment level due to the sheer size of the Sabie Sand catchment. As a result, the implementing partners identified five potential sites for the implementation of action-learning activities in the Sabie Sand catchment. These sites were: Peebles Valley, Sabie town, the Hazyview area, the Sand River, and the Venus Plantation/Sandton Bird Club (Figure 5).

1. **The Peebles Valley**, situated near White River in the upper reaches of the Sand River, was selected because of the substantial negative impact extensive commercial forestry plantations in the headwaters are having on stream flows to downstream intensive irrigated agriculture (e.g., banana, avocado, cabbage, paprika, tobacco, citrus and macadamia nuts) and rural settlements.

18. The replacement of plantation forest by indigenous trees will result in water use by a young, fast-growing forest which has higher water-use rates than a mature forest. The value of 20 million m^3/yr refers to a young, fast-growing forest. After 20 years we assume the forest has achieved maximum tree size and rates of water use. From this point and as the trees mature further, water use declines. After 30 years this value will reduce to a net loss of about 10 million m^3 annually.

Figure 6

Potential PCPS sites in the Sabie Sand catchment

2. **Sabie town** was selected because of the poor quality water (acidic and carrying heavy metals) coming from an abandoned gold mine in the area.[19]

3. **Hazyview town**, and the surrounding fruit farms located downstream of Sabie town, was selected because the water it extracts from the Sabie River is continuously being contaminated by an effluent processing plant in Sabie town (which is not yet fully operational and is plagued with maintenance and management problems).

4. The **Sabie Sand Game Reserve** was selected as a potential buyer of catchment protection services because the Sand River often stops flowing for several months each year, which disrupts aquatic ecosystems along the river and negatively impacts on tourism.

5. The **Venus Indigenous Forest and Forest Plantation** was selected because it provides a sanctuary for birds and other wildlife (and is used often by the Sandton Bird Club) but is threatened by alien invasive species.

Each of these sites is summarised in Table 10 according to the catchment protection activities and services available and the potential buyers and sellers of these services.

19. The water pollution is so severe in town that many residents have had to buy expensive home-based water purification systems.

All these smaller sites represent the complex socio-economic, political and environmental characteristics typical of most catchments in South Africa and therefore presented good case studies to investigate the potential of payments for land- and water-use changes that would lead to the improved provision of ecosystem services (primarily water quantity and quality) and benefits to rural poor.

Table 10 **Summary of proposed sites in the Sabie Sand catchment**

Option	Buyer	Seller	Catchment protection activity	Catchment protection service
Peebles Valley	Commercial farmers	Commercial forestry owners	Remove forest plantations in the upper catchment.	Improved water quantity to commercial farmers.
Sabie town	Residents of Sabie town	To be determined	Control leakage from goldmines and timber yards.	Improved water quality.
Hazyview town	Residents of Hazyview town	To be determined	Address management and maintenance of effluent treatment plant in Sabie town.	Improved water quality.
Sabie Sand Game Reserve	Sabie Sand Game Reserve	Upstream water users, especially forest owners and managers	Remove forest plantations in the upper catchment.	Improved water quantity to commercial farmers.
Venus Plantation	Sandton Bird Club	Sappi Ltd., as managers of the Venus Plantation	Remove alien invasive species from within the indigenous (intact) forest on the Venus Plantation.	Improved biodiversity with improved water quantity as a spinoff (or bundled service).

4.2.3 Potential for pro-poor payments for catchment protection services in the Sabie Sand catchment

This project was able to identify and quantify the larger hydrological issue in the Sabie Sand catchment and identify five potential pilot sites with a variety of water issues. However, beyond this the project made no progress in developing these sites further. There were a number of reasons for this, namely:

- **The water problems being experienced by the towns of Hazyview and Sabie were not amenable to a PCPS-led solution.** In the former case, the problem was one of governance and management relating to the upstream effluent treatment plant. In the latter case, the water quality problems were caused by pollution of the water supply from large and powerful mining and timber enterprises. In both cases, the stronger application of regulatory and legal

instruments is likely to represent a more appropriate entry point, rather than a PCPS-led intervention. In both cases the inappropriateness of PCPS is evident from the lack of sellers willing to participate in PCPS. This outcome has often been experienced in other regions of the world (Robertson and Wunder 2005, report on similar experiences in Bolivia), and Jack *et al.* (2008) state that 'overall viability will be determined by the preferences and power of all relevant stakeholders, including beneficiaries of the ecosystem service, policymakers, financiers, community members, and program administrators'.

Feeder pipes to the irrigated avocado orchard in the Legalametse Nature Reserve

- **Incentives to key stakeholders that prevent their participation in PCPS.** For example, the proposal for the Sandton Bird Club to pay the WfW Programme to remove the alien invasive species from the indigenous forest on the Venus Plantation was constrained by an existing, longstanding agreement between the Sandton Bird Club and Sappi Ltd., which ensured that the former had free access to the indigenous forest.[20] The implication of this was that the Bird Club was not now prepared to pay for services and privileges that they had previously enjoyed for free. A further factor limiting PCPS was the vested interests of Sappi Ltd. foresters, who saw the preservation of the indigenous forest as extra work and expense (particularly managing the spread of fires and invasive species).

- **The catchment protection activities were not pro-poor (ie. did not address livelihood issues).** A PCPS scheme will be pro-poor only 'when the poorest providers have the highest service provision potential' and 'when the poorest providers are those with the lowest opportunity costs' (Jack *et al.* 2008). Neither of these requirements is met in the any one of the five sites selected in the Sabie Sand catchment and could therefore not meet this requirement of the project.

20. The Sandton Bird Club built and manages three lodges in the forest.

4.4 Summary of action-learning in two catchments

Unfortunately, this project was not able to facilitate any form of payments for catchment protection services in either of the two catchments selected. Of the six sites (the upper Ga-Selati sub-catchment in the Lower Olifants Sub-Area and the five sites in the Sabie Sand catchment) the most progress towards a PCPS was made in the upper Ga-Selati sub-catchment. By removing the black wattle from the upper Ga-Selati sub-catchment and halting irrigation of the avocado orchard in the protected area, it was estimated this would save about 1.6 million cubic metres of water per annum (see Table 7). The commercial farmers in the area below the Legalameetse Nature Reserve are currently constrained by their lack of water and have to drill and equip boreholes to ensure sufficient water for their horticultural enterprises. In comparable terms, the cost of clearing wattle is between R0.40 and R0.59 per cubic metre and of clearing the avocado orchard is between R0.09 and R0.11 per cubic metre. In both cases the upper estimate is below the estimated costs of drilling, equipping and running boreholes, for which the estimated unit cost of water is between R0.76 and R3.03 per cubic metre.

Developing PCPS in the other sites in the Sabie Sand catchment made very little progress. One of the overwhelming reasons was that, in all but one case, the problems that existed were not appropriate to a PCPS-led solution.

Despite the strong financial logic for the development of payments for catchment protection services in the upper Ga-Selati sub-catchment, no progress was made beyond the financial analysis. There were several reasons why progress was not made. These include:

- Uncertain land tenure (and water rights), particularly amongst the potential buyers of catchment protection services (ie. the commercial farmers).
- The absence of an effective catchment management agency meant that there was no appropriate, legitimate intermediary with which a payment mechanism could be developed.
- The project's activities in the upper Ga-Selati sub-catchment were constrained by the limited time and financial resources that remained for site-level action-learning.
- Because of the government's substantial funding of the Working for Water Programme there was a sense or expectation that it was government's role to control the spread and impact of alien invasive species.

5 Lessons learned from South Africa

5.1 Introduction

The project's activities in South Africa can be divided into two phases. During the first phase, the CSIR team conducted a scoping exercise that identified two catchments in which there was the greatest potential for the development of PCPS. The second phase of action-learning attempted to develop payment mechanisms in the upper Ga-Selati sub-catchment and five pilot sites in the Sabie Sand catchment. Despite this structured approach – supported by field visits and extensive baseline research – no payment mechanisms were developed during the project. The experiences from both phases, however, have been distilled into six key lessons for the development of pro-poor payments for catchment protection services in South Africa. These are:

1. PCPS alone are unlikely to have substantial impacts on poverty and the livelihoods of poor people.

2. The current water, land and environment legislation is both enabling and constraining the development of PCPS in South Africa.

3. Secure land and water rights are critical for the development of effective PCPS in South Africa.

4. Stable institutional organisational frameworks are critical for the development of PCPS in South Africa.

5. The Working for Water Programme (WfW) can inform and transform into privately led PCPS.

6. South Africa possesses a unique body of information, data, knowledge and skills that can facilitate the development of both government and private sector-led PCPS.

Each of these is discussed in turn below.

5.2 PCPS alone are unlikely to have substantial impacts on poverty and the livelihoods of poor people

Because no payments were actually made at the South African project sites during the course of the project, these lessons are technically theoretical but grounded in the baseline and associated work (workshops, surveys, reviews) undertaken during the project.

Poor people in the communal areas are challenged by a lack of livelihood assets such as skills and information (human capital), poor infrastructure in terms of service delivery and road infrastructure (physical capital), as well as an absolute lack of financial means (financial capital). Their precarious livelihoods mean that they are extremely vulnerable to external threats[21] such as extreme climatic events. Above all, the current poverty in the Limpopo and Mpumalanga provinces is largely a function and legacy of the inequity of apartheid (Visser *et al.* 2005).

The experience of this project in South Africa suggests that PCPS may provide a partial solution to these pervasive livelihoods problems, but PCPS will need to be:

- **Innovative and flexible:** simple blueprint PCPS, with upstream sellers and downstream buyers, are not going to be the standard in South Africa. Where appropriate, PCPS are going to have to be developed in context to recognise economic complexities, different land tenure systems, and the reality that the wealthier stakeholders are often located in the upper sections of a catchment.

- **Complemented by regulatory mechanisms:** this project has shown that within the Olifants and the Sabie Sand catchments there are many diverse and complex causes of water and land-use problems. In the Sabie Sand catchment, for example, there are many different sources of water pollution (from mines, forests and municipal sewerage works) all of which are widely distributed. Consequently, the marginal environmental benefits from additional abatement will vary substantially between sources, making it necessary to develop and implement regulatory mechanisms (such as standards) or more complex incentive-based mechanisms (such as differential taxes, discharge permits). In the Ga-Selati catchment, on the other hand, there may indeed be opportunities to develop incentive-led mechanisms while simultaneously addressing other aspects of water management (for example, the illegal weirs on the Ga-Selati River).

21. The poverty and livelihoods review (Visser *et al.* 2005) was underpinned by sustainable livelihoods theory, which is in turn based on five resource capitals or assets, set within a wider framework of factors such as vulnerability contexts, structures and processes.

- **Inclusive of all stakeholders:** if agreements are made without full consultation and representation of all stakeholders' needs, there is a real danger that historical inequities may be perpetuated as the process is vulnerable to being hijacked or controlled by powerful economic and/or political groups.

- **Include elements to develop skills and capacity:** low levels of formal education and language barriers are major constraints to using PCPS-based interventions to promote social, economic and environmental progress in the former homelands as these factors may hinder negotiation processes or increase the transaction costs related to setting up a system of PCPS.

- **Provide long-term incentives for appropriate and permanent land-use changes:** the long-term nature of the livelihood and environmental challenges suggest that people will have to be given long-term incentives (security) otherwise changes to livelihoods and the environment may only be realised for a limited time. This is particularly difficult under PCPS schemes, which use markets and prices as incentives for suppliers to modify their land- or water-use practices, because the future relative prices of alternative land or water uses may exceed those being paid for the catchment protection services.

5.3 The current water, land and environmental legislation is both enabling and constraining the development of PCPS in South Africa

The current complex and strictly governed legislative environment, which is unique to South Africa, presents both opportunities and challenges for any PCPS scheme.

On the one hand, South Africa's water and environmental legislation is so comprehensive that key land-use changes needed to improve ecosystem services are often already required by law. In other words, activities that might form part of a PCPS scheme are already a legal obligation. For example, South Africa's *National Water Act* makes provision for a basic human right of 25 litres of water per person per day, and an 'Ecological Reserve' that ensures that the integrity of the in-stream ecosystems is maintained. Parallel legislation, the *Conservation of Agricultural Resources Act* (CARA) (Act 43 of 1983, Republic of South Africa) as another example, requires land owners to remove alien vegetation from riparian zones. It is clear, however, that implementing these progressive legal frameworks is – and will continue to be – a major challenge (Quibell 2007).

There is, however, no explicit legislation that prevents payments for catchment protection services from being traded between willing buyers and willing sellers. Under the *National Water Act* (NWA), water users can buy and sell water rights. Furthermore, the NWA allows water management institutions to enforce, control

and receive water charges, which could be extended to payments for catchment protection services.

A major condition of all current legislation in South Africa is that it supports redress and poverty alleviation in order to address the inequity of apartheid. This is an important legislative proviso that should prevent inequitable arrangements being made between buyers and sellers of catchment protection services.

5.4 Secure land and water rights are critical for the development of effective PCPS in South Africa

The international literature argues that clearly defined and effective property rights are essential to the development of PCPS (Wunder *et al.* 2008). South Africa is still in a period of transition in which the government is working to address the inequalities perpetrated during the apartheid era. In particular, land is being restituted and redistributed from a historical white agricultural farming sector and awarded to previously displaced or disadvantaged communities or individuals. In the upper Ga-Selati sub-catchment, land redistribution was the dominant concern amongst potential buyers of watershed services and the primary impediment to implementing PCPS.

In a parallel process to the land redistribution process, the Department of Water Affairs was also re-assessing the allocation of water rights. Under this process, water rights are being reassigned from previously advantaged water users (principally white commercial farmers) to previously disadvantaged water users. This process creates further insecurity around the opportunities to develop payment-driven mechanisms for catchment protection.

The above-mentioned reasons for the current insecurity of land and water rights are expected to have important – but generally positive and long-lasting – impacts on livelihoods. The authors of this paper believe that when these processes are complete and the uncertainties and tensions abate, opportunities to develop PCPS are likely to emerge.

5.5 Stable institutional organisational frameworks are critical for the development of PCPS in South Africa

Reflecting the changes in the legal and policy frameworks, as well as the changes in water and land tenure, the government of South African is also transforming water management institutions and processes. Across the country 19 CMAs are in the process of being established.

At the time of implementing this project, only three CMAs had been established but none was fully functional and effective. This meant that for both the Olifants catchment and the Sabie Sand catchment, there was no established organisation to act as an intermediary in transactions, or to fulfil the role of arbiter between the competing water users. The capacity of CMAs will be severely limited in the short to medium term due to their limited capacity and their need to establish their legitimacy amongst all the stakeholders.

5.6 The Working for Water Programme can inform and transform into privately led PCPS

In addition to leading the dynamic and multiple changes to water, land and resource legislation, the government of South Africa is also a major buyer of catchment protection services through the Working for Water Programme (WfW). WfW is an expanded public works programme that is largely publicly funded (in 2003 its budget was R400 million). Its core activity is the control of water-intensive alien invasive species in upper catchments and riverine areas (Turpie *et al.* 2008). It is credited with clearing about 1 million hectares of land since 1995, with an estimated saving in water of 43 million cubic metres (Marais and Wannenburgh 2007).

During the project, the WfW Programme was active in the upper Ga-Selati sub-catchment, although a considerable amount of work remained as teams appeared to be only removing large eucalyptus trees (personal observation), leaving expanding stands of black wattle (*Acacia mearnsii*). The success of the programme has also led to the creation of similar public works programmes for the management of wetlands (Working for Wetlands), woodlands (Working for Woodlands) and the management of fire (Working for Fire) in sensitive ecosystems.

The extent of the financial support of WfW by the Department of Public Works is a major disincentive to the development of privately funded PCPS. This is because there is no incentive for other water users to pay for clearing of alien invasive vegetation as long as the WfW Programme does the work for free (Turpie *et al.* 2008). However, the precedent/example that has been set by WfW, namely that clearing alien invasive species is good for water supplies, is important. Currently a major constraint to privately funded invasive alien species clearing programmes is the cost. For example, initial clearing costs can be as much as R7,000 per hectare (depending on species, location and density); follow-up visits are required every one to three years at a cost of approximately R50/ha (depending on regeneration rates) and will have to continue for anything up to 30 years (depending on the size of the seed banks).

5.7 South Africa possesses a unique body of information, knowledge and skills that can facilitate the development of both government and private sector-led PCPS

South Africa is a water-scarce country that for decades has focused on developing substantive engineering solutions to water scarcity (Turpie *et al.* 2008). The country also possesses a unique combination of hydrological information and skills (e.g., hydrological modelling) that is not found anywhere else in Africa. These have been used effectively to develop and implement the government's Working for Water Programme to the extent that the relationships between different land uses and water (groundwater and stream flows) are widely recognised.

Notwithstanding the extent of the legislative, regulatory, organisational and property rights changes related to all natural resources in South Africa, the skills and information that currently exist (together with the models that are being developed under the government's Working for Water Programme) provide South Africa with an excellent base for the development of PCPS. A remaining challenge, however, is the development of low-cost, robust methodologies that allow stakeholders to monitor land-use changes and the impact of these changes on water quality and water quantity. These methodologies will go a long way to reducing the high transaction costs of PCPS schemes in South Africa. These models will also be highly appropriate in many neighbouring countries that face the same challenges.

Another challenge facing the South African community will be to continue moving away from a focus on supply-side, engineering solutions towards more innovative, market (incentive)-based mechanisms that facilitate management interventions to improve the efficiency, effectiveness and equity of natural resource provision (supply) and use (demand). The emergence of the Working for Water/Wetlands/Woodlands/Fire initiatives has drawn attention to the importance of land use–water relationships, as has the introduction of water tariffs for all stream flow reduction activities.

5.8 Summary of lessons learned and action-learning approaches

The South African component of the project 'Developing markets for watershed protection services and improved livelihoods' has identified six lessons. Three of these lessons (sections 5.3, 5.4 and 5.5) relate to the dynamic and often uncertain environment in which the action-learning activities were being undertaken and the negative effect of these on the willingness of stakeholders to participate in PCPS.

Within the two selected catchments for example (and this is a characteristic of all catchments in South Africa), ownership and enforcement of land rights and water

rights are in continual flux due to the *National Water Act* and land restitution/redistribution, making the implementation of a market-based approach such as PCPS very difficult. Furthermore, water management in South Africa is in the early stages of being radically transformed as decision-making is devolved to catchment management agencies. Lessons 5.6 and 5.7 recognise some of the very positive aspects that will lead to the emergence of PCPS as a management tool in the future. However, PCPS are not a 'silver bullet', and complex land use–water relationships will need a mix of market-based and regulatory instruments.

Our experience in South Africa has important implications for the use of action-learning research approaches. The dynamic institutional and organisational environment potentially creates opportunities for action but can also be a major hindrance. With hindsight, more attention should have been paid to these 'governance' factors when selecting the pilot sites.

The first phase of the project took far longer than expected to complete. This reduced the time available for site-level work in the Olifants and Sabie Sand catchments. With hindsight it was highly optimistic to attempt to develop effective action-learning sites without building on existing initiatives – an approach that was used to great effect in Bolivia (Los Negros watershed) and Indonesia (Brantas and Cidanau watersheds). To be effective, action-learning projects need extended time horizons of at least ten years. Short-term projects and programmes have less chance of alleviating poverty and improving ecosystem management. Short-term projects are also less able to react to their own findings (Sayer and Campbell 2004).

5.9 Conclusions: the way forward for PCPS in South Africa

South Africa's water resources are scarce, getting scarcer, and are often unpredictable. Long-term as well as seasonal water shortages are a reality in some areas and will become a binding constraint to economic development (Falkenmark 1994; Ashton and Haasbroek 2002). However, a dramatic shift in government attitudes, encouraged and supported by growing public awareness, is leading to a multifaceted approach to water management that includes supply-side engineering, innovations with respect to land use, and an emerging demand-side (incentive-based) component. This change in approach provides an ideal opportunity to evaluate the new opportunities to design and implement a system of payments for catchment protection services as an option to assist water demand management.

In some other countries, payments for catchment protection services seem to be a viable option to maintain and improve catchment management activities and to deal with some of the prevailing poverty issues affecting farmers who live in the catchments (for example in Mexico, Costa Rica and Guatemala). For several reasons

the work in South Africa strongly suggests that payments for catchment protection services will not, on their own, address the deep and underlying structural inequalities that are ongoing causes of poverty for many people living in the communal lands of the country.

There is, however, a raft of initiatives that are addressing many of these structural challenges. In the two catchments considered in this project, land redistribution, land restitution and water re-allocation were all processes in action, and previously disadvantaged communities were being given rights to land and water. When these processes are complete, the rural landscape of South Africa is likely to be very different socially and economically. However, the challenges facing land use and water are unlikely to diminish, especially in the northernmost provinces that will be most severely impacted by climate change (Hewitson and Crane 2006).

The Working for Water Programme has set an important precedent in South Africa, particularly with respect to the relationship between land use, groundwater and surface water. However, there is a real danger of free-riding, as land users and owners get accustomed to WfW clearing alien invasive species at no direct cost to themselves. The real challenge for WfW is to begin to develop robust examples of private sector payments for catchment protection services. These will provide important precedents that others can then emulate. These initiatives should be developed so as to complement the thousands of job opportunities, skills training and entry points for HIV/AIDS programmes pioneered by WfW (Turpie *et al.* 2008).

Within South Africa there is a unique body of knowledge and skills in the water sector. There is a need to maintain this talent and also to develop the scientific basis for land use-water relationships beyond the current understanding of plantation forestry and the role of alien invasive species. Changes in land ownership are likely to lead to major land-use changes in some parts of South Africa as the new managers explore and develop agricultural systems that meet their needs.

Finally, South Africa has recently enacted (and continues to develop) highly innovative legislation for the management of the country's water resources. There is, however, insufficient capacity in the central and regional governments and the emerging catchment management agencies to fully develop the opportunities that this legislation provides. An immediate challenge for the water sector is to ensure that the organisations responsible for implementation of policy have the human and financial capacity to fulfil their mandates.

References

Adams W.M. and Jeanrenaud S.J. (2008). Transition to Sustainability: Towards a Humane and Diverse World. IUCN, Gland, Switzerland.

African National Congress (ANC) (1994). Reconstruction and Development Programme: A Policy Framework. Umanyano, Johannesburg, RSA.

Appleton A. (2002). How New York City used an ecosystem services strategy carried out through an urban-rural partnership to preserve the pristine quality of its drinking water and save billions of dollars and what lessons it teaches about ecosystem services. Paper prepared for Forests Trends, Tokyo Meeting, 2002.

Ashton P.J. (2007). 'Disputes and conflicts over water in Africa' in N. Mlambo (ed), Violent Conflicts, Fragile Peace: Perspectives on Africa's Security. Adonis and Abbey, London, UK (in press).

Ashton P.J. and Haasbroek B. (2002). 'Water demand management and social adaptive capacity: A South African case study' in A.R. Turton and R. Henwood (eds) Hydropolitics in the Developing World: A Southern African Perspective. African Water Issues Research Unit (AWIRU) and International Water Management Institute (IWMI).

Ashton P.J., Hardwick D. and Breen C. (2008). 'Changes in water availability and demand within South Africa's shared river basins as determinants of regional social and ecological resilience' in M. Burns and A. Weaver (eds) Exploring sustainability science: A southern African perspective. (Stellenbosch, AFRICAN SUN MeDIA). Pp. 279-310.

Basson M.S. and Roussouw J.D. (2003). Inkomati Water Management Area: Overview of Water Resources Availability and Utilisation. Department of Water Affairs and Forestry Report Number P WMA 05/000/00/0203, Department of Water Affairs and Forestry, Pretoria, RSA.

Basson M.S., van Niekerk P.H. and van Rooyen J.A. (1997). Overview of Water Resources Availability and Utilization in South Africa. Department of Water Affairs and Forestry, Pretoria, RSA.

Bekker F. (2006). Personal communication, September 2006.

Blignaut J. (2008). An inventory of current and potential projects and markets for payments for ecosystem services. Draft working paper for the East and Southern Africa Katoomba Group (E&SA KG).

Blignaut J. and King N.A. (2005). Developing a framework for payments for catchment protection services and improved livelihoods in South Africa. CSIR Contract Research Report No. ENV-P-C 2005-018, prepared for IIED, London, UK.

Bond I. and Mayers J. (forthcoming). Fair deals for watershed services: Lessons from a multi-country action learning project. International Institute for Environment and Development, London.

Bradstock A. (2005). 'Changing Livelihoods and Land Reform: Evidence from the Northern Cape Province of South Africa' in World Development. Vol. 33, No. 11: 1979-1992.

Chapman R.A. (2006). Hydrology and land use in the Ga-Selati catchment. Paper No. 8 in the SA Working Paper Series for the IIED-funded project 'Payments for catchment protection services and improved livelihoods in South Africa'. CSIR Contract Research Report No. ENV-P-C-2005-043, prepared for IIED, London, UK.

Chapman R.A. (2007). Hydrology and land use in the Sand River catchment. Paper No. 10 in the SA Working Paper Series for the IIED-funded project 'Payments for catchment protection services and improved livelihoods in South Africa'. CSIR Contract Research Report No. CSIR/NRE/ECO/ER/2006/0123/C, prepared for IIED, London, UK.

Central Intelligence Agency (CIA) (2006). The World Fact Book. Available online at: https://www.cia.gov/library/publications/the-world-factbook/ (Last updated on 7 August 2008)

Claasen M., Damon M., King N.A., Letsaolo, A., Moilwa, N., Ramoelo A. and Visser A. (2005). The Feasibility of Developing Payments for catchment protection services and improved livelihoods in South Africa. CSIR Contract Research Report No: ENV-P-C 2005-014.

Council for Scientific and Industrial Research (CSIR) (2003). South African National Land-Cover Database Project 2000. Satellite Application Centre, CSIR , Pretoria, RSA.

Dent M. (2007). 'The Way of the Seed' CMA Leadership Letter, 68.

Department for International Development (DFID) (1999). Sustainable Livelihoods Guidance Sheets. DFID, London, UK.

Dick B. (1997). Action learning and action research. Available online at: www.scu.edu.au/schools/gcm/ar/arp/actlearn.html

Diederichs N., Mander M., Blignaut J., Turpie J., Jewitt G., Schafer W., Markewicz A., O'Conner T., Mavundla H. and Murphree M. (2004). Payments for ecosystems services baseline study. Unpublished report for the Maloti Drakensberg Transfrontier Project.

Department of Land Affairs (DLA) The Ad Hoc Committee on Land statement to Communal Land Rights Bill process of the Department of Land Affairs.

Department of Water Affairs and Forestry (DWAF) (1986). Water Resources of South Africa. Department of Water Affairs and Forestry, Pretoria, RSA.

DWAF (1997). White Paper on a National Water Policy for South Africa. Department of Water Affairs and Forestry, Pretoria, RSA. Available online at: www.dwaf.gov.za/Docs/

DWAF (1998). National Water Act for South Africa. Department of Water Affairs and Forestry, Pretoria, RSA.

DWAF (1999). A Pricing Strategy for Raw Water Use Charges. Department of Water Affairs and Forestry, Pretoria, RSA. Available online at: www.dwaf.gov.za/Docs/

DWAF (2002). The National Water Resources Strategy for South Africa. Department of Water Affairs and Forestry, Pretoria, RSA.
DWAF. (2003). Overview of Water Resources and Utilization. DWAF Report No P WMA 05/000/00/0203. Department of Water Affairs and Forestry, Pretoria, RSA.
DWAF (2004). Olifants Water Management Area: Internal Strategic Perspective. Prepared by GMKS, Tlou and Matji and WMB on behalf of the Directorate: National Water Resource Planning. DWAF Report No P WMA 04/000/00/030.
DWAF (2006). Water use charges 2006/07. Water use licensing, registration and revenue collection. Department of Water Affairs and Forestry, Pretoria, RSA. Available online at: www.dwaf.gov.za/Projects/WARMS/Revenue/charges1.asp
Dye P. and Jarmain C. (2004). 'Water use by black wattle (Acacia mearnsii): implications for the link between removal of invading trees and catchment stream flow response' in South African Journal of Science, 100: 40-44.
Engel S., Pagiola S. and Wunder S. (2008). 'Designing payments for environmental services in theory and practice: An overview of the issues' in Ecological Economics 65 (4): 663-674. Elsevier, Amsterdam, The Netherlands.
Falkenmark M. (1994). 'The dangerous spiral: near future risks for water related eco-conflicts' in Proceedings of the ICRC Symposium Water and War: Symposium on Water in Armed Conflicts. International Committee of the Red Cross, Montreaux. Switzerland 21-23 November 1994.
Frost P. and Bond I. (2008). 'The CAMPFIRE programme in Zimbabwe: Payments for wildlife services' in Ecological Economics 65 (4): 776-787. Elsevier, Amsterdam, The Netherlands.
Gorgens A.H.M. and van Wilgen B.W. (2004). 'Invasive alien plants and water resources in South Africa: Current understanding, predictive ability and research challenges' in South African Journal of Science, 100: 27-33.
Hendricks, L.B. (2008). Speech by the Minister of Water Affairs, Mrs L.B Hendricks, on the signing of the Memorandum of Agreement on the Olifants River Water Resources Development Project. Available online at: www.dwaf.gov.za/communications/ministerspeeches/2008/ORWRDP26May08.doc
Hewitson B.C. and Crane R.G. (2006). 'Consensus between GCM Climate Change Projections with Empirical Downscaling' in International Journal of Climatology doi:10.1002/joc.1314.
Hope R. (2005). Water, Workforce and Poverty: The impact of the Working for Water Programmes on Rural Poverty Reduction. Environment, Development and Sustainability. Springer Volume 8. Number 1.
Hope R. (2007). From Mountain to Tap. DFID Report. DFID, London, UK.
Intergovernmental Panel on Climate Change (IPCC) (2000). Special Report on Land Use, Land Use Change and Forestry. Eds R.T. Watson, N.H. Ravindranath, D.J. Verardo and D.J. Dokken. UNEP.

Jack B.K., Kousky C. and Sims K.R.E. (2008). 'Designing payments for ecosystem services: lessons from previous experience with incentive-based mechanisms' in the Proceedings of the National Academy of Sciences. 105 (28): 9465–9470.

King N.A. (2002). Valuing a City's Water: The Case of Tshwane. Unpublished M. Com. thesis. University of Pretoria, Pretoria, RSA.

King N.A. and Bond I. (2005). How Can Payments Help Manage Watersheds Sustainably and Fairly? Phase 3 – Workplan for Action Learning Process in South Africa 2005-2006. CSIR Contract Research Report No. ENV-P-C-2005-029, prepared for IIED, London, UK.

King N.A., Damon M. and Forsyth G. (2005). An Inventory of Current Ecosystem Service Payments, Markets, and Capacity Building in South Africa. CSIR Contract Research Report No: ENV-P-C 2005 050, prepared for Forest Trends, Washington DC, USA.

King N.A. and Hattingh H. (2005). The role of good governance in making payments for catchment protection services in South Africa. Paper No. 2 in the SA Working Paper Series for the IIED-funded project 'Payments for catchment protection services and improved livelihoods in South Africa'. CSIR Contract Research Report No. ENV-P-C 2005-015, prepared for IIED, London, UK.

King N., Letsaolo A. and Rapholo B. (2003). Developing markets for watershed protection services and improved livelihoods in South Africa. CSIR Report No. ENV-P-C-2003-059. Contract report prepared for IIED. London: CSIR-Environmentek.

Landell-Mills N. and Porras I.T. (2002). Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor. 'Instruments for sustainable private sector forestry' series. IIED, London, UK.

Le Maitre D.C., Versfeld D.B. and Chapman. R.A. (2000). 'The impact of invading alien plants on surface water resources in South Africa: A preliminary assessment' in Water SA 26(3): 397-408.

Marais Christo. Personal communication, November 2006.

Marais C., van Wilgen B.W. and Stevens D. (2004). 'The clearing of invasive alien plants in South Africa: A preliminary assessment of costs and progress' in South African Journal of Science, 100: 97-103.

Marais C. and Wannenburgh A.M. (2007). 'Restoration of water resources (natural capital) through the clearing of invasive alien plants from riparian areas in South Africa – costs and water benefits' in K.J. Esler, P.M. Holmes, D.M. Richardson and E.T.F. Witkowski (eds). Riparian Vegetation Management in Landscapes Invaded by Alien Plants: Insights from South Africa. South African Journal of Botany Volume 74, Issue 3 (July 2008). Available online at www.sciencedirect.com/science/journal/02546299

Mbongwa M., Van den Brink R. and Van Zyl J. (1996). 'Evolution of the agrarian state in South Africa' in J. Van Zyl, J. Kirsten and H.P. Binswanger (eds). Agricultural Land Reform in South Africa. Oxford University Press, Oxford, UK. Pp. 36-63.

Milton S.J., Dean W.R.J and Richardson D.M. (2003). 'Economic incentives for restoring natural capital in southern African Rangelands' in Frontiers of Ecology and Environment 1: 2247-2254.
Pagiola S. (2008). 'Payments for environmental services in Costa Rica' in Ecological Economics 65 (4): 712-724. Elsevier, Amsterdam, The Netherlands.
Pagiola S., Landell-Mills N. and Bishop J. (2002). 'Market based mechanisms for conservation and development' In S. Pagiola, N. Landell-Mills and J. Bishop (eds). Selling Forest Environmental Services: Market-based mechanisms for conservation and development. Earthscan, London, UK.
Palmer R., Diedericks G.and Rogatshnig S. (2005). Sabie-Sand Catchment: Site selection discussion document. South African Working Paper Series, IIED, London, UK.
Perrings C. (2007). 'Future challenges' in Proceedings of the National Academy of Sciences, USA 104: 15179-15180.
Pollard S., Shackleton C.and Carruthers J. (2003). 'Beyond the Fence: People and the Lowveld Landscape' in J. du Toit, ,K. Rogers and H. Biggs (eds). The Kruger Experience. Ecology and Management of Savannah Heterogeneity. Island Press, Washington DC, USA.
Porras I., Grieg-Gran M. and Neves N. (2008). All that glitters: A review of payments for watershed services in developing countries. Natural Resource Issues, No. 11. IIED, London, UK.
Quibell G. (2007). 'Policy and Practice Analysis Assessing Policy Influences On People's Relationship To Water Ecosystem Services: The South African Experience'. Appendix 7 of Water ecosystem services and poverty reduction under climate change. IIED, London, UK.
Quibell G. and Steyn R. (2005). Payments for catchment protection services and improved livelihoods in South Africa: A legal review. CSIR Contract Research Report No: ENV-P-C 2005-017, prepared for IIED, London, UK.
Republic of South Africa (RSA) (1983). Conservation of Agricultural Resources Act (CARA) 43 of 1983. Department of Water Affairs and Forestry, Pretoria, RSA.
RSA (1996). The Constitution of the Republic of South Africa (Act No. 108 of 1996). Government Printer, Pretoria, RSA. Available online at: www.acts.co.za
RSA (1998). The National Water Act, 1998 (Act No. 36 of 1998). Department of Water Affairs and Forestry, Pretoria, RSA. Available online at: www.acts.co.za
Robertson N. and Wunder S. (2005). Fresh tracks in the forest: assessing incipient payments for environmental services initiatives in Bolivia. Center for International Forestry Research, Bogor, Indonesia.
Rural Integrated Engineering (2006). Lekgalameetse Nature Reserve Irrigation Scheme. Scoping Report, May 2006.
South African National Treasury (2003). Intergovernmental Fiscal Review, 2003. South African National Treasury. Available online at: www.treasury.gov.za/documents/ifr/2003/chp11.pdf

Sayer J. and Campbell B. (2004). The science of sustainable development: Local livelihoods and the global environment. Cambridge University Press, Cambridge.
Scholes R. and Biggs R. (eds) (2004). Ecosystem services in Southern Africa: A regional assessment. CSIR, Pretoria, RSA.
Schultze R.E. (2005). Climate Change and Water Resources in Southern Africa. WRC Report No: 1430/1/05. WRC, Pretoria, RSA.
Sekhukhuneland Ad Hoc Committee on Land (2003). Submission to the Portfolio Committee on Agriculture and Land Affairs.
Statistics South Africa (Stats SA) (2001). Census 2001 Database. Available online at: http://www.demarcation.org.za/municprofiles2003/index.asp (Accessed on 21 July 2005).
Stats SA (2008). Labour force survey. Available online at: www.statssa.gov.za
Turpie K., Marais C. and Blignaut J. (2008). 'The Working for Water Programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa' in Ecological Economics 65 (4): 788-798. Elsevier, Amsterdam, The Netherlands.
van der Berg S., Burger R., Burger R.P., Louw M. and Yu D. (2005). Trends in poverty and inequality since the political transition. Department of Economics, University of Stellenbosch, RSA.
Visser A., Olorunju S., Dippenaar S. and Moilwa N. (2005). An analysis of the livelihoods of communities of the upper Selati catchment, South Africa. CSIR Contract Research Report No. ENV-P-C 2005-042. prepared for IIED, London, UK.
Water Research Commission (WRC) (2001). State of the Rivers Report: Crocodile, Sabie-Sand and Olifants River Systems. Water Research Commission Report No. TT 147/01. WRC, Pretoria, RSA.
Wise R. and Musango J. (2006). A framework for decision-making using a cost-effectiveness approach: a case study of the Ga-Selati River. Council for Scientific and Industrial Research, Pretoria and IIED, London.
Whiteford A. (2004). Fact sheet poverty in South Africa, 1. Human Sciences Research Council (HSRC), Pretoria, RSA.
Woodworth P. (2006). Working for Water in South Africa, saving the world on a single budget? World Policy Journal, Summer 2006.
Wunder S.(2005). Payments for environmental services: some nuts and bolts. Occasional Paper No. 42. Centre for International Forestry Research, Bogor, Indonesia.
Wunder S., Engel S. and Pagiola S. (2008). 'Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries' in Ecological Economics 65 (4): 834-852. Elsevier, Amsterdam, The Netherlands.

Appendix 1
List and summary of supporting studies

South African Working Paper Series, papers 1 to 11

1. *The feasibility of developing market-based mechanisms for watershed services and improved livelihoods in South Africa*. Claasen M., Damon M., Moloi B., King N.A. and Visser A. (2004).
2. *The role of good governance in making payments for catchment protection services in South Africa*. King N.A. and Hattingh H. (2005).
3. *Can payments be used to manage South Africa watersheds sustainably and fairly? A legal review*. Quibell G and Stein R. (2005).
4. *Making a difference: using payments for catchment protection services to improve integrated water resource management in South Africa*. King, N.A. and Turton A. (2006).
5. *Developing a framework for payments for catchment protection services in South Africa*. Blignaut, J. and King N.A. (2006).
6. *National review of payments for catchment protection services in South Africa*. Herling M. and King N.A. (2006).
7. *An analysis of the livelihoods of communities of the upper Selati catchment, South Africa*. Visser, A.E., Olorunju S., Dippenaar S. and Moilwa N. (2005).
8. *Hydrology and land use in the Ga-Selati catchment*. Chapman, A. (2006).
9. *Challenges to establishing markets for watershed services: learning from country diagnostics*. Geoghegan, T. (2005).
10. *Hydrology and land use in the Sand River catchment*. Chapman, A. (2007).
11. *A framework for decision-making using a cost-effectiveness approach: a case study of the Ga-Selati River*. Wise, R.M. and Musango J.K. (2006).

Summary of studies

1. *The feasibility of developing market-based mechanisms for watershed services and improved livelihoods in South Africa*

This report investigates the feasibility of implementing market-based mechanisms for watershed protection services and improved livelihoods in six pre-identified sites in South Africa (namely the Olifants catchment, the Sabie Sand catchment, the upper Vaal catchment – specifically the Klip River, the Mhlathuze catchment, the St. Lucia Estuary and the Levuvhu-Letaba catchment). Each site is assessed against criteria concerning hydrology, land tenure and ownership; the identification of poor and marginalised groups; power imbalances; land use; and economics. Based on the assessment and the outcome of a workshop, two pilot sites are proposed: the Olifants River catchment and the Sabie Sand catchment. The Olifants River catchment presents excellent opportunities for the development of payments for watershed protection services. Both buyers and sellers of services are well defined and interested in finding solutions to meeting water quantity and quality demands in the region. Furthermore, community initiatives are

already focusing on improving land management practices through the planting of trees and grasses. The Sabie Sand catchment is, however, more complex. The catchment is vast and the downstream buyers are, potentially, unwilling and unable to facilitate payments that will effect change. Currently there are no water quality concerns but water supply issues may increase with development in the region.

2. *The role of good governance in making payments for catchment protection services in South Africa*

The public good nature of many ecosystem services, including water resources, means that responsibility for their management rests with governments. Although payments for ecosystem services fall within the realm of the market, they cannot be employed effectively in the absence of 'good governance'. Good governance includes the principles of openness, participation, accountability, effectiveness, coherence, democracy and integrity. The levels of governance applicable to catchment protection services range from international agreements (e.g., for trans-boundary catchments) to local agreements. Overall, South Africa's governance and legislative environment provides a firm framework for the development of payments for catchment protection services. However, the scope for definition of these services, and the land management activities that are required in order to supply them, need to be considered carefully. While institutional arrangements are being carefully planned and formed, they are still largely in a state of flux. In the interim, transitional institutions can be effectively used to support payments for catchment protection services.

3. *Can payments be used to manage South Africa watersheds sustainably and fairly? A legal review*

This paper highlights the opportunities and constraints offered by South African policy and legislation to developing markets to effect payments that are made voluntarily between a willing buyer and a willing seller – and which are not mediated by the state. In general, the policy and legislative environment is supportive of such markets. In some cases, legislation specifically requires potential buyers of these services to undertake similar social improvement programmes. However, the broad scope of much of the legislation allows the state to control or manage any activity that could impact on the environment and/or water resources. As such, rigorous application of legislation may constrain the implementation of these payments. Payments for ecosystem services should, therefore, be motivated as complementing the activities of the state. Similarly, security of tenure or ownership of land may constrain implementation of catchment ecosystem services, but in most cases where the land has been occupied for many years, land reform legislation is likely to provide some protection for the occupants.

4. *Making a difference: using payments for catchment protection services to improve integrated water resource management in South Africa*

This paper explores the potential for developing payments for catchment protection services within the complex South African environment, where there is chronic water stress, high demands of economic growth, and many institutional, social and political challenges. Within this context, economic instruments may potentially provide solutions

to managing catchments, but they have a limited scope due to the underlying requirements for clearly defined property rights, perfect information and low transaction costs. The paper also discusses different types of payments such as direct payments – widely used in developed countries – and indirect approaches, which employ integrated management planning and project development, or community-based resource management. The latter are more commonly used in developing countries as they have broader social benefits.

5. *Developing a framework for payments for catchment protection services in South Africa*
The South African context creates a complex and yet opportunistic environment for implementing payments for catchment protection services. Water scarcity and water quality issues are evident, and projected to become even more important as demands on water resources continue to increase. Typical supply-side solutions are no longer as viable as they once were, due to increasing infrastructure costs and fewer suitable sites for dams and other large-scale developments. As a result, demand-side solutions such as market-based mechanisms or payments for catchment protection services have an increasingly significant role to play in addressing water supply and quality shortfalls. These mechanisms allow for the development of incentives that encourage actors to engage in changing their behaviour so as to effect positive change and impact on water resources. The potential role of payments for ecosystem services is recognised as an emerging topic of interest in southern Africa. Although various approaches to implementing payments exist, a framework for developing payments for catchment protection services in the southern African context has not yet been developed. This paper suggests such a framework to facilitate the implementation of initiatives.

6. *National review of payments for catchment protection services in South Africa*
This paper presents a review of existing projects and initiatives that are related to the establishment of payments for catchment protection services in South Africa. Initiatives reviewed include two that are being planned (the IIED-CSIR initiative: 'Payments for catchment protection services and improved livelihoods in South Africa'; and the Maluti-Drakensberg project in KwaZulu-Natal: 'Developing a framework for watershed payments') and two that have been implemented (the Working for Water initiative and the Working for Wetlands initiative, both funded by the Department of Water Affairs and Forestry). Lessons learned from these projects and initiatives suggest that payments for catchment protection services are a viable option to aid the maintenance and improvement of such services. However, the following aspects of the process will need to be managed carefully: building capacity to handle all aspects of these transactions, the legal and institutional environments, the scale of the project in terms of monitoring and transaction costs, the transparency and accuracy of 'service delivery', and the effects of changes in the current political landscape – especially in terms of land reforms and the allocation of water rights.

7. *An analysis of the livelihoods of communities of the upper Ga-Selati catchment, South Africa*
This report presents a baseline study of the livelihoods of communities in the Ga-Selati catchment since the poor communities of the communal areas in the catchment are potential providers of improved water services. The livelihood strategies and outcomes

of households in these villages are very similar to those of communities in former homelands throughout South Africa. The current low average household incomes and high unemployment rates in the upper Ga-Selati catchment clearly indicate the need for alternative livelihood strategies, one of which could be provision of ecosystem services. However, there are two particular areas of concern. Firstly, the environmental problems of the upper catchment are largely the result of the activities of community members, ie. the potential providers of ecosystem services also contribute to the environmental problems, so any intervention should be based on both proactive and reactive measures. Secondly, the land reform process will dramatically alter ownership patterns in the upper Ga-Selati catchment – ownership of the Legalameetse Nature Reserve is to be transferred to the local Sekororo community. There will need to be clarity as to which institution will enforce access to the reserve; this is a key element in the potential success of a market-based mechanism.

8. *Hydrology and land use in the Ga-Selati sub-catchment*
The Ga-Selati River is small by international standards and is subject to occasionally severe droughts and floods. It is heavily utilised for irrigated agriculture, which has restricted supplies for other downstream users as well as limited the potential to dilute polluted water from the large mining operation at Phalaborwa. This paper considers the various competing demands on the river's water supply – with the present abstractions from the Ga-Selati River and its associated groundwater entities, the outlook for constant delivery of water is negative. The principal challenge is how this situation is going to be turned around; payments for ecosystem services have been suggested as one possible solution. The paper outlines various interventions that could be made on the Ga-Selati river system, and estimates the likely impacts. It also describes threats to the process of improving the equitable sharing of water in the region: the increasing population of rural poor in the upper catchments, their demand for land and other natural resources, failure by local and regional authorities to regulate water abstractions from the river and nearby groundwater resources, and failure to conserve the natural resources of the Legalameetse Nature Reserve.

9. *Challenges to establishing markets for watershed services: learning from country diagnostics*
This paper synthesises a set of diagnostic studies carried out by IIED and its partners to explore the potential of market-based approaches for watershed protection. The studies responded to concerns raised in earlier work by IIED that markets for watershed services were being promoted without adequate consideration of their costs and benefits. Studies carried out in the Caribbean, India, Indonesia and South Africa included an assessment of key watershed management issues and needs, potential market actors, the policy and institutional context, and interest in and demand for market-based approaches. There was a generally consistent picture of a notable lack of mechanisms for watershed management actors, whether states, communities, or individuals, to recover their costs directly from the beneficiaries of their actions. Nonetheless, many financial and other incentives do exist to encourage good watershed practices, and with most of these the state or community institutions play a major role. The studies found little evidence of

the existence of, or demand for, market-based mechanisms – either by governments or potential 'buyers' of watershed services. However, it did uncover a number of needs that market-like incentives might help meet. The diagnostics illustrate the complexity of addressing livelihood issues through market-based approaches, particularly in terms of providing market opportunities for the poor, while at the same time protecting them from exploitation from more powerful 'buyers' and 'sellers' of watershed services. Aspects of this complexity are described in terms of technical, social and institutional challenges. Any further exploration of economic instruments for watershed protection should explore whether payments for watershed services can serve to decrease rather than increase risk and vulnerability for the poor; assure security of access by local people, including the poor, to watershed resources and services upon which they depend; reinforce rather than undermine existing state, traditional, community, and private systems of management; and complement rather than compete with new government institutions, structures, and fee systems coming out of water sector reform processes.

10. *Hydrology and land use in the Sand River catchment*
The Sand River catchment is under high and increasing water stress, due largely to highly wasteful irrigation practices, combined with a high human population competing for inadequate resources, and widespread poverty in the middle catchment. Flows in the Sand River have either ceased or are near-zero during the important dry winter months along the middle and lower reaches of the river. However, downstream game reserve owners could potentially make payments for catchment protection services. This paper focuses on quantifying the potential hydrological benefits of changing land and water use. It considers the potential impacts of removing plantations, of conversion to grassland, and of rehabilitation of land to indigenous woodland. The latter may bring more benefits but only in the longer term, and there is a risk that potential beneficiaries will become frustrated before the benefits become apparent. Improving the efficiency of irrigation and provision of alternative economic opportunities to catchment inhabitants are thought to have the greatest potential effects.

11. *A framework for decision-making using a cost-effectiveness approach: a case study of the Ga-Selati River*
This study evaluates the economic feasibility of trade options between potential buyers and sellers of catchment services along the Ga-Selati River. It includes a cost-effectiveness analysis undertaken to determine the least-cost way for upstream water users to increase the quantity of water flowing downstream. It considers aspects such as criteria used to rank catchment protection activities, costs per unit of water, alternative means of securing water supplies, overall potential impact, and potential buyers and transaction costs. The study notes, but does not examine, the practicalities of implementing a PES system, and recommends that various practical issues are resolved first. Such issues include the need for simple pilot mechanisms, the need for innovative economic and legal mechanisms to improve water allocation and efficiency, how to minimise transaction costs, and monitoring and verification requirements.

Appendix 2

Costs and estimated value of water saved from land-use changes along the Ga-Selati river (Wise and Musango 2007)

Descriptions of existing land-use (baseline) and watershed-protection activities	Total water evaporated or removed from the river (m^3ha^{-1} yr^{-1})	Total groundwater or stream flow 'saved' per ha of changed land use (m^3ha^{-1} yr^{-1})	Cost of change (R ha^{-1} yr^{-1})	Cost of H20 saved (R m^{-3})
Baseline A: Infested with black wattle.	10,000	–	–	–
Scenario A1: Eradicate black wattle.	6,000 – 8,000[a]	2,500-4,250 **(6)**	907 – 1,109[e] **(2c)**	0.20 – 0.59 **(6)**
Baseline B: Divert river flow into earth canal for avocado farming.	34,600[b]	–	–	–
Scenario B1: Remove avocados and stop diverting water (85%) from river.	5,200	29,400 **(1)**	2,541 – 3,078[c] **(4)**	0.09 – 0.11 **(2)**
Scenario B2: Rehabilitate existing irrigation (decrease water loss by 54%).	15,800	18,800 **(3)**	4,180 – 4,777[d] **(5)**	0.22 – 0.25 **(5)**
Scenario B3: Replace irrigation with micro system (70% decrease in water loss).	9,100	25,500 **(2)**	5,374 – 6,568[d] **(6)**	0.21 – 0.26 **(4)**
Baseline C: Invasive plants infesting riparian zone.	13,000	–	–	–
Scenario C1: Eradicate invasive plants from riparian zone.	6,000 – 8,000[a]	3,940-4,800 **(5)**	907 – 1,109[e] **(2b)**	0.13 – 0.28 **(3)**
Baseline D: Infested with invasive weeds: (i) *Lantana camara* (ii) *Chromolaena odorata*	 9,000 9,500	– – –	– – –	– – –
Scenario D1: Eradicate invasive weeds: (i) *Lantana camara* (ii) *Chromolaena odorata*	 6,000 – 8,000[a] 6,000 – 8,000[a]	 1,500-3,250 **(8)** 2,000-3,750 **(7)**	 1,054 – 1,288[e] **(3)** 907 – 1,109[e] **(2a)**	 0.32 – 0.86 **(8)** 0.25 – 0.56 **(7)**
Baseline E: Inefficient water transport and storage.	9,124	–	–	–
Scenario E1: Line storage dams.	2,737 – 4,562	4,560-6,590 **(4)**	200 – 244d **(1)**	0.03 – 0.05 **(1)**

[a] Grasses are assumed to replace the alien species, therefore evaporation drops to the known range of 6,000 to 8,500 m^3 ha-1 yr^{-1} for 'indigenous grasslands' (Dye and Jarmain 2004).
[b] The condition of the canal is poor. It overflows often and leaks badly and water losses are estimated at + 60 per cent. Two irrigation systems are used: 1) dragline and impact sprinkler, and 2) flood irrigation. Water losses from these are estimated at + 45 per cent.
[c] Estimated as the time-averaged present value of the foregone revenues from the sale of the annual avocado yields over 15 years + 1st year clearing costs (F. Bekker, pers. comm. 2006).
[d] Estimated as the time-averaged present value of the capital costs + annual maintenance costs (10 per cent of capital costs) over 15 years. Data source: Rural Integrated Engineering (2006).
[e] Calculated as the time-averaged present value of sum of the labour, equipment, transport, administration and herbicide costs (but excludes the revenues lost from harvesting firewood) over 25 years (Le Maitre *et al.* 2000; Marais *et al.* 2004; Gorgens and Van Wilgen 2004; Chapman 2006). The range is large because costs vary dramatically with the density of the infestation, the total area treated, and the topography of the area infested.

(1) to **(8)** Numbers in brackets represent the ranking of each option by criteria.

Natural Resource Issues

If poverty is to be reduced and livelihoods improved, significant shifts in policies, institutions and markets will be required to encourage sustainable natural resource management. How to go about this is a major challenge facing governments and civil society groups. Much guidance is available for farming, forestry and fisheries, but in reality livelihoods depend upon many forms of natural capital and are not amenable to sectoral interventions. This series of reports aims to present material on key cross-cutting themes of significance to many natural resource sectors, including water, soil, biodiversity, carbon and climate.

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South Africa's water resources are scarce, getting scarcer, and are often unpredictable. Long-term as well as seasonal water shortages are a reality in some areas and will become a binding constraint to economic development. However, an important shift in government attitudes and public awareness is leading to a multifaceted approach to water management. This change in approach presents an opportunity to evaluate the potential for a payments for catchment services scheme that could assist with water demand management.

This report reviews the potential of developing such a scheme in the upper Ga-Selati sub-catchment and the Sabie Sand catchment. The study indicates that there is most potential for developing a payment mechanism between the buyers and sellers of catchment protection services in Ga-Selati, where improving the transport and storage of water would be the most cost-effective intervention. Key lessons and conclusions arising from the process, baseline studies and analyses are presented.

This study was funded by the UK Department for International Development (DFID) as part of a multi-country project coordinated by the International Institute for Environment and Development (IIED) on Developing Markets for Watershed Services and Improved Livelihoods. The views expressed in this study do not necessarily represent those of the institutions involved, nor do they necessarily represent official UK government and/or DFID policies.

DFID Department for International Development

IIED Natural Resource Issues No. 12

ISBN: 978-1-84369-651-3
ISSN: 1605-1017