

## **Regional Review of Payments for Watershed Services: Sub-Saharan Africa**

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*This review of African Payment for Watershed Services (PWS) schemes describes ongoing and proposed initiatives, and describes the factors that cause Africa to have far fewer PWS initiatives than Latin America. An understanding of these factors can help natural resource management and development practitioners identify the field characteristics under which PWS programs can succeed. One particularly important element of existing and proposed African PWS initiatives is their focus on poverty alleviation. As a PWS objective, poverty alleviation in Africa is considered as valuable, or more valuable, than the watershed services that are the ostensible target of these payments. The implied social targeting that comes with a focus on poverty alleviation increases the transaction costs and decreases the level of watershed services provided by PWS in Africa. Moreover, it implies that the current dependence of African PWS programs on general tax revenues for financing, rather than direct payments from beneficiaries, will likely continue. Further experimentation and information-sharing over the next 5 years should offer a clearer picture of the potential for PWS to achieve environmental and social objectives on the African continent.*

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## INTRODUCTION

Although there has been global experimentation with Payments for Watershed Services (PWS) schemes for almost a decade, only a couple of schemes exist in sub-Saharan Africa (heretofore “Africa”; North Africa has no documented PWS schemes). The two African PWS programs that are currently making payments are both located in South Africa. As described below, these two programs have characteristics that are unusual when compared to PWS schemes in Latin America and Asia: They are essentially public works programs oriented toward securing hydrologic services. Given that the most common definitions of Payments for Environmental Services (PES) in the literature do not include such public works programs (e.g., Ferraro, 2001; Wunder, 2007), one could reasonably argue that there are **no** PWS schemes currently operating in Africa.

To define a PES, this review extends Wunder’s (2007) definition of a PES:

1. A *variable* payment, in cash or in-kind, is made *conditional* on a *well-defined*, environmental *outcome*. The notions of “variable” and “conditional” imply that offering a school or land title in exchange for a promise to provide environmental services is not a PES *unless* the amount of school or land title can be varied with performance (e.g., part of the school is destroyed or some of the rights inherent in the title are rescinded if the quality or quantity of services is lower than promised). In some cases, the outcome may be costly to observe or may be substantially affected by factors outside the control of the supplier. Payment may therefore be conditional upon observable performance that is correlated with the desired outcome (e.g., paying landowners to create riparian buffers that reduce runoff into nearby surface waters).
2. The buyer (payer) of the outcome *does not have complete control* over the production of the outcome, whereas the seller (payee) has *partial or total control* over the production of the outcome. Thus, for example, the wages a farmer pays to laborers to construct a riparian vegetative strip on the farmer’s land are not considered PES.
3. Sellers participate in the contract voluntarily (although a regulatory threat, should not enough volunteers be forthcoming, may be implied). Buyers may participate voluntarily or they may be induced to participate via regulatory means (e.g., taxes or user fee charges, cap-and-trade or offset system).

In addition to the two programs in South Africa, there are at least eight other initiatives in formal planning phases in South Africa, Tanzania, and

Kenya. Presentations at recent (2006) workshops and conversations with practitioners suggest that other initiatives are being considered by field practitioners and government agencies, but have not yet entered a formal planning phase.

Given the paucity of on-the-ground PWS initiatives, one cannot write about an “African PWS model” or “regional PWS trends in Africa.” Thus, this review has two objectives: (a) briefly characterize the South African initiatives and the proposed initiatives in other nations; and (b) describe the factors that likely cause Africa to have fewer PWS schemes than Latin America and other regions, where there are tens of such initiatives. The latter exercise is intended to help natural resource management and development practitioners think about the field characteristics under which PWS programs can succeed.

### PAYMENTS FOR ENVIRONMENTAL SERVICES (PES) IN AFRICA

For all types of environmental services, Africa lags behind Latin America and Asia in the development of PES schemes. For example, in the global carbon offset market for 2003 and 2004, Latin America and Asia accounted for more than three quarters of the emissions reduction projects. Africa accounted for only 3% (only Uganda and South Africa had any large-scale transactions; Lecocq & Capoor, 2005). Relative to other areas of the world, Africa also had fewer projects under preparation (only a half dozen sub-Saharan nations were preparing projects as of April 2005; Lecocq & Capoor, 2005).

The Katoomba Group commissioned PES inventories for Kenya (Mutunga & Mwangi, 2006), Madagascar (Randimby & Razafintsalama, 2006), South Africa (King, Damon, & Forsyth, 2005), Tanzania (Scurrah-Ehrhart, 2006), and Uganda (Ruhweza & Masiga, 2005). These inventories list 20 biodiversity projects (of which 4 are making payments, in cash or in kind), 20 carbon projects (of which 7 are making payments), and 12 water projects (of which 2 are making payments). A few other biodiversity payment initiatives exist in a couple of nations (see <http://epp.gsu.edu/pferraro/special/ci/index.html>). Bond (2006a) reports that water schemes were proposed in Zimbabwe and Malawi, but later abandoned. No other payments for water services initiatives were identified. With regard to carbon, Jindal (2006) lists 12 nations with carbon sequestration projects, but none of them has more than one project. Examples of biodiversity and carbon PES activities in Africa are shown in Table 1.

Not all of the documented cases of African PES in the previous paragraph qualify as PES based on the definition above. For example, the Katoomba Group inventories' definition of what a “payment for biodiversity” project comprises in Africa (as well in many other documents and presentations on PES in Africa) includes community-based natural resource management initiatives, ecotourism market participation (e.g., tourist service providers), agricultural

**TABLE 1** Examples of Carbon and Biodiversity PES Projects in Africa

Country	Initiative	Organization	Status	For more information
Kenya	Amboseli National Park (biodiversity)	FAO and partners	Proposed	<a href="ftp://ftp.fao.org/es/esa/roa/pdf/roanews07.pdf">ftp://ftp.fao.org/es/esa/roa/pdf/roanews07.pdf</a>
Kenya	Kitengela wildlife conservation lease program (biodiversity)	The Wildlife Foundation	Ongoing	<a href="http://www.usaid.gov/ke/ke.naremgnt/success_kitengela.htm">http://www.usaid.gov/ke/ke.naremgnt/success_kitengela.htm</a>
Kenya	The International Small Group and Tree Planting Program (carbon)	TIST	Ongoing	<a href="http://www.tist.org/tist/kenya.php">http://www.tist.org/tist/kenya.php</a>
Madagascar	Andasibe-Mantadia Biodiversity Corridor (carbon)	ANGAP	Ongoing	<a href="http://carbonfinance.org/Router.cfm?Page=Projport&amp;ProjID=9638">http://carbonfinance.org/Router.cfm?Page=Projport&amp;ProjID=9638</a>
Mozambique	Nhambita Community Carbon Project (carbon)	Envirotrade, ECCM, Univ of Edinburgh	Ongoing	<a href="http://www.carbon-livelihoods.org/Gorongosa.htm">http://www.carbon-livelihoods.org/Gorongosa.htm</a>
Niger	Acacia Community Plantations (carbon)	Achats Services International, (ICRISAT)	Ongoing	<a href="http://carbonfinance.org/Router.cfm?Page=Projport&amp;ProjID=9634">http://carbonfinance.org/Router.cfm?Page=Projport&amp;ProjID=9634</a>
Sierra Leone	Conservation concession (biodiversity)	UNEP and partners	Proposed	<a href="http://www.unep.org/dec/onlinemanual/Enforcement/InstitutionalFrameworks/CoordinationAmongRelevantAuthorities/Resource/tabid/1083/Default.aspx">http://www.unep.org/dec/onlinemanual/Enforcement/InstitutionalFrameworks/CoordinationAmongRelevantAuthorities/Resource/tabid/1083/Default.aspx</a>
South Africa	Richtersveld Contractual National Park (biodiversity)	South African government	Ongoing	<a href="http://www2.gsu.edu/~wwwcec/special/">http://www2.gsu.edu/~wwwcec/special/</a>
Tanzania	Sea Turtle Nest Performance Payments (biodiversity)	SeaSense	Ongoing	<a href="http://www2.gsu.edu/~wwwcec/special">http://www2.gsu.edu/~wwwcec/special</a>
Uganda	Plan Vivo Project (carbon)	UK DFID, USAID, START, Tetra Pak UK	Ongoing	<a href="http://www.planvivo.org/fx.planvivo/scheme/uganda.aspx">http://www.planvivo.org/fx.planvivo/scheme/uganda.aspx</a>

technology transfer projects, and projects that reward communities with limited access to protected areas (offering limited access is more like a cost-sharing program than a payment for the provision of environmental services). A minority of the listed projects use conditional (performance-based)

payments. The Kenyan inventory lists 10 PES projects (1 water, 1 carbon, and 8 biodiversity) but has a disclaimer which states, "The projects show elements of PES but may not necessarily exhibit explicit characteristics of the buyer-seller model." The Ugandan inventory includes, as a payment initiative for water services, the Uganda Breweries Limited wetlands program, in which the company installed technology to reduce its wetlands pollution and funded the government's public education efforts about wetlands.

A recent workshop aimed at "Catalyzing Payments for Ecosystem Services in Africa" further illustrates the paucity of initiatives (East and Southern Africa Katoomba Group, 2006). Of the eight African case studies presented from four nations, only one is about an on-going PES project, five are about the "potential for PES" in three nations, one is about implications of another initiative for thinking about PES, and one calls itself a PES; but the actual initiative is no different from a typical development project (villagers were offered a mix of persuasion, coercion, and token compensation to revegetate river banks).

Most African PES initiatives are funded through overseas development assistance, international conservation organizations, and increasingly, governmental agencies. There is currently little private sector involvement. A common refrain at PES meetings is that somehow conservation and development practitioners must "engage the private sector," which currently is unaware of the substantial purported gains from trade in environmental service contract schemes. Whether private sector involvement in PWS in Africa is likely or not is explored later in this article. In the next section, existing and planned PWS initiatives are examined more closely.

## PAYMENTS FOR WATESHED SERVICES (PWS) IN AFRICA

In this section, two on-going PWS programs in South Africa, as well as four other initiatives in South Africa and two in East Africa that are in the planning phases, are briefly described. The latter six proposed projects may or may not describe the future of PWS in Africa. Bond (2006a) found that of 16 PWS proposals made globally in 2002, 9 were abandoned by 2006, 3 were still proposals, and the other 4 were in progress ("in progress," however, does not imply payments are being made yet).

### Working for Water (WfW) Program, South Africa

Launched in 1995, the Working for Water (WfW) program is a public works initiative that employs low-skilled, currently unemployed laborers and "historically disadvantaged individuals" (rural women, youth, and the disabled). The contracted laborers remove invasive plant species that are established in about 10% of South Africa's total land area (about 10 million hectares). Over the last two decades, South African scientists have developed

a strong scientific foundation that documents the effects of invasive plants on the South African environment and the most effective methods for controlling them. Invasive plants are estimated to use 7% of all water resources, as well as intensifying floods and fires, and threatening native biodiversity.

WfW was created with the intention of contributing toward the newly elected (1994) democratic government's goals of alleviating poverty, creating jobs, empowering the poor economically, and rectifying inequities created from decades of apartheid rule. Although it does little environmental targeting, it engages in strict social targeting. Part of the WfW's mission is to encourage small business development as a form of social empowerment in poor communities. The WfW system encourages small-business entrepreneurs (particularly less experienced ones) to bid on WfW contracts for land management units where invasive species removal has been identified as important to increase water flows.

WfW also has elaborate, affirmative action hiring protocols to ensure that the independent contractors focus on employing low-skilled, unemployed citizens; with a particular emphasis on women, youth, and the disabled (including HIV-infected individuals). Wages are set by WfW, and contractors are instructed to hire only the formerly unemployed and achieve hiring targets for women, youth, and the disabled. Because of its emphasis on economic empowerment and working with largely unskilled labor in poor communities, WfW has a substantial training program that runs the gamut from work-related skills (e.g., machine operation) to general life skills (e.g., health education). The number of days of training an employee receives is a function of the number of days they work each month.

Most of WfW's activities are on public lands. For private land where the owner has not paid for WfW services, preference is given to emerging farmers (full funding) and land that is deemed a priority with regard to the "holistic clearing strategy" of WfW (80% funding for first two clearings, 60% for third). Private land that is not deemed a priority may be given incentives in the form of expertise, herbicides, or a maximum of 50% funding.

WfW's annual budget is currently a little more than 500 million Rand (over US\$70 million). Most of the budget (~80%) comes from general tax revenues from the central government through its Poverty Relief Fund. The next largest contribution (almost the rest of the budget) comes from the Department of Water Affairs and Forestry's general budget, about which a little more than half comes from "water resource management fees" charged in 13 of the nations' 19 Water Management Areas. In order of decreasing importance, foreign donors, municipalities, and the private sector comprise the remaining small fraction of the WfW budget.

Since its inception, WfW has cleared more than 1 million hectares of invasive plants. In recent years, the program has been clearing almost 200,000 hectares each year while employing 25,000 to 32,000 people annually. While these figures are impressive, South Africa's invasive species problem is

enormous and the WfW has not succeeded in reversing the spread of invasive plant. Supporters contend, however, the spread would have been worse in the absence of the WfW. Although no careful empirical evaluations have tested this hypothesis, one might reasonably assume that much of the plants removed would not have been removed without the program. Thus, by using hydrologic models that relate the area and species cleared to water flow, an estimate of the additional water flow provided by the program can be estimated. One study reports additional water flows as a result of the WfW equal to 250 million m<sup>3</sup> annually (Turpie & Blignaut, 2005).

The WfW program is essentially a government paying to secure environmental services on government-controlled lands. Thus many PWS proponents would not consider it to be a PWS initiative. Rather than enter this debate, it can be emphasized that the infrastructure established by the WfW can permit activities that are more consistent with the use of the term "PWS" in the literature. The Department of Water Affairs and Forestry has been trying to encourage voluntary payments from private and municipal actors with catchments infested with invasive plants. A few municipalities, state-owned utilities, and private companies have paid into the WfW program in order to have WfW teams clear invasive species from their catchments. Rather than incur the costs of setting up their own systems for invasive species removal, these local and private actors have taken advantage of the WfW institutional infrastructure. Such transactions are closer to what PWS proponents describe as "true" PWS programs. Note also that the WfW structure also offers opportunities for foreign donors, like the Global Environment Facility, to invest in removing invasive species that threaten the habitats of globally important biodiversity. (Sources for material in this section, unless otherwise noted, are: WfW, n.d.; Christo Marais, personal Communication, March 2007. For municipal and private sector involvement, the sources are: Turpie, 2004; Turpie and Blignaut, 2005; participant comments at the East and Southern Africa Katoomba Group meeting, 2006.)

### Working for Wetlands (WfWet) Program, South Africa

Working for Wetlands (WfWet) was informally started in 2000 when the Working for Water (WfW) program rehabilitated some wetlands. WfWet became a separate program in 2001 and, in 2003, its management was taken over by the South African National Biodiversity Institute (SANBI) on behalf of the departments of Environmental Affairs and Tourism, Water Affairs and Forestry, and Agriculture. Management by SANBI, under the Department of Environmental Affairs and Tourism, underscores the greater environmental emphasis of WfWet compared with WfW. Nevertheless, the model through which WfWet achieves its environmental goals is the same as WfW: a public works program that focuses on employment creation and training for the unemployed and historically disadvantaged individuals.

Wetland rehabilitation requires more than simply clearing invasive plant species. It requires highly skilled planning and engineering labor, as well as more careful environmental targeting. Thus, WfWet has a less onerous hiring protocol for contractors than WfW. The most important aspects of the contractor bid are price and technical merit. Only 10 out of 100 points allocated to a contract in the bidding system are designated for details related to participation by disenfranchised individuals, women, and disabled people. For the labor intensive portions of the projects, similar criteria to WfW are used to ensure the hiring of the unemployed with the same percentage targets for women, youth, and the disabled. Due to the amount of engineering involved with some of the projects, equipment operators can receive higher pay than laborers. Moreover, unlike the WfW program, WfWet prioritizes the wetlands slated for rehabilitation based on biophysical characteristics with less regard paid to the land ownership. WfWet first identifies its priority catchments, and then narrows the choice by site and landowner criteria (current use, perceived value, etc.).

Like WfW, the vast majority of WfWet's budget (67 million Rand in 2006) comes from the Poverty Relief Fund. Other funds come from international donors and conservation groups. For the 2006 fiscal year, WfWet is implementing 42 projects covering all provinces, employing almost 1700 people from the target population of poor and historically disadvantaged, and rehabilitating 157,000 square miles of degraded wetlands. Funding for long-term maintenance and protection is a concern, but there are plans for follow-up support and regulation enforcement to maintain the benefits of rehabilitated wetlands over time. (The source for material in this section is Working for Wetlands, n.d.)

### Proposed Projects in South Africa

King et al. (2005) list five other South African PWS initiatives that are in the planning stages: (a) Ga-Selati River, Olifants Catchment project; (b) Maloti-Drakensberg Transfrontier project; and (c) three initiatives in the Sabie River, Sabie-Sand catchment. These five proposed initiatives are structured more like traditional PWS initiatives than the two South African initiatives described above.

In the Ga-Selati River catchment, proponents of the initiative envision downstream users paying upstream land managers to change land use practices to increase flows and reduce sediment. A mine located within this catchment already leases 500 hectares from an upstream rural community to protect the riparian zone of their water source (Turpie & Blignaut, 2005). Among the "payments" to upstream farmers being considered by the project are training in the best agricultural practices for saving water by more sophisticated downstream commercial farmers, transfers of old piping from mines that upstream farmers can use to line earthen irrigation canals, and



wages to laborers who remove invasive plants. The degree to which these payments are conditional is unclear (other than, of course, the wage for plant removal).

The Maloti-Drakensberg Transfrontier project (Diederichs & Mander, 2004), which spans parts of Lesotho and South Africa, is a larger project that includes a PWS component. The project falls in the catchment that supplies approximately 25% of South Africa's water. The main identified threats are invasive plants in and along the rivers and land degradation from burning and grazing.

Within the Sabie-Sand catchment, research is underway to examine how payments for catchment protection can be incorporated into the management plan of a newly created Catchment Management Association (CMA). South Africa's National Water Act (Act No. 36 of 1998) called for the creation of CMAs as a way to decentralize catchment management. The Sabie River catchment was chosen as one of the first locations for creating a CMA. Researchers are exploring the potential for payments from commercial game farmers, urban water users, and a local bird club to directly pay communities to protect riparian habitat and stream flow.

#### Proposed Project: Eastern Arc Mountains, Tanzania

The Uluguru Mountain watershed is home to 48 villages and an estimated population of 90,000 people. Forests in the watershed are believed to be important for downstream hydrologic services that benefit Dar es Salaam, the coast, and the Morogoro region. Deforestation is threatening these forests. A scoping project—run by WWF, CARE, and IIED, and entitled “Equitable Payments for Watershed Services”—is exploring the potential for PWS in the watershed (as well as payments for other services such as carbon sequestration; World Wildlife Fund [WWF], 2006, n.d.). ICRAF has recently become involved in this project through its Pro-poor Rewards for Environmental Services (PRESA) initiative in Africa (Swallow & Yatich, 2007).

This scoping project is currently documenting hydrologic relationship and the potential buyers and sellers of watershed services. Preliminary evidence suggests that the watershed's forests can no longer hold enough water during the wet season, which leads to water shortages downstream. The goal of the project is to “help mountain communities stabilize and improve the productivity of their farms as well as prevent further forest loss.” Downstream water authorities and private sector corporations are the intended buyers of the hydrologic services, but the scientific case is being developed before the buyers will be approached for participation. Similar scoping work is also being conducted in another nearby watershed (South Nguru).

Tanzania is also home to a proposed project that has a PWS component: the IUCN-WANI Pangani River Basin Demonstration Site Project. Although

the project is not primarily a PWS project, it proposes to initiate feasibility studies with a particular eye toward establishing the willingness on the part of users to pay for water services.

### Proposed Project: Sasumua Water Treatment Plant, Kenya

The Sasumua Water Treatment Plant treats water for the Nairobi Water Company, which provides water services to the Kenyan capital. The plant draws water from a few small watersheds in the Aberdare Mountains. The treatment plant is affected by two water quality problems: sedimentation, which clogs the intakes, and water contamination from nutrients and agrichemicals. The plant expends funds each year to clear its intakes of silt (\$50,000/year) and treat the water prior to delivering it to consumers (\$100,000/year). The sedimentation and pollution originate mainly from runoff from upstream land users and from effluent from towns.

A project is exploring the potential for the plant to pay upstream land users to alter their land use in ways that reduce sedimentation and agricultural pollution (World Agroforestry Center, 2006). The costs of engineering approaches to removing silt and pollution serve as the benchmarks from which a PWS scheme will be evaluated. Project proponents note that making the case for payments is easier when the damage is already visible, as it is at the Sasumua plant. However, the same proponents note that reversing the damage is more costly than preventing it from arising in the first place. The necessary payments are anticipated to be needed on an ongoing basis and would be paid either out of the existing treatment plant budget (from cost savings in avoided dredging and treatment costs) or through additional “conservation fees” to water users. The institutional structure for making the payments must be worked out and could be difficult given overlapping jurisdictions over different components of the water system (Nairobi Water Company, Athi River Water Services Board, Water Resource Management Authority, and the Nairobi City Council). The project is connected to a larger agricultural development project called the Kenya Agricultural Productivity and Sustainable Land Management (KAPSLM) project.

Kenya is also home to a newly proposed PWS project in watersheds associated with Mt. Kenya and the Tana River. The project, a collaboration of the GreenWater Credits project and the International Fund for Agricultural Development, is part of a larger program entitled “Pro-poor Rewards for Environmental Services in Africa.” One other Kenyan program that sometimes appears in lists of African PWS schemes is the Western Kenya Integrated Ecosystem Management Project. The objective of this project is to reduce soil erosion and associated pollutant transport into Lake Victoria, which is a critical fresh water resource. A key project component is to encourage adoption of sustainable land management (SLM) practices that sequester carbon and pay local communities for carbon credits. The SLM initiative is believed to

lead to a cobenefit of reduced sediment, nutrient, and chemical runoff into surface waters. This project shows that, in some cases, payments for nonwater ecosystem services may generate water-related services.

## WHY SO FEW PWS SCHEMES IN AFRICA?

Africa is the most capital-poor, inhabited continent on earth and thus, not surprisingly, most of its rural populations depend upon ecosystem services for their livelihoods. With regard to water, more than 300 million of the estimated 800 million who live on the African continent live in water-scarce environments. Sub-Saharan Africa includes 11 of the 16 nations of the world having less than 1,000 m<sup>3</sup>/head/year of water, a situation described as “absolute water scarcity” where food shortages are a constant threat and water shortage can only increase (Food and Agriculture Organization [FAO], 1995). Forecasts (Johns Hopkins Population Information Program, 1998) estimated that by 2025, about one in two Africans will be confronted with water stress or water scarcity (stress implies less than 1,500 m<sup>3</sup>/capita/year). Pollution from agricultural runoff, industrial discharges, and sewage exacerbates water scarcity.

If water is so scarce and increasing its supply so important, why are there so few PWS programs in Africa? Payments for watershed services proponents frequently cite a common list of obstacles to the development of PES schemes: lack of technical and market information, limited institutional experience, inadequate legal framework, limited successful business models, suspicion of markets for public goods, and equity concerns. Based on this review of PWS and the African continent, these characteristics are also likely barriers to African PWS development (as in other continents); but there seem to be more fundamental barriers, which are described in this section.

To begin to answer the question of why there are so few PWS initiatives in Africa, it is instructive to rephrase the question: “Why are there a large and growing number of PWS initiatives in Latin America and so few in Africa?” The contrast between the two regions is instructive for understanding constraints to the development and occurrence of PWS in Africa.

### Is There Substantially Less Demand for Water Services in Africa?

A recent global review of all types of PES concluded (Waage, Scherr, Jenkins, & Inbar, 2006, p. 3), “[t]he barriers first and foremost stem from finding willing and able buyers” and “[t]he reasons for this unrealized demand range from a lack of awareness through a sense that PES is too nascent and thus risky.” It has been established that water scarcity and, to a lesser extent, water quality, are important issues in Africa. Thus, perhaps it

is true that the economics favor PWS, but lack of information and familiarity with the PWS mechanism constrains demand.

However, even if the values for watershed services were clearer and the hydrologic relationships between land uses and hydrologic services were more transparent, securing financing for payments requires two things: (a) institutions capable of excluding nonpayers (free-riders); and (b) water service consumers with the ability to pay. The potential institutional sources of payments for watershed services in Latin America and Africa, and the ability of Latin Americans and Africans to pay, are considered below.

### Institutional Sources of Payments

In general, payments for watershed services come from five sources: hydroelectric power suppliers, large industrial users, municipal water suppliers, irrigation water users, and general tax revenues. It is worth mentioning that in most PWS cases in the world, existing revenue streams are being used to make the conservation payments. Only in a few cases have rates paid by end-users been raised. Thus, the financial health of institutions is an important prerequisite for PWS schemes, a quality for which African institutions are not well known.

**Hydroelectric power.** Africa generates little electricity in comparison to other regions of the world (and within Africa almost half is generated within South Africa alone) and less than 20% of this generation comes from hydroelectric sources (Lokolo, 2004; United Nations, 2004a). In contrast, almost 70% of Latin America's substantially greater electricity production comes from hydroelectric sources (United Nations, 2004a). Unlike Latin America and parts of Asia, Africa does not have high hydroelectric potential due to much of the continent being subject to a semiarid climate with periodic droughts. Sub-Saharan Africa has hydroelectric potential of 710 Terawatt hours (TWh), of which 6% was developed in 1990s. Latin America, in contrast, had 3280 TWh of potential, of which 12% was developed (i.e., almost 10 times the amount of hydroelectric power in Africa is currently produced). Much of the hydroelectric capability of Africa is located in its institutionally weakest nations: Democratic Republic of Congo, Cameroon, Ethiopia, and Madagascar (Lokolo, 2004). Moreover, in terms of potential numbers of payers, Latin America and the Caribbean nations have the highest electricity coverage (84%) of any region in the developing world, whereas Africa has the lowest (around 10%).

**Municipal water suppliers.** As with hydroelectric power, Africa has fewer formal water delivery systems and fewer citizens connected to them in comparison to Latin America (United Nations Human Settlements Programme, n.d.). Thus, there are fewer people that can be easily charged for domestic water. A study of water supply and independent providers in 10 African capital cities (including Nairobi) estimates that in the majority of these cities, only one quarter to one half of the households have access to

pipled supplies, with the rest of the households relying on independent providers or traditional sources (Collignon & Vézina, 2000). In Kenya, there are 201 urban centers in the country, but only 109 have piped water systems and all are government-run (World Bank, 2004a). Within Nairobi, only 42% of households have water connections serviced by the Nairobi Water and Sewerage Company (Athi River Water Services Board [AWS], 2007). Almost all other households obtain water from kiosks, vendors, and illegal connections. Of the existing customers, more than 40% do not receive 24-hour service, 30% receive water about once every 2 days, and 10% receive water only once a week. Asking such customers to pay an additional charge for hydrologic services might be difficult even if they were not as poor.

Rural households have much lower connection rates (Donkor, 2006). For example, in the Sudan in 1995, urban housing units with piped water constituted 62%; whereas in the rural areas, the coverage was only 18%. In Malawi in 1990, the figure for urban areas was 75% and for rural areas 16%. Most Latin American nations have higher rates of urban access to piped water and, more importantly, much higher rates of urbanization. About three quarters of the Latin American population is urban (similar to the United States). In contrast, only 35% of the African population lives in urban areas, although this figure is projected to double by 2030 (United Nations Development Programme [UNDP], 2002).

Furthermore, investing in watershed management is not an obvious priority for African municipal water supply systems. Urban water systems are caught in a cycle of declining investment, quality of service, and financial returns, characterized by (a) low coverage and unreliable service, (b) high levels of unaccounted-for water and unpaid bills, (c) poor financial management, (d) revenues insufficient to cover operations and maintenance costs, and (e) inadequate commercial management (World Bank, 2001, 2004b). For example, studies in Dar es Salaam (Cudjoe & Okonski, 2006) and Nairobi (Gulyani, Talukdar, & Kariuki, 2005) found that about half of the water that entered the system was “unaccounted-for” through leaks, theft, and unbilled or uncollected revenues. In Mombasa, Kenya, all of the 57,500 connections are metered, but about one third of these meters do not work (unaccounted-for water was estimated at 40%). Billing and collection efficiencies for Nairobi and Mombasa, Kenya were between 60% and 70%, with accounts receivable representing more than 2 years service in Nairobi (Gulyani et al., 2005).

Scurrah-Ehrhart (2006) recounts an interview with a water authority in Tanzania on the topic of PWS. Although results from studies conducted in the water authority's catchments implied water users were willing to pay for water services, the water authority disputed such results. It claimed that it was difficult simply to collect the current low user fees from their customers. A potentially higher fee associated with a PWS scheme would be even more difficult.

Irrigation associations. Payments for watershed services schemes involving the irrigated agricultural sector are not common on any continent. In Africa, agriculture represents the bulk of water withdrawal. The FAO (2005) reports that for the African continent as a whole, 86% of water withdrawals are directed toward agriculture and this percentage is even higher in the arid and semiarid regions. In Latin America, however, water use by agricultural sector is also high at 73% (FAO's Information System on Water and Agriculture, 2007).

Latin America has seen a much greater degree of irrigation network privatization and decentralization to irrigation user associations than Africa (FAO, 2005; FAO's Information System on Water and Agriculture, 2007). Although the difference between the two regions will likely decline over time (e.g., all new irrigation schemes in Kenya between 1992 and 2003 were private), the absence of irrigation-driven PWS schemes in Latin America where conditions are more conducive suggest that African irrigation-driven PWS schemes are unlikely in the near term.

Industrial water users. Industrial water users are self-supplied industries not connected to a distribution network. No specific data on differences between Latin American and African industrial users were identified. Industrialization is certainly much lower in Africa than in Latin America, and thus, were this sector to be a potentially important source of funds for PWS schemes, one would expect to see more industry-driven PWS programs in Latin America. These were not found. However, in Africa, the frequency of mining activities in water scarce environments may counterbalance Latin America's advantage in this regard.

General tax revenues. The final institutional source of PWS financing is general tax revenues. With regard to this potential source of funds, Africa has much less capacity for PWS financing than Latin America. Africa has smaller government budgets (just over half those of Latin America (UN, 2004b; Fan & Rao 2003), larger populations, almost doubling those of Latin America (World Overpopulation Awareness, [www.overpopulation.org](http://www.overpopulation.org)), up to three times higher poverty levels (World Bank, 2000), and higher rates of government expenditures expressed as a percentage of GDP (despite the African GDP being much lower; UN, 2004b; Fan & Rao, 2003). All of these observations imply that Africa has much less capacity than Latin America for drawing on tax revenues to fund PWS programs.

### Ability to Pay

Getting African water users to pay for hydrologic services is made difficult by high levels of poverty. Thirty-four of the world's 49 least developed countries are African (FAO, 2005). In 1993, the World Bank-estimated poverty rates for Africa and Latin America were 50% and 15%, respectively (World Bank, 2000). However, poverty also makes the required payments

for PWS lower in Africa than in Latin America (i.e., African suppliers' opportunity costs are lower). Thus there is no clear relationship between poverty and the ability of beneficiaries to pay for water services.

However, the high-profile development goal to increase Africans' access to safe drinking water makes it politically more difficult to insist that water users pay a higher fee. The weighted average of population with access to safe drinking water for 52 African countries covering the period from 1992 to 1994 was 46%, while in Latin America the rate was 80% (Gleick, 1998). Even in South Africa, where the percentage of the population with access to safe water is relatively high by African standards, restricting water access to nonpayers is controversial. Opponents to pricing water often point to a serious outbreak of cholera in 2000 that occurred when water prices increased in Kwazulu Natal and many poor residents sought other, less safe sources of water as substitutes. Because water is a larger portion of their budget, poor residents likely have a much higher price elasticity of demand for water than nonpoor residents (a tiered pricing system, which charges low rates for use below some threshold level and rapidly increasing rates above the threshold, may be one way to raise revenues without placing a heavy burden on the poor when there are wealthier, large consumers of water in a market).

On top of these constraints, one must also recognize that Africans already use much less water per capita than in other areas of the world and they pay more per unit. For example, in Kenya, Gulyani et al. (2005) found that the mean per capita daily water use is 33 liters for the poor and 41 liters for the nonpoor, and both groups pay an average of about US\$3.50/m<sup>3</sup> (almost six times what a consumer pays in Atlanta, Georgia, USA).

### Transaction Costs

When discussing barriers to PES development in Africa, many authors identify high transaction costs as important barriers (Muramira, 2005; Grieg-Gran, Noel, & Porras, 2006; Ochieng, Otiende, & Rumley, 2007). Although transaction costs are frequently identified as a problem in all nations (Bellagio Group, 2007), there are reasons to believe that PWS schemes in Africa may be particularly affected by such costs.

Land distribution. Although average population densities per square kilometer in the late 1990s are similar in Latin America and Africa (about 25 people/km<sup>2</sup>; McDevitt, 1999), 73% of Latin Americans (including Caribbean) lived in urban areas in 1995, compared to only 35% of Africans (United Nations Human Settlements Programme, n.d.). Land ownership is much more concentrated in Latin America than in Africa (Lastarria-Cornhiel & Melmed-Sanjak, 1999). Thus, in Latin America, PWS schemes are more likely to contract with a smaller number of large landowners; whereas in Africa, they must contract with many small land users/owners. Note that the less

concentrated distribution of land in Africa also implies that should a PWS be feasible, it is more likely to be propoor than in Latin America.

Transboundary watersheds. Africa has 60 transboundary river basins which together cover more than 60% of the continent's total area. However, although water management in Africa is therefore often transboundary in nature, the same is true in South America (Wolf, Natharius, Danielson, Ward, & Pender, 1999). Thus, it is not clear that transboundary water management should be more problematic in Africa or a reason for less PWS initiatives. However, in Africa, regardless of whether watersheds cross national boundaries, they are more likely to have greater cultural heterogeneity among upstream and downstream users than in Latin America. For example, upstream and downstream users in Africa are more likely to speak different languages. Such heterogeneity may increase the costs of creating mutual understanding, trust, and other forms of social capital, which lower the transaction costs of contracting.

Making and enforcing contracts. A PWS scheme is a contracting scheme and thus the factors that are typically identified as curtailing business activity apply to PWS development: e.g., regulatory environment, rates of literacy, judicial system, availability of information, trust, and corruption. Although most nations in Latin America are not paragons of business-friendly societies, they do tend to have higher indicator scores than Africa. For example, of the 64 most corrupt nations in the world (Transparency International, 2006), 25 are from sub-Saharan Africa (out of 48 African nations). In contrast, only 8 are from Latin America (out of 21 nations).

A more directly relevant indicator of transaction costs is the measure of the cost of enforcing contracts in a nation. The World Bank measures this cost as court fees and attorney fees expressed as a percentage of the debt value. In Latin America and the Caribbean, the value is 23%, while in sub-Saharan Africa, the value is almost double at 42% (Doing Business Project, n.d.).

Furthermore, in Africa, many of the water suppliers, hydroelectric power sources, and other potential water buyers are controlled by the state. Thus, governance is an important issue. Scurrah-Ehrhart (2006) relates the story of the Tanzania Electricity Supply Company, Ltd. (TANESCO). TANESCO currently pays the Ministry of Water and Livestock Development an annual "user fee," of which a proportion is given to Water Basin Authorities to carry out catchment management activities. In practice, however, the Water Basin Authorities do not carry out these activities.

## Land Tenure Security

When discussing barriers to PES development in Africa, other authors have identified the African land tenure situation as important (Muramira, 2005; Mwangi & Mutunga, 2005; Ochieng et al., 2007). One could argue that issues related to land tenure belong under "transaction costs," but because



many authors in the PES literature seem to treat tenure issues as different from transaction costs, they are separated here. Although land tenure systems are diverse on every continent, a review of global tenure trends (Lastarria-Cornhiel & Melmed-Sanjak, 1999) argues that Latin American systems have historically been based on private ownership; whereas in Africa, most land is held under customary tenure that provides access to all recognized members of the community. Thus, PWS schemes in Africa will frequently have to address multiple sources of formal and informal authority over a given tract of land. Indeed, in South Africa, the program in the Ga-Selati River catchment made a lot of progress in the design phase, but was stalled due to conflicting land claims and ongoing reform over water allocations (Nicola King, personal communication, January 2007).

Customary tenure systems in Africa generally do not permit land sales, particularly to persons outside the community, and even leasing can be complicated by tenure insecurity (i.e., someone leasing land could gain rights over it), which makes rental rates higher than they normally would be (Lastarria-Cornhiel & Melmed-Sanjak, 1999). Compared to Latin America watersheds, African watersheds are much more likely to have many people with usufruct land rights. Thus, PWS contracts, which typically contract for actions that curtail access and use to land, may be more difficult in Africa than in Latin America.

Given the likelihood of multiple property claims on a piece of land, payments in Africa are more likely to be at the community level than the household level, which complicates project design. Although there are examples of community-based revenue sharing schemes (e.g., CAMPFIRE in Zimbabwe) and community-based PES (e.g., Nhambita Community Carbon Project in Mozambique), not all African nations recognize customary tenure or “communities” (villages, village councils, etc.) as autonomous legal personalities, particularly when the land in question is forests or wetlands. Even when such tenure systems and local institutions are recognized, designing a community-based contract that induces the required individual behaviors is much more difficult than in situations with single owners with secure property rights.

### Enabling Legislation and Policies

Reports on PES related to Africa (Muramira, 2005; Mwangi & Mutunga, 2005; Waage et al., 2006; Scurrah-Ehrhart, 2006) argue that a key constraint is the lack of “enabling legal, regulatory and administration elements.” Nations in which there is some PES activity (Uganda, Kenya, and South Africa) indeed have some enabling legislation (Ruhweza & Muhumure, 2005). However, no inventories have been completed in nations without PES, and thus one cannot clearly observe a causal relationship between the enabling legislation and PES development.

Nations such as Costa Rica have demonstrated that the policy environment can catalyze PES initiatives. Other nations, such as the United States (cities of New York City, Boston, and Syracuse with respect to their watershed management activities) have also demonstrated that the regulatory environment can directly stimulate PWS contracting. Local government authorities may be reticent to engage in PWS schemes, but through suasion and regulatory threats, that reticence can be reduced. Moreover, it has been amply demonstrated that enabling legislation is important for carbon markets.

In some cases, there may be legislation that explicitly forbids a PWS-related activity. For example, South Africa's National Water Act prohibits some activities for which someone might want to make a payment, such as removal of vegetation from a riparian zone or stopping agriculture in a riparian zone (King et al., 2005). In other cases, authority over water and land use may be too decentralized to allow for effective coordination across a catchment (e.g., if water user's associations are defined at the subcatchment level).

However, no clear case for the lack of enabling legislation being an important barrier to PWS development has been made. In many African nations, there is legislation for channeling "user fees" (called "abstraction fees") to watershed management. There may be weaknesses in the systems (Scurrah-Ehrhart, 2006) and an unwillingness to charge such fees, but the authority to do so exists in many African nations. Indeed, the summary of the East African and South African PES inventories (Katoomba Group, 2006) identifies the lack of supporting legislation as a barrier, but notes that "in most countries, policies establishing the right to buy and sell ecosystem stewardship services have not been essential for pilot activity in PES."

### Supporting Institutions

The Katoomba Group (2006) claims that, "Most countries cited lack of necessary institutions—such as certification bodies; financial intermediaries; national registries for ecosystem services; and so on—across the value chain from seller to buyer that increase current PES transaction costs." However, it is not obvious that certification bodies, financial intermediaries, and national registries for ecosystem services have been important in the development of PWS in Latin America. A much more likely institutional barrier to PWS development in Africa, in comparison to Latin America, is simply the unsophisticated state of most water management agencies and the absence of the will and means to charge water users for water quantity and quality improvements.

### Hydrology

It is difficult to determine if there is a fundamental difference in the hydrologic regimes of Africa and Latin America that makes PWS schemes less likely in Africa. Average annual precipitation in Africa is estimated at about

of 678 mm with wide variability (FAO, 2005), whereas average precipitation in South America and Central America is much higher averaging between 1,000 and 3,000 mm/year (R-Hydronet, 2007). With less precipitation and surface and subsurface flows, interventions over similar land areas may have smaller impacts on downstream flows in Africa and PWS schemes may have to operate on a larger scale to achieve comparable impacts. At large scales, however, measuring impacts from PWS programs may be difficult because of the larger set of confounders and the potentially longer time-lags in hydrologic response associated with low precipitation.

### Awareness and Human Capacity

When discussing critical barriers to PES development in Africa, some authors identify a simple lack of awareness about the idea and the lack of capacity to design and implement a PES scheme (Katoomba Group, 2005; Muramira, 2005; Mwangi & Mutunga, 2005; Katoomba Group, 2006; Ochieng et al., 2007). The concept of PWS schemes is relatively new and given the constraints on information transmission in Africa, one would expect PWS development in Africa to be moving more slowly than in Latin America.

In 2005, practitioners established an East and Southern African working group on PES to share information and conduct training for practitioners and policymakers. Development donors are also conducting PES training for Africans. Thus, in the next 5 years, one should be able to test the hypothesis that lack of human capacity is a major bottleneck. If this lack of awareness and capacity is truly a constraint on PWS development, one should see an increase in PWS development.

However, if an absence of hydrologic knowledge is a key constraint, then one might not see more PWS development in the next 5 years. Participants at a 2005 African PES workshop concluded that the “[t]echnical capacity to identify and monitor links between resource management and provision of ecosystem services is weak in all countries” (Katoomba Group, 2005). A search of water-related articles from Water Resources Abstract for a dozen African and a dozen Latin American nations showed Latin American nations had about double the number of articles per nation. Even removing a few outliers (Mexico, Brazil, South Africa) left Latin American nations with almost 60% more articles. If articles are a good proxy for the state of knowledge, then Latin America has a much better level of understanding of the hydrologic relationships relevant to PWS schemes.

### Insights from South Africa

Given the barriers to the development of PWS listed above, it should come as no surprise that the majority of African PWS activity is taking place in South Africa. Relative to the rest of sub-Saharan Africa, South Africa has a

better business climate, higher income levels, greater scientific capacity, better understanding of the nation's hydrology, greater institutional capacity, a stronger national water law that makes provision for the use of economic instruments in water management (Act No. 36 of 1998), and higher rates of access to safe water.

In its two operational PWS programs South Africa has managed to address the imperative of assisting the poor and circumvent the problems that arise from complex tenure systems. They have done so by adopting a public works program approach that permits targeting of benefits to the disadvantaged and avoids contracting with land users (i.e., focuses on government lands). This approach also leads to broad national support for the programs. Moreover, the contracts in these programs are for activities for which compliance is relatively easy to monitor (removing invasive plant species on a plot of land, or rehabilitating a wetland).

Although general tax revenues fund the two current PWS schemes in South Africa, the infrastructure that has been developed lends itself to municipal and private sector involvement. From this perspective, the South African program has much in common with the Costa Rican Programa de Pagos de Servicios Ambientales, which is also a national-level program into which non-national government agents can pay to secure ecosystem services for their private benefit. Given that South Africa has better governance than much of Africa, it is unclear whether such an infrastructure could be built elsewhere in the near future. Trust that a government agency would deliver services commensurate with the level of payment requested is generally low in Africa.

## DISCUSSION AND CONCLUSION

The paucity of on-the-ground PWS initiatives precludes a definitive discussion of an "African PWS model" or "regional PWS trends in Africa." Nevertheless, there are some common elements of existing and proposed African PWS initiatives.

First, and most importantly, poverty alleviation and equitable wealth distribution are key objectives in the majority of African PWS projects. Poverty issues are important components of Latin American PWS schemes, but the top priority of Latin American PWS schemes is maintenance of watershed services. In Africa, poverty alleviation and services are viewed as equally valued joint products of PWS schemes, or the provision of watershed services is merely viewed as a cobenefit of the poverty alleviation scheme (e.g., Working for Water Program). The implied social targeting that comes with a focus on poverty alleviation will likely increase the transaction costs and decrease the level of watershed services provided by PWS in Africa. Whether PWS can have a large impact on poverty remains to be

seen. PWS proponents tend to not view PWS as an important poverty alleviation tool unless the program is a large-scale public works initiative like South Africa's Working for Water program (e.g., Bond, 2006b; Bellagio Group, 2007). The appeal of a PWS scheme that provides employment benefits may explain the African interest in the potential role of PES to restore degraded ecosystems (Ruhweza & Muhumure, 2005).

Second, as in most other nations, there are no programs that involve trading under a regulatory cap on the level of ecosystem services, nor trading schemes that are induced because of increasingly more stringent regulatory requirements. Third, the two existing programs in South Africa depend on general tax revenues for financing. The choice of such financing stems from a strong program emphasis on economic empowerment and poverty alleviation rather than ecosystem services, and from the political controversy surrounding raising water prices in a poor nation. The planned programs in Africa are hopeful for financing that comes from water users directly, but none have clearly secured such a funding source. South Africa's WfW program shows that the dichotomy that some PWS proponents make between "public payment schemes" and "self-organized private deals" is not a strict one: The government can maintain an institutional infrastructure through which individual beneficiaries of ecosystem services (e.g., private companies) can make their payments to service suppliers. Such a system currently operates in Costa Rica, where private beneficiaries can set up self-organized deals (e.g., Heredia water utility) or pay into the centralized national payment system (e.g., Energía Global hydroelectric company).

When PWS programs are government-funded, like the programs in South Africa, some observers claim they are less "sustainable" than self-organized deals between the beneficiaries and the sellers of the service. Such claims, however, implicitly assume that market transactions are somehow more sustainable than government programs funded by taxation and user fees. There is no evidence to support such a claim. If anything, large government programs that lead to large numbers of rent-seekers seeking to protect and expand the program may be more sustainable than market transactions.

For example, the Working for Water program in South Africa, with former president Nelson Mandela as its "patron in chief," is so popular that it is slated to continue until at least 2020 (WWF, 2006). According to a former South African Minister of Water (K. Asmal), the Ministry of Finance now sees the program as a positive contribution to economic, not just environmental, goals and thus also supports it (East and Southern Africa Katoomba Group, 2006). Rather than sustainability being a weakness of government-financed PWS, a more important problem is the difficulty that government-funded programs have in adapting to changing conditions and new information that call for a redistribution of their investments.

Another argument frequently made in the PES gray literature and presentations is that tax-financed PWS programs are inherently less cost-effective

than private payment programs. However, given that most water and hydro-electricity suppliers in Africa are government-run or regulated private entities, there is no reason to believe they will be any more cost-effective. Even when the buyer is a private enterprise, the fact that many private enterprises engage in these deals for reasons of corporate social responsibility and reputation also suggests that they may be no more cost-effective than tax-financed initiatives. Indeed, the greater scrutiny of government programs may lead tax-financed PWS to be more cost-effective over time.

PWS schemes that connect water users directly to water suppliers, however, do have the advantage of generating new money for conservation. However, this additional money may not necessarily go to the area to which the water users are directing their payments. Other governmental or nongovernmental agencies may simply redirect their funds to other areas: In other words, the new money will be a substitute, rather than a complement locally (globally, it may indeed be a complement). Such substitution has been observed in Costa Rica (e.g., Heredia water supply company's PWS program, which receives no payments from the government's PES program; Luis Gámez, personal communication, 2007).

In conclusion, for all of the reasons discussed in the previous section, there will likely be fewer PWS schemes in Africa than elsewhere. However, these barriers to PWS development do not imply there are no opportunities for PWS. There are already a couple of large-scale initiatives and a number of incipient initiatives that may succeed in establishing PWS schemes. Further experimentation and information-sharing over the next 5 years should offer a clearer picture of the potential for PWS to achieve environmental and social objectives on the African continent.

## REFERENCES

- Athi River Water Services Board. (2007). Retrieved on June 4, 2007, from <http://www.awsboard.com/faqs.asp>
- Bellagio Group. (2007, March). *Payments for watershed services. Building on pilot experiences to mainstream a tool for sustainable conservation and development*. International meeting of Fundación Natura Bolivia, IIED, Centre for International Forestry Research and EcoFund Ecuador, conducted at the Rockefeller Foundation's Bellagio Conference Centre, Como, Italy.
- Bond, I. (2006a). *A review of payments for watershed services*. Paper presented to the Norwegian Agency for Development Cooperation, Oslo, Norway. Retrieved December 20, 2007, from <http://www.iied.org/NR/forestry/documents/IvanBondpresentationtoNORAD.pdf>
- Bond, I. (2006b, September). *Payments for watershed services*. Presentation at the workshop Building Foundations for Pro-Poor Ecosystem Service Payments in Africa, Queen Elizabeth National Park, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/documents/events/event10/payments.ppt>

- Collignon, B., & Vézina, M. (2000). *Independent water and sanitation providers in African cities: Full report of a ten-country study*. Washington, DC: World Bank, Water and Sanitation Program.
- Cudjoe, F., & Okonski, K. (2006). The reality of water provision in urban Africa. In K. Okonski (Ed.), *The water revolution: Practical solutions to water scarcity* (pp. 175–200). London: International Policy Press.
- Diederichs, N., & Mander, M. (2004, December). *Payment for environmental services baseline study final report*. Everton, South Africa: Maloti-Drakensberg Transfrontier Project, FutureWorks!
- Doing Business Project. (n.d.). Retrieved June 2007, from <http://www.doingbusiness.org/ExploreTopics/EnforcingContracts/>
- Donkor, S. M. (2006). *Water in Africa: Management options to enhance survival and growth. Our common Earth*. Addis Ababa, Ethiopia: United Nations Economic Commission for Africa.
- East and Southern Africa Katoomba Group. (2006, November). *Catalyzing payments for ecosystem services in East & Southern Africa*. Proceedings of the East and Southern Africa Katoomba Group Meeting, Kirstenbosch Botanical Gardens, Cape Town, South Africa. Retrieved December 20, 2007, from: <http://147.202.71.177/~katoomba/documents/events/event13/meeting.pdf>
- Fan, S., & Rao, N. (2003). *Public spending in developing countries: Trends, determination and impact* (EPTD Discussion Paper No. 99). Washington, DC: IFPRI.
- FAO's Information System on Water and Agriculture. (2007). *AQUASTAT*. Retrieved December 20, 2007, from <http://www.fao.org/nr/water/aquastat/main/index.stm>
- Ferraro, P. J. (2001). Global habitat protection: Limitations of development interventions and a role for conservation performance payments. *Conservation Biology*, 15(4), 990–1000.
- Food and Agriculture Organization. (1995). *Water sector policy review and strategy formulation: A general framework*. Rome: Author.
- Food and Agriculture Organization. (2005). *Irrigation in Africa in figures: AQUASTAT Survey—2005* (Water Rep. 29). Rome: Author.
- Gleick, P. H. (1998). *The world's water 1998–1999: The biennial report on freshwater resources*. Washington, DC: Island Press.
- Grieg-Gran, M., Noel, S., & Porras, I. (2006). *Lessons learned from payments for environmental services* (Green Water Credits Rep. 2, ISRIC Report 2006/5). Wageningen, The Netherlands: ISRIC. Retrieved December 20, 2007, from [http://www.isric.org/Webdocs/Docs/GWC2\\_Lessons%20learned%20\(July%202006\).pdf](http://www.isric.org/Webdocs/Docs/GWC2_Lessons%20learned%20(July%202006).pdf)
- Gulyani, S., Talukdar, D., & Kariuki, R. M. (2005, January). *Water for the urban poor: Water markets, household demand, and service preferences in Kenya* (Water Supply and Sanitation Sector Board Discussion Paper Series, No. 5). Washington, DC: World Bank.
- Jindal, R. (2006). *Carbon sequestration projects in Africa: Potential benefits and challenges to scaling up* (EarthTrends Environmental Essay Competition Winner, World Resources Institute). Retrieved December 20, 2007, from [http://earthtrends.wri.org/features/view\\_feature.php?fid=68&theme=3](http://earthtrends.wri.org/features/view_feature.php?fid=68&theme=3)
- Johns Hopkins Population Information Program. (1998, September). Solutions for a water-short world. *Population Reports*, 26(1).

- Katoomba Group. (2005, September). Summary of workshop *Building Foundations for Pro-Poor Ecosystem Services in Africa*, 8th public meeting of the Katoomba Group, in Kampala, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/africa/uganda.htm>
- Katoomba Group. (2006). *Summary of country-level PES inventories carried out in East and South Africa*. East and Southern Africa Katoomba Group, Kampala, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/regions/africa/assessments.php>
- King, N., Damon, M., & Forsyth, G. (2005). *An inventory of current ecosystem service payments, markets, and capacity building in South Africa*. Washington, DC: Forest Trends. Retrieved December 20, 2007, from [http://www.katoombagroup.org/regions/africa/documents/South\\_Africa\\_Inventory.pdf](http://www.katoombagroup.org/regions/africa/documents/South_Africa_Inventory.pdf)
- Lastarria-Cornhiel, S., & Melmed-Sanjak, J. (1999). *Land tenancy in Asia, Africa, and Latin America: A look at the past and a view to the future* (Working Paper No. 27). Madison: University of Wisconsin, Land Tenure Center.
- Lecocq, F., & Capoor, K. (2005). *State and trends of the carbon market*. Geneva, Switzerland: International Emissions Trading Association.
- Lokolo, M. C. (2004, October). *Enlightening a continent in the dark: Prospects for hydropower development in Africa*. United Nations Symposium on Hydropower and Sustainable Development, Beijing, China. Retrieved December 20, 2007, from [http://www.un.org/esa/sustdev/sdissues/energy/op/hydro\\_lokolo\\_ppt.pdf](http://www.un.org/esa/sustdev/sdissues/energy/op/hydro_lokolo_ppt.pdf)
- McDevitt, T. M. (1999). *World population profile: 1998* (U.S. Bureau of the Census, Rep. WP/98). Washington, DC: U.S. Government Printing Office,.
- Muramira, T. E. (2005, September). *Overview of payment for ecosystem services in Uganda*. Presentation at the workshop Building Foundations for Pro-Poor Ecosystem Service Payments in Africa, Queen Elizabeth National Park, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/documents/events/event10/OverviewofPayment.ppt>
- Mutunga, C., & Mwangi, S. (2006, March). *Inventory for ecosystem service payment in Kenya*. Washington, DC: Forest Trends. Retrieved December 20, 2007, from [http://www.katoombagroup.org/regions/africa/documents/Kenya\\_Inventory.pdf](http://www.katoombagroup.org/regions/africa/documents/Kenya_Inventory.pdf)
- Mwangi, S., & Mutunga, C. (2005, September). *Overview of PES in Kenya*. Presentation at the workshop Building Foundations for Pro-Poor Ecosystem Service Payments in Africa, Queen Elizabeth National Park, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/documents/events/event10/OverviePES.ppt>
- Ochieng B., Otiende, B., & Rumley, R. (2007). *African regional workshop on compensation for ecosystem services (CES), May 22–24, 2006, Nairobi, Kenya* (ICRAF Working Paper No. 35). Nairobi, Kenya: World Agroforestry Centre. Retrieved December 20, 2007, from [www.worldagroforestrycentre.org/downloads/publications/PDFs/WP14959.PDF](http://www.worldagroforestrycentre.org/downloads/publications/PDFs/WP14959.PDF)
- Randimby, B., & Razafintsalama, N. (2006, October). *An inventory of initiatives/activities and legislation pertaining to ecosystem service payment schemes (PES) in Madagascar*. Washington, DC: Forest Trends. Retrieved December 20, 2007, from <http://www.katoombagroup.org/regions/africa/documents/madagascar%20inventory.doc>
- R-Hydronet. (n.d.). Retrieved June 2007, from <http://www.r-hydronet.sr.unh.edu/>



- Ruhweza, A., & Masiga, M. (2005, September). *An inventory of initiatives/activities and legislation pertaining to ecosystem service payment schemes (PES) in Uganda*. Washington, DC: Forest Trends. Retrieved December 20, 2007, from <http://katoombagroup.org/regions/africa/documents/NationalInventoryMatrixforUganda-UpdatedDraft.doc>
- Ruhweza, A., & Muhumure, S. (2005, September). *Strategic PES in Africa*. Presentation to the private Katoomba meeting associated with the workshop Building Foundations for Pro-Poor Ecosystem Service Payments in Africa, Jinja, Uganda. Retrieved December 20, 2007, from <http://www.katoombagroup.org/documents/events/event10/1PES.ppt>
- Scurrah-Ehrhart, C. (2006, July). *Tanzania inventory of payments for ecosystem services*. Washington, DC: Forest Trends. Retrieved December 20, 2007, from [http://katoombagroup.org/regions/africa/documents/TanzaniaInventory\\_7-06.pdf](http://katoombagroup.org/regions/africa/documents/TanzaniaInventory_7-06.pdf)
- Swallow, B., & Yatich, T. (2007). *RUPE-Africa: Propoor rewards for environmental services in Africa (PRESA)*. The Global Event on Payments/Rewards for Environmental Services. Lombok, Indonesia. Retrieved December 20, 2007, from <http://www.worldagroforestry.org/sea/Networks/RUPES/download/ISCLombokJan07/Annex%208%20BS.pdf>
- Transparency International. (2006). *Corruption perceptions index (CPI)*. Berlin, Germany: Transparency International.
- Turpie, J. K. (2004, September). *Maloti Drakensberg Transfrontier Conservation and Development Programme: Ecosystem services trading project* (Rep. on Ecosystem Service Trading in the Region). Everton, South Africa: FutureWorks!
- Turpie, J. K., & Blihnaut, J. (2005, June). *Payments for ecosystem services: Towards improved biodiversity conservation and water security in South Africa, a semi-arid, developing country*. Presentation at the workshop on Payments for Environmental Services (PES)—Methods and design in developing and developed countries, Titisee, Germany. Retrieved December 20, 2007, from [http://www.cifor.cgiar.org/pes/publications/pdf\\_files/PES\\_SA\\_Presentation.pdf](http://www.cifor.cgiar.org/pes/publications/pdf_files/PES_SA_Presentation.pdf)
- United Nations Development Programme. (2002). *Human development report 2002*. New York: Author.
- United Nations Human Settlements Programme. (n.d.) *Human settlements conditions and trends*. Statistics Programme. UN-HABITAT, Global Urban Observatory and Statistics Unit. Retrieved December 20, 2007, from <http://ww2.unhabitat.org/habrd/stat1prog.htm>
- United Nations. (2004a). *Energy studies yearbook: 2004*. New York: Author.
- United Nations Economic and Social Council. (2004b, February). Committee of Experts on Public Administration, 3rd session, New York, March 29–April 2, 2004, Item 3 of the provisional agenda, Revitalizing public administration. *Basic data on government expenditure and taxation* (Rep. of the Secretariat).
- Waage, S., Scherr, S., Jenkins, M., & Inbar, M. (2006). *A scoping assessment of current work on payments for ecosystem services in Asia, Latin America, and East & Southern Africa*. Adapted from the full report submitted to the UNDP-GEF project: Institutionalizing Payments for Ecosystem Services, Supplement III. Building National Capacity for PES.
- Wolf, A. T., Natharius, J. A., Danielson, J. J., Ward, B. S., & Pender, J. K. (1999). International river basins of the world. *International Journal of Water Resources Development*, 15(4), 387–427.

- World Agroforestry Center. (2006, June). *Laying the foundations for a payment for watershed services scheme for the Sasumua Reservoir, Central Highlands of Kenya*. Kenya Agricultural Productivity and Sustainable Land Management Project, PES Component. Proposal.
- World Bank. (2000). *World development report 1999/2000*. Washington, DC: The International Bank for Reconstruction and Development/The World Bank.
- World Bank. (2001). *Kenya: Review of the water supply and sanitation sector* (Rep. 22182). Washington, DC: Author.
- World Bank. (2004a). *Kenya: Country assistance strategy* (Rep. 28825-KE). Washington, DC: Author.
- World Bank. (2004b). *Kenya: Nairobi water and sewerage institutional restructuring project: Project appraisal document* (Rep. 28825-KE). Washington, DC: Author.
- World Wildlife Fund. (2006). *Payments for environmental services: An equitable approach for reducing poverty and conserving nature*. Washington, DC: Author.
- World Wildlife Fund. (n.d). *Valuing the arc: Linking science with stakeholders to sustain natural capital*. Washington, DC: Author.
- Working for Water. (n.d.) Retrieved June 2007, from <http://www.dwaf.gov.za/wfw/>.
- Working for Wetlands (n.d.) Retrieved June 2007, from <http://www.sanbi.org/research/wetlandprog.htm>
- Wunder, S. (2007). The efficiency of payments for environmental services in tropical conservation. *Conservation Biology*, 21(1), 48–58.