DEVELOPING MARKETS FOR WATER SERVICES FROM FORESTS

ISSUES AND LESSONS FOR INNOVATORS

FOREST TRENDS

WORLD RESOURCES INSTITUTE

the katoomba group

FOREST TRENDS

Forest Trends, a Washington D.C. based non profit organization, was created in 1999 by leaders from conservation organizations, forest product firms, research groups, multilateral development banks, private investment funds, and foundations. Its mission is to maintain and restore forest ecosystems by promoting incentives that diversify trade in the forest sector, moving beyond exclusive focus on lumber and fiber, to a broader range of products and services. To fulfill its mission Forest Trends works to accelerate development of markets for forest ecosystem services, expand markets of sustainably produced forest products and advance markets that serve the interest of forest communities. Forest Trends convenes market players to advance market transformations, generates and disseminates critical information to market players, and facilitates deals between progressive actors in sustainable forestry.

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The World Resources Institute (WRI) is an independent center for policy research established in 1982 to provide information, ideas, and solutions to global environmental problems. WRI's mission is to move society to live in ways that protect Earth's environment for current and future generations. WRI's program meets global challenges by using knowledge to catalyze public and private action to reverse damage to ecosystems, to expand participation in environmental decisions, to avert dangerous climate change, and to increase prosperity while improving the environment. In all its work WRI seeks to build bridges between ideas and action, meshing the insights of scientific research, economic and institutional analysis, and practical experience with the need for participatory decision-making.

THE KATOOMBA GROUP

The Katoomba Group is an international working group led by Forest Trends and composed of leading experts from forest and energy industries, research institutions, the financial world, and environmental NGOs, all dedicated to advancing the development of markets for ecosystem services. The Group is dedicated to facilitating strategic partnerships that can launch new green forest products in the market-place, building collective understanding of how market-based instruments for environmental services are constructed and the conditions in which they can work, and providing technical support to pilot projects of broad relevance. The Group met for the first time in Katoomba, Australia in May 2000 and subsequent meetings have been held in Vancouver, British Columbia in October 2000 and in Brazil in March 2001.

DEVELOPING MARKETS FOR WATER SERVICES FROM FORESTS:

ISSUES AND LESSONS FOR INNOVATORS

Nels Johnson, Andy White, and Danièle Perrot-Maître

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There is growing awareness of the many services forests provide, such as watershed protection, biodiversity conservation, and carbon storage. There is also growing awareness of the costs to society when these services are degraded or lost. These costs may come from the local effects of degradation, such as floods and landslides, or more global effects, like global climate change. These impacts are drawing attention to the financial benefits of healthy forest ecosystems and the environmental services they provide — benefits of great social value but until recently not of great financial worth. This interest and the growing number of innovative investments around the world are moving markets for ecosystem services towards center stage in the debate about forest conservation.

Of the many services that forests provide, hydrological services, such as water quality and water flow, are among the most valuable. As we look ahead into the next decade, water will become an increasingly critical issue as it becomes an increasingly scarce resource. The value of these hydrological services will only grow over time. Policy makers, forest landowners, and investors in downstream utilities are recognizing the financial value of healthy forests and are developing innovative mechanisms to finance forest conservation. Markets for hydrological services are potentially immense with every person a potential participant. Not only is the global market for water huge but investments in ecosystem management have been shown in several cases to be cheaper than investments in new water supply and treatment facilities.

Developing Markets for Water Services from Forests examines innovative experiences from around the world in the emerging markets for hydrological services. A companion piece by Danièle Perrot-Maître and Patsy Davis describes a set of nine innovative cases of forest-water markets in detail. This paper distills common issues and lessons from those cases and other experiences. It describes the basic types of financial incentive mechanisms, the common issues in developing these mechanisms, and suggested actions to advance the practice of this new approach.

This review was originally prepared for the October 2000 meeting of the Katoomba Group in Vancouver, British Columbia. It was subsequently revised with many valuable inputs from Katoomba Group members, some of whose innovations are described here. Its purpose is to assist innovators — be they forest landowners, private sector investors, or policy makers — understand the opportunities posed by the emerging markets for forests and water and the risks of ignoring these developments.

Forest Tends has been fortunate to have a growing global network of collaborators who are committed to the goals embodied in our mission and program. We are particularly fortunate to have Nels Johnson and Danièle Perrot-Maître, two of the authors of this report, as two of these collaborators. Mr. Johnson is Deputy Director of the Biological Resources Program at the World Resources Institute, and Danièle Perrot-Maître, a Natural Resources Economist with Forest Trends. The third author is Andy White, Program Director of Forest Trends.

Building value into standing forests by creating markets for the environmental services they produce is a critical step to maintaining forests, in all of their diversity, on the landscape.

Michael Jenkins | *Executive Director*
Forest Trends

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INTRODUCTION

The conservation of ecosystems is often seen as a cost to society rather than as an investment that sustains nature and human livelihoods. For example, natural forest and wetland ecosystems filter and purify water while absorbing rain and snow melt for gradual release. When these ecosystems become degraded, large investments in water treatment plants, dams, and flood control structures may be needed to replace these lost "ecosystem services." Despite the economic value of these services ecosystem protection is chronically under-funded. By understanding the financial value of these services and investing in their conservation it may be possible to save money spent to replace lost services and to increase investments in sustainable forest management.

The hydrological services of forests, chiefly water quality and water flow, are among the most valuable of the many ecosystem services from forests. An ecosystem approach to watershed management seeks to achieve water management objectives by conserving forest and wetland habitats, creating buffer zones along rivers and streams, shifting away from farming and road-building on steep slopes, and avoiding agricultural chemical use in sensitive areas.

The scope for using financial incentives to encourage the conservation of forest watersheds is potentially huge for at least two reasons. First, the global market for water is immense and second, investments in sustainable watershed management may be substantially cheaper than investments in new water supply and treatment facilities. Reid (2001) estimates that the majority of the world's population live downstream of forested watersheds and therefore are susceptible to the costs of watershed degradation. Further, about 13 percent of the world's land area is needed to protect water supplies for the global population — an area that will grow with the population. By investing approximately $1 billion in land protection and conservation practices New York City hopes to avoid spending $4-6 billion on filtration and treatment plants (Echavarria and Lochman 1999). Elsewhere in the United States — Portland, Oregon; Portland, Maine; and Seattle, Washington — have found that every $1 invested in watershed protection can save anywhere from $7.50 to nearly $200 in costs for new filtration and water treatment facilities (Reid 1997). In South Africa removing thirsty alien tree species in Cape Town's watershed and restoring native vegetation produces water at a fraction of the cost of water delivered through diversion or reservoir projects (Gelderblom and van Wilgen 2000).

Public sector agencies have traditionally made most investments in watershed management but that may be changing. Typically, funds for watershed management and protected areas (which are often justified in part based on their water benefits) come from government general revenues and are not based on the value of water that these areas provide. This approach has been effective in some places, but there are also serious limitations. One problem is that many governments have serious revenue shortfalls caused by ineffective tax systems or depressed economies. Burgeoning social welfare demands compete with public sector investments in protected areas and natural resources management, which have actually declined in many countries during the past decade. A related problem is that using general revenues may not be equitable since some people and businesses use much more water than others do. Also, the political leadership in many places has failed to develop and implement effective policies and institutions to sustain public benefits from forests. Meanwhile, there is growing recognition that traditional watershed management projects, which rely either on regulatory approaches or subsidies to encourage the adoption of soil conservation techniques on private lands, are not having the impact desired (Kaimowitz 2000). Watersheds continue to degrade and most water users around the world pay less than it costs to provide the service and often waste the resource, even where it is increasingly scarce.

Given these problems, investors and policy makers around the world are exploring alternative approaches to achieve watershed management goals and many governments are privatizing their downstream public water and hydroelectric utilities (Tognetti 2001, Trust for Public Land 1997). Governments and the private sector alike are looking for new, lower cost approaches to deliver high quality water. As a result, there is growing interest in ecosystem approaches to ensure water services and in how financial mechanisms can be used to improve the production of those services.

The purpose of this paper is to help forest owners, policymakers, and investors assess the feasibility of developing markets or other financial incentive mechanisms for watershed management and give them general guidance on developing new mechanisms. Our overall goal is to help forest owners add financial value to their forests based on the water-related benefits they provide, thus increasing their incentive to maintain healthy forests. This paper presents an overview of findings derived in large part from a global scoping of innovative cases of markets and financial incentive mechanisms prepared for Forest Trends by Perrot-Maître and Davis (2001). A table comparing elements in these cases is included at the end of this paper as Annex 1, and the case studies may be found on the Forest Trends' Web site. http://www.forest-trends.org.

In this overview, we begin with a summary of the biophysical relationships that link forests, water, and people (Box 1). We then introduce the different types of financial mechanisms for watershed management, illustrate how they are currently being used in practice, and focus on a set of questions that can help guide the development of new mechanisms. From analyzing current mechanisms we derive preliminary lessons and rules of thumb for innovators. We conclude with recommendations for next steps in advancing the development of financial incentive mechanisms for watershed management.

Box 1 *Biophysical Relationships that Link Forests, Water, and People*

The biophysical relationships between forests and water are highly variable from one location to another depending on climate, soils, and vegetation types; there is no substitute for site-specific information. The following are a few simplified basic relationships:

Forests slow the rate of runoff in a watershed. Forest vegetation takes up water and delays the time to soil saturation (after which water pools or runs off the land into the nearest watercourse). Forest soils also usually have a higher water storage capacity than non-forest soils (Falkenmark et al. 1999). And, the more complex structure of the forest ground surface and underlying soil allows more efficient soil infiltration compared to a deforested watershed. By slowing the rate of runoff, forests can help to minimize flooding in smaller watersheds (although they may not influence large-scale flooding). By slowing the runoff rate forests may also increase minimum stream flows during the dry season.

Forests reduce soil erosion and sedimentation of waterways. Interception of rain and snowfall by forest canopies means that less water falls on the ground compared to a deforested watershed. Understory forest vegetation and leaf litter protect the soil from the impact of rain that does fall through the canopy. Extensive root systems help hold soil more firmly in place and resist landslides compared to clear-cut or heavily disturbed watersheds. Sedimentation levels in waterways of forested watersheds are generally lower than in nearby agricultural or urbanized watersheds, but the degree depends on soil types, topography, and climate (Falkenmark et al. 1999).

Forest soils filter contaminants and influence water chemistry. Forest soils are more waterlogged than other soils (except wetlands) and contain more nutrients, allowing them to filter out contaminants (Falkenmark et al. 1999). Clearing and cultivating forest soils tend greatly to accelerate decomposition and to release large amounts of nutrients that leach into groundwater, surface water runoff, and streams. For example, streams in agricultural areas in temperate regions typically have nitrate levels 10 times higher than streams in nearby forested watersheds (which is partly the result of fertilizer applications).

Forests reduce the total annual water flow in a watershed. Contrary to popular opinion forests generally reduce the total annual stream-flow (Calder 1998). This is because trees consume water for transpiration, which is then evaporated back into the atmosphere. In general, trees consume more water than other types of vegetation, including grasses and annual crops. The degree to which forests reduce stream-flow, however, depends on various factors. For example, shallow-rooted trees tend to use less water than deep-rooted trees. Young regenerating forests tend to use much more water than mature and old growth forests (Bruijnzeel In press).

Forests can increase or decrease groundwater recharge. Forest cover can lower groundwater recharge because more precipitation is intercepted by vegetation and returned to the atmosphere through evapotranspiration. In some areas, however, removal of forest cover can result in a crusting of the soil surface that reduces or prevents water infiltration and groundwater recharge (Falkenmark et al. 1999).

Forest loss shifts aquatic productivity. Forest cover plays an important and complex role in sustaining aquatic productivity (Thomas et al. 1993). Trees shade waterways and moderate water temperatures. Woody debris provides fish with habitat while leaves and decaying wood provide nutrients to a wide array of aquatic organisms.

Forests may influence precipitation at a large regional scale, but the effect of forest cover on rainfall in most areas is limited. The distribution of forests is a consequence of climate and soil conditions — not the reverse. Some evidence suggests large-scale deforestation has reduced rainfall in China and some climate models indicate extensive forest losses in Amazonia and Central Africa could lead to a drier climate (Institute of Hydrology 1994; Xue 1994). Still, afforestation is not an effective strategy to increase rainfall (Kaimowitz 2000).

Source: Johnson (2000)

FINANCIAL MECHANISMS FOR WATERSHED MANAGEMENT

The desirability and potential for financial incentive mechanisms in watershed management will vary widely from place to place. Differences in the nature of the service provided, who supplies it, who receives it, how economically important it is, and what legal and regulatory systems are in place are just a few of the factors that shape this potential. In most situations ownership responsibilities to protect ecosystem services are poorly defined, as are the rights to be compensated for providing them. This is complicated by the difficulty of tracing the origin of the ecosystem service as one moves downstream. Furthermore, water-related ecosystem services are often thought of as public goods flowing from a mixture of private and public lands, which people are understandably reluctant to pay for. For these reasons governments will often retain an important or even predominant role in protecting water-related ecosystem services. Still, a variety of economic tools, including markets and other financial mechanisms, are being used to help restore, maintain, and enhance water-related ecosystem services on forestlands.

Here we adopt the typology of financial incentive mechanisms used by Powell and White (2001) to describe the wide variety of mechanisms in practice. This typology organizes the incentive mechanisms into three indicative categories, separated by the degree of government intervention in the administration of the mechanism. These three categories include self-organized private deals, trading schemes, and public payment schemes. In reality, of course, there is continuum of mechanisms involving public and private actors, and many cases involve a combination of different mechanisms. A brief description of these mechanisms and some examples are described below.

Self-organized private deals

In some situations private entities have developed their own mechanisms to pay for watershed protection with little or no government involvement. These cases are more likely to be found where an ecosystem approach can provide private interests with water services at a lower cost than can traditional treatment approaches. For example, private interests may need water quality or flow that goes beyond regulatory standards, or where there is no effective regulatory system in place. Financing is from private sources but may take various forms as user fees, transfer payments, land purchases, cost sharing arrangements, and/or low interest credit.

For example, in France Perrier-Vittel is the world's largest bottler of natural mineral water. Its most important water sources are in heavily farmed watersheds where nutrient runoff and pesticides threaten the aquifers the company relies on. Perrier-Vittel has found that reforesting sensitive infiltration zones, financing farmers to build modern facilities, and switching to organic farming practices are cheaper than building filtration plants.

In Colombia large agricultural producers in the Cauca Valley assess themselves fees through their water users' associations to finance watershed management practices in upland areas to improve base flows and reduce sedimentation in irrigation canals. These practices include reforestation, erosion control on steep slopes, land purchases and protection agreements for springs and stream buffers, and economic development in upland communities.

Neither case required legal or regulatory reform; rather, they were based on intensive negotiations between the potential buyers and sellers of water services. A critical factor affecting their performance was that both efforts developed a participatory process early on to negotiate the actions and payments. Public sector institutions played support roles in both cases. In the Perrier-Vittel case a government research agency helped finance and conduct research that led to the program. In Colombia a regional public development agency carries out watershed management activities and provides technical assistance to local communities and landowners carrying out watershed protection.

Trading schemes

Trading schemes are beginning to emerge in countries with regulated environments where government sets either a very strict water quality standard or a cap on total pollution emissions. In most cases individual facilities or landowners have a defined maximum allowable amount of emissions they can release. The opportunity for trading, however, requires the government to say, in effect, that it does not care who takes action so long as the overall standard is met or the cap is not exceeded. This enables companies or landowners to trade emission credits between those who can achieve them cheaply and those who cannot. Emission credits are earned based on production of emissions lower than the set standard and companies and landowners can make economic decisions as to whether it is cheaper to lower their emissions or to buy credits from others who have been able to do so.

In the United States, for example, highly regulated factories (point sources) that must spend large sums on pollution control technologies to comply with their limits on nitrogen and other organic pollutants are paying unregulated farmers (non-point sources) to reduce their emissions. Trading allows those factories seeking to reduce their emissions to find the most cost-effective means of doing so. And since the farmers can often achieve significant reductions at a fraction of the cost to factories, pollution standards can be met at less cost to factories and to the community as a whole (Faeth 2000). In Australia land clearing has exacerbated salinization problems in many parts of the Murray-Darling Basin. This occurs because the lost vegetation no longer takes up water and transfers it back to the atmosphere so water tables rise and bring dissolved mineral salts to the surface. State Forests of New South Wales recently launched a pilot project which is testing how irrigation farmers can purchase transpiration credits from other landowners downstream. Irrigation farmers are purchasing transpiration credits from State Forests which plants trees on state land upstream (State Forests of NSW 1999). This pilot project is designed to test the possibility for generating a new market in water transpiration to benefit irrigation farmers and other water users. If the pilot is successful, farmers, other water users, and governments could purchase units of transpired water from landowners who planted forest or restored native vegetation. The next step in establishing this trading scheme would be for the government to establish forest cover targets for individual landowners or watershed areas.

Financing for trading schemes typically comes from those companies or landowners that have found that buying credits or units from other sources is cheaper than changing its own processes to comply with the regulatory limitation. Authority for trading schemes, however, must come from state, federal, or local regulatory agencies. A strong regulatory system and effective monitoring systems are key requirements.

Public payment schemes

Public payment schemes are where government or a public sector institution pays for the ecosystem service. Of the three categories of financial mechanisms, public payment schemes are the most predominant in the world today. The financing can come from various sources including general tax revenues, bond issues, or user fees. Payments are made to private landowners and private or public resource managers.

New York City's watershed management program, for example, is an alliance between federal, state, and municipal governments to protect water quality in the Croton and Catskills watersheds that supply the city's 9 million residents with some of the highest quality drinking water in the United States. In Brazil the state of Parana uses a public redistribution mechanism to finance payments to those municipalities that take action either on their own or in cooperation with private landowners to protect watersheds. Allocation of the transfer payments is on a competitive basis; municipalities that protect more watershed area receive a larger allocation of the tax funds.

In both cases intensive negotiations between downstream and upstream governments, businesses, and citizens groups were necessary to establish these mechanisms. Significant changes in the regulatory environment were also needed to enable downstream beneficiaries to pay for watershed improvements in upper watersheds. Because of the public goods nature of hydrological services, publicly financed transfer payments are likely to remain the most common financial mechanism used to protect water-related ecosystem services.

KEY QUESTIONS IN DEVELOPING MARKETS FOR WATER SERVICES FROM FORESTS

Although the great diversity of biophysical and institutional conditions means that there is no unifying blueprint to develop financial mechanisms, there is a set of common issues that innovators will need to consider. The following questions are designed to help innovators assess these issues in their particular situation and consider the development of new financial incentive mechanisms.

What water-related ecosystem services are provided?

Forests provide a range of water-related ecosystem services; in the Murray-Darling Basin of Australia, for example, forest cover keeps water table levels under control and prevents dissolved mineral salts from rising to the surface where they degrade freshwater supplies. Halfway around the world on the slopes of Oregon's Mount Hood, thick coniferous forests shade the Sandy River and keep water temperatures within optimum ranges for salmon and trout. In the country of Colombia reforesting steep slopes reduces erosion and helps extend the life of irrigation canals in the rich farmlands below. Meanwhile in the Rhine-Meuse watershed of northeastern France natural forest restoration and the use of organic farming practices protect vital infiltration zones that feed an important aquifer. The first step in assessing market potential is to identify the different services provided. In most forested watersheds there will be several kinds of water-related ecosystem services. The key is to identify those ecological functions or conditions that provide direct and demonstrable benefits to people. There also must be a determination as to whether the watershed area could, if managed differently, improve the quantity and/or quality of existing services or provide other services.

Can these services be measured and monitored?

Assuring purchasers that they are getting something for their money is basic to any financial transaction. In order to develop a basis for payment it is important to understand the scientific cause and effect relationship between the land use that generates the service and the service itself, and to measure how these elements change over time. Some ecosystem services are easier to measure than others. For example, it would be easier to measure the effect of restoring riparian forest buffers on water quality for a fish hatchery immediately downstream than it would be to measure their effect on oyster production at the mouth of the watershed a hundred kilometers away. Since the range and nature of ecosystem services is highly variable, this is also an important step in verifying that the identified ecosystem services actually exist in the watershed. In some cases, a watershed reforested with young deep-rooted trees may actually reduce base-flows during the dry season rather than increase them. While water flow and water quality are generally easy to measure, it is important that other relevant factors, such as changes in forest cover or creation of riparian buffer zones, are measured as well. Unfortunately, in most watersheds there will be little or no credible data on these basic hydrological functions. In this situation it may be possible to start with extrapolated measurements and relationships from similar watersheds where data is available.

Box 2 *Water-Related Ecosystem Services from Forests*

Forest ecosystems provide people with four types of water-related benefits. These include:

Water Quality. Forests can provide people and companies with high quality water supplies that have low nutrient and chemical contaminant levels. There are a wide variety of potential beneficiaries, such as rural and urban domestic water users and industrial water users, including distilleries, water and soft drink bottlers, film processors, and microchip manufacturers. The best opportunities for the use of market-based instruments to protect water quality are in watersheds serving relatively large populations.

Flow Regulation. Forest cover can regulate surface and groundwater flow in various ways that benefit people. For example, flooding and landslides have been widely linked to deforestation, road building, and other forms of development. In Australia the loss of forest cover is leading to salinisation of water supplies and farmland. With fewer trees transpiring water the water table rises and brings mineral salts to the surface. Again, there are many potential beneficiaries including farmers, agricultural markets, property owners in flood plains, taxpayers, insurance companies, and a range of government agencies. The best opportunities for market-based instruments to maintain or restore this service are in watersheds where chronic or catastrophic damages have caused major economic losses.

Water Supply. Although forests generally reduce total annual water flow, in some cases they can increase minimum flows during the dry season (base flows). The main beneficiaries of this type of ecosystem service are irrigators, municipal water utilities, electric utilities, and large industrial water users that require adequate water supplies during the dry season. The best opportunities to use market-based instruments to maintain this service are in regions with annual dry seasons or frequent droughts where base-flow demands meet or exceed supplies. It should be noted, however, that some research indicates forests are likely to decrease water supplies during both wet and dry seasons.

Aquatic Productivity. The condition and quality of fisheries is often linked to the condition of adjacent or upstream watersheds. For example, valuable sport and commercial fisheries, such as Chinook salmon in British Columbia, can be very sensitive to water quality. Beneficiaries of this service include sport and commercial fishermen, fishery management agencies, and the tourism industry. The best opportunities are probably in watersheds with high value fisheries.

Source: Johnson (2000)

What are the rights and responsibilities for water use and management?

Introducing market mechanisms into ecosystem management raises important and difficult questions about ethics and equity. Of fundamental importance is the distribution of rights and responsibilities regarding water. Do landowners have the right to pollute? Do downstream users have a right to clean water? It is also important to reinforce that in most situations people adhere to legal/formal systems of rights as well as customary/informal rights. Should we be paying landowners for a service they already have a moral and legal responsibility to provide? Will the use of market tools disproportionately benefit certain groups who may be responsible in the first place for the decline in water quality and supply? Clearly defined rights and responsibilities are important factors in the use of market tools to protect ecosystem quality. The degree of confidence to attach to these tools will be determined by the integrity of the legal and regulatory systems that support the allocation of rights, as well as by public attitudes about fairness and equity.

If citizens have a right to high quality water they may be unwilling to pay landowners for improving degraded water quality. In this situation the market opportunity may be limited to transactions among landowners as they seek the most cost-effective ways to meet their responsibilities. In the real world, of course, things usually aren't so simple. Beneficiaries might be willing to pay landowners for measurable water quality improvements if the government has not defined water quality standards, has no monitoring system in place, or lacks enforcement capacity. On the other hand, if landowners have the right to pollute, changing their behavior may require compensation from downstream users.

Who supplies and who receives the ecosystem service?

Let's assume that we've defined an ecosystem service (say maintenance of base flows) in a particular watershed that we can easily measure and monitor and that the rights and responsibilities for maintaining the service are reasonably clear. We next need to be able to trace the flow of that service. What parts of the landscape within the watershed provide the service and who owns or manages those areas? Without knowing where the service comes from it will be impossible effectively to use market tools to restore, protect, or enhance the service.

And who exactly receives the ecosystem service? A large forest manager in British Columbia may have a well-defined ecosystem service she could enhance. But it is unlikely market tools will be helpful if the watershed is sparsely populated or has little or no economic activity directly affected by the service. The link between suppliers and recipients of water-related ecosystem services becomes increasingly tenuous with distance since many other activities and conditions along the way can "dilute" the contributions made by a forest owner far upstream. Unlike carbon sequestration and biodiversity, the potential "markets" for most water-related ecosystem services are likely to be fairly localized.

What is the value of the ecosystem service?

If we define ecosystem services as those ecological functions that directly benefit people, then by definition all ecosystem services will have some level of economic value. Costanza et al. (1997) in a controversial study estimate that the annual value of ecosystem services worldwide is $33 trillion. Of course, very little of this value is captured or traded in markets and most of it may never be, even with ecologically literate citizens, consumers, and policy makers.

While it may be impossible to put a precise dollar value on an ecosystem service, it is important to demonstrate its economic importance to generate support for financing the service. Because of the complexity and difficulty in determining the real economic value of the service in most cases, these values are usually devised according to rough estimates. This can be done in a variety of ways. One way is to value the cost of replacing the service, as the New York watershed case illustrates. Another way is to value the economic activities that depend directly on the service, as in the case of Energia Global's hydroelectric facilities in Costa Rica. In other cases, such as with a highly valued trout fishery, it may be possible to convincingly use "willingness to pay" methods to demonstrate market potential.

Are beneficiaries willing and able to pay for the ecosystem service? Are suppliers willing and able to provide it?

These are the most important questions for any potential investor in mechanisms to maintain or enhance ecosystem services. Everything up to this point is academic unless there are willing buyers and sellers of ecosystem services. Education of potential consumers and suppliers of ecosystem services may be needed to expand the willingness of consumers and suppliers to use market-based instruments. Discovering the answer to these questions in a given watershed may not be possible until someone makes an offer to buy or sell a service. There are, however, ways to get an advance indication of the willingness to pay for an ecosystem service. The following questions might be helpful:

- Is the ecosystem service scarce or declining?
- Is the economic activity linked to the ecosystem service relatively important or potentially so?
- Are the substitutes for the ecosystem service expensive or unavailable?
- Is there a reliable source to provide the ecosystem service?
- Are there multiple suppliers who will compete to provide the service?
- Are there new markets for the ecosystem service, perhaps consumers or companies who use more expensive alternatives?

Development of mechanisms to maintain or enhance ecosystem services can begin either by purchasers or suppliers, government agencies or NGOs. Governments and NGOs, however, often play the critically important role of initiating the debate around the ecosystem cost of degraded ecosystems and bring investors and sellers together for the first time. Consumers willing to pay for an ecosystem service are no guarantee that a market will develop. A key factor in willingness to pay is consumer confidence that the money spent is actually maintaining or enhancing the ecosystem service in question. Potential suppliers have to be willing to offer the service at prices purchasers are willing to pay. In general purchasers will have to pay as much or more as the landowner could obtain from alternative uses (what economists call opportunity costs).

Opportunity costs will vary from location to location and even among adjacent landowners. Therefore, finding a price that brings suppliers into the market is likely to be a trial and error exercise and based on political or business negotiations. Price levels may be difficult to set effectively at first and continued experimentation and negotiation may be needed before finding the right price. For example, if the price consumers are willing to pay is too low few landowners will participate and few ecosystem services will be produced. It is also quite possible that potential suppliers will enter the market even while incurring opportunity costs because they find personal satisfaction in contributing to a healthy environment. A number of conservation incentive programs in the United States have been very successful simply by offering to cover landowner costs.

What transaction costs are involved?

The basic economics of a strategy to use financial mechanisms in watershed management may be good and there may be willing buyers and sellers. But there are likely to be significant transaction costs involved in designing and maintaining such a scheme and such costs should be recognized when assessing the potential for a particular strategy. As the case studies by Perrot-Maître and Davis (2001) illustrate, stakeholder participation, negotiation, and institution building are fundamental to creating any new mechanism and can be expensive. Research will be needed in many areas to define and trace the flow of ecosystem services. And other expenses may include monitoring and enforcement, conflict management, and making necessary changes in legal and regulatory frameworks.

The complexity and expense required to address these issues will vary tremendously from watershed to watershed. For example, transaction costs are likely to be higher in a watershed with many small forest landowners than in a watershed with a few large owners. Strategies can be developed to minimize or share transaction costs. Negotiating with established associations of forest owners, for example, can reduce the costs in a watershed with many small owners. Governments, philanthropic foundations, and donor agencies may be interested in paying for transaction costs if the strategy shows promise for sustainable financing of watershed protection.

EARLY LESSONS AND RULES OF THUMB FOR INNOVATORS

Forest ecosystems play an undeniably important role in the hydrological cycle and society in general, and downstream investors in particular benefit from this in a variety of ways. There is no simple roadmap, however, for developing markets and other financial mechanisms to protect water-related ecosystem services. The immense size of the global market for water and possible cost savings together with the many examples of the failure of the public sector has stoked enthusiasm for new mechanisms to generate revenues for private forest managers who protect and enhance water flow and quality. However, this potential is highly variable from one watershed to the next. In some watersheds the opportunities do not yet exist or are extremely limited. This is especially true in remote, very large, or sparsely settled watersheds and in countries with poorly defined or ineffective legal and regulatory frameworks. In other places the opportunity is there but its development is hindered by a lack of information about the source of the ecosystem service and who exactly benefits from it. Even where this is known, the beneficiaries of the service may have little interest in paying for a service they now believe they are getting for free.

Most experience using economic tools and market instruments to protect water-related ecosystem services is relatively recent. This makes it difficult to devise general advice regarding when a financial mechanism is superior to a regulatory approach, how to choose among the different types of mechanisms, or how to best develop them. Few studies have examined the actual performance and efficiency of these instruments. Nonetheless, the case studies prepared by Perrot-Maître and Davis (2001) and the other reviews, make it possible to derive some preliminary lessons and rules of thumb for innovators (Box 3). These findings will need to be revised and refined as we gain experience and knowledge.

Lessons learned

- A variety of innovative financing mechanisms are being used in watershed management, but transfer payments from downstream water users to upstream stakeholders for ecosystem conservation are the most common approach and account for the largest current source of financing by far.

- Self-organized, private deals are likely to occur when the water services provided are related to private goods (bottled water, electricity, agricultural products). Such deals will be best suited to the particular watersheds upstream of their investment where a strong link between land use actions and a watershed service can be demonstrated. These deals will take place only if the market price covers the monitoring and transaction costs or if such costs can be subsidized.

- Trading schemes are rare, but growing, and private sector participation in trading schemes stems from opportunities for large cost savings.

- In practice political or budgetary considerations rather than strict economic evaluation of the benefits have usually set the price paid to secure water-related ecosystem services.

- The existence of a strong legal and regulatory framework will reduce the transactions costs of establishing and maintaining a financial mechanism. It is an important, if not essential, condition for major private investments and trading schemes.

- Stakeholder participation, negotiation, and institution building are critical in all strategies — self-organized private deals, trading schemes, and public payment schemes — and while some initiatives have succeeded without formal alliances between users and suppliers, such alliances are uncommon.

- Complexity of designing and maintaining the financial mechanism increases with scale. This is because the cost of collective action grows as more actors are involved and because the uncertainty of the biophysical relationships between land use and hydrology increases as the area expands. For these reasons it is most likely that the scope for private deals will be particular, smaller watersheds. Publicly initiated systems will dominate in larger landscape systems where watershed protection is desired for public reasons irrespective of the watershed scale.

- Overall, there is no blueprint mechanism that fits all situations — innovative mechanisms will be site-specific, will often involve elements of different approaches, and will vary depending on the nature of the ecosystem services, the number and diversity of stakeholders, and the legal and regulatory framework in place.

Box 3 *Rules of Thumb for Innovators*

There are many opportunities to develop markets for hydrological services and many innovators eager to seize these opportunities. Although these approaches are relatively new, there has been enough experience to suggest several rules of thumb. A preliminary set of these rules follow.

Biophysical:

- Protect or restore wetlands and riparian vegetation first.
- Maintain natural forests before investing in reforestation.
- Focus on road-building and soil compaction before reforestation.
- Do not rely on fast growing tree species to slow erosion or extend dry season flows.
- Anticipate differences between species, young versus old forests, natural versus plantation forests.

Economic

- Focus on services that are scarce, declining, and have expensive or no substitutes.
- Focus on services directly linked to downstream investments or beneficiaries.
- Base compensation levels on the estimated value or the economic importance of the service.
- Package hydrological services with other ecosystem services if possible.

Social

- Seek out and use local knowledge of the watershed.
- Clarify rights and responsibilities under the existing law and customs.
- Identify stakeholder groups and involve key members in early planning.
- Consider equity implications of watershed investments.

Operational

- Initiate work at reasonably small scales — tens of thousands of hectares rather than hundreds of thousands of hectares — before scaling up.
- Treat major assumptions as hypotheses — monitor and test once implementation begins.
- Do not underestimate transaction costs — seek government or donor help.
- Assemble an interdisciplinary planning and management team.
- Share experiences and findings early and often, especially with decision-makers and stakeholders.
- Choose financial mechanisms that fit existing institutional conditions. Practitioners in areas with weak public institutions, for example, in Colombia's Cauca Valley, may find that self-organized private deals are the most effective. Those in a highly regulated environment, such as the United States, may find that the additional effort to set up a trading system is more than compensated for by dramatic improvements in the efficiency of reaching water management goals. Where public institutions play an important role in land and/or water management, public payment schemes are likely to be important.

NEXT STEPS: ADVANCING THE DEVELOPMENT OF MARKETS FOR WATERSHED MANAGEMENT

Clean reliable water supplies and healthy aquatic ecosystems are increasingly scarce in most parts of the world. Forests play a critical role in these hydrological systems. The search for innovative solutions to the decline of freshwater supplies is expanding rapidly and financial mechanisms in water conservation and management can play an important role. In order fully to utilize these opportunities to add value to forests by watershed management policy makers and practitioners need to undertake major efforts in several areas:

- Encourage innovation. In many parts of the world there are pioneering efforts to use market instruments to achieve water objectives. Transaction costs for these innovative projects will be high. There is a clear role here for the private sector, government agencies, and donor organizations to support these initiatives and to keep such projects from sinking before they can be fully tested.

- Work to clarify legal rights and responsibilities for ecosystem services. There is ambiguity and confusion surrounding rights and responsibilities for forest and water resources in most countries. Actions to clarify these rights and responsibilities range from seeking legal opinions and drafting new regulations to major legislative and legal reform. Public debate should be an important part of the process to clarify rights and responsibilities.

- Develop credible, low cost verification systems. Monitoring, verification, and certification methods, and standards for forest hydrological services are now undeveloped. Developing these systems, as well as building institutions that can provide these services, is critical to ensure the integrity of financial mechanisms and decrease transaction costs. The Forest Stewardship Council system for certifying forest management outcomes, which entails international principles and criteria, local standards, and a system of accredited auditors, provides a useful model for consideration.

- Increase applied biophysical research. More applied research is needed to document the role of forest ecosystems and land use changes in hydrological cycles for representative ecoregions around the world. This is important because efforts to use market tools that rely on widely accepted but poorly documented assumptions about the relationship of land use to hydrology, such as the belief that forests increase water supplies, will have a high risk of failure.

- Accelerate research on application and effectiveness of financial mechanisms in watershed management. This overview paper has captured some of the many innovative financial mechanisms used around the world, but more intensive examination is needed fully to explore and develop this approach. Important study topics include how to determine when financial mechanisms would be preferable over traditional regulatory approaches, when particular types of mechanisms are most effective, and how to design them to maximize impact, efficiency, and fairness.

- Develop and implement mechanisms to disseminate research findings. The use of financial mechanisms in forest management for ecosystem services depends on well-informed private sector leaders and public policy makers. Already, valuable lessons are being learned about land-use approaches to water management and the role of financial mechanisms. There is a need to collect, analyze, and disseminate the lessons learned from emerging experiences and to do so in locally appropriate languages.

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Annex 1 *Features of Innovative Cases of Watershed Management from Around the World*

As taken from Perrot-Maître, D. and P. Davis 2001. Case studies: Developing markets for water services from forests. Washington, D.C.: Forest Trends. http://www.forest-trends.org.

	Self-Organized Private Deals			Trading Schemes	
Name of Case Study	**France: Perrier Vittel's Payments for Water Quality**	**Costa Rica: Hydroelectric Utilities Financing of Upstream Reforestation**	**Cauca River, Colombia: Associations of Irrigators' Payments**	**United States: Nutrient Trading**	**Australia: Irrigators Financing of Upstream Reforestation**
What water-related ecological service is being provided?	Quality drinking water	Regularity of water flow for hydroelectricity generation	Improvement of base flows and reduction of sedimentation in irrigation canals	Improved water quality	Reduction of water salinity
Who is supplying the service?	Upstream dairy farmers and forest landholders	Private upstream owners of forest land	Upstream forest landowners	Point source polluters discharging below allowable level; non-point source polluters reducing their pollution.	State Forests of New South Wales
Who is paying for the service?	A bottler of natural mineral water	Private hydroelectric utilities, Government of Costa Rica, and local NGO	Associations of irrigators; government agencies.	Polluting sources with discharge above allowable level	An association of irrigation farmers
What instruments are being used?	Payments by bottler to upstream landowners for improved agricultural practices and for reforestation of sensitive infiltration zones	Payments made by utility company via a local NGO to landowners; payments supplemented by government funds.	Voluntary payments by associations to government agencies and by agencies to private upstream landowners; purchase by agency of lands.	Trading of marketable nutrient reduction credits among industrial and agricultural polluting sources	Water transpiration credits earned by State Forests for reforestation and sold to irrigators
What are the intended impacts on forests?	Reforestation but little impact because program focuses on agriculture	Increased forest cover on private land; expansion of forests through protection and regeneration.	Reforestation, erosion control, springs and waterway protection, and development of watershed communities	Limited impact on forests — mainly the establishment of trees in riparian areas	Large-scale reforestation, including planting of desalination plants, trees and other deep rooted perennial vegetation

Public Payment Schemes

New York City: Watershed Management Program	Colombia: Environmental Services Tax (Eco-tax) for Watershed Management	State of Parana, Brazil: Public Redistribution Mechanism	United States: The Conservation Reserve Program
Purification of NYC's water supply	Regularity of water flow for industrial uses; regularity and water purity for drinking water.	Rehabilitation of private and public areas for watershed protection	Reduction of soil erosion; improvement of water quality and regularity of stream flow.
Upstream landowners	Private land owners and municipalities	Municipalities and private landowners	Owners of cropland and marginal pasture lands
Water users taxed by NYC with supplemental funds provided by federal, state and local governments	Industrial water users and municipalities	The State of Parana	United States Department of Agriculture
Taxes on water users; NYC bonds; trust funds; subsidies; logging permits; differential land use taxation; development rights; conservation easements; development of markets for non timber products and certified wood.	Eco-tax on industrial water users; payments by municipalities and watershed authorities to landowners.	Public sector redistribution mechanism: State provides additional funds to those municipalities with protected areas and which harbor watersheds that supply neighboring municipalities.	Conservation easements; restoration cost share agreements; yearly rental payments to landowners for engaging in conservation; additional incentive payments.
Adoption of low impact logging; retirement of environmentally sensitive land from agricultural production; forest regeneration.	Improved Forest management; expansion of forests.	Rehabilitation of degraded forest areas	Though the program is directed at farms advantages to trees are many: tree planting, strips, riparian buffers, grassed waterways, field windbreaks, shelter belts, living snow fences, and establishment of bottomland timber.

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