# 3. Demand for environmental services

Several forces are stimulating a growth in demand and willingness to pay for environmental services. Public awareness of the value of environmental services and the costs of their depletion is growing and information on the issues is becoming more widely available.

Environmental and, to some extent, health regulations are an important outcome of this trend and are major drivers of the willingness to pay for environmental services. Individuals and firms are ready to pay for such services when they provide a low-cost way of complying with a regulation. In the early 1990s, for example, the city of New York in the United States of America concluded that the least-expensive means of meeting water quality standards for the city's water supply was through paying farmers in the upper reaches of the watershed to change their agricultural practices (Box 4). Similarly, payments for carbon sequestration are largely driven by regulations at the international, national and subnational levels limiting carbon emissions and creating a market for offsets.

Payments for environmental services beyond the regulatory requirements are also emerging. When the value of wetlands outside New Orleans in the United States of America became clear in the aftermath of Hurricane Katrina, the state of Louisiana started directing funds towards coastal wetlands restoration, reversing former policies that had actually degraded wetlands (Verchick, 2007). Consumers also have shown a marked willingness to pay for environmental services through their purchases of ecolabelled products. Swallow *et al*. (2007b) identify three important links between flexible and regulatory approaches to environmental governance:

- New environmental regulations that allow flexibility in the approach to compliance create institutional space for public utilities, local governments and private firms to innovate with regard to PES activities.
- Firms or industry groups may actively promote PES schemes as a way of demonstrating commitment to the environment in order to forestall environmental regulations.
- Firms may seek to establish or illustrate best practice in environmental management as a way of influencing the shape of future environmental regulation.

Most PES programmes are funded by the public sector. However, the private sector is increasingly becoming involved in purchasing environmental services. A recent survey identified more than 100 types of private environmental service payment programmes – with a relatively even distribution across the domains of carbon sequestration, water and biodiversity – and an estimated number of transactions totalling more than 1 100 (FAO/Forest Trends, 2007).

This chapter examines the basis for the demand for environmental services and the differences between public- and private-sector programmes.[4] It then examines the current market situation for three major services: carbon sequestration, watershed management and biodiversity conservation.

## Value and beneficiaries of environmental services

To understand the basis for payments for environmental services provided by agriculture, it is first necessary to look at the benefits they generate and to whom they accrue.

[4] The chapter draws heavily on FAO, 2007c.

BOX 4

**Demand for and supply of water services in Sukhomajri, India and New York, United States of America**

Two well-known cases of payments for environmental services in the area of water quality from India and the United States of America illustrate the importance of assessing both demand and supply.

The small village of Sukhomajri in India provides an early and complex example of watershed development that has helped inspire modern watershed development programmes. In the 1970s, high rates of sedimentation in Lake Sukhna in the northern Indian state of Haryana created problems for the drinking water supply of the nearby town of Chandigarh (Kerr, 2002). Recreational benefits were threatened also. The source of the problem was traced to a small upstream village named Sukhomajri, where villagers were cultivating steep lands and allowing animals to graze freely throughout the watershed. Around 80–90 percent of the sedimentation in Lake Sukhna was found to originate from Sukhomajri (Sengupta *et al.*, 2003). The Sukhomajri farmers' agricultural practices were not only felt downstream; runoff water on one side of the watershed also flooded and destroyed agricultural lands in the village itself.

A central government agency, the Central Soil and Water Conservation Research and Training Institute (CSWCRTI) revegetated the watersheds and installed conservation structures such as check dams and gully plugs to stop the flow of silt. Villagers were asked to refrain from allowing grazing animals into the watersheds. Benefits to the villagers were twofold: not only reduced damage to agricultural lands, but also access to irrigation water stored by the check dams. Although no direct payments were involved, the villagers were thus indirectly compensated for providing the environmental service. At the time of the project implementation, the notion of markets for environmental services was little known, but in effect the project functioned as an environmental services payment scheme. A drawback was that only a minority of landowners in the village benefited from the scheme; other villagers, particularly the landless,

## Valuing environmental services

For traded commodities and services, market prices indicate the value at which buyers and sellers agree to exchange them. For many environmental services, however, market prices do not exist, so quantifying their importance or estimating their value is difficult. Information is lacking regarding the underlying process that results in environmental services and their implications for human well-being. In many cases, the benefits may be uncertain and may occur only in the future, if at all. A common approach to estimating environmental values is the "total economic value" concept, which encapsulates the full range of economic values· that people attach to each type of land use.[5]

- **Direct use values** are those derived from marketed goods or services that normally involve private benefits, such as commodities, timber, fuelwood, non-timber forest products, recreation, education and tourism. These also generally correspond to the Millennium Ecosystem Assessment's category of provisioning services. Valuation of these types of service is usually straightforward.
- **Indirect use values** refer to benefits that people derive indirectly from the "ecological functions" performed, such as watershed protection, fire prevention, water recycling, carbon sequestration, biodiversity conservation, and pest and disease resistance. Environmental services often fall into the latter category of benefits, which relate to the Millennium Ecosystem Assessment's categories of regulating and supporting services.

[5] See, for example, Pearce, 1993; Johansson, 1990; Barbier, 1989; Pearce and Turner, 1990; Munasinghe and Lutz, 1993; Ayres and Dixon, 1995; Kumari, 1995; Adger *et al.*, 1995; Hearne, 1996; Andersen, 1997; Markandya *et al.*, 2002.

stood to lose from reduced access to grazing lands. The problem was solved by distributing rights to the water to all villagers and allowing them to trade among themselves – a system that was later abandoned in favour of user fees for water. The project resulted in a 95 percent decrease in siltation into Lake Sukhna, saving the town of Chandigarh about US$200 000 annually (Kerr, 2002).

In the second case, which was initiated in the early 1990s, a combination of federal regulations and cost realities in the United States of America drove New York City to reconsider its water supply strategy. Municipal and other water suppliers were required to filter their surface water supplies unless they could demonstrate that they had taken other steps, including watershed protection measures, to protect their customers from harmful water contamination. Ninety percent of the New York City water supply is drawn from a watershed that extends 200 km north and west of the city. City authorities concluded that managing land use in the watershed was more cost-effective than building a filtration plant. A filtration plant would have cost US$6–8 billion. Watershed protection efforts, including not only the acquisition of critical watershed lands but also payments to farmers to change practices so as to reduce contamination sources in the watershed, would have cost only about US$1.5 billion and would have provided the same level of water quality. New York City chose to invest in natural rather than produced capital. Farms that opt to participate in the Watershed Agricultural Program receive technical assistance in designing a strategy for controlling potential sources of pollution on the farm, with New York City covering all costs associated with the implementation, and become eligible for other elements of the compensation package for specific environmental services (Rosa *et al*., 2003).

*Source:* FAO, 2007d.

- **Option values** are based on the benefit of preserving the possibility of future direct or indirect use. They represent the insurance premium people are willing to pay today to secure environmental services in the future. Much of the importance of biodiversity conservation lies in option values: preserving ecosystems, species and genes for potential future use.
- **Non-use values** are benefits that are totally unrelated to any personal use of an ecosystem. Individuals may value environmental services without ever actually deriving any use value from them. Benefits in this category include the value of knowing that an ecosystem exists and will be conserved for future generations, as do securing the survival and well-being of biodiversity, endangered species and habitats (FAO, 2004c). They are also referred to as existence values.

Precisely because markets do not exist for many environmental services, estimating their value is difficult. If society has decided that an environmental service is worth protecting (or enhancing), even without a precise estimate of its monetary value, other methods – such as environmental benefits indices – can be used to prioritize spending in such programmes. These methods are discussed in greater detail in Chapter 5.

## Identifying beneficiaries

Who actually benefits from these different forms of value from environmental services? The benefits from environmental services occur at local, regional and global levels. They may occur immediately, after a few years or well into the future. Establishing where and when the benefits from environmental services occur is fundamental to understanding the basis of demand and payments for them. Table 5 provides a

**TABLE 5**
**Indirect, option, and non-use values associated with environmental services**

| | INDIRECT USE VALUE | OPTION VALUE | NON-USE VALUE |
|---|---|---|---|
| Off-site local benefits | ■ Watershed, soil and flood protection<br>■ Water quality<br>■ Water and nutrient recycling<br>■ Soil fertility<br>■ Pest and disease resistance<br>■ Aesthetic, cultural and spiritual values | ■ Conservation of agricultural biodiversity for potential future uses | ■ Aesthetic, cultural and spiritual values |
| Global benefits | ■ Climate change mitigation | ■ Genetic material that can be used for agricultural, medical other future purposes | ■ Biodiversity conservation and species preservation |

*Source:* adapted from FAO, 2004c.

rough categorization of the benefits from environmental services, grouped according to scale and type of value.

## Who are the potential buyers?

Owing to their nature, environmental services are not easily packaged and traded, and in many cases their benefits will occur mostly in the future. Many environmental services take the form of public goods (see Box 2 on p. 14). Coordination of purchasers of public goods is required in order to overcome problems of "free-riders" (those who benefit from the service without paying for it). Moreover, the actual purchaser of an environmental service is often not the same as the beneficiary (see Table 6). In many cases, the purchaser is the public sector, acting on behalf of individual beneficiaries. However, there are also other intermediaries who coordinate purchases for environmental services, including non-governmental organizations (NGOs) and product certifiers.

### Public-sector funding of PES programmes

Public-sector funding for agriculture is the most frequent source of funds for PES programmes, whether it is the Grain for Green programme in China (see Box 17 on p. 83), the CRP in the United States of America (see Box 5 on p. 38), Costa Rica's Payments for Environmental Services programme (see Box 16 on p. 81) or Brazil's Programme of Socio-environmental Development of the Rural Family Production, known as Proambiente (May *et al*., 2004). Usually, public-sector programmes do not have a direct link between buyers and sellers; instead, governments use general tax revenues or external funds such as those provided as overseas development assistance. In some cases, however, revenues are generated by earmarking a share of taxes or fees charged to some users of the services, such as the water fee in Mexico (Muñoz-Piña *et al*., 2005), or the South African "water resource management fee" included in the water charges, to cover part of the costs of clearing "thirsty" invasive alien plants (see Box 22 on p. 97) (Turpie and Blignaut, 2005).

International public-sector funding is also an important source of finance for PES programmes in developing countries. One key player is the GEF, which has co-funded several PES projects in developing countries (see Box 6 on p. 39). GEF payments can reasonably be considered as payments from service users, in that the global community (through the Convention on Biodiversity Conservation and the United Nations Framework Convention on Climate Change [UNFCCC]) has empowered the GEF to act on its behalf in conserving global public

**TABLE 6**
**Environmental services and examples of buyers**

| ECOSYSTEM SERVICE | BENEFICIARIES | BUYERS |
|---|---|---|
| Carbon sequestration | ■ Global community | ■ Local, regional and national governments<br>■ International organizations (World Bank – BioCarbon Fund)<br>■ National carbon funds (Italian Carbon Fund, The Netherlands CDM Facility)<br>■ Conservation groups<br>■ Land trusts<br>■ Corporations<br>■ Hedge funds and investment groups |
| Biodiversity | ■ Global community | ■ International and national NGOs<br>■ Private businesses (offsets) |
| Water quality | ■ Local community (potable water)<br>■ Fishers (pollution)<br>■ Farmers (salinity) | ■ Municipalities<br>■ Private water suppliers<br>■ Public water suppliers<br>■ Bottled water companies<br>■ Farming organizations |
| Erosion control | ■ Local community (potable water)<br>■ Dam owners (sedimentation)<br>■ Fishers (sedimentation) | ■ Hydroelectric energy providers |

*Source:* adapted from FAO, 2007d.

goods (Pagiola and Platais, 2007). The BioCarbon Fund provides an example of an international source of payments for carbon emission offsets from land-use change that includes payments for activities allowable under the Kyoto Protocol (see p. 41), such as reforestation and afforestation, as well as a broader menu of options for offsets, such as soil carbon sequestration.

Overseas development assistance in the form of loans and grants has also been a significant source of funds for PES programmes. Loans from the World Bank have financed some of the most well-established PES programmes, such as the Costa Rican and Mexican national PES programmes. The critical role played by these projects has centred on helping both countries develop new, sustainable sources of finance from water users, the tourism industry and carbon buyers to improve programme efficiency and to support the participation of poorer landholders.

## Private-sector purchasers of environmental services

The private sector is playing an increasingly active role in payment programmes in developing countries. Their motivation for paying to promote environmental service provision includes concerns about maximizing sales to environmentally aware consumers and pressures from shareholders and consumers for greater corporate social responsibility.

Examples of private-sector programmes include payments for voluntary carbon sequestration and biodiversity conservation, payments through intermediaries such as NGOs for the adoption of conservation practices, private purchases of water quality services and involvement in ecolabelling initiatives, including ecotourism. It is estimated that around 100 megatonnes of carbon have been sequestered through voluntary payments to landowners, many of whom are in developing countries (Bayon, Hawn and Hamilton, 2007). Some companies engaged in land development in developing

BOX 5
**The United States Conservation Reserve Program**

Created in 1985, the United States Conservation Reserve Program (CRP) is the largest payment scheme for environmental services in the world, providing annual rental payments and sharing the cost of conservation practices on farmland. First created to address problems of soil erosion and to support farm incomes at a time of declining crop prices, the programme has grown over the years and now pays for land-use changes that promote water quality and wildlife habitat, as well. Annual payments exceed US$1.4 billion for activities on over 32 million acres (approximately 13 million hectares) (USDA, 2007).

CRP contracts extend from 10 to 15 years. To be eligible for CRP support, farmland must have been planted in two of the five most recent crop years and meet a set of requirements to ensure it can provide services. The land must be physically and legally capable of growing an agricultural commodity or constitute marginal pastureland suitable for planting as a riparian buffer. In addition, the land must present some sensitive environmental characteristics, such as being highly erodible or a cropped wetland.

Farmers wishing to enrol in the CRP have their offers ranked by government field officers according to an Environmental Benefits Index (EBI) that includes such elements as erodibility, as well as wildlife habitat or water quality benefits. Farmers who are selected for enrolment receive annual rental payments (averaging US$49 per acre in 2006), as well as cost-share payments to establish approved vegetative cover. Topsoil loss on CRP land is estimated to have been greatly reduced, and benefits to water quality, wildlife and recreation have also been significant (Sullivan *et al.*, 2004).

Despite CRP's achievements, critics have raised several concerns. First, land withdrawn from crop production in the CRP may be partially offset by land brought into production elsewhere, although the precise magnitude is difficult to determine (Roberts and Bucholtz, 2006). Second, concerns have been expressed about fairness, in that participating farmers are paid to adopt practices that other farmers may have adopted voluntarily (without compensation). Finally, concerns have been raised about cost-effectiveness, as it is possible for owners of land with substantial environmental benefits (as reflected in a high EBI), but low agricultural productivity, to qualify for CRP payments well above what they would be willing to accept, in view of the low returns they would have were they to keep that land in production (Kirwan, Lubowski and Roberts, 2005). Considerations in programme design to address these concerns are discussed further in Chapter 5.

countries are voluntarily offsetting the negative effects of their activities on local biodiversity by restoring and enhancing habitat elsewhere.[6]

Consumers of ecolabelled products represent a further source of private-sector payments. The Forest Stewardship Council (FSC), which sets standards for sustainable forest management, and the Marine Stewardship Council (see Box 21 on p. 92), which provides standards for sustainable fisheries, are two notable sources of product certification. Both accredit independent certification bodies to carry out certification. In both cases, certification requires a management system that generates environmental services, particularly biodiversity conservation, as well as fish and forest products. In the case of the FSC, the global extent of certified forest area

[6] For more detailed discussion of the potential for biodiversity offsets see http://www.forest-trends.org/biodiversityoffsetprogram.

BOX 6
**Global Environment Facility and payments for environmental services**

*Pablo Gutman*[1]

Over the early 2000s, the Global Environment Facility (GEF) has built a portfolio of 22 projects that have some elements of an environmental services payments programme. The cumulative budget for these programmes is somewhat less than 3 percent of GEF cumulative investments. Most of the projects' total budgets are in the range of US$25–100 million. Almost all projects are part of the GEF biodiversity portfolio and are heavily concentrated in the Latin America and the Caribbean region. The ecosystem services they provide include all those discussed in this report. Thus far, GEF's role in the payments for environmental services arena has been small, but important in several ways: acting as the glue for other institutions to participate; increasing incentives for the recipient country; bringing in funds for institutional development and capacity building; promoting new ideas and approaches.

The current GEF payments for environmental services portfolio is largely focused on protection of natural forests and management of protected areas. Many projects anticipate the growth of international markets for biocarbon sequestration and avoided deforestation for future funding. Others hope to find local buyers for watershed protection services. Current payers are always the national government or international donors, both bilateral and GEF. With the exception of the carbon emission offsets projects, these projects do not rely on the markets of wealthier countries as a source of funding.

[1] *World Wildlife Fund.*

is small, accounting for only 7 percent of total global forest area, and most is located in developed countries. Certification has so far focused on public and large private forests. It can represent an additional cost that poorer countries and smaller producers find difficult to meet and thus they may be disadvantaged. Nevertheless, although both the demand for, and supply of, certified products is concentrated primarily in developed countries, some growth in supply is also beginning to occur in developing countries. For example, Argentina and China rank second and third in the world for their areas of certified organic land, while virtually all Rainforest Alliance certified crops are grown in Latin America (P. Liu, personal communication, 2007).

Considerable diversity exists in the certification of agricultural crop commodities in terms of products covered and types of environmental benefits associated with the standard. Organic agriculture is the largest certified product market in agriculture, with over 31 million hectares currently certified as organic and a market value of 25.5 billion euros in 2005 (IFOAM, 2007). Most types of organic certification are not directly tied to a specific environmental service, and evidence on the net environmental benefits remains mixed. They are based on criteria linked to environmental management and thus could be considered a form of payment for environmental service. While many types of certified product programmes exist, and they are increasing in number, there is considerable fragmentation in the range of crops and environmental services receiving attention. Rainforest Alliance certification for example, encompasses coffee, cocoa, fruits and flowers and requires ecosystem management, wildlife protection and the protection of waterways. The Biodiversity and Wine Initiative in South Africa (see Box 7) certifies vineyards that implement practices aimed at conserving biodiversity.

Finally, examples exist of environmental services that are provided to discrete beneficiaries. In such cases, individual private PES buyers may be willing to pay

BOX 7
**The Biodiversity and Wine Initiative in South Africa**

South Africa is the world's eighth largest producer of wine, 90 percent of which is produced in the Cape Floral Kingdom, a World Heritage site and global biodiversity hotspot. Since the late 1990s, a boom in wine exports has raised concerns over the expansion of vineyards. Conservation organizations, including The World Conservation Union, Conservation International and the South African National Biodiversity Institute, have teamed up with the South African wine industry to create the Biodiversity and Wine Initiative (BWI). Specific biodiversity best practice guidelines have been incorporated into the environmental guidelines of the Integrated Production of Wine, an industry-wide technical system of sustainable wine production. From the industry's point of view, highlighting sustainable natural resource management and efforts to conserve South Africa's natural heritage creates an important marketing opportunity.

The BWI now represents the conservation element of the Wines of South Africa brand. Participating producers agree to implement biodiversity best practices to reduce negative impacts on biodiversity and enhance habitat quality. In properties with priority habitats, growers can benefit from additional support from the Cape Nature Conservation's Conservation Stewardship Programme – a programme for the conservation of priority habitats in private lands.

Benefits include assistance with on-farm habitat management, alien plant clearing and property rate rebates. The BWI provides media coverage on its Web site and in wine and tourism magazines and also plans to establish a biodiversity wine tour during which visitors can enjoy both the wine and the biodiversity richness in the property of each participating producer.

By mid-2007, the BWI scheme already covers half of the total vineyard footprint in the Cape winelands – over 50 000 hectares, managed by 76 producers.

*Source:* adapted from BWI, 2007.

providers to ensure continuous provision. One such example is the French bottled water company Vittel mentioned in Chapter 2, which pays farmers to maintain specific land-use practices above the aquifers they use for bottling (Perrot-Maître, 2006). In Costa Rica, La Esperanza Hydroelectric Company pays landowners in the watershed of its power-generating reservoir to maintain their forests intact in order to control erosion.[7] Similarly, ecotourism operators sometimes pay local communities to ensure the conservation of attractive biodiversity in the surrounding areas (Teixeira, 2006).

[7] For further details, see http://ecosystemmarketplace.com/pages/marketwatch.transaction.other.php?component_id=1827&component_version_id=2951&language_id=12.

## Demand for three main environmental services

The sections that follow examine more closely the trends in demand for the three main environmental services that are the focus of this report: climate change mitigation, watershed services and biodiversity conservation.

### Climate change mitigation

The unique characteristic of carbon emission reductions or mitigation is the absence of geographic limitations. The location of carbon mitigation is irrelevant for its effectiveness. Furthermore, increasing carbon stocks in farm soils and vegetation can often be accomplished while simultaneously improving farm productivity. This represents a valuable opportunity for diversification

and risk-spreading, two crucial components of smallholders' livelihood strategies in developing countries.

Most demand for carbon emission reductions worldwide is driven by the Kyoto Protocol and the national and regional implementing policies and trading schemes enacted to carry it out. The Kyoto Protocol is an agreement under the UNFCCC that involves commitments on the part of a set of industrialized countries (referred to as Annex I countries) to legally binding limits or reductions to their greenhouse gas emissions from a base of the levels prevailing in 1990. The Kyoto Protocol became legally binding in 2005, with its first commitment period ending in 2012. Two flexible trading mechanisms were established to meet emission reduction requirements under the Kyoto Protocol: the Clean Development Mechanism (CDM) and the Joint Implementation Program. The first allows trading in emission reductions between Annex I countries and developing countries through the issuance of a certified emission reduction (CER). Joint Implementation allows trading between two or more Annex I countries. At present, the rules of the CDM restrict the type and amount of carbon emission reduction credits that can be obtained from carbon sequestration. Only afforestation and reforestation projects are allowed, and these can only make up 1 percent of the total base-year emissions. The rules for what will be allowed after 2012 are not yet clear and remain the subject of considerable debate.

Overall, the prospects for the market in carbon emission reductions are extremely promising, and the global carbon markets are expanding rapidly. In 2005, market volume was approximately US$10 billion, while in the first quarter of 2006 alone emissions-related business transactions were valued at US$7.5 billion (World Bank/IETA, 2006) and, by the end of 2006, the global carbon market had tripled to reach US$30 billion (World Bank, 2007). In 2006, 508 megatonnes of carbon dioxide equivalents were sold by developing countries to Annex 1 countries, for a total value of US$5.4 billion (including transactions within the CDM, Joint Implementation and voluntary markets) (World Bank, 2007).

However, only a small share of the market is for emission reductions from carbon sequestration, due to the CDM restrictions mentioned above and because the EU Emissions Trading Scheme – the largest market, accounting for US$25 billion in 2006 – does not allow credits from forestry carbon. Emission reductions from land use, land-use change and forestry (LULUCF) account for only 1 percent of volumes so far (World Bank, 2007), with only 0.3 percent of the CERs being issued for LULUCF projects, and more than half of these are generated from projects in China.

Currently, these regulated markets are unfavourable to small farmers for a number of reasons. First, the CDM excludes two of the major forms of carbon emission reductions that farmers can deliver relatively easily: reduced emissions from deforestation in developing countries (known by its acronym RED-DC) and soil carbon sequestration. Second, the process of certifying projects to be CDM-eligible is complex and costly, as is the process of delivering carbon credits to the market (see Box 20 on p. 90).

A third problem relates to the limits placed on the size of small-scale carbon projects. The CDM allows simplified procedures for establishing small projects; however, the maximum size of these projects is set at 8 kilotonnes of carbon dioxide that can be offset from sequestration per year, which is too small for the projects to be financially feasible at current market prices. Most country submissions to the UNFCCC in 2007 requested an increase in this cap to 32 kilotonnes in order to improve their feasibility.

Finally, for buyers who are not interested in social co-benefits and who are concerned about the risks associated with the reversibility of emission credits from agriculture-based projects, other energy projects and projects that capture potent industrial greenhouse gases are now considered those with the best prospects for the carbon-trading market. Nonetheless, regulated markets could still involve significant numbers of small farmers if the rules were changed to encourage their inclusion.

The prices that are being paid for credits for carbon emission reduction vary widely by source of demand and type of offset. The Ecosystem Marketplace reported prices of around US$7 per tonne of carbon dioxide in

BOX 8

**Payments for reduced emissions from deforestation: what is the potential?**

*Heiner von Lüpke*[1]

It is estimated that at least 18 percent of all greenhouse gas emissions originate from deforestation processes worldwide, making this the second largest emitting process, after fossil fuel combustion. According to the 2005 FAO Global Forest Resource Assessment, deforestation is taking place at a rate of 13 million hectares annually and is principally a result of conversion to other land uses, forest degradation, timber and fuelwood removals and shifting cultivation, as well as forest fires. Important underlying and proximate causes of deforestation are economic factors such as market growth, policy and institutional factors, and formal and informal policies, as well as issues related to land tenure and property rights.

At the eleventh Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 11), a group of countries led by Costa Rica and Papua New Guinea proposed the consideration of a framework to contribute to reducing greenhouse gas emissions through avoiding deforestation in developing countries. Developing countries would identify projects to achieve voluntary carbon emission reductions by reducing deforestation in return for international financial compensation. Other policy approaches besides payments, including capacity and institution building, have been included in the proposals, as well. A possible mechanism is currently being discussed and is to be addressed during COP 13 (Indonesia, December 2007). A common feature is the proposition that the international community would bear the costs of implementing the mechanism. Options under discussion include a mechanism based on existing carbon markets and a separate global fund.

Issues include the weak database on actual and historic trends of carbon stock changes in forests, the development of a baseline scenario, technical matters related to the monitoring of carbon stock changes in forests, strengthening capacities of institutions and the need to build institutional frameworks to implement a mechanism.

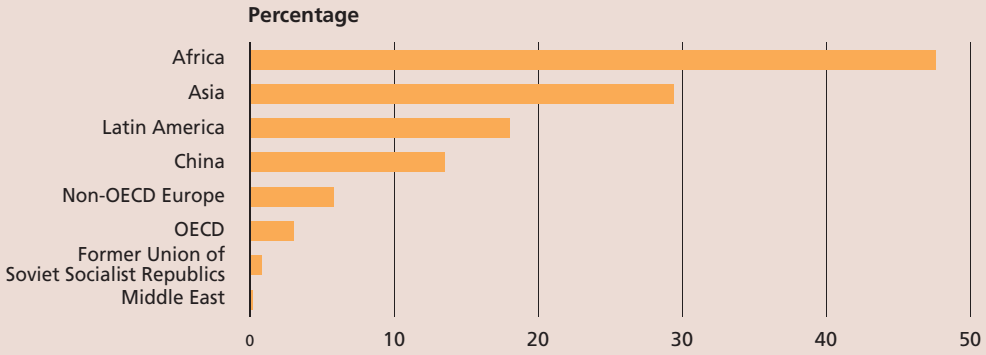
[1] *FAO Forestry Department.*

2007, up from a range of US$3–6.5 per tonne in 2004 (Walker, 2007).

The size of voluntary markets and public payments is likely to be smaller than for the regulatory carbon markets, but their interest to farming communities is likely to be greater, because they capture a much higher share of carbon sequestration projects (Bayon, Hawn and Hamilton, 2007). Voluntary buyers are often more interested in demonstrating positive social and economic co-benefits, and public-sector buyers can choose to invest in low-income areas and to utilize carbon payments to restore degraded lands and encourage agroforestry on a large scale.

Another potential source of payments for emission reduction currently under much debate is payments for reducing emissions from deforestation. Deforestation arising from conversion of land to annual crops or pasture is a major contributor to global emissions of greenhouse gases, and much of it occurs in developing countries. At its eleventh session in 2006, the Conference of Parties of the UNFCCC invited parties and accredited observers to submit their views on issues related to reducing emissions from deforestation in developing countries, including policy approaches and positive incentives. Payments to land users for reducing emissions from deforestation are one of the most important types of positive incentive measures being proposed, including by FAO in its submission (UNFCCC, 2007) (see Box 8). This source of payments,

FIGURE 6
**Share of bioenergy in total primary energy supply**




*Source:* based on data from OECD/IEA, 2007.

if it materializes, will have the potential to augment the flow of payments for emission reductions from the agriculture sector. In addition, emission reductions from LULUCF activities have been identified as having a high potential "development dividend", defined as benefits to developing countries. These benefits include economic growth, technological improvement and poverty reduction (Cosbey *et al*., 2006).

Bioenergy represents another potentially important source of carbon emission reductions. In 2004, bioenergy provided about 10 percent of total primary energy supply at the global level and approximately 35 percent in developing countries (Figure 6).

The share of bioenergy projects in the CDM market has been significant. In May 2007, bioenergy projects (excluding biogas) represented the fourth largest project type in terms of share of CERs but are expected to drop to the fifth largest share by the end of the first crediting period in 2012.

Full life-cycle greenhouse gas emissions of bioenergy systems depend on a range of aspects along the entire production chain, including land-use changes, choice of feed-stock, agricultural practices, refining or conversion process and end-use practices. Estimates of net emission reductions that can be obtained with bioenergy thus vary widely. Bioenergy can reduce emissions by substituting for transport fuels and replacing fossil fuels such as coal for power and heat generation. Bioenergy development can have impacts on water use, soil erosion and biodiversity conservation also, depending on the specific production system. These are important in assessing the sustainability of emission offsets from this source and could affect their eligibility for CDM credits.

A major problem with current patterns of biomass use for energy, particularly for traditional bioenergy systems in developing countries, is its low conversion efficiency, frequently as low as 10 percent (Kaltschmitt and Hartmann, 2001), and related degradation of carbon stocks in and outside forests.[8] Improving bioenergy efficiency is a fairly straightforward means of reducing carbon emissions and it represents a large potential source of carbon payments for those countries that currently depend on traditional bioenergy (i.e. almost all least-developed countries). The rules and modalities of the CDM have so far not allowed bioenergy projects that reduce emissions through improving efficiency or introducing renewable energy systems. This could be a key reason behind the very low share of CDM projects in sub-Saharan Africa and least-developed countries in general (Jürgens, Schlamadinger and Gomez, 2006).

## Watershed services

Demand for watershed services appears to present a growing opportunity for farmers

[8] Wood removal for energy use represents a large share of total wood removals from forests, particularly in Africa and Latin America. See FAO, 2006b.

**TABLE 7**
**Size of selected watershed service markets**

| Nature and location of market | Services paid for | Size of market *(Million US$)* | Price of service *(US$)* |
|---|---|---|---|
| **Regulatory:** COSTA RICA[1] | Water-based ecosystem services markets (1996) | 89.0 | 40–100 per hectare of forest |
| **Regulatory:** MEXICO[2] | Payment for hydrological services (2003) | 23.1 | 33 per hectare |
| **Regulatory:** UNITED STATES OF AMERICA | Water pollutant trading and offset (2003) | 11.3 | 2.37 per pound sediment/ nutrients |

[1] US$0.5 million of the Costa Rica funding was provided through voluntary agreements with water users, which includes public-sector water users such as the state power corporation Compañía Nacional de Fuerza y Luz (CNFL) and the public utility of the town of Heredia.
[2] Mexico is working to develop voluntary payments by water users to supplement funding from the central government, under the World Bank/GEF-financed Environmental Services Project.
*Source:* FAO/Forest Trends, 2007; Pagiola, 2004.

located in a critical watershed. Public watershed payment schemes, which currently represent by far the largest market for watershed services, are valued at US$2 billion annually, worldwide (Ecosystem Marketplace, 2005). Monetarily, these payments are concentrated mostly in China and the United States of America, but numerous smaller public watershed programmes are being established in Africa, Asia and Latin America. Private voluntary watershed programmes consist mainly of small, localized markets totalling about US$5 million annually, worldwide (Ecosystem Marketplace, 2005). Table 7 provides some estimates of the size of selected markets in the mid-2000s.

In contrast with carbon sequestration and many biodiversity conservation services, watershed protection services are primarily of interest to local and regional users (Landell-Mills and Porras, 2002). This characteristic is both an asset and a liability for the development of watershed payment programmes. On the positive side, it is relatively easy to identify the users or beneficiaries of watershed services; these include municipal water suppliers, hydroelectric facilities, industrial users and irrigation systems. Furthermore, the critical day-to-day use value of these services may make revenue streams less subject to market fluctuations than payment programmes driven by philanthropy, goodwill, public relations or long-term environmental well-being at the global level.

On the negative side, the local orientation of watershed service benefits is the limited scope for attracting payments from international beneficiaries. However, considerable external funding has been provided by the international community to assist in the establishment of watershed payment programmes. To date, US$108 million in approved World Bank loans and US$52 million in GEF grants have been made available for World Bank/GEF-supported PES projects involving water payments. Likewise, funding from The Nature Conservancy, an international NGO, has helped establish the FONAG (Fondo para la Protección del Agua) water fund in Quito, Ecuador; funding from Swiss Aid has helped fund the PASOLAC (Programa para la Agricultura Sostenible en Laderas de América Central) programme that helped many rural towns to establish local PES programmes in Central America; and the Inter-American Foundation has provided start-up funding for the PES mechanism in the Ecuadorian town of Pimampiro. Such external support has been used to cover start-up costs and, perhaps more importantly, technical support for mechanism design.

The development of local watershed PES programmes is difficult where the water users are poor and unable to afford payments to upstream stewards. For example, although funds collected from household water users in Pimampiro covered the payments made to upstream land users,

outside support was needed to cover the start-up costs of the programme and its ongoing administrative expenses (Echavarria *et al*., 2004).

### Biodiversity conservation

Payment programmes for biodiversity conservation are in various phases of development around the world, addressing components of biodiversity ranging from the genetic to the ecosystem level and including both agricultural and wild biodiversity. In the United States of America, the conservation banking market is a biodiversity cap-and-trade system that allows for the sale and purchase of endangered species credits to offset negative impacts to endangered species and their habitat. Internationally, particularly in developing countries, payment mechanisms being developed include certification of biodiversity-friendly agricultural products, hunting concessions, ecotourism development, markets for biodiversity offsets and niche markets for products with high agricultural biodiversity value.

Regulated markets for biodiversity remain practically non-existent in the developing world at present, but might become significant if developing countries pass regulations that require corporate real estate and natural resource developers to offset their environmental impacts. Examples of biodiversity offsets have been documented, and models to mainstream this concept are being developed (ten Kate, Bishop and Bayon, 2004). Such programmes are unlikely to target agricultural lands in general but could do so when there is a preference for offsetting impacts locally and where local agricultural landscapes contain significant biodiversity.

Biodiversity markets aimed at protecting the services of wild pollinators and pest control agents are poorly developed, but have the potential for future expansion. The Millennium Ecosystem Assessment (2005b) quantified the high economic costs associated with loss of wild pollinators, a concern that has motivated a handful of projects to pay for pollinator habitat protection (McNeely and Scherr, 2002). A recent study by the United States National Academy of Sciences reported that more than 90 crops in North America rely on honeybees to transport pollen from flower to flower. These pollination services are worth an estimated $14 billion a year to the United States economy (Committee on the Status of Pollinators in North America, 2007).

Three factors currently hinder the development of biodiversity markets. First, many of the benefits of biodiversity will arise in the future and are highly uncertain. The market is therefore driven mainly by philanthropy, consumer preference and, to a lesser extent, by regulation. Second, it is difficult to define "units of biodiversity" for the purpose of carrying out transactions. Finally, the conservation community continues to debate the value of conservation funds being expended in agricultural settings, where native biodiversity may already be significantly degraded, or whether investment should focus on lands that have been less disturbed.

## Farmers and landholders as buyers of services

Chapter 2 focused on the central role of farmers as providers of services, but it is also important not to overlook their potential as buyers. Almost all agricultural production still ultimately relies upon fertile soil, adequate water and protection against biological pests and natural disturbances. Most crops depend upon pollinating insects, whose recent declines have caused alarm within the agricultural community (Biesmeijer *et al.*, 2006; Committee on the Status of Pollinators in North America, 2007). In the long term, agricultural production will also depend on the maintenance of crop genetic diversity and other biodiversity that supports agriculture in numerous ways.

Thus far, individual farmers and farmer organizations are only minor buyers of environmental services (although the value of climate and soil fertility services is reflected in the price of agricultural land). Documented cases of voluntary private markets include mainly irrigators paying for upstream water-flow management, fruit-growers paying to protect pollinator habitat and farming communities paying neighbouring communities to protect critical sources of drinking water (Landell-Mills and

Porras, 2002). This approach seems likely to grow significantly for large-scale commercial producers, especially those who seek to export commodities to ecosensitive markets in Europe and elsewhere. Predicted shortages of water for surface and groundwater irrigation may lead smallholder farmer organizations, especially those producing higher-value, water-intensive crops, to establish contracts to secure hydrological services.

## Future developments affecting potential growth of PES programmes in developing countries

Finally, this section touches on some of the main issues that may affect future demand and willingness to pay for environmental services from developing countries. There is little doubt that concern over, and awareness of, the costs of environmental degradation will continue to grow, but it is less clear to what extent this will result in increased funds to pay for environmental services, particularly in developing countries. The actual flow of funds to developing countries for environmental services is currently very small and primarily derived from public-sector funding in a handful of countries. Furthermore, payments for environmental services are only small relative to the income that can be obtained from alternative uses of the resources (CTS Nair, FAO Forestry Department, personal communication, 2007). Is there likely to be an increase in external funds to developing countries for payments for environmental services? Are developing countries themselves likely to use more public-sector funds to support PES programmes in their countries? These are the questions addressed in this section.

The private sector is an important source of potential increases in external funding for PES programmes in developing countries. One indicator is the increasing weight given to sound environmental management as a core business strategy for companies. Insurance companies and investors are increasingly noticing links between environmental management and returns on investment. The insurer Swiss Re, for example, calculates that natural disasters cost approximately US$230 billion in 2005, of which the insurance industry bore one-third (Vigar, 2006). Insurance industry concerns are likely to translate into higher premiums, and therefore greater operating costs. In response to these issues, some insurers are offering incentives for climate-aware actions. According to a CERES (2006) report, AIG and Marsh – the world's largest insurer and insurance broker, respectively – have launched carbon emissions credit guarantees and other new renewable energy-related insurance products, in an attempt to engage more companies in carbon offset projects and carbon emissions trading markets (FAO/Forest Trends, 2007). These new insurance products, in turn, are creating incentives for private companies to enter carbon markets.

Environmental-based challenges to companies' "licence to operate", for example in the areas of mining, water bottling and tuna fishing, also reinforce their motivation to pay for environmental services. Consumers are showing stronger interest in the environmental performance of companies, as illustrated by the growth in demand for certified products. Finally, regulators – particularly in Europe – are exploring more innovative approaches to environmental regulation for carbon offsets, as well as other environmental services.

The two global environmental service markets – carbon emission reductions and biodiversity conservation – appear to have the greatest potential for bringing new streams of finance into the agriculture sector (including forestry) in developing countries. The need to offset carbon emissions is clearly generating the greatest expectations. Interest among potential suppliers and buyers in developing countries is also high owing to the lower cost of service provision, although at present sales of carbon offsets are unevenly distributed – with Africa far behind Latin America and Asia (World Bank, 2007).

The potential growth of this market in developing countries depends on three main factors: the extent to which the overall market size expands (which in turn depends on the fate of international agreements to reduce emissions); the types of activities allowed as emission offsets; and the comparative attractiveness of carbon credits from agriculture *vis-à-vis* other sources, such as energy conservation projects.

For example, an agreement on payments for voluntary reduction in emissions from deforestation would significantly increase carbon payment flows to the agriculture sector in developing countries.

Developments in the voluntary carbon market are equally, if not more, important. Even though the voluntary market is smaller, the share of emission offsets from land-use change is much higher. At the same time, less stringent requirements are likely to mean lower transaction costs and easier access to this market for small farmers (A. Ruhweza, personal communication, 2007).

The volume of compliant carbon transactions tripled over the last year, and the voluntary offset segment is also "building in size and dynamism" (Point Carbon, 2007). Some sources project the voluntary market to become as important, by 2010, as the CDM is today, with a volume of 400 million tonnes a year compared with only 20 million tonnes in 2006 (ICF International, 2006, cited in World Bank, 2007). Reaching a generally acceptable standard for this market segment is the next major hurdle to overcome (World Bank, 2007). A determining factor for the fate of voluntary markets is how well offsets from the agriculture sector in non-regulated markets are perceived to be performing in mitigating emissions. At present, concerns over the validity of these offsets are emerging, which could seriously impair the growth of these markets (World Bank, 2007).

Even with rapid growth in the regulated and voluntary markets, the potential for developing countries to benefit depends on their taking steps to provide the necessary institutional structures to engage in such projects. The Nairobi Framework,[9] a United Nations-led partnership linking government action to the private sector, is one example of an initiative to spur the development of capacity to access carbon markets in developing countries, particularly Africa.

Unlike carbon emission reductions, no international regulatory framework currently underpins payments for biodiversity conservation. Nevertheless, several sources of demand for biodiversity services have emerged. National regulations governing the biodiversity impacts of planned economic development projects are stimulating growth in demand from corporate developers for biodiversity offsets.

Even in the absence of any regulations, corporations might seek to enhance their corporate image by offsetting the biodiversity impacts of their activities. Large-scale development projects by private and public actors – road building, mining, oil and gas extraction, and urban development – could bring significant funding and high visibility to this market. Appropriate standards could encourage projects with high social co-benefits.

Second, philanthropic buyers, especially large conservation NGOs, are likely to increase the use of conservation payments and conservation easements in developing countries because the establishment of new nature reserves has become more contentious in many regions, in part because of their impacts on rural livelihoods.

Individual consumers are driving the development of markets for agricultural products certified against environmental standards and represent another important potential source of growth in demand for biodiversity conservation services. This market is small but shows some promise of significant growth with increased consumer awareness and demand for improved environmental management. The expansion in the market for organic agricultural products can provide some insights into how consumer demands for environmentally friendly products are changing. World retail sales of such products were estimated at US$35 billion in 2006. Sales trebled in the period 1997–2005 and, according to industry sources, are expected to double between 2006 and 2012. The extent to which changing consumer preferences will translate into increased demand for products associated with environmental services – particularly biodiversity – is yet to be seen.

The global market for biodiversity conservation will be influenced by the extent to which it can be linked with economically significant problems such as the transmission of diseases or the incidence and severity of natural disasters. Both problems generate high social costs. To the extent that maintaining various forms of biodiversity can be found to reduce these costs, the value and demand for services will increase.

[9] For further information, see http://cdm.unfccc.int/Nairobi_Framework/index.html.

An important constraint that developing countries face in building their markets for ecolabelled products is the lack of local certification systems or, when these exist, their lack of recognition by buyers in international markets. This situation implies that foreign certification bodies must be called in to carry out the inspection and certification work for export products, which tends to raise costs, especially when inspectors must be flown in from abroad. The extent to which developing countries will be able to benefit from the growth of the market for environmentally friendly products will be determined by their capacity to develop local certification bodies and have them fully recognized in importing countries.

A final question to be considered is the degree to which payment programmes will expand for environmental services with primarily local benefits, particularly watershed services. A key issue here is the degree to which users of the water services are willing and able to pay for such services; imposing fees on low-income urban populations for drinking water is not likely to be politically or economically feasible. However, in situations where water users are already bearing heavy costs associated with the degradation of watershed services – be it in the form of payments for water treatment, desiltation or new water-supply development – the demand and willingness to pay for watershed services may be quite substantial.

## Conclusions

While there has been significant growth in PES programmes in recent years, the overall size of the markets remains small, and they are mostly confined to developed countries. The public sector has been the major source of payment programmes so far in both developed and developing countries. The international public sector has played an important role in financing PES schemes in developing countries through the GEF, as well as through development loans.

Future effective demand is likely to grow, driven by increased demand for environmental offsets (carbon emissions and biodiversity) that developing countries can supply at relatively low prices. Interest in developing countries as suppliers is high for two reasons: in the case of carbon offsets, because of the lower cost of service provision found in developing countries; for biodiversity, because much of the world's biodiversity is located in developing countries.

The carbon market has seen rapid growth in recent years, but the segment relevant to carbon emission reductions from land-use change is still small. There are two main sources of carbon payments: the regulated market under the CDM and a variety of voluntary and public-sector sources of payments. Voluntary and public sources allow a wider range of land-use changes to generate carbon emission offsets. The potential for growth in carbon markets is promising, although the extent to which this will increase demand for emission offsets from land use depends on future negotiations regarding the activities that will be permissible. A potentially important source of demand currently being discussed is payments for reducing emissions from deforestation.

Environmental services related to biodiversity are purchased by the public sector and NGOs through a variety of mechanisms, by consumers expressing demands for improved environmental management via purchase of ecolabelled products and by private-sector buyers interested in improving their corporate image. Biodiversity offset programmes represent a further potential source of demand, but are not yet well developed. There is also potential for growth in public-sector-funded PES programmes in developing countries where environmental services meet critical policy objectives such as clean water availability and prevention of natural disasters.

Growth in demand and willingness to pay for environmental services from developing countries must be supported by a set of policy and programmatic efforts. These include strengthening the international environmental regulatory framework governing climate change and biodiversity conservation, which are both important sources of demand for offset services, and allowing activities that facilitate the participation of agricultural producers in developing countries. This latter approach

could include the reduction of emissions from deforestation in climate change mitigation. Improving coordination among various forms of ecolabelling schemes and clarifying the environmental benefits that can be obtained from certified products are important for future growth in this form of payments for environmental services.

Building institutions and capacity for managing environmental service payments in developing countries is equally important. The potential of developing countries to benefit from PES programmes will be greatly diminished in the absence of such policy and institutional efforts undertaken at the local, national and international levels.