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Forests and Water: Managing Interrelations

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Berne, 2004

cde centre for development and environment

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Berne, August 2004

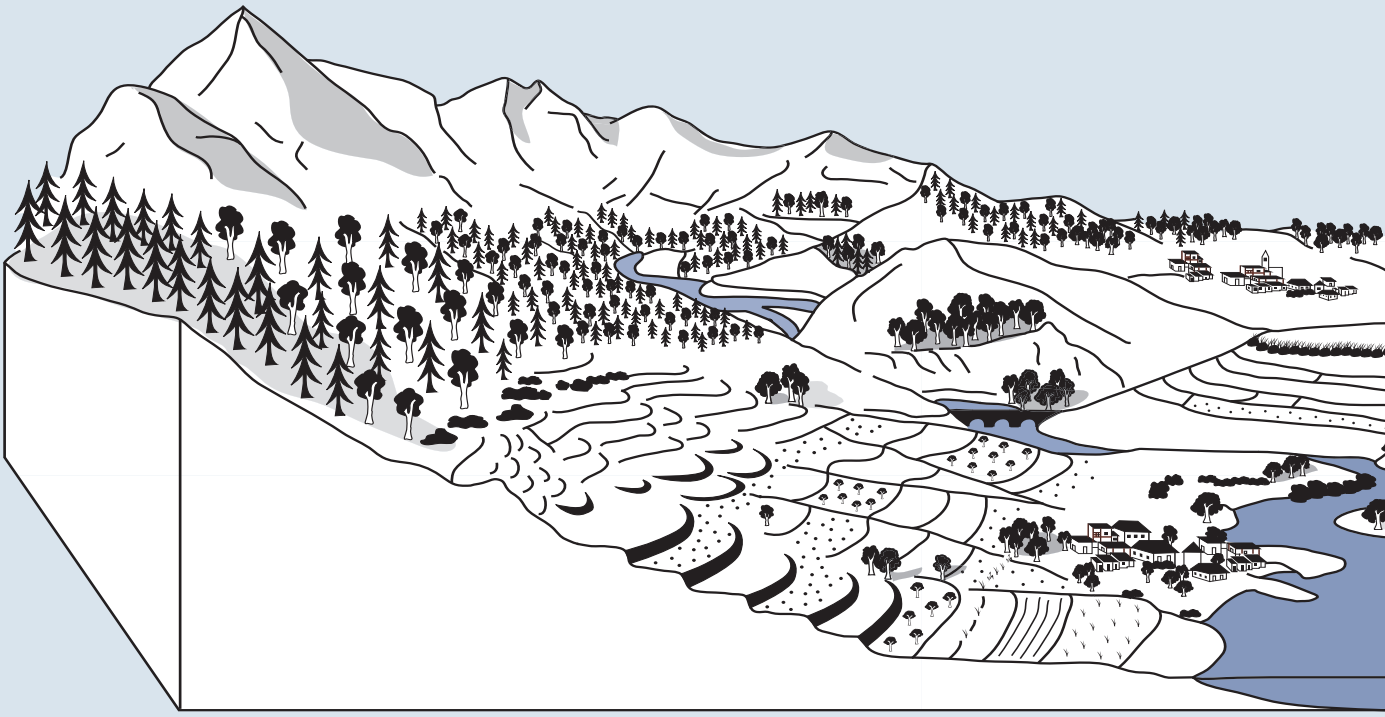
Preface

In September 2000, the world's heads of state met in New York to adopt the United Nations Millennium Development Goals (MDG), and they set themselves the goal of halving world poverty by 2015. This is an ambitious agenda that requires close collaboration between the nations, as well as good governance at both national and international levels. Moreover, development that aims for poverty alleviation can only be sustainable if the regeneration of natural resources is assured over the long term, since innumerable communities rely on these resources for their survival and well-being. Indeed, water, soil, forests, biodiversity, and climate – which are closely linked natural resources – provide populations with the products and services on which they base their existence. When one of these resources is subject to degradation, the others are affected as well. Any form of governance committed to poverty alleviation must, therefore, by all means orient its approach towards sustainable and integrated management of the natural surroundings that the populations in question depend on, and towards management that reflects the complex nature of the terrain, i.e. the numerous interrelations between the various resources, as well as their relation to the socio-cultural and economic setting.

The International Year of Freshwater 2003 reminded the countries of the North that many people in the South and East suffer severe water shortages, that a fifth of the world's population does not have access to safe drinking water, and that this situation will be further aggravated if we continue to degrade our resources. What we are facing is not merely a water crisis, but a general crisis of renewable natural resources – a problem caused by inadequate management and a lack of political will to take more integrated and ecologically sound action.

By organising two one-day conferences on the subject of "Forests and Water", SDC offered specialists from the scientific, practical, and institutional spheres a platform where they could exchange information and experiences, and created a framework for an intersectoral and transdisciplinary discussion on possibilities of improving the management of these two intimately linked resources. The discussion centred around the aspects of multifunctionality, management at institutional and community level, and integrated natural resource management, as well as on the economic approach of payments for environmental services. This approach offers a new opportunity to correct the current global dominance of economic considerations, as it makes a point of valorising nature in other ways than just exclusively in terms of exploitable products. Methods of compensation for environmental services open a new pathway to an integrated form of management in which products, producer ecosystems, and stakeholders involved in the management of these ecosystems are all given equal importance.

Martin Sommer
Head of Natural Resources and Environment Division
Swiss Agency for Development and Cooperation



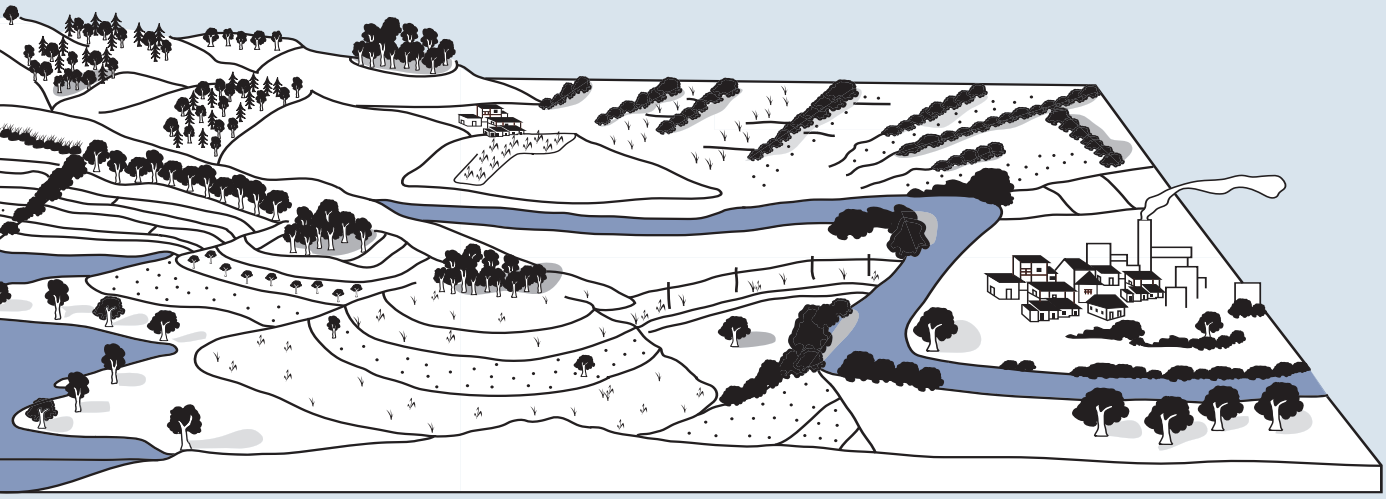
Forests and Water: Managing Interrelations

Introduction

Forests play a vital role in collecting, conserving, purifying and replenishing water resources. This natural phenomenon has gained increasing importance in the eyes of the international community, which has become aware of the 'water crisis' threatening large parts of the world's population, and of the advanced degradation of ecosystems that regenerate water resources, among which are the world's forests.

Within the framework of the International Year of Freshwater 2003, the Working Group "Forests and Trees in Development Cooperation" organised two one-day conferences on the theme of 'Forests and Water'. These conferences brought together scientists, experts, and those involved in the field to discuss how to improve management of these two intricately linked renewable resources.

The theme of the first conference was 'Multifunctional forest and water management in development cooperation'. Discussions focused on the multiple roles of forests, and on potentials and constraints of forest management in relation to water, both in Switzerland and in devel-



oping countries. The second conference was devoted to the theme of 'Payment for environmental services' as a specific tool to create more sustainable management regimes for natural resources. This was a conclusion drawn by the first conference on 'Multifunctional forest and water management'. The approach aiming to introduce payment for environmental services (PES) and compensation for environmental services (CES) in the specific context of sustainable forest / water management is important for developing countries. At present, only limited practical experience with this context is available, although the general approach is widely debated in international circles.

The purpose of this brochure is to provide an extended synthesis of the results and conclusions of the two conferences by presenting a systematic approach to the 'Forests and Water' theme and the new concept of 'Payment for Environmental Services'. It is intended for readers who work in international development cooperation and assistance in Switzerland and abroad. It offers additional information for local programmes in the field and at policy level.

Forests provide services

From a biophysical point of view, the forest ecosystem has the characteristics of a dynamic balance. If this balance is not exposed to major natural and anthropogenic disturbances (fires, violent storms, avalanches, landslides, deforestation, pollution, insect epidemics), the ecosystem is capable of ensuring a great variety of vital functions over the long term. The main function for human beings has always been the production of biomass. However, the perception of forests and ways of managing them have changed over time. The wood crisis in 18th century Germany (Grober, 1999), for example, led for the first time to an awareness of the importance of long-term management of this renewable natural resource. Eventually, societies gave increased value to forests as ecosystems, having recognised that forests offer humankind further services. After having been reduced mainly to sources of timber, forests today have acquired a new status as a source of life and natural resources of vital importance for combating poverty, water scarcity, desertification, and other forms of environmental degradation.

Functions of forests:

1. Forest ecosystems are characterised by high biodiversity. Indeed, more than half of the 1.6 million animal and plant species known in the world today live in forests.
2. Biomass production is vitally important for human beings. Moreover, when used for construction or as a source of energy, wood is a raw material. Its production can meet sustainability criteria (including those referring to climate change: balanced CO_2 cycle).
3. Forests offer a great array of non-timber forest products (see Box 1).
4. Plant cover, root systems, and the quality of topsoil enable good infiltration and water retention.
5. Vegetation, plant roots, and soil quality also mitigate the impact of floods and erosion.
6. Forests are a reservoir of good quality soils.
7. Forests also play a role as landscape and recreation areas. They often have cultural and spiritual value (see Box 2).

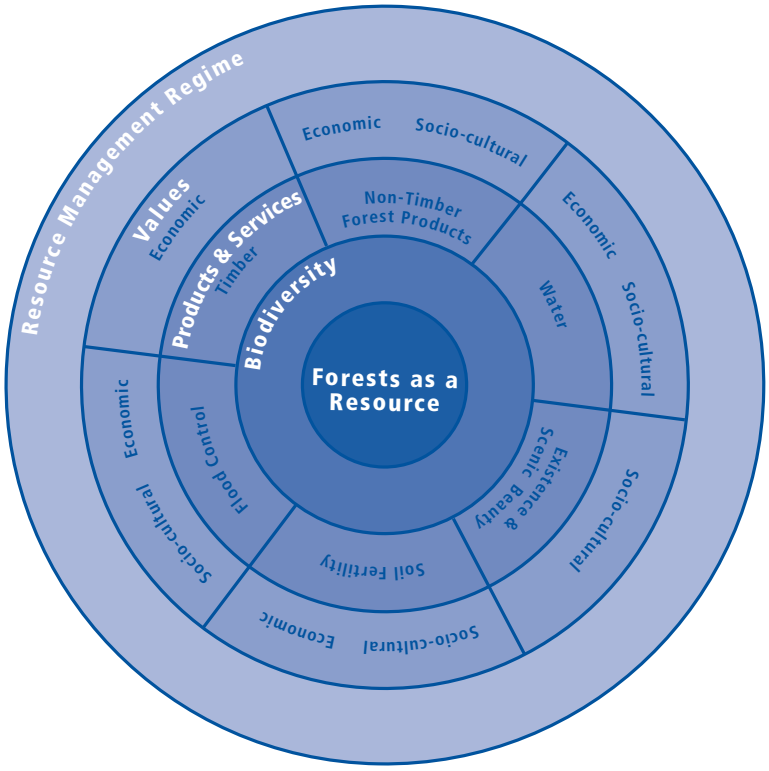


Figure 1
Multifunctional forests as providers of services for humankind. Through the biodiversity they harbour (2nd circle), forests as a resource (1st circle) engender a great variety of products and services (3rd circle) that have economic, social, and cultural value for human beings (4th circle). To achieve sustainable resource management, it is important to maintain and enhance the value of forests' multifunctionality (5th circle).
CDE, 2004.

Non-Timber Forest Products (NTFPs)


U. Lutz

Nepalese woman cutting grass for fodder.

NTFPs consist of biological materials other than timber collected in their natural environment, or products originating from forest plantations or agroforestry. They can be used as food and food supplements (seeds and nuts, mushrooms, fruit, herbs, spices, game meat), fibre (construction, furniture, clothing, tools), in the form of resins, gums, and vegetal as well as animal products used for medical, cosmetic, and cultural purposes. Numerous families in developing countries are highly dependent on NTFPs for their subsistence and/or income.
Currently, approximately 150 NTFPs have been identified as relevant to international trade, including honey, gum Arabic, rattan and bamboo, cork, nuts and mushrooms, resins, essential oils, and certain parts of plants and animals used in the production of pharmaceutical products. For several years, NTFPs have been arousing considerable interest on a global scale. A reason for this is growing awareness of their importance when pursuing environmental objectives such as biodiversity conservation, or social objectives such as providing an additional source of income for poor population groups.

Adapted from http://www.fao.org/forestry/index.jsp

Box 1

The cultural value of forests in Haiti: Voodoo as a means to protect springs

To protect the spring at Digoterie, local people walk in a procession along the path to the spring, singing and dancing for Damballah, the patron of trees, and Simbi, the patron of water. At the source, the people call upon the patrons of the location, distributing tree seedlings to reforest the surroundings. Certain individuals go into trance and communicate with the spirits. Thus, the spring and the trees conserving it become sacred and protected.
Helvetas, a Swiss NGO, integrates this spiritual component into spring rehabilitation and protection projects in Haiti. Activities to protect springs often include cultural activities to enhance the work accomplished and as a tribute to the environment.

Box 2 **Case Study 1: Haiti – a problem case. (M. Bützberger and U. Fröhlich, Helvetas, February 2003)**

Forest ecosystems offer a multiplicity of services that contribute to human survival and well-being. There is a need to acknowledge this potential and to promote its conservation through sustainable management, in order to guarantee that human populations today and in the generations to come have regular, equitable, and balanced access to forest products and services.

The role of forests in relation to water

Water retention and filtering

Forest ecosystems enable regeneration of water resources, and groundwater recharge with good quality drinking water. These functions are key elements in the international debate on global water scarcity.

Quantitatively, a forest generally returns less water to the soil than well-managed grassland or cultivated areas, for example, as it gives back greater quantities to the atmosphere through evapotranspiration. However, the dense and deep root system of forest soils and the high porosity of its essentially organic horizons make for an excellent water infiltration and retention capacity. Surface runoff is minimal and groundwater recharge is more efficient, to the benefit of permanent springs.

Qualitatively, forest water usually contains very few toxic substances. The absence of fertilisers, wastewater, roads, and settled zones reduces external pollutant input in the environment. Moreover, forest soils have a higher retention potential for organic and mineral substances than agricultural or urban soils.

The concentration of pollutants in drinking water taken from wells and springs fed by watersheds used mainly for agricultural purposes is many times higher than in water provided by the forest hydrological cycle.
(OFEFP, 2003)

Protection against floods and erosion

For over 150 years, the presence of forests has been considered an efficient protection measure against floods and erosion. In the face of increasing risks related to natural phenomena (floods, droughts, landslides) in the past few decades, the international community has realised that it is necessary to intervene. Conservation of forests has become an integral tool in improved natural resource management regimes. Indeed, roots stabilise the soil and contribute to preventing erosion and landslides. By comparison with other environments, forest ecosystems also have a better flood mitigation capacity, due to the fact that vegetation cover intercepts rainfall and that the soil has a high infiltration and retention capacity. But this advantage is lost when rainfall events have a high intensity and duration, and forest soil has consequently reached its maximum saturation. This was demonstrated in 1919 by Engler, a Swiss researcher. The results of his research show that surface runoff during heavy precipitation events is 30 to 50% lower in forests than in areas without forest cover, but that this percentage decreases as rainfall duration increases, until it becomes irrelevant (Engler, 1919). The positive impact of forest cover is more visible on small areas as compared to larger areas on a regional scale (Robinson et al., 2003). Recent studies have shown that the mitigating effect of forests on floods also greatly depends on local geological and pedological factors (Hegg et al., 2004). Further factors are the topography of an area, the surface and density of afforestation, vegetation composition, and forest growth stage. Thus, for example:

- The more soils are porous and rich in organic matter, with a dense and deep plant root system, the greater is their water infiltration capacity;
- Sandy soils have an infiltration capacity up to five times higher than that of clayey soils;
- However, clay increases a soil's water retention capacity compared to sand; but if the clay content is too high, the infiltration capacity decreases;
- Infiltration and retention are most efficient with medium porosity, high organic matter content, a dense and deep-reaching plant root system, and the presence of clay particles;
- Dense and mature stocking intercepts more rainwater than sparse and very young

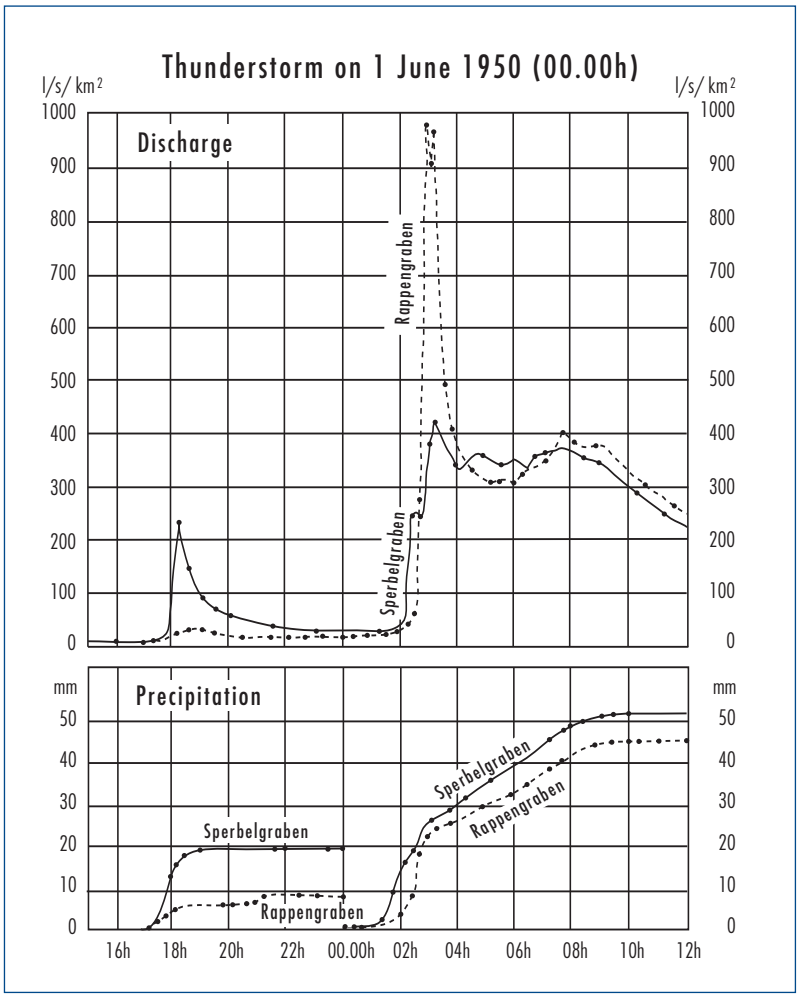


Figure 2
Comparison of discharge behaviour in a fully forested catchment (Sperbelgraben) and a catchment with only 25% of forest cover (Rappengraben).
The retention effect of the forest shows well during the first part of the storm beginning around 2 a.m. on 1 June 1950. As precipitation continues, the entire storage capacity is eventually reached in both catchments, causing retention to diminish and the discharge behaviour of the two catchments to become similar. (Source of diagram: Burger, 1954, p 33)

stocking; moreover, conifers intercept more rainwater than broad-leaved trees;

- Fast-growing tree species (e.g. pine and eucalyptus) use more water than slow-growing species (e.g. oak and maple);
- Soils saturated with water can increase the risk of landslides during extreme events;
- Forests tend to lessen floods by reducing the volume of surface runoff and slowing down the transit of water through the watershed. But this can also be observed with other types of vegetation such as well and sustainably managed grasslands. The contrast is really evident only when comparing forested areas with inappropriately managed cultivated land, pastures, and non-vegetated areas, including urban zones (see Table 1).

Soil texture	Bare soil (mm/h)	Covered soil (mm/h)
Clay	0-5	5-10
Loamy clay	5-10	10-20
Loam	10-15	20-30
Sandy loam	15-20	30-40
Sand	20-25	40-50

Table 1 **Water infiltration capacity according to soil type and vegetation cover. (Lee, 1980)**

PROMIC

Hydraulic control measure for a riverbed.

Flood protection in Bolivia: forests are certainly not the only solution

Over 800,000 people live in the Central Valley of Cochabamba, Bolivia. Major parts of the valley are exposed to torrents that rush down the mountain from over 5000 m asl to the valley bottom at 2600 m asl. There is clear historical evidence of a high flood risk. This risk has increased due to environmental degradation and erosive processes in the steep watersheds, as well as to population increase in the valley bottom. Water shortage during dry periods is becoming another pressing problem, as groundwater tables have decreased due to over-exploitation and lack of supply from the watersheds, where infiltration rates have diminished due to environmental degradation.

To increase protection of the valley, an integrated watershed management project (PROMIC) has been implemented since 1991. PROMIC is characterised by an interdisciplinary and participatory approach aiming to encourage a rational use of natural resources – particularly water, soil, and vegetation – within the steep watersheds. This approach is combined with hydraulic control measures of riverbeds and ravines such as protection, retention, and channelling infrastructure for sediment deposition, conservation of water resources, and flood risk attenuation. Degraded areas are controlled, stabilised, and recovered through mechanical, biological, and biomechanical measures. Appropriate crop management techniques, soil conservation measures, and improved water utilisation methods are introduced through a specific agricultural extension method developed for watershed purposes.

Box continued next page

Box continued from previous page

Within this framework, conservation of natural forest remnants, restoration of vegetation cover, establishment of forest vegetation, and reduction of vegetation burning have been important means to revert environmental degradation trends. Forests have been established in strategic areas from a watershed management point of view (stabilisation to prevent erosion processes, increasing of infiltration rates, and soil improvement). As the communities clearly perceive that forests have protective functions at the local level, they have almost completely maintained forests. Besides protection, uses include mainly firewood and tools. 3.9% of watersheds are covered with forests established through activities promoted by the project. Around 70% of the trees planted are native species. Local farmers have strongly reduced their practice of burning vegetation (by 70 to 80%). The socioeconomic impact of the project can be assessed as positive, both for the peasant families living in the watersheds (increase in sustainable agricultural production and income for local farming families) and for the urban population settled in the valley bottom (reduction of flood risk and flood impact, and increase in groundwater recharge and base flow in watersheds).

PROMIC

Bio-mechanical measures for slope stabilisation in critical areas.

Regarding the issue of forests, the main conclusions of PROMIC, which is working in very degraded watersheds, are:

- Protection of forest remnants and reforestation activities form only part of a wide range of watershed management tools;
- Reforestation has to be implemented in a very targeted way in order to contribute to the overall goal of the project – along with other watershed management tools;
- Reforestation is a rather small part of implemented activities, both in terms of area covered and expenditures;
- Reforestation can only be one of several options on marginal and very eroded sites where most other land use forms are not a valid option for local farmers.

Box 3 **Case Study 2: Forests in watershed management as a means to reduce flood risks – the example of the PROMIC project. (T. Stadtmüller, Intercooperation, February 2003)**

Although forests have a considerable potential with regard to the regeneration of water resources and protection against floods and erosion, it is very important to take into account the different factors and the relationships between them when discussing the impact of forests.

In countries particularly affected by poverty and natural resource degradation, numerous projects have banked entirely on reforestation and afforestation to re-establish the water balance and guarantee secure livelihoods for the local population. In terms of water management and by comparison with conservation of natural forests, however, reforestation and afforestation often do not produce the expected results, as it may take a very long time before a reforested area has regained a high level of water infiltration and retention capacity. Apart from the ecological factors that can influence the functions of forests with regard to water, it is also essential to integrate the role of forests and their multifunctionality from a socio-cultural and economic perspective.

Multifunctional management: a variety of contexts and approaches

Multifunctional forest management

Multifunctional forest management is not a new approach: it covers dimensions neglected by the era of dominant timber production. Efforts must be made to rediscover multifunctional forest management and apply it once again, after adapting it to current conditions. History tells us that this form of management is the origin of the interaction between human beings and forests in industrialised countries, and that it is being applied by many societies around the world. Forest ecosystems provide a vital source of food, energy, medical products, and additional income for deprived populations, especially for those living close to forest areas.

Forest policies are undergoing radical change worldwide. Forest laws are being modernised and forestry organisation (administration, training and research) is often subjected to fundamental change. These modifications at the global level are frequently linked to social and political change: they show how important the role of forest and tree resources is for populations worldwide. (Sorg, 1999)

International organisations now consider the multifunctionality of forests as a potential that can be tapped to alleviate poverty, improve living conditions, enhance opportunities for communities, contribute to sustainable natural resource management, and conserve the diversity and vitality of unique ecosystems, with a view to preserving the interests of human beings in the long term. In the past few decades, international development cooperation has promoted participation of local communities when applying multifunctional management. Indeed, these communities are the main ones concerned by the use of forest resources and forest services; moreover, they often apply multifunctional management in a traditional manner.

National Forest Programmes (NFPs)

NFPs were developed following the Rio Summit. They consist of a common basis of elements that must be part and parcel of every sustainable forest management programme, and of a wide range of approaches for the development of national policies, including preservation, use, and equitable sharing of forest resources, while taking account of the specific priorities and needs of the given country. NFPs are frameworks for the implementation of concrete actions. The United Nations Forum on Forests (UNFF), created in 2000, has the task of promoting and facilitating the implementation of proposed actions.

However, NGOs have taken a somewhat critical attitude, as they fear that the programmes may focus too strongly on afforestation without analysing the local socio-cultural, ecological, and economic settings, leading to a regression in the application of the concept of multifunctionality. The lack of integration into other fields of action such as biodiversity, the absence of transparency, and the lack of precision with regard to participation are also criticised. In addition, for the time being the UNFF seems more involved in dialogue than in taking action.

Adapted from http://www.fern.org/pages/unff/ipfiff.html

Box 4

Multifunctional management must be anchored at the local level and should therefore be facilitated by a political system that acknowledges the multiple interactions and assists local management through adapted and competent institutional structures.

Community forestry movements

In the past few centuries, the economic focus on timber production led most governments to intervene in forest management and change the status of land ownership. This in turn led to loss of the sense of responsibility and to abandonment of local multifunctional management systems, which were often declared illegal or submitted to state regulations without prior consultation. In Nepal, for example, the government passed a law to nationalise private forests in 1957. All private forest plots, often managed by the local population, became national property. The enactment of the new law led to a dramatic increase in deforestation. Indeed, to avoid losing land, local communities simply transformed their forests into cultivated land.
(Upreti, 2003)

Such centralised policies have been strongly questioned in the past few decades. Thus, in the 1970s, the fuelwood crisis and increased land degradation, especially in semiarid areas, led the FAO and the World Bank to revise their policies and focus more concretely on the potential of local communities to take on 'forest stewardship'. What we need to focus on even more closely today than multifunctionality – what we need to rediscover – is participation by those directly concerned in development and management of forest resources (Müller & Sorg, 1995). After the publication of "Forestry for Local Community Development" (FAO, 1978), numerous documents aimed to reveal the vital role of trees and forest resources for communities living near forests. A number of projects were initiated, especially in developing countries.

When the community forestry movement began, efforts aimed mainly at afforestation in order to respond to the crisis of fuelwood of the 1970s. Projects concentrated only on the planting of trees and simply forgot to think about management of existing and newly planted forests. Moreover, they did not sufficiently take into account the local population's real needs. Only in the 1990s did community forestry adopt a more integrated approach that took account of local perceptions and uses, interactions between forests and neighbouring agricultural land, links with markets and the economy, and the need for awareness raising programmes, training, and a more active participation of the local population. However, although community forestry activities exist and evolve as effective tools of locally driven development, Djeumo (2001) mentions that "a multitude of community forest initiatives with locally limited objectives may turn out as islands in an ocean of forest resources". He then suggests that long-term and integrated participatory approaches are necessary, as community forests are only part of a larger whole. Recently, community forestry has also focused on conflict management, economic incentives for forest conservation (systems for payment of environmental services, for example; see Chapters 5 and 6), the issue of user rights, and the establishment of an adequate political, legal and institutional framework.


B. Upreti

Public awareness building.

The Nepal Swiss Community Forestry Project (NSCFP)

In Nepal, the community forestry movement emerged based on the new national forestry plan of 1976, which aims to integrate local people into forest management. Forest user groups have enjoyed legal status and the rights to exploit and commercialise forest products since 1993. The "Nepal Swiss Community Forestry Project" (NSCFP), supported by SDC (Swiss Agency for Development and Cooperation), was launched in 1990 to respond to government policy at the time. At present, the project is in its fifth phase and focuses on the social and economic development of forest user groups.

Some results:

- Improvement of community forestry both at the local and national levels;
- Participation of local institutions, NGOs, and the private sector as facilitators of micro projects;
- Research on and development of new methods and practices of sustainable forest management, based on the local ecological, socio-cultural, and economic context;
- Consolidation of participatory approaches through training programmes for local people involved in forestry and agroforestry;
- Introduction of intercropping (cardamom, ginger, bamboo, etc.) to relieve particularly poor population groups;
- Active integration of women in choice and decision making, reduction of their workload, and development of training programmes for women.

Critical issues:

- The project has not integrated the aspect of sustainable management practices for non-timber forest products and services;
- Enhancement of the income of local users has not reached the declared objectives;
- Local service providers remain too dependent on the project financially, which keeps them from developing their own strategies to diversify sources of funding and build the capacity of their own institutions;
- Efforts must be made to enhance transparency at all levels of interaction within the project;
- Intersectoral cooperation (e.g. between the water and forest sectors) is not being implemented.

Box 5 Case Study 3: Institutional context of Community Forestry and public perception of the forest water relationships in Nepal. (B. Upreti, King's College, London, February 2003)

Implementation of a community forestry project must take into account the needs of the people who depend immediately on forest resources, as well as the means that these people already have to apply a sustainable form of resource management, including existing forms of local organisation.

Agroforestry systems

Forests are an integral part of broader natural resource management systems in many contexts, e.g. in agrosilvopastoral or agroforestry systems. In such systems, the use and handling of trees, crops and/or livestock are combined in all land management techniques applied. Agroforestry is not limited to crop cultivation in forests or silvopastoral use: it covers a much wider spectrum of systems to develop and manage land and natural resources. In these systems, components of trees as well as shrubs contribute to improving ecological and socioeconomic conditions in an area. Orchards, hedges, groves, copses, and riverine forests are good examples of such contexts.

Just like community forestry and multifunctional forest management, agroforestry is an age-old practice. It has been investigated by scientific research for the past twenty years, as it has very attractive potentials for development. It is a production system capable of adapting to demographic pressure as well as to increasing pressure on cropland, making it possible for farmers to avoid using slash-and-burn in new areas. Moreover, combining crops, livestock and trees leads to more diversified and increased production, thus offering additional food security. This is particularly useful in subsistence farming. Finally, agroforestry techniques use natural resources more sparingly and are better adapted to fulfilling sustainable development goals.
Though it has many advantages, agroforestry is not a universal remedy in fighting against demographic pressure, world poverty, and degradation of resources. The fact that agroforestry land use systems are very specific to a particular place makes it difficult to elaborate a model adapted to all situations. While there are numerous scientific studies on biophysical aspects of land use techniques, little information exists on the institutional, administrative, political, and socioeconomic aspects that constitute the framework within which agroforestry production systems are embedded. The distinction between agriculture and forestry, which is the result of laws established very long ago, is a major obstacle for agroforestry projects. Agriculture and forests are considered to be competing forms of land use and the administrative units that deal with them are rivals. Currently, the best results are achieved when agroforestry is applied at the level of individual farms. Concrete implementation is also constrained by problems related to inequitable distribution of land, disorganised product distribution and commercialisation networks, lack of rural infrastructure, and broader development issues at the national level. At the local level, a major problem is the difficulty of making farmers accept a new form of production that does not necessarily correspond to his or her cultural, social, and economic values.

The *Grevillea* agroforestry system in Kiawanja catchment, Kenya

H.P. Liniger

***Grevillea* boundary planting.**

Grevillea robusta, commonly known as "Silky Oak", originates from Australia and was introduced from India to Eastern Africa in the early 20th century, as a shade tree and wind break in tea and coffee plantations. It has gained increasing popularity since the 1970s and is now the most common agroforestry tree in small farms.

In the Kiawanja catchment of Nembure division, Embu, Kenya, the climate is sub-humid, slopes are steep, and soils erodible. Small-scale farmers subsist on rainfed continuous cropping, but removal of vegetation cover and continuous cropping over many years have led to severe land degradation and decline of soil fertility due to water erosion. Farmers introduced *Grevillea* along farm boundaries and on terrace risers in order to improve ground cover and soil moisture, reduce wind velocity, and control downstream flooding and siltation, as documented by WOCAT (World Overview of Conservation Approaches and Technologies). Additionally, the trees provide farmers with fuelwood, building materials, fodder and shade. They also have an important ornamental value.

The acceptance of the new technology by land users in the Kiawanja region is high, and the planting of *Grevillea* is supported by the Ministry of Agriculture Extension Office and several NGOs through the financing of tree nurseries.

Although the benefits of *Grevillea* are many, it is important to also mention its weaknesses and disadvantages, in order to improve the method in future:

- planting *Grevillea* on a farm leads to increased labour; this activity may conflict with other activities;
- the space occupied by *Grevillea* is lost for cropland;
- the trees compete with the crops for sunlight and water;
- the leaves used as fodder have to be mixed with additives to improve palatability and digestibility;
- the purchase price of seedlings is high;
- boundary conflicts emerge due to shade cast by *Grevillea* upon neighbours' crops;
- this technology helps combat soil erosion efficiently only if it is combined with additional measures such as mulching (with leaves from *Grevillea*) or bench terraces.

Source: World Overview of Conservation Approaches and Technologies: www.wocat.org
Contact: J.M. Mwaniki, Ministry of Agriculture and Rural Development, Embu, Kenya.

Box 6

Agroforestry reconciles forests and cropping areas; it also offers further possibilities of taking advantage of the multifunctionality of forest elements. It requires efforts from the resource users themselves as well as adaptation and collaboration at the level of community, regional, and national agricultural and forestry policies, with a view to efficiently and sustainably supporting this form of land management.

Sustainable management of natural resources

In order to avoid signing away the future of the next generations, we need to live on the interests yielded by nature and not on its capital. (Baumgartner, 2004)

Forests function as open units with regard to human use as well as to other natural resources. Forest management has an impact on water, soils, biodiversity, and climate. Forest services and the numerous interrelations between forests and other natural resources are a boon not only for people living in and near forests, or who practice agroforestry; they are also very beneficial for a region as a whole. To guarantee the continuation of natural functions and services in the long term, multifunctional management of forests and agroforestry systems must be perceived as comprehensive management of natural resources.

Resource use is sustainable if specific types of use in a particular ecosystem are considered reasonable in light of both the internal and the external perspective on natural resources. "Reasonable" in this context means that all actors agree that resource use fulfils productive, physical and cultural functions in ways that will meet the long-term needs of the population affected. (Group for Development and Environment, 1995)

This definition of sustainable resource use shows that it is not possible to determine the exact nature of 'sustainability'. The use of the concept can only reflect an approximation: the sustainability of forms of resource management and the assessment of resources themselves are the negotiated result of a socio-political process.

Simultaneously, this definition contributes to formulating the conditions under which it is possible to combine external and internal perspectives, while seeking and developing better and more sustainable solutions. The following are key principles in the negotiation process:

- All functions – biophysical, economic, and cultural – of resources must be explicitly negotiated and acknowledged;
- All stakeholders must be in a position to voice and defend their viewpoint;
- Possible choices and their consequences must be assessed as precisely as possible, a process that is supported by bringing together external and internal perspectives on resources.

Until now, important development policy decisions especially at the macro level have not sufficiently taken into account existing conditions in rural areas. Ideally, all actions necessary at all levels must be based on concrete situations in the local context. In particular, the local population's knowledge and ideas about sustainable natural resource use must be taken into account. In many cases, improvements of natural resource management require modifications in all institutional realms, and must address all levels of action and all sectors in a community, in a "transversal" way, so to speak.

From theory to practice: the difficulty of applying integrated natural resource management

Agenda 21, Chapter 11 – Combating Deforestation, Rio Conference, 1992:

There are major weaknesses in the policies, methods and mechanisms adopted to support and develop the multiple ecological, economic, social and cultural roles of trees, forests and forest lands. Many countries are confronted with the effects of air pollution and fire damage on their forests. More effective measures and approaches are often required at the national level to improve and harmonize policy formulation, planning and programming; legislative measures and instruments; development patterns; participation of the general public, especially women and indigenous people; involvement of youth; roles of the private sector, local organizations, non-governmental organizations and cooperatives; development of technical and multidisciplinary skills and quality of human resources; forestry extension and public education; research capability and support; administrative structures and mechanisms, including intersectoral coordination, decentralization, and responsibility and incentive systems; and dissemination of information and public relations.

Twelve years after Rio, policies, methods, and mechanisms are still unsatisfactory, especially at the level of institutions, administrative structures, and intersectoral collaboration.

In local rural contexts, where populations depend directly on resources at hand, and where maintaining the various functions of ecosystems ensures livelihood security for entire communities, local knowledge often guarantees that multifunctionality and the interrelation between different natural resources are acknowledged.

The complexity of reality, which is obvious to the local population, is not reflected in national political and institutional structures; this is a major problem. Priorities are often strongly determined by particular interests at the political and economic levels, and conflict with the interests of the rural population, as illustrated by the timber trade, tourism, and the creation of natural reserves. The gap between local reality and institutional, legal, and administrative reality hampers the implementation of integrated and sustainable natural resource management or sometimes even aggravates the situation by triggering social conflicts.

One example is the issue of water allocation within a basin: management of natural resources upstream (water, forests and farmland, etc.) can have positive or negative consequences for the population downstream, especially for those who also depend directly on natural resources. In the absence of a clearly defined legal framework that takes into account all the actors concerned, conflicts due to problematical upstream–downstream interactions can emerge very quickly.

Basin (or watershed) management implies management of several different natural resources (water, biodiversity, soil, vegetation, microclimate). In many countries, however, the water, forest, agriculture, and environment sectors function as independent units, be it in terms of research, administration, or any other institutional form. Intersectoral collaboration is insufficient. Other factors further complicate and impede integrated management, e.g. dominant economic interests, power conflicts, inappropriate legal frameworks (inequitable allocation of land, uncertain land ownership and user rights), and population growth. Under such conditions, the first to suffer are always the most deprived social groups.

Water user associations and forest user groups in Nepal

In Nepal, the government promotes community management and the local population has the possibility of associating in legally recognised units such as forest user groups or water user associations. This gives them equal access to these resources. The community has a perception of natural resources as an interlinked system. Indeed, the local population, more and more frequently exposed to water shortage, confirms that the forest contributes to improved water availability, and manages the two resources in a manner that ensures the maintenance of functions that are vital for nature and human society. The boundaries between local organisational units concerned with water and forests are thus blurred when placed in a concrete context. By contrast, the local organisations' national representations, i.e. the "Federation of Irrigation Water Users Associations" and the "Federation of Community Forest Users", function independently from each other. Policies are still far too sectoral, hampering or even preventing integrated activities at the local level and, consequently, an evolution towards sustainable management.

Adapted from Upreti B., 2003.

Box 7 **Case Study 3: Institutional context of Community Forestry and public perception of the forest water relationships in Nepal. (B. Upreti, King's College, London, February 2003)**

Sustainable management of natural resources requires important changes in a country's policies. This includes a reorientation from sectoral approaches towards an integrated participatory approach, involving the following steps:

- **Establish links between the different sectors through a participatory approach based on the needs and means of those involved, and allocate responsibilities carefully and adequately;**
- **Modify property legislation in a way that enables sustainable resource management by creating ownership and taking into consideration traditional rights and regulations, and giving special attention to the most disadvantaged population groups;**
- **Establish training programmes to enable competence and capacity building in sustainable management of natural resources;**
- **Promote horizontal (i.e. within sectors) and vertical (i.e. from local community to national government) collaboration;**
- **Enable information and education for local populations, as well as integrate field experience in national and international policies;**
- **Support integrated applied research and interdisciplinarity;**
- **Create discussion and negotiation platforms;**
- **Support methods that show the value of natural resources and their services and favour those who help preserve them through institutional rules and methods for compensation and payment for environmental services, for example. These methods are discussed in the following chapters.**

The need for appropriate resource management regimes

The multiple functions of forests generate a variety of environmental goods and services that are of considerable value to society. This value increases in the face of increased pressure on natural resources. There are many forms of resource management, and resource managers and owners have a critical influence as providers on the generation of environmental goods and services from these resources. Similarly, users of environmental goods and services whose livelihoods and development depend on these goods and services, need to be able to influence the definition and operation of resource management regimes.

Economists distinguish between *use values* and *non-use values* of environmental goods and services. Figure 2 describes the total economic value of natural resources as consisting of a variety of values of different nature.

The reason why many resources that generate environmental goods and services do not have a price is that either exclusion from consumption is not possible, or property regimes are ill defined. Multifunctional natural resource systems thus disintegrate into open access systems or ill-managed common property resources with many users but no owner who, by virtue of a defined ownership, is responsible for the management of the resource. Moreover, in the absence of a price for a resource, signals of scarcity are not transmitted and resource users do not adjust their consumption. As a result, there is often no incentive to modify management regimes in order to ensure a sustainable generation of environmental goods and services.

Many countries are faced with a dwindling natural resource base. Over the last two decades, structural adjustment programmes

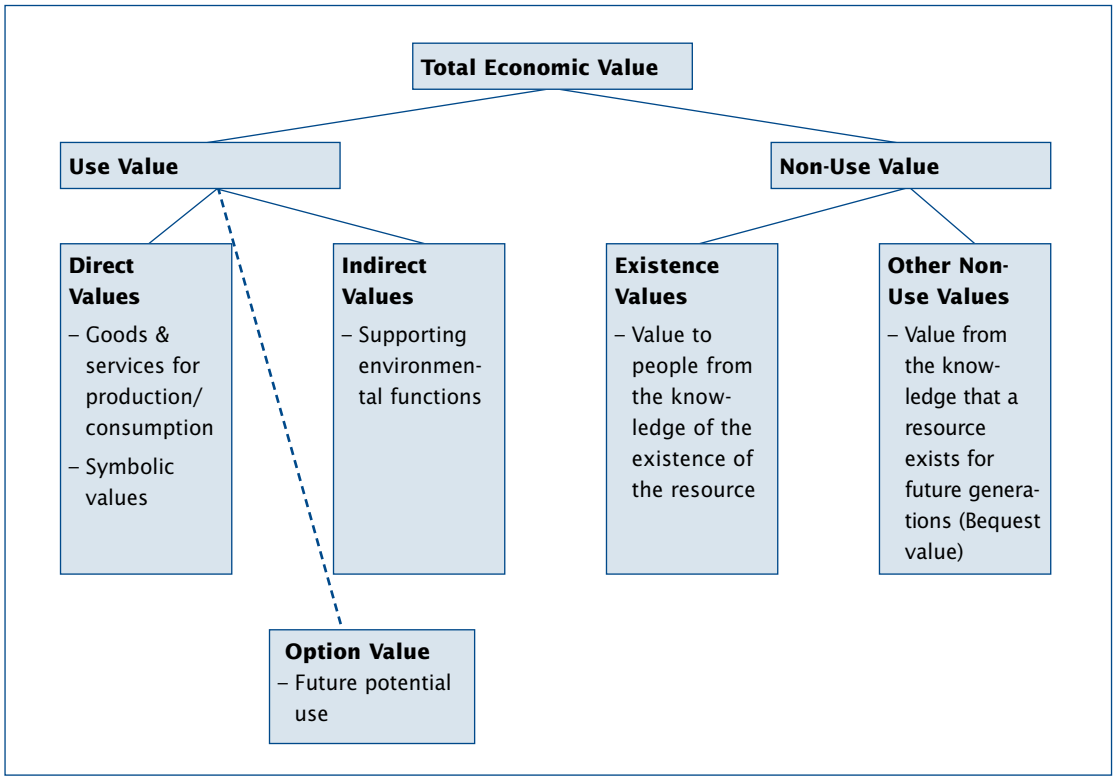


Figure 2 **Total economic value of environmental goods and services (adapted from German Advisory Council, 2001).**

in such countries have increasingly prescribed economic mechanisms to tackle, among others, problems of resource degradation and management, in an attempt to set up appropriate resource management regimes.

While the term 'market' is frequently at the centre of international debates, the creation of markets for environmental goods and services does not necessarily imply that markets are created in which supply and demand shape prices, and market actors are fully informed and unprejudiced. In the context of this early debate on PES, markets have been defined as exchange platforms where demand for environmental goods and services is expressed as a value for which either payment or another form of compensation is given.

How can markets be created for environmental goods and services provided by natural resources? By and large, such goods and services from the forest / water complex are considered to be global, public, open, free – i.e. they carry no price tag as yet because the majority of them are perceived as unlimited and unconditionally available 'gifts of nature'. Thus, current perceptions of public goods and services do not readily agree with a need to pay for environmental goods and services.

Systems of payment for environmental services (PES) involve monetary exchange, whereas systems of compensation for environmental services (CES) involve in-kind exchange. Both systems are based on identified and quantified environmental values. They attempt to transfer some of the benefits enjoyed by users of environmental goods and services to those who ensure the provision of environmental goods and services through their ownership and/or management. As a result, the returns for service providers increase, and so does the incentive for resource conservation (Pagiola et al., 2002).

The PES/CES approach suggests that such transfers should take place on exchange platforms that have a market character. This seems a valid suggestion because economic theory has shown that, in situations of scarcity, a higher price is a mechanism that induces actors to adapt use of resources according to their scarcity (Rosales, 2003).

Externalities

Economic theory recognises the problem of externalities. The British economist A.C. Pigou describes an externality as 'costs imposed or benefits conferred on others (as the result of an activity) that are not taken into account by the person taking the action' (Liberty Fund Inc., 2004). To discourage activities that cause negative externalities, Pigou advocates a tax. To encourage activities that create positive externalities, he advocates a subsidy. These are referred to as Pigovian taxes and subsidies.

Cornes and Sandler (1996) describe an externality as an 'uncompensated cost or benefit'. Negative externalities involve a misallocation of resources. This constitutes a loss for an economy and weakens its potential to support socioeconomic development.

Economic theory advises to attempt achieving efficient levels of resource allocation, referred to as 'Pareto optimality' (after Vilfredo Pareto). In this stage of optimality no more wealth or resources can possibly be reallocated without making someone in that particular society worse off. From this point of view, resource use that creates externalities which are not compensated, i.e. make someone worse off, impairs economic efficiency.

Externalities in resource management emerge when:

- External costs and/or benefits of a particular resource management activity for other actors are not known and can therefore not be valued;
- Economic reality attempts to avoid costs wherever possible;
- Existing institutional structures largely prevent externalities from being recognised;
- The predominant economic paradigm only insufficiently takes into account effects beyond immediate economic values.

Sukhomajri, India: Externalities in a watershed

During the 1970s, an artificial lake in the Indian city of Chandigarh suffered from gradual siltation that affected its recreational and aesthetic value.
The silt originated from a degraded area in the upper watershed. The community to whom the area belonged had abandoned this land, as the common property management regime of the village had broken down for a variety of reasons.
The impact of not managing a resource in a sustainable manner, therefore, manifested itself as an externality in another location (loss of the recreational and aesthetic value of a lake).

Who was responsible? What was the value of the damage? Were there legal and institutional mechanisms that would have prevented the damage from taking place? In the absence of price signals, what mechanisms might have alerted both the victims and those who caused the externality?

Box 8 **Case Study 4: Sharing the benefits of watershed management in Sukhomajri, India. (John Kerr, Michigan State University, November 2003)**

Internalisation

Internalisation ensures that resource managers who create negative externalities are induced to internalise the costs of their action in their cost accounting. In the case of positive externalities, internalisation means that users of positive externalities indemnify providers. With regard to forest services, *'the issue is to make users (of forest environmental services) pay for forest services'* (Zumstein, 2003).

Internalisation of social costs is a concept from political economy and finances. It involves the attribution of external effects and related social costs to those who cause them. In general, internalisation is achieved by making social costs incurred by the general public part of individual economic calculations. In economic theory, internalisation is the theoretical basis for environmental policy measures. The aim is to have a pricing system that makes those who cause environmental pressure pay for the costs incurred, and forces them to integrate these costs in their calculations (polluter-pays principle); (Sellien and Sellien, 1993; translation by CDE).

Critical aspects of internalisation

While each case requires specific internalisation procedures, the following are overall critical issues with regard to internalisation:

- Identifying the value of a specific externality: though this is a difficult task, a range of valuation methods exist (see Table 2);
- Understanding the legal, institutional, and administrative structures and processes that govern resource use;
- Identifying entry points for internalisation of externalities in existing structures and procedures, with the aim of establishing a system of payment for environmental goods and services;
- Based on clearly defined property rights, designing market-like exchange mechanisms that operationalise payment / compensation mechanisms.

The following listing and brief explanation of valuation methods serves as an overview. These methods are not mutually exclusive, and more than one method may be applicable in a single situation. Further details about valuation methods can be found in OECD (1989), Winpenny (1991), and Champ et al. (2003).

Real cost method of valuation	Description	Example
Cost of damage	A method that quantifies damage caused to an environmental service.	Downstream groundwater levels are decreased as a result of deforestation upstream. Damage is caused to harvests downstream because they are affected by scarcity of irrigation water. Downstream industries may suffer production losses due to lack of process water.
Cost of averting damage	The level of preventive expenditure to safeguard an environmental service is indicative of its value.	Soil protection structures that aim to reduce runoff and increase water infiltration are typical preventive expenditures required in efforts to avert damage to environmental services.
Cost of repair	Costs generated by efforts to restore a damaged environmental function.	Costs of re-vegetation are typical repair costs.
Cost of compensation	Users of environmental goods and services request providers of such goods and services to adopt management regimes that ensure their continued generation. Compensation is based on the costs generated by adapting the management system.	Coffee farmers are compensated by downstream water users for a certain loss of production as a result of growing coffee bushes under shade trees. These trees are not cut by the farmers because they protect the soil and have a regulating influence on water retention and infiltration, which benefits downstream water users.

Table continued next page

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Preference method of valuation	Description	Example
Cost of travel and effort	The value people place on an environmental service is inferred from the time and costs incurred when travelling to it (Winpenny, 1993).	Costs that users are willing to spend to travel to locations with recreational value or scenic beauty. A deforested area loses this value, as users will not visit such a site anymore.
Hedonic pricing methods	No markets exist for environmental services. However, values for these services are indirectly inferred from the observable value of surrogate goods.	Decreased groundwater availability due to deforestation in an area reduces agricultural production capacity. This reduction is indicated by decreasing market prices for agricultural land.
Contingent valuation	The expressed willingness of users to pay for the continued availability of environmental goods and services is elicited using a range of survey and interview techniques as well as situational games.	Contingent valuation methods could be used to elicit the value attributed by users to the environmental services of recreation and scenic beauty. (See example of the lake in India, Box 8.)

Table 2 Real costs methods and preference methods as valuation tools for environmental goods and services.

Although progress has been achieved with valuation methods, a general problem of valuation remains: values for environmental goods and services in demand in concrete situations are often computed empirically and based on assumptions.

Valuation methods can help to identify values that are used to reflect real costs of environmental goods and services. However, it is necessary to keep in mind that the resulting prices are not formed on the basis of actual supply and demand.

The functional multiplicity of the forest / water context ensures the generation of goods and services that are valued either because they are consumed, because they exist, or because they regulate important biophysical processes. Natural resource management regimes are often based on economic parameters that do not take into account a range of environmental goods and services, thus leading to resource degradation on a large scale. PES/CES approaches in the forest and water context are based on economic instruments that attempt to identify values for environmental goods and services. On the basis of values identified, these approaches support various forms of internalisation of costs and benefits from environmental services into natural resource management regimes.

Payment / Compensation for Environmental Services (PES/CES)

The nature of environmental goods and services

Environmental goods and services are increasingly recognised as a value provided by environmental systems. These goods and services are benefits reaped directly or indirectly by human society from particular functions of ecosystems. Ecosystem functions are biological and ecological properties of both ecosystems and ecosystem processes that contribute to the functioning of the ecosystem.

Services can have a variety of characters:

1. Productive (timber and non-timber forest products: productive function);
2. Regulative (water cycle regulation, biodiversity habitats: physical functions);
3. Services to which no immediate tangible value can be attributed (scenic beauty, existence: cultural functions) but whose availability is required.

Market systems have evolved around the productive services of environmental systems (e.g. timber). The demand for timber has propelled the international timber trade into a global trade system.

This is not the case for other environmental goods and services provided by forests and not captured in a market system in the sense of an organised system of production and consumption. Such environmental goods and services are largely perceived to be free of charge, although their productive and regulative roles are often critical to productive and life sustaining processes. The unexpressed demand for such goods and services and the perception that they are simply 'given' have prevented the development of markets for them in the past. In addition, such environmental goods and services often appear on a wide spatial and temporal scale, making it difficult to establish clear cause-and-effect relationships and identify them as goods and services.

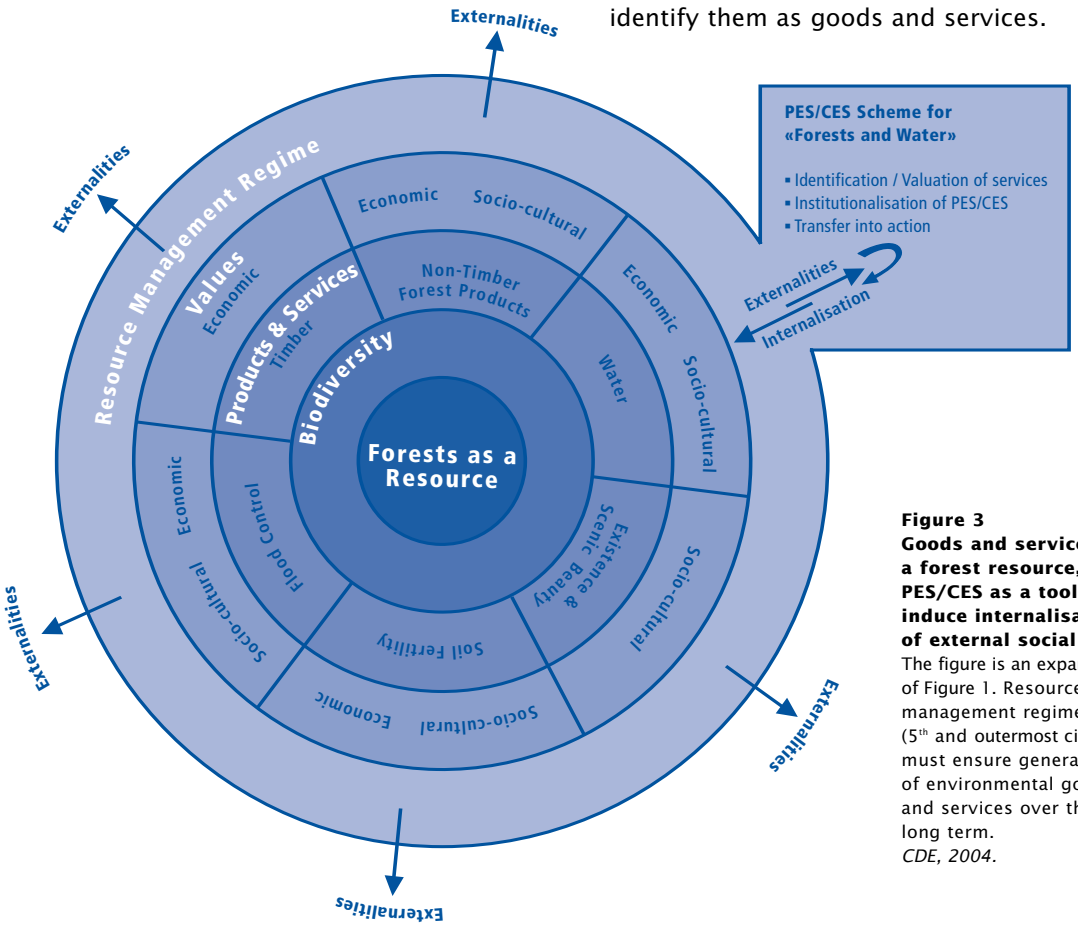

Figure 3
Goods and services of a forest resource, and PES/CES as a tool to induce internalisation of external social costs
The figure is an expansion of Figure 1. Resource management regimes (5th and outermost circle) must ensure generation of environmental goods and services over the long term.
CDE, 2004.

However, often resource management regimes generate considerable external benefits and costs (externalities) to society. Payment systems for environmental goods and services offer a tool to internalise these external social values and incorporate them into the overall accounting of the resource management regime.

The example presented in Box 10 describes a situation where a perceived aesthetic and recreational value is affected. The benefit of the externality that was endangered could not be directly quantified, as 'aesthetics' and 'recreation' were not tradable items. However, the cost of repair for the damages were known; the figures were used for comparison with the costs of permanent afforestation at source. Through afforestation of the source area, the city avoided further siltation.

Managing resources in a manner that ensures the generation of a multiplicity of environmental goods and services entails additional costs for the resource owner / manager. Users of environmental goods and services need to compensate those who restore environmental functions and manage the resources in a sustainable manner.

Looking back at PES/CES

A number of developments over the past two decades appear to have contributed to the development of the PES/CES approach:

Recognising environmental goods and services

An early example of institutional recognition of environmental goods and services dates back to 1888 in Costa Rica, when a decree was passed declaring a 2-km-wide strip on the sides of the Barva Volcano to be state-owned land, because streams and springs supplied drinking water to nearby towns.

However, communities that are associated closely with environmental systems (traditional indigenous societies, forest dwellers, and communities whose lifestyle entails a considerable dependence on environmental goods and services) tend to valuate natural resources in a more holistic manner. (Aylward and Rojas, 2003)

Box 9

Sukhomajri, India: PES/CES in a watershed context

As described in Box 8, the Indian city of Chandigarh, during the 1970s, was concerned about the gradual siltation of a lake that was used as an aesthetic site for popular recreation. Dredging the lake annually proved exorbitantly expensive (cost of repair). The source of the silt was identified in an upstream watershed area close to the village of Sukhomajri.

In consultation with the village, the Central Soil and Water Conservation Research and Training Institute (CSWCRTI) – a government institute – reforested the upper watershed around the village with the aim of rehabilitating vegetation and preventing soil degradation and runoff towards the city lake.

The village incurred certain costs during this rehabilitation process and consented to manage the areas in future in such a manner as not to induce soil degradation again.
While no payments for these costs were made in effect, the village did, however, receive compensation for (1) sparing the areas for a certain time and (2) their willingness to modify their management of the affected areas through reforestation of wasteland and development of water sources.

Box 10 **Case Study 4: Sharing the benefits of watershed management in Sukhomajri, India. (John Kerr, Michigan State University, November 2003)**

D. Maselli

Regeneration of the vegetation through improved resource management (afforestation and area closing) in a degraded area: Varzob Valley, Tajikistan.

- The **pressure on natural resources** has increased as a result of increased consumption, combined with national and international policies that encourage unsustainable use of natural resources.
- **Science** has progressed in establishing cause-and-effect relationships in environmental systems, making it possible to integrate scientific arguments in policy formulation (political acceptance).
- Recent **discussions and decision processes** have been aiming to ensure the continued availability of environmental goods and services.
- Many environmental goods and services are perceived to be public goods, but **public budgets** cannot effectively prevent the increased loss of such services. Public funds to restore lost services or to enact policies that prevent resource degradation are scarce.
- The increased importance of **participative approaches** in development within the past two decades has helped to focus development and policy intervention on people. Local populations who traditionally live in close relation to the natural environment are increasingly involved in management decisions about natural resources. Identification of providers and users of environmental goods and services has been given greater priority.

As a result, recent years have witnessed an increase in market-based approaches to address the problem of resource degradation (Pagiola et al., 2002). It is hoped that such approaches will provide incentives to guarantee the continued availability of environmental services through effective internalisation. This requires identification of providers and users, development of negotiation platforms, and creation of markets for environmental services, thereby generating funds for sustainable resource use while also supporting decentralised rural development.

Information about the impact of PES/CES systems has only recently begun to be documented. The most comprehensive study of the social impacts of payment systems for environmental goods and services to date has been carried out by Miranda et al. (2003) in Costa Rica.

Impacts of PES/CES in Costa Rica and Mexico

A study of the social impacts of the PES/CES scheme entitled 'Central Volcanic Mountain Range Conservation Area' in Costa Rica identified a number of positive impacts (Miranda et al., 2003). The PES/CES scheme compensated landowners financially and through other, non-financial incentives for the environmental goods and services that their forests and plantations provided society with. PES/CES payments helped to generate significant positive impacts on:

PASOLAC

Rural households can benefit from PES/CES payments.

- **Farm household budgets:** PES/CES payments received ranged between 4 and 34% of total household budgets.
- **Social assets** were generated through various institutional innovations required for the PES/CES scheme.
- **Human assets** were generated through environmental awareness creation and learning processes experienced by individuals and communities.
- **Natural assets** were generated by protection of primary forests, reforestation, and changes in sustainable forest management regimes.

Pagiola et al. (2002) report that the income of poorer households in Chiapas (Mexico) has been significantly boosted by payments received in compensation for growing coffee under shade trees instead of clearing the land for coffee production.

Box 11

Building blocks for PES/CES

The establishment of a payment system for environmental goods and services requires identification of the following important building blocks for a PES/CES system:

Recognition

1. A **concern** about the quality and availability of an environmental service needs to be developed.
2. Such a concern must be **expressed** by those concerned.

Identification / Valuation

3. Key **components** of environmental services need to be identified and described (scoping).
4. Specific environmental services need to be **described** and **quantified**.
5. Key **stakeholders** have to be identified.
6. Identification of service type, quantities, and involvement of stakeholders allows for a **valuation** of environmental goods and services.

Institutionalisation of PES/CES

7. Innovative resource management approaches require that legal, institutional, and administrative **conditions** be enabled.
8. An intensive process of awareness creation should contribute to building an effective **negotiation** platform. However, considerable social inequity in many developing countries may hamper effective negotiation.

Transfer into action

9. Mechanisms that regulate the transfer of environmental goods and services between providers and users **need to be agreed upon**. Who contributes to what extent to ensuring the provision of environmental goods and services? Who benefits to what extent from environmental goods and services, and how are payment / compensation mechanisms made functional?

Sukhomajri, India: Sharing benefits within a watershed community

In the Sukhomajri watershed (described in Boxes 8 and 10) the problem of internal distribution of the benefit that fell to the village in the form of a source of water quickly emerged; it was created as a compensation that the villagers were granted for their efforts to protect those parts of the watershed that generated the environmental service. Because villagers did not make equal contributions to watershed protection, a system of equitable access to the benefits was required in order to prevent the PES/CES agreement from falling apart.

U. Höggel

Dry season fodder as compensation in a watershed development programme.

Box 12 **Case Study 4: Sharing the benefits of watershed management in Sukhomajri, India. (John Kerr, Michigan State University, November 2003)**

10. Payments or compensation made to providers of environmental goods and services may be difficult to target in cases where environmental goods and services are generated within a common pool or open access context. Who contributes to what extent to the restoration or generation of an environmental service? Once payment or compensation is received, issues related to **distributional equity** may emerge and need to be addressed by the project management.

Driving factors for PES/CES

Growing concern about continued availability of resources contributes to the debate on PES/CES as an innovative resource management tool. A number of driving factors for PES/CES systems exist (Pagiola et al., 2002):

- A desire to ensure continued availability of environmental services;
- A desire to behave in an environmentally friendly way;
- Ethical concerns (individuals, groups, companies, governments);
- Public relation and marketing concerns (companies);
- Income generation (resource owners, farmers, local communities);
- Potential to relieve public budgets (to manage public resources);
- Concern related to the expected increase in future environmental legislation (need to devise cost-effective methods to comply with new legislation).

However, the mere existence of an environmental good or service and the demand for it do not mean that a market system will develop and ensure the continued availability of that service. A range of fundamental issues need to be addressed.

Prerequisites for PES/CES

A number of important aspects related to resource management in general need to be taken into account when designing a PES/CES system.

Property rights

Ensuring sustainable management of natural resources through a market for environmental goods and services requires a clear definition and allocation of property rights to natural resources.
While this demand makes sense in the context of PES/CES, the reality in many developing countries is quite the opposite.

Payments for forest landowners in Costa Rica

Forest management systems under PES/CES in Costa Rica are honoured based on 5-year contracts with landowners as contract partners. It is assumed that specific forest management operations contribute to the generation of certain amounts of water, the value of which is reflected by different per hectare payments for the contract period:

- US$ 550 for reforestation;
- US$ 320 for forest management;
- US$ 225 for forest protection.

Average payments, however, are less than the figures quoted above (Miranda et al., 2003).

Box 13

Property rights are ill defined; in the absence of political will and enabling democratic structures, a change is difficult to achieve (O'Driscoll and Hoskins, 2003).

Many authors agree that the question of property rights is very important (Pagiola et al., 2002; Kissling Näf, 2003). The inherent political sensitivity of the ownership issue could perhaps be addressed by broadening the legal definition of ownership, in the sense that a PES/CES approach does not rest exclusively on a rigid definition of property. Rosa et al. (2003) advocate an expansion of user rights and call for a broad understanding of rights, one that breaks down traditional property rights into rights of access, withdrawal, management, alienation, and exclusion. However, according to the economist Coase, the question of explicit property rights is somewhat less important, as long as parties – e.g. polluters and victims, or providers and users – succeed in engaging in effective negotiation that leads to agreements on prices/compensation to be paid (Helm and Pearce, 1996).

Market creation

Besides the traditional value of forests as a source of timber, forests as a resource generate a multitude of services that have value for people. The challenge of developing a PES/CES scheme is the creation of a market-like economic exchange platform, in the hope that such markets will give signals about scarcity of resources and services, as a result of which resource management would adopt a stronger 'conservation' approach. Market mechanisms for environmental goods and services require that property rights for these goods and services be assigned. It is only on the basis of such assigned rights that two parties can enter into a negotiation process. Negotiation will focus on what a provider receives for ensuring the continued availability of a resource and its services. The negotiation process is a core element of PES/CES schemes.

During the start up phase, markets require a core fund to finance initial operations. As PES/CES projects are not bankable at present, the task of creating such a fund remains with governments, international NGOs, or a variety of donors. These often assume the role of market actors who initially make payments for environmental goods and services in an effort to stimulate the market.

U. Höggel

Negotiation as an important prerequisite for PES/CES.

Importance of information and awareness

"... another lesson learned is that it is necessary to have high environmental awareness in the community. The continuing success of the LK (local watershed protection group) may be rooted in the recognition of the members themselves of the watershed environmental service. One of the LK's major tasks is to implement a continuing information and education campaign of the benefits of protecting the watershed among the residents of Balian. These have always emphasised that constant dialogues and lectures with their constituents cannot be compromised..." (Rosales, 2003)

Box 14 Example from a community watershed protection programme in the Philippines.

Negotiation

It is often the demand for a service that brings users of an environmental good or service to negotiate with providers. Especially in situations where markets for a certain service are new, the process of negotiation needs to be facilitated.
A considerable amount of pre-operational information is required to gain the confidence of market actors:

- In ideal cases, the value of the service in question is known and agreed upon;
- In most other cases the negotiating parties first need to identify the service and attempt to valuate it. They may need external support to assist with valuation methods.
- Actors in emerging markets need to be clear about their roles.
- After having reached a common understanding and equipped themselves with information and institutional support, market actors may attempt to negotiate a value for the service created. It is important that by the end of the negotiation process, the value of the demand for a service is expressed either through direct payment or some form of compensation flowing back to the resource owners, inducing them to manage the resource according to scarcity and demand.

While economic and biophysical analyses are important, in the final instance it is the negotiations between the actors that define how much will be paid for a specific service (Haldimann and Stadtmüller, 2003). The apparent necessity of giving an economic value to a service is therefore somewhat relativised. It appears that negotiation systems as a basis for PES/CES services might become more important than strict value-based market systems.

Information

Information, the right to information, as well as access to and quality of information vary greatly between countries and contexts. In many developing countries, a considerable lack of information exists. In the context of PES/CES, the following aspects of access to information are important:

- Actors need to be aware of new approaches to resource management;
- Actors need to be able to retrieve relevant information from a variety of sources;
- Actors need to be aware of what issues must be addressed;
- Information must flow unrestrictedly within and among the actor groups. This is particularly significant with regard to equity, especially gender equity.
- Institutions and the administration must provide all actors with relevant information in a forthcoming and transparent manner.

Valuation of services

Economic valuation

The valuation of environmental goods and services is a central element of PES/CES schemes.
The creation of markets for environmental goods and services requires that a price or a proxy price for the service is available. A multitude of valuation methods have been developed and are constantly being refined (see table 2 pp. 25-26 for a description of selected valuation methods). Advancing scientific knowledge about environmental

Valuating environmental goods and services, incorporating multiple views

Proctor (2002) describes a multi-stakeholder process in Australia that attempts to generate a scale of values for environmental goods and services using a jury of citizens who, in a multi-criteria decision process, run through a number of methodological steps:

- Development of scenarios and objectives;
- Selection of criteria;
- Weighing of criteria;
- Evaluation of scenarios.

It is expected that by the end of the process, stakeholders adhere to the scale of values.

Box 15

cause-and-effect relationships has contributed to the development and refinement of a range of valuation techniques. Similarly, the role of traditional indigenous knowledge may assume increased importance in efforts to identify and valuate environmental goods and services. Indigenous knowledge of interrelations, effects and causes in the living environment can be a critical input in an effort to identify values for environmental goods and services.

Integrated valuation

Opposition to the PES/CES idea exists, as it attempts to attribute monetary value to environmental goods and services although a number of such services may be difficult to monetise. Another school of thought proposes broadly based approaches as tools for an integrative learning process aiming to arrive at values for environmental goods and services (Constanza and Tognetti, 1996). Rather than quantify the service in question in monetary terms, such approaches aim to generate a value scale, based on which all stakeholders in the area enter into negotiation about mutual contributions towards securing the environmental service. This is a very intensive social process.

Both approaches – economic valuation and integrated valuation – place the value of environmental goods or services at the centre of interaction involving those who use such goods or services and those who critically influence their availability through natural resource management.
The economic valuation approach uses the price or an in-kind equivalent as the medium of exchange, whereas the integrated valuation approach relies on the definition of common environmental values, generated through an intensive interactive process.

It remains to be seen whether market exchange of environmental goods and services generates sufficient signals and incentives to adapt management regimes. Another open issue is whether the integrated valuation approach is practical over wider distances.

Up-front costs

Given the novelty of the PES/CES and the need for information and awareness creation, fairly considerable up-front costs occur and may be a limiting factor. Such up-front costs are needed to finance market establishment, generate information,

Up-front costs of PES/CES in the Virilla watershed, Costa Rica

Miranda et al. (2003) describe a range of indicators of positive impacts in a PES/CES scheme in the Virilla watershed in Costa Rica. One must, however, acknowledge that the intensive process of starting PES/CES schemes entails considerable costs – especially in terms of human and social assets.

Box 16

Opportunity costs of changing management regimes

Experience from watershed development projects in India shows that the upper tracts of watersheds are usually inhabited by poorer segments of the community. It is those upper tracts in a watershed that have a critical influence on the downstream water balance. PES/CES suggests that downstream farmers request upstream farmers to modify their land management practices because the water as a service enjoyed by downstream farmers is valuable to them. But as upstream farmers are resource poor, in many cases they may not be able to afford a shift in land management practices because of inherent costs (need for more inputs; reduced use intensity; closure; increased risk; etc.). In such a case, the opportunity costs for upstream farmers of altering land management practices may be higher than the value of the 'water' service for downstream farmers. A PES/CES system can therefore not be implemented in such a case. (Indo Swiss Goat Development Project, 1991)

Box 17

and stimulate the necessary social processes. Costs associated with legislative changes at the national level, modification of institutional and administrative functions, awareness creation, and information generation and sharing are considerable.

Opportunity costs

The idea of PES/CES implies that providers of environmental goods and services are either paid or given compensation for the additional costs of adapting their management of resources.

However, changing management methods to make them more sustainable entails costs and risks, and payment or compensation offered may be lower than the cost of change. Providers may not be willing to change their resource management under such conditions. Indeed, for providers 'no change' is a cheaper and less risky opportunity that they lose by changing the management regime. If the cost of the lost opportunity is higher than the compensation/payment received, more sustainable resource management through PES/CES will not be achieved.

A similar problem exists in areas where markets other than the environmental goods and services market have generated a high demand for land and other natural resources. Markets for environmental goods and services may not be able to compete with these other markets, and conservation may not be achieved. For example, in a watershed context the balance between the value of water to downstream users and upstream opportunity costs of changing management systems is a critical issue. Environmental markets are more likely to function if downstream benefits from environmental goods and services are high and upstream opportunity costs of sustainable management regimes are low. They may not function in the opposite case. If both downstream benefits and upstream opportunity costs are high, the potential for an environmental goods and services market is unclear (Pagiola, 2002).

Important actors

The chances that a PES/CES approach is used as an innovative tool in resource management depend critically on the support of key actors and stakeholders at different levels.

Legal level

PES/CES as an instrument to achieve sustainable resource use may require considerable modifications of an existing legal framework (see on Property rights).
The people, governments, development agencies, and other stakeholders and actors need to generate sufficient will and momentum to enable a favourable adaptation of legal conditions for PES/CES. An ability to critically reflect on existing legal frameworks, sufficient insight into legal mechanisms and opportunities for change, and the ability to ward off unwanted party political influences are important qualities of actors involved.

Legal adjustments for PES/CES in Costa Rica

Concerned by dwindling forest resources, the Government of Costa Rica started creating incentive systems for resource conservation in the 1970s. These systems were largely based on tax rebates.

By the time a fully fledged PES/CES scheme was developed in Costa Rica, the country had already established an elaborate system of payments, incentives, and institutions for forest management and reforestation. In addition, two important legal changes were now successfully enacted:

- The Government changed the justification for payments in the Forest Law from 'support to the timber industry' to 'support for provision of environmental goods and services';
- The Government changed the financial source for environmental payments from regular Government budgets to an earmarked tax from users of such services.

(Pagiola, 2002)

Box 18

Institutional level

Legal provisions are typically facilitated by institutions that frame Rules based on Acts. While land laws secure ownership, the existence of local customs and practices (usufruct, management) often exerts a decisive influence on how legal provisions are interpreted and resources managed. Therefore, the development of a PES/CES system needs to take place in a participative and transparent manner, taking local conditions and their relevance to resource use in the PES/CES context into account. Rosales (2003) suggests that markets for environmental goods and services can be created if institutional mechanisms exist that are both community based and part of the local culture. Institutions that facilitate such processes are important factors in operationalising PES/CES schemes. In particular, institutions need to play a facilitating role in a few critical areas:

- In framing of rules to enact legal provisions;
- In facilitating the operational design of PES/CES schemes;
- In establishing functional links to other institutions concerned with legal, financial, and social matters in a society.

Institutional actors for PES/CES in the Philippines

In 1992 the Government of the Philippines established the National Integrated Protected Areas System (NIPAS) through a legal Act.

- One of the features of the Act is the establishment of an Integrated Protected Area Fund (IPAF).
- Another feature is that NIPAS empowers the Secretary of the Department of Environment and Natural Resources to "fix and prescribe reasonable fees from any user deriving benefits from protected areas".

(Rosales, 2003)

Box 19

Management level

At the management level, legal provisions are translated into practice within the overall institutional framework.

Well-functioning local relations between communities and the administration enable the latter to generate local support for changes, and bring important local actors at various levels into critical discussion and a negotiation process. Administrators, local management, and the government therefore have an important initialising role in PES/CES.

The quality of local contacts and the prominent role of local administrations can, however, also be used to disqualify innovation. This danger exists because PES/CES requires modifications of property rights and/or management regimes in many cases. Requirements for change in these areas are not easy to implement, and projects are challenged to initiate discussion with all actors and involve them in decisions that respect local perceptions and values.

Local actors in the management of PES/CES systems

Joint management by water boards, municipalities, and representatives of the communities decreases the risk of PES/CES systems collapsing in the event of replacement of local authorities as a result of elections, etc.

Box 20 **Case Study 5: PASOLAC – Introducing payments for environmental services in a sustainable land use programme in Central America. (E. Haldimann and T. Stadtmüller, Intercooperation, November 2003)**

In order to set up more effective resource management regimes, the multifunctional nature of natural resources and the multitude of inherent cause-and-effect relationships needs to be better acknowledged at various levels.

Innovative management regimes that respect multifunctionality entail costs. Effective distribution of such costs among providers and users of environmental goods and services requires a good understanding of this multifunctionality. The suggestion of developing PES/CES as an economic instrument to combat resource degradation appears to be in line with a general trend over the past few years to design economic measures to address structural problems.

PES/CES as an improved tool of resource management appears to have potential, although the system requires a targeted adjustment of existing institutional structures. Policy makers at various levels need to support such adjustment processes.

Conclusion and relevance for development agencies

Conclusion

Forest ecosystems offer a variety of goods and services that contribute directly and indirectly to the well-being and livelihood security of people. The continued generation of such goods and services is ensured through the multifunctional nature of forest ecosystems. For example, forest ecosystems have an important regulative influence on the water cycle. Far beyond the mere presence of trees within the ecosystem, this is due to a range of ecological interactions that enable multifunctionality. Once a forest ecosystem is degraded, its multifunctionality – and therefore its regulative influence on water resources – cannot simply be restored through afforestation.

In order to guarantee continued existence and effectiveness of the multiple functions of a forest ecosystem, these functions need to be recognised at various institutional levels. Appropriate resource management regimes can then be formulated and operationalised. This requires enabling institutional frameworks at local, national as well as global levels.

However, in many cases institutional frameworks that govern resource management need to be modified so that they can indeed constitute an enabling basis for the formulation of appropriate management regimes. The main elements in an effort to improve existing institutional frameworks should be (1) a fresh look at property issues that have an influence on the quality of resource management, (2) an integration of sectoral resource management structures through a more participative and integrated approach, (3) the inclusion of local knowledge, people's expertise, and their visions.

Currently, such an integrated understanding of the multifunctional role of forest ecosystems is often lacking. This is the reason why natural resources are exposed to increased pressure from unsustainable use. As a result, degradation processes endanger the functionality of forest ecosystems and generate external social costs. This in turn makes it very difficult to ensure continued generation of environmental goods and services for a growing population.

In many instances, current economic reality encourages the emergence of external social costs. Economic triggers of such externalities are, for example, (1) the policy of supplying natural resources as inputs for production and consumption as cheaply a possible, without taking into account the need for regeneration and substitution of these resources, and (2) approaches to resource management that largely disregard environmental interactions.

In view of dwindling natural resources and services, PES/CES appears to be an innovative attempt to develop resource management regimes that pay greater attention to the multifunctional nature of natural resources, thus contributing to a less extractive and more sustainable use of natural resources and their services. If comparative monetary values for environmental goods and services are defined, changes in value will occur. It is expected that these changes will be signals of scarcity or abundance. This should in turn induce providers to adjust their management of the natural resources that generate environmental services, and users to adjust their consumption of such services.

The central elements of PES/CES approaches are: (1) identification and valuation of resources/services; and (2) institutional modifications enabling the establishment of PES/CES systems.

A variety of valuation methods exist that can be applied in various circumstances. They measure either effective costs or expressed preferences. PES/CES systems require intensive negotiation between providers

and users of environmental goods and services. However, especially in the context of developing countries, considerable vertical as well as horizontal barriers to communication and information may exist. Capacity building in this area requires considerable investment.

The legal and institutional framework regulating property of natural resources needs to be modified in many countries, so that PES/CES systems can be used to support the establishment of appropriate resource management regimes that translate the multifunctional character of natural resources into effective institutional frameworks. However, the adaptation of existing institutional frameworks is, in many instances, a very sensitive undertaking. Careful negotiation and lobbying is necessary to deal with the multiplicity of interests and influences. Political will and a cooperative administration are decisive supporting elements.

Some critics argue that resource degradation exists because no fundamental environmental values underlie economic processes. This leads them to reject the PES/CES idea, based on the argument that the fundamental lack of values cannot be corrected by assigning property rights to, and defining prices of, environmental goods and services that cannot, by their very nature, be quantified. An integrated approach to PES/CES systems based on a well-founded understanding of the multifunctionality of ecosystems can help mediate between this position and a view of natural resources as economically exploitable raw material. Indeed, recognition of the multifunctionality of ecosystems offers a basis for deciding whether a specific function can be the object of compensation or requires regulation through other institutional approaches.

Documentation on experience garnered in many parts of the world with PES/CES systems and their impact is starting to be available. The PES/CES idea could be regarded as an attempt not to create a new scale of values but to design new tools that, under the given realities, help to make extractive economic systems more responsible vis-à-vis the natural resources they exploit.

Importance for development agencies

PES/CES approaches seek to contribute to the development of sustainable management regimes for natural resources, thereby contributing significantly to poverty alleviation.

As a result of their strong focus on people and their empowerment, development agencies are in a unique position to promote integrated resource management approaches in collaboration with their partners. Participative development approaches have proved useful in generating the required levels of involvement and equity in integrated resource management regimes.

Lack of awareness of the significance of environmental goods and services, lack of experience of negotiation, etc. generate upfront costs that can typically be taken over by development cooperation. Rather than continuously subsidising operational costs of PES/CES systems once they are initiated, development agencies can focus on facilitating learning processes and other aspects of capacity building.

Development agencies also have the possibility of advocating the type of favourable institutional and legal conditions required for innovative resource management regimes, both at the level of national policies and with local partners. A more dynamic 'policy dialogue' would be the appropriate platform for such advocacy. Programmes need to consider how local partner organisations could be strengthened to enable them to address institutional and legal issues that have a direct bearing on resource management regimes. Looking back at the failure of numerous past development efforts related to common property resources, partly as a result of ill-defined and inflexible property rights and lack of advocacy, a fresh and innovative look at the issue of rights to owning natural resources

appears essential within the overall context of fighting resource degradation and the resulting poverty.

Working with a multiplicity of cultures, development agencies are in a unique position to contribute to the development of the PES/CES approach by identifying and documenting environmental value systems applied by other cultures. Ideas and approaches from other cultures might be able to enrich and improve the PES/CES approach in future.

Glossary

Agroforestry

Agroforestry is a combination of agricultural and forestry technologies. Agroforestry practices include alley cropping, forest farming, nitrogen fixing trees (NFTs), orchards, hedges, groves, copses, riparian forest buffers, windbreaks, silvopasture, etc.
Agroforestry systems that aim for sustainable development result in more integrated, diverse, productive, profitable, healthy, and sustainable land use systems. Sustainable agroforestry is a form of social forestry (see below). Practices focus on meeting people's economic, environmental, and social needs. They include a set of practices that provide strong economic and conservation incentives for landowners. Tree, crop and/or animal components are structurally and functionally combined in a single, integrated management unit that takes into account broader watershed and landscape aspects. Integration may be horizontal or vertical, and above or below ground. Such integration enhances the productive capacity of the land and helps balance economic production with resource conservation.

Biodiversity

The Convention on Biological Diversity defines "Biological diversity" or "Biodiversity" as the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Biomass

Biomass is organic non-fossil material. For example, plants (including trees) and animals are biomass, as are the materials they produce (e.g. dung) or that are produced from them (e.g. wood, food, etc.).
Biomass is sometimes burned as fuel for cooking, heating, and production of electricity. When used for such purposes, it often consists of underutilised types such as agricultural residues and animal waste.

Catchment/ Watershed/Basin

The definitions of *watershed, catchment area,* and *drainage basin* vary considerably. The terms are often used synonymously and refer to the various sizes of areas in which water is drained towards a specific point or area. The European Environment Agency (EEA), for example, defines the three terms as follows:

Catchment area: (1) An area from which surface runoff is carried away by a single drainage system. (2) The area of land bounded by watersheds draining into a river, basin, or reservoir.

Drainage basin: The area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel.

Watershed: The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. The watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Community forestry/ Social forestry

Social forestry refers to "forestry programmes that purposely and directly involve local people, their values, and their institutions" (IUFRO). It is the practice of using trees and/or tree planting to specifically pursue social objectives and is equated with growing by the people and for the people on individually and community owned land.

Community forestry is a form of social forestry. It refers to forest management undertaken by a community on communal land. Local communities who have a direct stake in forest resources become key stakeholders for sustainability. They are empowered as decision-makers with regard to all aspects of forest management, from managing resources to formulating and implementing institutional frameworks.

Compensation for Environmental Services (CES)

Non-monetary compensation for the additional effort needed to ensure that the ecosystem or parts thereof continue to generate environmental services, and that an environmental good can be used by those who need it. Such additional efforts, e.g. improved land management, entail a variety of costs. *See also Payment for Environmental Services (PES)*

Environmental good

A good for consumption by society that is generated as a result of a range of supportive and regulative mechanisms within the ecosystem.

Environmental service

A benefit to society that arises as a result of continuous and mutually supporting and regulating interactions of elements within the ecosystem. A supportive element may be the maintenance of organic matter content in the soil through rotting plants in a forest, while adequate organic soil matter contributes in a regulative way to the soil's water absorption capacity.

Evapotranspiration

The conversion of water by transpiration (vegetation) and evaporation (soil moisture, snow, surface water, intercepted precipitation) into water vapour released to the atmosphere.

Global public good

Global public goods are public goods with essentially universal benefits (for countries, peoples, and generations).
See also Public good

Interception

In hydrology, the accumulation of precipitation on vegetation and other above-ground surfaces, and its evaporation during and after a storm event.

Intercropping

WOCAT defines intercropping as the mixed cultivation of two or more crops in the same field (FAO, 1985; ASA, 1976), either simultaneously or – in the case of relay intercropping – with an overlapping period. In simultaneous systems, two or more crops are either intermingled or cultivated with a distinct row or strip arrangement.
See also Agroforestry

Multi-stakeholder processes

Processes in development cooperation that aim to involve different categories of stakeholders in efforts to improve situations that affect them. Multi-stakeholder processes operate through a variety of social interactions at different levels and make it possible for different individuals and groups to enter into a dialogue and initiate negotiations, learning processes, concerted decision-making, and action. The overall intention is to induce local people, government staff, policy makers, community representatives, scientists, business people, and NGO representatives to think and work together and to develop collective commitment and capacity to turn ideas and plans into action.

Multifunctionality

Natural resources have many different interrelated functions for human beings. This multifunctionality emerges from ecological interactions that have various supportive, regulative, and productive effects. The functions of an ecosystem thus refer to their effects and to the value that human beings give to, and derive from, them. An intervention in an ecosystem

motivated by one function (e.g. timber production) will inevitably have an impact on the ecosystem's multifunctionality as a whole. Maintenance of multifunctionality is a key concept of sustainable natural resource management and contributes to environmental conservation as well as to sustaining rural areas and alleviating poverty.

NTFPs (Non-timber forest products)

Non-timber forest products consist of biological materials other than timber collected in their natural environment, or products originating from forest plantations or agroforestry. They can be used as food and food supplements (seeds and nuts, mushrooms, fruit, herbs, spices, game meat), fibre (construction, furniture, clothing, tools), in the form of resins, gums, and products for medical, cosmetic, and cultural purposes.

Opportunity costs

The income or benefit foregone as the result of carrying out a particular decision. Opportunity costs assume increased relevance in the face of limited resources and when mutually exclusive decisions are required. For example, the opportunity cost of changing land management in a particular way consists of the opportunities that are foregone by that change in land management. Opportunity costs are costs that are not actually spent and are not recorded in the accounts.
See also Transaction costs and Up-front costs

Payment for Environmental Services (PES)

Monetary compensation for the additional effort needed to ensure that the ecosystem or parts thereof continue to generate environmental services, and that an environmental good can be used by those who need it.
See also Compensation for Environmental Services (CES)

Preference methods

Valuation methods for environmental goods and services. Such methods identify and value preferences for environmental goods and services expressed through actors' economic behaviour and market trends or identified through a range of interview techniques.
See also Real cost methods

Public good

Good where one person's use does not decrease the amount available for others, and that good can be use by many persons at any time, i.e. it is not rival and not excludable. This is often contrasted with a private good, which is not available to others when used by someone, and private use diminishes the quantity available to others. A private good is thus excludable and rival. Such a distinction may be less clear in situations where the supply of goods diminishes. The exact nature is also determined by the relative scarcity of a good and the institutional framework that governs its use.
(Adapted from http://www.ukglobalhealth.org and Oxford Reference Online, 2004)

Real cost methods

Valuation methods for environmental goods and services. These methods measure costs incurred as a result of damage to environmental services. The methods are also applicable to measure additional costs incurred either in the form of preventive expenditures, or to ensure a continued generation of environmental services through adaptation of resource management regimes.
See also Preference methods

Retention

The part of precipitation falling on a drainage area that does not escape as surface runoff during a given period.

Siltation

The process by which a river, lake, or other water body is clogged with fine sediment.

Slash and burn

Shifting cultivation systems that alternate periods of annual cropping with extended fallow periods. "Slash and burn" systems use fire to clear fallow areas for cropping.

Sustainable use of natural resources

Resource use is sustainable if specific types of use in a particular ecosystem are considered reasonable in the light of both the internal and the external perspective on natural resources. "Reasonable" in this context means that all actors agree that resource use fulfils productive, physical, and cultural functions in ways that will meet the long-term needs of the population affected.

Transaction costs

A term from economic theory that describes the costs incurred for the process of reaching agreements about the organisation of market transactions. Such costs can be associated with the collection of information, negotiation of agreements, costs of control, etc.
See also Up-front costs and Opportunity costs

Up-front costs

A term that sometimes occurs in connection with the discussion of Payment for Environmental Services. It describes the costs incurred for preparing actors and institutions (1) to be aware of an issue and (2) to support them in preparing institutional mechanisms to absorb and operationalise an innovation. Typical up-front costs are those of awareness creation and training, information gathering, networking, and institutional adaptation processes. Up-front costs are different from transaction costs because they do not ensure that an innovation will really materialise.
See also Transaction costs and Opportunity costs

Willingness to pay

The expressed readiness of actors to pay for an environmental good or service that does not have a market. Willingness to pay is assessed through interviews, role plays, hypothetical scenarios, and questionnaire techniques. It is therefore an expression of will rather than a cost actually incurred.

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Some of the boxes in the present brochure refer to the five case studies listed above.

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