GREEN BREAKTHROUGHS

Solving Environmental Problems Through Innovative Policies and Law

" Two roads diverged in a wood and I,
I took the one less traveled by, And
that has made all the difference."
Robert Frost

UNEP

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Solving Environmental Problems Through Innovative Policies and Law

United Nations Environment Programme

Message from the Executive Director of UNEP

The environmental crisis is not an inevitable path. Sustainable Development is possible if based on sound policies and carefully crafted laws to intervene effectively at strategic points to change public policy economic signals and entrenched behavior and advance towards a brighter future. Green Breakthroughs introduces Ministers, their advisors and public policy makers to policies and laws around the world that have worked to respond to mounting environmental challenges. The booklet is written in a form that gives leaders the facts and a concise explanation of why the policies and laws depicted in this booklet have been successful.

The American poet and naturalist Robert Frost once wrote "Two roads diverged in a wood and I, I took the one less traveled by, And that has made all the difference." Many environmental leaders who have pioneered along the "roads less-traveled" are those that have had the foresight and courage to adopt far-reaching policies supported by effective laws and regulations, based on sound environmental judgment.

Green Breakthroughs shows that there are no silver bullets for each and every environmental problem, but there are a number of fundamental norms and principles that can form a basis for success. Some problems as UNEP's GEO4 assessment argues, are easier to solve where the point source of the pollution is localized and there are many solutions that are known to work. But there are problems that are persistent and pervasive like climate change, loss of biodiversity and desertification where the solutions require a commitment to the long-term future and the dedication to cohesive cooperation and raw determination from policy makers.

No matter the type of environmental problem, the breakthroughs in this booklet demonstrate that policies that are adaptive to uncertainty and change and recognize that science is not, and perhaps never will be, complete-that problems are complex and therefore responses must be flexible and collaborative, and that decision makers must learn and change with new knowledge or as new threats arise—have the best chance of success.

Policy mixes that use a combination of carrots and sticks and which are embedded in sound laws that are transparent and reflect the social and cultural values and which are enforced are more likely to be effective. Green Breakthroughs also confirms that policies and laws that are inclusive of the interest of all stakeholders, from the poorest and the most marginal, to the wealthiest and most powerful, and the knowledge holdings and values of them all—from the most ancient traditional experience or insight to the most modern innovation or invention – will conform more readily to societal acceptance.

It is also evident from these green breakthroughs that market mechanisms can work because human values are oriented towards profit, but in the longer term, education and awareness of our children can shift the value of the market towards reflecting the values of prevention and custodianship.

These opportunities include the following. For growth in renewable energy, national grids need to accept electricity from renewable sources, at guaranteed prices that are high and stable enough to reward investment. For proper management of wastes, tough targets and financial incentives can reduce waste volumes and promote re-use, reclamation and recycling, ideally in a 'circular economy' in which one sector's wastes become another sector's raw materials. For sustainable use of forests and other ecosystems, as well as fisheries, long-term tenure is needed, along with financial rewards for precautionary management of the services and harvests they yield, and the biodiversity they contain.

Biodiversity itself can be conserved if it is recognised for what it is – a limitless resource that can generate wealth indefinitely – and if some of that wealth is used to support conservation. Finally, in adapting to climate change, countries are carefully analyzing their own vulnerabilities and needs, identifying opportunities to restore their own environmental resilience and security while cooperating with other countries to find global solutions. In all these cases, success comes from the creative use of sound knowledge and an approach that is in harmony with fundamental human motivations.

I invite Ministers and indeed everyone in a position to catalyze change to read this booklet and see where there is resonance, and then inspire to replicate it or adapt the lessons in these pages to make their own breakthroughs and move the world away from a path of depriving future generations from what we used to take for granted – a world in which nature's ingenuity provides us with the renewable resources to sustain the development aspirations of all our nations. We can change the destination of the path we are on ; all we require is political determination and a willingness to share successes, opportunities and burdens.

Achim Steiner

Foreword

Global environmental decline and rapid depletion of the planet's natural resources is universally evident. The state of the world's natural environment is increasingly fragile and is faced with massive, and in some cases, irreversible environmental degradation and habitat and species loss. The causes of this decline range from extreme poverty to unsustainable production and consumption patterns; to poor governance and inadequate policy and institutional responses to meet the environmental challenges faced by current and future generations.

Through assessments like those produced by the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment (MA), and the Global Environment Outlook (GEO), we now posses greater awareness of how human activities are impacting the environment. At the same time, we are beginning to understand the kinds of policies and laws that are effective in solving the environmental problems that we are confronted by. The global consensus that has been forged to address these pervasive and imminent threats--through United Nations sponsored Global Summits, the network of Multilateral Environmental Conventions, and other global and regional initiatives--provides a strong foundation upon which developed and developing nations around the world can adopt and implement bold and innovative policies and laws to slow down and ultimately reverse environmental degradation and realise the goals of sustainable development. The focus today is on revitalising this consensus and converting it into collective action. In the words of the United Nations Millennium Declaration, "We must spare no effort to free all of humanity, and above all our children and grandchildren, from the threat of living on a planet irredeemably spoilt by human activities, and whose resources would no longer be sufficient for their needs."

Climate change is perhaps the most pervasive of all global environmental challenges, impacting all aspects of human lifestyles and livelihoods in terms of human health and well-being, food security, mobility, energy, water, vegetation, biodiversity, land and other natural resources, and ultimately the very foundations of peace and security. Earlier this year, the first of four new IPCC reports compiled by over 2,000 scientists concluded with 90 percent certainty that humans are altering the climate. Other threats to the environment include unsustainable lifestyles and heavy reliance on non-renewable energy use, increasing waste production and pollution, rapid urbanisation, habitat destruction and biodiversity loss, land degradation, and over harvesting of forest, marine and freshwater systems. The impacts and long term consequences of these threats are widespread and wholly unsustainable.

There are, however, some encouraging signs that the investment in human capital, financial resources, technology and partnerships over the past two decades by the United Nations system, and both industrialised and developing countries is beginning to show early signs of producing a change of direction towards a more sustainable future. There is a growing focus on, and investment in, renewable energy as a substitute for fossil fuels, increasing energy efficiency in industry, transport, construction and other sectors that has the potential to significantly reduce greenhouse gas emissions. Other areas in which major policy shifts towards more enlightened environmental and natural resource management have become evident in recent times include, integrated fresh water and marine resource management, forest conservation and sustainable use of forest products, ecosystems management, enhanced efficiency in chemicals and waste management, preservation of cultural diversity and the applications of a wide range

of new tools for environmental management such as market based instruments, strategic environmental impact assessment and multi-stakeholder partnerships.

The driving force behind these developments is innovative policies and their implementation mechanisms that have been enunciated by enlightened national leaders and policy makers, acting on the conviction that environment is the foundation of prosperity and have had the foresight and courage to eschew business-as-usual approaches to economic growth and development.

Central to UNEP's programme of work is the recognition that policy formulations that internalise the economic costs and opportunities of sustainability across governments, business, and at the individual level are called for to achieve better management of our natural resources. To this end, UNEP has strengthened its relationship with sister organisations like the UN Development Programme, the UN Industrial Development Organisation, the World Trade Organisation, and the UN World Tourism Organisation.

The current UNEP initiative, Green Breakthroughs, is designed to highlight and bring to the attention of a wider global audience of policy-makers some of the ground-breaking national policies that have signaled change towards improved and sustainable management of natural resources for the benefit of present and future generations. This booklet offers a brief outline of the some of the policy initiatives and their implementing mechanisms that have been taken recently by leaders and policy-makers in both developed and developing countries to address several major global environmental challenges. Its purpose is to provide a sense of the crucial importance of these polices and laws for the environment and sustainable development and to promote their wide dissemination and use. Close cooperation and the sharing of knowledge and creative ideas are essential for solving the current environmental problems and securing a sustainable future.

Bakary Kante
Director
Division of Environmental Conventions and Law

Executive Summary

This booklet is called Green Breakthroughs because it describes policies and laws that have been used effectively to solve environmental problems. Success stories are drawn from 45 individual countries, as well as from regional groupings such as those in Africa, the Caribbean and Europe, while others involve countries that share major rivers and lakes, or that are joined in common global endeavours. The successes relate to major environmental themes, the issues and challenges of each being explained. They include energy and climate change, the management of various kinds of wastes, the preservation and restoration of ecosystems, and the sustainable use of biodiversity and fisheries. The approach is always to show how policies and laws, whether singly or in mixtures, can reduce damage, increase efficiency and sustainability, and ensure that environmental, social and financial benefits reward those who use the world wisely and well.

By reviewing the evidence, conclusions have been reached that can help policymakers adapt past successes into new initiatives in new places. A switch from fossil to renewable sources of energy is urgently needed, for example, in order to reduce greenhouse gas emissions, improve local air quality, and reduce fuel costs. But such a switch need not be a burden if national power grids are required to accept electricity from renewable sources, at guaranteed prices that are sufficient to attract the necessary investments. For such investments have proved to be profitable and to create many jobs, while also meeting environmental goals. Likewise, lessons have been learned from the creation of carbon emission reduction credits, and the trading that results, which can stimulate new investment in renewables and in avoided deforestation.

The value of a similar judicious use of policy and law to stimulate investment in better waste management has been repeatedly demonstrated. The challenge is the explosive growth in urban, industrial and electronic wastes, some toxic but all of them potentially reducible, reclaimable, recyclable or manageable with greater care and attention. Tough targets and financial incentives can be used to encourage these outcomes, while also creating new businesses and jobs as each type of waste becomes seen as a raw material for others to use. In this, we are rediscovering two of the truths of nature: that nothing can truly be thrown away, and that everything is useful. Systems based on such principles are capable of absorbing and processing all wastes safely, productively and without exporting the problem to other locations or future generations.

Again, it has emerged that sustainable use and regeneration of ecosystems such as forests is much easier if long-term security of tenure is given to the people responsible for them, so that they can invest in the future. This effect is made stronger if the owners and managers of ecosystems are rewarded according to the harvests and environmental services they yield, whether they take the form of plant and animal products, or water catchment payments, carbon credits, or ecotourism and bioprospecting revenues. Creating ownership and equity arrangements that allow these things to happen is the unique responsibility of policy- and lawmakers in every country.

The same applies to the conservation of biodiversity, since this is a vast resource which can be used to generate wealth and other benefits indefinitely. In many cases, the skills to do so are embedded within the traditional knowledge possessed by local people, but modern technologies are also making new avenues of reward possible. And if biodiversity is seen as a resource, it follows that its wise and sustainable use to create wealth can also create jobs, businesses, tax revenues and investments, as well as

enhanced respect and rights for traditional peoples who would otherwise be oppressed and endangered. All of these changes will give people an interest in saving biodiversity for their own future well-being, provided that they share equitably in the opportunities – something that only the correct laws and policies can ensure.

Moreover, it is clear that the relentless over-fishing that is damaging fish stocks around the world has its roots in weak tenure, open access and the flow of benefits to the wrong stakeholders. These problems can be corrected, but the policy need is different for fishing fleets operating in the open sea than for communities fishing near the shore. For the open sea, governments can set precautionary, annual, total allowable catches for which individual quotas are issued, so that their owners will have a long-term interest in sustainable harvesting. In coastal waters, where communities are the chief allies, they can be helped to establish exclusive fishing zones where open-access and destructive fishing is prevented, aided by protected areas to maintain environmental productivity. These efforts can be supported by purchasers of fishery products, now that a credible certification system is in place to help them choose products from sustainable fisheries.

Many of these discoveries can contribute to the complex process of adapting to climate change – which is a challenge for every country and society on Earth. The threat itself ramifies through increased risks of disaster from extreme weather events, reduced availability of fresh water, spreading fires, invasive species and diseases, expanding sand dunes and deserts, the intrusion of sea water into coastal lands, and the destruction of soils from loss of biomass, accumulation of salt, water-logging and erosion. To cope with the precise mix of these and other dangers that any particular country is facing, an equally precise mix of policies and laws will need to be designed and put into effect. Each country will therefore need to analyse its own unique vulnerabilities and needs, identifying opportunities to restore its own environmental resilience and security, while also contributing to global solutions through cooperation with other countries. The stories told in Green Breakthroughs are a source of ideas that can be used to do just that.

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The United Nations University Institute of Advanced Studies (UNU-IAS) is a global think tank whose mission is "advancing knowledge and promoting learning for policy-making to meet the challenges of sustainable development". UNU-IAS undertakes research and postgraduate education to identify and address strategic issues of concern for all humankind, for governments and decision makers and, particularly, for developing countries.

The World Future Council (WFC)
The World Future Council is a global forum of 50 respected personalities who give voice to the shared ethical values of citizens worldwide. The Council works closely with policy-makers, civil society and business to identify and implement best policies to protect the rights of future generations.

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Reducing Reliance
on Oil, Coal and Other Fossil Fuels

Fossil fuels such as oil, coal and gas provide 80% of the energy we use but are a main source of environmental problems, as burning them produces greenhouse gases (GHGs) that affect the heat balance of the atmosphere. Average global temperatures have already increased by about 0.8oC as a result, and will continue to rise with further GHG emissions. The 2007 assessment by the Inter-Governmental Panel on Climate Change (IPCC) foresees average temperatures rising by a further several degrees during this century if greenhouse gas emissions are not drastically curbed.

Emissions from fossil fuel combustion also impact on human health and result in significant damage to crops, water bodies and other ecosystems through deposits in the form of acid rain. The increasing costs of oil and gas moreover place a heavy burden on the balance of payments, especially of poorer nations, reducing their ability to invest in poverty alleviation and basic human amenities, social security, health and education and environmental protection. These various factors all signal that global energy needs must henceforth be met increasingly from sources other than fossil fuels.

These alternatives are called 'renewables' because they draw energy from forces and events that occur naturally and continuously in nature, including:

- the high temperatures within the Earth (geothermal power),
- the momentum of flowing rivers and streams (hydroelectric power)
- the momentum of tidally-flowing sea water (tidal power),
- the vertical surges of waves (wave power),
- the horizontal pressure of winds (wind power),
- the hot dazzle of intense sunlight (solar power), and
- the use of living organisms to trap solar energy which can then be used by people in the form of biofuels.

Many countries have committed themselves to renewable energy targets in the 10-20% range by 2010-2020, including China, Egypt, India, Germany, Pakistan and the UK, and nearly half of the 50 states of the USA.

"Renewable energies are a success story that is going from strength to strength. It is more than realistic that we will also far exceed the target of at least 20 percent by 2020. This shows how effective our Renewable Energy Act is."

Sigmar Gabriel,
Federal Environment Minister, Germany

Germany
Re-newable Energy

One of the outstanding success stories in the field of renewable energy is Germany's Renewable Energy Law (EEG) of 2000, which has given a huge boost to the production and supply of renewable energy across the country, making Germany a world leader in the production of renewable energies.

The EEG was a response to mounting evidence of the immediate and widely recognized negative impacts of conventional energy sources such as oil, coal and gas on climate change, forestry and land, urban and rural environments and ecosystems as well as the broad rejection of atomic energy. A groundswell of public support that grew in the '90s for environmentally-friendly energy supplies was marshaled to develop and enact the Renewable Energy Law.

"We want to follow a path towards a sustainable energy supply, for the protection of the global climate, the conservation of finite resources and for the sake of future generations. We want to make even greater energy savings, increase energy efficiency even further and expand the use of renewable energies. In Germany this is known as the 'Energiewende' - the transformation of our energy system. Nuclear power is not needed to achieve this. Quite the contrary: technically speaking, this base-load relic of the past is standing in the way of flexible and intelligent electricity production. The safety risks associated with nuclear power have in no way decreased in recent years - in particular with regard to the threat of terrorism, they have in fact increased dramatically."

Former Federal Environment Minister Jürgen Trittin, who played a key role in Germany's decision to close all its nuclear reactors by 2020 and to make renewable energy a major factor in Germany.

The new law has three main elements:

- First, it provides guaranteed access to the grid for each renewable energy power supplier, even when it is a very small one.
- Second, a guaranteed price is required to be paid by the utility companies that collect the renewable energy from these suppliers, and
- Third, there is an open door policy that encourages private individuals and companies to invest in the generation of renewable energy

As amended in 2004, the EEG specifies higher rates for small installations than large ones, and for biomass units than for others. Thus, the payment rates vary as follows:

- €0.097 per kilowatt-hour (kWh) for small hydroelectric, landfill gas, mine gas and sewage gas installations;
- €0.115/kWh for small biomass units;
- €0.037/kWh for new large hydroelectric installations;
- €0.089/kWh for large biomass plants;
- €0.087/kWh for onshore wind-generated electricity;
- Offshore wind power is bought at higher rates to reflect higher investment costs and a preference for locating wind farms away from land: €0.091/kWh for the first decade, and €0.062/kWh for the next.

Germany

Re-newable Energy

The many successes of Germany's Renewable Energy Law may be summarised as follows:

1. In the early '90s the only "green power" in Germany was large hydropower schemes. With 16TWh, it reached a share of 4.2% of overall electricity production. In 2006, the total amount of renewable energy in Germany's energy supply was 73.9 TWh, made up as follows:

Wind energy	**30.5 TWh**
Hydropower	**21.6TWh**
Biomass	**17.8 TWh**
Solid biomass, including biogenic waste	**10.8 TWh**
Biogas	**5.4 TWh**
Liquid biogas	**1.6 TWh**
Landfill and sewage gas	**1.9 TWh**
Photovoltaics	**2.0TWh**
Geothermal energy	**0.0004 TWh**

2. In 2007, the German Environment Ministry announced that over 200,000 people are now employed in the renewable energy sector and that the country produces a share of around 14% of its electricity from renewable sources - solar, wind, hydro and biomass.
3. Germany will already have exceeded the target set in 2000 to increase electricity from renewables to 12.5% by the year 2010, as a first step towards an energy system mainly based on renewable energies envisioned for the mid 21st century.
4. The EEG has greatly stimulated private investment, both in power generation and in development of new technologies. About €9 billion were invested in installations to take advantage by the EEG in Germany in 2006.
5. New export opportunities have been created, with more than 70% of the wind power plants produced in Germany being exported, and promising export markets for solar power equipment as well.
6. Diverse energy sources competing in an open market tend to drive prices down, so the total price paid for electricity declined by about €5 billion in 2006 alone.
7. The avoidance of fuel imports has resulted in a saving of €0.9 billion.
8. The resulting prevention of environmental damage has been estimated at about €3.4 billion.
9. The economic benefit of the EEG has added up to approximately €9 billion, confirming that macroeconomic benefits from the EEG have clearly outweighing its costs.

Brazil

Bio-Fuels

In the 1970s, Brazil was faced by high international oil prices, and these were damaging the country's economy and making it hard to meet external debt service obligations. At the same time, Brazil's large sugar industry was suffering from low world prices for this commodity. The response to both challenges was the idea of producing ethanol from sugar, and to use it as a substitute for gasoline. To put this into effect required a systematic, large-scale effort supported by policy, law and public investment.

Government initiatives to promote the use of bioethanol had to avoid or overcome the need for to modify petrol engines, and two approaches were used. One was to require the addition of 10% anhydrous ethanol (i.e. ethanol containing less than 1% water) to all gasoline, and the other was to encourage the use of 100% hydrated ethanol (i.e. less purified ethanol containing up to 5% water) in modified motors.

Vehicles using gasoline with 10% anhydrous ethanol added require almost no changes, but more modifications are required when there is a larger share of ethanol in the fuel blend. With minor adaptations developed by the car manufacturers, all gasoline vehicles in Brazil can run with blends ranging between 20% and 26% of ethanol. After 20 years, the manufacturers have developed a flexible fuel technology, commercially available and predominant in car sales today at no additional cost. Sales of ethanol-fuelled vehicles reached a high of 96% of total sales in the mid-1980s.

"There is enough area available for an ambitious introduction of 10% of ethanol in the world's gasoline. There would be a need for nearly 30 million hectares of land, which is only 3% of the total area of harvested crops in the world ... If ethanol from sugarcane were to replace 10% of the gasoline consumed in the world ... carbon emissions would be reduced by 66 million tonnes (Ceq) per year. This is equivalent to approximately 1% of the world's emissions, or one fifth of the Kyoto Protocol target ... For that, another 30 million hectares of land are needed ... Environmental aspects must be taken into account, but the production of biofuels (especially sugarcane ethanol) is a win–win perspective for both developing and developed countries."

Professor José Goldemberg,
former Minister for Science and Technology and Minister of Education of the Federal Government of Brazil, and currently Secretary for the Environment of the State of Sao Paolo.

Brazil

Bio-Fuels

Government measures to stimulate the production and use of bioethanol included low-interest loans for the construction of ethanol distilleries and guaranteed purchase of ethanol by the state-owned oil company (both ended in the 1990s), as well as incentives for the purchase of ethanol-fuelled cars. Infrastructure was developed to distribute ethanol to thousands of pumping stations around the country. New tax breaks in alcohol producing regions, and legally-required 'green fleets' of government vehicles have also helped to boost sales.

- An investment of US$ 4.92 billion in the agricultural and industrial sectors for automotive ethanol fuel between 1975 and 1989.
- Savings of US$ 52.1 billion on avoided oil imports between 1975 and 2002, Thus, every dollar invested in the transition to bioethanol fuel use gained the country about ten dollars.
- Economies of scale and competition have led to reduced unit production costs, also helped by agricultural productivity gains supported by improved farm management and applied research programmes.
- The cost of producing ethanol has declined since 1975 by 4-5% annually. Even without subsidies, ethanol is now cheaper per unit of energy than gasoline.
- Brazil is now the world's largest producer of cane, sugar and ethanol, using some five million hectares of its land area to produce around 26 million tonnes of sugar and nearly 16 million m3/year of ethanol, equal to an energy equivalent of 1.5 million barrels of oil per day. Three-quarters of it is used to fuel vehicles, meeting a third or more of the country's total fuel needs.
- Bioethanol substitution and the development of offshore oil fields has allowed Brazil to reach complete self-sufficiency in energy.
- Financial benefits have largely been received by Brazil in the form of avoided foreign exchange costs, savings that may amount to US$100 billion.
- A positive effect on air quality.
- Biofuel manufacture produces substantial amounts of electricity for export to the national grid.
- Finally, Brazil's cumulative CO2 emissions in 1975-2007 are estimated to have been reduced by about 10% - a saving of almost 600 million tonnes.

Mauritius

A new energy future

"Energy is the defining issue of the 21st century. The new energy policy is based on conservation and developing alternative energy sources. This would involve increasing the proportion of electricity generated from renewable sources such as biomass, hydroelectricity, wind and solar power. Accordingly, the new Energy Efficiency Bill is aimed at encouraging energy saving policies including the application of standards in terms of energy efficiency."

Dr The Honourable Abu Twalib Kasenally, Minister of Public Utilities of Mauritius

The 1975 Sugar Protocol to the Cotonou partnership agreement between the European Union and African, Caribbean and Pacific (ACP) countries gave farmers in these developing countries preferential access to Europe's markets for 1.3 million tonnes of sugar annually. One beneficiary was Mauritius, where 90% of farmland is given over to sugar cane, mostly for export to Europe at a rate of about 500,000 tonnes per year. In 2004, however, the European Commission initiated measures to reduce subsidies to European sugar producers and at the same time to revise the sugar protocol. This would have the effect of driving down the guaranteed price for sugar supplied under its terms, leading to the termination of the Sugar Protocol entirely in October 2009.

The resulting economic shock has precipitated new strategic thinking within Mauritius, particularly in relation to energy and how to afford it.
In this context, biomass, in the form of bagasse, the carbon-neutral waste from sugar cane, is viewed as an important energy source. A leading option for Mauritius is to build on.

the fact that bagasse is used there as co-generation feedstock to produce both heat and electricity. The country's sugar industry is in fact self-sufficient in electricity, and sells excess power to the national grid.

The co-generation facilities that are already present are sufficient to double the current level of electricity generation.

- A Multi-Annual Adaptation Strategy has been jointly defined by the Government and the private sector. It will be jointly funded by the private sector, the Government and other financial partners, and the EU has agreed to make a significant contribution. The Strategy includes a bold re-structuring of the sugar industry, within which revenue from sugar will account for 75% of the total revenue, whilst electricity, ethanol and carbon credits will account for 15%, 7% and 3% respectively. This compares to the current proportions of 93% from raw sugar and 7% from electricity generation.
- The Mauritius Sugar Industry (MSI), for example, is transforming itself from a producer of a single base commodity product, sugar, into a business that exploits the full potential of the sugar cane biomass.
- Twenty percent of the electricity of Mauritius is from sugar cane fibre,
- MSI is also looking at new technologies. One is gasification, which will increase the output of energy from cane by about 250%. With these new technologies and the advent of high-fibre cane cultivars, it is expected that sugar cane biomass will be able to meet the country's entire electricity demand.
- The ultimate aim is to substitute bagasse for the annual import of about 250,000 tonnes of coal.

Renewable Energy Laws

Australia

The Renewable Energy (Electricity) Act 2000

Aims and targets

To encourage electricity generation from renewables, while ensuring that renewable energy sources are ecologically sustainable. Target for renewable electricity generation to reach 9,500 GWh in 2010 and maintain this level in later years.

Incentives and sanctions.

- Renewable Energy Certificates created by energy producers to confirm the sourcing of their electricity, which can be bought by energy users.
- Registration of the creation and transfer of certificates.
- Purchasers of electricity ('liable entities') to surrender a specified number of these certificates; penalties are incurred in the form of a Renewable Energy Shortfall Charge (RESC), if the purchaser cannot surrender enough certificates. No RESC is levied if the shortfall is within 10% of the required amount, but the shortfall is carried forward to the next year.
- Solar water heaters that displace non-renewable electricity to be issued similar certificates.

Austria

Eco-Power Act 2002

Aims and targets.

- A federally-uniform purchasing and payment obligation for 'eco-electricity' plants (i.e. those run on solar energy, wind, biomass, biogas, landfill gas, sewage gas, or geothermal energy and certain kinds of waste, but excluding hydropower facilities larger than 10 megawatts).
- Target of 4% of electricity supplied to end users to come from these energy sources by 2008.
- The supply of electricity from small hydro plants should have reached 9% of the total by 2008.
- Refers to an indicative target of 78.1% for energy from renewable sources by 2010, which was annexed to EU Directive 2001/77/EC.

Incentives and sanctions.

- Minimum prices to be set for electricity from renewable sources, and obliges grid operators to buy it.
- Operators are required to treat all connection applications equally, and must certify the origin of electricity generated by registered renewable projects.
- Operators are required to pay a national uniform support fee (€0.01/kWh of energy supplied to final customers) to create a fund to cover the additional costs.
- Obligation to purchase solar electricity up to a nationwide capacity of 15 MW, and a percentage of electricity from hybrid and co-firing plants based on renewable energy.
- Combined Heat and Power (CHP) plants are eligible for support through reimbursement of operating costs, but only if used for public heating, and only if their energy use and CO2 emissions are lower than would be the case for separate electricity and heat generation systems.
- Local governments to receive funds earmarked for the promotion of new eco-electricity technologies with some exceptions, with a budget of €25 million in 2003, €15million in 2004, and €7 million in 2005.

Renewable Energy Laws

China

The Renewable Energy Law 2006

Aims and targets.

- the use of renewable energy,
- an initial target of 15% by 2020
- an investment commitment of US$180 billion over that period
- to improve the energy infrastructure, diversify energy supplies and enhance energy security.

Incentives and sanctions.

- operators to provide connections to registered renewable energy producer and to purchase power from them.
- Two forms of renewable energy pricing: a government-set price and a government-guided price.
- For biomass energy, the price is set based on the price of energy made by burning desulphurised coal, which also provides a price ceiling when the production licence is awarded through competitive tender.
- The on-grid price of wind power is set based on the bid-winning price.
- The prices of energy from solar, marine and geothermal sources are determined on an "economic and reasonable" basis.
- A government subsidy for the first 15 years of any renewable energy project, which amounts to 0.25 yuan (US $0.03) per kilowatt-hour.
- For all such projects approved after 2010, however, the subsidy decreases by 2% each year.

Czech Republic

The Act on the Promotion of Use of Renewable Sources 2005

Aims and targets.

To facilitate a steady growth in the contribution of energy from renewable sources, with an initial target of 8% by 2010 and more thereafter.

Incentives and sanctions.

- The Act offers renewable energy producers the choice of selling electricity to the national grid operator through a defined pricing structure, or else taking advantage of a Green Bonus and selling it on the open market.
- The Green Bonus is a subsidy that reflects avoided environmental costs and is related to the type and size of the production plant and of the quality of supplied electricity.
- Preferential grid connection for renewable sources is guaranteed, with the costs being borne entirely by the grid operator.
- Wind farms larger than one sq km or with a total installed capacity of 20 megawatts or more are excluded from the purview of this Act.
- Heavy fines are laid down for non-compliance, both for the grid operator and the electricity producer.

Renewable Energy Laws

United Kingdom

Draft Climate Change Bill 2007

- sets a national target for reducing targeted greenhouse gas emissions by 60% below 1990 levels by 2050.
- provides for a system of carbon budgeting;
- confers powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere;
- makes provision about adaptation to climate change;
- confers powers to make schemes for providing financial incentives to produce less domestic waste and to recycle more of what is produced;
- amend the provisions of the Energy Act 2004 about renewable transport fuel obligations
- UK has several pieces of legislation that are relevant to the use of renewables, as well as a Draft Climate Change Bill 2007, which if passed would put a limit on the greenhouse-gas emissions and

The Climate Change and Sustainable Energy Act 2006
Aim- "to make provision about the reduction of emissions of greenhouse gases, the alleviation of fuel poverty, the promotion of microgeneration and the use of heat produced from renewable sources, compliance with building regulations relating to emissions of greenhouse gases and the use of fuel and power, the renewables obligation relating to the generation and supply of electricity and the adjustment of transmission charges for electricity; and for connected purposes."

India

Draft Renewable Energy Bill

Aims and targets.
The draft was submitted in August 2007 to the Minister for New and Renewable Energy of the Government of India, who agreed to process it for Parliament's approval. The law would set a National Renewable Energy Target of 10% by 2010 of all electricity generated (excluding large hydro), rising to 20% by 2020.

Incentives and sanctions.
The proposed Renewable Law would introduce:

- Differential tariffs for renewable energy, encouraging investment in new and renewable sources and technologies.
- Preferential treatment for grid connection of renewable energy, with costs being borne by grid operators.
- Renewable obligations and certificates, including tradeable Renewable Energy Certificates created by accredited renewable energy generators.
- Regulatory support for biofuels, including a requirement for gasoline and diesel to be blended with biofuels.
- Targets for renewable energy programmes, including those to make renewable energy micro-generation more accessible in India's remote rural areas, to promote indigenous manufacture of solar energy components, to develop and commercialise hydrogen and fuel cell technology, and to promote the greater use of biofuels in electricity generation.

Resonance & Replication

- As well as meeting internal goals within Germany, the EEG also served to implement the EU Directive on Electricity from Renewable Energy Sources (2001/77/EC), which covers electricity from hydropower, biomass, landfill gas, sewage gas and biogases, as well as wind, solar and geothermal power. The EU Directive and Germany's EEG clearly influenced each other in development, with the implication that much of the impetus for the Directive came from Germany.
- In 2007, the European Council, chaired by Germany's Federal Chancellor, set ambitious targets to reduce greenhouse gas emissions and increase energy efficiency, and also agreed a binding target of a 20% share of renewable energies in overall EU energy consumption by 2020, from a baseline of around 6.6% in 2005.
- Encouraged by the success of this programme, Brazil is now testing other combinations of fuels for blending, including methane, vegetable oils, and hydrogen, and is developing a national biodiesel programme. The technologies and market models developed in Brazil have inspired and contributed to similar efforts in several other countries.
- The process by which Mauritius initiated urgent strategic dialogue between government and the private sector in a search for new ideas, and successfully negotiated a new partnership with the EU around structural reform, has been a useful model for other ACP countries facing similar challenges.

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Using CDM Projects

to advance sustainable development and reduce greenhouse gas emissions

The Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), which is supervised by the CDM Executive Board under the guidance of the Conference of the Parties. Its aim is to allow industrialised countries with a greenhouse gas (GHG) reduction commitment to invest in sustainable development projects that reduce such emissions in developing countries, and in turn earn Certified Emission Reductions (CERs). The designated national authority of the host country must decide whether a CDM project activity contributes to sustainable development in the host country. Each project must also demonstrate that reductions in greenhouse gas (GHG) emission would not have occurred without the additional incentive provided by earning CER credits.

The Clean Development Mechanism (CDM) was designed as a bilateral mechanism to encourage investment by developed-country partners into developing economies as a way to reduce their own greenhouse gas emissions, with developing countries being mere passive recipients of this investment. This was not satisfactory to a number of developing countries, which promoted a new idea at the Sixth Conference of the Parties in The Hague in 2000. They suggested instead that emission-reduction projects initiated by themselves should be supported by the CDM. This new approach was called unilateral CDM, since it would involve only one party. The aim was to provide incentives to developing countries for projects to reduce emissions, which in the form of Certified Emission Reduction (CER) credits could then be traded in the carbon market. The idea was approved by the Board in April 2005 with the registration of the first unilateral CDM project, the Cuyamapa Hydroelectric Project in Honduras. This project created an historic precedent, and completely changed the nature of the CDM.

Honduras

CDM project

The Cuyamapa Hydro-electricity Project

The Cuyamapa project, is located in the community of El Salto, Honduras, in a country that is one of the poorest in the Western Hemisphere. Honduras is a net importer of electricity, taking 356 GWh of foreign power in 2005. In 2000-2003, the contribution of fossil-fuelled power plants to total electricity production grew from 37% to 60%, while that of hydroelectricity (the only other industrial energy source in use) declined by an equivalent amount. Meanwhile, CO2 emissions increased from 4.54 to 6.03 million tonnes, a 33% increase in just three years. The Cuyamapa project established a medium-sized (12.2 megawatt) run-of-river facility that became operational in September 2006. Run-of-river projects divert only a portion of the water flow, so they avoid many of the environmental impacts of large dams. The project generates 48.19 GWh per year, reducing Honduras' dependence on foreign oil (by about 2.5 million gallons each year) and the country's annual greenhouse gas emissions by the equivalent of 35,660 tonnes of CO2. The resulting CER credits are now trading at a price of US$15-20 per tonne.

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"The registration and participation of the Cuyamapa Hydroelectric Project in the CDM process has been valuable to the sustainable development of Honduras and it has helped to break down preconceived barriers at the international level."

Roberto Nuñez,
General Manager of ENETRAN (one of the partners, alongside CABEI and EcoSecurities, in the Cuyamapa Hydroelectric Project).

China
CDM project

Though China has not imposed binding greenhouse gas emissions limits upon itself, it has taken a number of regulatory steps to reduce the intensity of its emissions. China has also identified three priority areas for CDM investments: improving energy efficiency, developing new and renewable energy, and recovering and using methane. These priority areas involve technologies for the development of which the Government has indicated its strong support, in recognition of their huge potential.

Rapid progress has been made since the adoption in October 2005 of Measures for Operation and Management of Clean Development Mechanism Projects in China. The first projects to be approved under this regulation involved selling Certified Emissions Reductions (CERs) to Annex I governments, but private buyers have since become accepted as well. These decisions are made by the National Development Reform Commission (NDRC), which is the official Designated National Authority under the Kyoto Protocol. Although the NDRC expects certain minimum prices for CERs before giving approval, it accepts real market-based transaction structures. China closely examines additional CDM project objectives, not just the reduction of greenhouse gas emissions and sales of CERs. In particular, China anticipates that the CDM will help deliver a more sustainable energy sector through efficiency and renewables.

Projects involving reduction of the highly-potent greenhouse gas trifluoromethane (HFC23) dominated the early CDM market in China, accounting for 67% of CERs in 2005. Since these projects did not provide significant sustainable development benefits, the NDRC has made such projects less attractive by imposing, in its October 2005 regulations, a 65% levy (compared with 30% for nitrous oxide and 2% for all other projects) on all CERs sold from these projects. The Chinese government reinvests this income in clean energy through its China CDM Fund, ensuring that revenue from CER funds still goes toward its intended purpose. In its eleventh five-year plan, which outlines policy to 2010, China pledged to increase the use of power from renewable sources to 15% by 2020 and increase energy efficiency by 20% by 2010.

China continues to have a dominant share of the CDM market, with 61% in 2006, and has established a relatively stable price floor for the global supply of CERs. China alone accounts for more than half of the CERs being generated by the CDM. By trading CERs, China has developed an additional revenue stream to fund local emissions reduction projects. This amounted to US$3 billion in 2006. One such project benefiting from the CER mechanism is the Jincheng coalbed methane (CBM) power plant, which will be the largest of its kind in Asia. Annually, the plant is expected to transform 180 million cubic meters of CBM gas into 730 gigawatts of electricity. Following the few large HFC23 destruction projects in late 2005 and early 2006, there were 225 projects that entered the China project pipeline in 2006. Although relatively small on average, these new projects have the potential to deliver almost twice as many expected emission reductions before 2012 as the ones prior to December 2005.

"All the data show that the carbon market is becoming a powerful financial force supporting clean development."

Karan Capoor,
World Bank, Sustainable Development Department (Africa)

Nigeria & Cameroon

Community forestry and the carbon market


One community in Nigeria and two in Cameroon were visited in 2004 and 2005, to assess the carbon mitigation potential of community forests. At approximately 330 sq km, the Ekuri community forest in Nigeria is the largest such reserve in West Africa. The Tinto community forest in Cameroon comprises a 12.95 sq km core forest area with a surrounding 13 sq km buffer zone of regenerating forest and farm fallow. The proposed Tali-Bara community forest, meanwhile, comprises 35.5 sq km of forest and farmland. Three carbon mitigation strategies were considered for each, these being reforestation, forest conservation, and reduced fuelwood consumption through the use of improved cooking stoves.

In Ekuri and Tinto, farm-fallow lands are set aside for future agriculture so they cannot wholly be restored to dense forest. Accordingly, their potential for reforestation was assessed in terms of introducing tree crops, such as Ricinodendron heudelotii and Dacryodes edulis, at a low-enough density to allow farming to occur among them at a later date. This density was assumed to be 100 trees per hectare. Even on this basis, there is significant carbon-sequestration potential for the five years 2008-2012 (i.e. the end of the first commitment period of the Kyoto Protocol), and this was estimated to be 46,998 tonnes of CO2 equivalent (tCO2e) at Ekuri and 13,650 tCO2e at Tinto. At a price of US$10/tCO2e, planting tree crops on farm-fallow land could therefore be associated with potential carbon-market values of US$469,980 at Ekuri and US$136,500 at Tinto.

From the Ekuri land-use plan, it was estimated that 55 sq km of standing forest would be set aside for conservation. For Tinto, because no forest activities were taking place in the core area, all 12.95 sq km were included as set aside. The carbon content of the two communities' protected forests was therefore estimated at 4.4 million tCO2e at Ekuri, with a value of US$44.3 million, and 1.0 million tCO2e at Tinto, with a value of US$10.5 million. Almost all local community residents interviewed in Nigeria and Cameroon were in favour of carbon credits being awarded for forest conservation (i.e. avoided deforestation). Indeed, there was a strong sentiment amongst residents that the community was making a sacrifice by refraining from exploiting their entire forested territory.

Field surveys in 2005 in Tali-Bara sought to determine patterns of fuelwood consumption in order to establish a baseline from which to estimate the amount of carbon credits that might be generated by using locally-designed cooking stoves that consume less wood than traditional ones. An experimental stove was found to reduce fuelwood consumption by 38.5%, which if used by all members of the community might reduce emissions from domestic cooking by 223 tCO2e per year, or 1,115 tCO2e over five years, potentially worth US$11,150. Extrapolating these results to the populations of Ekuri and Tinto, the universal use of improved stoves over five years would save 13,480 tCO2e (worth US$134,800) and 4,495 tCO2e (worth US$44,950) respectively.

"Emissions resulting from the net loss of forest cover must come to a complete halt within two decades and be reversed afterwards. Options to tackle deforestation include effective international and domestic forest policies coupled with economic incentives. Large scale pilot schemes are required soon to explore effective approaches combining national action and international support."

European Commission (2007)

Resonance & Replication

The Cuyamapa project thus improved the local environment and encouraged community development, while achieving meaningful greenhouse gas reductions. The project required no public funding, and overcame a variety of technological and investment barriers which have plagued similar projects, thereby showing how other small- and medium-scale hydroelectric projects can be replicated in Honduras and other developing nations. Building on this precedent, a significant number of CDM projects are now unilateral ones. Following this transformation, developing countries are no longer bystanders waiting for investment from developed countries, but can join global actions to address climate change as equal partners.

Following the Cuyamapa project in Honduras the CDM has been quietly transformed from a compliance mechanism for developed countries into an incentive mechanism for developing countries, allowing their own initiatives to help reduce greenhouse gas emissions even in the absence of binding targets to do so. Consequently, developing countries are no longer bystanders waiting for investment from developed countries, but can join global actions to address climate change and benefit from the measures that they take to reduce the emission of GHGs.

In October 2007, UNEP and UNDP announced a Joint Environment Facility that includes a Climate Partnership designed to help poorer countries implement the CDM. Initially, these will comprise Kenya, Mozambique, Tanzania, Zambia and a fifth African country to be chosen in the coming months.

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Dealing with
Urban waste

The industrial-urban model of development has driven much of the world's economy into a stage of rapid growth, accompanied by increased environmental pollution. Together with new lifestyles associated with greater affluence, this has led to rapid changes in consumption patterns, the generation of large quantities of waste and changes in waste composition. The management of the overwhelming amounts of solid waste generated by cities in particular is causing increasing problems.

Faced with such challenges, countries are starting to implement cleaner production policies and practices, although effective waste management strategies and systems are still lacking or inadequate in many, posing a serious threat to human health and the environment. Policy responses are often based on the recognition that urban wastes in particular provide opportunities to create jobs for the poor. The proper re-use and recycling of waste (its collection, sorting and processing) is labour intensive, and can provide employment for the poor and unskilled. There is also the concept of a 'Circular Economy', an economy deliberately organised to use and re-use materials and energy in an efficient cascade from which leaks are systematically minimised.

In a Circular Economy all stages of a product's life cycle are designed to contribute to waste minimisation and sustainability. This can include creating it from biodegradable or eco-friendly materials, sourcing the materials from another industry's by-products, maximising the re-usability of the product, designing-in an ability to strip down and re-use its components, minimising wastes at the end of its useable life, and using as much of it as possible for inputs into new processes.

"The problem of rubbish cannot be resolved by throwing it in your next-door neighbour's garden ... I see it as a question of the sensitivity, not of the citizens but of local government. If an administration has the courage to make certain choices, and stick with those choices, the citizens will follow ... If you explain why something is to be done, and in addition give a concrete advantage from doing it, and if you are right, the citizens will follow you, whether they are in Naples, Milan or London. They just want to understand."

Professor Giovanni Romano,
Mayor of Mercato San Severino, Naples, Italy

Italy

Recycling in Mercato San Severino

The Italian city of Naples and its surrounding suburbs and satellite towns have been struggling for decades with increasing amounts of municipal solid wastes. In the usual Italian system, rubbish is thrown every day into the municipal bin or cassonetta standing on the street. In Naples, the fate of the contents of these bins has long been affected by organised criminal groups, who arrange for rubbish to be dumped into illegal landfills, and by green groups and local protesters who prevent the opening of new legal landfills and incinerators. A crisis was reached in 2007, with huge mounds of uncollected, undifferentiated waste decaying in the streets, prompting angry residents to set them on fire. An environmental nightmare had arisen in the city of Naples.

In the Naples satellite town of Mercato San Severino (population 20,000), however, this crisis had been anticipated and avoided through a strategy based on recycling. Since 2001, the municipal bins have been removed from the streets, and citizens are asked to separate their rubbish into organic, paper and card, plastic, ferrous metal, aluminium and glass. They are required to keep the rubbish in their homes, until collected by council workers. The separated rubbish is collected on fixed days of the week, with a detailed calendar for each year being provided in advance to every household. Six kinds of colour-coded rubbish sacks are provided to each household and business, along with unique bar-code stickers with which to label them when they are put out for collection. The council weighs the sacks of each kind of rubbish from each houshold or business, and the weight is translated into credits towards council tax bills. The separated wastes are then sold to reprocessing companies.

By 2007, after six years of education and tax incentives, the town of Mercato San Severino had achieved a 60% recycling rate for household waste, more than double Britain's 27%, and higher than Germany's 57%. The nearby town of Sarno, meanwhile, has retained its municipal bins and recycles a mere 0.4% of its rubbish. The accompanying cultural change has been towards a position where rubbish is seen as a resource for tax relief, and also as a personal responsibility, one that cannot simply be offloaded onto someone else, or into someone else's environment. This shift has also enhanced openness to other environmental messages, which is exploited by the town's leadership in favour of reducing water consumption, using renewable energy sources, and sustainable consumption in general. It is supported by campaigns to install free nebulisers on taps, to reduce water use by mixing it with air, and to encourage people to install solar heating panels.

Germany
Waste Management

Before the Waste Disposal Act 1972, German waste management was rudimentary, and saw contamination of various sites through a lack of standards for treatment and disposal. There followed a gradual build-up of legislation during the 1980s that responded to increasing public perceptions of environmental harm caused by wastes, and that encouraged waste avoidance, recycling, energy recovery and proper final disposal. This got the public and businesses increasingly used to the idea that wastes should be reduced and re-used as a matter of principle.

This was taken to a new level in 1993, when German industry set up its own take-back and recycling system, financed by more than 19,000 licensees using the Green Dot as a label on their packaging and, in this way, funded the separate collection, sorting and recycling of plastic sales packaging. Within a decade of the Green Dot system being introduced, more than 20 million tonnes of used packaging were recycled, and the consumption of packaging per year had been reduced by about 1.3 million tonnes compared to 1991 levels. This laid the groundwork for a much more comprehensive commitment to the Circular Economy

Waste management legislation in Germany

1. The Closed Substance Cycle and Waste Management Act 1994 as amended 2000, which:
   - enacted the 'polluter-pays' principle.
   - made product responsibility its centrepiece with the aim of promoting the development of long-lived products that are easily repaired and that can be recycled and disposed of in the safest possible way.
   - provided a platform for Germany to develop tighter legislation to address different aspects of waste management: for separate collection of biodegradable waste from households and commerce; for composting or anaerobic digestion of biodegradable waste; for separate collection of paper and cardboard; and for banning untreated waste going to landfill.
2. Federal statutory rules were applied, along with guidelines and voluntary agreements, containing requirements for waste supervision, transport licenses, specialised waste management companies and associations, waste management concepts, waste-life-cycle analysis and requirements for the disposal and recovery of wastes.
3. Special regulations also exist for the following goods: packaging, end-of-life vehicles, batteries, electric and electronic equipment, waste oil, waste wood, commercial wastes, biodegradable wastes, sewage sludge, and hazardous wastes.
4. Voluntary agreements exist for construction and demolition waste and special paper.
5. A waste incineration ordinance based on the Federal Emission Control Act.

Germany

Waste Management

Implementation of this detailed raft of legislation in Germany, backed up by long-nurtured public support for the effort, resulted in dramatic improvements in waste management. For example, by 2005 the ban on organic waste being sent to landfill had already by far exceeded the 2016 target of the EU Landfill Directive. Meanwhile, other progressive measures were introduced, including a deposit on drinks cans from January 2003 (the deposit being increased in May 2005 to €0.25), which reduced the amount of single-use packaging, while also reducing littering and shifting consumption on a large scale to returnable containers. Meanwhile, the German paper industry agreed a voluntary code on paper recycling in 1997, and by 2001 had achieved a 65% recycled content in all paper produced. This pioneering raft of legislation continues to develop, as a result of addressing perceived needs with political will and public support. Applying circular economy principles has been shown to pay off in the long-term. Focusing on efficiency reveals potential for cost reduction within individual companies and in the economy as a whole. Additionally, the search for eco-efficient solutions in production unleashes innovative forces and creates business opportunities resulting in enhanced competitiveness not only domestically but also internationally.

Ireland

Plastic Bag Levy

The use of plastic bags has become a ubiquitous shopping experience worldwide, and the sight of shopping bags clinging to trees and barbed-wire fences is now common almost wherever there are people. Typical plastic bags do not bio-degrade but rather photo-degrade in the sun by breaking apart into small pieces of plastic dust, a process that takes between 20 and 1,000 years. These fragments contaminate the soil and waterways and enter the food chain. Many bags end up in the oceans and kill sea turtles, whales and other marine mammals that mistake them for food. Many cows, goats and other animals die by accidentally eating the bags. The burning of plastic bags releases harmful gases into the air. Collection, hauling and disposal of plastic bag waste all create additional environmental impacts. Close to four million tonnes of plastic bags, wraps and sacks are estimated to enter the waste stream every year in the US alone, putting an unnecessary burden on diminishing landfill space and causing air pollution if incinerated.

Since they are not essential items, there is a broad consensus that an across-the-board reduction in plastic bag use would be beneficial in many ways, from energy savings to reduced litter and long-term contamination of soils and waters, so should be encouraged as a matter of public policy. There are several ways to do this, ranging from outright prohibition to public education, but the middle way of price incentives – involving deposits, charges or taxes - has proved particularly effective. The Irish government has been a pioneer in the use of a levy to this end.

The Waste Management Acts 1996 and 2001 contain the Regulations which apply the levy: Waste Management (Environmental Levy) (Plastic Bag) Regulations 2001. Therefore, the Waste Management code and the Regulations share the same enforcement provisions. In addition, the Regulations adapt various provisions of the Tax Acts for the purposes of the Revenue Commissioners' functions. Enforcement is undertaken by both the Revenue Commissioners and local authorities. The tax is straightforward in concept and administration. Plastic bags at checkouts are charged at €0.15 each, unless exempted. Grounds for exemption include that they are re-usable shopping bags which are sold for €0.70 or more, or are used to contain fresh meat, fish or poultry, or are used to contain loose fruit, vegetables and other unpackaged foods, or are used to contain ice, or are used within passenger air or shipping systems. Retailers keep simple records on purchasing and receipts, while the government monitors retailer compliance and collects revenue.

"The primary purpose of the plastic bag levy is to reduce the consumption of disposable plastic bags by influencing consumer behaviour. Since its introduction on the 4 March 2002 the levy has been an outstanding success. The fall in the consumption of plastic bags has been considerable with the reduction being estimated at over 90%, while receipts collected by the Revenue Commissioners up to the end of September 2004 have realised almost €30 million."

Irish government statement on the Waste Management (Environmental Levy) (Plastic Bag) Regulations 2001

Ireland
Plastic Bag Levy

Under the new system, retailers are enjoying significant financial savings as they can stock fewer bags (in Ireland, on average, they were spending up to €45 million a year on single-use plastic bags before the tax). Many retailers also now profit from selling re-usable bags. Within two years of the levy being introduced, approximately 18 million litres of oil had been saved due to reduced production of plastic bags. The so-called 'PlasTax' also raised around €9 million in its first year, which the government ring-fenced to a 'green fund' for waste management and other environmental initiatives. Thus the overall effect of the levy has been to remove over a billion plastic bags from circulation while raising funding for future environmental initiatives. The levy has not only changed consumer behaviour in relation to disposable plastic bags, but has also raised national consciousness about the role of the individual citizen in tackling the problems of litter and waste management.

Singapore

Zero Waste

The amount of solid waste generated in Singapore each year rose by 278% between 1972 and 2000, from 0.74 to 2.80 million tonnes. The main challenges faced by Singapore are an increasing volume of industrial waste, a shortage of land for landfills, and escalating costs of incineration plants. Rapid economic and population growth continues to contribute to the burden of solid waste disposal. This is an acutely sensitive matter in a small, densely-populated country that prides itself on the quality of its environment.

The Environmental Pollution Control Act came into force in April 1999, consolidating existing legislations on the control of air, water and waste, including the Environmental Public Health Act and the regulations passed under it. Faced with an ageing workforce and difficulties in recruiting collection workers, the Ministry then privatised waste collection. The Ministry established guidelines on good practices under its "Code of Practice for Licensed General Waste Collectors" that licensed waste collectors must adhere to.

Although considerably more expensive, incineration was given priority over landfilling for the treatment of solid waste, in order to conserve the limited landfill capacity of the country. Energy is recovered for electricity generation in waste-to-energy plants. All waste incineration plants are equipped with pollution control systems. The air emission standards were revised in 2000 and specified in the Environmental Pollution Control Act. In addition to being more stringent for controlling the emission of solid particles, heavy metals and sulphur, nitrogen and carbon oxides, etc., the new standards also introduce control of new substances, such as dioxins and furans.

In 1992, the Ministry established the Waste Minimisation Department to develop, promote and direct the nationwide implementation of waste minimisation programmes. The Department launched a free waste audit programme in August 1992 and established a Green Labelling Scheme to promote 'green consumerism'.

In April 2001, the National Environment Agency launched the National Recycling Programme to provide a convenient means for all residents living in high-rise housing estates and landed properties to recycle their waste. Under the NRP, public waste collectors are required to provide door-to-door collection of recyclable materials from households every fortnight. To supplement this, recycling bins were placed in public areas, most of them being set up and maintained by the private sector.

By 2002, Singapore's waste reduction strategy had established the aims of reducing the volume produced, reducing the amount sent to landfill, and increasing recycling, against a long-term goal of zero landfill and zero waste. In that year, the country's strategy for environmental sustainability was launched, under the name of the Singapore

"Sustainability in solid waste management is now a growing concern all over the world. Several countries are looking beyond 'towards zero landfill'. They are now striving 'towards zero waste'."

Lim Swee Say,
Former Minister for the Environment, Singapore

Singapore
Zero Waste

Green Plan 2012. Targets outlined in this are to increase the overall recycling rate to 60% by 2012, to reduce the need for new incineration plants from one in every 5-7 years to one in every 10-15 years, extend the lifespan of the offshore Semakau Landfill to 50 years, and to strive towards zero landfill by closing the waste loop.

Recycling rates in Singapore are similar to or greater than rates in many countries in Europe and the USA. The shortage of landfills for waste disposal is the major factor encouraging recycling and this will only intensify because of the limited availability of land. Efforts to reduce waste in Singapore caused the amounts produced to fall from 7,600 tonnes/day in 2000 to 7,000 tonnes/day in 2006. Recycling rates rose from 40% to 49% between 2000 and 2005. Incineration disposes of 91% of the total waste, 57% of which is from residences, food centres and markets, and the rest from commerce and industry.

Through campaigns such as 'Recycling Day', and 'Clean and Green Week', people's awareness about recycling is growing, and by December 2005, 56% of all Singapore households had taken part in the National Recycling Programme. There is now a reduced need for new incineration plant, from one in every 5-7 years to one in every 8-10 years. The lifespan of Semakau Landfill has been extended from 25-30 years to 35-40 years.

The National Environmental Agency works closely with NGOs to bring partners and sponsors on board. It also sets up initiatives like the US$20 million Innovation for Environmental Sustainability (IES) scheme to fund the testing of technologies with commercial value. For example, IES funding was used to develop technology with which to recycle wood waste into pallets and corner boards. Another company introduced a One Stop Plastic Recycling Operation to buy back post-consumer plastic wastes, winning an Enterprise 50 Award in 2005 for innovation and enterprise.

Resonance & Replication

- The recycling system of Mercato San Severino has been introduced in 20 municipalities in the Naples region, and many more in northern Italy.
- Germany's waste management aspects of the circular economy led to other countries developing similar policies and laws. In Japan the Basic Law for Promoting the Creation of a Recycling-oriented Society provides a legislative framework for such a society, and rules for other recycling-related laws and regulations. The 'Extended Producer Responsibility' policy is also helping to shift the waste management burden from the public to the private sector.
- China has adopted the concept of the circular economy, in which all economic activities pursue low resource use, maximum efficiency, and low waste generation, with one facility's waste energy, water and materials becoming another facility's inputs.
- The policy goal of 'zero waste' was adopted by Canberra, Australia in 1995, and has since spread to local governments elsewhere in Australia as well as in the USA, Canada, New Zealand, Japan, and most recently in Argentina and South Africa.

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Disposing of
Electronic Waste

The use of electrical and electronic technologies has come to define 21st century life, and products like computers, TVs, radios, telephones, MP3 players, navigation systems, microwave ovens, coffee makers, toasters, hair-dryers and refrigerators are ubiquitous. Not surprisingly, e-scrap and e-waste are among the fastest-growing components of the global waste stream, and are arguably among the most troublesome. About 40 million tonnes of e-waste are generated worldwide each year.

E-waste contains significant amounts of material that is toxic, hazardous or otherwise environmentally harmful, and can cause serious health and environmental impacts if not properly disposed of or recycled. The materials of most concern include brominated flame retardants, cadmium, chromium VI, lead, mercury and PVC plastic. Landfills, though widely used for waste disposal, may leak, and e-waste contained within them can release heavy metals and other toxic substances like mercury, cadmium and lead into the soil, groundwater and atmosphere.

If recycling is well managed, however, considerable amounts of valuable material can be recovered from e-waste, including precious metals such as gold, palladium and silver, and also less well-known metals that have become increasingly important in electronics. These include niobium and tantalum (both used in capacitors), bismuth (used in lead-free solders), ruthenium (used in resistors and hard disk drives) and indium (used in more than a billion products each year, including flat-screen monitors and mobile phones), the prices of which have been driven up dramatically over the past decade.

The EU
Waste Electrical & Electronic Equipment Directive

Several EU laws aim to promote reduction and better management of wastes, including the 'WEEE' Directive on Waste Electrical and Electronic Equipment 2002/96/EC), and the 'RoHS' Directive on the Restriction of Certain Hazardous Substances (2002/95/EC), as well as other laws on landfill and incineration. The WEEE Directive demands increased recycling of electrical and electronic equipment (EEE) and that producers be responsible for taking back and recycling it. It also requires that consumers should be able to return their EEE free of charge and, reinforcing the RoHS Directive, that lead, mercury, cadmium, hexavalent chromium and brominated flame retardants must be replaced in new EEE by January 2008.

"... the amount of WEEE material that has been recycled by Irish householders is a national success story ... The emphasis in August 2005 was in establishing a viable and sustainable WEEE take back system and this has now been done ... this is demonstrated in the collection of 7.4 Kgs of household WEEE for recycling in 2006, almost double the 4 Kgs target the WEEE Directive requires Ireland to achieve by the end of 2008".

John Gormley TD,
Minister for the Environment, Heritage and Local Government, Republic of Ireland

Retailers must provide free in-store take back for old electrical and electronic equipment from customers. This must be done on a one-for-one, like-for-like basis. This means that the old product must be of the same type or have fulfilled the same function as the new item purchased. For example a consumer buying a toaster may return a toaster but a consumer buying a computer may not return a toaster with that particular purchase. A retailer may, with the permission of their local authority, put in place alternative arrangements for take-back. This alternative must not be less convenient for the customer than returning the waste to the shop when buying a new product.

If a new product is being delivered to a customer's home retailers cannot charge for collection of the waste equipment (although a retailer can charge a delivery fee). Retailers must give 24 hours notice of delivery and the old item must be disconnected from all utilities. If one does not avail of the free collection of waste equipment on delivery of new equipment, then there will be a period of 30 days to return it to the retailer's premises if one wishes to avail of free retailer take back.

Ireland

Retailer take back

Since the 13th August 2005, Irish retailers of electrical and electronic equipment have a number of obligations in relation to waste from electrical and electronic equipment. They must:

- Register with their local authority
- Provide free in-store take back for customers buying new electrical equipment
- Ensure that waste electrical products are stored and transported to an approved collection facility appropriately
- Ensure that consumers of electrical equipment are aware of take-back options available to them.

Irish Legislation for the implementation of the EU WEEE & RoHS

The Waste Management Acts, 1996-2003 gaive the necessary powers to local authorities to regulate specific waste streams, like waste from electric and electronic equipment, and allowed for "producer responsibility" obligations where they are considered necessary. This provides the basis of Ireland's transposition of the WEEE and RoHS Directives into national law. The legislation transposing the WEEE and RoHS Directives consists of three sets of regulations:

- S.I. 290 of 2005 - amending the Waste Management Acts 1996 to 2003 in accordance with the provisions of section 62 of the Waste Management Act 1996 in order to provide the enabling provisions under which the detailed regulations for the two Directives will operate;
- S.I. 340 of 2005 - implementation arrangements for the WEEE Directive; and
- S.I. 341 of 2005 - implementation arrangements for the RoHS Directive.

Switzerland
Pioneering E-waste Recycling

In 1991, Switzerland implemented the world's first industry-wide electronic waste recycling system. The programme began with the collection of refrigerators, but was extended over the years to cover all other electric and electronic devices. Long before they became legally required, two independent 'Producer Responsibility Organisations' began e-waste take-back activities based on the principle of Extended Producer Responsibility. One, known as SWICO, mainly handles electronic waste ('brown goods' such as computers and TVs), while the other, called SENS, is mainly responsible for electrical appliances ('white goods' such as refrigerators and ovens).

Legislation followed in 1998, with the Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Appliances (ORDEA). Since January, 2005 it has been possible to return all electronic waste to the point of sale and other collection points free of charge. The key feature of the system is secured financing of the collection and recycling by charging an Advance Recycling Fee (ARF) on all new appliances. The ARF is used to pay for the collection, the transport and the recycling of the disposed appliances. Furthermore, the ARF finances the take back of old equipment bought before the implementation of the fee.

The Swiss Ordinance on the Return, the Taking Back and the Disposal of Electrical and Electronic Appliances (ORDEA)

This law forms the legal framework allowing the industrial and commercial sectors to establish tailored and efficient return and recycling schemes. The Ordinance takes into account the regulations on co-operation between Federal Council and private sector that Parliament included in the revised Law Relating to the Protection of the Environment. The ORDEA came into force on 1 July 1998. Its provisions require the following:

- Users of electrical and electronic appliances must bring worn-out appliances back to the manufacturer, importer, dealer or to a specialised disposal firm.
- Manufacturers, importers and dealers of electrical and electronic appliances are obliged to take back worn-out appliances.
- Worn-out appliances must be recycled or finally disposed of in an environmentally sound way, by the most technically up-to-date means. The ORDEA also contains criteria for the environmentally sound disposal of worn-out appliances.
- Anyone who accepts appliances for disposal in Switzerland requires a cantonal permit. Export of appliances for disposal must be authorised by SAEFL.

Switzerland
Pioneering E-waste Recycling

In 2003, SWICO and SENS had 500 official collection points around Switzerland, in addition to the thousands of retail locations which have to take back old equipment free of charge, irrespective of the brand or year of manufacture. This makes it easier for consumers to dispose of their e-waste at convenient locations. By having common collection points, the two organisations are better able to manage logistics, benefit from economies of scale and provide a consumer friendly, all-inclusive solution rather than a prohibitively expensive brand-specific one. As a result, in 2003 the system collected 68,000 tonnes of e-waste, corresponding to a little over 9 kg/person or more than double the 4 kg/person target set by the EU WEEE Directive in 2002. The steady expansion of e-waste legislation among European countries is illustrated in the following table.

The Swiss State Secretariat for Economic Affairs (SECO) has funded a programme, implemented by the Swiss Federal Institute of Material Science and Technology (EMPA), which has been working in India, China, South Africa and elsewhere. It analyses current e-waste disposal and recycling streams, and provides inputs for the improvement of their e-waste management systems. Field studies have shown that each country's system has unique characteristics, so any legislation would have to take these systems into account to overcome the challenges they pose as well as build on the opportunities they provide.

Switzerland

Pioneering E-waste Recycling

E-waste legislation in Europe (selected countries, status as of July 2006)

COUNTRY	LEGISLATION	RESPONSIBILITY	ENTRY INTO FORCE
Switzerland	Ordinance on the Return, Taking back and Disposal of Electrical and Electronic Equipment. (ORDEE)	Manufacturer/Importer	July 1998
Denmark	Statutory Order from the Ministry of Environment and Energy No. 1067	Local Govt.	December 1999
Netherlands	Disposal of White and Brown Goods Decree1	Manufacturer/Importer	January 1999
Norway	Regulations regarding Scrapped Electrical and Electronic Products	Manufacturer/Importer	July 1999
Belgium	Environmental Policy Agreements on the take-back obligation for waste from electrical and electronic equipment	Manufacturer/Importer	March 2001
Sweden	The Producer Responsibility for Electrical and	Manufacturer/Importer	July 2001
Finland	Ordinance on Electrical and Electronic Waste	Manufacturer/Importer	September 2004
Germany	Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment (ElektroG)	Manufacturer/ Importer	March 2005
Ireland	SI 340 Waste Management (Waste Electrical And Electronic Equipment) Regulations	Manufacturer/Importer	July 2005
Austria	Electro Ordinance (EAGVerordnung)	Manufacturer/Importer	August 2005

Resonance & Replication

The WEEE Directive brought the issue of e-waste to national attention throughout the EU and itself generated lessons for the future. South Korea, Japan and Taiwan have followed the EU in requiring that sellers and manufacturers of electronics be responsible for recycling 75% of them. In the USA several states have passed their own laws on e-waste management. California was the first, followed by Maryland, Maine, Washington, Minnesota, Oregon and Texas. Canada has added a disposal fee to the cost of purchasing new televisions, computers, and computer components in British Columbia, while recycling was made mandatory for all such products.

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Cleaning Up
Toxic Waste

Industrial civilization produces millions of chemicals in the course of its economic activities – principally mining, manufacture, farming, transport and energy generation – and the list of those that are considered to be toxic increases every year with biomedical research. The lack of application of a precautionary approach in the production and use of chemicals means that the modern world is awash in toxic chemicals, the dangers of which are only gradually becoming apparent.

Managing toxic chemicals and hazardous wastes requires:

- a sound legal and institutional infrastructure,
- the construction and operation of hazardous-waste management facilities using public funds, private investment, or a combination of the two, and
- influencing the behaviour of generators and operators of hazardous waste management facilities to ensure that waste is properly managed.

Germany, Denmark, the USA and Canada all began the process during the 1970s, and for the most part their regulatory programmes were fully operational by the end of the 1980s. Subsequent laws and policies have focused mainly on encouraging waste minimization and recycling. Malaysia, Thailand and Indonesia, meanwhile, began focusing serious attention on hazardous waste management in the late 1980s and early 1990s, and are still some way from having what most would describe as fully operational programmes.

The case studies that follow describe efforts to achieve cross-border cooperation in managing toxic wastes and cleaning shared ecosystems.

The Rhine

Cleaning The Rhine Action Plan

"The river Rhine, it is well known
Doth wash your city of Cologne
But tell me, Nymphs, what power divine
Shall henceforth wash the river Rhine?"
Samuel Coleridge

The Rhine, one of Europe's great rivers, flows down from the Swiss Alps and passes through eastern France into Germany's Ruhr Valley and the Netherlands. Even in the early 19th century, the river was a byword for pollution. Between 1900 and 1977, concentrations of chromium, copper, nickel and zinc rose to toxic levels. Fish almost disappeared from the middle and upper Rhine by the 1950s. Apart from poisoning the river, pollution from French and German industry was threatening drinking water and the flower industry in the Netherlands.

Almost the final straw was an ecological catastrophe that hit the Rhine in 1986, when fire destroyed a storage building at a Sandoz chemicals factory near Basel, Switzerland. The building held poisonous agricultural chemicals, and water sprayed by fire-fighters washed about 30 tonnes of pesticides and mercury into the Rhine. This lethal cocktail then flowed onwards through Switzerland, Germany, France and Holland before reaching the North Sea, killing or deforming everything in its wake. This was just the most spectacular pollution event in the slow poisoning of the river by urban, industrial and agricultural run-offs and effluents.

The clean-up of the Rhine began rather tentatively after the Second World War. In 1950, France, Germany, Luxembourg, the Netherlands and Switzerland established the International Commission for the Protection of the Rhine (ICPR). The 1986 Sandoz disaster stimulated more effective cooperation. For then Europeans dramatically boosted their goals for the ecological rehabilitation of the Rhine. The 1987 Rhine Action Plan firmly established the idea that the Rhine was a total ecological system, rather than a dead drain for northern Europe, where fish should one day thrive again. Major spending commitments were made, and tough targets adopted for the main pollutants of concern. When floods occurred in 1993, ICPR activities expanded to include flood protection. The following year a new Rhine Treaty was signed, and in 2001 the 2020 Programme for Sustainable Development of the Rhine was adopted.

- By 1992, implementation of the 1987 plan had cut the amount of cadmium in the Rhine by 34%, mercury and zinc by 47%, the herbicide atrasine (which is implicated in feminising amphibians) by 63%, and polychlorinated biphenyls or PCBs (which are persistent toxic carcinogens) by 77%.

- By 2006, €60 billion had been spent on water purification, at least 60 species of fish had returned to the river, and the Rhine had become a World Heritage Site.

- The remaining problems largely involve agrochemicals leaking from groundwater. To solve these would require much broader reforms to agriculture throughout the Rhine catchment, including the wholesale introduction of organic farming.

The Rhine

Cleaning The Rhine Action Plan

The ICPR is now an effective intergovernmental body to which member states must report their actions. It has a plenary assembly, secretariat and technical bodies—and considerable political authority through a ministers' conference, which can make politically binding decisions. Nongovernmental organizations have observer status, which facilitates public participation. Such cooperative structures and institutions take time to develop, and they work best with high-level political leadership.

"... institutional cooperation can unlock a wide range of mutually reinforcing benefits across borders. As governments and the public in riparian countries have seen the benefits of cooperation emerging, so the authority and legitimacy of these institutions have strengthened. But successful cooperation has taken large investments of both financial and political capital."

2006 Human Development Report by the United Nations Development Programme

American Great Lakes

The five Great Lakes of the USA and Canada are Huron, Superior, Erie, Michigan and Ontario. Four of them straddle the US-Canada border and touch the Canadian province of Ontario, while the fifth, Lake Michigan, is entirely within the USA. The Saint Lawrence River, which marks the international border for a portion of its course, is a primary outlet of these interconnected lakes, and flows through Quebec and past the Gaspé Peninsula to the northern Atlantic Ocean. The Great Lakes have more than half of North America's heavy industry in their catchments, so the basin ecosystem as a whole is at serious risk of pollution and has accumulated a burden of such persistent pollutants as mercury, dioxins, furans and polychlorinated biphenyls (PCBs). The Great Lakes supply drinking water to tens of millions of people, and the water resource is collectively administered by the state and provincial governments adjacent to the lakes. The combination of pollution vulnerability and social utility has made the elimination of dangerous pollutants a priority for all lake management institutions.

The International Joint Commission (IJC) was established by the USA and Canada under the International Boundary Waters Treaty of 1909. Its aim is to help prevent and resolve disputes about the use and quality of boundary waters and to advise the two countries on related issues. Although the Commission investigates issues only when requested to do so by both nations, and its recommendations are not binding, it nevertheless provides an important forum for issues to be addressed. It also assists the two countries in the implementation of the Great Lakes Water Quality Agreement of 1978, as amended in 1987. A model for success in cleaning up the Great Lakes is provided in the form of the 1994 Canada-Ontario Agreement on Respecting the Great Lakes Basin Ecosystem (COA).

The 1994 COA achieved considerable progress in developing pollution control and pollution prevention instruments, both regulatory and non-regulatory, augmented by restrictions, bans and phase-outs of specific compounds and classes of compounds. By 2002, significant reductions had been achieved in the production, use, release and/or unsafe disposal of many listed chemicals, including (compared to 1988 figures) 86% for PCBs, 85% for mercury and 84% for dioxins/furans. The amount of mercury released into the Great Lakes Basin had dropped from more than 14 tonnes a year in 1988 to just under 2.4 tonnes. This was due to a dramatic reduction in mercury from paint and household batteries, the virtual elimination of the use of mercury-based fungicides, and reductions in emissions from sewage sludge and biomedical waste incineration. Less progress had been made in other areas, however, with only a 45% reduction in benzopyrene and 62% for hexachlorobenzene.

It was recognised that eliminating the last of these persistent pollutants would require an even greater investment in effort, resourcefulness and ingenuity, and this was the main aim of the renewed COA that was signed in March 2002. The goals set out in the 2002 COA include (against the 1988 baseline) a 90% reduction in mercury releases by 2010, and a 90% reduction in the release of dioxins and furans by 2005.

American Great Lakes

Reducing releases of Mercury

Under the new COA, both governments will take steps to further reduce the use and release of mercury to the environment. Actions include encouraging the use of substitute products (mercury-free alternatives), alternative fuels and better technology to reduce and monitor mercury pollution. Additional activities include expanding recycling programs, decommissioning current mercury sources and the cleaning up of mercury-contaminated sediment and historic contamination. Cooperative programs with business, industry and local community groups are essential to the continued success of these efforts.]

The total elimination of persistent pollutants has proven to require the implementation of a broad range of regulatory instruments, combined with diligent education and significant investment. These have included the following.

For PCBs, the number of PCB storage sites was reduced, as was the amount of high-level PCB waste in storage, while new regulations were developed for PCB phase-out, destruction and/or harmonization of import and export regulations.

For mercury, new provincial regulations required dental amalgam separators to be installed in dental practices and laboratories, best-practices flowcharts were published for the management of dental amalgam and mercury wastes within dental practices, a Model Municipal Mercury Policy was developed to help municipalities eliminate the use of mercury in equipment such as thermostats and lights, 20,000 mercury switches were removed from cars before disposal, and mercury control equipment was installed at other potential emission sources.

For dioxins and furans, Canada-wide standards were adopted for dioxins/furans from steel manufacturing and iron sintering plants, compliance with which would reduce emissions by an estimated 72% by 2010, and new provincial regulations closed down all hospital incinerators.For air pollution, new provincial regulations required a 53% reduction in nitrogen oxides and a 25% reduction in sulphur dioxide emissions from Ontario's power stations by 2007, a lakeside coal-burning facility was closed in 2005, and Ontario's Smog Patrol inspected tens of thousands of vehicles.

For hexachlorobenzene, new federal regulations limited its content in products such as coagulants used in municipal wastewater treatment, an Ontario Municipal Discharge Strategy was developed, as was a long-term, nationwide strategy for reducing releases from municipal wastewater systems.

Combined with voluntary agreements, inventory projects, pollution-tracking activities and public education efforts, the COA strategy is placing steady pressure on the continued release of persistent pollutants.

"... while the importance of a sound scientific basis for conclusions and recommendations should be emphasized, it may sometimes be necessary to adopt a precautionary approach and act even in the absence of a scientific consensus where prudence is essential to protect public welfare".

International Joint Commission (2006)

Resonance & Replication

- **The Rhine and the Danube.** In 1991, all the states located in the drainage basin another of Europe's great rivers agreed to develop what became the Danube Convention, which came into force in 1998 and established the International Commission for the Protection of the Danube River (ICPDR). Serbia and Montenegro acceded to the treaty in 2002, Bosnia and Herzegovina in 2004. Since 2001, when the Danube-Black Sea Strategic Partnership for Nutrient Reduction commenced, a GEF investment of about US$100 million has leveraged nearly US$500 million in co-financing, with additional investments by the EU, the EBRD and others totalling US$3.3 billion. The Black Sea and Danube River ecosystems are recovering from serious eutrophication in the 1970s and 1980s, oxygen depletion has greatly declined, species diversity has doubled from 1980 levels, and the Black Sea ecosystem is well on its way to conditions last seen in the 1960s.
- **The Great Lakes Binational Toxics** Strategy. The COA is embedded in a collaborative network that includes the US Environmental Protection Agency and the 1997 Great Lakes Binational Toxics Strategy. The latter provides a framework for actions to reduce or eliminate persistent toxic substances, especially those which bioaccumulate, from the Great Lakes Basin. It establishes reduction challenges for an initial list of persistent toxic substances targeted for virtual elimination: aldrin/dieldrin, benzo(a)pyrene, chlordane, DDT, hexachlorobenzene, alkyl-lead, mercury and its compounds, mirex (perchloropentacyclodecane), octachlorostyrene, PCBs, dioxins and furans, and toxaphene. Since most of the chemicals targeted by the strategy are persistent organic pollutants, its implementation is connected to the requirements of the Stockholm Convention on this class of chemicals, which in 2001 Canada became the first country to ratify.

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Making Best Use
of Water Supplies and Catchments

Water is central to all life on Earth. How we manage our ecosystems and the services they provide will ultimately determine our ability to manage water supplies and our chances of meeting the Millennium Development Goals by 2015 and beyond. Over a billion people lack access to adequate water supply and more than 2.5 billion have inadequate sanitation, causing millions of illnesses and deaths every year, mostly among children. We now use over 3,000 km3 of fresh water each year, with irrigation taking some 70% and rising, but industry's needs are also growing, and are expected to reach a quarter of all fresh water by 2025. That would leave little or nothing at all for domestic use in cities, where half the world's population already live, and where two-thirds will live by 2050, unless we succeed in creating a universal mind set in favour of water conservation and protection of water-bearing ecosystems.

The regular supply of fresh water depends on healthy ecosystems, especially catchment forests and wetlands, and crises of water scarcity, distribution and quality are inevitable consequences of abusing them. Natural forests have been catastrophically reduced in many countries, and widely lost, fragmented and degraded elsewhere. Decision-makers have often fallen into the trap of seeing wetlands as cheap, reclaimable or disposable wastelands, so these ecosystems have been devastated by drainage, dams, pollution, construction, farming and fire. Lakes have often been seen only as sources for irrigation, and their catchments as suitable for farming, logging and settlement, without attention to the one-way flow of agrochemicals, sewage and eroded silt into the lake, or its sump-like vulnerability to accumulating toxins.

Protecting and restoring catchment ecosystems has therefore become one of the most urgent global challenges for ensuring even the minimum supply of water to meet the basic needs of an ever increasing population. The following success stories illustrate two aspects to this, one concerning a grass-roots movement in India, and the other a major city in the USA.

India

Catchment restoration & aquifer recharge in Rajasthan

Early in the 20th century, the Aravalli hills in the Alwar district of Rajasthan were well treed, with waterfalls and abundant and diverse wild animals and plants despite an average annual rainfall of only about 60 cm. But over time the situation changed for the worse. The forests suffered from over-grazing and the extraction of wood for charcoal and fuel. Wildlife declined and groundwater reserves diminished. The human population increased, and destructive patterns of drought and emigration emerged. Eventually, the river Aravari remained dry except during the monsoon rains. Famine in 1983-1987 severely impacted millions of villagers in Rajasthan.

Then, in 1984, the youth organization Tarun Bharat Sangh (TBS) became active in the area. Guided by community activist Shri Rajendra Singh, who later won the Ramon Magsaysay Award for community leadership on behalf of the TBS, they began working with local villagers to try to revitalise local water resources. Thus mobilised, the villagers undertook to build a series of check dams and to re-build johads (ponds), the traditional tank system for water harvesting, so using ancient techniques designed to recharge the aquifers and rehabilitate the catchments. The johads and check dams slowed run-off and allowed water to seep into the ground, recharging aquifers and re-establishing the water balance, while also reducing soil erosion.

The early lack of shared perception was partly because the approach being used was an holistic one, being known as jal-jameen-jungle ('water-soil-forest'), with forests, aquifers, rivers and fields all being seen as connected and needing to be managed as one system, with all stakeholders acting collectively. What crops are grown, how much ground cover exists, depletion rates from aquifers and rivers, all interact to determine whether or not the system is healthy or not. The planning, decision-making and monitoring of all work was done by the local people themselves.

Recognising the need for participation and public support was the impetus for creating an Aravari Sansar, a council or parliament in which two representatives from each of 72 villages meet six times a year to discuss the management of rivers and catchments. Working with the district administration and the police, the Sansar deals with threats to catchments and aquifers. While there have been some jurisdictional issues, the people of the villages claim the right to manage their water resources.

India

Catchment restoration & aquifer recharge in Rajasthan

- From a modest start in the mid-1980s, with three men from TBS manually desilting a tank at the suggestion of a village elder, the project has had phenomenal results.
- As the story of the initial Alwar village success in working with johads spread, people came to see for themselves. This provided energy for a paryatra (a people's walk) to spread the message further. The approach has now been replicated in over 700 villages across Alwar and in parts of other districts as well. Almost 7,000 old and new water bodies have been built or restored, and five previously dead rivers now flow again, including the Aravari and Ruparel, which have flowed anew since 1994.
- Forest cover has increased despite the continuing scarcity of rainfall. People, through self-governance, are more disciplined about protecting the ground cover, maintaining water harvesting and limiting water usage. Crops are once again harvested regularly, and the water table has risen by about 30 metres..
- Rajendra Singh, the leader of TBS, himself admits at being startled by the results. After witnessing the virtual destruction of their catchments by decades of mismanagement, over-use, pollution and neglect, the villagers decided to work together to restore what had become a desert and to retake control of their environment. The results have included previously dry rivers once more flowing through parched land, forests, fish and wildlife re-emerging, and people returning to villages that previously offered no hope for future prosperity.
- For many, this has become an inspiring story of community involvement and personal commitment, as well as a model for successful rainwater harvesting.

New York City

Sustainable water supply Catskill & Watersheds

New York City has long provided one of the earliest and clearest examples of an ecological service in action. It has historically expanded its water supply system by securing lands and water resources in its rural hinterland. This started with the acquisition of forest land in the Croton catchment and the construction of the Croton Aqueduct system in the mid-19th century. It continued with land acquisitions in the Catskill and Delaware catchments and construction of the 190 km Catskill Aqueduct, starting in the early 20th century.

The drivers of this water strategy have always been the assumption that fresh water released from an intact forested catchment would be fit to drink without further treatment, but that preventing harm to the catchment forests would best be achieved if the City has actual ownership (or other direct control) over activities within the catchment. Based on these assumptions, it was considered more cost effective to acquire control over catchment lands and protect their forests, than to invest in expensive water filtration or other treatment facilities.

By these means, the City secured a reliable water supply of about five billion litres of water daily for over nine million consumers in the City and several suburban counties. This supply is delivered by means of a complex network of reservoirs, aqueducts, tunnels and pipes. The system depends on a 5,200 square kilometre catchment that spans eight counties in New York State, some 73% of which is under forest.

It comprises the Delaware system (about 2,600 sq km), the Catskill system (about 1,600 sq km) and the Croton system (about 1,000 sq km). The City of New York owns over 433 sq km of this land, including 134 sq km of reservoirs, in the three catchments. It also has easement agreements covering a small part of the catchment area. Another 20% of the area is protected as New York State Forest Preserve, but the remaining 70% or more is privately owned and occupied by over 207,000 people, necessitating dialogue and negotiation with stakeholders to minimise threats to catchment function.

To maintain its water supply arrangements and avoid the cost of major investment in filtration facilities, the City of New York had to remain exempt from federal regulations which require municipal suppliers to filter drinking water from surface sources, a rule designed to protect public health. To do this, it would have to convince the Federal Environmental Protection Agency (EPA) that it had put in place a catchment management programme able to safeguard the public from waterborne disease.

A series of complex negotiations therefore began, to secure a waiver from the filtration requirements of the federal Surface Water Treatment Rule. These negotiations involved the City, EPA, upstate communities, New York State agencies, and environmentalists. The outcome in 1997 was that a ten-year filtration avoidance determination was secured from the EPA, a water supply permit was granted by the state, and a Memorandum of Agreement (MoA) was finalised among all the parties.

New York City

Sustainable water supply Catskill & Watersheds

The success of this arrangement was confirmed in July 2007, when New York State's environmental and health commissioners announced a 10-year extension agreed to by federal, state and New York City officials to protect the Catskill/Delaware catchment. This Filtration Avoidance Determination, continues and expands a number of core programmes critical to water quality protection.

These include community and wastewater management, septic repair and replacement, land acquisition, forest easements and riparian and buffer programmes. The continuing MoA, of which the filtration waiver is a vital foundation, is an experiment in taking shared responsibility for catchment protection, and its renewal is both a testament to the innovative cooperative efforts of wide variety of catchment stakeholders, and a reminder of what is possible when committed individuals and agencies strive to achieve effective, forward-looking environmental stewardship.

" By protecting the watershed at its source, we avoid spending the estimated $8 billion to $10 billion to build a filtration plant and the $400 million in annual maintenance and operation costs. New York State is a committed steward of the watershed."

Pete Grannis,
Commissioner of the New York State Department of Environmental Conservation

Resonance & Replication

- The TBS has had great impact in over 150 villages directly, but also across India and around the world by reputation. The Swadhyaya movement achieved similar results in Gujarat, constructing close to 1,000 percolation wells (nirmal neers) and recharging 100,000 community wells that made participating villages effectively immune to the 2000 drought. Many are now advocating solutions based on local and traditional measures such as the restoration of johads throughout India.
- A UNEP mission to Indonesia in 2006, discussed water security with the government of Yogyakarta, in Java, Indonesia. Here, virtually the entire water supply for the city of Yogyakarta (population about one million) is drawn from a small catchment within a national park on the sparsely-forested middle slopes of the south side of Mt Merapi. An opportunity was seen to finance the protection of these forests by taxing water users in Yogyakarta and using the revenues to pay local people to manage the forest. This was accepted as desirable by the Yogyakarta government and is consistent with national policy, but its implementation would require a detailed water valuation study to provide a basis for water pricing, a feasibility study to design appropriate institutional and financial mechanisms, and consensus amongst the provincial and district government, the Ministry of Forestry (which is responsible for national parks), and local people.

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Payments
for Ecosystem Services

The benefits that people get from the workings of ecosystems are known as ecosystem services (ES). The United Nations' Millennium Ecosystem Assessment classifies such services as: a) provisioning (supply of food, fresh water, wood and fibre, and fuel), b); regulating (influencing climate and weather, floods and disease, and purifying water); c) cultural (providing aesthetic, spiritual, educational and recreational satisfaction) and d) supporting (through nutrient cycling, soil formation and primary production). These services are essential to human well-being, but in the modern world their true value is seldom fully taken into account.

Among the key messages of the Millennium Ecosystem Assessment are that:

- Everyone in the world depends on nature and ecosystem services to provide the conditions for a decent, healthy, and secure life.
- Humans have made unprecedented changes to ecosystems in recent decades to meet growing demands for food, fresh water, fibre, and energy.
- These changes have helped to improve the lives of billions, but at the same time they weakened nature's ability to deliver other key services such as purification of air and water, protection from disasters, and the provision of medicines.
- Major outstanding problems include the dire state of many of the world's fish stocks, the intense vulnerability of the 2 billion people living in dry regions to the loss of ecosystem services, including water supply, and the growing threat to ecosystems from climate change and nutrient pollution.
- Human activities have taken the planet to the edge of a massive wave of species extinctions, further threatening our own well-being.

Costa Rica

"What we're building up is not the same as what was there, but we have a good shot at preserving Costa Rica's biodiversity and forests for the future." "You can not go from zero to a payment of environmental services system in any country. You have to go step by step. Certainly, with the experience of Costa Rica and others, you can avoid many mistakes."

Alvaro Umaña,
Costa Rica's first Minister of Natural Resources and Environment

More than half of Costa Rica was covered by forest in 1950. Forest cover declined rapidly over the following decades, falling to 24% by 1985. Agriculture, particularly pasture, replaced the forest. Conversion was driven by rapid expansion of the road system, cheap credit for cattle, and land titling laws that encouraged deforestation.

Costa Rica undertook one of the first national efforts to value ecosystem services. In the 1970s, concerned about rapid deforestation, the government began to offer incentives for timber plantations, primarily in the form of tax rebates. The system comprised a number of forest accreditations, the most significant being the Forest Protection Certificate (Certificado para la Protección del Bosque, CPB) in 1995, which supported forest conservation rather than timber production. In 1997, The Payments for Environmental Services or Pago por Servicios Ambientales (PSA) built on this base with two key changes. Forest Law No. 7575 changed the rationale for payments from support for the timber industry to the provision of environmental services, and it changed the source of financing from the government budget to an earmarked tax and payments from beneficiaries.

Forestry Law No. 7575

Explicitly recognized four environmental services provided by forest ecosystems: (i) mitigation of GHG emissions; (ii) hydrological services, including provision of water for human consumption, irrigation, and energy production; (iii) biodiversity conservation; and (iv) provision of scenic beauty for recreation and ecotourism.

The law: (a) delegates responsibilities and duties inter alia to licensed foresters, the Ministry of Environment and Energy (MINAE), the National Forestry Financing Fund (FONAFIFO), the National System of Conservation Areas (SINAC), and the Costa Rican Office for Joint Implementation (OCIC); (b) provides the legal and regulatory basis to contract with landowners for environmental services provided by their lands, and establishes a financing mechanism for this purpose; and (c) empowers FONAFIFO to issue such contracts for the environmental services provided by privately-owned forest ecosystems.

With the passage of Forestry Law No. 7575, the forestry sector has established a modern legal framework, which
(i) recognizes environmental services provided by forest ecosystems;
(ii) defines the role of the State in protecting forests as well as in promoting and facilitating private sector activities;
(iii) decentralizes duties and responsibilities to local actors; and

Costa Rica

(iv) establishes that forests may only be harvested if there exists a forestry management plan that complies with the criteria for sustainable forestry as approved by the State.
Regulations within Forestry Law No. 7575 establish the conditions for and levels of environmental service payments (PSAs) through FONAFIFO to small- and medium-sized landowners."

The PSA programme has been very popular with landowners, with requests to participate far surpassing available financing. The forest area enrolled in the PSA programme at the end of 2005 represented about 10% of the country's forest area and studies have generally found that PSA recipients have higher forest cover than non-recipients. The rising number of contracts with water users indicates that many share the common perception of the benefits of forests. Most of these contracts are in catchments that are providing satisfactory levels of water services and where forest cover is still substantially intact. In 2005, about 65% of PSA conservation contracts were in biodiversity priority areas. It is estimated that the PSA Program prevented the loss of 720 sq km of forests in biodiversity priority areas in 1999-2005. The new agroforestry contracts are anticipated to have a significant impact on biodiversity in agricultural landscapes. Finally, the 210 sq km of forest plantation that the PSA programme contracted in 1998-2005 stored about a million tonnes of carbon, and the whole PSA Programme is estimated to have avoided the emission of 11 million tonnes of carbon in 1999-2005.

Nicaragua

Environmental Services Index

Cattle production is a significant cause of habitat and biodiversity loss in Nicaragua. In addition to the environmental problems caused by the initial deforestation, overgrazing results in reduced crop yields, diminishing grass cover, soil erosion, water degradation, land degradation and air pollution. Declining producer income results in continuing poverty and can lead to pressure to clear additional areas. Adoption of improved silvopastoral practices in degraded pasture areas is thought to provide valuable local and global environmental benefits, including biodiversity conservation

The US$4.5 million Regional Integrated Silvopastoral Ecosystem Management (RISEM) Project, financed by the Global Environment Facility, is piloting the use of payments for ecosystem services (PES) to generate biodiversity conservation and carbon storage benefits by encouraging the adoption of silvopastoral practices in degraded pastures in three areas: Quindío, in Colombia; Esparza, in Costa Rica; and in Matiguás-Río Blanco, in Nicaragua.

To provide payments that capture the different levels of ecosystem services, the RISEM Project developed combined indices of biodiversity conservation and carbon sequestration under different land uses into one 'environmental services index' (ESI). Ecosystem service providers were chosen using geographical criteria. The Matiguás–Río Blanco site was selected because it is located in a biological corridor. Within it, all households meeting minimal criteria of herd size were eligible to participate, and slightly over 100 households did so. As demand exceeded the budget, households were enrolled on a first-come, first-served basis until this limit was reached.

Participating landowners enter into contracts under which they receive annual payments from GEF, over a four-year period, based on the net increase in ESI points. Payments are made after land use changes have been monitored in the field. This approach differs substantially from earlier methods that relied primarily on subsidising the cost of adopting the desired practices. In contrast, RISEM Project payments are proportional to the level of services provided (as measured by changes in the ESI), regardless of the cost of providing them.

Nicaragua

Environmental Services Index

Initial analyses showed that participants made substantial land use changes during the Project's first two years, affecting over 24% of the total project area. The area of degraded pasture was reduced by 68% and that of annual crops by 52%. Pastures with low tree density showed a net increase of 19%, but pastures with high tree density increased by 23%. The area devoted to fodder banks more than doubled, and the length of live fences increased by 160%. The total biodiversity and carbon sequestration or ESI score of the participants increased by 42%. Biodiversity and carbon storage are being monitored to ensure that the desired ecosystem services are actually being generated. The RISEM Project therefore differs from most other PES programmes, which have generally assumed that the land uses they support are generating the desired services.

"To me, maybe the most promising … mechanism for exploration is payment for ecosystem services (especially hydrological ones) … in that it provides both ecological and financial sustainability, with the costs being borne by the consumers, or (where consumers are poor) supported by global financial institutions."

Thomas Brooks,
Senior Director, Conservation Synthesis Department, Conservation International

United Kingdom

Stewardship Payments

This was the first country-wide scheme that purchased ecosystem services from land managers on a targeted and discretionary basis. The UK has since developed several other arrangements that feature stewardship payments to improve environmental performance, most recently the Environmental Stewardship scheme that replaced the earlier ones. This rewards the conservation of biodiversity and genetic and other natural resources, the maintenance of landscape quality and character, the protection of the historic environment, the promotion of public access, and measures to reduce flood risk and damage.

Modern farming has profoundly shaped the countryside of the UK and much of the rest of Europe, often with devastating consequences for biodiversity, wildlife abundance, landscape quality, and the capacity of catchments and wetlands to absorb water and prevent damaging floods. These effects come mainly from the use of agrochemicals, the removal of hedgerows and other forms of woody, deep-rooted vegetation, and the installation of field drains. The resulting large, well-drained fields combined with downstream changes such as the canalisation of rivers, the expansion of roads and parking areas, and building on floodplains, have hugely increased the vulnerability to flooding even of small countries like England with its relatively small catchments and short rivers. Furthermore, important habitats in the wider countryside have become increasingly fragmented, isolated and marginalised by the process of agricultural change. Because of increasing concern over biodiversity loss and vulnerability to climate change, some of these landscape developments will have to be reversed.

An early start was made in the UK on a mechanism to provide landholders with incentives to re-establish more extensive and less damaging agricultural practices. In the early 1980s, farmers were paid to drain marshland and convert it to cereal production. This caused the draining and ploughing of the Halvergate Marshes in Norfolk, which in 1985 led to the Broads Grazing Marsh Conversion Scheme and a year later the launch of the Environmentally Sensitive Areas (ESA) scheme. This was the first such programme in the EU, and was a voluntary arrangement that offered farmers payment for reducing stocking rates and the use of pesticides and fertilisers. About 50 sq km were initially designated, and 90% of farmers joined in. The programme was then expanded to include 43 designated locations.

A number of similar programmes were then created to supplement the ESA scheme, the most prominent of which was the Countryside Stewardship Scheme (CSS), established in England in 1991. This was open to farmers outside the ESAs, and like the ESA programme, was intended to protect valued landscapes and habitats and to improve public enjoyment of the countryside. Under it, farmers and land managers enter 10-year agreements to manage land in an environmentally beneficial way, in return for annual payments. Grants are also available to subsidize works such as hedge laying and planting, and repairing dry stone walls.

United Kingdom

Stewardship Payments

By 2003, over 10% of England's farmland was covered by ESA or CSS agreements. Both programmes proved to be effective in enrolling farmers in entry-level contracts, thereby halting or slowing degradation of rural landscape and other environmental features. Cost-benefit analyses of these and earlier schemes showed that in ten of the 12 cases, they yielded, in addition to the main targets, 'primary' benefits in terms of wildlife conservation and landscape effects, and 'secondary' benefits in water quality, recreation and archaeological values. Many of these evaluations presented a range of estimated benefits, and the upper ones consistently exceeded the cost of each scheme, sometimes by many times. A nationwide evaluation of 500 CSS agreements that were in effect in 1998 revealed that, in 36% of the cases, none of the work under the CSS would have been undertaken without the agreement. UK agri-environmental schemes such as the ESA and CSS schemes have contributed greatly to the 'greening of edges' of Britain's agriculture. Losses of bird habitat, historic features (e.g. hedgerows), and natural and scenic landscapes have been substantially reduced. Special schemes such as those for reducing nitrate contamination have also reduced negative externalities

"UK agri-environmental schemes such as the Environmentally Sensitive Areas (ESA) scheme and Country Stewardship Scheme (CSS) have contributed greatly to the 'greening of edges' of Britain's agriculture. Losses of bird habitat, historic features (e.g. hedgerows), and natural and scenic landscapes have been substantially reduced. Special schemes such as those for reducing nitrate contamination have also reduced negative externalities"

Dobbs and Pretty

Resonance & Replication

- By building on its system of forest subsidy schemes, Costa Rica developed an elaborate, nationwide system of payments for environmental services. This has attracted worldwide interest, and in 2003, México established a similar Payment for Hydrological Environmental Services programme (Pago por Servicios Ambientales Hidrológicos, PSAH).
- Initial results from the RISEM Project in Nicaragua suggest that PES can induce land use change, and that silvopastoral practices can generate environmental services. The project focuses on a variety of land uses. Similar World Bank administered GEF projects that are now underway include the Ecomarkets Project in Costa Rica (US$33 million WB & US$8 million GEF), and the Cape Action Plan for the Environment in South Africa (US$9 million GEF). Projects under preparation in 2006 included: the Canaima National Park Project in Venezuela, the Agricultural Productivity and Sustainable Land Management Project in Kenya, the Rural Poverty and Natural Resource Management II Project in Panama, and a range of 'Land Use, Land-Use Change and Forestry' or LULUCF carbon projects worldwide.
- The EU Regulation 2078/92, the Agri-Environment Regulation, was proving effective in maintaining environmentally-friendly farming systems. It proved notably less so, however, in bringing about any major de-intensification of agriculture in the most sensitive areas, either because of poor take-up rates or because schemes have not been targeted in such zones. The newer Rural Development Regulation 1257/99, covering the period 2000-2006, stated that "a prominent role should be given to agri-environmental instruments to support the sustainable development of rural areas and to respond to society's increasing demand for environmental services". UK's environmental stewardship scheme remains in advance of most widespread EU practices, although the latter are expected to converge with the former as environmental priorities move increasingly to the fore.

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Halting Desertification and Land Degradation

Land degradation takes many forms, including nutrient depletion, salinisation, soil erosion and desertification. Nutrient depletion happens where continued cropping occurs with little or no nutrient input, and is made worse by the leaching effects of rainfall. Salinisation is a feature of lands that have been deforested and then over-irrigated, since mineral salts are first dissolved in soil water and then drawn to the surface by evaporation, where they are deposited in a toxic crust. Soil erosion is facilitated when vegetation cover is damaged by tree-felling or grazing, and can be driven by wind or water, often locally to create scarred and sculpted landscapes but sometimes over very large areas as entire topsoils are blown or washed away. These processes can all interact with each other, with land use, and with climate, and harsh treatment of vegetation and soils combined with a harsh climate is often the short cut to desertification, which is the frequent end-point of land abuse.

Desertification is strongly associated with dry areas, and it is widespread around the fringes of natural deserts, such as the Sahel in Africa, where the Sahara is spreading south at about 25 km a decade. It is severe in Afghanistan, Kazakhstan and elsewhere in Central Asia, as well as in western China, the Indian states of Rajasthan and Chhattisgarh, and in Mongolia. Some 10% of the island of Madagascar has been desertified, Nigeria is losing about 3,500 km2 annually, and deserts are expanding in Brazil and México. The problem is often a savage combination of over-grazing and poor farming practices to expose the soil, drought to weaken it, and wind to blow it away.

Opportunities to meet these challenges include application of existing knowledge, diversification of land use, in particular to farming systems that mimic natural ecosystems and closely match local conditions instead of ignoring them, technological advances, harnessing markets to the delivery of ecosystem services, and independent initiatives by civil society and the private sector.

"Desertification is a continuum of degradation, crossing thresholds beyond which the underpinning ecosystem cannot restore itself, but requires ever-greater external resources for recovery. Resilience is lost when a disturbance, which a system used to be able to absorb, tips the system to a less desirable state from which it cannot easily recover ... Loss of ecosystem resilience is often accompanied by a breakdown in social resilience and adaptive capacity, when vulnerable people are forced to draw on limited resources with diminished coping strategies ...."

UNEP, GEO 4

China

Grain for Green Policy

It is estimated that desert area and the area affected by desertification cover one third of the territory of China, mainly affecting the northern part of the country. For example, the rate was 1560 km2 per year in 1950–1975, which more than doubled to 3600 km2 per year in 1988–2000.

In 2000, China implemented the largest environmental subsidies programme in the developing world. The Sloping Land Conversion Program, known as the Grain-for-Green programme-- managed by the State Forestry Administration, the Ministry of Finance and the State Development and Planning Commission-- attempts to reduce soil erosion while simultaneously maintaining the livelihoods of farmers. Grain-for-Green's aims to halt soil erosion by converting sloping farmlands back to forest. Farmers are asked to set aside plots that are prone to erosion and poor for farming in exchange for grain provisions and cash subsidies. They are then given saplings to plant and are granted the rights to benefit from the forests as long as they cultivate them.

According to China's 2004 State of the Environment Report, in since the 1999 trial start almost 17 million ha of land has been afforested. An article in the December 2004 edition of the International Forestry Review estimated that the programme was set to increase China's current national forest area by almost ten percent.

In addition, an economic analysis of the programme found that overall the subsidies had contributed to an increase in the average household income. Though there were concerns about lowered productivity affecting food security this has not been the case, as farmers in the programme largely compensated for the missing land by increasing production on their remaining plots.

Niger
Re-greening

One of the biggest barriers to rural development in Niger is the agro-ecological resource base, which is characterised by fragile and degrading arable land, low rainfall and intermittent droughts. A combination of rapid population growth, southward migration due to droughts, and few opportunities for employment outside of agricultural sector, has stressed the limited amounts of fertile land, which is disappearing fast. In 1965, one quarter of Niger was arable, but this has since halved during a period when population almost quadrupled.

In the 1980s, discussions focused on more global, integrated management of forest resources for all the main beneficiaries. In the course of the Zinder Conference in 1982 and the Maradi Conference in 1984, initiatives were designed to combat desertification. These included the National Plan to Combat Desertification (1985, revised in 1991) and the National Programme for the Management of Natural Resources.

A landmark in Niger's forestry policy came with the adoption of the Domestic Energy Strategy in 1989. This recognised the true value of standing trees, making rural populations aware of their responsibility regarding the management of the forest estate and the optimal collection of taxes on wood. Thus the tax rate increased almost ten-fold, and in 1995 the forestry sector contributed around 30 billion CFA francs or about 4% of GDP.

A Ministry for Environment and for Combating Desertification was created in April 2000, with responsibility for implementing national environmental policy and combating desertification in general, but particularly in the forestry sector. Meanwhile, a National Action Plan to Fight Desertification and Manage Natural Resources was developed in December 2000 to meet Niger's obligations under the UN Convention to Combat Desertification. A number of projects are being implemented under this plan, including projects on institutional reform, forest management, water catchment and land management.

Recent studies of vegetation patterns, highlighted by satellite imagery, have found that over the last 30 years Niger has cultivated millions of new trees, slowing desertification and generating additional income for farmers. As reported in February 2007, in the New York Times and datelined Guidan Bakoye, Niger, innovative farmers had abandoned a generations-old pattern of clearing saplings from their fields before planting. Instead, they had taken up protecting and cultivating the young trees, ploughing around them when sowing their crops. This change in behaviour had restored much of the region's biodiversity and productivity. This change was ultimately due to the government's National Energy Strategy, which allowed individuals to own trees. This had sparked collective action as farmers began to view and value trees as their own property, and as a source of income from their branches, pods, fruit, and bark. The inevitable result was a rapid increase of tree cover.

Niger

Re-greening

Using simple techniques such as planting trees and preserving natural vegetation, teams of workers have already rehabilitated some three million hectares of severely degraded land, according to the Niger government. Surveys in parts of southern Niger found 10-20 times more trees in 2005 than in 1975. In August 2005, national researchers began a long-term study on trends in agriculture and environment in Niger, and the multiple impacts of investments in natural resource management.

The results showed that at least 250,000 ha of seriously degraded land have been rehabilitated since the mid-1980s. Dry-season cultivation has also expanded considerably, and FAO data show that Niger's production of dry onions had increased from 100,000 tonnes in 1980 to 270,000 tons in 2004, even though that was a drought year. It has turned out that farmers in rural Niger are remarkably adaptable, and have created more complex and more productive farming systems by integrating agriculture, forestry and livestock. They have achieved this even under very unfavourable macro conditions.

The reform of timber legislation

Ordinance No. 92/37 of 21 August 1992, Decree No. 96/390/PRN/MHE of 22 October 1996, Ordinance No. 39/MHE/DE of 15 July 1997

This reform which is the central structural element of SED;

1. enabled the transfer of forest management to rural communities and restoration of their rights by the institution of rural fuelwood markets.
2. changed the roles of the stakeholders in the timber sector, both in primary production and in marketing of timber in rural areas to villagers, in transport and marketing of timber in urban areas to transporter-traders, and in monitoring, follow-up and advising of employees of forestry services.
3. instituted fiscal reform to transfer the proceeds from the forestry tax levied on villagers and instituted a distribution of income to benefit all partners, including rural dwellers, territorial divisions, the national treasury and even forestry services, through the Supervision Fund (special account No. 3001).

Burkina Faso

Rehabilitation of Barren Land

In the 1970s, the densely-populated northern part of the Central Plateau of Burkina Faso faced an acute environmental crisis. Some 80% of land in the central part of the Yatenga region was under permanent cultivation for sorghum and millet, but fallow had practically disappeared as a means to restore soil fertility, and 40% or so of this cultivated land was marginal to agriculture. By 1980, the Yatenga region was considered to be the most degraded part of Burkina Faso.

Continual droughts led to frequent crop failure, and the region experienced substantial out-migration to less densely populated regions with better soils and higher rainfall. Women had to walk longer distances to collect firewood. Vegetation was destroyed for firewood, and also to expand farms. Groundwater levels fell by an estimated average of a metre per year, and many wells and boreholes ran dry just after the end of the rainy season. Frequent droughts made cultivation of upper and mid-slopes increasingly difficult and, as farmers migrated to the lower slopes and valley bottoms, the area of completely barren land increased dramatically.

In this difficult context both farmers and NGO technicians began to experiment with soil and water conservation (SWC) techniques. The farmers concentrated on improving traditional planting pits or zaï, and NGO technicians concentrated on building stone bunds along land contours. Traditionally, planting pits were used on a small scale to rehabilitate rocky, barren land that rainfall could no longer infiltrate. Over the years innovations were added, increasing the dimensions of the pits and adding manure, which concentrated water and nutrients. The combination of both techniques proved to be very effective in the rehabilitation of badly degraded land. Thus, agricultural intensification in the region started in the early 1980s when SWC technologies became available that were simple, easily mastered by all farmers, and quickly increased yields.

Soil fertility has been restored to tens of thousands of hectares of degraded land using the zaï technique. An increased supply of fodder supported greater livestock numbers, in turn increasing manure supplies for raising soil fertility. Due to water harvesting efforts, groundwater recharge improved significantly: wells that used to run dry in the dry season now provide water year-round. Farmers reported substantial productivity gains, with millet and sorghum yields increasing by 50% on average.

These processes were supported and complemented by external intervention. In 1985-2000, substantial public investment has taken place in soil and water conservation. The socio-economic and environmental situation on the northern part of the Central Plateau is still precarious for many farming families, but the predicted environmental collapse has not occurred and in many villages there are indications both of environmental recovery and of poverty reduction.

"It is imperative that effective policies and sustainable agricultural practices be put in place to reverse the decline of drylands."

Hans van Ginkel,
Former Rector of United Nation University

Argentina
Bolivia, Chile and Peru
The Community Exchange Programme

Puna Americana, located in the high Andean plateau, which extends from Bolivia, through Ecuador, Peru and Argentina and into Chile, is home to the indigenous Aymara population, comprising about 6 million people. The area, which is rich in both cultural heritage and natural resources, is faced with increasing environmental problems, such as land degradation, soil erosion and water degradation.

In 2000, the Global Mechanism of the United Nations Convention to Combat Desertification and the International Network of Non-Governmental Organisations against Desertification (RIOD) launched the Community Exchange and Training Programme (CETP). The CETP is a capacity building programme at the grass-roots level based on the premise that direct exchange between natural resource users is one of the most cost-effective methods for the transfer of knowledge at the local level. Within this framework, the Parlamento del Pueblo Qullana Aymara (PPQA)--an indigenous NGO that represents the social, cultural and livelihood interests of the Aymara people--brought together representatives of the four Qullana Aymara areas (Argentina, Bolivia, Chile and Peru) and submitted a project proposal to the Global Mechanism to help Aymara local communities address the issues of local degradation and desertification of their lands.

A major outcome of the project was the formulation and endorsement of the Aymara delegates' own proposal for combating desertification, and promoting sustainable development in the Qullana Aymara region. The proposal adheres to ancient Aymara philosophy and culture and its adoption by the Aymara representatives gave important legitimacy and momentum to sustainable development programming in the Puna Americana. In addition, it led to the approval of a seed harvesting programme for the reseeding of native pastures with indigenous species, and a training programme that includes the establishment in each of the four Aymara areas of a local centre for combating desertification. The project significantly contributed to the empowerment of Aymara peoples' indigenous institutions, which have been given a central function in advocacy, and in the implementation of the proposals for combating desertification and the promotion of sustainable development in the Aymara lands.

Resonance & Replication

China's Grain for Green programme's overall objectives and design parallel much of the thinking that has been developed by policy-makers in OECD countries on green payment programs. In general, the key issues to consider are economic efficiency, targeting specific issues/areas, and establishing clearly defined links to environmental benefits. The EU, Switzerland, Japan, Canada, and the US have all converted large amounts of land with their long-term land set-aside programs, which share characteristics with Grain for Green. China's experience so far shows that green payment programs can be adapted successfully in developing countries.

While Niger's experience of greening on a vast scale is unique, smaller tracts of land have been revived in other countries. National Action Plans have been adopted by 42 African countries, and many have also formulated initiatives to control drought and desertification, some of which have scored successes. In Algeria, for example, an afforestation plan under the National Fund for the Regulation of Agricultural Development has registered plantations of fruit trees, which now cover more than 1.2 million hectares, as well as the conservation and improvement of soils over an area of more than 2.8 million hectares.

Experience has shown that acceptance of the techniques used in Burkina Faso spreads quickly, thanks to their simplicity and effectiveness. The success of zaï planting pits and stone contour bunds has now been documented all over the Sahel region, particularly in Mali and Niger. In one such example, the benefits of this innovation spilled over into Illela, Niger in a powerful demonstration of the value of farmer-to-farmer sharing of ideas.

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By seeing what their neighbours had done, the Illela farmers became convinced that the benefits were worth investing in. They implemented the zaï technique on their degraded land, and the practice saved them from the worst effects of the 1990 drought. By 1998, 9,000 hectares had been rehabilitated, or some 15% of the cultivated area. Farmers even began buying degraded land, confident they could restore it, and land that was previously considered worthless now saw rising market prices. The practice continued to spread after the life of the project.

Several CETP projects have been implemented across Africa, Asia and Latin America, exposing communities to a wealth of indigenous knowledge and opportunities in sustainable land management, income enhancement and alternative and sustainable production practices. Using the example of the CETP, many developing countries can build on such initiatives to organise interactive exchanges with development partners and civil society stakeholders on the outcomes of CETP and other programmes promoting the transfer of knowledge at community level.

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Involving Communities
in forest management

The ownership of living resources to a large extent determines their fate, since sustainable harvesting rates are only likely if those doing the harvesting expect to be earning a living in the same way decades or generations into the future. Thus a forest exclusively owned by government and exploited by a company with a five-year logging concession is at extreme risk of being badly damaged or even destroyed. Likewise at risk is a government-owned forest that is exposed to informal harvesting by people from many different communities, all of them in competition with one another.

In both cases, the incentive structure is not conducive to sustainable use. All that stands between the forest and deforestation is the supervising authority of the state, which often proves inadequate to the task. Nevertheless, this has been the commonest arrangement around the world in the modern era.

In response to this, many have looked at models of living resource ownership that link the livelihoods of local people to a share of the wealth generated by using the resources concerned, whether these are wildlife, forests, non-timber products, fishes, medicinal plants or biodiversity in general. For conservationists, the starting point was the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe in the 1980s, the principles of which have been adapted to many other locations ever since, including community fish sanctuaries in the Philippines, reef-guarding communities and scuba ecotourists in Indonesia, bioprospecting programmes in Costa Rica, and great ape tourism in Uganda and elsewhere.

Here, the basic idea is that if living resources are redefined as an asset of local people (whether completely, or shared with other stakeholders), and revenue streams from their use distributed fairly according to the ownership, then the whole incentive structure will automatically change, and values and behaviours with it. Villagers who one year would cooperate with gangs of elephant poachers, the next would be reporting them to the police and digging water-holes for their prey, as happened in Zimbabwe.

All of this reasoning is equally applicable to community involvement in forest management. The case studies that follow show clearly that once communities obtain clear and exclusive title to forest land, the forest becomes a permanent communal resource for long-term use.

"You must not deal only with the symptoms. You have to get to the root causes by promoting environmental rehabilitation and empowering people to do things for themselves. What is done for the people without involving them cannot be sustained."

Dr. Wangari Maathai,
Nobel Laureate

Tanzania
Forest Resources Management

Forests in Tanzania were historically managed by the Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism. This was a centralised management approach with state control and no involvement of local communities. In it, available managerial resources were too thinly spread to resist pressures on the forests from illegal exploitation driven by denser populations of people. Thus, forests have been steadily reduced and degraded by settlement and farming, commercial charcoal and fuel wood production, overgrazing, uncontrolled fires, shifting cultivation and illegal logging.

The result was that forest cover in Tanzania was more than 50% in the mid-1960s, 45% in the late 1970s, and about 38% in the late 1990s. Local deforestation rates were often far higher than the national figures suggest - between 1991 and 2003, for example, there was an annual rate of forest loss of 4% in the area surrounding Gombe National Park in the Kigoma region of western Tanzania.

In 1985, international concern over the rate of tropical deforestation led to the formation of the Tropical Forestry Action Programme (TFAP). This led to a project in Tanzania in 1992-1999 that aimed to strengthen national institutions responsible for forests and lands and improve their policies, and to strengthen local forestry services in the Mwanza and Tabora regions in the north-west and north-centre of the country. Forest cover was mapped, policy studies were undertaken, and the technical competence of the forestry department was improved particularly in the area of monitoring royalty collection.

A national land policy was developed and led eventually to the Land Act and Village Land Act in 1999. The technical competence of the institutions concerned in land demarcation and survey, as well as in land registration and titling, was improved through training and modern equipment, especially GPS. Village demarcation, survey and titling were done with community participation. The new field activities had three main themes. First, some built on ngitiri, a traditional practice of reserving and self-policing tracts of pastureland for later use, and extended this to residual pockets of woodlands. Second, others used joint forest management, where the benefits and responsibilities of management of government forest reserves were shared with communities. And in a third approach, women were taught to construct improved and more fuel-efficient stoves made from clay.

The first three community-owned and community-managed forest reserves were established in September 1994. More than 500 villages now directly own and manage such reserves. The Duru-Haitemba forest in the Arusha region served as a model. This degraded 9,000 ha dry woodland was to be gazetted as a forest reserve, which provoked much local resistance. Negotiations led to the return of the proposed reserve to the eight communities within whose jurisdictions it lay. Village forest committees were appointed to manage the forest for the communities. Grazing was restricted to

Tanzania
Forest Resources Management

specified zones and months. Illegal timber harvesters were evicted, charcoal burning ceased, and felling of live trees came to a halt. By March 1995, the entire forest was under the direct management of one of the eight villages. Each village drafted its own forest management bylaws, which were subsequently approved by the district council.

An independent evaluation of the ngitiri concept found that is sound and has great potential for replication elsewhere. The evaluation also found there had been a sharp reduction in illegal forest use and that the condition of forest reserves had improved, but that a fuller transfer of decision-making responsibilities to the communities would have enhanced impact. Meanwhile, promotion of private nurseries enabled increased production of about 9 million tree seedlings, sufficient to cover 3,500 ha of land with a firewood yield of about 400 m3/ha in 3 rotations of 7 years each. About 10,500 improved wood stoves were built, with firewood savings of 50% on family usage of 5 kg/day for an annual saving of 9,600 tonnes. Compared with the total costs of the forestry services in Mwanza and Tabora, these two benefits alone generated an internal economic rate of return of 12%.

Tanzania
The Land Act, 1999 and The Village Land Act, 1999

These Acts are of particular importance, since secure land rights are key in promoting women's economic empowerment and the majority of working women in Tanzania live in rural areas, are engaged in agricultural work and are without the right to own, manage or inherit land. In general, the new land laws secure the rights of women in the following ways:

a. Secure women's rights to acquire title and registration of land.
b. Actively promote women's representation in decision-making bodies addressing land issues, such as participation in administrative and dispute settlement institutions.
c. Address issues of customary land rights and uphold the principle of non-discrimination based on sex.
d. Inclusion of women's land rights in the forthcoming National Land Policy (see Government Programmes below).

Specific provisions in both Acts regarding women's rights, and equal opportunity for women concerning land management, include:

a. Sub-section 20(2) of the Village Land Act, 1999 prohibits the use of customary law in determining the right of occupancy, if the law discriminates against, inter alia, women:

"Any rule of customary law and any decision taken in respect of land held under customary tenure, whether in respect of land held individually or communally, shall have regard to the custom, traditions, and practices of the community concerned and the rule of customary law or any such decision in respect of land held under customary tenure shall be void and inoperative and shall not be given effect to by any village council or village assembly or any person or body of persons exercising any authority over village land or in respect of any court or other body, to the extent to which it denies women, children or persons with disability lawful access to ownership, occupation or use of any such land."

Nigeria

The Ekuri Initiative

The Ekuri community is made up of Old and New Ekuri, two villages six km apart and located in the buffer zone of Cross River National Park (CRNP) in south-east Nigeria. The villages, with a total population of about 6,000, jointly possess 336 sq km of forest on their communal land - probably the largest community forest remaining in Nigeria. Until 1989, members of both villages had a four-hour walk to the nearest motorable road. No one in the village owned a vehicle, which meant that all the products harvested from the forest were carried to the road and then sold to middlemen for low prices.

Prior to this, both villages separately tried to make agreements with logging companies – seeking, in effect, to swap their forest for a road. In every case, however, one or other village vetoed the agreement because they felt that the benefits from the agreements were too meagre. Then in 1990, when the CRNP was created, the villagers approached the park authorities for assistance with constructing a road. The villages realized that with a proper road, they could take larger quantities of forest products directly to markets in nearby cities and sell them for much better prices.

Once contacted by the villages, the park sent a community forester to live with them for a year to find out how best the park could provide support to the community. As a result, the villagers decided to discontinue any discussions with logging companies and to manage their forest themselves, in order to generate revenue that they would use to construct the road. They established a community-based organisation called The Ekuri Initiative, the aim of which is to conserve and manage the Ekuri community forest in a sustainable manner for the purpose of community development and poverty reduction.

The Ekuri Initiative demarcated their communal land boundaries through negotiation with 20 neighbouring communities. After receiving training from the Cross River State Forestry Commission (and a British Department for International Development project), it produced stock surveys of two 50-hectare plots of forest and drew up maps showing all trees above one metre in diameter. These maps were used to select trees for felling, which were then converted into planks in the forest and head-loaded to the nearby road. The planks are conveyed to the timber market in Calabar (the nearest city) or directly to wood processing companies using hired trucks, and the money received is paid into the community bank accounts for local development projects. The initiative produced a 5-year management plan for sustainable forest activities (which the aim of eventual certification), and a land-use plan for the whole communal area to ensure sustainable use of it all.

In addition, the village has several traditional systems to manage the harvesting of non-timber forest products, including bush mango (Irvingia gabonensis), rattans, chewing sticks, and afang (Gnetum africanum). Most of the money made from the sale of these products goes to middlemen, so the Ekuri Initiative established a road tax for forest and agricultural products being bought in bulk from the village by city-dwelling traders.

Nigeria

The Ekuri Initiative

These funds represent increased capture of revenues from local resources and are also paid into the Ekuri communities' bank accounts.

To ensure equitable use of community funds, the community meets regularly to decide how they should be spent. Community revenues from the timber and non-timber harvests have been used in several ways. First, to build a 30 km road and four bridges to the two communities, which allows people in the community (especially women) to sell farm produce for the first time, thus bring in a substantial regular income to individual households. Funds were also used to part-pay for a health centre in one of the villages, to pay the university fees of six students from the village, and to pay the school fees of another six children attending secondary schools outside the village. There were also allocated to maintain a large truck to take forest and agricultural products to markets over 40 km away, and to pay lawyers in a successful court action to prevent a logging company from obtaining a logging concession on their community forests.

The project has enabled the Ekuri Community to resist the temptation of selling their forest to logging companies. This has meant that most of their 336 sq km forest area has never been logged, and remains some of the most biodiverse forest in West Africa. The Initiative is wholly accountable to the people of Old and New Ekuri. Funding for the Initiative comes from the proceeds of selling products from the communities' forests. Only a small proportion of these go towards the running of the Initiative, and the majority accrue to the village bank account. The low technology methods used by the initiative without heavy machinery – selective cutting of trees, conversion of the wood at the stump site and head loading out of the forest - ensures very little impact on the forest itself. The area being harvested is less than 0.3% of the whole community forest. The Ekuri Initiative inspired the women of both Old Ekuri and New Ekuri to establish a cooperative of their own. This focuses on enhanced processing of agricultural produce. The Initiative has been able to attract donor funding for a micro-credit scheme for the women of the villages and has given the cooperative two oil palm mills and a cassava-grating machine. This equipment greatly reduces the tedium of the daily activities that the village womaen used to do.

India

Ecodevelopment in Harda, Madhya Pradesh

Located in Madhya Pradesh, the District of Harda has a total forest area of 1,417 sq km, of which 983 sq km is Reserve Forest and 433 sq km is Protected Forest. These are mainly tropical dry deciduous teak forests, and they have a long history of degradation due to organised but illicit logging. The area's reserved forests, though seemingly well stocked, are not regenerating adequately due to excessive grazing by livestock and recurrent fires. Bamboo (Dendrocalamus strictus) has also suffered due to grazing and fire. Villages are dotted all over the reserved and protected forests in the region.

An experimental scheme for Participatory Resource Management and Ecodevelopment started at Harda in October 1990, covering both interior and fringe areas and involving 190 villages, each with a village committee organized specially for the programme. Village micro-plans for ecodevelopment are prepared jointly by villagers and forest staff. Such plans aim at protection, regeneration and stocking of the adjoining forests, aiming to meet the genuine needs of the local community. At the same time, the plans seek to divert unsustainable pressures from the forests through on-farm and off-farm improvements. These include protecting, regenerating and managing forest areas, watershed treatment, making water harvesting structures, establishing additional income-generating activities, developing village infrastructure (on a limited scale), energy conservation measures and the development of alternative energy sources.

Funds for micro-plan implementation are mobilized by tapping Forest Department funds and by channelling funds from various district-level development agencies through inter-departmental co-ordination. With the aim of achieving financial decentralization, the village committees have been helped to acquire a village common fund. This fund is built up initially in various ways, including voluntary donations from local wages, from the money paid by the Forest Department for protection work done by the villagers, from social fines, from charges levied by the committee on the use of community assets such as water, and from bank interest. The money from the fund is used by the village committee to extend credit to members, to develop additional community assets, and for protecting adjoining forest reserves.

The village of Khatmakheda is typical of the impact of the programme in Harda. In 1990, its 35 families obtained nearly half their income by selling fuelwood from the nearby Reserve Forest, with a further 10% from farming. Within four years, the same village had undergone a transformation, with average income having increased by more than 20%, the sale of fuelwood having declined almost to nil while farming now contributed 68% of the income. Other new income streams, mushroom and silk farming, were contributing nearly 25%, and agricultural labour provided the rest. Development of the Village Forest Protection Committee had cemented the partnership between local people and the Forest Department.

Diversified production attracted other partners, such as the NGO Professional Assistance for Development Action to market mushrooms, the Kasturbagram Rural Institute, Indore, to provide technical support

India
Ecodevelopment in Harda, Madhya Pradesh

for alternate energy programme such as biogas, Urja Vikas Nigam (a state-owned corporation) to support improved energy conservation devices such as improved stoves, and the Sericulture Department to support silk making.

At a landscape level, the 190 village forest committees, one in each village, had shown that they could successfully combat forest fires, which affected only 2% of the area since the programme began, as compared to 23% in 1990. Grazing had been regulated over 85% of the forest area, thereby voluntarily closing 475 sq km of forest area to grazing. In accordance with the village committee grazing management plan, grazing has been restricted to below carrying capacity in the remaining forest area.

Local people's stake and interest in the recovery of Harda forests can be attributed to two main factors. Firstly, their real needs for fuelwood, fodder, bamboo and small timber had been recognized by the Forest Department, and they have been assured access to these resources at sustainable levels from the forest area which they protect under Joint Forest Management agreements. Secondly, the ecodevelopment programme helped to increase the villagers' income, and has reduced pressure on forests.

Resonance & Replication

Nigeria

The Ekuri community has one of the finest community forests in West Africa. The successes of the Initiative have already started to inspire other village communities in Nigeria, neighbouring Cameroon and elsewhere in Africa. The Ekuri experience inspired the Cross River State Forestry Commission to re-write its forestry Strategy making community forestry a central principle. DFID recently carried out a project to assist the Commission to support similar initiatives for 33 other communities. Many hope to emulate Ekuri's example. A Nigerian NGO, Living Earth Nigeria Foundation, is also working in six villages in the state to support similar developments. Communities from Cameroon, Mozambique and Kenya have also visited the site.

India

The ecodevelopment and joint forest management approach has been significantly institutionalised in India, becoming a component in national government wildlife schemes since the time of the 8th Five-Year Plan (1992-1997). The India Ecodevelopment Project (IEDP) has envisaged ecodevelopment as a strategy that aims to conserve biodiversity by addressing both the impact of the local people on the protected areas and the impact of the protected areas on local people. The Madhya Pradesh Forestry Project, has also resulted in a remarkable recovery in the target ecosystem and an abundance in wildlife, while also addressing the concerns of local communities

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Restoring Ecosystem

Sometimes it takes a calamity to make people think in new ways, and the tsunami which struck several countries in the Indian Ocean rim in December 2004, certainly had that effect. Studying the ways in which it impacted the coasts, and the different kinds and levels of damage it did in different places, led to the realisation that long-term deterioration of coastal ecosystems prior to the tsunami may have increased people's vulnerability to large waves.

Mangroves are physically sturdy and complex, with stilt roots and other structures that help to absorb wave energy. Healthy mangrove ecosystems play an important role in moderating the action of wind-generated waves, and thus are important in limiting both coastal erosion and storm damage. Since they are also immensely productive of useful aquatic wildlife such as fish and frawns, mangrove ecosystems are particularly important for both the environmental and livelihood security of people living in tropical coastal zones.

It had long been known that coastal wetlands, especially forested ones like mangroves, as well as coral reefs and big sand dunes, could absorb large amounts of wind and wave energy, but for decades there had been pressure on these ecosystems, from the mining of coral rock and sand, and the clearance and drainage of coastal wetlands for aquaculture, settlement and infrastructure. This progressive damage went largely unnoticed until the tsunami, but thereafter it became of considerable public interest to know if coastal ecosystems had a role in mitigating the impacts of seaborne threats.

Since the answer was very much in the affirmative, an important policy priority throughout the region became to restore coastal ecosystems as fast and as widely as possible. Many stakeholder groups began investing in such activities, in partnership with communities and local and national governments. Lessons were quickly learned, however, notably that it is much harder to restore ecosystems than to destroy them, so motivation must be sufficient for the long haul. This requires tenure security to be clear, so that local people who are being asked to help replant or rebuild have a reason to participate in the long term. It also requires environmental education, so that all partners understand why they are doing what they are doing, as well as training, so that they know how to do it best. A UNEP-supported study by Wetlands International in Indonesia, for example, found that half of 30 million mangrove seedlings planted after the tsunami had died due to weaknesses of these sorts.

Restoring Ecosystem

Similar considerations apply to one of the other great challenges in the modern world: tropical deforestation. Such large areas of forest have been cleared for farming and ranching in particular, that whole catchment systems are now unable to hold themselves together under storm conditions, spreading mudslides and floods downhill in times of environmental crisis, bringing death and misery to millions. Here again, to halt and reverse these processes demands clear land tenure, livelihood security, environmental education and political leadership of a high order, and few countries have yet risen to this challenge. But the importance of reforestation is so great that it is becoming a priority in many locations, and some important successes have been scored. The case studies that follow provide evidence that wholesale ecosystem restoration is possible, and the regenerative capacity of ecosystems is so great, that significant environmental recovery and local livelihood and security benefits can be achieved within a very few years of determined effort.

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Sri Lanka
Restoration of tsunami-affected lands

The tsunami of 26 December 2004 devastated coastlines around the Indian Ocean, and the Sri Lankan district of Ampara had the highest death toll, at 10,436, of any district in the country. Waves 6-8 metres high penetrated 320 metres inland on average and in places up to a kilometre, flattening trees, crops and houses, depositing saline water and marine sediments across farmlands and into wells, and spreading organic and inorganic debris and sewage from latrines far and wide. After the tsunami, it was realised that sand dunes and coastal forests had had a significant protective function where they still existed after decades of damage, although they could also be overwhelmed by a disaster on this scale. Even so, their value in protecting against more common events, such as storm surges and wave erosion, became established. Coastal forests also provide ecological services by trapping sediment and pollutants, converting nutrients to biomass, providing wood, fodder and medicine, and enhancing estuarine and coastal fisheries. Thus, a priority after the tsunami was to restore coastal ecosystems as a way to enhance both livelihood and environmental security. In the process, bioremediation of drinking water supplies and farmlands was also attempted. The measures described here were focused around the community of Kalmunai.

The structure and species composition of remnant littoral forest patches were examined, to provide the design basis for a 3 km conservation forest that was then planted along the coast. The native trees and shrubs were densely planted in 2005-2006, to form a wall of vegetation with a dense root mat underground. Meanwhile, thousands of drinking water wells in Kalmunai had been contaminated with sea water, sewage and other waste. While the conventional way to address this problem was to clean the wells, and then administer chlorine bleach, the problem of salinity or nitrate/nitrite pollution remained unsolved. Many wells were in fact over-pumped, which encouraged sea-water intrusion underground.

Bioremediation involved growing selected plants in the contaminated substrate, choosing native and other species useful to local people as sources of food, timber, medicine and green manure. Thus the environs of 1,001 wells were planted with a dense mixture of deep rooted, mostly native species of trees and shrubs. The landscape design also included a production area where tree crops dominated. Over 25,417 plants of 74 species were established in 2005-2006. In addition, 40 demonstration plots for ecological farming were established in 2006-2007, plus another 125 kitchen gardens as a further contribution to household food security. These incorporated raised beds containing abundant green manure and fertilised using neem (Azadirachta indica) and other plants.

Sri Lanka

Restoration of tsunami-affected lands

The farm lands were monitored from ecological, social and economic perspectives. Increases in vegetation cover brought about an increase in shade, soil biomass and moisture retention in soil. After a year, the gardens began to yield, and the diverse array of food at the homestead level resulted in an increase in diversity of diets. In addition, the income generation from the gardens was significant, with the average monthly income for the twelve best farmers exceeding Rs 25,000 or US$250. These income figures are only in the first year of production where the farmers began from scratch.

The dominance of tree crops in the landscape design is a pivotal factor in the ecological maturity of farmlands. The inclusion of trees in an agricultural landscape results in increased soil biomass and fertility, better shade and reduced water stress. They also provide habitat for pollinators and other wild species. The abundance and diversity of butterflies were seen to increase, for example. Above all, the diversity of species used reduced the risk of planting only one type of crop where each tree has an independent utility value. As the benefits of this approach for environmental and livelihood security become increasingly apparent, it will be easier to replicate in the coastal zone of Sri Lanka, in line with government priorities.

"The Tsunami disaster of the 26th December 2004 ... caused the loss of tens of thousands of lives, property and livelihood damage as well as severe damage to the natural and built environment in most of the country's coastal zone. ... Apart from the actual direct environmental damage observed, it also became clear that urgent action needed to be taken to integrate environmental considerations in the national recovery and reconstruction process"

A.H.M. Fowzie MP,
Minister of Environment and Natural Resources, Government of Sri Lanka.

Indonesia
Restoration of Mangroves

Pemalang in Central Java, Indonesia, is an important example of a success story in the replanting of mangroves. Here, as recently as 1998, the entire mangrove ecosystem surrounding a number of villages was just bare mud and stagnant water, having been replaced by prawn ponds in the previous decade. The ponds were artificially fertilised and thrashed by mechanical aerators. But then the captive prawns began dying of white rot disease, and after the Asian economic crisis no-one could afford the chemicals and fuel any more.

The local people had owned and occupied this landscape for many decades, living by fishing in the Java Sea, and at the village of Desa Pesantran, a small group of men had begun thinking about restoring their environment. They called themselves Mitra Bahari ('Ocean Partners'), who together with Wetlands International Indonesia Programme (WI-IP) began to encourage the planting of mangrove trees (mainly Rhizophora mucronata, with some Avicennia spp. colonising naturally) along dikes around tidal fish and prawn ponds, tidal creeks that feed the ponds, and brackish rivers, as well as around farmed islands within ponds, in shallow areas within ponds, and in seaward locations. Planting was also undertaken of an eroding barrier beach system, using Casuarina equisetifolia and other trees.

Within a year, members of Mitra Bahari were enthusiastically tending Rhizophora seedlings in nurseries, growing them to the 'four-leaf' stage, and planting them around and inside their ponds. Every one of these hundreds of thousands of new trees has a place in the record book of the village group, back to 17 December 1999. There is great vigour in Rhizophora, and if you plant them along both sides of a dike, within a year or two the banks are hardened against erosion, so will no longer need continually to be rebuilt. Meanwhile, Mitra Bahari also had work to do on the barrier island, which was deforested and eroding fast into the ocean. This was not mud but sand, and called for beach trees, which were also raised and planted out, the Casuarina growing vigorously with the help of the nitrogen-fixing fungi living in their roots. It was soon discovered that the best planting sites were parts of the beach that were being colonised by a creeping Ipomoea plant, and here the forest thrived early.

> "Before the tsunami, we really didn't understand the importance of mangroves ... Since the tsunami, there is an increased awareness about mangroves and people are getting more involved in protecting them ... We know that they are important to protect us from the waves and other natural disasters."
>
> **Viroj Dedsongprak**

By 2006, the members of Mitra Bahari were managing their environment through collective decision-making to yield significant harvests of a sea-weed (which is dried and exported to Jakarta as a source of agar-agar), milkfish (Chanos chanos), reared prawns (i.e. those allowed to enter the ponds with the tide and grown there until harvested), crabs, other shellfish, and Casuarina fuel wood. Forage plants were also being grown and used to feed goats, which were held permanently in elevated cages because they would otherwise damage crops and mangrove seedlings.

The landscape managed by Mitra Bahari had come to be dominated by avenues and patches of stilt-rooted mangroves up to about eight metres tall in and around the ponds and creeks. It was once again a shady, cool and productive environment. The barrier island had been stabilised under tall Casuarina trees with undergrowth and patches of Avicennia colonisation, and the restored system was protecting the creek, mangroves and ponds inland. By June 2006, the impression was of a landscape that, while not converted back to a wild mangrove swamp, had been moved strongly in the direction of sustainable aquaculture and environmental security.

Costa Rica

Ecosystem Restoration

"We proved a developing country can succeed using conservation as an economic engine. We showed that an acre of forest is worth more than a cow."

Carlos Manuel Rodriguez, Former Minister of the Environment and Energy, Costa Rica

Between 1950 and 1990, Costa Rica put into practice an aggressive agricultural policy which promoted land titling, use of technology, construction of infrastructure to access markets, and subsidised credits for export monocultures. As a result, Costa Rica's forests suffered some of the highest deforestation rates in the world, an average of 38 sq km per year from 1973 to 1989. By 1985, forest cover had been reduced to just 24% of the original forest area.

By the mid-1980s, concern over deforestation had led the government to establish a National Conservation Strategy for Sustainable Development. This combined a system of national parks, debt reduction through 'debt-for-nature' swaps, development of ecotourism, and sustainable forestry practices. The strategy aimed to broaden the basis for decision making, making it responsive to strategic and inclusive inputs rather than being based on narrow special interests. During the late 1980s and 1990s, therefore, a succession of measures were enacted to encourage reforestation, and also the sustainable use of natural forests and other wildlands as essential contributors to national development.

In 1996, forest law was changed to formalise forest production incentives, encouraging timber production in plantation forests and rewarding forest owners for managing natural forest ecosystems sustainably and for a range of outputs, including ecosystem services. The law removed all regulations on managing and harvesting trees from plantation forests and agroforestry systems, leaving only the need for a certificate of origin in order to transport these forest products to market. The law also prohibited conversion of forest land to other uses and disallowed the concession of public forest lands.

Meanwhile, a comprehensive legal framework for the conservation and sustainable use of biodiversity was established with the Biodiversity Law of 1998, and further developed through a national strategy and the establishment of a National Commission for Biodiversity Management which, together with SINAC, is responsible for the administration of the country's natural resources. Meanwhile, Costa Rican institutions were actively searching for new products and business models by which to make money from the forest without damaging it, for example by encouraging bioprospecting and ecotourism.

Costa Rica

Ecosystem Restoration

"It is true that we are one of the few developing nations that have recovered part of their forest cover in the last twenty years, but it is also true that there is garbage floating in our rivers and oceans. It is true that a quarter of our territory is legally protected, but it is also true that illegal logging takes place. It is true that more than 95% of our energy comes from renewable resources, but it is also true that we continue to depend on fossil fuels for transportation and for many of our daily activities. It is true that we have beaches that have won prizes for their cleanliness, but it is also true that our management of solid wastes is far from adequate. In summary, it is true that we are a country that respects the environment, but it is also true that we are a country that could respect it a great deal more."

Óscar Arias Sánchez,
President of the Republic of Costa Rica

Costa Rica has become a leader in plantation forestry, sustainable forest management, and the design and implementation of innovative forest policies aimed at protection and use of forest resources and promotion of the forest sector. It achieved negative net deforestation in the early 2000s, and is the first developing country to have halted and reversed deforestation. Official figures show that 46% of the national territory is now under forest at some stage of regeneration back towards a natural condition, the forest area having nearly doubled in 20 years. The main drivers of this process are forest and development policies that support marketing ecosystem services and ecotourism, and the collapse of the cattle industry in the early 1990s when the global beef trade became unprofitable with the end of protectionist tariffs.

7788
BIODIVERSITY LAW
THE LEGISLATIVE ASSEMBLY OF THE REPUBLIC OF COSTA RICA
DECREE

ARTICLE 9.- General principles
The general principles which constitute for the purposes of the application of this law, are, among others, the following:

1. Respect for all forms of life. All the living things have the right to live, independently of actual or potential economic value.
2. The components of biodiversity are valuable. They have decisive and strategic importance for the development of the country and are indispensable for the domestic, economic, social, cultural and aesthetic use of its inhabitants.
3. Respect for cultural diversity. The diversity of cultural practices and associated knowledge of the components of biodiversity should be respected and promoted, in conformity with national and international legal standards, particularly in the case of the peasant communities, the indigenous people and other cultural groups.
4. Intra- and inter-generational equity. The State and private individuals will watch over the sustainable utilization of the components of biodiversity to ensure that the possibilities, opportunities and benefits of their use will be guaranteed

Costa Rica

Ecosystem Restoration

in an equitable manner for all sectors of society and will satisfy the needs of future generations.

ARTICLE 10.- Objectives

This law will endeavour to achieve the following objectives:

1. To integrate the conservation and use of the components of biodiversity in the development of socio-cultural, economic and environmental policies.
2. To promote the active participation of all sectors of society in the conservation and ecological use of biodiversity, in the pursuit of social, economical and cultural sustainability.
3. To promote education and public awareness about the conservation and use of biodiversity.
4. To regulate access and in so doing make possible the equitable distribution of the environmental, economic and social benefits to all sectors of society, paying special attention to local communities and indigenous peoples.
5. To improve administration for effective management of the components of biodiversity.
6. To recognise and provide compensation for the knowledge, practices and innovations of indigenous peoples and local communities in the conservation and sustainable ecological use of the components of biodiversity.
7. To recognise the rights deriving from the contribution of scientific knowledge to the conservation and sustainable ecological use of the components of biodiversity.
8. To ensure environmental safety to all citizens as a guarantee of social, economic and cultural sustainability.
9. To not limit the participation of any sector in the sustainable use of the components of biodiversity or in the development of research and technology.
10. To promote access to the components of biodiversity and the associated transfer of technology.
11. To promote international and regional co-operation to achieve the conservation, ecologically sustainable use and the distribution of benefits derived from biodiversity, especially in frontier areas or from shared resources.
12. To promote the adoption of incentives and the reward of environmental services for conservation, the sustainable use and the components of biodiversity.
13. To establish a system of conservation of biodiversity, that will achieve coordination between the private sector, the citizens and the State, to guarantee the application of this law.

Resonance & Replication

Indonesia

Learning from the experience at Pemalang, it was decided that the mangrove aquaculture model should be introduced to Aceh as a matter of urgency, to provide an alternative to the unsustainable pond development model currently used there. Communities at demonstration sites in Aceh were therefore 'twinned' with the community enterprises in Central Java, and communities and small-scale enterprises in Aceh were encouraged and enabled to copy the Javanese experience of creating mangrove aquaculture landscapes, and using them to sustain diversified livelihoods.

Costa Rica

In October 2006, the 'Peace with Nature' initiative in Costa Rica was designed to raise additional environmental investment, while also consolidating the environmental gains of the previous two decades. It also aims to provide a platform for international outreach and collaboration in the areas of environmental protection and climate change mitigation. Cooperation arrangements with Norway and New Zealand have already been established.

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Halting Over-Fishing
Through Ecolabelling

Today over a third of all fish stocks have collapsed or are in steep decline, and the remaining stocks are being over-exploited. Reasons for such widespread over-fishing are diverse, but are generally rooted in three factors. The first is that the theoretical basis for fisheries management was weak, having been rooted in assumptions based on our understanding of how to manage wildlife populations on land. In the sea, all the operations that make it possible to manage wildlife for a 'maximum sustainable yield' (MSY) are far harder to do than on land, including owning fish, counting fish, sexing and aging fish, and selecting fish to catch.

The second factor is that far less was and is known about fish behaviour and the ecology of the sea, compared with our knowledge of terrestrial animals and ecosystems. Assumptions were made to justify levels of fishing that later proved to be unrealistic and unsustainable, For it was discovered that different fish species have very different growth rates and maximum ages, that environmental changes can kill variable numbers of eggs and young fish in any given year, that fish species vary greatly in the number of offspring that reach maturity in ideal conditions, that older adult fish often produce far more eggs each year than younger adults, and that some widely-used fishing methods, such as trawling, do great damage to sea-bed ecosystems where fish breed, feed, shelter and mature, so undermining the productivity of the ocean above them.

The third underlying factor was that decision-making powers over fishing were distributed in ways that encouraged over-fishing. Influence was granted to stakeholders who controlled wealth from fishing or who depended on the votes of fishing families, and decisions were made by politicians and bureaucrats who knew little of marine ecology and were in thrall to fishing lobbies. Meanwhile, the technological stakes were raised, in the form of new sonar fish-finders, satellite navigation systems, targeted purse seines, factory ships, vast nets and monofilament long-lines, so poor decisions would have dire effects before they could be corrected. And the global demand for fish products continued to increase with human population. All this bore down on marine ecosystems that had once seemed infinite and inexhaustible, but which have proved to be anything but.

The Marine Stewardship Council

Blue Ecolabel

"I very much welcome the work that the MSC is undertaking to help improve management of the world's seafood resources, particularly the MSC eco-labelling award scheme."

Margaret Beckett,
Secretary of State, Department for Environment, Food and Rural Affairs

This experience convinced many that incentives were needed to encourage better management of fisheries, including reduced catch levels relative to population numbers and breeding capacity, and less damage to the environment and populations of non-target species. The challenge was to find a way to guide consumers to fish produced from best-practice fisheries so that they, and perhaps only they, would one day have a market.

The Marine Stewardship Council (MSC) is an independent non-profit organisation that was established in 1997 by the World Wide Fund for Nature (an NGO) and Unilever, but became fully independent of both in 1999. It has its main offices in London, Seattle and Sydney, and local offices in Tokyo, Japan and The Hague. Its purpose is to identify and certify the best-managed ocean fisheries, and label the products of those fisheries so that people can choose to buy them. The MSC environmental standard for sustainable fisheries was developed over two years through consultation with experts and other stakeholders. It is the only internationally recognised set of environmental principles for judging whether fisheries are well managed and sustainable.

Any fishery, regardless of its location or size, may apply to be independently assessed against the MSC Standard. Independent organisations, approved by the MSC to carry out the fishery assessment process, are known as certification bodies. The MSC Standard aims to confirm that there are enough fish to ensure that the fishery is sustainable, that fishing causes minimal impact on the marine environment including non-target fish species, marine mammals and seabirds, and that there are rules and procedures in place, and implemented, to maintain a sustainable fishery. The MSC standard is consistent with FAO's 2005 'Guidelines for the Eco-labelling of Fish and Fishery Products from Marine Wild Capture Fisheries'.

The MSC programme is voluntary, but only fisheries that are assessed and meet the

"The MSC and the Commonwealth have a common aim when it comes to fisheries management, that is, a desire for fisheries to be managed on a sustainable footing and to achieve the conservation and economic goals that Australians expect and deserve from our fisheries. I am happy to support the MSC in the attainment of those common goals."

Senator the Hon Ian McDonald,
Minister for Fisheries, Forestry and Conservation, Australia

The Marine Stewardship Council

Blue Ecolabel

standard can use the MSC blue ecolabel on products from it. Any fish or fish product bearing the blue MSC ecolabel should have come from a fishery that operates in an environmentally responsible way and does not contribute to the global environmental problem of over-fishing.

"It is consumer power that drives the MSC. The organisation enables individuals, literally around the world, to make individual choices about sustainability. Retailers and restaurants will increasingly have the opportunity to offer their customers fish which is independently certified, as coming from well managed, sustainable fisheries and I hope they do."

HRH, The Prince of Wales

By September 2007, ten years after MSC's foundation, 24 fisheries had been certified by MSC, and 850 of their products had been labelled for sale in shops in 34 countries. By then, a further 27 fisheries were undergoing assessment, and the MSC assessment process was underway, or had been completed, for fisheries that amounted to about half of the global wild salmon catch, a third of the global prime whitefish catch (cod, pollock, hake, haddock, ling, and saithe), and a fifth of the global spiny lobster catch. These are already substantial parts of the global fish business, and the process is continuing to grow and spread.

"In the 1880s they invented barbed wire and divided up the ranges [for cattle ranching]. Now everybody accepts that's the way it is ... Nobody will think it should be any other way with the sea in 20 years' time".

John Gruver, former Alaska pollock fisher.

Iceland
Individual Transferable Quotas

Iceland established control over its 200 nautical mile Exclusive Economic Zone by winning the 'cod wars' against Britain and Germany in 1976. The following years were marked by over-fishing by Icelandic trawlers, but a system of rigorous control based on individual transferable quotas (ITQs) was then brought in, starting in 1979 for herring. This proved so successful that the government established a similar quota system for other fisheries, leading to a uniform fisheries management system in 1990. Since 1995, the total allowable catch (TAC) of cod has been limited by law to no more than 25% of each year's spawning stock. In the mid-1990s, for comparison, fleets from many countries were taking close to 100% of adults in the North Sea (and many juveniles as well). The Icelandic system also forbids an increase of more than 30,000 tonnes in the TAC from one year to the next. The ITQ system coexists with other management arrangements, including those constraining equipment, location and size limitations.

In the ITQ system, each licensed vessel is granted a share of the TAC. Although these are fully transferable, annual vessel quotas do have some restrictions, such as being limited to a particular region to prevent quotas being stripped from an area, which would affect local employment. The allocation process includes an annual charge for enforcement. The ITQ system has proved to have several important advantages. First, it ended competition between vessels for a limited fish stock, so there was a reduction in wasteful over-investment in equipment.

Second, fishers have private ownership of their allowable allotment of fish, so they can concentrate on minimizing costs, instead of racing to get the largest catch in the shortest period of time. Finally, as well as increasing efficiency in effort and capital expenditures, the ITQ system provides a way to measure the value of the fish stock, since the market value of a fishery is related to the price of a quota.

All sixteen of Iceland's major commercial stocks are now managed under ITQs. The rules are strictly enforced by the government fisheries directorate and coast guard, with loss of quota being one possible penalty, and there is an incentive for fishers to watch each other to make sure that they comply with the rules, since the value of their own quotas would fall if stocks were over-exploited. The net result of Iceland's ITQ system is to have brought the herring industry back from the edge of ruin and to have restored sustainability to most of the other fisheries.

Resonance & Replication

Eco/ethical labelling. On the environment, the MSC was inspired by the Forest Stewardship Council, which was set up in 1993 as a response to public concern over deforestation, aiming to develop standards for sustainable management of forests and the labelling of their products. By 2005, the value of FSC-labelled products exceeded US$5 billion worldwide; and by 2006, over 68 million hectares of forests had been FSC-certified. By then, non-FSC timber products were becoming hard to find in shops and construction projects in the UK and elsewhere, and large publishing companies (e.g. Random, Bloomsbury and Scholastic) were committing themselves to using FSC-certified materials, as were banks (e.g. ING) and music companies (e.g. Warner).

For food safety, the 'organic' certification is going from strength to strength, drawing on studies showing the labelled foods contain few agrochemical residues or none, are more nutritious than others, and are grown in diverse ecosystems managed by people who care about soil microbes, the balance of nature, and clean water. Since the early 1990s, the retail market for organic produce in developed countries has been growing by about 20% each year.

Somewhat similar has been the spectacular growth of Fairtrade certification, a system that since 1997 has let people identify products that meet agreed social as well as environmental standards.

New Zealand. An ITQ-based fishery system was introduced in New Zealand in 1986. The quotas are permanent but restricted to a given species and location. Together the ITQs add up to a TAC, set by government, which is supposed to ensure that only a sustainable number of fish are caught. Within this restriction, however, tradable property rights create the flexibility to lower production without large scale sacrifices in profitability. Although the system initially discriminated against small-scale and indigenous fishers, intervention by the Waitangi Tribunal secured for the Maori a 10% ownership of their original fishery rights, roughly in line with their abundance in the New Zealand population.

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Halting Loss
Of Biodiversity

Biodiversity is the variety of life, or the information in living systems. This information has accumulated over evolutionary time, as lineages and ecosystems have evolved. Stored in DNA and other media, it both records the history of life on Earth and instructs the generations in how to live it. As we have learned how to 'read' biodiversity, we have also discovered how useful it can be. Table 1 lists some biodiversity discoveries the values of which add up to a quarter of the pharmaceutical industry, worth well over US$200 billion per year. These are just some of the natural product and gene businesses that are now valued at close to two trillion dollars annually

Yet despite the demonstrable economic value of biodiversity, the mass extinction of wild species is now underway. Scientists have identified 34 biodiversity 'hotspots' which between them contained most (60-80%) of the world's species in what was originally about 16% of the planet's land area. These hotspots would have sheltered tens of millions species in total, many of them occurring nowhere else on Earth. But 86% of the total area of these hotspots has already been destroyed, and the remnants now occupy only little more than 2% of the Earth's land surface.

The key challenge today is to realize the commitment made by parties to the Convention on Biological Diversity to achieve a significant reduction in the rate of biodiversity loss by 2010 as a contribution to poverty alleviation, a goal that was accepted by the Johannesburg World Summit on Sustainable Development, and later firmed into the European Council commitment to halt biodiversity loss entirely by 2010. This is reinforced by an understanding that the conservation of biodiversity and ecosystems is essential to achieving the Millennium Development Goals, and to the anti-poverty agenda, since living resources sustain livelihoods in ways that cannot be substituted by other things.

> The most important direct drivers of biodiversity loss and ecosystem service changes are habitat change (such as land use changes, physical modification of rivers or water withdrawal from rivers, loss of coral reefs, and damage to sea floors due to trawling), climate change, invasive alien species, overexploitation, and pollution.
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> **Millennium Ecosystem Assessment**

Table 1: Some contributions of wild biodiversity resources to medicine			
TYPE OF MEDICINE	**USE OF MEDICINE**	**SOURCE SPECIES**	**SOURCE SITE**
Reserpine	Reduces hypertension	Rauwolfia serpentina	India
Tubocurarine	Muscle relaxant	Chondrodendron tomentosum	Brazil
Vinca alkaloids	Anti-cancer agents	Catharanthus roseus	Madagascar
Diosgenin	Oral contraceptive	Dioscorea spp.	Mexico
Quinine family	Anti-malarial agents	Cinchona ledgeriana	Peru
Cocaine family	Local anaesthetics	Erythroxylum coca	Andes
Emetine	Amoebicide	Cephaelis ipecacuanha	Brazil
Aspirin family	Analgesic/anti-fever	Salix spp.	Europe
Erythromycin	Antibiotic	Soil fungus	Philippines
Taxol	Anti-cancer	Taxus brevifolia	NW America

The Global
Protected Area System

By the late 19th and early 20th centuries, sufficient damage was being done to nature that national parks started to be set aside to preserve samples of the past. These early parks included Yellowstone (1872), the first national park anywhere, and the Virunga (1925) and Kruger (1926), which were the first and second national parks in Africa. These set-asides are supplemented by other efforts to moderate threats to ecosystems and species such as:

- arrangements to connect protected areas with corridors of habitats that are managed to encourage the migration of plants and animals.
- efforts to embed protected areas in buffer or support zones where special measures are deployed to build local awareness and acceptance of conservation.
- arrangements to place protected areas under the co-management of people, particularly indigenous people with traditional lifestyles, who live within them.

The growth of the world's protected area system was marked by a number of milestones. It amounted to one million sq km in 1948, expanded to 12 million sq km by 1992, and now comprises more than 115,000 protected areas of one kind or another, covering some 12% of the world's land surface.

Benefits that protected areas offer local people.

Harvests, for example of medicinal plants, thatching, structural wood, climbing palms, and a range of foodstuffs, spices, dyes and drinks.
Ecological services, such as safeguards against drought, flooding, fire, soil erosion, land-slides and the drying out of aquifers, wells and springs.
Genetic resources, which may yield lucrative discoveries in which local people can share.
Education and tourism, which offer diverse livelihood opportunities.
Buffers for global warming, by preventing the release of greenhouse gases.
Employment, such as in research, management, tourism, education, training and other activities in and around the reserve.
Amenity, in providing a clean and beautiful local environment.
Traditional values, by providing a habitat for distinctive local cultures.
Preserving options for sustainable livelihoods in the future.
Tenure security, when local people obtain legal rights for the first time to occupy or use nearby areas.

It is now understood that protected areas have real productive and economic value, which bring real benefits to people living around them

These local benefits can multiply into national or regional advantages, as floods and droughts are avoided, downstream cities, factories and plantations are watered, tourists are attracted, scientific discoveries are made, national patrimony is preserved, and taxes are paid on economic activities that would not otherwise occur. These are some of the reasons why the protected area model has achieved such a phenomenal success world wide over the past 50 years.

Nepal

Recovery of snow leopards in Sagarmatha (Mt Everest) National Park

The 1,148 sq km Sagarmatha (Mount Everest) National Park was created in 1976. Its upper valleys are dominated by snow peaks, glaciers and barren rock and scree slopes with little vegetation. Lower down, however, there are grasslands and forests, which support ungulates such as Himalayan tahr (Hemitragus jemlahicus) and musk deer (Moschus chrysogaster). These ungulate populations have been under hunting pressure, along with their main predators, snow leopards (Panthera uncia) and wolves (Canis lupus), both of which had become locally extinct.

A World Heritage Site since 1979, the park is spectacular and includes the highest peak in the world as well as several important cultural and religious sites. About 3,500 Sherpas live in the park, and a similar number of their livestock. Relatively isolated until the 1960s, the region received only about 1,400 visitors in 1973, but is now visited by more than 20,000 trekking tourists and scores of mountaineering expeditions each year. These create solid and biological wastes as well as pressures on the forests, both directly through demand for fuel for cooking, heating water and keeping warm, and indirectly since porters and guides also burn fuelwood, and many lodges have been built to accommodate visitors. Grazing by tourists' pack animals is also damaging fragile, high-altitude pastures.

Local villagers have responded enthusiastically to economic opportunities linked to tourism, and their remote, poor, rural society has rapidly become more affluent and cosmopolitan. Economic activity unmoderated by environmental education or regulation placed park resources under increased pressure. Part of the problem was that local residents were not included in the initial park planning process, despite being descendants of people who settled in the area at least 400 years ago, and relations between the Sherpas and the park authorities were often poor. Although settlements were excluded from the park, its managers tried to regulate local use of grazing lands and forests. These efforts had limited success but prompted local resentment towards the park and its agents of enforcement. Park managers have in been constrained by inadequate funds, by a lack of authority over military detachments, tourists and mountaineers in the park, and by ambiguity over the role of local people in park management.

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The Ministry of Forests and Soil Conservation approved a Buffer Zone Management Plan for the park in March 2004. Its aim is to promote local participation in management and conservation of natural resources, and community and livelihood development activities through sharing the park revenue. This was based on Nepal's Buffer Zone Regulations and Management Guidelines of 1996, which advocate a community-based approach to the conservation of park resources by forging partnership agreements between community organisations and park authorities. The dominant principle is equitable development of human social, financial and environmental resources. Such buffer zones have now been established around most of Nepal's conservation areas, and in 1997-2003 over US$1.2 million of park income was recycled for community development, and more than 700,000 people received direct or indirect benefits.

Improvement in relations between local people and park managers is indicated by a decline in poaching and recovery of tahr and musk deer populations in the park. Increased wild food supplies have been accompanied by the re-occupation of the park by snow leopards from Tibet. After an absence of at least 40 years, the signs of this most beautiful of big cats are now found in many areas of the park. Their distribution suggests that they mainly use grazing land and open forest between 3,000 and 5,000 metres above sea level. There is some predation of livestock, but Sherpa people seem to tolerate this for religious reasons.

South Africa

market forces protecting a unique flora

The Cape Floristic Region (CFR) is home to one of the greatest concentrations of higher plant species in the world, with 9,000 species in less than 80,000 sq km, almost 70% of them endemic to the area. The flora includes five of South Africa's 12 endemic plant families and 160 of its endemic genera. The unique shrubby vegetation type of the CFR is known as fynbos, and is dominated by plants of four main growth forms: tall protea shrubs with large leaves; heather-like shrubs; wiry reed-like plants; and herbs that grow from underground bulbs.

Farming has reduced the fynbos ecosystem dramatically, and less than 20% of the original vegetation survives intact, much in isolated fragments in a matrix of farmland. Expanding vineyards and plantations of rooibos tea (Aspalathus linearis) and honeybush tea (Cyclopia spp.) threaten the remaining native vegetation. Urban encroachment and development, particularly near Cape Town, is also eroding natural habitats. Another serious threat to the CFR is the effect of invasive alien plant species, which were introduced from other Mediterranean-type climates in Australia and elsewhere to supplement the few tree species native to the Cape.

Several conservation initiatives have helped strengthen public awareness of the CFR's importance. One is a scheme to remove alien plants and encourage regeneration of native vegetation and restoration of catchments, which has created 3,600 jobs and cleared nearly 500 sq km of alien growth. Eight protected areas in the CFR were listed by UNESCO as a natural World Heritage Site, an indirect conservation measure that encourages ecotourism and sustainable use of native plant resources.

An initiative of the latter type involves the 13 sq km Flower Valley Farm, a lowland fynbos area 80 km east of Cape Town that was under threat from agricultural development. It was purchased in April 1999 by the Flower Valley Conservation Trust (FVCT) with help from the UK-based NGO Fauna & Flora International.

Under the Trust's management, research is helping to improve the balance between conservation and sustainable use of fynbos. Strict environmental guidelines are being developed for the harvesting of the wild flowers and other plant material, mainly for use in cut-flower products. Flowers are harvested not only from the Flower Valley Farm, but also from a supply network of privately-owned farms and state conservation areas covering 200 sq km, mostly based in the threatened Agulhas Plain. This income provides an incentive for these farmers to retain fynbos rather than convert the land to other uses. Flower Valley's strategy is to improve the marketing of fynbos material, using eco/ethical labelling to add value, gain market access and a price advantage. Thus, Flower Valley is using market mechanisms to reward landowners for sustainable biodiversity management.

Flower Valley is both a key conservation asset and a main source of livelihood for the nearby community who harvest selected flowers seasonally. Surplus income is re-invested in alien species clearance, the

South Africa

market forces protecting a unique flora

purchase of harvested wild flowers from local landowners and farmers, the development of marketing plans, support for micro-enterprise activities based on fynbos products and the creation of an Early Learning Centre and adult education facilities.

Recognizing the importance of linking business and biodiversity and having a strong trading operation to support the conservation and community initiatives in Flower Valley, the energy company Shell has donated funds to improve working and living conditions for the community, to support niche market development and to upgrade operational equipment. These improvements have enabled Flower Valley to become a strong player in the marketplace for sustainably-produced flower bouquet products, which are sold in supermarkets in South Africa through Pick 'n Pay and in the UK through Marks & Spencer.

Resonance & Replication

- The degree and percentage to which protected areas are effectively managed varies greatly with each ecosystem. Tropical and marine habitats in particular are relatively under-represented, and mountainous and high-latitude are over-represented. This reflects the lower economic cost of preserving the least productive and least desirable areas rather than places where people want to live and farm. It is now understood that protected areas have real productive and economic value, which bring real benefits to people living around them (Box 1). The recognition of the value of these benefits, which extend to national and regional advantages such as flood protection and tourism, has resulted in the world-wide success of protected area model over the past 50 years. However, the global network is far from complete.

- Even with the phenomenal success of the global protected areas system, much of the world's remaining biological diversity still remains in danger of disappearing. The recovery of snow leopards in Sagarmatha National Park is a small but important symbol of how dialogue, trust building and incentives for collaboration can be used to oppose biodiversity loss. With a revenue sharing system in place and better training in how to treat local people with respect, managers began to experience less hostility and more cooperation. Poaching declined, and prey and predator populations bounced back – albeit that this was only possible because a colonising population of snow leopards still survived in Tibet. Comparable results have been seen in other locations, with widely different kinds of animals, plants and people involved. In all cases we see that success comes from the sharing of benefits from conservation, the effective explanation

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of conservation values, sensitivity to local cultural preferences, and the applied use of accurate knowledge about how ecosystems and populations work.

- Together with the establishment of protected areas and reversing species and habitat loss, conservation of ecosystems is essential for maintaining the range of environmental services upon which humans depend while maintaining biodiversity. South African National Parks (SANParks) is using Flower Valley as a model to support fynbos conservation through the establishment and development of the Greater Agulhas National Park, part of the multi-stakeholder Agulhas Biodiversity Initiative. It is the first project to be implemented under the Government's Cape Action for People and Environment (CAPE). In addition, the Flower Valley Learning Centre is developing a partnership with the Western Cape Department of Education, in order to ensure quality education, training and support for educational development. The Flower Valley demonstrates a development for resource conservation and sustainable livelihoods, which has the potential for replication particularly in regions where loss of ecosystem services disproportionately affects the poor.

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Creating Local
Livelihoods from Ecotourism

Damage caused by tourism development is an irony, since people often visit places precisely because they are natural, peaceful and clean. Moreover, if relatively wealthy urban people are willing to go to more rural locations regularly, they could offer a useful set of economic opportunities for local communities. If tourism development had been managed with these aims in mind, then much good would have come of it. Instead, tourism has grown with little regulation or guidance into the world's largest business.

Many of the world's most attractive coasts and wild places have been ruined by construction in the process. The state of Quintana Roo in Mexico is as an example, for here there is rapid growth in tourism infrastructure all along the Caribbean coast to Belize. The conversion of mangrove forest into beachfront tourist resorts along the Mayan Riviera, south of Cancun, has left coastlines vulnerable. Threats to aquifers come from increasing water use, of which 99% is taken unsustainably from groundwater, and wastewater disposal.

These trends are echoed in Belize, where ecotourism is giving way to large-scale tourism development, involving the transformation of entire cays, lagoons and mangrove forests to accommodate cruise ships and recreational facilities.

It need not be this way, and in many places it is not. Nature-based tourism is one of the fastest growing tourism sectors worldwide, representing 7% of the total worldwide export of goods and services. Such tourism depends on the conservation of natural landscapes and wildlife, and using ecosystems in this way can promote both human well-being and biodiversity conservation. There are many options to harness tourists' willingness to pay, whether to see a healthy environment with abundant and diverse wild species, or to feel that they are contributing to the conservation of wild species and places while helping local people live more prosperous lives. The following case studies explore some of these options.

Ecotourism
& The Great Apes

"By conserving the great apes, we can also protect the livelihoods of the many people who rely on forests for food, clean water, and much else. Indeed, the fate of the great apes has both practical and symbolic implications for the ability of human beings to move to a sustainable future."

Kofi A. Annan,
Secretary General of the United Nations

The six species of great apes are our closest living relatives. In Africa they include the eastern and western gorilla (Gorilla beringei and G. gorilla), and the chimpanzee and bonobo (Pan troglodytes and P. paniscus), while the Sumatran and Bornean orangutan (Pongo pygmaeus and P. abelii) are found in parts of Indonesia and Malaysia. All are inhabitants of tropical moist forests, and are therefore vulnerable to all the factors that lead to forest clearance, including excessive logging, development of plantations, farming and forest fires. Deforestation has resulted in many great ape populations being lost or becoming isolated within protected areas, where in many cases they are also vulnerable to hunting and disease. As a result, all the great apes are declining in numbers and threatened with extinction.

Great ape tourism is well developed for mountain gorillas in all three of their range states (DR Congo, Rwanda and Uganda), for chimpanzees in Tanzania, and for orangutans in Malaysia.
In some countries, such as Uganda, gorilla-based tourism is seen as a means of alleviating poverty and as an ideal conservation tool, able to attract sufficient visitors to merit significant investment.

Other examples in Africa include western lowland gorilla viewing in Dzanga-Ndoki NP in the Central African Republic and at Lopé in Gabon, chimpanzee tourism in Kibali NP in Uganda, and the famous mountain gorillas in the Volcans NP in Rwanda.

In South-east Asia, orangutan tourism has operated continuously since the early 1970s. From the outset, it focused on rehabilitant orangutans, i.e. those captured for the illegal wildlife trade as infants, then confiscated from illegal captivity and rehabilitated to forest life. Four rehabilitation sites have been heavily involved: Sepilok (Sabah), Tanjung Puting (Central Kalimantan), Bohorok (northern Sumatra) and Semenggoh (Sarawak).

Great Apes Conservation Law – USA

In November 2000, President Clinton signed into law H.R. 4320, the Great Ape Conservation Act of 2000, that now provide critically needed funding for conservation programs designed to protect chimpanzees, bonobos, gorillas and orangutans. The bill authorizes $5 million in annual U.S. aid to support conservation and protection of the great apes by allocating grants to local wildlife management authorities and other organizations in Africa and Asia dedicated to protecting the apes and their habitat.

Uganda and Rwanda charge US$400 for one hour spent with a family of mountain gorillas, making this the most expensive wildlife-viewing experience in the world. The livelihoods of hundreds of people depend on the Bwindi Impenetrable National Park (NP) in Uganda, where foreign tourists trek to view gorillas while local people work as rangers, guides and camping staff, or else sell food, crafts and entertainment to the tourists. In the Buhoma valley just outside the park, many local businesses have started up, offering goods and services to visitors.

Stakeholder participation in Ecotourism

Seychelles: Investment in ecotourism by tour operators

The Seychelles has linked ecotourism with the restoration of native species, by making protected area status dependent upon the eradication of rats that are threatening endangered land birds. Since protected area status is valuable to ecotourism operators, three operators have invested US$250,000 in rat eradication.

Indonesia: A dollar a dive to coral conserving villagers

In islands in Maluku, in eastern Indonesia, local people have a tradition of managing nature collectively. Called sasi, this was adapted to scuba divers when it was realised that divers enjoy pristine coral reefs with plenty of fish, and are happy to pay for them. Divers spend at least a dollar for every minute underwater, if all their costs are considered, and often up to three if international travel is included.

A typical dive costs the diver up to US$150. This is only worth paying if the water is clean and the environment healthy. So the villagers made a deal with nearby dive resorts: to be paid the equivalent of a dollar a dive, in exchange for their help in protecting the reefs near their homes. This is given directly to the village, and has turned every single inhabitant into a reef guard, continually alert to the possibility of raids by dynamite or cyanide fishers from elsewhere. If every sport diver insisted on participating in an arrangement like this, then quite soon there would be tens of millions of people working to make the future safe for divers and the marine ecosystems that they visit. Thus the potential of nature-oriented tourism to leverage environmental investment is considerable, and other examples are given in the case studies that follow.

Costa Rica
Ecotourism

During the 1980s there was a growing trend towards mass tourism in Costa Rica, and many contracts were signed with international consortia to build resorts. Many saw this as threatening to national interests, and President Figueres began a programme aimed both at reversing deforestation and restoring options for a more sustainable and locally-beneficial tourism model based on nature.

Several government initiatives were therefore introduced in the early 1990s. New taxes were imposed (on carbon to restore forests on idle cattle pastures, on electricity to promote energy conservation, and on petrol to reduce carbon emissions) and tax reliefs offered (to encourage the preservation of privately-owned rainforest and its use for ecotourism). Planned developments were cancelled if they were considered harmful, or replaced by less polluting alternatives. A commitment was made to double the size of Costa Rica's protected area system to nearly a quarter of the country's land area. Political and financial backing was given to the National Biodiversity Institute (INBio) in its efforts to catalogue Costa Rica's wild species and develop partnerships to make use of them sustainably. These and other measures systematically changed the investment environment of Costa Rica.

The strong, clear messages sent out by government in the early 1990s made it clear that sustainable, nature-oriented tourism would be the dominant theme of the future. This was well-timed, in that the early 1990s also saw the growth of mass environmental awareness in the USA, Canada, Europe and elsewhere. Thus the market position targetted by Costa Rica found many companies eager to respond by investing in ecotourism.

By 2000, a million visitors were generating about US$1 billion annually in Costa Rica, making tourism – now significantly slanted towards the environment – the country's second-largest source of income after silicon chip production. With skilful international marketing based on real progress in protecting and restoring the environment, Costa Rica has developed one of the world's most successful ecotourism industries and is regularly praised for its attention to conservation.

""The [La Fortuna waterfall] generates 150 million colones [US$300,000] a year for this community. Six people work here and many more are employed indirectly. We want to build better trails through the rainforest here, as tourists love to walk. But the waterfall is the big draw for them. We don't advertise as we don't want to be swamped with visitors - we get between two and three hundred a day."

Carlos Espinosa,
Executive Secretary,
Associación de Desarrollo La Fortuna, Costa Rica

Resonance & Replication

That people enjoy viewing nature and will often spend considerable amounts do so is not in dispute. Clearly some organisms are more attractive – or more easily marketed - than others, with the great apes leading the field. But it is also clear that any wild species or ecosystem can be marketed, and that TV coverage, interpretation centres and nature trails can create an enjoyable and interesting experience almost anywhere, using any resources. The cacti of the deserts of the American south-west, the aloes of South Africa's Karoo, the butterflies of Sulawesi, the giant monitor lizards of Komodo, the monarch butterflies of Mexico, and the marine iguanas of Galapagos, are all potent attractors of potential ecotourists. Thus the principles of ecotourism have enormous scope for application in support of conservation world wide, demanding only imagination, regulation and investment to put into practice.

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Solving Environmental Problems Through Policy Mixes

Environmental problems tend to be interlinked. Thus for example deforestation, biodiversity loss, decline in ecosystem services, climate change and poverty eradication cannot realistically be treated as if they were unconnected. Because of this connectedness, policy-driven interventions to address any one environmental problem have the capacity to impact upon other problems.

A challenge for policy makers is therefore how best to use a mix of policies, laws, regulations and incentives (i.e. 'instruments') to address a given environmental problem which will, at a minimum, not result in negative impacts on efforts to resolve other environmental problems.

To address these multiple issues, states have developed a number of policy instruments, often used in combination, including bans, take-back requirements, product taxes, deposit-refund systems and voluntary or educational approaches. Technological advances in recycling and reclamation processes, as well as the use of waste as an energy source, offer new opportunities for efficient and effective management of waste. The bringing-together of some of these pressures and instruments is illustrated by the UK's efforts to manage wastes.

Jan Tinbergen, the Dutch economist and Nobel laureate in 1969, argued that a separate instrument is needed to achieve each economic objective, since two goals cannot be achieved with the same policy tool. When applied to development, this 'Tinbergen rule' suggests the need for a separate programme or procedure for each objective in order to achieve the multiple goals of growth, sustainability, social well-being, freedom, good governance, or civil liberty.

The complexities of waste management are a case in point. Not all wastes are collected since, for example, garden waste and some industrial and mining wastes are disposed of on site. If collected, wastes are then disposed of in various ways, such as landfilling, incineration, recycling, and composting. Wastes are diverse, and include domestic, hazardous, packaging, biodegradable and non-biodegradable, electronic components and batteries, and radioactive materials, requiring specific disposal processes for each. Public opinion about the location of waste processing and deposition facilities adds other complexities.

United Kingdom
Waste Management

In the UK, the Environmental Protection Act of 1990 obliges local authorities to arrange for the collection of household waste without charge, except as provided by regulations. The costs of providing these services are met by local Council Taxes and government grants. This is all done under the oversight of national government, which must comply with relevant EU directives, and the EU also makes available funding to help local authorities comply with these directives.

The current national strategy for waste management has an emphasis on minimising total volume, and recycling and reclaiming where possible. There is an enhanced role for economic instruments, including incentives for new investments and delivery structure reforms. Increasing public awareness of the merits and demerits of the available options, based on scientific evaluation, is another priority.

The mixture of legal, economic and other instruments applied under the current strategy include:

- a land-fill tax on local authorities, to encourage them to find ways to reduce the volume of waste sent to land-fill;
- a prohibition on local authorities charging households according to the volume or kind of waste they produce, so they cannot pass on the land-fill tax to them;
- obligations for recovering and recycling packaging wastes for some businesses, such as those with a turnover of more than £2 million and handling more than 50 tonnes of packaging in a year;
- a Tradable Compliance Credit System which allows packaging to be collected and reprocessed by private contractors, which document their activities through a system of Packaging Waste Recovery Notes;
- in England, but not in Wales, statutory recycling targets and Landfill Diversion Targets that place rapidly-declining upper limits on how much biodegradable waste is allowed to be placed in a landfill;
- in England and Scotland, but not Wales, a Landfill Allowance Trading Scheme linked to the Landfill Diversion Targets, which allows local authorities to bank unused allowances, to borrow future allowances to meet current needs, and to trade allowances with other authorities;
- encouragement for waste separation at point of origin, and subsidies to stimulate waste prevention and recycling; and
- a national Waste Implementation Programme which provides for Waste Performance Efficiency Grants for local authorities in areas such as data collection, research and technology, waste minimisation and awareness-raising.
- Having started from an extremely low level, without even records of waste flows being kept prior to 1983/84, waste separation at point of origin is fast becoming routine in most UK households and businesses.

United Kingdom

Waste Management

- Although representing only 9% of total waste, household waste is politically visible and the proportion recycled or composted, relative to that sent to landfill, is a UK Government sustainable development strategy indicator.

The category includes household bin waste and also waste from civic amenity sites, other household collections and recycling sites. Between 1995/96 and 2005/06, household waste per person increased by 14%, to a level of just over half a tonne per year. Meanwhile, though, the share recycled or composted increased from 6% to 26%. The proportion sent to landfill decreased each year since 2003/04, and is now at the lowest level since estimates were first made in 1983/84

- Progress has been made in other areas too. The UK's 50% recovery target for producer packaging has been met or exceeded by the firms for which it is obligatory.
- The Landfill Allowances Trading Scheme generated exchanges among 16 local authorities that were worth some £10 million in 2005/06.
- According to the Department for Environment, Food and Rural Affairs (Defra), this has contributed to England "making good progress towards meeting the 2010 target" of 11.2 million tonnes of biodegradable waste sent to landfill that was set by the EU Landfill Directive.
- In 2005/06, just under 12.4 million tonnes of biodegradable waste went to landfill, having declined from 13.9 million in 2004/05. Future targets under this directive are 7.5 million tonnes in 2013, and 5.2 million tonnes in 2020. These improvements in recycling and composting performance must continue, in order to ensure that the 2010 target as well as the later targets are met.

Netherlands

Landfill tax and other instruments

Like the UK the Netherlands applies a Landfill Tax but, in about 20% of municipalities, this tax is passed on to households through waste collection charges that vary with the quantity and type of waste put out for collection. The Landfill Tax is combined with a ban on landfilling (with some exemptions) and minimum standards for the requirements to be set in firms' environmental permits, which oblige them to avoid landfilling most waste categories. The Netherlands also applies a ban on exports and imports of waste destined for disposal, operates a number of subsidy schemes to promote energy generation from wastes, and imposes a broad spectrum of requirements obliging producers to take back waste stemming from the products they sell. In both countries, too, several of the instruments addressing household waste overlap, particularly Landfill Taxes with statutory Landfill Diversion Targets in the UK, and with the ban on landfilling in the Netherlands.

The EU Waste Directive has caused each Member State to take its own measures to meet waste targets, and while there are weaknesses in implementation (notably the export of wastes to avoid land-fill disposal and expensive reprocessing), progress is being achieved throughout the EU. This is matched in other countries, and several common denominators for success have been identified, including policy mixtures that have the following effects.

- First, they give high priority and government support to waste disposal authorities, thus promoting waste prevention and minimisation as well as recycling.
- Second, they phase out land-filling, partly by banning it for biodegradable and combustible waste, and by taxing the land-filling of recoverable waste.
- Third, they establish minimum standards for waste management, including obligatory and voluntary targets.
- Fourth, they provide incentives for waste prevention and separation, and place obligations on selected producer groups to reduce and/or reprocess packaging.
- Fifth, they introduce landfill diversion targets and tradable allowance schemes.
- And finally, they initiate and maintain strong enforcement and robust monitoring programmes.

The EU

Water Framework Directive (WFD)

Many decades of industrialisation, agricultural change, urbanisation and engineering works had, by the 1980s, left many of Europe's rivers, lakes, wetlands and catchments in a parlous state, polluted and prone to damaging floods, as well as threatening groundwaters in many places. The fact that so many water systems were shared across the borders of Europe's many countries meant that transfrontier solutions would often be needed for environmental problems.

The varied issues involved also demanded an exquisite differentiation of policy targets, including those addressing land use (for catchment function and agrochemical runoff), groundwater abstraction (for wetlands), civil engineering (for releasing rivers from canalisation and restoring their access to floodplains), and industrial technologies and water purification systems (for reducing industrial and urban pollution). This called for a comprehensive international regulatory framework capable of mixing policies and standards relevant to many different stakeholder interests.

- First, the 1992 regional Convention on the Protection and Use of Transboundary Watercourses and International Lakes obliged European countries to prevent, control and reduce water pollution.
- The EU then built on this treaty through the Water Framework Directive (2000), which requires integrated river basin management, and aims to ensure clean rivers and lakes, groundwater and coastal beaches throughout its territory. The WFD sets standards for river basin planning, and for the ecological quality and chemical purity of surface and ground waters.

The WFD is a unique management approach that sees water not as a 'sector' but as an ecosystem product and landscape connector, one that responds to all aspects of environmental change and that conveys environmental impacts over great distances, often in subtle ways. The EU approach is to take the best scientific knowledge, combine it with a precautionary orientation, reconcile conflicts of interest through dialogue wherever possible, and then impose an agreed set of high standards on member states.

Costa Rica

The 'Peace with Nature' Initiative

In 1948, Costa Rica abolished its armed forces and turned its barracks into classrooms for its children. Almost sixty years later, in Costa Rica and around the world, another type of 'war' is raging, this time with nature, and the Government of Costa Rica decided that another declaration of peace was needed: a declaration of Peace with Nature, and the abolition of the forces that destroy it. By 2007, Costa Rica had spent nearly 20 years in an attempt to achieve environmental as well as social sustainability, using a variety of instrument mixtures that included rationalisation and expansion of the protected area system, debt-for-nature swaps to reduce public indebtedness, and leveraged investment into biodiversity conservation, reform of forest laws to encourage reforestation, institutional reform to enhance performance against new goals and targets, promotion of nature-oriented tourism, and organising new revenue-earning arrangements from the use of the nation's biodiversity.

In 2006, President Óscar Arias Sánchez appointed a 46-member Presidential Commission for Peace with Nature, whose recommendations led to the announcement by President Arias in July 2007 of four national and four international commitments by the Government of Costa Rica, any one of which must be regarded as a major success in policy development. The national commitments of the Peace with Nature initiative are:

- that Costa Rica will becoming entirely carbon neutral by the year 2021, with all emissions offset by forest protection or reforestation at rates calculated by the National Fund for Forestry Financing (FONAFIFO), complemented by other actions including a significant reduction in the tax on hybrid automobiles and other vehicles that use renewable energy;
- that with the immediate signing of an Executive Order requiring all State institutions to design and implement an environmental action plan, a clear signal will be given that Peace with Nature "is not just tangible, but obligatory; not just of the people, but led by the State";
- that there will be an increase in forest cover and the size of protected areas, with the expansion of the system of Payment for Environmental Services through FONAFIFO to cover an additional 6,000 sq km of forest, the planting of five million trees in 2007, and the expansion of systems of biological corridors to promote gene flow among conservation areas and between them and surrounding landscapes; and
- that a curriculum of sustainable development and environmental education will be actively promoted in all schools, "to make sure our children and young people grow accustomed not to subtracting trees, but adding forests, multiplying mangroves and giving all the species within our borders an exponential value".

Resonance & Replication

There are several instances where complex mixtures of policies have been brought together across national frontiers in order to achieve something that would not otherwise have been possible, usually in the area where water, industry and agriculture overlap.

- In southern Africa, Lesotho and South Africa are cooperating in the construction of infrastructure on the Orange River in the Lesotho Highlands Project, providing South Africa with low-cost water and Lesotho with a flow of finance to maintain water catchments.
- In South Asia, India financed the Tala hydroelectric plant in Bhutan, gaining a source of energy while Bhutan gained guaranteed access to the Indian energy market.
- The Nile Basin Initiative links Egypt politically and economically to countries in Sub-Saharan Africa.

The inventory and bioprospecting work coordinated by INBio in Costa Rica has resonance with comparable activities from Mexico to Indonesia, and has enriched the knowledge base of many countries as they explored similar paths.

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Halting Loss of Cultural Diversity and Traditional Knowledge

Traditional knowledge is embedded within and largely maintained by the 6,500 or so languages in the world, and the cultures that sustain and are sustained by them. The fact that 96% of those languages are spoken in total by only 4% of the world's population suggests how fragile the cultural heritage of humanity may be. In fact, over half of the world's languages are not being passed on effectively to the next generation, so within perhaps two generations, most languages in the world will die out.

The traditional knowledge that will be lost as each language expires is made up of several linked features, including: information about the physical, biological and social components of a landscape; rules for using them without damaging them irreparably; relationships among their users; technologies for using them to meet the subsistence, health, trade and ritual needs of local people; and a worldview that incorporates and makes sense of all of these features in the context of a long-term and holistic perspective in decision-making.
Other forms of traditional knowledge, including plant varieties, planting and harvesting systems, technologies and world-views have less or no commercial potential but are nevertheless the intellectual property of their originators and owners. To protect this interest, an holistic approach to intellectual property is needed, the aim of which would be to ensure a fair return rather than to exclude or monopolize.

Pre-conditions for the fair and equitable treatment of traditional knowledge include the following.

- First, that groups possessing such knowledge are recognized in law so that they can enter into access agreements.
- Second, that the traditional knowledge concerned is recognized in law as the common property of the group entering into the access agreement.
- Third, that all access to such knowledge is through an access agreement with its owners, where these can be identified.
- Finally, that access agreements define terms for the three main circumstances in which access to traditional knowledge might be sought - i.e. where the aim is to manage an ecosystem in partnership, or to invent patentable products for commercial use, or to share knowledge freely with others.

Examples where traditional knowledge as been used in a way that matches the needs and expectations of knowledge holders are given in the case studies which follow. Other examples include:

- the project of the Grand Council of the Crees in Québec (Canada), to document their traditional ecological knowledge in the context of environmental impact assessments in Cree territory under the James Bay and Northern Quebec Agreement.
- the initiative of the Nisga'a Tribal Council Office in British Columbia (Canada), to record House (family) 'entitlement stories' in the context of native land claim settlements.
- the work of the Nunavut Planning Commission in Nunavut (Canada), to document Inuit traditional knowledge, mapping wildlife populations, human use and areas of archaeological significance while examining land use issues in Nunavut.
- the use of the terms of the Treaty of Waitangi of 1840 in New Zealand, to secure protection of Maori traditional knowledge.

Guyana

Intellectual Property Rights & Indigenous People

The Iwokrama International Centre for Rain Forest Conservation and Development has its origin in the 1989 Commonwealth Heads of Government meeting, at which Guyana offered 3,600 sq km of tropical forest as a proving ground for techniques of conservation and sustainable use. In 1990, a Commonwealth appraisal team chose the site of the Iwokrama reserve in the centre of the country

Meanwhile, the Iwokrama International Centre, the Iwokrama forest, and the Board of Trustees were all established in law through the Iwokrama Act, 1996. The Iwokrama forest is in a zone wholly or partly occupied and used by indigenous Amerindian people, however, part of a group whose interests have historically tended to be eclipsed by those of majority people descended from non-indigenous settlers who now live and work in towns and plantations. The Iwokrama Act guaranteed continued access to resources by local people, but it was recognised that there would be Amerindian sensitivities to the allocation of indigenous lands to an international enterprise.

Iwokrama incorporated from the beginning a sensitivity to Amerindian priorities, and sought to develop in partnership with the indigenous communities in and around the forest. In particular, Iwokrama sought to respond to the recognition that the absence of alternative livelihoods, compounded by a lack of capacity in project management and implementation, was a serious constraint to the sustainable development of the North Rupununi Amerindian communities.

On March 14, 1996 the National Assembly (Parliament) of Guyana passed the Iwokrama International Centre for Rain Forest Conservation and Development Act with the unanimous approval of both sides of the house. The Act was signed into law on May 12, 1996 by President Cheddi Jagan.

The 371,000 hectare Iwokrama Forest and adjacent North Rupununi Wetlands combine in an extraordinary ecosystem encompassing a range of habitats which include over 200 lakes, braided rivers flowing over volcanic dykes, 1000 metre mountains, lowland tropical rain forests, palm forests, and seasonally flooded forests and savannahs. The area contains an extraordinary biodiversity, including over 475 species of birds and the highest recorded number of species of fish (over 400) and bats (over 90) in the world, for an area of comparable size.
"Nothing in this Act shall be construed to prejudice, alter or affect any right or privilege heretofore legally or traditionally possessed, exercised or enjoyed by any Amerindian who has a particular connection with any area of land within or neighbouring the Programme Site".- Section 6(1) of the Iwokrama Act 1996.

Guyana
Intellectual Property Rights & Indigenous People

Iwokrama used participatory methods to facilitate local analysis and action around sustainable forest and wildlife management. Staff members facilitated numerous community appraisals, each of which involved participatory resource mapping. Local people were encouraged to document their resources and begin to analyse how they might use them sustainably. Subsequently, participatory management plan assessments were conducted in the communities of Fairview, Surama and Toka. These led to the identification of conservation projects and the signing of conservation contracts which provided cash or in-kind compensation for a variety of environmental management services. A seed grant of US$2,000 per village per year was provided for conservation projects, linked to performance indicators. The community of Fairview, for example, was prioritised for ecotourism activities such as a 'jaguar ecotourism lodge', and drew up a community development plan with which to attract and guide investors.

- By engaging at the immediately local level, Iwokrama became an influential dialogue partner with the Amerindian Peoples Organisation and contributed to building the capacity of the North Rupununi District Development Board (DDB). This was set up as a link between primary stakeholders, local agencies and external government and donor agencies.

A further rationale was the vulnerability of local communities to powerful outside interests, making it essential for Iwokrama to encourage the growth of a collective capacity to engage with outsiders on a more equal footing.

- Through the North Rupununi DDB, Iwokrama created both a political space for dialogue and a constituency for change at the local level. Support from Iwokrama included financing the posts of secretary and treasurer, providing short courses on financial management and projects, and facilitating access to key information related to resource management decisions. As its capacity has grown, it has effectively taken ownership of local networking and development processes.
- From 1999, the North Rupununi DDB started to receive from Iwokrama a share of user fees charged to all guests of the Iwokrama Field Station. It also received royalties from the publications of the MRU, including substantial amounts earned by a compilation of Makushi traditions known as Makusipe Komanto Iseru. The MRU has helped to challenge and reverse perceptions of language amongst young people, and revive an interest in culture. Its work at schools has helped overcome a reluctance by some teachers to incorporate local culture and language into teaching practice. It has scored a great success in getting the Ministry of Education and the Book Club of Guyana to help in distributing Makushi booklets.
- An indication of the growing profile and assertiveness of the Amerindian community is that private sector groups now increasingly recognise the legitimacy of Amerindian interest groups. This is consistent with Iwokrama's approach to business development, with its emphasis on joint ventures between outside investors and local enterprises.

India

Conservation & sustainable use of Medicinal & Aromatic Plants

India's medicinal and aromatic plants (MAPs) have been used in traditional Indian health systems like Ayurveda, Sidhha, Unani and the Tibetan system for millennia, and these are still very much alive today. The All India Ethnobiology Survey carried out by the Ministry of Environment and Forests (MoEF) in 1995 estimated that over 7,500 plant species are used by 4,635 ethnic communities for human and veterinary health care across the country. In 1993, the Government of India (GoI) estimated that 60-80% of India's population rely on medicinal plants for health care. Medicinal plants are particularly important to the rural poor, who are able to harvest them from the wild to meet their primary health care needs.

There are numerous laws and policies with some bearing on the sustainable use and conservation of MAPs in India. The most relevant of the older policies and legislation are:

1. the National Forest Policy (1988),

2. the Indian Forest Act (1927) and related state legislation,

3. the Forest (Conservation) Act (1980), and the Joint Forest Management orders and rules promulgated by both GoI and by various states.

4. The Panchayats (Extension to the Scheduled Areas) Act (1996) is particularly relevant to community-owned forests and tribal areas, as it gives local tribal people certain rights over natural resources.

The GoI's growing concern about the status of medicinal plants is better reflected in more recent policy statements and actions. Thus, the 1999 National Policy and Macro-level Action Strategy on Biodiversity recognizes the national significance of medicinal plants, and states that key areas for action are their conservation in the wild, and their cultivation elsewhere. Also in 1999, the Planning Commission of India, recognizing the importance of the medicinal plants sector, set up a National Task Force on the Conservation, Cultivation, Sustainable Use and Legal Protection of Medicinal Plants.

US Patent Office cancels Turmeric patent turmeric patent

In March 1995, two expatriate Indians at the University of Mississippi Medical Centre, Jackson, (Suman K Das and Hari Har P. Cohly) were granted a US patent (patent number 5,401,504) for turmeric to be used to heal wounds.

The Indian Council for Scientific and Industrial Research (CSIR) filed a case with the US Patent Office challenging the patent on the grounds of "prior art", i.e. existing public knowledge. CSIR said turmeric has been used for thousands of years for healing wounds and rashes and therefore its use as a medicine was not a new invention.

The claim had to be backed by written documentation claiming traditional wisdom. CSIR went so far as to present an ancient Sanskrit text and a paper published in 1953 in the Journal of the Indian Medical Association. The US Patent Office upheld the objection and cancelled the patent.

India

Conservation & sustainable use of Medicinal & Aromatic Plants

The Foundation for Revitalization of Local Health Traditions (FRLHT) focuses on the conservation, sustainable use and research on biodiversity used in Indian systems of medicine, on promoting traditional medicine in primary health care, establishing linkages between traditional and allopathic medicine and on the dissemination of traditional knowledge. Together with numerous state forest departments and communities, it has established 55 Medicinal Plant Conservation Areas in Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu, over 150,000 Home Herbal Gardens, and a community-owned enterprise, the Gram Mooligai Co. Ltd.

The Department of Indian Systems of Medicine and Homeopathy houses the National Medicinal Plants Board, which is responsible for assessing supply and demand, developing conservation strategies, promoting cultivation and collectors' cooperatives, protecting intellectual property rights, supporting research, and facilitating information exchange.

Almost all of India's 28 states and 7 Union Territories have now established State Medicinal Plants Boards, which have similar functions to the national board at the state and regional level, and are mainly funded by their respective state governments. Finally, the Department of Science and Technology works to raise public awareness about the use and value of medicinal plants, and in some regions (e.g. the north-east) is investing in the conservation and sustainable use of MAPs.

The UNDP-GEF project 'Mainstreaming Conservation and Sustainable Use of Medicinal Plant Diversity in Three Indian States' is supported by a US$5.28 million grant approved in 2005. This project seeks to mainstream conservation and sustainable use aims into forest management policy and practice at the national, state and local level in three Indian states: Arunachal Pradesh in the north-east, Chhattisgarh in the centre-east, and Uttarakhand (formerly Uttaranchal) in the north. The project works with at least 400 species of MAPs, including several endangered ones.

South Africa

Merging Traditional & Modern Medicine

In Sub-Saharan Africa, there is on average one traditional medicine practitioner for every 500 people, compared to Western medicine practitioners where the ratio is one to about 40,000. In South Africa, traditional herbal medicine also still forms the backbone of rural healthcare. About 3,000 plant species are used medicinally in South Africa, reflecting the country's remarkable plant and cultural diversity. In KwaZulu-Natal, for example, Zulu traditional healers use about a quarter of the entire flora. In the country as a whole, some 500 species of medicinal plants are traded in large quantities through informal markets. Traditional knowledge systems in Africa are largely oral, which heightens the fragility of this type of knowledge, and there is an ever-increasing loss of such knowledge in South Africa and elsewhere in southern Africa.

Efforts have been directed towards investigating and documenting the traditional medicinal practices of a number of southern African cultural groups in recent years. The Traditional Healers' Association of South Africa, for example, is co-operating with the universities of KwaZulu-Natal, and the International Centre for Indigenous Phytotherapy Studies (TICIPS), an alliance developed through collaboration between the University of Missouri-Columbia and the University of the Western Cape, in the research and development of Sutherlandia frutescens ('cancer bush'). This plant is used extensively in traditional medicine and is considered the most powerful of the herbs that are used to treat 'wasting diseases'. It is currently being tested for effectiveness in treating patients newly diagnosed with HIV/AIDS. Clinical trials of the medicine began in August 2007 and the results are expected in August 2009. Six traditional healers are acting as full collaborators in the Sutherlandia research, helping to design the study and recruit and evaluate the volunteers.

The TICIPS scientists are also taking care to protect healers' traditional knowledge and have created an 'Access and Beneficiation Agreement' that conforms to the laws of South Africa. This document ensures communities will benefit financially if, in future, profits are made from plants that healers have identified as medicinal.

Examples of other South African medicinal plants that have contributed to herbal medicines used internationally include: Cape aloe (Aloe ferox), for arthritis and the healing of wounds, buchu (Agathosma betulina), a diuretic and urinary antiseptic, Devil's claw (Harpagophytum procumbens), used as an analgesic and anti-inflammatory, and Hoodia gordonii, used as an appetite suppressant.

> "Traditional medicine is our culture and heritage - it occupies pride of place in Africa because it is affordable and easily accessible. We need to raise the profile of traditional medical practitioners, and recognise the important role they play in the health care delivery system ... We must not lose sight of the need to protect our rich traditional medical knowledge and indigenous plants"
>
> **Welile Shasha,**
> **South Africa Country Representative, WHO**

Brazil

Ethno-development of the Sateré-Mawé people

The integrated project for the ethno-development of the Sateré-Mawé people began in 1995, effectively as a race against time. This nation lives in an 8,000 sq km area on the border between the Amazonas and Pará states of Brazil. It is recognized as an indigenous reserve, to which the Indian population enjoy usufruct rights, but it stands in the path of the cutting edge of the advancing agricultural frontier that is penetrating towards the heart of the Amazon, driven chiefly by expanding soya bean plantations.

The lands of the Sateré-Mawé people are rich in petroleum resources, leading in the late 1970s to what the inhabitants saw as an invasion by the oil company Elf-Aquitaine. This opened new lines of penetration which would have harmed the future of an enormous area, making ecologically sustainable development in the Amazon impossible. It became clear that the Sateré-Mawé could only conserve their own land by showing that they knew to develop it, using their resources sustainably, and providing a model for regional development.

To support these efforts, the Sateré-Mawé had access to an abundant resources of guaraná (Paullinia cupana), a native climbing plant the berries of which contain a high concentration of the stimulant alkaloids caffeine and theobromine. This has considerable and increasing value in international trade. The Sateré-Mawé saw themselves as the protectors of a natural genetic bank of guaraná, which they revered

To support these efforts, the Sateré-Mawé had access to an abundant resources

of guaraná (Paullinia cupana), a native climbing plant the berries of which contain a high concentration of the stimulant alkaloids caffeine and theobromine. This has considerable and increasing value in international trade. The Sateré-Mawé saw themselves as the protectors of a natural genetic bank of guaraná, which they revered as the ancestor of all climbing plants in the forest, and indeed of themselves, and as the inventors of techniques for domesticating and improving guaraná, as well as being the masters of how to use it correctly.

The aim, then, was to base community development on sustainable use, harvesting and sale of guaraná and the preservation of a culture linked to it, thus showing that socio-biodiversity could be a key to development in the Amazon. This involved overcoming a number of challenges.

- First, there was a need to find a way to export the product at good prices.
- Then, the resulting income would need to be used to promote the self-confidence and self-esteem of the producers, to boost self-reliance among a people determined to manage its own territory, and to develop collective projects that combine environmental concerns with the improvement of the quality of the life of the local population.
- A final aim was to establish an 'economic movement' in which all the forest communities would be involved, whether indigenous or of mixed race, so that economies of scale could be exploited, diverse human resources absorbed and used, and cooperation developed with like-minded partners, without undermining the autonomy of local inhabitants.

The continuity of the commercial relationships that the Tribal Council had established gave credibility to the Council and also attracted several European cooperation projects. These have been strengthening the logic of pragmatic cooperation with the involvement of local people.

Peru

Law for the Protection of the Collective Knowledge of Indigenous Peoples

[PERU - LAW N° 27811

(PUBLISHED IN THE OFFICIAL JOURNAL "EL PERUANO" ON AUGUST 10, 2002)

LAW INTRODUCING A PROTECTION REGIME FOR THE COLLECTIVE KNOWLEDGE OF INDIGENOUS PEOPLES DERIVED FROM BIOLOGICAL RESOURCES

RECOGNITION OF THE RIGHTS OF INDIGENOUS PEOPLES IN THEIR COLLECTIVE KNOWLEDGE

Article 1.- Recognition of rights. For the purposes of this legislation:

(a) "Indigenous peoples" means aboriginal peoples holding rights that existed prior to the formation of the Peruvian State, maintaining a culture of their own, occupying a specific territorial area and recognizing themselves as such. These include peoples in voluntary isolation or with which contact has not been made, and also rural and native communities. The term "indigenous" shall encompass, and may be used as a synonym of, "aboriginal," "traditional," "ethnic," "ancestral," "native" or other such word form.

SCOPE OF PROTECTION

Article 3.- Scope of protection afforded by this legislation

This legislation establishes a special protection regime for the collective knowledge of indigenous peoples that is connected with biological resources.

OBJECTIVES

Article 5.- Objectives of the regime

The following shall be the objectives of this regime:

(a) To promote respect for and the protection, preservation, wider application and development of the collective knowledge of indigenous peoples;

(b) To promote the fair and equitable distribution of the benefits derived from the use of that collective knowledge;

(c) To promote the use of the knowledge for the benefit of the indigenous peoples and mankind in general;

(d) To ensure that the use of the knowledge takes place with the prior informed consent of the indigenous peoples;

(e) To promote the strengthening and development of the potential of the indigenous peoples and of the machinery traditionally used by them to share and distribute collectively generated benefits under the terms of this regime;

(f) To avoid situations where patents are granted for inventions made or developed on the basis of collective knowledge of the indigenous peoples of Peru without any account being taken of that knowledge as prior art in the examination of the novelty and inventiveness of the said inventions.

Resonance & Replication

The Sateré-Mawé Tribal Council has established two socio-ecological projects, one on waste management and the other promoting bee keeping, as a contribution to the maintenance of forest biodiversity while also yielding useful products. Alongside these, a biodiesel project was developed, based on the use of oily nuts found locally.

There are also organisations dedicated to promoting solidarity among endangered language groups and the international community of interest associated with them. Typical among these mechanisms is the Foundation for Endangered Languages (www.ogmios.org), which aims to support, enable and assist the documentation, protection and promotion of endangered languages. Others include:

- Terralingua (www.terralingua.org),
- Diverscité Langues (www.teluq.uquebec.ca),
- Endangered Language Fund (www.endangeredlanguagefund.org),
- Lingucubun (www.chibcha.demon.co.uk)
- Yinka Dene Language Institute (www.ydli.org)
- European Bureau for lesser used languages (www.eblul.org)
- Clearing House on Endangered Languages (www.tooyoo.L.u-tokyo.ac.jp)
- Central Institute of Indian Languages (www.ciil-spokencorpus.net)
- Hans Rausing Endangered Languages Project, SOAS (www.hrelp.org)
- Comité International Permanent des Linguistes (www.ciplnet.com)
- MOST Clearing House on Linguistic Rights (www.unesco.org/most/

Examples of efforts to investigate and document traditional medicinal practices include the Traditional Knowledge Digital

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Adapting to Climate Change

Supporting interventions in developing countries that increase resilience to the adverse impacts of climate change is one of the highest priorities of the global development agenda. Incorporating climate change considerations in planning mechanisms and legislation and ensuring their proper implementation is a major focus of adaptation projects that address areas such as water resources management, land management, agriculture, health, infrastructure development, fragile ecosystems, including mountain ecosystems, and integrated coastal zone management; improved forecasting, monitoring and prevention of diseases and vectors affected by climate change; capacity-building for preventive measures, planning, preparedness and management of disasters relating to climate change.

Because climate change adaptation is very much a work in progress (as it will be for the foreseeable future), the case studies which follow are inevitably not as definitive and retrospective as those in other chapters, which reflect a longer tradition of addressing challenges. They are indicators of the kinds of mixes of polices, measures and forward planning that countries, peoples and communities are currently making

> "All countries are vulnerable to climate change and instability in weather patterns but the poorest countries and the poorest people within them are most vulnerable, being the most exposed and having the least means to adapt."
>
> **IMF and World Bank Development Committee (2006)**

Africa

Adaptation Policy Development

Africa's vulnerability to climate change means that planned adaptation is vital. Adaptation measures include improved seasonal forecasting to allow better management of farmland and water resources, and diversifying livelihoods, for example by using forest products as resources to buffer crop failure in climatically-marginal areas. Such measures would also be needed even without the threat of climate change.

Adaptation projects funded under the Global Environmental facility include:

- Incorporating Climate Change in Integrated Water Resources Management in Pangani River Basin, Tanzania, which aims to build national and regional capacity in water resources management.
- Coping with Drought and Climate Change (Kenya, Mozambique, Zimbabwe and Ethiopia), which aims to pilot coping mechanisms for reducing vulnerability of farmers and pastoralists to future climate shocks, including coping strategies, early warning systems, drought planning, integrating climate change and drought across sector policies, and disseminating lessons learned.
- Adaptation to Climate and Coastal Change in West Africa (Senegal, Cape Verde, Guinea Bissau, Gambia and Mauritania), which aims to pilot adaptation actions in vulnerable locations, and to formulate national and regional adaptation strategies for coastal zones.
- Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Eastern and Southern Africa (Kenya, Mozambique and Rwanda, with Tanzania and Madagascar as observers), which aims to help mainstream adaptation into development planning and implementation.
- Community-based Adaptation (CBA) Programme (Global, to include Morocco, Namibia and Niger), which aims to develop a framework with which to respond to CBA needs, while financing a selection of CBA projects, and capturing and disseminating lessons learned.

Other initiatives that are outside the UNFCCC process include:

- Sustainable Land Use and Forestry/ USAID programmes, which aim to sequester carbon within ecosystems, while conserving biodiversity, reducing ecosystem vulnerability, improving forest management and promoting sustainable agriculture.
- The Central African Regional Program for the Environment (CARPE), which covers the Congo Basin and aims to reduce the rate of forest degradation and biodiversity loss there.
- The Monitoring, Mapping and Analysis of Disaster Incidents in South Africa (MANDISA) database at the University of Cape Town focuses on urban floods, wildfires and extreme wind events.
- The World Hydrological Cycle Observing System programme is based on regional projects that providing technology and training to monitor rainfall, river flow and evaporation in the world's river basins, with two of these being in Africa, covering West/Central and Southern Africa.

Tanzania

Mainstreaming Climate Change adaptation in integrated water resources management

The goal of the GEF-funded Pangani River Basin project is to mainstream climate change adaptation into Integrated Water Resources Management, to support the equitable provision of freshwater for the environment and for livelihoods for current and future generations.

The Pangani River Basin is about 43,650 sq km, with about 5% of this area in Kenya and the rest in the Arusha, Manyara, Kilimanjaro and Tanga regions of Tanzania. The Pangani River system drains the southern and eastern sides of Africa's highest peak, Mt. Kilimanjaro (5,985 m), as well as Mt. Meru (4,566 m), then passes through the arid Maasai Steppe, draining the Pare and Usambara Mountain Ranges before reaching the coastal town of Pangani and the Indian Ocean.

The Basin has a population of about four million people, most of whom rely on agriculture for their livelihoods . Irrigated agriculture in the basin (300-400 sq km) contributes significantly to Tanzania's food security and supports almost 3 million livelihoods. The basin also includes four hydroelectric power facilities with a combined production capacity of 91.5 MW or 17% of Tanzania's national power grid supply. The Pangani River Basin also hosts globally important biodiversity resources in the Kilimanjaro, Arusha and Mkomazi protected areas and in the Eastern Arc Mountains

The objective of the project is prepare water managers and users for changing climatic conditions (especially reduced flows) by providing technical data, planning, and improved allocation, capacity building and awareness-raising. The project focuses on three technical areas:

- Understanding current and future climatic vulnerability (in the broadest sense of the term): developing and using information for equitable water allocation in a changing hydrological regime
- Negotiated outcomes to minimize future climatic vulnerability and future climatic risk: Continuing dialogues to sustainable water resources management
- Mainstreaming climate change adaptation in the water sector: national linkages and lessons learned

Chapter 16: Adapting to Climate Change

Small Island States

Areas of adaptation

Measures to address the impacts of climate change on biodiversity and land degradation, include: creating land use plans and corresponding enforcement strategies; rainwater harvesting, water demand management, provision of water storage and water efficient household appliances; flood risk analysis with land zoning and flood mitigation actions; strengthening of institutional capacity to enforce land zoning restrictions, including the application of beach setbacks for construction; the use of land use models in order to make farming more efficient and less destructive to the environment and training fishermen and women in sustainable fishing practices.

Possible measures to address impacts on infrastructure and settlements include: providing for the scientific and engineering services required to assess vulnerabilities and define priorities, then retrofitting buildings; integrating adaptation into population and resettlement programs; improving the planning and permitting processes to guide coastal zone activities, including regulatory adjustments, awareness raising and enforcement; producing design and construction guidelines and applying them in pilot investments.

Measures that have been suggested to respond to projected decreases in water resources include: incentives to encourage the use of water saving devices; selecting appropriate drought tolerant vegetation; establishing river buffer zones to enhance the resilience of the river and catchment area; updating national water policies, improving water resources management; revising building codes to increase opportunities for rainwater catchment and storage; preparing water resource master plans for islands; and assessing and improving the water supply system.

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