CONNECTING THE DOTS

Biodiversity, Adaptation, Food Security and Livelihoods





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Connecting the dots: Biodiversity, Adaptation, Food Security and Livelihoods

Purpose of the present report

As mentioned in the preface of the 2008 interim report on the economics of ecosystems and biodiversity (TEEB), we are still learning about the nature of the value of biodiversity as we broaden the concept of capital to encompass not only human and social capital but also natural capital. In the same vein we are struggling to delineate the value of nature. Global efforts to overcome the sustainability challenge are still relatively weak and generally not very successful as indicated by the recent UN report on achieving the Millennium Development Goals (MDGs) (UNDESA 2010). By contrast, local and indigenous communities – and other ecosystem-based initiatives active on a local scale – are demonstrating success at the poverty-environment nexus. Local and indigenous communities rely on their natural capital for food security, medicine, shelter, nutrition and livelihoods and are advancing innovative solutions in biodiversity conservation, poverty alleviation and adaptation to climate change

This report seeks to explore the state of knowledge on the linkages between biodiversity conservation, climate change adaptation, food security, and sustainable livelihoods and aims to address a longstanding knowledge gap on how local action could contribute to policy making. The report documents best practices and lessons learned from community-based projects that synergistically address biodiversity conservation, poverty reduction (sustainable livelihoods), and adaptation to climate change. The report aims to demonstrate the co-benefits resulting from local biodiversity conservation projects – e.g. for sustainable livelihoods, food security, climate change adaptation etc – to "make the case" for investing in local and community-based initiatives, and to communicate lessons learned to policy makers that might facilitate better informed decisions and interventions in environment and development policy formation.

Introduction

Biodiversity, the variety of life on Earth, provides millions of people with livelihoods besides helping to ensure food security and is a rich source of both traditional medicines and modern pharmaceuticals. The Millennium Ecosystem Assessment clearly and unequivocally identifies the immense importance of biodiversity, ecosystems and ecosystem services to human well being and sustainable human development (MA, 2005). The biodiversity crisis and the associated challenges biodiversity loss poses to deepening poverty and climate change, is now well understood as a human development crisis as much as an environmental one.

The global community has signalled its commitment to achieving a significant reduction in environmental degradation, and notably to meeting the challenge of biodiversity loss. The 2010 Biodiversity Target (also known as the "Biodiversity Challenge") has been hailed as "one of the most important declarations ever to be made in support of environmental protection for sustainable development" (UNEP-WCMC 2003). However, the third edition of the Global Biodiversity Outlook (SCBD, 2010) indicates that countries have failed to meet this challenge.

Multilateral Environmental Agreements (MEAs) such as the UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the UN Convention to Combat Desertification (UNCCD) constitute important guiding global frameworks, under which national governments have developed strategies and implementation plans to deal with environment. Similar multilateral agreements and national implementation plans exist for global and national poverty reduction and development objectives. Review of these frameworks and implementation plans reveal, however, administrative structures and reporting mechanisms do not overlap in relevant and meaningful ways, resulting in limited communication among them. There seems limited coherence at the national level, making duplication of efforts and inefficiencies very real and pressing concern. Given wide recognition that development and environmental management are mutually reinforcing, it is important to ensure that development and environmental strategies work handin-hand to address poverty-environment linkages on the ground level.

There is overwhelming consensus among policymakers that biodiversity conservation, poverty reduction and development should be mainstreamed. At the country level, however, governments and development agencies are still slow to accept biodiversity and environment conservation as integral elements of development strategies. Similarly, some conservationists and academics are

hesitant to accept poverty reduction, small enterprise development, health and social development as a part of the conservation mandate.

This study is intended to provide local examples of successful initiatives and to make the case for investing in the scaling up of local good practice in biodiversity conservation, which has co-benefits for poverty alleviation, climate change adaptation, food security, health and others.

At the local level, relatively little has been done to systematically document how communities are involved in activities to accrue benefits and co-benefits from conservation and development action. Despite growing recognition that access to biodiversity and the sharing of its benefits are fundamental to poverty reduction efforts among many of the world's poorest communities, documentation from the local level has been largely anecdotal, which in turn limits the reach and efficacy of policy recommendations to scale-up local good practice at the poverty-environment nexus.

Learning from local ecosystem-based initiatives

Biodiversity loss is recognized as an important global challenge, as now reflected in global frameworks and national action plans. Such a loss of ecosystem goods and services and biodiversity contribute to climate change, loss of livelihoods and food security beside destabilizing communities.

Given this there is consensus that biodiversity is not just an environmental issue, but a serious development issue with vast implications for poverty reduction, food security, population health, sustainable livelihoods, particularly among the world's poorest and most vulnerable populations. Despite acknowledgment of the linkages between biodiversity conservation and human development co-benefits, there remain significant obstacles to mainstream biodiversity into effective policy development. Central among these are:

- A lack of overlap and communication between biodiversity and development implementation plans and strategies, at both the national and international levels;
- Persistent reluctance among policymakers to integrate biodiversity conservation considerations into development discussions and economic plans;
- While local and indigeonous communities are showing leadership at the poverty - environment nexus, the international community and national governments are still struggling to connect the dots between biodiversity

- conservation and development co-benefits.
- Relatively little systematic research has been done, however, that
 documents how biodiversity conservation and development co-benefits
 overlap. A close look at some projects at the local level can be telling of
 the co-benefits that are possible from conservation actions.

This report illustrates some of the most critical issues in climate change, biodiversity conservation and sustainable development, and explores important linkages among these topics (Part 1). The key linkages documented in this paper are illustrated using case studies of projects that have achieved multiple benefits (Part 2). In Part 3, using these case studies, the report explores the fact that the projects yielded co-benefits even though they were not designed to do so. Part 4 proposes a series of recommendations/solutions on how to move from an appreciation and improved understanding of these linkages towards a more supportive policy environment.

In light of the above, the present report aims to:

- Outline the overlap of international crises biodiversity loss, food security, climate change, poverty, etc, demonstrating in the latter how biodiversity underpins successful solutions;
- Explore local and indigenous community success at the intersection of biodiversity conservation and development co-benefits;
- Present a number of case studies from the local level that illustrate the linkages between biodiversity conservation and development cobenefits;
- Re-examine the same case studies to explore where other co-benefits might have been possible;
- Offer policy recommendations/solutions for (scaling up local solutions at the poverty-environment nexus) fostering a supportive policy environment for realizing co-benefits.

PART 1

Identification Of Concepts

Biodiversity

onservation actions are generally referred to as those actions that seek to halt the decline in the world's biodiversity. Biodiversity in simple terms refers to the variability among life forms on earth, including genes, species and ecosystems (article 2, Convention on Biological Diversity 1992). It is widely accepted that biodiversity is under stress at each of these levels (MA, 2005). Some academics and scientists, however, may argue that biodiversity has always been under stress. The question is whether the current levels of stress are historically critical due to human intervention and the need for development (Millennium Ecosystem Assessment, 2005). Gaia theorists may ask whether the earth is merely getting ready to impose another major event that will yet again "clear the decks" through mass extinction (Lautensach *et.al.* 2008).

The parties to Convention on Biological Diversity (CBD) in 2002 agreed on a global commitment to "achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation, and to the benefit of all life on Earth". This was later endorsed by the Heads of State who participated in the World Summit on Sustainable Development (WSSD).

The third edition of the Global Biodiversity Outlook (GBO 3) published in 2010 amply demonstrates, however, that these targets have not been met (SCBD, 2010). It further states that most of the future scenarios predict continued extinctions and loss of habitats with associated decline of some ecosystem services important to human well-being. It also cites a lack of scientific uncertainty in

identifying precise connections between biodiversity and human well-being and the functioning of ecosystems. The loss of biodiversity has been attributed to a range of factors. The Millennium Ecosystem Assessment report identifies the main direct causes of biodiversity loss as habitat loss, invasive alien species, climate change, unsustainable use of biological resources and environmental pollution. Many of these drivers continue to wreak havoc on biodiversity. The role and relevance of biodiversity in dealing with global challenges such as achieving the Millennium Development Goals (MDGs) and climate change has been well documented (Pisupati and Warner, 2003; Pisupati and Rubian, 2008).

When looking at the linkages between biodiversity, development and poverty reduction, biodiversity is often referred to in terms of its "use" value that is, in terms of things such as agricultural biodiversity, non-timber forest products, bush meat, medicinal plants and pharmaceutical products. There are a number of non-use values such as ecosystem services (watershed protection, soil organisms and habitat for natural pollinators and predators which can lead to significant savings in fertiliser and pesticide use and human assisted pollination) and existence values (such as the aesthetic, spiritual, moral and cultural values associated with retaining species and ecosystems).

Under the CBD, 193 countries are currently developing a framework for preventing biodiversity loss through a series of targeted actions. These actions focus on the three objectives of the CBD, namely, conservation, sustainable use and access to genetic resources and the fair and equitable sharing of their benefits. It has to be seen, however, the extent to which these targets are based on field experiences. If such experiences are not appropriately assessed, we run the risk of repeating our mistakes in the period beyond 2010 and missing an opportunity to save global biodiversity and, in the process, to secure livelihoods.

Climate change adaptation and mitigation

Climate change adaptation and mitigation activities seek to reduce the impacts of climate change felt by communities. Climate change is commonly defined as the variation in the average state of the climate for an extended period of time that can be directly or indirectly attributed to human activities and that has altered the composition of the atmosphere (article 1.2 UNFCCC, 1992).

Climate change mitigation deals with the causes of climate change whereas adaptation addresses the consequences (IPCC, 2001b). Mitigation strategies seek to limit the extent of climate change by reducing emissions of greenhouse gases or by enhancing carbon sequestration, while adaptation options seek to help

ensure the resilience of communities and ecosystems in the face of a changed climate. Adaptation activities may have immediate or short-term positive effects for those who implement them, whereas mitigation activities affect the global climate and global carbon levels and benefit a wider populace, including those who have not invested in them (IPCC, 2001b).

Adaptation activities may involve changing practices through measures such as organic farming or agro-forestry projects aimed at maintaining soil structure and moisture levels and preventing erosion. They may also involve activities such as promoting drought resilience through changes in crop varieties, promoting infrastructure such as small dams or embankments to prevent flooding, encouraging re-vegetation of steep slopes prone to landslides or restoring coastal vegetation to prevent tidal surges.

Effective adaptation planning incorporates the uncertainty associated with current climate change models, presenting planners with a range of potential changes and implications for both ecosystems and human settlements and livelihoods (UNDP, 2007). Climate change adaptation may also take into consideration links that might at first seem tenuous. For example the forestry sector will have to consider the implications of changed precipitation patterns and temperatures not only for forest growth and regeneration but also for the frequency of pest outbreaks and forest fires (IPCC, 2001a). Industries may have to contend with changes in water availability and Governments may have to negotiate trans-boundary water-use agreements that account for climate-related changes in water flows (IPCC, 2007). Effects on the health sector may include the need to contend with increased heat-related mortality and increased frequency of disease outbreaks (UNDP, 2007).

Mitigation activities include reducing outputs of greenhouse gases into the atmosphere from livestock or industry, changing behavior patterns of consumers and developing and disseminating technologies that can be used to reduce emissions. Carbon plantations may also be established, where vegetation is planted specifically to sequester carbon (IPCC, 2001b). Although mitigation is the key to addressing the issue of climate change, there is debate about the validity of some approaches to mitigation. For example, establishing carbon plantations in some marginal agricultural areas may enhance carbon sequestration, but agricultural activities that are displaced in the process may be taken up elsewhere, leading to deforestation and associated carbon loss. This type of problem is termed "leakage". Likewise, the permanence of carbon sinks is an issue of debate. It has been suggested that the carbon in forest plantations is not likely to be sequestered as long as the carbon stored within fossil fuels in

the ground. Attempts to mitigate climate change by reducing burning of fossil fuels are therefore favoured by some, while others see considerable biodiversity benefits to increasing forested areas.

In 2005, the Conference of the Parties to UNFCC began discussions on the scope of reduced emissions from deforestation and degradation (REDD). In December 2007, at its thirteenth session the Conference of the Parties to the UNFCCC, countries decided to develop a mechanism for compensating for REDD, a matter that was not covered by the Kyoto Protocol.

As part of the Bali Action Plan¹ and the Bali Road Map², the discussions broadened further and the Parties to UNFCCC called for: "Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries". This expanded discussion has been labelled "REDD Plus" in current negotiations. Deforestation, especially in tropical countries, account for 20 per cent of global emissions of carbon dioxide, making it the second largest contributor to climate change after greenhouse-gas (GHG) emissions.³ It has been suggested that a new mechanism at the multilateral level linking reductions in deforestation through earmarked donor funding and the international carbon markets would provide a cheaper and more sustainable option for mitigating climate change. It has also been suggested that such a mechanism could increase economic incentives for protecting forests.

Livelihoods

Singh and Vangile (1994) advocate that people's capacity to generate and maintain their livelihood or means of living is "contingent upon the availability and accessibility of options which are ecological, socio-cultural, economic, and political and are predicated on equity, ownership of resources and participatory decision making" (Singh and Vangile, 1994; Scoons, 1998).

Sustainability in this context is generally understood to be as defined by the World Commission on Environment and Development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The Stockholm Environment Institute, however, reminds us that the definition of sustainable livelihoods should go beyond the basic requirements for living (food, shelter and clothing) to take into consideration local cultures and customs and environmental constraints.

¹ UNFCCC Decision 1/CP.13

² UNFCCC Decisions 2-4/CP-13, Decision 2/CP-13 being dedicated to REDD

³ Jane Saunders, Ruth Nussbaum 2008. Forest governance and reduced emissions from deforestation and degradation (REDD). Chatham House Briefing Paper (Chatham House, London).

A fundamental aspect of the livelihoods approach is the need to recognize the various dimensions of poverty (Sen, 1983). Defining poverty requires moving on from traditional definitions of "dollar a day" and poverty line assessments (which assess the level of per capita consumption required to satisfy basic nutritional needs). The research framework used in the present report builds on the conceptualization of poverty developed by the World Bank in 2000 to incorporate four main elements (Oviedo, 2004; Figure 1):

- 1. Opportunity (access to markets, resources and income-generating opportunities leading to wealth creation);
- 2. Empowerment (influence on state institutions and participation in political processes and local decision-making);
- 3. Security (reduced vulnerability to risks such as ill health, economic shocks, natural disasters and seasonal or annual variations in resource availability);
- 4. Capability or human capital, which addresses the ability of the poor to seize economic opportunities, including education, skills and health.

There are significant inter-linkages between these four dimensions and they need to be addressed in an integrated fashion if meaningful outcomes are to occur at the field level (Oviedo, 2004).

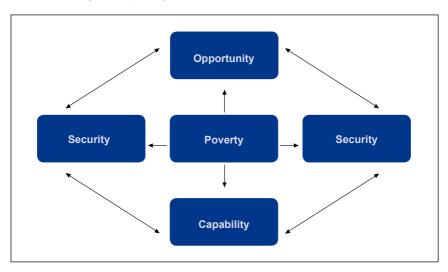


Figure 1: The four dimensions of poverty – vulnerability, assets and opportunities, power and voice and capabilities – are all inextricably linked (Oviedo, 2004)

The relationships between the different dimensions of poverty are mediated by a diverse set of institutions that affect decision-making. At the micro level these institutions include resource tenure arrangements, social and power relations (including gender relations), labor arrangements, capital endowments and technologies. At the macro level they include macro-economic policies, markets and prices, donor approaches, governance, political conflict and demographic changes. In effect, the linkages between poverty, environment and development are rather more complex than has traditionally been assumed (see, e.g., Richards, 2003).

Implementation of the livelihood approach and poverty reduction is guided by international frameworks such as PRSPs. PRSPs reflect an approach jointly led by the International Monetary Fund and the World Bank and are intended to facilitate the coordination of national activities and ensure adequate donor support.

One of the major weaknesses of PRSPs has been addressing the environment-poverty linkage. Most PRSPs, along with food security strategies, ignore their impact on biodiversity and the opportunities that biodiversity conservation presents. Conversely, many strategies and action plans in the area of biodiversity neglect the poverty dimension. The implementation of PRSPs needs to be coordinated and conducive to the implementation of national biodiversity strategies and action plans. Biodiversity is an important natural asset that contributes to the achievement of sustainable livelihoods for poor people and provides livelihood opportunities in the form of a natural resource base for food security, income generation, healthcare, shelter and cultural and spiritual practices. Bangladesh is one of the very few countries that have included biodiversity conservation as an important chapter of a PRSP (African Energy Policy Research Network, 2004).

Food security

The MDG report of 2010 indicates that globally we have yet to achieve MDG 1, on eradicating extreme poverty and hunger. In the face of the recent economic crises and rising food prices, many countries have yet to come up with strategic, long-term actions to secure food for their people (UNDESA, 2010). From 817 million between 1990 and 1992, the number of undernourished people in the world reached 830 million in 2005. Absolute hunger might have been reduced globally from 1990 to 2005 (from 20 to 16 per cent) but hidden hunger (owing to a drop in micronutrient availability and food absorption capacity) has been on the rise. In Africa even absolute hunger has shown little change and may even be

rising. In the 1990's, while the average number of underweight children declined in the developing world overall, there was little change in Africa, with Northern Africa showing the same percentage of undernourished children from 1990 to 2005 (UNDESA, 2010).

Many would claim that the green revolution and improvements in cereal crops have led to an increase in world food supplies. The developing world, however, is faced with the phenomena of hidden hunger, where dietary habits have changed to rely increasingly on starch and oils at the expense of foods richer in micronutrients. This manifests itself in dietary deficiencies such as vitamin A deficiency, which leads to infertility and blindness (Olusola and Yemisi, 2003). Food security depends not only on having enough food to eat, but also having quality food with sufficient nutritional value. Addressing dietary diversity therefore requires a multi-dimensional approach focusing on nutritional and health status, social and cultural traditions, income generation and biodiversity conservation (Figure 2).

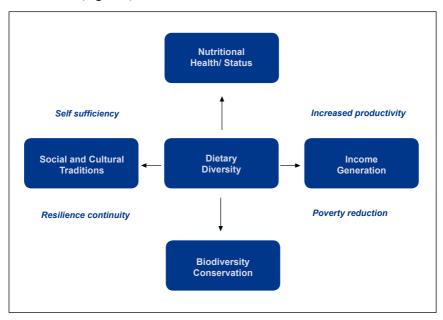


Figure 2: Addressing dietary diversity requires focusing on the dimensions of nutritional health/status, social and cultural traditions, income generation and biodiversity conservation. This will in turn facilitate achievement of the goals of self-sufficiency, resilience and continuity, increased productivity and poverty reduction.

Aggregate food availability, globally, was relatively good in 2008 and 2009 but higher food prices and reduced employment and incomes meant that the poor had less access to food. A lack of safe food and water presents innumerable challenges to the world's poor. In addition, the manner in which food is prepared may cause health problems. For instance, charcoal burning and the charcoal trade constitute an important food security strategy for households in the arid and semi arid lands of sub-Saharan Africa. It is estimated, for example, that approximately 82 per cent of Kenya's urban population depends on charcoal as a source of energy. Petroleum-based fuels, such as kerosene, LPG and natural gas, and electricity are too expensive for many or the urban and rural poor and are likely to remain so. The harvesting of wood from local forests to make charcoal has long been recognized as one of the key causes of environmental degradation in the region. Over-harvesting has led to a decline in forest foods, which are an important source of food security during times of hardship (Muyango, 2004). The use of charcoal indoors also leads to direct health effects; smoke inhalation is a key cause of respiratory illness and poor health, especially in women, who perform most of the cooking (WHO, 2002; Listorti and Dourmani, 2000).

Food security depends on timely access to food of sufficient quality and quantity at affordable prices, coupled with environmental and health conditions that allow for the consumption and assimilation of available food.

Identifying linkages between biodiversity conservation, adaptation, food security and livelihoods

The relationships between biodiversity, adaptation, livelihoods and food security are mediated by a diverse set of institutions and stresses. They cannot always be attributed to simple cause and effect relationships and can increase in complexity when they are linked to development strategies.

If we consider these relationships in the context of subsistence economies it can be seen that many poor people rely on biodiversity for food, healthy soil, medicine, fibers and wood. This reliance causes several stresses, especially when overconsumption or destruction of natural resources are promoted through circumstances such as inequitable tenure arrangements, a lack of suitable markets, insufficient income to ensure household food security or increased population growth.

Climate change, through global warming and altered weather patterns, may also bring specific challenges to livelihoods, requiring communities to halt unsustainable practices such as overgrazing or deforestation that exacerbate the destructive impacts of weather extremes such as floods, droughts and storms. Furthermore, it may require communities to adapt to weather events through altering agricultural practices, installing new technologies for water harvesting or setting up early warning systems.

In both instances of declining biodiversity and altered weather cycles (whether human or not) food security becomes a key issue (UNDP, 2009). Destruction of biodiversity through deforestation has been blamed as one of the key factors in exacerbating the impact of extreme weather events such as hurricanes and droughts (Telford J et.al. 2004). Inevitably such events have led to chronic food shortages and the need for foreign aid. This is one example where greater integration between multilateral environmental agreements such as CBD, UNFCCC and UNCCD and PRSPs could generate benefits in guiding country-level responses.

While efforts are being made to promote synergies between conventions, it is becoming increasingly apparent that relationships need to be built with the development sector. In forming these relationships, however, the meaning of development needs to be clearly agreed upon. The term "development" is subject to a myriad of definitions but it can be generally accepted that it involves the movement of something towards a more advanced stage. For the purposes of the present report, development is defined in terms of the Millennium Development Goals, that is, as the state towards which the United Nations and others have determined that the world must move, i.e., from a situation of abundant hunger, poverty, disease and lack of empowerment to one of sustainable development featuring the following eight conditions:

- 1. Absence of extreme poverty and hunger;
- 2. Universal primary education;
- 3. Gender equality and empowerment of women;
- 4. Low child mortality;
- 5. Improved maternal health;
- 6. HIV/AIDS, malaria and other diseases are combated;
- 7. Environmental sustainability;
- 8. A global partnership for development.

Table 1 identifies the links between the MDGs, biodiversity and climate change, showing the impacts of climate change and loss of biodiversity on achievement of the MDGs.

Table 1: Linking the MDGs with impacts of climate change and biodiversity loss

Millennium Development Goals	Impacts of climate change	Impacts of biodiversity loss	
Eradicate extreme poverty	Impacts	Impacts	
and hunger (Goal 1)	Reduction of livelihood assets, i.e., health, access to water, homes and infrastructure. Alteration of the path of economic growth due to changes in natural systems and resources, infrastructure and labour productivity and ultimately reduced income opportunities. Alteration of regional food security and lack of national and local food security.	Local poverty reduction strategies undermined by lack of natural assets such as agricultural biodiversity, timber and nontimber forest products, which are essential to livelihood (i.e., income) security. Local ecosystems services undermined; such services include natural water filtration by forests, soil biodiversity, vegetation for temperature regulation and natural pollinators and predators, which maintain healthy agricultural ecosystems.	
Achieve universal primary	Impacts	Impacts	
education (Goal 2)	Loss of livelihood assets (natural, health, financial and physical) leading to reduced opportunities for full time education. Children's time diverted to household tasks. Increased displacement and migration preventing continuous schooling.	Loss of income-generating opportunities to pay for schooling. Children's time diverted to household tasks.	
Promote gender equality	Impacts	Impacts	
and empower women (Goal 3)	Additional burdens placed on women's health and household commitments, thereby reducing time for participation in decision-making and income generation activities. Increased stress on assets, especially since the women often have fewer assets to start with.	Increased time taken to perform household duties such as obtaining food, water fuel and fodder due to increasing scarcity of natural resources. Increased burden of disease due to malnutrition. Unsafe water and physical stress suffered from walking long distances to collect food, water, fodder and fuel.	
Health-related goals	Impacts	Impacts	
Combat major diseases; Reduce infant mortality; Improve maternal health (Goals 4, 5 and 6)	Increased heat-related mortality and illness; Increased prevalence of vector-related diseases (e.g., malaria and dengue fever) and vulnerability to diseases transmitted through water and food or person to person (e.g., cholera and dysentery). Particularly important for women, who are relatively susceptible to water-borne diseases. Reduced quality and quantity of drinking water. Threatened food security and increased levels of malnutrition due to reduced natural resource and agricultural productivity.	Increased malnutrition, maternal nutritional depletion, low birth weight children, growth retardation and other nutrition-related diseases, incidence of increased vector borne diseases due to declining ecosystem	

Millennium Development Goals	Impacts of climate change	Impacts of biodiversity loss
Ensure environmental sustainability (Goal 7)	Impacts Alteration of quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged. Increased stress on already degraded ecosystems and further reductions in biodiversity. Loss of opportunities for adaptation and mitigation actions.	Impacts Increased pressure to find sustainable alternatives to use of organic materials for energy consumption, i.e., biomass and charcoal. Declining integrity of natural systems to provide use values such as non-timber forest products and ecotourism opportunities, watershed protection and sustainable harvesting programmes and existence values such as preservation of rare species. Increased pressure to clear vegetation and undertake destructive practices to generate income.
Global partnerships	Impacts	Impacts
(Goal 8)	Increased need to help least developed countries adapt to climate change, particularly those countries prone to natural disasters, storm surges and coastal inundation. Opportunities for technology transfer and cooperation minimized, inability to scale up experiences and best practices on climate change actions.	Loss of biodiversity leads to increased pressure on finite resources from population growth, displacement of people to marginal lands and urban development in sensitive areas. Minimized opportunities to realize the economic potential of ecosystems and biodiversity.

While the above linkages have been discussed and identified, the recognition that livelihoods, climate change and biodiversity are linked is not new, nor is the suggestion that initiatives to address these issues should be linked. Despite this, much work remains to ensure that projects to address each of these issues accounts for the others, and, it is hoped, to ensure that future projects aim at the achievement of co-benefits, i.e., gains in two or more of these areas. It can be difficult for project manages and grant providers who have traditionally worked in only one of these areas to envisage how co-benefits can be achieved and to understand the value of multi-sectored approaches. The next part of the present report therefore presents case studies that illustrate how successful projects have helped to achieve gains in each of these areas. Success is highlighted in these case studies, but also challenges. In part 3, table 2 summarizes the benefits achieved in the case studies highlighted.

PART 2

Case Studies

Case study 1: Mangrove restoration by the Pred Nai community in Thailand

Based on information provided by Dr. Somsak Sukwong, Mrs. Samnao Pedkawe, Ms. Jaruwan Kaewmahanin and Ms. Supaporn Worrapornpan for the 2004 Equator Awards (UNDP, 2003).

here are numerous examples of successful mangrove restoration activities with benefits to biodiversity, development and climate change mitigation and adaptation. The Pred Nai Mangrove Restoration project, however, demonstrates significant benefits for both biodiversity conservation and poverty reduction through the creation of valuable habitat for fish and crustacean species that have been on the decline. The restoration of this area is of considerable national importance as it is the last remaining mangrove forest ecosystem on Thailand's eastern seaboard. It is estimated that the area once covered 48,000 hectares but reduced to a mere ten percent now.

Rehabilitation of the mangrove forests of Pred Nai started when a group of Pred Nai people attempted to restore the degraded forestland following its destruction through charcoal mining and water pollution caused by commercial prawn farming. The group gained momentum when Pred Nai villages, under the leadership of a respected monk, enlisted the support of surrounding villages to create the Community Coastal Resource Management Network in Trat Province. The project features the development of a management plan that clearly recognizes the linkage between biodiversity conservation and livelihood

security. It supports the principle of addressing conservation and establishing private enterprise based on natural resources to ensure livelihood security and development outcomes. Restoration of the mangrove forests therefore not only delivers conservation benefits but also enhances income and food security and thereby boosts the local economy. Micro-credit programs were initiated to extend the ability of communities to engage in development projects.

Mangrove forests play an important role in stabilizing shorelines, thus buffering villages against the effects of tropical storms that result in severe erosion; this function may increase in importance if storms increase in frequency or severity as a result of climate change. From an ecosystem services perspective mangroves also contribute to carbon storage, nutrient cycling and waste processing.

Pred Nai villagers have been successful in protecting the mangroves in the immediate vicinity of their villages and creating a sustainable inshore fishery for crabs and other aquatic species. The community has recorded a marked improvement in the biodiversity of the mangrove forest. Crabs, shrimp, fish and birds have all become more abundant. Villages have reported monkeys returning to the area, and the useful species Hoy Lod (razor snail), which had been unseen for 20 years due to lime pollution from shrimp farming started reappearing.

While significant moves have been made to protect the inshore fishery, there is also a need to protect the offshore areas where species such as crabs migrate during specific times of their lifecycle. Although, by law, commercial boats must stay at least 3 kilometres from the shoreline, push nets and trawlers encroach on this boundary and destroy habitat by uprooting marine plants and threatening the inshore fishery. In addition, drag nets used within the mangroves damage the substrate, pulling mud away from the roots of the trees and leaving only sand and gravel, which do not hold the roots as firmly or allow new mangroves to germinate. A community patrol is enforcing the regulation against push nets with local government support.

Despite the obvious benefits of forestry co-management and the large amount of international recognition given to the Pred Nai community's efforts (including a Green Globe Award in 2002 and a prize by the Royal Forest Department in 2004), legislative recognition of local management efforts continue to be debated in Thailand. People's organizations and their supporters drafted a community forestry bill, which they submitted to the Thai parliament along with the signatures of 52,698 supporters. The bill was approved by Parliament but a key provision was omitted. The provision would have regulated how villagers that

had settled in the forests before they were protected could continue to use forest products. The Pred Nai community believes that it is only through the effective involvement of local people that environmental, social and economic solutions to food security and poverty reduction can be achieved.

Key strategies for linking conservation and poverty reduction in the project

The Pred Nai mangrove restoration project included a number of strategies for linking conservation and poverty reduction. Thus, for example, the reestablishment of the mangroves has assisted the community to restore the local crab fishery. Part of the community's strategy has been to close the fishery voluntarily during the crab's reproductive season each October. This has helped to increase harvests of grapsoid crabs (*Metapographus sp*) from 8 kg per day by six collectors to 15 kg per day by thirty collectors in about five years, which is equivalent to a near doubling of income per collector.

Similarly, villagers have sought to increase numbers of more economically valuable species such as the mud crab (*Scylla serra*) by taking females with eggs to a "crab bank", where the next generation is reared. Since beginning their efforts, families have seen their incomes from each "crab crop" rise from 10,000 baht for 6 families to 15,000 baht for 10 families.

Realizing that poverty reduction is a long-term goal, the villagers have also initiated a village saving fund. Villagers own stock in the fund and are able to borrow money from it to invest in their careers and their children's education. Yearly profits from the fund are set aside for members' welfare and village development. The fund has grown from 37 members and 9000 baht to 514 members and 2 million baht in five years.

Under the project, villagers were responsible for demarcating forest areas and ensuring its protection through the development of local rules and regulations to govern its use. The resulting sustainable harvest and production practices ensure that non-timber forest products can be processed and marketed for the benefit of the community. A People's Mangrove Forest Network has also been established to ensure that everyone has a say in the decision-making process and the sharing of benefits.

Lessons learned

Co-management for conservation

Conservation projects need to reach a level of momentum at which the natural environment can provide goods and services with enough resilience for sustainable harvesting. The key elements of this project are that it is community driven and there is a clear enough understanding of key threats (such as non-selective fishing and logging) that the community will take the initiative to defend its work against future environmental harm. Local actions have also influenced appropriate policy making at national level.

Case Study 2: The Garifuna Emergency Committee in Honduras

Based on information prepared by Ms. Suzanne Shende for the 2004 Equator Awards (UNDP, 2003); Telford, J., Arnold, M. and Harth, A. (2004), Garifuna NGO Recognized for Protecting the Environment, Honduras, This Week Online, Marrder Omnimedia http://www.marrder.com/htw/speial/environment//120.htm.

When Hurricane Mitch struck Honduras in 1998 there was little doubt that human factors contributed to the severity of the disaster, which killed 18,000 people and injured a further 13,000 more. Environmental degradation, including widespread deforestation, rapid population growth and inadequate infrastructure, especially for flood management, contributed to the extreme vulnerability of the poorest, as did massive disparities in the distribution of wealth.

In the days following the disaster, it was estimated that over 1 million landslides occurred in Honduras, displacing hundreds of thousands of people and destroying infrastructure throughout the country. Economic losses were estimated at some \$4 billion. A report by the World Bank described the country as being vulnerable and unprepared in terms of policy, systems and resources for rapid recovery.

One of the major areas that have been overlooked in planning for disaster recovery is appropriate environmental management. Lessons from nearby Belize show that the maintenance of forested areas, mangrove forests and barrier reefs

can greatly reduce the impact of extreme weather events such as storms and tidal surges.⁴ In Honduras massive deforestation, inadequate drainage systems for agriculture, river straightening practices and loss of coastal vegetation are all blamed for removing protective environmental services and increasing the destructive capacity of landslides and floods.

One of the most vulnerable groups in Honduras is the Garifuna community. The Garifuna, an Afro-Honduran people, own a broad swath of land along Honduras' north shore dotted by small villages, some of which can be reached only by canoe. The farmers in this area are mostly poor women who practice in non-mechanized subsistence farming. To complicate matters further their existence in this low lying environment can best be described as precarious as scientists predict rising sea levels and more frequent extreme weather events as a result of climate change.

The Garifuna Emergency Committee came together after the hurricane. Recognizing that disaster preparedness extends far beyond just having a good emergency response programme, this group has embarked on an ambitious revegetation programme along the shoreline, and has encouraged the adoption of more sustainable agricultural practices.⁵ Through this community initiative the committee is developing new markets for agricultural and artisanal products to ensure a greater degree of financial security and putting in place measures to reduce wood consumption, thereby protecting the forests. While this may not protect them completely against damage from hurricanes, it is hoped these steps will lessen the effects of future disasters. This project is effective in demonstrating how an initiative focused on poverty reduction and disaster mitigation can encourage local communities to come together. It also illustrates how biodiversity resource conservation can ensure nutritional security and promote health. As most of the farmers are women, this shows a genuine commitment to women's empowerment and participation, which led it to be acknowledged as a "best practice" by the global women's network, the Huairou Commission.

The project relied on the following methodology to achieve its aims.

Hardwood nurseries and associated reforestation projects were initiated to

⁴ The same is said of the Dominican Republic and Haiti, where in September 2004 tropical storm Jeanne caused severe flooding, death and destruction. Although both countries were badly affected, the Dominican Republic fared better than Haiti because large areas of forest minimized the effects of the storm.

⁵ India offers another experience. A simple coastal vegetation restoration and rehabilitation project in the southern Indian State of Tamil Nadu has saved thousands of lives by minimizing the impact of the recent Asian tsunami disaster. This project, implemented in collaboration with local communities along coastal areas, has provided one good example on how preventive research will bear fruit in the long term.

replenish stands of mahogany, cedar and bay trees. These trees are locally important as they are used to make a variety of products including canoes, mortars, graters and drums.

A pioneering project was introduced in five towns to reforest areas with "balaire" or "bayal", a wild vine which provides the material used to make basket sifters and strainers (which are used in the production of cassava) and other artisanal and household goods. Growing the vine also protects the other trees and shrubs that it relies on for support and locally protected sites have been set up for its conservation under the rubric "Area Verde" (Green Zone).

Reforestation projects were undertaken along the beaches using formerly abundant wild fruit plants including oranges, avocados, cacao and coco-plums.

The Committee organized political marches to protect Garifuna land and protested against an illegal road which was damaging water supplies. In particular, the has taken up the challenge of protecting mangrove forest reserves from illegal charcoal making, sand extraction and waste dumping.

Diversification of agriculture through the planting of fruit trees and other plants such as ginger is encouraged. Traditional crops such as taro root, red grow yams, white yams, "badu", arrowroot and sweet potatoes are also being re-established. Following Hurricane Mitch, these foods were very scarce and the Garifuna Emergency Committee struggled to obtain seed tubers for distribution to communities. Coconut stocks were being threatened by lethal yellowing disease and the Committee helped to introduce disease-resistant coconuts. The new fruit trees are reported to provide better nutrition for young people in particular.

A market called "Wabagari" (Our Life) was established by the Committee in Trujillo. Farmers from one village are reported to make around \$370 from the sale of fruit at the market. Women also earn income from selling prepared and processed foods, including cassava, which is in demand but is seldom produced in the cities. Trainees engaged in a young artisan's course also earn around \$30 a month from selling their products at the market.

Organic farming techniques such as "bocaschi", a form of composting, and the use of organic pesticides are being promoted to improve productivity naturally and to reduce reliance on chemical inputs. The introduction of better banana farming methods, such as disinfecting plantain seeds, pruning plantain leaves and preventing soil erosion, are also helping to improve crop productivity and

conserve soil. Within the 16 towns covered by the project the Committee elected representatives, collectively known as the "tool bank", who lend communal tools so that farmers can undertake their work.

New technologies have been introduced, including the yucca mill, which enhances food security by improving yucca storage, and the Justa Stove, which creates less smoke than traditional stoves and uses 50–60 per cent less fuel, saving women time and labour in the collection of firewood.

Action is being taken to restore mangrove communities. Land defense committees and ecological defense units have been established to protect shoreline vegetation from destruction. Shoreline vegetation is valued as a valuable line of defense against storm surge and beach damage.

Emergency response and local governance structures have been tested with varying results to ensure the future effectiveness of early warning systems and disaster relief efforts.

Case Study 3: Community-based floodplain resource management programme in Haor Basin, Bangladesh

Based on information provided by IUCN Bangldesh, 2004

The north-eastern corner of Bangladesh has a unique landscape, where natural patterns of flooding have created very productive fisheries in the wet season and allow rice harvest in the dry season. The productivity of these wetlands, called haors, has contributed to a food surplus in this region and many believe that there is potential for further increases in rice yields. The land is fragile and insecure, however, and changed patterns of flooding threaten the richness of the ecosystem and the livelihoods of the local people.

In the Sunamganj district, the way of life of 80 percent of people, who work as landless labourers, has been threatened by these floods. When the flooding becomes untimely, before the rice harvests can be collected, the impact is felt by the whole of Bangladesh. The loss of productivity has serious implications for national food security, as the Hoar basin provides up to 10 per cent if the national granary.

Threats to local livelihoods are not confined to wet season catastrophes. During the dry season, the landscape changes to reveal small water bodies called *beels* and *kuas* as well as lakes and canals which are critical for breeding and maintaining stocks of fish. If these dry season water sources are over-fished, the critical monsoon fishery is threatened, with implications for local food security. Unfortunately, insensitive human development and natural occurrences have resulted in many canals becoming blocked, preventing the migration and spawning of fish that would otherwise replenish the haors during the monsoon. Tree-clearing has also affected fish productivity. For example, submersed trees provide an important substrate for algal growth; without trees, fish have less algae to graze on, which may further endanger them. Migratory bird species and other natural populations are also affected by tree-clearing. Through the revegetation of local areas critical food sources and biodiversity may be conserved.

While a limited degree of protection can be afforded through engineering and construction solutions, the effects of climate change and biodiversity loss call for a more integrated approach including habitat restoration, climate change adaptation and social organization. To help address the need for sustainable management, IUCN implemented the "Community Based Haor Management" project, which is run through the Bangladesh Ministry of Environment and Forests and is funded through the United Nations Development Programme.

A challenge to the management project lies in the need to address transboundary issues. The flash-floods that have affected the Haor basin are generated across the Indian border in the Meghalaya Hills. These hills are the site of large-scale deforestation that is contributing to the flooding problem. Industrial, urban and agrochemical activities in upstream communities also contribute to pollution loads in the basin. Joint efforts are therefore required to ensure that land-management practices start to reverse the trend of increased flooding. Through revegetation of the hills area the overland flow of water can be slowed; if this is done, more water will seep into and be stored in the local soils and less will flow into the Haor basin during floods.

Through appropriate management programme, villages are protected from the highly erosive flood waters, and critical food sources and biodiversity are being conserved. To help with future revegetation efforts, over 100 community wetland nurseries have been established to provide saplings. Villagers have planted wetland tree species and management plans that allow for sustainable harvesting have been established. Replanting trees has led to natural regeneration of grass and reed species, including local medicinal plants. Tree branches interfere with net fishing, so during the monsoon this area is a naturally protected fish breeding

ground. Villagers have reported the catch of bigger fish as well as the appearance of other species of fish, indicating positive effects on biodiversity. The growth of *chailla* grass has also been encouraged. This grass is used both as cattle feed and for making barriers to protect houses and crops from wave erosion. Villages are taxed for harvesting the grass, with the funds going into community programmes.

Canals and beels have been excavated and demarcated as wildlife sanctuaries. Special consideration has been given to designating conservation areas for the globally endangered Pallas's Fishing Eagle, cormorants, bat colonies and snails. Studies have also been completed on threatened Ganges dolphins and the status of butterflies. Further seven fish conservation areas have been prioritized, with two sanctuaries being established. In one of the communities a turtle hatchery has been established and 100 hatchlings released.

Five hundred community members have been trained on livelihood security and sustainable haor resource management. As a result, alternative livelihood opportunities have been created. Micro-credit programmes have been established to fund livelihood options such as rearing ducks, establishing nurseries and plantations and planting vegetable gardens. Funds have also been used to introduce solar power programmes. Community environment funds have been used to strengthen the income-generating activities of 1200 poor women

In the Madhumati Floodplain 23 groups have been formed to provide micro-financing for environment-related projects; three of these groups have been funded so far. A similar programme has been established in the Padma-Jamuna Floodplain, and four groups have been funded. Medicinal plants and traditional medical knowledge are being preserved, with five demonstration sites being created in Madhumati Floodplain and two in the Padma-Jamuna Floodplain.

This project has provided diverse benefits. The biodiversity benefits of establishing conservation areas to protect threatened and endangered species are clear, but the biodiversity benefits of revegetating with natural wetland tree species and encouraging sustainable use of forest products should not be underestimated. Without a recognition of the needs of local communities to maintain and enhance livelihood opportunities, however, this project would have been unlikely to succeed. Its success owes to the fact that the revegetation and fisheries activities had positive effects on local livelihoods.

The project has also provided climate change adaptation and mitigation benefits. Although increases in the frequency and severity of flooding are probably attributable to land clearing in the watershed, at least in part, climate change may

have already contributed to changes in the frequency and severity of flooding and may continue to do so. By increasing the stability of land, and thus the resilience of landscapes and communities, the communities have begun adapting to climate change. Because of Bangladesh's extreme vulnerability to climate change, however, much more work is required. Finally, the revegetation efforts will result in vegetation that will increase the carbon sink. Likewise, where kerosene was used previously, the switch to solar power has reduced reliance on fossil fuels and reduced carbon emissions. Both of these gains may be minor in the context of global carbon budgets, but should not be overlooked.

Lessons learned

Need for defined land ownership

The inhabitants of the Haor Basin claim ancestral and historic rights to the land and resources in and around their villages, based on their own traditions. Their rights, however, are not documented, which has resulted in conflicts involving villages, former lease holders and local government authorities. This demonstrates that clear government and legal support in respect of land tenure is needed to enable communities to manage their land and derive livelihoods from it

Lessons learned

The importance of community involvement and local leadership

The Haor Basin communities have developed rules and regulations to govern the use of the land and resources based on their own experience and knowledge, rather than depending on management solutions proposed by others with less knowledge of the local environment and the needs of the local people. The success of the project demonstrates the value of traditional and indigenous knowledge in seeking appropriate livelihood and cultural outcomes.

Another important point is that community involvement requires an appropriate degree of community organization and capability. The Haor Basin project shows that community involvement is most effective when at least one group within a community has resource management or conservation as its primary focus and has the capacity to act as a leader and to assist in raising awareness.

Case study 4: Community-based rangeland rehabilitation for carbon sequestration at Gireigikh Rural Council in Sudan

Based on information presented by S. Zaki-Eldeen, and A. Hanafi, 2004, Dougherty, B. Abusuwar, A. and Abdel Razik, K. 2001, Zaki-Eldeen, S., Goutbi, N. and Osman, B. 2005.

The community-based rangeland rehabilitation for carbon sequestration project, carried out in the Gireigikh Rural Council area in Sudan, is distinct from many of the projects described in the present report as it was designed specifically to promote climate change adaptation and mitigation actions through biodiversity conservation. The project is based on the premise that natural resource management actions such as revegetation of degraded or vulnerable lands and the promotion of sustainable agricultural practices are important components of an adaptation strategy. Mitigation actions include the revegetation of large tracts of land to help redress the balance between methane production by animals and carbon sequestration by vegetation. The social and economic well-being of the communities throughout the Gireigikh rural Council is integrated into the project through the development of alternative livelihood options which reduce pressure on local biodiversity.

The Gawama'a and Kawahla tribes, of Bara province in Sudan, suffered several blows to their livelihoods from three droughts between 1976 and 1992. The lands have low productivity and are highly susceptible to drought and climate change. Land degradation, caused by a decline in rainfall over recent decades in conjunction with unsustainable agricultural practices such as overgrazing and clearing of the land, has exacerbated the situation. With rainfall as the primary determinant of food security, the prognosis for improved food security in a changing climate is poor. With the adoption of adaptation strategies, however, 17 communities within the Gireigikh Rural Council have been able to take some steps towards improving their livelihoods. Through the community-based rangeland rehabilitation project sustainable agricultural practices have been adopted and land degradation is being arrested and even reversed.

Before the start of the project, farmers depended upon shifting cultivation and livestock production. Marginal lands were quickly being converted into agricultural uses, but the land quickly degraded as the natural vegetation was removed. Farmers abandoned lands as they lost their fertility, leaving them without ground cover and susceptible to erosion. Goats were the primary

livestock species, as cattle couldn't cope with drought. Uncontrolled goat grazing, however, had a heavy impact on the land, contributing to desertification. Through the project, funded by the Global Environment Facility (GEF) and UNDP, the communities have been able to develop more sustainable practices and have worked to rehabilitate degraded lands.

From a community perspective the project can be seen as successful because it has built the resilience of the community to climate change by building sustainable livelihoods and ameliorating the impact of current and future drought. A community resilience profile was developed by the research team to measure five types of capital: natural, financial, human, physical, and social. Owing to improvements in rangeland productivity substantial improvements were noted in natural capital, particularly in relation to improved meat and milk supplies from livestock. Diversification of income sources also meant that the community was no longer reliant solely on rain-fed agriculture, which led to significant financial improvements. Human capital was increased through the fostering of effective extension services and social capital also benefited from the greater number of women and marginalized groups involved in decision-making. Substantial improvements were also seen in physical capital (e.g., grain stores, mills and water pumps), although the continuing drought meant that there was little or no surplus grain.

While improvements in the five areas of capital can be seen readily, quantifying the outcomes for climate change adaptation and mitigation is much more difficult. Some scientists claim that meaningful measurement of the effects of carbon sequestration can only be done over long time spans using precise methods. It is nevertheless suggested that carbon sequestration in dryland ecosystems is valuable because of the large expanses of land involved, which mean that even low rates of carbon sequestration can make a substantial difference. To capitalize fully on the potential of such carbon sequestration, however, up to 50 per cent of the cultivated and fallow land would have to be converted to grazing land and the project would have to be scaled up to encompass around 1,000 rural councils (Dougherty *et. al.* 2001). Scaling up would present its own challenges: the larger the project area the more difficult it might be to keep solutions locally appropriate, and it would be necessary to strike a balance between the social and economic needs of the community and the larger environmental benefits.

The methodologies the project used to derive benefits in relation to natural, financial, human, physical and social capital are described in the following paragraphs.

Through an incentive programme that ensured support for the continuation of the project, many farmers have been able to replace their goats with sheep, which have a lower impact upon the ecosystem and are more profitable, although they are less resilient to the impacts of drought. One sheep was provided for every five goats sold outside the project area, leading to the replacement of up to 80 per cent of the goats in the poorer segments of the population. The replacement of goats with sheep has meant that farmers can earn a profit with their sheep and can afford to forgo converting large areas of land to broad-scale cropping that destroys biodiversity.

Sustainable grazing methods, including rotational grazing and fodder conservation, have been adopted in some areas and farmers have been planting more drought-tolerant species of crops. Seedlings of native trees have been cultivated and planted in rangeland sand forests to help stop the encroachment of sand dunes and provide shelterbelts for croplands. The seeds of native trees, shrubs and grasses have also been spread across rangelands to help maintain vegetative cover, improve fodder production, increase soil fertility and increase rates of carbon fixation.

More than 700 hectares (about 30 per cent of grazing land) was set aside for rehabilitation. Grazing and fuel-wood collection were prohibited in these regions until the land was adequately rehabilitated. Upon seeing the benefits of this action, a further 500 hectares of private land was also voluntarily set aside, adding another 166 farming families to the exercise.

Villagers have been encouraged to build their houses of mud instead of wood. This saves about 30 medium-sized trees per household per year, equating to approximately 49 hectares of trees across the 17 villages. In addition, new, more fuel-sufficient woodstoves were installed in almost 100 per cent of the homes in the project area.

Groups of up to 40 to 60 local women (one in each of 17 villages) have established community gardens in which they grow low-water-demand vegetables. The vegetables, which are irrigated by hand with water from nearby dug wells, have helped people (particularly pregnant women and children) meet their nutritional needs, while extra produce is sold at market to support the further development of the garden and the purchase of seeds.

A revolving funds programme has been established to finance local income generating activities such as "disaster resistant income generation business and enterprise diversification" in each village. A sub-committee in each of these 17 villages oversees the spending under the fund. Training and extension programmes have also helped large numbers of villagers to develop the skills to take on new projects and income generating activities.

Grain storage and credit programmes have been established to prepare for droughts and hunger and malnutrition that they cause. A credit-based food security and risk management system provides grain storage facilities for emergency food supplies and seeds for replanting failed crops in each village. This initiative is capable of providing grain credits for up to 80 per cent of the project area population in the event of crop failure and the need to tap into emergency food supplies.

Five pastoral women's groups were established, each with access to revolving credit programmes and access to female facilitators that train others in value-adding activities such as rangeland management, sheep fattening, cheese and milk marketing, wool weaving, poultry rearing and other activities that contribute to micro-enterprises and the diversification of household income and food security. The incorporation of women into the project was crucial as many men leave for other parts of the Sudan in pursuit of seasonal employment due to the land's poor agricultural carrying capacity.

Village water supplies were developed through the construction of 17 deep bore holes. Water management sub-committees were set up to ensure the long-term viability of the wells. The wells are used to irrigate home vegetable and fruit gardens; increase the nutritional value and variety of plants in the gardens; and provide fresh drinking water. The wells significantly reduce the amount of time women must spend collecting water.

In areas where desert encroachment was threatening economically sensitive areas, approximately 5 kilometres of denuded sand dunes were revegetated and stabilized. A further 195 km of windbreaks were constructed, buffering approximately 30 farms.

Lessons learned

Importance of local institutions and effective representation

The strengthening of local institutions was found to be crucial. Local leaders and committees and the local branch of the Sudanese Environmental Conservation Society (SECS) all played major roles in the implementation, success and sustainability of the project under study. This was expected as they represent the primary beneficiaries. They were also very effective, however, in the enforcement of certain regulations, such as those requiring the retention of vegetation cover on council lands. The role of some non-governmental organizations, particularly those working in the field of the environment, (namely SECS) was found to be very significant as they conveyed messages related to environmental conservation in a very simple way that ensured popular support for the project, particularly when their members were from the community. In spite of these very efficient institutions, it was felt that the absence of active unions such as the farmers' and the herders' unions was thought had led to the loss of many opportunities that would have positively affected the community.

Lessons learned

Recognizing community needs

The community-based rangeland rehabilitation project was constructed around two basic assumptions.

The first assumption was that community participation was essential to improving rangeland management and that to enlist the community would require the devising of an implementation strategy that was structured around traditional local social institutions pertaining to leadership, social discipline, alliances and reciprocity.

The second assumption was that a range of activities that would not directly contribute to carbon sequestration would be needed to create the necessary good will of the community and to secure its support for implementation of the project. To that end, the project was designed to target and alleviate certain local vulnerabilities through activities such as improved fodder production and water development, livestock restocking, development of village-level irrigated gardens, introduction of revolving credit systems and drought contingency planning. Through such activities, the project aimed to meet villagers' near-term needs and thereby relieve pressure on the resource base and increase the prospects for long-term improvements.

Lessons Learned

Linkages with government policy

The linkages between government policies and income-generating activities before and after the project are not entirely clear prior to the project was initiated. Upon the completion of the project, many income-generating activities were put in place supported by the government in the region. This was found to have a very positive effect in the performance of the Credit Committees.

Ample opportunities exist in both the NAPA and the Adaptation Policy Framework to "plug in" these types of experiences and secure a place for community-based sustainable livelihoods activities in national adaptation strategies. This should be accompanied by a communications strategy that ensures community members are fully aware of their ongoing impacts.

Lessons Learned

Importance of linking microfinance programmes to markets

A sheep-fattening activity was made possible through loans provided through a revolving-fund programme. It was found that the beneficiaries needed only one disbursement of the loan funds and thereafter were able to continue the activity without further funding. The injection of financial capital was thought to play the biggest role in the improvement of livelihoods as it gave households the space to find alternative ways for making a living. The rate of loan repayment was found to be excellent (88 per cent). The success of the sheep-fattening measure could be attributed largely to good access to markets (local, national and regional), facilitated by the presence of retailers and their movement between the project area and major market centres on a good road network. The fattened sheep are of good quality and find their way to markets in the Persian Gulf region.

Case study 5: Sagarmatha (Mount Everest) National Park

Based on information presented by Nepal, S.J. (2000)

Protected areas have long been used to achieve *in situ* conservation in accordance with CBD article 8. Unfortunately, many protected areas have often been

established with little "social conscience", leading to the exclusion of local and indigenous peoples and causing them hardship and poverty. Although protected areas have not usually been designated with poverty reduction in mind, there have been increasing efforts to engage local communities. This is often a difficult task for the managers of protected areas, as such areas often exist only on paper and there is often a critical lack of financial and human resources for management actions, while resources for poverty reduction are non-existent.

While resources are lacking in formal management structures, examples from around the world nevertheless illustrate the capacity for effective community management of protected areas. A good example of the trade-offs and consequences of protected area management for community-level poverty reduction can be seen in Sagarmatha (Mount Everest) National Park in Nepal.

Political reforms and changes in government policies concerning land and forest resources have meant that indigenous communities are increasingly being seen as partners in resource management and conservation. For many, however, this is a case of too little too late. Historically Sherpas have had a strong sense of community stewardship over the forests, to the extent that a powerful group of local villagers, the *shingii nawa*, annually elected forest guardians. This traditional system of management was compromised when the Forest Nationalization Act of 1957 declared all forest cover within the country to be government property. This effectively undermined local rights and responsibilities in respect of forest management and led to gradual forest destruction, which was further compounded by increased demand for firewood as tourism expanded. The solution was deemed to be the reservation of the Sagarmatha (Mount Everest) National Park as a protected area.

Despite its protected area status, the popularity of the park as a tourist destination continues to create numerous problems for its management. It would appear that while the management of the park as a protected area may run parallel with continued poverty reduction for the Sherpa population it is having a detrimental effect on the environment as it ignores traditional management systems.

During peak tourist months, visitors to the park may exceed the local population by a factor of five. It is estimated that this influx may provide income and employment opportunities for between 60 and 80 per cent of the population. The indigenous communities of Sherpas have therefore become very affluent compared to the average Nepalese as they find positions as labourers and porters for tourist hotels and trekkers. This has come at the expense of cultural erosion

as present day Sherpa life revolves around tourists at the expense of traditional community and spiritual chores.

The park has no jurisdiction or control over tourist-related activities. A lack of governance has meant that tourism has given rise to problems such as garbage pollution, trail damage, contamination of drinking water sources and other social and cultural problems. Furthermore, despite the adoption of relatively sustainable energy options or energy-saving devices by some lodges, the plundering of the native forests for firewood continues.

In response to rising tension between local communities and park managers, a new forestry act was passed in 1993, followed by a set of forest rules in 1995. The forestry act and rules included a provision to allocate up to 60 per cent of park revenues to local community-based development programmes. They also legitimized the devolution of management responsibilities to independent, local forest user groups. The enactment of a buffer zone management act allowed for the establishment around protected areas of buffer zones, where local communities are supported through community-based development programmes.

The Ministry of Population and Environment reported in 2002 that over 848,000ha of forests had been handed back to the community and were managed by about 11,000 Forest User Groups (FUGs) representing 1.2 million households and 2.9 million trees protected in private forests. Although the forests still remain under ownership of the State, FUGs (providing they meet criteria on accessibility, traditional use rights and willingness and capacity to manage resources) now make all management decisions with each household having equal rights over resources. In these instances outsiders have no access to the forest resources.

It is assumed that without the designation of the park, the Solu-Khumbu region would have suffered much greater levels of destruction than it has suffered already (Nepal, 2000). Designation of the park has been beneficial, therefore, but the early top-down approach to park management, the inability to engage the Sherpa community effectively before reaching a crisis point and the lack of governance for environmentally sensitive tourism has left a legacy that is difficult to reverse

Lessons learned

Ensuring appropriate levels of access and benefit sharing

The Sagarmatha (Mout Everest) National Park project revealed that a passive and protection-orientated (passive) management styles led to under-use of the lands' capacity which in turn led to a waning of interest when the local community failed to benefit from the Park. This in turn led to the degradation of adjoining forests through over-use. The completion of a national forestry master plan in 1988 and new forestry legislation coupled have yielded significant changes and a new commitment to co-management of resources. This has led to greater incentives for people's participation in a sustainable use (albeit actively production oriented) approach to conservation. This change in mindset was needed to create the conditions necessary for achieving both conservation and poverty reduction aims.

Forest user groups have been seen as integral components of Nepal's national action plan for implementing UNCCD. From a gender perspective it is considered that land degradation affects both men's and women's ability to achieve food security. Although firewood consumption has been decreasing over the years, deforestation and desertification have been increasing, with women and children, the main collectors of firewood, being the primary victims. Four-hundred-forty forest user groups consist entirely of women, although this represents only 4 per cent of the total number of groups. It is increasingly recognized that it is necessary to involve women not only in forest user groups but in all development programmes.

Case study 6: Model ecologically sustainable community tourism project (MESCOT), Malaysia

Based on information prepared by Mr. Robert C. Ong, Mr. Mohd Hasim and Hamid J, Ms. Joanna Kitingan, Mr. Jeflus Sinajin, Mr. Abdul Latiff Kadok and Ms. Caroline Pang for the Equator Initiative Awards 2004 (UNDP, 2003).

The designation of protected areas has presented many challenges for many of the world's forest dwelling communities. The model ecologically sustainable community tourism project illustrates how protected area conservation can lead to environmental improvements when issues of poaching, expansion of plantations and unsustainable timber harvesting are addressed. It also illustrates how environmental improvements can lead to poverty reduction.

The Lower Kinabatangan catchment, in Malaysia, has been recognized by conservationists as a mega biodiversity site owing to its very high concentrations of lowland wildlife, including large mammals and primates. The community of Batu Puteh, which is made up of five villages, is completely surrounded by the Supu Forest Reserve and the Kinabatangan Wildlife Sanctuary. These areas have been declared protected areas because they feature a wide variety of forest types which containing all ten species of Bornean primates, 9 out of the 11 known species of hornbill and several other of the world's rarest birds. Traditionally the villagers of Batu Peteh have been heavily reliant on the forests for timber and other resources. A compromise was therefore needed that would allow for adequate conservation of the forests without leading to increased poverty for the local community.

As a means of securing alternative livelihood options, the Model Ecologically Sustainable Community Tourism (MESCOT) Project sought to develop a community-led ecotourism industry. With the support of WWF Norway, the Sabah Forestry Departments' Kinabatangan District Office and the Sabah Ministry of Tourism, Culture and Environment local people were assisted in the identification of suitable tourist features and training in customer service. The main products to come out of this project include a home-stay programme, village boat service, guiding service, and culture group and handicraft outlet. Like many similar projects involving protected areas around the world, one of the key outcomes has been raising the awareness of the local population of conservation. This was achieved by actively involving villages in the documentation of resources at the initial stages of the project, engaging their assistance in forest fire fighting and restoration activities and developing their skills in guiding visitors. This is reported to build the links between communities recognizing the value of local resources.

To date the outcomes of this approach appear to be relatively effective. In its first year of operation, the home stay program sold over 1000 bed nights and generated returns of over 70,000 Malaysian ringit (RM). In its second and third years bed nights remained stable and income grew to RM104,000. This is a substantial return given the average per capita income for the region is RM3,600 to RM9,600. The project was successful in engaging local unemployed youth from the five villages. The project provided proper training and helped identify appropriate roles for these youth in the ecotourism programme. Although the increase in income translates to between ten and 30 full time jobs, this benefit was shared among more than 100 people. There are also 20 families in the home stay program with numerous others involved in boat services, nature guiding,

culture groups and other coordination type roles. The MESCOT program has another innovative feature, in its creation of a community fund built on tourist contributions. Each year, the fund amounts to about RM9000 which is invested in micro-credit programs for improving access to sanitation, water, electricity and adequate housing. The funds are paid back through household income generated through tourism and the program has reused the funds twice to date.

It appears that through the project the community has come to feel a great deal of pride in the forest and is seeing the benefits of habitat restoration and preservation. Funds were obtained under the project for the planting of more than 30,000 trees and the restoration of more than 50 hectares of degraded fresh water swamp forest. Interestingly, the forest restoration techniques learned through the project have also benefited the local oil palm industry, which lost vast areas planted with oil palms during the floods of 2000. Information on restoration techniques and species selection has been shared with both the private and government sectors. Forest ecology and its restoration has also become another product to offer the tourist market; many eco-tourists are keen to contribute to restoration efforts, learn about rainforest ecology and share in the traditional knowledge of the villagers.

To minimize any negative effects of tourism, a code of conduct has been established to ensure social, cultural and environmental sustainability. Tourists staying in the villages conduct themselves in accordance with local culture and lifestyles. This benefits tourists by increasing the authenticity of their experience minimizes negative feedback from both tourists and villagers.

In order to engage local community support for the protected areas effectively, a five-stage process was undertaken which started in May 1997 and was finally operational in March 2000. The process included the following five phases:

Research phase – MESCOT group gathered and documented information about the surrounding biodiversity and recorded and documented histories, traditional beliefs, medicines, uses of forest resources, culture and the history of the area.

Exposure phase – Training and study trips were undertaken to various tourist facilities and destinations in Sabah and Sarawak. These trips provided first-hand experience in service skills, marketing strategies, interpretation and communication requirements, visitor management and reduction of site impacts. They also exposed participants the difficulties of traveling and touring. This phase also involved basic computer training to enable participants to document research and community plans;

Brainstorming phase – All potential tourism activities, products and developments were identified and prioritized according to the extent to which they would deliver multiple benefits to the community; criteria included whether they were within the community's capabilities, were appropriate to local culture and would adversely affect the local environment;

Detailed planning phase – The project featured detailed discussions and wider community dialog and further consultations on the development of tourism activities. Budgets were drawn up, implementation strategies were agreed upon, decisions were made on suitable packaging and pricing, appropriate legal procedures for licensing and registration were clarified, internal rules and regulations were established and the code of conduct was formulated;

Operational phase – Community tourism activities were made operational and registered with the Ministry of Tourism.

The project appears to have established conditions under which conservation-led environmental improvements (such as rehabilitation and reduced poaching and logging) will lead to improvements in the lives of the indigenous peoples of the Batu Puteh area, including an overall reduction in poverty.

Clearly, protection of this area has had important impacts upon local biodiversity but halting unsustainable forestry and promoting revegetation can also help increase carbon stores and mitigate climate change. Healthier ecosystems may also be more resilient in the face of the negative effects of climate change.

Lessons learned

Ecotourism: a panacea for poverty reduction?

Ecotourism is often offered as an alternative livelihood for local communities displaced from their traditional lifestyles as a result of the designation of protected areas. Many projects, however, often overlook the need for clearly and legally guaranteed rights and responsibilities of all actors in the initiative. The model ecologically sustainable community tourism project has paid special attention to strengthening local institutions through the clarification of legal rights and responsibilities and developing internal systems of governance. It has also set out to empower the local community by giving it the opportunity to experience tourism options from other areas and prioritize tourist activities and products according to their capabilities. An important lesson is that although ecotourism can provide livelihoods, markets may take time to develop and must be carefully researched. In addition, the effects of ecotourism on the environment and local culture should be considered.

Lessons learned

Effective community-led forest conservation

The project illustrated that community forestry conservation can be effective when the community has control over decision-making processes. One of the most important factors in the success of the present project is that the community had the opportunity to learn and apply conservation skills and to see their value in the context of ecotourism, which led to a sense of pride in and connection to the forest and its resources. In contrast, top down management approaches often do not allow for self-regulation or promote a productive relationship between biodiversity and livelihoods.

Case study 7: Mamiraua Sustainable Development Reserve, Brazil

Based on information provided by Mr. Andrew Taber and Ms. Ana Rita Alves for the 2004 Equator Initiative Awards (UNDP, 2003)

The Mamiraua Sustainable Development Reserve is found deep in the flooded forests of the Amazon and is the meeting place for the Solimoes and Japura rivers in Brazil. It is the size of England and has been described as the world's largest floodplain. For six months every year it is flooded to the tree-tops when the water rises up to 12 metres. The reserve covers a total area of 1,124,000 hectares and is home to approximately 1,700 people in 23 settlements; a further 3,600 people from 37 surrounding settlements depend on the forests of the reserve for their livelihoods and nutritional needs.

The area was designated as a fully protected "ecological station" by the government of the state Amazonas in 1990. Initially, the designation allowed people neither to live in the reserve nor to use its natural resources. People and nature were deemed incompatible. This led to the establishment in 1992 of the Sociedade Civil Mamiraua. Founded by Amazonian researchers in the belief that the conservation of biodiversity in the Amazon ought to be closely related to the alleviation of poverty, the group successfully took on the role of co-management of the reserve with the Institute for Environmental Protection of the government of Amazonas and the National Science and Technology Council. This partnership has been remarkably successful in promoting sustainable development in the reserve.

Sociedade Civil Mamiraua's participation has heralded a new era in protected area management. The group has embarked on a two-phase process. The first involves the elaboration of a management plan for the reserve that addresses both how to manage the reserve sustainably and how to improve local livelihoods by allowing sustainable use of natural resources and improving access to social services. The second phase is the sustainable management of the reserve's biodiversity through a partnership between local residents, users and institutions.

The Sociedade successfully lobbied the government of Amazonas for legal recognition of forest communities' rights. The result was the development of a new legally recognized category of land, a "sustainable development reserve", which was introduced in 1996 by the state government to help meet the needs of the Mamiraua. In a country where land access has traditionally been restricted to a small but powerful class of people, the establishment of such a precedent is crucial for the millions of peoples that rely on forests for their livelihoods.

Caution is being exercised in the use of this new protected area category. Today, there are nine sustainable development reserves throughout Brazil, with the Sociedade Civil Mamiraua managing the Mamiraua Reserve as well as the Amana Sustainable Development Reserve.

The population density in the forest areas is relatively low. They are mostly located on the river margins and have very limited infrastructure and access to social services. Birth rates are very high and life expectancy is very low. Livelihood requirements are met through fishing, hunting, slash and burn agriculture and timber exploitation. Most fishing and agriculture occurs during the low water period, creating a highly seasonal economy and heavy work loads during the low-water season. During periods of high-water, timber extraction is carried out. When the community can produce a surplus of food it is sold or bartered for other products with itinerant river traders – regatões – or is sold directly to markets in the local urban areas. These markets are often unreliable, due to their demand patterns. This uncertainty also contributes to poverty.

The Sociedade Civil Mamiraua introduced the Economic Alternatives Programme in 1998 to help the local community develop income-generating projects and reorient traditional resource use practices to achieve sustainability. The Sociedade worked with community associations and households to investigate fisheries and forest management, ecotourism potential, agricultural practices and handicraft production. Specific attention was paid to strengthening local institutions by encouraging local producers to become politically organized. Efforts were also

made to reduce the community's dependence on commercial capital and to move the production of forest, agricultural and fisheries products closer to regional end markets (such as hotels, restaurants and the plywood industry) rather than relying on barter systems or the *regatões*. With this greater access to the market economy, income levels are higher. For instance, communities are now able to sell pirarucu fish (*Arapaima gigas*) for twice as much as before. The increased commercialization of natural resources appears to not have had a negative effect on the environment. Fish monitoring programmes have indicated a 100 per cent increase in populations of black caymans (*Melanosuchus Niger*) and 300 per cent in adult pirarucu – both top predators in the river food chain.

The community is also seeing the benefits of improved forest management. Over the last 10 years there has been a considerable decrease in the amount of forest habitat being converted to agricultural land. This is primarily attributable to improved agricultural practices, the use of swamps and beaches for farming and fishing and opportunities to diversify income through forest management and ecotourism ventures. This has important benefits for biodiversity conservation as it gives an alternative to the rapid deterioration of the environment – often for relatively short-term economic gains. The use of markets which favour sustainably harvested products has been a strong incentive, with communities able to sell timber exploited through forest management plans at prices 100–150 per cent higher than those for timber extracted through unsustainable means. The decrease in the amount of land being converted to agricultural land also has outcomes for climate change mitigation, as it ensures that the carbon sink afforded by the forest maintains a higher level of integrity than it otherwise would.

Case Study 8: The Uganda Food Security Initiative

Based on information provided by Professor Steven C. Smith, Mr. Alan Alemian, Mr. Abdalla Meftuh and Dr. Brima F. Ngombi for the 2004 Equator Initiative Awards (UNDP, 2003); Gerrits A. (1999), KARI-KEFRi-ICRAF (1998).

South-western Uganda is very densely populated. Densities of around 400 people per square kilometer mean that land holdings are fragmented and farmland is critically scarce. Most people must survive on farms smaller than one hectare and rural poverty and malnutrition are severe. The situation is worsening in many areas, as already low agricultural productivity is declining due to land degradation in an area once considered to be among the most fertile in the tropics.

The ability to grow two crops a year is key for survival in the region, but this intensive farming has led to rates of nutrient depletion in the soil that are among the highest in sub-Saharan Africa; high rates of erosion further threaten soil fertility. There are two ways of addressing this loss of soil fertility. The first is to encourage the use of inorganic fertilizers. The second is to encourage the use of low-cost, low-external-input practices, such as composting, that will return nutrients to the soil (IFPRI, 2002).

In addition to declining land fertility, farmers have lacked access to good quality seeds. Road infrastructure in the region is poor so without external sources farmers have traditionally used seeds from previous harvests, and many of them have seen beneficial genetic traits in their seed stock erode over time. Resistance to diseases such as blight has eroded yields and a combination of degradation in soil quality and poor seeds meant declining yields were declining and increasing food insecurity. Effects within the community have included very high levels of preventable health problems among children, including protein deficiency, malaria, diarrhea and attack by parasitic worms. A lack of access to markets has also meant that communities have relied on subsistence agriculture and have been unable to sell excess produce to obtain food items from other areas. When middlemen have visited the community, the prices paid for local produce have been very low.

The Africare Food Security Initiative has been operating in the south-western Uganda (District of Kabale) since 1997. This programme has shown significant success in reducing poverty. It has also led to improved resilience of farming systems in respect of climate disruptions, the diversification of income sources and the development of more resilient seed stocks. The project also produces benefits in respect of climate change adaptation as communities are able to plan in advance for climatic variations. In addition, by building the fertility of soils the programme has been able to reduce the pressure on farmers to expand agriculture into other lands including, steeply sloped areas unsuitable for agriculture, as well as national parks, forest reserves, and wetlands. This has not only helped reduce the rate of desertification in Uganda, but has also helped maintain and enhance existing carbon sinks and protect remaining areas of natural vegetation and its associated biodiversity.

Given the complex nature of the interrelated problems of south-western Uganda and the seemingly endemic poverty and environmental degradation that exist there, an integrated rural development programme was needed. Areas of intervention are described below

Tree species with good ecological and commercial properties were planted. Over 5,337,000 tree seedlings have been raised on community nursery beds. At least 18 different tree varieties were chosen according to their ability to replenish soil fertility, stabilize soils and control erosion and provide products such as wood, timber, high value fruits, fodder and medicinal products. Examples of the species planted include *Calliandra calosthysus and Sesbania sesban*. These species provide superior fodder and help enhance soil fertility by fixing nitrogen. They also provide source for climbing beans; building materials for houses; firewood and opportunities for income generation through seed sales.

Improved land management practices were implemented, including the use of natural fertilizers seed selection and the addition of new crops (such as leafy vegetables) to add much-needed minerals to the diet. Communal seed multiplication schemes were established for crops such as potatoes, beans and bananas. This was accompanied by the introduction of integrated production and pest management practices.

New production technologies and techniques to increase the productivity of small plots were introduced (such as building contours with vetiver grass) to minimize expansion into steeply sloped, environmentally sensitive areas.

Farmer field schools were established to provide farmers with learning opportunities about integrated pest management practices and different types of potatoes, from which they select those that best suit their needs. In the early phases of the project 401 farmers (223 women and 178 men) from five watersheds were trained in agro-forestry, using manure fertilizers, composting, crop spacing and border hedges to improve soil fertility, control erosion and aid in water capture. These farmers are in turn training others. Particular attention is paid to waste management and recycling. Agricultural by-products are now used as fertilizers or animal feeds, or to improve the productivity of fish farms.

Roads were upgraded to allow farmers to visit markets within the area to sell their produce and get a sense of the demand for different products. This allows for information exchange and farmers have learned more about different methods for growing and processing products for market. As a result, some temperate crops that are suited to the region's high-altitude environment (approx. 2500 meters) have been introduced. Apples were once imported, for example, but are now grown locally. The upgraded roads have also been crucial for improved access to medical care and schools.

Cash cropping options have been provided. Root-rot resistant Irish potatoes are now grown for the potato chip manufacturing market. This was deemed an effective strategy for sustainable commercialization and income generation.

Encouraging the farming of small animals such as rabbits and poultry has led to increased protein intake and added income. The initiative has also helped to improve nutritional and health education and health monitoring through the measurement of child growth and the management of disease. More efficient wood stoves have also helped reduce the severity of indoor air pollution.

Lessons Learnt

Recognizing gender issues in respect of food security

The Uganda Food Security Project found that increased productivity did not necessarily translate to improved food use in the community. There are often strong cultural beliefs and taboos surrounding food. To improve food use community-based education centres were established to teach women about nutrition and build pride in traditional food products (particularly fruits and green leafy vegetables), as well as to provide a forum for discussing health issues such as AIDS.

Women participating in the Uganda Food Security Project were trained in farming methods. There is a major effort to ensure that women are represented on all relevant committees. In the planning stages, men, women and youth met separately to decide on priorities; this was intended to address the problem of women being reluctant to speak up in mixed groups and ensured that all voices were heard.

Lessons Learnt

Valuing Local Biodiversity Over Introduced Species.

Scientists from the Agroforestry Research Network for Africa (AFRENA) make the observation that there is a relatively low level of indigenous knowledge among farmers in regard to native fodder sources. Few patches of natural forest remain in the area because much of the forest has been cleared for cultivation over successive decades and stands of the introduced *Eucalyptus grandis* now dominate the landscape replacing the local tree species that were traditionally used for timber, poles. Farmers have also become interested in new, exotic tree and shrub species, some of which grow much faster than local species. The challenge lies in being able to promote the value of indigenous tree species ahead of the popular new exotic species.

Case study 9: Seed banking by the GREEN (Genetic Resource, Energy, Ecology and Nutrition) Foundation, India

Based on information provided by Vanaja Ramprasad and Krishna Prasad (GREEN Foundation) for the Equator Prize 2004 (UNDP, 2003)

Winning the 2004 Equator prize for its work highlights the success of the Green Foundation in promoting conservation actions that have driven environmental improvements and helped to reduce poverty. By conserving agricultural biodiversity and encouraging sustainable farming practices, this organization is strengthening partnerships between farmers, their communities (in particular women's groups, known as "sanghas") and non-governmental organizations.

The conservation of traditional seed varieties on farms has crucially improved food security for poor and marginal farmers in the rain-fed drylands of the Indian state of Karnataka, where the project is centered. This method of conservation, through on-farm selection of high yielding, pest- and disease-resistant strains, also provides a source of constantly adaptive options for responding to significant future climatic changes.

In introducing conservation-driven actions to address food security issues, the group has therefore provided opportunities to enhance livelihoods, empower women and reduce poverty. Specifically the activities undertaken by the Foundation focused on issues not only related to conservation and use of traditional germplasm but also on related issues of relevance to local development. These include:

- Revitalizing many of the traditional practices in Karnataka to ensure
 preservation of traditional crop varieties. The Foundation has facilitated
 the collection and conservation of over 90 varieties of finger millet, 85
 varieties of paddy, 55 minor millet varieties, 25 pulses and numerous oil
 seeds and vegetables. This has ensured the conservation of species that
 may be disappearing from large-scale agricultural systems;
- Increasing the participation of farmers and extend its activities to more villages and climatic zones to ensure maximum conservation and benefit. Between 1994 and 2003, the number of farmers participating in the seed conservation programme increased from 10 in two villages

to 1,500 in 161 villages throughout 6 climatic zones in southern India. By 2004, over 2000 farmers were participating in farmer-to-farmer seed exchanges;

- Reduction in farmers' dependence on external markets for seeds and other inputs (including foodstuffs) by increasing crop yields and extending the variety of crops grown, thus enhancing both the security and the nutritional value of food available to the community;
- Increase in the use of both traditional and new agricultural practices such as mixed cropping, intercropping and nursery production of seedlings to increase the diversity and yield of crops grown. For example, a transplanting programme introduced for finger millet and paddy cultivation lead to a 25 per cent improvement in yields compared to broadcasting and line sowing. Similarly, new and indigenous agroforestry and livestock management practices have improved soil fertility and water retention and enabled the production of bio-pesticides, again reducing dependence on external inputs;
- Promoting kitchen gardens. This is another major aspect of the Foundation's work. Kitchen gardens are now providing 450 families with food, fuel, medicines and fodder for livestock. Fundamental to the success of the kitchen gardens was the building of water tanks, the introduction of drip irrigation and the use of vermin-compost, green manures and mulching techniques;
- Focus on markets with the marketing of surplus produce from kitchen gardens, seeds, vermiculture and bio-pesticides in local markets by establishing communal marketing arrangements supported by micro credits. Sales of food products such as papads, millet mix and soapnut in urban markets and saplings for reforestation programmes are also supported. Small loans are provided to support similar new income-generating projects. These activities all provide a small amount of extra income, mainly to women, that is saved and used as collateral for future loans. For example, individual farmers are reported to have earned up to 2000 rupees (Rs) per year (after accounting for their own farm use) from vermiculture enterprises. Women make an average Rs500 per year selling organic seed to commercial farmers and Rs600 per season from their kitchen gardens; two women's groups earn approximately Rs1000 per year selling bio-pest regulators;

Promotion knowledge of sustainable farming practices through the
identification of expert farmers, who may earn Rs250 per day consulting.
Campaigns such as seed "yatras" (processions) and seed fairs as well
as seed management committees and seed saver networks also spread
knowledge and provide organized opportunities for selling seeds.

Lessons learned

Participation and effective communication

The Green Foundation project's strength lay in its design, which from the outset was intended to ensure sustainability and good communication. The project began with an exploratory period in which a few farmers were engaged in a pilot study. Attention was paid to gathering information, developing the capacity of staff and ensuring strong links with other organizations involved in similar activities. The next stage was an evolutionary period during which the network was extended to include a greater number of climatic zones and villages. Finally, the Foundation took care to include a consolidation phase during which steps were taken to lay a foundation for strengthening and reviving local culture, traditional health systems, improving values-based education and the encouraging leadership and decision-making in the community. Stabilization of economic conditions through the promotion of sustainable agricultural practices was key.

Case study 10: Valuing biodiversity for poverty alleviation and food security in Miombo, United Republic of Tanzania

Based on a presentation by Peter Oduol and Remen Swai (World Forestry Centre) and Lawrence Mhwambo (Tanzania Forestry Research Institute) entitled "Valorization of Miombo Biodiversity Forum for Africa: Biodiversity and livelihoods in Africa: Delivering on the Millennium Development Goals". 9–11 June 2004, Dar es Salaam, Tanzania, a related paper and interviews. See also, Temu, P.C. and Chihongo, A. (1998); Nsubemuki L., Ramadhani T, Nyakimori, Swai R and Mziray W. (1997).

The Miombo woodlands in the Tabora region of western Tanzania are characterized by diverse landscapes and climatic conditions and rich biodiversity. Like many countries in Africa, the United Republic of Tanzania has faced the hardships of food shortage, widespread poverty, malnutrition, HIV/AIDS and degradation of renewable resources.

Most of the rural communities in Tabora depend on several tree species in the Miombo woodlands that provide food, medicinal products and opportunities to generate income. Eighty three indigenous tree species, which bear edible fruits and nuts through out the year, have been identified in the Miombo area, while more than fifty fruit trees are found in Tabora region (Temu and Chihongo 1998).

While rural communities use a wide variety of edible fruits both for their own food needs, and to sell in local markets, it is estimated that only 10-30 per cent of available fruits are harvested, with the rest going to waste. This is due in part to unreliable and unorganised markets and limited harvest and processing technology, as well as natural limits on harvests such as fruits dropping to the ground, and herbivory (Nsubemuki *et al* 1997).

Increasing fruit harvests could contribute significantly to household nutrition and income within these poor farming communities as forest fruits are rich in sugar, essential vitamins, minerals, oils and proteins.

Importantly, they are available year-round and can therefore help improve food security during the dry season, when food shortages often occur. Experience in other parts of Africa and Asia has shown that the effective processing and marketing of indigenous fruit products and medicinal trees can significantly contribute to wealth creation and poverty reduction.

The woodlands not only provide fruits but also firewood, poles and timber, all of which help to sustain local communities. In addition, the forests can be used to produce honey, although to date the industry is very small. Numerous improvements in practices, including access to local processing, improved technologies, better marketing and improved quality control, are required to expand honey production.

Biodiversity also plays an important role in local health care systems. About 80 per cent of rural people in Tanzania depend on traditional healers and traditional herbs for their health care needs and over 300 medicinal trees in the Miombos area have been determined to be useful in the treatment of more than 100 human diseases (Dery *et. al.* 1999).

Despite the enormous potential inherent in this area, biodiversity resources are continuously threatened by deforestation, which is currently estimated to be occuring at the rate of 130,000–150,000 hectares annually in Tanzania.

With the assistance of the International Centre for Research in Agroforestry (ICRAF) and the Agriculture Research Institute (ARTI) local populations have been able to make more efficient use of the natural products from local fruit trees and transform them into products with greater food and cash value than the mango, papaya, orange, avocado and other fruits normally preferred by most farming communities. This increases the value of fruit and medicinal trees for poverty reduction and food security and is therefore expected to create the conditions necessary for the conservation and sustainable use of biodiversity.

Lessons learned

Making food security cost effective

Discussions with participants of the Miombo Woodlands Project reveal that even when production technologies are available for processing wild fruit varieties the high cost of the equipment (such as bottles and seals) needed to do so inhibits large-scale production.

The project team found that despite the eagerness of the community to adopt new techniques for fruit and honey production a lack of market information, unstable prices, high market fees, poor storage and packaging facilities, poor quality control, the use of obsolete technologies and the risk of snakebites during fruit collection were considerable barriers to establishment of viable enterprises. Inadequate extension services and poor research facilities and a complex and expensive certification process by the Tanzania bureau of standards serve to limit the commercialization of forest products.

The main methodologies used to create the conditions necessary for effective use of the native fruits and woodland products are detailed below:

In 1997, ICRAF in collaboration with national partners in Southern Africa started domestication programme for indigenous fruit and medicinal trees in the Miombo ecozone. The programme started with a priority setting exercise in Zimbabwe, Zambia, Tanzania and Malawi to determine farmers' choices of indigenous fruit and medicinal trees for domestication (Dery *et. al.* 1999). Work started on documenting the available indigenous knowledge on these species, germplasm collection, germination studies, propagation techniques and agronomic and horticultural evaluations. In addition, sensitization of farmers on the importance of indigenous fruits and medicinal trees and how to add value through processing and marketing of their various products led to improved nutritional status, health,

income and livelihoods of rural communities. The top indigenous fruit tree species and popular exotic fruits selected by farmers based on their availability, multiple uses and commercial value were planted on farmer and fields and other areas such as school grounds. These include *Vitrex doniana, Adansonia digitata, Parinari curatellifolia, Uapaca kirkiana, Strychnos cocculoides. Vitex mombassae, Sclerocarya birrea, Flacourtia indica, Tamarindus indica Berchemia discolor, Mangifera indica, Carica papaya, Passiflora edulis, Citrus sinensis, Ananas comosus and Musa spp.* Ten different varieties of medicinal trees have also been planted on farmer and fields and other areas such as school grounds. These are *Securidaca langipedunculata, Zahna Africana, Cassia abbreviate, Entada abyssinica, Turraea fischeri, Albizia anthelmintica, Entandrophragma bussei, Combretum zeyheri, Zanthoxylum chalybeum and Terminalia sericea.*

In 1998 ICRAF and ARTI began to train women around Tabora in the processing of indigenous fruits into juices, jams and wines. To date, about 2100 women from 41 women's groups have been trained. The women who undertook the training are now involved in the processing of various products, including peanut butter, pickles, juice, jam, wine, chutney, cake, cooking oil and beer, among others. Some of the women are now earning cash by selling their products in local markets in Tabora, Mwanza, Arusha and Dar es Salaam.

About 100 farmers have introduced beehives in the woodlands in the project area. Honey harvesting has the potential to generate income for smallholders. There has been an increase in the number of women participating in this activity, which was previously dominated by men.

Lessons Learnt

Recognising roles of gender and culture

The Miombo Woodlands Project illustrated the need for project designers to be aware of the role of gender in the community. While 40 people including men originally joined the fruit processing project, only 20 men remained in the group since the fruit processing involved cooking which is generally seen as women's work.

The Miombo Woodlands Project in Tanzania highlighted some interesting cultural lessons for promoting native fruits as a means of increasing nutritional diversity. When interviewed one of the women from the Mpombwe village in the Sikonge District stated that her husband feels ashamed and cannot eat guava in front of his children but if she makes guava juice he feels proud taking in front of his children.

Case study 11: Kalinga Mission for Indigenous Children and Youth Development, Inc. (KAMICYDI), Philippines

Based on a presentation by Donato B. Bumacus (Kalinga Mission for Indigenous Children and Youth Development, Inc) at the Fourth Asian Regional Session of the Global Biodiversity Forum (GBF): Southeast Asia, 20–23 June, 2004, Manila; and information prepared by D.B. Bumacus for the Equator Initiative Awards 2004 (UNDP, 2003).

Like many indigenous communities around the world, the Kalinga way of life has been threatened by a lack of legal recognition of land tenure and traditional modes of land use, spiritual ties and indigenous based legal systems.

The Kalinga have a long history of traditional land management practices that support their diet of rice and root crops and other vegetables. Like those of indigenous peoples around the world, the lifestyle and culture of the people of the Cordillera Autonomous Region in the Philippines are shaped and nourished by the wealth of their environment. According to their belief system trees, rivers, mountains and other natural elements are regarded as sacred dwelling places of ancestral spirits that must be accorded the utmost respect.

To strengthen their capacity to cope with the challenges of poverty reduction, food security and protection of traditional lands, many indigenous communities throughout the Philippines have formed Indigenous People's Organisations (IPOs). The KAMICYDI group, made up of indigenous peoples, students and professionals, formed as an IPO in 1984. This group used its peoples respect for the environment and traditional knowledge to help foster sustainable development. In particular, encouraging traditional methods of sustainable harvest of wild animals has helped meet protein needs within local communities, but has been paired with activities to ensure forest protection. Returning watershed management responsibilities to families as a part of the project activities has encouraged reforestation, but has also enabled families to guard and protect their resources. Communal irrigation systems has connected these watersheds to rice fields, to improve irrigation. Over 90 systems have been repaired and 18 new irrigation systems have been constructed. This in conjunction with the changes in watershed management allows continuous supply of water to local rice terraces. Finally, the group has encouraged introduction of fish and vegetables into rice terracing systems, which has improved the nutritional diversity of local diets and ensure greater food security.

KAMICYDI operated for more than ten years before it was officially registered with the Philippines Securities and Exchange Commission in 1996. This formal registration has been essential to cement the group's voice as an advocate for law change and garner funding support for the expansion of the technologies introduced by the project.

KAMICYDI has created the conditions necessary for achieving food security by looking at elements of the natural environment holistically and recognizing the value of traditional agricultural practices in ensuring sustainability. Forests, water, rice terraces, fish and vegetables are used in an integrated fashion as has been done for centuries. The project has worked in seven indigenous communities in Kalinga (with 1,071 households or families). The results have been impressive; in the poorest regions, family incomes have increased by 36 per cent and reports indicate that 81 per cent of forested lands in the province of Kalinga, including many hectares of old growth forest, are being protected.

The KAMICYDI group has ensured that it is able to scale up the effects of its work by undertaking advocacy and creating partnerships aimed at the replication of sustainable technologies, the encouragement of multi-stakeholder partnerships in implementing the technology and the advancement of policies sympathetic to traditional land management. To date it has formed effective partnerships with nine local government units, who have become members of local indigenous networks. Other indigenous groups in the Cordillera and other parts of the Philippines have requested help in the replication of the project and where funding has permitted the project team has responded positively. Other indigenous communities in neighbouring communities have learned from the initiative and today rice terraces exist throughout the cordillera administrative region, with a total of 72 per cent of forest resources being protected. This equates to the protection and sustainable management of 108 watersheds.

The KAMICYDI group has become a respected voice in the community. Its advocacy efforts ere successful in influencing the passage of the Banaue Rice Terraces Commission, the Indigenous Peoples Rights Act of 1997 and the termination of environmentally destructive project such as the Chico River Dam Project.

Some of the methods advocated by the KAMICYDI group included:

 Establishing the Kalinga School of Heritage and Living Tradition to teach local communities about traditional farming methods which

- enabled the sharing of traditional knowledge from one generation to another;
- Promoting what was termed "sustainable indigenous peoples environment-friendly enterprise development", utilizing indigenous arts and handicrafts in promoting environment-friendly "one community, one product manufacturing" to generate income and employment. As a result, KAMICYDI successfully joined in local and national trade fairs and won awards;
- Establishing the Mobile Environment & Enterprise Education (Mobile e3) Programme with the aim of empowering indigenous peoples, women, children and young people to protect their environment and helping them establish alternative enterprises to generate income and employment. This is particularly important for those people that do not own rice terraces:
- Promoting biodiversity and women's health through a community learning farm to encourage and promote the use of traditional rice varieties (TRVs). At present, highly nutritious red rice and organic products like beans, mongo and coffee are being sold;

Lessons learned

Recognizing traditional knowledge and land ownership

The KAMICYDI group's success lay in its ability to build on existing traditional knowledge to improve the sustainability of local agriculture and forest management. Its use of effective advocacy techniques and willingness to share information with other NGOs and tribal groups and create partnerships with local government has meant that the technology has spread throughout the Philippines. They have also been willing to share fiscal resources where available so that other groups can take up appropriate technology.

Table 2			
Action	Climate change adaptation link	Biodiversity conservation link	Poverty reduction link
Mangrove restoration	Stabilia act as climatical act as climatical act as climatical act as climatical act as a climatical act		Development of village savings fund for education and career development of village savings fund for education and career development. Improved access to resources and benefit-sharing within the local community. Increased food security and diversity of income opportunities through creation of habitats for species with medicinal. Income-generating and nutritional benefits. Large savings on dyke maintenance through stabilization of the mangrove banks. Buffering of the coastline to protect communities against devastating losses in lives, property and livelihoods in the event of typhoons. Provision of food and medicinal items as well as fibres and building materials. Stabilization of shorelines to protect communities in low-lying areas against tidal surges and shoreline erosion
Sustainable fishing practices	• Increased opportunities for species to breed, which leads to opportunities to increases the genetic diversity of populations and in turn increases species' ability to adapt to new pests and diseases brought about by changing environments and climates	Sustainable fishing practices such as "crab banking" and closed seasons that allow species and their natural predators to flourish, which in turn supports ecosystem services	Sustainable fishing, which ensures that fish will be available to enable future generations to earn income and contribute to village saving and development programmes
Sustainable agricultural practices	Ensure adequate supplies of water, food and timber for communities during climatic extremes Protect soil against flooding and erosion Ensure responsible use and disposal of water to prevent local hotspots of vulnerability during climatic events Encourage more sustainable water management techniques and allow for modification of practices that exacerbate damage from climatic events such as lands ideas and water remarkations.	Prevent loss of biodiversity, accelerated by farmers clearing land in areas vulnerable to flooding, landslides or other erosion forces. Increase soil fertility and encourage conservation of wild food species through diversification practices management techniques and allow for modification of practices that exacerbate damage from dilmatic events such as landslides and water recision. Allow targeting of regionally important areas for vegetation and watershed protection thereby protecting valuable biodiversity such as mangrowes and vegetation on dunes and steep slopes. Through the incorporation of community foresty agreements ensure that traditional practices continue to preserve forests and wetlands in a sustainable manner and in turn the biodiversity they harbour	Increase productivity per unit of land area, thereby increasing income and food security by increasing nutrition and food options during times of hardship Reduce economic burden placed on communities by reducing the need for reconstruction following extreme weather events
Swamp forest restoration	Stabilizes soil and substrate during monsoons and reduces the intensity of waves that threaten to destroy villages and infrastructure Provides a refuge for species to fourlish, which may be important in success lonal role during climate changes. Encourages the growth of algae and more vegetative matter thereby creating a carbon sink to increase sequestration.	Provides habitat for fish, bird, insect and other important wetland species Through restoration of substrate encourages growth for wetland plants and algae and provides shelter where aquatic fauna can breed and hide Assists in restoring local hydrological processes, which are important for cycling nutrients and supporting life cycles of dependent species Through submersion of trees. Through submersion of trees. Through submersion of trees, provides as alse shelter for breeding by fish species to breed and roosting or predators such as commorants, turtles, monitor lizards and fishing eagles.	
Agroforestry	Provides genetic diversity of tree species, stabilizes soil in vulnerable areas such as steep slopes and other areas subject to landsides, and provides a weather conditions Assists in carbon sequestration Promotes increase in woody blomass for carbon sequestration Through incorporation of trees promotes increased soil quality and protection against droughts and other extreme climatic events Through incorporating of events Through incorporating of weather such and other extreme climatic events Through incorporating of weather such and the extreme climatic events Assistance of cultivated land to climatic extreme such as droughts, heavy rainfall and erosion	unlogged provides habitat for species and solid substrate for the growth of reeds, which in turn provide habitat for bids and other wildife which may be useful pollinators and predators for agriculture Increases the relative diversity of the landscape by promoting tree species that are useful to people and attract fauma and flora Increases available habitat for tree-dependent species in the agricultural landscape Encourages on-fam conservation of tree species Extends the range of existing biodiversity frituoght the establishment of corridors between isolated forest remnants and protected areas Increases the diversity of natural predators and pollinators such as birds, bats and insects	Through the establishment of plantations provides alternative income from the sale of fibres, wood, fruits, fuel and fencing materials. Provides products such as stakes for climbing beans, fodder, flewood, building materials, seeds and medicinal products and ensuring greater food security and income opportunities Through the promotion of multi-purpose tree species provides income opportunities or more opportunities on women. Through increased vegetation cover provides ecosystem services that increase the productivity of land, thereby improving living conditions for farming families
Conservation of beels, lakes, kuas and canals	•	Ensures conservation of species during dry months and ensures that they have the opportunity to breed and replenish stocks during the monsoon	Provides a source of food and water security during lean times
Microfinance programmes	Allow communities to invest in more effective energy options such as solar power Reduces pressure on vegetation such as trees and reeds that protect villages from monsoon damans and energin.	2	Provides funds for livelihood options such as duck rearing, nursery establishment and culirvation of plantations or vegetable gardens Provides opportunities to assist marginalized groups such as women
Medicinal plant gardens Solar power	Provide medical options for diseases favoured by increased rainfall and other impacts of climate change. Reduces reliance on fossil fuels and reduces the amount of and reduced the amount of the amount o	Provide for the conservation of biodiversity that is beneficial for human health Reduces the need to harvest local reas and thereby reduces one sure.	Provide a ready source of medicines and encourage the preservation of traditional knowledge, thereby reducing reliance on expensive imported medicines. Reduces household costs, allowing income to be used for food and recreational items such as talaxieshore.
Turtle hatchery and crab culture	an reduces ure amount or greenhouse gasse emitted to the atmosphere propulations may give species a higher probability of surviving catastrophic events and	ρ Ε	and recreational refins social as televisions Through increasing turtle populations improve food security and expand protein options for local diets
Floating gardens	Provide an effective means of climate change adaptation by allowing the growth of food crops during monsoon floods	Provide substrate upon which biodiversity can fourish Encourage the proliferation of natural pollinators and predators that support the ecological food chain	 Provide an additional source of income during the monsoon and enhance food security
Participatory natural resource management	Phrough development of Peoples Mangrove Forest Network ensures that everyone understands the importance of mangrove conservation, which in turn ensures that the mangroves and their resources remain intend and continue to act as a coastal buffer.	Creates local ownership of biodiversity assets and control over their future and increases knowledge of how to manage mangrove foresis to conserve local ecosystem processes	Through protection of mangrove forests promotes the protection of ensure income-generating opportunities, food security and continuation of fishers lifestyle
Environmental education	Through the conservation of local knowledge ensures that future generations are able to monitor biodiversity as it relates to pressures brought about by climate change and to develop appropriate management strategies. Promotes familiarity with the main climate risks in the region and how they link to livelihood vulnerability and resilience.	Promotes increased understanding of the importance of blodiversity, including its attributes and ecosystem services, and promotes interest in conserving it. Increases understanding of the intrinsic value of local knowledge of biodiversity and the significance of biodiversity to tourists and the global community. Increases knowledge about restoration methodologies and species choice	Promotes knowledge and the importance of conserving the ecosystems that provide such goods to food security and poverty reduction strategies for the future. Promotes an integrated approach that combines improvements in social and natural capital to promote poverty reduction and blodiversity protection. Promotes formation of partnerships with international non-governmental organizations and government bodies to fund skills development and purchase of equipment for forest studies, thereby reducing reliance on timber extraction and other destructive forest activities.

Action	Climate change adaptation link	Biodiversity conservation link	Poverty reduction link
Revegetation of rangelands	Through improving biodiversity helps to redress the balance between methane production by animals inhabiting rangelands and the amount of carbon being sequestered by vegetation Through the rehabilitation of rangelands encourages the growth of species that may be more suited to future climatic changes and can provide fodder reserves for livestock during times of drought	Through replanting of key rangeland species assists in the conservation of biodiversity by providing habitats for insects, birds and mammals. Stabilizes soil and microclimates to the benefit of a number of species.	Improves the carrying capacity of land for agriculture thus improving food security compared with cultivation of marginal grasslands and unrestricted goat grazing
Grain storage and credit programmes	•	• Through the establishment of safe, long-tern storage facilities, ensure that grain supplies are available during times of drought, thus reducing reliance on biodiversity	Help create food security by ensuring that supplies are available during times of drought and thus reducing the impacts of hunger and malnutrition
Community vegetable gardens	Ensure that species are not lost due to drought and desertification. Through irrigation and hand-dug wells achieve a degree drought proofing and increase plant yields	Through the development of gardens by local women's groups, ensure the preservation of important medicinal and food plant species	Ensure food security by increasing the variety of species consumed as food and ensuring a more reliable supply. When coupled with credit and micro-enterprise programmes enable women to generate income
Sustainable forestry management Ecotourism		Through large-scale forest management profects a diversify of habitat types and species with varying range requirements Creates to cal pride in broidversity and increases awareness and knowledge of local wildlife and ecosystem processes	
Farmer field schools	Promote the development of new farming norms whereby vegetation and trees are included as valuable component of farming systems to prevent erosion and buffer against climate change.	Promote the use of villagers' and regular forest users' knowledge of plants, including lifecycles, pollinators and predators, in the implementation of soil and land conservation measures	 Deliver training in a manner that is locally relevant and guided by local people, for example by providing a venue for farmers to stare their knowledge and skills and thereby buffering the future impacts of poverty through widespread adoption of sustainable agricultural practices
Agricultural diversification	Through intensive crop rotation involving intercropping and relay-cropping increases plant cover of soil and reduces erosion and reduces incidence of pests and insects, thereby reducing chemical use	Allows for greater productivity per land area, thereby reducing pressure to clear natural vegetation	 Lowers labour costs relative to production and income generation and thereby enhances livelihood security
Improved road access		 Allows for coordination of movements through biologically sensitive areas thereby preventing their fragmentation by paths and tracks 	Allows more direct access to markets for i products, seeds and locally crafted goods income opportunities and food security
Nutritional education			Provides opportunities for communities to achieve self-sufficiency and resistance to disease and mainutrition, which have both in human and financial costs Promotes the continuity of customs and traditions associated with food
Seed banking		• Conserves genetic material and representative specimens of species with agricultural and nutritional benefits that are disappearing from the landscape	Provides farmers with food security, seed security and a range of crops to choose from, thereby reducing reliance on seed supplies, diversifying income opportunities through seed and produce sale and the reducing mono-cropping, which limits income opportunities
Reintroduction of traditional agricultural practices		Through traditional agricultural practices such as vermiculture, compositing, soil and water conservation, agro-forestry and companion planting promotes increased soil biodiversity and allows matural predators and polimators to fourish, which in turn supports ecosystem services and other levels of the natural food chain	Promotes local varieties of agricultural crops that may give higher protein yields, produce better fasting food due to naturally occurring genes and are less dependent on expensive pesticides and chemical fertilizers than are higher yielding varieties. Through soil and water conservation initiatives like composting, regenerates soil nutrients and results in more nutritious and tastier food
Participatory crop improvement	Through the maintenance and enhancement of soil fertility and moisture availability, reduces the vulnerability of cuttivated land to droughts		Provides for farmers to work together to form community seed banks that decrease farmers' reliance on seed companies. Promotes community farming to reduce reliance of individual farmers on external inputs and subsequent overuse of fertilizers, pesticides and mechanized agricultural practices.
Women's self-help groups			Promote women working collectively to ensure food and seed security. Establish income generation programmes to help poor and marginal farmers generate alternative incomes and act as a backup to the local markets Through community farming with seed provided by the GREEN Foundation, benefit women farmes who have land but are unable to cultivate it due to extreme poverty Provide women access to micro-credit programmes and freedom from restrictions according to caste or creed
Organic farming practices		Promote increased soil biodiversity enrough the use of green fertilizers such as leguminous crops and manue, ecological ploughing and the cultivation of earthworms, symbiotic relationships and natural predators and pollinators.	 Promote increased production of crops and decreased reliance on artificial fertilizers, reducing farmer input costs and increasing financial returns

PART 3

Co-benefits of project activities

rom the above case studies, we can point to a few lessons relevant to identifying how community based actions in almost all of the instances explained above contributed to securing co-benefits. First, the projects were not necessarily aimed at achieving co-benefits, which were accrued by chance rather than by design. Second, the level of local participation in the design, implementation and monitoring was quite high, and provided lessons on improving the design of local governance structures in project development and implementation. Third, unknowingly the projects have all contributed to the overall well-being of the communities by contributing to social, economic and environmental improvements. These contributions are captured and reflected in the following table (Table 2). Fourth, project activities contributed to significant policy formulation, review and change in the areas where the projects were implemented. This has contributed significantly to achieving the objectives of the host countries under a number of key multilateral environmental agreements. Fifth, the sustainability of the actions cannot be questioned as all of the projects described in the present report continue to flourish in 2010 (the descriptions of the projects above are based on the status of the projects as of 2004). This confirms the fact that when communities are empowered to undertake local actions on conservation and development, the rate of sustainability and success will be significant. Sixth, even though the projects were not aimed at improving well-being or securing livelihoods per se, they have all contributed to local development and household security, thereby contributing to improvements in local biodiversity, climate change adaptation and mitigation and food security, thereby contributing to overall livelihood improvements.

The following table (Table 2) attempts to summarize the benefits of project activities with links to biodiversity conservation, climate change adaptation, food security and livelihood benefits in as much detail as possible, based on various interventions identified through the case studies.

PART 4

Making the links – a summary of key issues

s described in the interim report of TEEB (2008), the classic development challenge of increasing economic opportunity and securing sustainable ecosystems is still with us. Indeed, it has been sharpened by an emerging recognition of global ecological constraints. Similarly, development of global, regional and national environmental legal and regulatory regimes to deal with biodiversity loss, climate change, food security and development are not achieving needed results (Leary and Pisupati, 2010). Environmental governance challenges continue to pose a threat to multilateralism on environmental and development issues.

While reports such as the TEEB offer a comprehensive overview of key challenges and opportunities, realizing the opportunities requires different approaches and solutions. Assessments of the costs of biodiversity loss, climate change inaction and achieving local development will not by themselves yield needed long-term results or impacts. What is needed is to identify what works at the local level, develop tools, methods and options for scaling up successes where possible and to change the mindset of policy makers, project designers and donors in identifying priority actions.

Based on the projects analysed in the present report, table 3 identifies possible solutions for dealing poverty reduction and development challenges that can be found using the approaches identified and put in place by the communities. The table also suggests a series of policy and practical interventions that can be learned from the case studies.

Table 3:

Dimensions of poverty	Solutions (Entry points)	Suggested national policy/practical interventions		
		Climate change adaptation and mitigation	Biodiversity conservation	
Lack of assets and opportunities	 Employment Value added investments Access to capital, technology and markets Resource tenure Trade policy Competition policy 	 Investigate ways to create employment opportunities associated with reforestation programmes, building or operation of renewable energy systems and construction of technology for cleaner production or recycling projects. Undertake agronomic research to identify crops that show resistance to drought or water logging. Train agricultural extension officers to assist farmers in diversifying crops, shifting to greenhouse or intensive agriculture (where appropriate) and practising soil and water conservation to buffer against the effects of drought. Promote markets in ecosystem services (through incentives or market instruments) to reward communities that maintain carbon sinks or undertake reforestation and watershed protection activities to benefit downstream users. 	Investigate means to encourage improvements in the design of businesses associated with biodiversity conservation Investigate local markets and means of sustainably harvesting non-timber forest products such as fruits, fibers, construction items and medicinal plants in situ and increasing their production ex-situ through nursery or agro-forestry enterprises. Investigate transfer mechanisms to compensate for losses and reward community stewardship commitments. Build measures of sustainable use or certification into trade agreements to ensure that biodiversity products are not depleted to the detriment of local communities. Encourage the uptake of agricultural practices that build soil biodiversity and improve productivity, thereby reducing pressures on in-situ biodiversity. Support research programmes that seek to identify potential and traditional crop species and develop means for their integration in agricultural production. Assess competition policies to ensure fair trade in biodiversity products and ensure gate prices that are sympathetic to input costs for farmers and processors trading in biodiversity products. Promote markets in ecosystem services that support local livelihoods and provide benefits for local and indigenous communities in return for protection of important areas of biodiversity.	

Dimensions of poverty	Solutions (Entry points)	Suggested national policy/	practical interventions
		Climate change adaptation and mitigation	Biodiversity conservation
Power and voice	 Participation Democratic decision-making Rule of law (equality before the law) Access to information Accountability and transparency 	Develop and implement education and pubic awareness programmes on climate change to improve understanding of the importance of mitigation measures. Design early warning systems in conjunction with local communities so that all parties understand predictions of climate change impacts and their roles in adaptation or mitigation measures. Ensure that rules governing cleaner production or use of environmentally friendly technologies take into account the financial capacity of individuals and organizations to meet environmental requirements.	Investigate possible solutions for reforming policy and legislative systems to recognize and guarantee the rights and responsibilities of indigenous and local communities to play key roles in managing natural resources and to ensure their access to common property resources. This may involve processes of restitution where rights were previously taken away. Ensure thorough community consultation at the onset of bio diversity management projects to ensure adequate assessment of social and economic impacts as they pertain to access and benefit sharing and specific gender needs.

Dimensions of poverty	Solutions (Entry points)	Suggested national policy/practical interventions	
		Climate change adaptation and mitigation	Biodiversity conservation
Vulnerability	 Diversification Insurance Prevention Early warning and prediction systems. 	Identify areas of greatest vulnerability to climate change i.e. small islands: low-lying coastal zones: arid and semi arid areas: areas liable to floods, drought and desertification; fragile mountainous ecosystems; areas vulnerable to salinity and establish appropriate early warning systems and land management systems to minimize the effects on vulnerable populations. Identify infrastructure in climatically vulnerable areas that can be used for food banks and permanent water sources to minimize the effects of hunger and thirst during time of drought or flood. Identify potential hotspots for diseases induced by climate change i.e. vector borne diseases such as malaria and dengue and investigate ways to reduce the intensity of outbreaks. Assess the capability of existing infrastructure i.e. bunds, drains, waste water disposal systems and altered river courses to cope with increased rainfall, to prevent the spread of water borne diseases such as cholera and dysentery. (-some of these changes would be too expensive to undertake immediately — worth emphasizing that future projects should be planned with these considerations in mind). Support research, promotion and local innovation for cleaner production systems and new and renewable forms of energy at the household level, especially for areas where lack of available energy has severe ramifications for health during times of intense cold or heat or there is an over reliance on firewood. Provide training for extension staff to assist women's groups in identifying special needs for women and children as part of disaster mitigation plans i.e. special child/mother clinics during flood and drought.	Promote initiatives such as seed saving networks and seed banks to ensure conservation of agricultural biodiversity and adequate supplies of seed for nutritional diversity in the absence of food supplies and market and to ensure adequate supplies for crops following drought or flood. Support initiatives that promote ex-situ conservation of biodiversity and ensure livelihoods and food security such as agro-forestry, nurseries, kitchen gardens and plantations. Investigate means of using biodiversity for alternative livelihoods options such as eco-tourism.

Dimensions of poverty	Solutions (Entry points)	Suggested national policy/	y/practical interventions	
		Climate change adaptation and mitigation	Biodiversity conservation	
Lack of capability	Literacy Health Provision of basic services Access to information	 Provide training for local agricultural and community development officers to assist households to prepare emergency plans that complement early warning systems for natural disasters. Ensure that women have access to appropriate micro-finance programmes that will allow them to employ new technologies or seek financial assistance during times of hardship. Investigate means of creating support groups for women who are landless or have lost family so that they have a safety net during times of drought or flood. Encourage the inclusion of traditional knowledge on climate change and associated adaptation and mitigation practices in both formal school curriculums and in community development training programmes. Encourage projects that build social capital in the form of effective partnerships or relationships between different sectors of the community to increase the effectiveness of early warning systems and emergency response operations. 	Conduct research into local agricultural biodiversity and food security options such as the production and processing of bush fruits, vegetables and meats and investigate means of linking such produce to local markets. Support the development of local language materials to inform community members of new rules and regulations involving biodiversity conservation and to increase community awareness of conservation concepts and the need to protect species or ecosystems. Recognize local communities for actions leading to the achievement of national or global targets, e.g., through the Equator Awards, and support local involvement in regional knowledge networks which allow the sharing of information, experiences and innovations. Provide support for training programmes, exchange programmes, exchange programmes and other initiatives for sharing information on project design and new innovations for combining conservation and development projects. Encourage the inclusion of traditional knowledge and modern biodiversity conservation practices in both formal school curriculums and in community development training programmes to encourage recognition of biodiversity and its components and the need for sustainable use practices.	

CONCLUSIONS

Conservation and sustainable use of biodiversity create opportunities for reducing poverty, securing livelihoods, adapting to and mitigating the adverse impacts of climate change and contributing to overall achievement of the MDGs. Responses to biodiversity loss and strategies for biodiversity conservation need to be reinforced and re-tooled to reverse current trends of continued loss of biodiversity, which have a negative impact on local livelihoods. Integrated solutions and options for better design of field options need to be found based on principles of inclusiveness, workability, sustainability and equity.

Besides achieving the triple goals of conserving biodiversity, sustainably using resources and sharing the benefits of their use, countries need to identify the cobenefits of actions that contribute to climate change adaptation, climate change mitigation and food security. Local experiences can inform and contribute to the effort to find long-term ways of achieving these goals.

Linking conservation and development does not stop with developing sustainable strategies and regulatory frameworks. The frameworks need to be translated into actionable opportunities. The present report discusses such experiences from the field, that is, real-life experiences with options that are being tried by local communities in an effort to secure their livelihoods.

It is hoped that the elements of the report will help to make policy makers, project developers and donors cognizant of the wealth of community experience available and how local action can contribute to achieving multiple benefits in respect of conservation, climate change adaptation and mitigation and food security, thereby contributing to human well-being.

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