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Rural livelihoods and carbon management

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Executive summary

Successful strategies to mitigate climate change will involve, at least in part, improved management of the terrestrial components of the carbon cycle. Environmental, economic, and livelihood benefits associated with better land use practices provide further support for terrestrial carbon management. However, for both technical and political reasons, the eligibility of land use and forestry management practices as carbon offset options under the FCCC[1] process and elsewhere is still subject to much uncertainty. Indeed, the UK Government does not support the inclusion of land use as a viable carbon offset option. Some parties in the various policy processes see land use-derived offsets as a way for the North to avoid addressing its own emissions, at the South's expense. Others see them as ways to secure additional funding for productive and sustainable land use. It is expected that this issue will be resolved at the 6th Conference of the Parties to the FCCC in November 2000.

In spite of the uncertainties surrounding carbon offsets, particularly land use offsets, more than 150 bilateral carbon offset schemes have been developed to date. Investor motives include anticipation of legislation, demonstration of corporate responsibility, and secured first-mover advantage. About 30 are based on forestry or land use options designed to conserve and/or sequester carbon, or to substitute renewable wood products for fossil fuel based products.

Within this evolving context of policy and practice, in what may ultimately become a highly significant global market, the agenda is at risk of being set by the more powerful players. Against this risk, four institutions[2] were jointly commissioned by the United Kingdom Department for International Development's (DFID) Forest Research Programme to examine the

[1] Both the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and its daughter agreement, the 1997 Kyoto Protocol, accommodate carbon offsets. These notional commodities are generated by projects that result in a net reduction in atmospheric carbon dioxide (CO_2), through activities that either avoid CO_2 emissions or actively remove CO_2 from the atmosphere. The resulting carbon offsets are so named because of their potential use in compensating for or offsetting CO_2 emissions elsewhere. A myriad of activities could potentially generate carbon offsets, though emphasis thus far has been on the energy, construction, transport, and land use sectors.

[2] International Institute for Environment and Development (IIED), Edinburgh Centre for Carbon Management (ECCM), the Department of Forestry at the University of Aberdeen, and EcoSecurities Ltd.

implications of carbon offset scenarios for developing countries and, in particular, for the rural poor and landless. The work reported in this document examines the experience of carbon offsets to date, as well as analogous experience of rural poor and landless people benefiting or otherwise from land use projects. It seeks to raise the key rural livelihood issues that need to be considered in relation to carbon offset projects and policies, with a view to recommending where further research is needed, and where development assistance may be most effectively channelled. In so doing, the report does *not* promote any position on the emerging international policies, *nor* on DFID's or the UK government's stances or policies. However, the implications of possible policy decisions and outcomes are considered, so as to support the carbon policy debate in relation to the needs of poor people in developing countries. An international workshop on carbon offsets and rural livelihoods was held in Edinburgh, UK, in September 1999, in which the following *key questions* were discussed by a range of stakeholders:

What is the real added value of carbon offsets?

Any approach to offsets ought to support activities that are needed for good land use, but which might not otherwise occur. Examples might include encouraging the retention of biomass in vegetation and soils, and securing long-term funding streams. Various initiatives have contributed guidelines for determining the additionality of carbon offset projects.

What might the impacts be on rural livelihoods?

The rural poor and landless require resilient, sustainable livelihood systems that are flexible in the short term – this invariably means dependence on multiple products. However, if large protected areas or plantations are managed for long-term carbon sequestration and storage, local people may lose access to other products such as fibre and food. Carbon offset policy must therefore build in adequate provisions concerning local environmental and social factors, with relevant local participation and powers of veto. Much of the learning from participatory forestry and protected area experience is relevant and could be incorporated into carbon offset policy.

Are rural people and their farming and forestry systems well-suited to the provision of carbon offsets?

The push to produce secure carbon storage at the lowest price may tend to favour large, contiguous areas under simple management and clear tenure, that can guarantee a single, readily verifiable commodity – carbon storage – for many years. Obvious examples of such conditions include set-asides of natural forest in protected areas, or large-scale plantations. All things being equal, governments and companies, rather than small farmers, are best placed to benefit from such schemes.

Can rural people benefit from carbon offsets?

In rural areas where people want to plant or tend trees for other purposes, and where there are checks and balances to ensure that land use changes do not reduce equity, it is possible that rural people could benefit directly from offset projects. However, the frequently weak organisation (or high transaction costs of improving organisation) of the rural poor and landless will reduce their access to the carbon offset market, particularly given the many complex requirements of carbon offset interventions. Other barriers to the involvement of rural people centre on their prevailing small-scale and complex land use practices, without clear tenure systems. And, whilst carbon offset revenue may offer one source of security, cash income is not enough for the rural poor and landless – they will always need access to natural capital for sustainable, resilient livelihoods.

These questions raise several challenges that must be addressed if carbon offsets are to benefit rural groups:

- **International carbon offset policy, standards, and accounting and certification protocols** must build in sustainable forestry, land use and livelihood criteria. Whilst agreement over all such definitions is currently needed, so also is flexibility to allow for local differences. Improved information must be available to developing countries and their participation in international developments increased.

- **National institutions** need to be strengthened to act as brokers between a global carbon offset marketplace and potential local suppliers with their own particular needs and interests. Better scrutiny of potential foreign investments in carbon offsets is needed to avoid interventions that may be damaging to local livelihood and land use systems. Infrastructure needs to be developed to sustain equitable community-oriented offsets at the lowest transaction cost. National land use and forest policy needs to be focused on sustainability – indeed, verified improvements here might themselves form the basis for national carbon schemes.

- **Local carbon offset organisational and project management capabilities** need to be developed. The special challenge is to achieve efficient, equitable and competitive organisation of rural poor and landless people, so that it is not just a local technical elite who benefits. Methods to control leakage might best be provided by systems with a broad land use or developmental mandate and a wide reach, such as extension systems and rural development NGOs (Non Governmental Organisations).

Some of these challenges suggest *potential roles for development assistance*. Aid agencies could foster an enabling environment for private sector investment in carbon offsets, which, as a minimum, is benign for the rural poor and landless, but preferably would also enable them to benefit materially and equitably. Potential roles for development assistance include the following:

- **Mainstreaming and policy coherence:** Promoting synergies between carbon management and other policy processes and development projects covering forestry, livelihoods and other relevant areas.

- **Building balanced capacity:** Building awareness of sustainable land use and the potential roles of carbon investments. Developing capacities to set up and run sustainable carbon offsets in the land use systems of the rural poor and landless, in ways that reduce risk to both the investor and local partners.

- **Influencing demand:** Influencing the development of market niches for 'socially sound' rural development carbon offsets.

- **Influencing supply:** Supporting better information on opportunities. Applying all the above to development-aided projects, to establish best-practice case studies in: community forest management of various types; community conservation management; agroforestry; and integrated energy and land-use systems.

In conclusion, sustainable offsets will integrate global needs for carbon management with local livelihood requirements from the land. *A reliable carbon commodity could assist local rural development, but only if appropriate policies, institutions, community mechanisms and project procedures can be put in place.* These must ensure equity as well as competitiveness in relation to larger-scale schemes. As a general rule, the best way forward is to build on mechanisms that already work well in relation to sustainable land use and multiple rural stakeholders.

Contents

Preface

The purpose of this issues paper

Concern about the role of atmospheric CO_2 as an agent of global climate change has led to intensive efforts to find ways to reduce or offset fossil fuel emissions. Innovative technologies, policies and financial mechanisms are now emerging to this end. One such development involves methods for quantifying and assessing carbon stocks and flows in forestry and other land use activities. This has led to the prospect of carbon sequestration in terrestrial ecosystems becoming a bankable asset, as well as a global public benefit. Over 30 pilot carbon offset projects are offering some insight into future potentials in this field, as well as contributing to an invaluable base of experience on which future protocols and guidelines can be based.

Four institutions[3] have been commissioned by DFID's Forest Research Programme to prepare this Issues Paper on emerging carbon management policies in relation to the livelihoods of the rural poor and landless in developing countries. The objective of the paper is to explore the precedents, potentials, issues and risks of carbon offset land use activities, as a basis for developing appropriate mechanisms that might support both effective carbon management and rural development.

It should be stressed that this research does *not* take any position regarding emerging international policies, *nor* on DFID's or the UK government's stance or policies. However, the implications of possible international policy decisions and outcomes are considered, so as to improve the chance that the carbon policy debate supports poor people in developing countries.

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[3] The four institutions are IIED, ECCM, the Department of Forestry at the University of Aberdeen, and EcoSecurities Ltd.

This issues paper aims to help DFID form its policy on global carbon management in relation to its principal mandate of poverty alleviation. It also offers guidance as to the roles of DFID, in particular, and development assistance in general, in the context of the emerging field of terrestrial carbon management so as to best serve rural development objectives. In addition, the issues paper may be found a helpful aid to major groups in developing countries, the intergovernmental community and the development assistance community. Part of this process involved an international workshop in Edinburgh (September 20-21, 1999). The workshop was designed to be an information-sharing exercise, to ensure that this paper fully reflects the facts, experiences and opinions of both DFID and of a range of participants from developing countries with direct experience of land use carbon management.

Glossary of key terms

Like many emerging fields, the world of carbon offsets has rapidly developed its own set of terms and acronyms, embracing both policy and technical aspects. This glossary is provided to ensure the reader has a clear understanding of these terms as and when they arise in the main body of the report.

Technical terms

Carbon sequestration – the absorption of carbon dioxide from the atmosphere by photosynthetic organisms; note, however, that the term is also used by some to include technology-based sequestration activities such as deep sea gas-bed storage of liquified carbon dioxide.

Carbon storage – the process by which sequestered carbon is stored over time as biomass, e.g., in terrestrial vegetation; in this example, biomass is considered a **carbon pool**.

Carbon sinks – a carbon pool that is expanding, e.g., a growing forest.

Carbon flows or fluxes – transfers of carbon between carbon pools.

Terrestrial carbon management – refers to any land use management activity or practice which produces net carbon benefits; these benefits usually entail either less carbon dioxide emissions into the atmosphere, or more carbon being stored in biomass for longer time periods.

Carbon or carbon dioxide? – the two are used almost interchangeably; although the actual greenhouse gas is carbon dioxide, carbon is the more common general term; the result can be confusing references to 'carbon emissions' which refer to carbon dioxide not soot! However, it is important to distinguish between quantities expressed in carbon dioxide (CO_2) and in carbon. The mass of CO_2 is 3.7 times that of carbon.

GHGs (Greenhouse Gases) – gases which exert a warming influence on the earth's atmosphere; the principal greenhouse gas is carbon dioxide; other GHGs relevant to land use activities are methane and nitrous oxide.

Policy terms

UNFCCC (United Nations Framework Convention on Climate Change) – signed in 1992, the FCCC is the legal foundation of international policy on climate change.

Kyoto Protocol – signed in 1997, the Protocol introduced legally-binding GHG emission reduction commitments for developed countries, as well as a variety of policy mechanisms designed to help countries meet those commitments.

Carbon offsets – used in a variety of contexts, most commonly either to mean the result of carbon sequestration projects in the land use sector, or more generally to refer to the result of any climate change mitigation project; in this report, it is used in the former sense. A formal definition of a carbon offset has yet to be widely agreed on; however, we propose the following for the purpose of this report:

> *"An amount of carbon withdrawn from the atmosphere by storage in vegetation and soil, for sufficient time to compensate for the radiative forcing over an agreed period (100 years is the convention used by the IPCC to calculate warming potential) caused by an emission of a specified quantity of CO_2 or other GHG."*

Carbon credits – as for carbon offsets, though with added connotations of (1) being used as 'credits' in companies' or countries' emission accounts to counter 'debits', i.e. emissions, and (2) being tradable with emission permit trading systems.

IPCC (Intergovernmental Panel on Climate Change) – a panel of international scientists, nominated by governments and other organisations, that inform the working bodies of the Climate Change Convention.

Also see Box 4.1 (page 45) for terms related to climate change mitigation projects.

1

Climate change, the global carbon cycle and terrestrial ecosystems

Summary: Populations in developing countries, particularly the poor, are most at risk from the effects of climate change. While the main causes of the rising atmospheric concentrations of CO_2 are from fossil fuel combustion and cement production, terrestrial ecosystems play a dominant role in the global carbon cycle. For this reason, a successful climate change policy must also take into account the dynamics of the terrestrial carbon cycle. Simulations from global climate models suggest that the quality of forest management can make a substantial contribution to controlling atmospheric CO_2 levels over the next century. Whilst it is acknowledged that emissions control is the major task, there are other economic and livelihood reasons for encouraging a push towards better forestry, as well.

1.1 Climate change: Impacts on natural resources and developing countries

Predicted changes in rainfall and temperature due to climatic change are likely to affect the natural resources of many countries. Soils may become more vulnerable to erosion; disease and pest outbreaks may become more frequent; and, natural vegetation, a source of fuel, fibre and food for many rural communities, is likely to change dramatically. While such impacts pose significant threats to societies around the world, populations in developing countries are most at risk given their higher dependency upon their local natural resources. These resources are frequently of low productivity and vulnerable to events such as flooding and drought. In particular, it is the rural poor who will find it most difficult to adapt to a changing climate, for it is the poorest farmers who till the steepest slopes, the most marginal soils, and the most flood-prone paddies. They have less capital to invest in new technology, less access to information and health care, little access to policy processes, and their governments are unable to provide high levels of support.

1.2 Terrestrial ecosystems and the carbon cycle

Climate change is driven principally by rising atmospheric concentrations of carbon dioxide. Since the 1920's, this rise can be convincingly attributed to emissions from fossil fuel combustion and cement production (Schimel, 1995). However, terrestrial ecosystems also play a dominant role in the global carbon cycle. Approximately 110 Gt of carbon[4] are exchanged annually between vegetation, soils and the atmosphere (Figure 1.1). Forests account for about 80% of this exchange.

Deforestation during the late 1980's was estimated to account for emissions of 1.6 to 1.8 GtC y^{-1} (IPCC, 1996). Recent evidence provided by Fearnside (1999) suggests that emissions from deforestation for the early 1990's may be even higher–perhaps 2.1 GtC y^{-1}. Current evidence also indicates that the world's remaining forests sequester at least 25% of the carbon dioxide emissions from fossil fuel combustion (Malhi, Baldocchi and Jarvis, 1999). Most climate models predict that this terrestrial carbon sink is likely to increase in strength during the first half of the 21st century as a result of forest expansion.

However, some models indicate that there is a danger of large-scale forest die-back leading to a rapid loss of sink activity; or even a reversal in the net flux of carbon in the second half of the century (Hadley Centre, 1998). The vulnerability of the terrestrial carbon sink is significant since any reduction in sink strength would not only increase the rate of CO_2 accumulation in the atmosphere, but would increase the atmospheric residency time (and therefore the warming effect[5]) of each unit of gas.

1.3 The significance of land use and forest management for climate change mitigation

To obtain an idea of the significance of forest ecosystems and their management to future changes of atmospheric CO_2, it is possible to consider alternative scenarios of atmospheric CO_2 (Table 1.1). These scenarios are based upon predictions of fossil fuel emissions, ecosystem responses and potential forest management interventions. A simple dynamic model of the

4 A Gt is a Gigatonne = 1 billion tonnes = 1 x 10^9t
5 This warming effect is approximated by the IPCC's Global Warming Potentials (GWPs). The GWP of each greenhouse gas in the atmosphere is defined as the cumulative presence of the gas (concentration x time) within specified timeframes (normally 100 years) multiplied by a radiative forcing coefficient (the amount of warming caused by the presence of one unit of the gas for one year) (IPCC, 1995).

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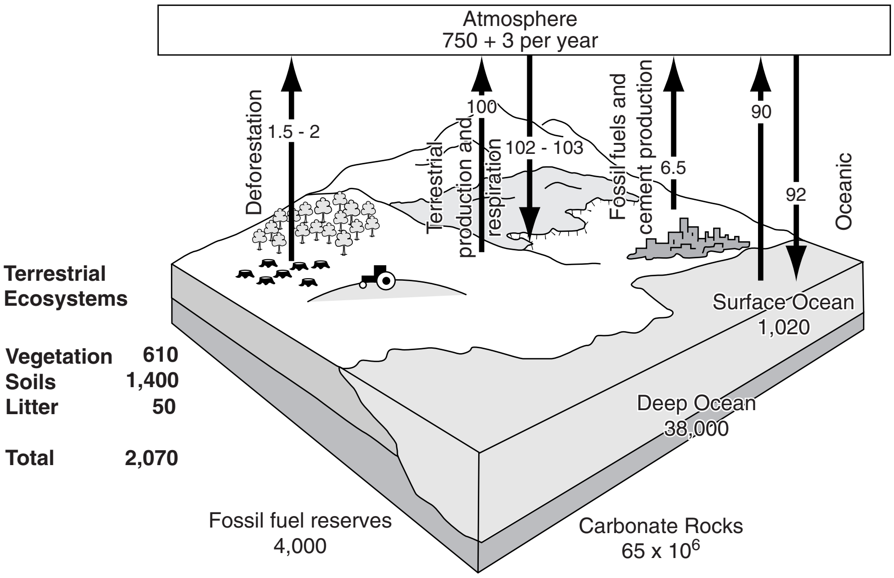
Figure 1.1 Overview of the current state of the global carbon cycle. Carbon stocks are presented in Gt and carbon flows in Gt y^{-1}



carbon cycle indicates a potential difference in atmospheric carbon content between *best* and *worst* forestry cases of approximately 450 GtC by the end of the period (Figures 1.2 and 1.3). The proportionate effect of forest management is much greater when fossil fuel emissions are constrained (IS92d scenario in Table 1.1). In the worst case forestry scenario, CO_2 concentrations are still rising at the end of the century, but in the best case, they appear to be under control.

In other words, the quality of forest management can make a substantial contribution to controlling atmospheric CO_2 levels. The same applies, though to a lesser degree, to all forms of land use management, particularly those that affect the soil carbon pool. Thus, whilst it is acknowledged that emissions control must be the focus of climate change mitigation measures, it is increasingly recognised that a successful, integrated strategy must also take into account the dynamics of the terrestrial carbon cycle. Moreover, the need for appropriate forms of terrestrial carbon management is compounded by the many other economic and livelihood reasons for encouraging a push towards better land use practices.

Table 1.1 Alternative scenarios for future emissions in fossil fuels and forestry developed by the IPCC. The four scenarios were used as inputs to generate Figures 1.2 and 1.3

Fossil fuel emission scenarios	Forestry emission scenarios
Middle of the road case (IS92a) • fossil fuel emissions rise from 6 GtC y^{-1} to 14GtC y^{-1} by 2040, and then to 18 GtC y^{-1} by 2100	*Worst forestry case* • deforestation continues at present rate for next 50 years, by which time most large forest areas are severely depleted • forest sink grows for 50 years but collapses suddenly around 2050 to become a source of about 2 GtC/year • no mitigating forestry programme undertaken
Strict Emissions control case (IS92d) • emissions constrained to <10 GtC y^{-1} between 2000 and 2100	*Best forestry case* • deforestation is halved by 2010 and then halted by 2020 • the forest sink grows for 50 years and then stabilises – any die-back of forests is compensated for or prevented by management • an international afforestation programme provides a sink of around 0.6 Gt/year by 2050

Figure 1.2 Difference between the best and worst case scenarios for carbon sequestration by forestry under a 'middle of the road' fossil fuel emissions scenario (IS92a; see Table 1.1)

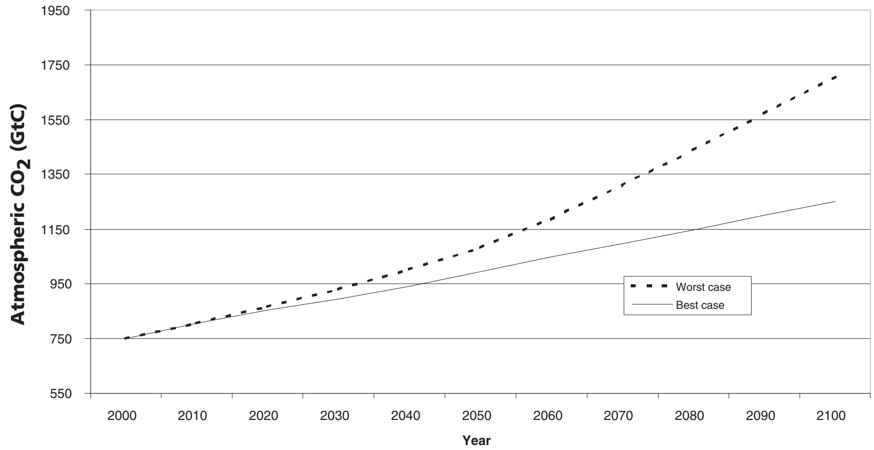
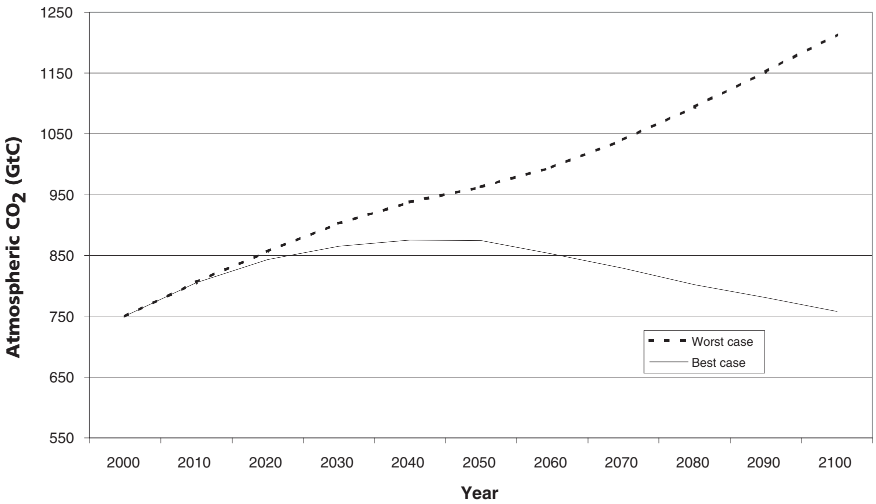


Figure 1.3 Difference between best and worst case scenarios for carbon sequestration by forestry under a strict emissions control fossil fuel emissions scenario (IS92d, see Table 1.1)



1.4 Overview of terrestrial carbon management options

Carbon sequestration through land management practices is a function of biomass accumulation and storage. Therefore, any activity that has a positive effect on a given land area's capacity to sequester and store carbon could potentially be considered a terrestrial carbon management option, as it reduces the accumulation of carbon dioxide in the atmosphere.

In the land use and forestry sector, two main carbon management strategies have been identified. The first is actively to increase the amount or rate of accumulation of carbon by creating or enhancing carbon sinks. The second is to prevent or reduce the rate of release of carbon already fixed in existing carbon sinks. These strategies have been termed 'carbon sequestration' and 'carbon conservation' respectively (IPCC, 1996). A third strategy, 'carbon substitution',[6] involves reducing demand for fossil fuels by increasing the use of renewable wood either in durable wood products (i.e., substituting these for energy-intensive materials such as steel and concrete) or as biofuels. Table 1.2 provides an overview of some of the different management options falling

6 Technically-speaking this is simply a specialised example of the 'carbon conservation' strategy.

under these three somewhat overlapping strategies, with further illustration for forestry provided by Figure 1.4. Details of each option, together with case studies, are provided in Section 3.

It is worth noting here that one of the outputs of such terrestrial carbon management activities at the project level are 'carbon offsets'. Carbon offsets can be defined as the result of any activity specifically taken to remove carbon dioxide (CO_2) from the atmosphere, and/or to prevent the release of CO_2 into the atmosphere, in order to balance CO_2 emissions from elsewhere. The policy context in which the notion of carbon offsets arose is described in Section 4.

Table 1.2 Overview of terrestrial carbon management strategies and potential land use and forestry activities

Carbon management strategy	Types of land use and forestry activity
Carbon sequestration	• Silviculture to increase growth rates • Agroforestry • Afforestation, reforestation and restoration of degraded lands • Soil carbon enhancement (e.g., alternative tillage practices)
Carbon conservation	• Conservation of biomass and soil carbon in protected areas • Change forest management practices (e.g., reduced impact logging) • Fire protection and more effective use of prescribed burning in both forest and agricultural systems
Carbon substitution	• Increase movement of forest biomass into durable wood products, used in place of energy-intensive materials • Increase use of biofuels (e.g., introduction of bioenergy plantations) • Enhanced utilisation of harvesting waste as a biofuel feedstock (e.g., sawdust)

2

Interactions of forests, land use and rural livelihoods

Summary: The role of forests in rural livelihoods is changing in many parts of the world, as a result of population pressure, new economic policies and economic development. Where populations are sparse in relation to the forest resource, farming systems are often part of a cycle that includes regeneration of secondary forests. As population density increases and the access to and influence of markets becomes dominant, the cash value of forest products becomes more important – and the forests become more vulnerable. Forests often become a 'bank' for communities or individuals, and issues relating to access and decision-making over the use of the resource become critical.

2.1 Sustainable livelihoods

Fundamental to DFID's mission – of reducing poverty in developing countries – is an understanding of the implications of development activity on rural livelihoods. Livelihoods can be understood by considering the assets, capabilities and activities required for a means of living (Chambers and Conway, 1992). These components are combined in different ways to form livelihood strategies. Such strategies are sustainable only when they can cope with and recover from stresses and shock. Thus sustainable livelihoods entail activities that maintain capabilities and assets without undermining the natural resource base.

Box 5.1 Capital assets for sustainable livelihoods

The assets available to individuals to build their livelihoods can be disaggregated as follows:

- **Natural capital** – the land, wildlife, biodiversity and water that provide the resource flows necessary for livelihoods.
- **Physical capital** – the infrastructure, equipment and means which enable people to pursue their livelihoods.
- **Social capital** – membership of networks, groups and institutions which facilitate livelihoods.
- **Human capital** – the skills, knowledge and abilities needed to take advantage of different livelihood strategies.
- **Financial capital** – savings, access to credit and remittances that allow different livelihood options.

The context in which assets are found plays an important role in the choice of livelihood strategy. In particular, the vulnerability of assets to trends such as increasing population and economic pressure, to shocks such as climatic variations and to changing cultural practices, exerts a heavy influence on how people meet their livelihood needs (Carney, 1998).

Similarly, people's capabilities to access and use assets play a determinant role in the choice of livelihood strategy. People's capabilities are, in turn, circumscribed by external organisations such as government agencies and trade associations, by policy making and legislative processes, and by markets, as well as by internal rules and institutions. These largely determine which livelihood options are available. The capability to influence decision-making within and outside the community is important.

For the rural poor, there are so many asset shortages and insecurities in access to them – or to decision-making processes – that most rural livelihoods are multiple and temporal in nature, with dynamic and often improvised portfolios of activities.

Despite the inherent complexity, three broad approaches to rural livelihoods can be identified:

- Some households choose to gain more of the their livelihood needs from *agriculture*, including livestock rearing, aquaculture and forestry (albeit rarely dependent on one product). This involves either intensifying output per unit area, or putting more land to productive use.

- An increasing number of rural households meet their livelihood needs from *a diverse portfolio of off-farm*[7] *activities and income sources* (Ellis, 1998). Livelihood diversification is not merely a transient feature of the move from full-time agricultural to full-time industry and service activities. It is both widespread and enduring, particularly in low-income countries, although the mix may change frequently.[8]

- Some individuals and families will choose to migrate to urban centres, or even abroad as in much of the Caribbean, in search of income.

[7] *Off-farm* income refers to wage labour on other farms and income derived from resources such as firewood, wild plants, charcoal and timber. In contrast, non-farm income is that obtained from non-agricultural sources such as property rental income, remittances and urban transfers and wages, (Ellis, 1998).

[8] Ellis, 1998 notes that in southern Africa rural household income obtained from non-farm sources can be as high as 80%.

These strategies are not mutually exclusive. Often elements of each are combined. In many cases rural households have increased the natural capital available to them through remittances from migrant family members. The success of family farms in many parts of the Andes is attributable to land purchases made this way (Bebbington, 1999).

In this paper, we are concerned with how carbon offset scenarios might impact upon the ability of rural households to pursue sustainable livelihoods. Hence we are concerned about carbon offset implications on:

- rural people's access to capital assets,
- the policy, institutional and market environment that determines how people may use these assets in practice, and
- the incidence of shock or stress.

All of these are very much a function of the politics and economics of carbon offsets, as much as the technical/land use issues.

2.2 Sustainable forestry and land use in the context of rural livelihoods

The world over, poor people have been planting and/or managing forest resources where they can, for the forest goods and services they need, if they have the rights, resources, and security of returns.

2.2.1 Forests and livelihoods can have both positive and negative links

There are various degrees of complexity in the forest/livelihood relationship. At the aggregate level, i.e. the village, district or region, four basic types of association between the status of people's livelihoods and the status of forests can be characterised (Table 2.1). This table reveals, however, that context is all-important.

2.2.2. It is the goods and services that matter, not forests *per se*

At the level of the individual or household, there are a number of ways in which forest goods and services play critical roles in livelihood strategies. Table 2.2 shows how they provide *subsistence* goods and materials such as

Table 2.1 Relations between forests and livelihoods

	Worsened livelihoods	Improved livelihoods
'Forest Reduction'	• Decline in forest goods and services, or returns from them, leads to increasing exploitation and reduced incentives to manage forests	• Extending agriculture onto forest lands • Forest assets sold and invested in other livelihood strategies
'Forest Increase'	• Reduced access to forest goods and services due to forest protection/inequitable forest management/lack of infrastructure and skills • Forest type or composition has negative (or no positive) effects on livelihoods	• Intensified agriculture/ employment outside forest areas • Sustainable collaborative forestry, farm forestry, agroforestry, forest enterprises • Sustained markets for (non timber) forest goods and services • Common property regimes improve

Adapted from Mayers 1997

food, medicine, energy and building materials, on which the majority of households in developing countries depend. Forest products also generate *income* in areas with access to markets. Entry thresholds are low, which benefits the poor. Gathering and production activities are likely to be labour-intensive and household-based, with little opportunity to invest surpluses in livelihood improvements. However, in areas where market demand is growing, production of forest-based products is becoming a specialised activity, dominated by those with the skills and capital necessary to exploit market opportunities (Roberts and Dubois 1996).

Forests also contribute *indirectly* to rural livelihoods. Trees can protect crops, prevent soil erosion and contribute to overall site productivity through nutrient cycling. This is an import low-labour means of keeping land in productive use.

Together these multiple forest benefits are critical in determining an important service to ensuring livelihoods are sustainable: *increased resilience to shock*. Many rural households are extremely vulnerable to unanticipated hardship caused by unemployment, crop failure, loss of land through landlord activity, among others. In times of crisis, forest resources can provide valuable subsistence inputs and income-generating opportunities.

2.2.3. Beyond forestry: Forests as part of land use-livelihood relations

Whilst Table 2.2 lists the multiple contributions of forests to livelihoods, forest goods and services constitute only part of the natural resources used by rural people in developing livelihood strategies. In places with a high forest cover, forests often compete with other land uses, typically agriculture, that bring faster and more significant revenue. However, agriculture and forests often co-exist in time and space. The different types of shifting cultivation systems presented in Table 2.3 illustrate this co-existence. In particular it shows that conversion of forest to agricultural land may result in a transformed forest after a certain period, while contributing to livelihood needs. Furthermore, many forest goods and services can be obtained from ecosystems other than intact natural or semi-natural forests, such as agroforestry systems, field-edges, small plantations, forest fragments, or fallow land.

The relationships between land uses – including forests – and livelihoods tend to depend upon interrelated key factors, typically:

- distance from urban/market centres
- population density
- strength of common property regimes (CPRs)

Table 2.3 Classification of shifting cultivation systems by distinguishing variables

Initial vegetative cover	Resource users	Final vegetative cover	Length of fallow
Primary forest	Indigenous users	Secondary regrowth	Long
Primary forest	Settlers	Natural regrowth	(Fields abandoned)
Primary and secondary forest	Indigenous users	Natural regeneration	Medium to long
Secondary forest	Indigenous communities	Natural regeneration	Medium to long
Secondary forest	Colonists	Natural regeneration	Medium
Primary and secondary forest	Mostly indigenous communities	Agroforest	None
Secondary forest	Government-sponsored colonists	Plantation crops a or *taungy*	None
Secondary forest	Mostly settlers and ranchers	Pasture	None
Grasslands	Indigenous users and settlers	Natural regeneration and pastures	Variable

Source: Fujisaka and Escobar, 1997

- governance, law and order
- the composition of farm-based livelihoods
- the type and quality of the forest resource

Carbon offset schemes need to take account of the diverse and complex interrelationships between livelihoods and vegetation types, while being cautious about introducing alternative forestry arrangements as blanket models.

2.2.4 Current Sustainable Forest Management (SFM) standards do not fully reflect the land use systems of the poor

Current notions of SFM have been developed to cover the production of multiple goods and services in many types of forest and plantation. Many sets of the Criteria and Indicators (C&I) developed by (inter-) governmental civil society bodies contain common elements (Table 2.4). Almost all these initiatives stress that they need to be interpreted for local conditions. However, as Thornber et al. (2000 forthcoming) point out, there has been little interpretation in relation to the forest production methods of the rural poor and landless. Their production methods are practically invisible to many of the forestry standards–that have usually been developed for, and applied to forests under formal or commercial management, rather than those of mixed land use. Some of these issues are pointed out in Table 2.4.

There is, of course, pressure from environmental groups to ensure that any offset approach meets the highest standards of SFM. However, if SFM standards suiting only large, commercial activities were to be employed, the poor would benefit only to a limited extent. Thus there are four special challenges which arise from Table 2.4:

- to understand the special needs (and limitations) of carbon offsets in refining SFM standards;
- to admit local forms of forest use into the SFM 'pantheon';
- to ensure that SFM criteria and indicators, and requirements, suitably broadened, are integrated into carbon offset schemes; and
- to acknowledge that the transition from no management (or conventional management) of forests towards SFM require a stepwise process, starting with less unsustainable practices. Market mechanisms based on carbon offsets could finance the short-term losses incurred by moving towards more sustainable use of land and forest resources. However, a key challenge lies in the competitiveness of this type of financial support with short-term benefits from non-forest uses of land.

Table 2.2 Various contributions of forests to rural livelihoods

Forest outputs	Contribution to rural livelihoods	Contribution to resilience	Dynamics
Subsistence goods	• food, medicine, fuel, fibre	• counter-seasonal sources of food and fodder and income • buffer role – income opportunities in times of hardship	• increasingly important when farm output or non-farm income declines • increasingly important when essential goods – food and fuel – become commodities and/or expensive • declining improtance as incomes or labour costs rise
Farm inputs	• fodder and forage, fibre for manufacturing farm implements • soil nutrient recycling, shade, windbreaks and contour vegetation • water supplies	• obtainable when other market alternatives inputs become too expensive • reduced vulnerability to climatic extremes, epidemics and declining productivity of natural assets	• increased capital availability and access to markets likely to lead to substitution by other (manufactured or imported) inputs
Cultural/social benefits	• recreation • social identity • sense of place • educational resources • cultural resources	• source of knowledge and beliefs, to help deal with change	• imposition of 'scientific' or product-focused forest management erodes or undermines the knowledge base
Income	• low return forest products characterised by easy access to resource and low capital and skill entry thresholds • higher return products associated with higher skill and entry thresholds produced for urban and rural markets • low-input gathering of raw materials for industrial processes and external markets	• can be major source of employment and income for forest-dwelling populations, particularly important for women • compensates for lost or declining income from agriculture or wage employment • seasonal income • occasional liquidation for large expenditures e.g., dowry	• growing demand in nearby markets will result in gathering activities becoming more specialised operations undertaken by wealthy and educated members of community, who are likely to restrict resource access

Adapted from Arnold (1999)

Table 2.4 Issues summary: Rural livelihoods and carbon management in relation to currently accepted SFM criteria

Common elements of SFM standards	Issues related to rural livelihoods (RLs)	Issues in relation to carbon offsets
Framework conditions		
Compliance with legislation and regulation	• Forest use aspects of RLs 'invisible' to policy and 'illegal' in relation to laws	• Land use legislation has not evolved to handle carbon offsets as yet
Securing tenure and use rights	• Custom, more common than codified, registered tenure – if latter emphasised, poor groups marginalised	• *Potential* clashes between long-term tenure of carbon and local needs for multiple, and changing use
Commitment to sustainable forest management	• Commitment is within custom or community rules rather than formal plans or codes • Link between sustainable development and SFM needs to be explored/clarified	• Projects required to contribute to sustainable development • Need for explicit linkages between Forestry Stewardship Council (FSC), Intergovernmental Forum on Forests (IFF) and other international SFM processes, and climate change policy
Sustained and optimal production of forest products		
Sustained yield of forest products	• Many products are sought • Need to control 'big' groups e.g., loggers	• Potential for additional carbon revenue to meet incremental costs of SFM
Management planning	• Informal; lack of capacity – but effective Common Property Regimes (CPRs) often best bet	• Will require improved planning
Monitoring the effects of management	• Few formal systems to do this • Forest certification misses many livelihood impacts	• Another layer of certification required by CDM (see page 45) terms in Kyoto Protocol
Protection of the forest from illegal activities	• Effective CPRs often best bet	• Requires strong assurance of this

Optimising benefits from the forest	• Need short-term options kept open in light of vulnerability of other parts of livelihood	• Lacking information on optimum mix with carbon • Who decides 'optimum'?
Protection of the environment		
Environmental impact assessment (EIA)	• External interests have dominated EIA	• Should be integral to project design
Conservation of biodiversity	• Win-wins if local biodiversity emphasised • Clashes if global bioquality emphasised	• Potential win-wins (and payments) in protected areas • Potential losses if emphasis on plantations
Ecological sustainability	• Need better understanding of sustainability of mixed land use	• Ecological sustainability characterised by a full valuation of all goods and services provided by forests and trees
Waste and chemicals management	• Not normally relevant	• Best-practice needed with plantations
Well-being of people		
Consultation and participation processes	• Build on traditional systems e.g., CPRs • Often need NGO brokers	• Build on processes that work • Use 4Rs (see page 16) approach to understand/negotiate
Social impact assessment	• CPRs and community rules	• Should be integral to project design and management plan
Recognition of rights and culture	• Good internally, although elites may dominate	• Essential – between groups
Relations with employees	• Understand employees' other livelihood needs	• Social audit needed
Contribution to development	• Integral to livelihood development	• SD criteria needed

2.3 Brief lessons on successful forest/livelihood interactions

Some useful lessons may be learned from a wealth of forestry and rural development experience. Indeed, for every carbon offset project type, there is much analogous experience of what makes for good livelihoods (Table 2.5).

The legal basis of forest and land use is significant, often imposing restrictions on the kinds of use which can be made, and who can undertake such uses. A number of factors can help to achieve equitable, collaborative arrangements, which could apply to individual carbon offsets in any kind of property regime:

- *Rights, Responsibilities, Returns (revenues, rewards, etc.) and Relationships*–The 4Rs is a useful framework for analysing and negotiating different roles in collaborative approaches. This framework can be used to gain a basic idea of power issues and then the right balance of the 4Rs can become an objective of the negotiation (Dubois, 1998).

- *Securing rights* of access to resources is important; unless rights and boundaries are resolved, disputes can escalate (ODA, 1996).

- *A management agreement* that reflects stakeholder values, as well as the 4Rs is essential; the process of developing this should involve a coalition of interested stakeholders (ODA, 1996).

- The *form of land tenure* is critical for determining collaborative mechanisms. In practice, they can take place on: 1) state land (handed over to legally-constituted user group; management shared by the state and user group; access rights allowed e.g., to protected area/buffer zone; or leased to user group); 2) open access land e.g., uncultivated state land or village land (in practice, few places are truly open access); 3) community/customarily owned land; or 4) private land (Carter, 1999).

- *Stakeholder* analysis is crucial – not just of the large group, but of sub-groups who will have different livelihood assets and activities (Higman *et al.* 1999).

- *Rural people's organisations* and NGOs can be important brokers and organisers – otherwise there will be a consequent 'umpiring' task, of which the State may not be capable (Carter, 1999).

Table 2.5 Examples of types of rural development and forestry projects that make for good livelihoods for three types of carbon offset projects

Carbon project type	Look for 'forestry/rural development that works' in...
Carbon conservation	• 'People and protected areas' projects • Agricultural intensification • Rotational shifting cultivation • Community fire control schemes • Home gardens • NTFP production • Eco-tourism
Carbon sequestration	• Community/farm/outgrower plantations • Forest rehabilitation or restoration • Agroforestry
Carbon substitution	• Community fuelwood • Community farm fuelwood • Charcoal production

- *Successful common property resource institutions* can help in achieving sustainable forest-livelihood relations where private property regimes are not the norm (Shepherd, 1999); their ingredients could be incorporated in carbon offsets (See Table 2.6).

2.3.1 Carbon conservation in protected areas must learn from the 'people and parks' experience

Protected areas approaches to carbon offsets are likely to prove more problematic in social terms than plantations and agroforestry. Any protected area approach has to learn from the recent history of approaches to integrating livelihoods concerns with protected areas. A spectrum can be observed (Brown, 1998, Bass *et al*. 1999). This spectrum reflects historical developments towards a more considered approach to livelihoods:

'Exclusion of people' was common during the 1960's-1980's boom in establishing national parks, in which the imperative was to exclude consumptive land use. External values predominated and local people's perceptions of any 'exclusion zone's' legitimacy were not considered important.

Table 2.6 Guidelines for successful common property resource institutions

Clearly defined boundaries for user group and resource
Those with membership of the group with use rights are clearly defined, as is the boundary of the resource itself.

Use rules and resource system tolerance
Use rules must correspond to what the resource can tolerate, and should be environmentally conservative to allow a margin of error.
Use rules need to be clear and easily enforceable.

The right to modify rules
Users must have the right to modify their use rules over time (within certain limits?)

Monitoring and Infractions
Those in charge of monitoring CPR conditions and user behaviour are among the users, or are accountable to them.
Infractions of use rules must be monitored and punished.

Distribution rules
Distribution of decision-making rights and use-rights to co-owners of the commons need not be egalitarian, but must be viewed as 'fair'.

Conflict-resolution mechanisms
Inexpensive and rapid means of resolving minor conflicts need to be devised.

Recognition of the right to organise
User groups need the right to organise their activities, or at least a guarantee of no interference.

Larger systems
Institutions for managing very large systems need to be layered, with considerable authority devolved to small components.

Shepherd 1999 (based on E. Ostrom, 1990, and McKean, M.A. and Ostrom, E. 1995.)

'*Exclusion plus alternative income*' involved the promotion of enterprise 'packages' such as game farming and poultry rearing, usually in 'buffer zones'. Invariably this was not based on an understanding of the livelihoods and motivation of the people who had been excluded. It assumed local acceptability of certain arbitrary activities; the 'packages' were not really market- or livelihood-led, but they were quick and easy for the projects to promote to local people. It met with non-participation or hostility.

'Exclusion plus compensatory payments' tended to underestimate the rather periodic but highly significant 'safety net' value of forest biodiversity. Yet developing country governments were not able to pay adequate compensation on a regular basis, and mechanisms for sharing benefits locally were often inequitable.

'Exclusion plus logging outside the protected area' has been attempted, with a few examples of (outside-supported) sustainable community logging approaches. This is based on the recognition that there is a real forest economy in which communities might participate, but it has proven difficult for community groups to compete with the major logging companies.

'Tourism within protected areas' has more recently been promoted as an attractive strategy, again because there is potentially a real market in which local people can participate, and more especially because the non-consumptive nature of tourism is not in apparent conflict with forest protection. Local people may be employed, or be entrepreneurs themselves, or receive a distribution of tourism revenue. Again, there are problems – notably the uncertainties of the 'ecotourism' market (many tropical forest areas are now potentially competing for an elusive market), the social impacts of (wealthy, foreign) tourists, the difficulties of raising capital and securing skills, and the high proportion of revenues that leave the forest area.

An emerging 'livelihoods approach' is building on lessons from the above, and from a recognition that forest-based livelihoods tend to be multiple in nature, rather than tied to any one market or subsistence product. Furthermore, those local forest management regimes that are biologically diverse – or carbon-rich – persist precisely because of their contribution to local livelihoods and local economies (i.e. not necessarily timber, tourism or carbon markets which are driven from elsewhere). Hence there is finally an appreciation that local people can be stewards of forests, rather than destroyers. However, the acts of some 'participation zealots' may have caused the pendulum to swing too far – with their assumptions that local people are always excellent stewards, irrespective of outside influences and the requirement for effective rights and responsibilities, checks and balances.

2.3.2 Carbon sequestration in plantations and agroforestry must learn from the experiences of participatory forest management

This experience also bears out the importance of understanding and negotiating the '4Rs', above. In addition (Dubois, 1998; Bass *et al.* 1999; ODA, 1996):

1. An agreement between plantation proponents and communities is not a once-for-all affair, but needs to be *kept under review*, depending upon outcomes and changing livelihood needs which have to maintain a relatively short-term view. Collaboration does not always mean full consensus; and capabilities for conflict management are needed.

2. *Misunderstandings about the level and type of participation* are common. Matching the degree and type of participation to local demands, and ensuring full transparency, are more important than 'full' (expensive) participation.

3. It is important *not to move faster than stakeholders' representatives can consult* with their constituencies.

4. The *process of collaboration* on big forestry projects can itself promote better stakeholder relations, improve local capacities, and help to revitalise stale policy processes and government authorities, but it can also be divisive if not handled well.

5. Transparent and efficient mechanisms for *cost/benefit-sharing*, and for ensuring tangible benefit flows, are crucial. There are no universal mechanisms for this which work. There is a current research agenda to identify these today; successes seem to come from traditional practice and that of the more progressive rural development banks.

6. *Successful participation does not focus on one production system alone.* For example, partnerships between South African forestry companies and local communities cover: 'outgrowing' wood on farms, for a guaranteed price, using inputs supplied by the company and land provided by the farmer; land sharing (with community rules to protect the company's forest resource); access agreements on company land for grazing and firewood; joint ventures in wood and fruit production; and communities sharing equity within the company (Clarke and Foy, 1997).

7. Agreed *indicators* of success, and participatory monitoring of these indicators, appear to be important.

8. However, experience so far also reveals that some *negative attributes* are all too common. It is too easy for project protagonists to assume that (certain aspects of forestry and) forests are a priority to local groups, rather than to find out the real local values are (2.2.3). For example, food production within forests may be the most important forest value, but partnerships that stress, for example, carbon or biodiversity may displace this. Furthermore, disadvantaged groups are rarely the immediate beneficiaries of partnerships, as opposed to middle-income groups (since secure tenure to land and some proven capacity and power are often needed to join partnerships). Whilst there are certain 'win-win' opportunities, they become exhausted, after which conflicts amongst stakeholders become apparent. However, means to resolve them are not always available. Finally, there are dangers that costs and risks are passed unduly from government bodies, or corporations, to local stakeholders under the guise of 'collaborative' approaches.

2.4 Summary of factors that lead to sustainable livelihoods and forests

The previous few pages suggest that the key factors that lead to both sustainable land use and sustainable livelihoods are:

- local people's access
- local capabilities
- cost/benefit-sharing mechanisms
- strong, equitable, legally-recognised community organisations
- policy that recognises and supports the above

2.4.1 Local people's access

- to forest resources (equitable, secure and transferable) for multiple benefits
- to land (it is not just forest goods and services that people need)
- to information on markets, technology, rights and any form of possible change
- to policy processes and claim-making fora (to influence them)
- to finance and markets (for commercial activities)
- to alternative means of livelihood if access to forests is denied

2.4.2 Local capabilities

- to negotiate (regarding all the other factors)
- to develop (community) rules
- to resolve disputes
- to undertake SFM

2.4.3 Cost/benefit-sharing

- access and management agreements between the community and government/private sector (outgrowers, etc.)
- cost/benefit-sharing within the community
- compensation mechanisms where cost-benefit is out of balance
- community internal rules to deal with shared private benefits and access to community resources

2.4.4 Strong, equitable, legally-recognised community organisations

Securing the right balance between different people and different forest management purposes requires strong community organisations. Where these do not exist, there will be considerable transaction costs in setting them up. The community itself, or component (resource user) groups, require legal recognition, especially with regard to the following:

- rights to enter contracts
- rights of resource tenure/transferability
- common property resource management institutions

2.4.5 Policy that recognises and supports the above

- forestry and land use policy, rules, incentives and C&I that recognise the potential of *local* land use systems to secure forest goods and services
- policy that encourages and enables local rights, responsibilities, returns and relationships so that local groups can be effective forest stewards
- policy that enables partnerships between communities and other groups, and secures transparency and equity within them
- policy that does not assume only positive relations between forests and people, or 'community' 'interest' in forestry, but supports consultation and participation
- policy that reduces the level of shock in rural systems

The above factors will be picked up in Section 6, where we propose carbon offset mechanisms that work.

3 Offsetting carbon through land use and forestry activities – strategies, potentials and livelihood issues

Summary: This section expands on the overview of terrestrial management strategies presented in Section 1. Quantitative estimates of the global potential for each strategy are presented, and the main categories of land use activities falling under each strategy are then described. Attention is given to the key carbon-livelihood interactions and relevant experiences from current carbon offset projects. Under 'carbon conservation' strategies, activities discussed include: expansion of protected areas, fire control, reduced impact logging and improved forest management, and soil conservation. Under 'carbon sequestration' strategies, activities discussed include: plantation establishment, restoration of natural forest and agroforestry. Under 'carbon substitution' strategies, activities discussed include: fuel wood management and bioenergy.

3.1 Carbon conservation strategies

3.1.1 Global potential

The potential for terrestrial management strategies designed to conserve existing carbon sinks is most clearly illustrated by global deforestation rates, estimated during the 1980's and early 1990's at between 13.9 and 20.4 million hectares yr^{-1} (see Table 3.1).[9] The associated emissions of CO_2 from tropical forest conversion to other land uses such as pasture and agriculture are estimated to be 1.6 ± 1.0 GtC yr^{-1} between 1980 and 1989 (Houghton 1996).

9 Note that these figures are dependent on the classification of forests used (FAO 1996, Cannell 1995 and Houghton 1996) and may be under-estimated due to the limitations of satellite remote-sensing techniques.

Table 3.1 Estimated forest cover and deforestation rates at regional and global levels based on 1990 and 1995 satellite data

	Forest cover at 1990 (Mha)	Forest cover at 1995 (Mha)	Deforestation rate 1980 to 1995 (Mha yr^{-1})	Deforestation rate 1980 to 1995 (%)
Tropical Africa	523.38	504.9	3.70	0.7
Tropical Asia	295.04	279.77	3.06	1.1
Tropical Oceania	42.66	41.90	0.15	0.4
Tropical and subtropical North and Central America	84.63	79.44	1.04	1.3
Tropical South America	851.22	827.95	4.66	0.6
Total tropical	1,796.93	1,733.96	12.59	0.7
Worldwide	3,510.73	3,454.38	11.27	0.3

Source: FAO (1996)

In 1996, emissions from Brazilian Amazonia alone were estimated at 0.3 GtC yr^{-1} for 1996, associated with a deforestation rate of 1.81 million hectares yr^{-1} (Nepstad *et al.* 1999). However, it is estimated that logging activities damage a further 0.97 to 1.51 million hectares yr^{-1} and that there may also be significant additional areas damaged by surface fires. These areas of impoverishment or 'cryptic deforestation' are not normally accounted for using satellite-based forest monitoring techniques, and have the potential to double the estimated net annual carbon release for the Brazilian Amazonia. Based on this revised estimate, carbon emissions from the region may account for a full 10% of the net carbon emissions stemming from human activities world-wide.

Considerable attention has focused on the loss of mature tropical humid forests because this category represents the largest stock of terrestrial carbon in the tropics, with a mean carbon content of around 150 tC ha^{-1} (derived from Brown and Lugo, 1982). However, there is considerable variation due to climatic and edaphic factors, as well as human disturbance. Some undisturbed tropical forests – in this case, oak and evergreen cloud forests in southern Mexico – have been found to contain up to 800 tC ha^{-1} including root and soil carbon (de Jong and Cairns, 1999). Conversely, many forests in areas accessible to human populations have lower biomass due to historical trends of extraction and periodic burning. Brown *et al.* (1991) reported that >60% of inventoried forests in south and south-east Asia[10] had an above-ground biomass of less than 250 t ha^{1} (above ground carbon <125 tC ha^{-1}), with a mean of 225 t ha^{-1}.

Although the biomass carbon pool has received most attention in terms of management strategies to mitigate climate change, it has been estimated that there is 1.5 – 3 times as much carbon in soils as in terrestrial vegetation, with 34% of this being in forest soils (Dixon *et al.* 1991). Inevitably therefore, soil management practices are receiving increasing attention, particularly in an agricultural context. Similarly, the potential for reducing necromass carbon loss, particularly in boreal forests, is being explored (e.g., Dixon and Krankina 1993).

3.1.2 Expansion of protected areas

Remaining primary forests, both tropical and temperate, represent vast pools of stored carbon. As a large proportion of such forests are threatened with conversion to other land uses that have substantially lower value as carbon sinks, the avoidance and mitigation of carbon releases from these pools through

10 The study synthesised forest inventory data from 22 x 10^6 ha of: Bangladesh, Burma, Cambodia, India, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam.

conservation activities provides the quickest, forestry-based opportunity to slow the rate of accumulation of carbon dioxide in the atmosphere (Thailand Environment Institute 1995). Conservation of forests plays a double role in relation to carbon sinks. Firstly, it prevents the emission of carbon that would be caused by the decomposition of the forest biomass following conversion. Secondly, it prevents the reduction in land areas with potential for active carbon sequestration.

The Food and Agriculture Organisation of the United Nations (FAO) (1999) estimate that out of a total world-wide forest resource of 3,221 million hectares, 290 million hectares are theoretically unavailable for wood supply as a result of legal or political protection (see also Table 3.2.). There is also a continuing trend for new areas of tropical forest to be designated as protected areas. In recent years Cambodia, Sri Lanka, the Philippines and Thailand have all either banned or severely restricted the harvest of timber in primary forests. In April 1998, Brazil also announced an intention to put 25 million hectares of rain forest under protected area status (FAO 1999).

Table 3.2 Areas of protected forest (all forests, including non-tropical) in tropical regions, 1996 data

Region	Forest area (Mha)	Protected forest area (Mha)	Percentage of forest protected
Africa	568.31	49.69	8.7
Australasia	149.32	12.58	8.4
Caribbean	5.38	0.79	14.7
Central America	90.19	8.81	9.8
Continental S and SE Asia	170.76	19.24	11.3
Far East	145.60	7.74	5.3
South America	842.94	87.49	10.4
Total	**1,972.53**	**186.35**	**9.8**

Source: WCMC (1999)

However, forests protected 'on paper' often differ markedly from on-the-ground realities. Protected areas are often poorly enforced due to a chronic lack of resources in the necessary institutional, monitoring, and enforcement capacity. Furthermore, government policies can also perversely induce pressure on standing forests by specifically encouraging forest utilisation. In this light, some countries view forest conservation motivated by developed world interests as patrimonial and an affront against a nation's sovereignty.

In this ambiguous context, some of the largest of the forestry offset projects developed during the UN Programme for Activities Implemented Jointly (see section 4) have focused on protecting carbon stocks by expanding protected forest areas (e.g., the Noel Kempff and Rio Bravo projects). The effectiveness of such a strategy as a means of generating genuine carbon benefits with minimal adverse social impacts depends to a large extent on the underlying social and economic drivers of land use change and forest exploitation. Three such drivers – land speculation, timber extraction, subsistence livelihoods – are considered here.

Where forest conversion is driven by land speculation, as occurs in large areas of the Amazon basin (Fearnside, 1999), the main actors are medium- to large-scale landowners. In such cases, the establishment of legal reserves is an ineffective measure against clearance for conversion to ranch land; neither are commercial farmers likely to be interested in the 'participatory conservation package' offered by most conservation NGOs; nor would the option of offering large farmers 'compensatory payments' in order not to deforest appear to be either politically or ethically acceptable (and is anyway almost certainly impractical). In such contexts, measures aimed at reducing the profitability of timber from land clearance, associated with incentives for less unsustainable logging practices, are likely to be more successful. Indeed, it is difficult to envisage how a discrete carbon conservation project could be successful, let alone have additional livelihood benefits for the rural poor.

Where forests are being exploited for timber – as in the case of the Noel Kempff Mercado project – the establishment of new conservation areas runs the risk of shifting demand for timber to other forest areas, thereby neutralising any carbon benefits. However, assuming that such 'leakage' problems (see Appendix 1) can be managed or factored into the net carbon conservation estimate, the problem of reduced local income from timber could remain a serious problem. If local communities are currently exploiting timber by their own means, this will imply a direct opportunity cost. If people from the region are employed by logging companies, this may cause local unemployment. The Noel Kempff project has acknowledged the probable impact of their new conservation area and has initiated a socio-economic component, designed to offer employment opportunities in park protection services or in developing agricultural or farm forestry activities to ex-employees of the logging concessionaire.

Where forest conversion is driven by demand for land by small/landless farmers/colonists, either for subsistence cultivation or mixed cash/subsistence livelihoods the expansion of strictly enforced conservation areas may directly reduce the natural capital available to the rural poor. However, there may often be a reasonable case for establishing protected/restricted use zones for watershed/soil protection and the long-term provision of certain forest products. Such zones could also generate carbon benefits.

If the establishment of forest reserves does impose opportunity costs on small farmers (even if it is a sub-group of the wider local population) it may be reasonable to expect some form of compensatory activity or payment to be offered. There are numerous examples of conservation organisations that have faced this type of problem. A common approach is to try to develop 'alternative livelihoods' based on apiculture, horticulture, small animal husbandry and sustainable extraction of non-timber forest products (NTFPs) from 'buffer areas'. These new livelihood options are often delivered in a package that includes a strong element of 'environmental education', and assistance to local organisations to develop support services such as eco-tourism agencies, small-animal vets, health advice and the commercialisation of handicrafts and other local products. Since many of these so called 'Integrated Conservation and Development Projects (ICDPs)' were initiated in the 1980's it is rather early to assess their success. While some observers have criticised the ICDP concept as outsider led and based on wishful thinking (Peters, 1998), there would seem to be genuine opportunities for combining conservation with improved farming systems, provided the planning framework takes reasonable account of future growth in the demand for land, and that the scale, access to and decisions regarding the status of protected areas have been agreed by consensus with those most affected.

Similarly, where local communities use forests for a variety of purposes – grazing animals, firewood gathering, timber for construction, leaf-mulch, ornamental and ceremonial plants, etc. – there may be direct conflict between local interests and any proposal to establish strict conservation areas. However, it should be noted that even in fairly densely populated areas, such as the central highlands of southern Mexico some communities have developed successful internal mechanisms for regulating forest use in a way that appears to be compatible with sustained forest cover (even if the forest composition is far from what would be considered as natural) (Konstant, 1997; Hellier 1996). Such practices may vary considerably from community to community within the same region and there may be considerable socio-economic and carbon benefits derived from efforts to disseminate and improve on 'best local practice'.

Two further caveats to the use of expanded protected areas should be noted. Firstly, their effectiveness in terms of reducing deforestation rates and emissions of carbon should be carefully considered on a site-by-site basis. A study of the Sarapiqui region of Costa Rica used satellite remote sensing to estimate rates of deforestation and forest fragmentation within and outside protected areas (Sanchez-Azofeifa *et al.* 1999). In protected areas the deforestation rate declined from 0.6% yr^{-1} between 1976 and 1986, to 0.2% yr^{-1} between 1991 and 1995. For the same time periods the rate outside the protected areas declined from 3.6 to 3.2% yr^{-1}.

Secondly, due to the complexity of land use drivers discussed above, direct conservation interventions can often be complemented by or integrated with indirect activities such as increasing agricultural productivity (thus lowering the need for cyclical slash and burn cropping[11]), the development of agroforestry to meet fuelwood needs, the opening of markets for indigenous forest products (thus improving the economic viability of sustainable forest management), and the promotion of wood waste and paper recycling.

3.1.3 Fire control

Tropical moist forests were once thought to be fairly resistant to fire because the humid conditions in the understorey made it difficult for fires to ignite, however, recent history has taught us otherwise. For example, during 1997 fire affected more than two million hectares of forest in both Brazil and Indonesia (FAO 1999). A forest's vulnerability to fire depends on past and prevailing weather conditions (e.g., drought related to El Niño events), but also on land use practices (past and current) and fire history (Nepstad *et al.* 1999).

11 However, it is worth noting that shifting cultivation is deemed to liberate less carbon over time than more permanent agricultural systems. Not all shifting cultivation systems result in a complete disappearance of forest-type habitats (see Table 2.3).

Disturbance that opens the canopy is likely to affect the rate at which the understorey and fuels dry, thereby increasing a forest's vulnerability to fire. As extreme weather events become more common (a predicted consequence of climate change), and as more forest is affected by either selective logging, fragmentation, or other forms of disturbance, it is likely that risks of forest loss to fires will increase.

The amount of carbon lost from a forest that is burned depends on the forest (e.g., fuel loads, flammability) and the fire (e.g., intensity). A number of studies have measured biomass loss and carbon emissions from forests that are burned. Graca *et al.* (1999) measured losses on burning of 37% of the above ground biomass of a tropical forest in Rondonia. Other studies from the Brazilian Amazon give a mean above ground biomass combustion of 46% for slashed primary forests, calculated to result in emissions of between 79 and 102 tC ha^{-1} (Guild *et al.* 1998). However, actual losses of carbon stocks per hectare are likely to depend to a large extent on the composition of the forest, the forest moisture regime at the time of burning, wind conditions, and humidity.

However, reduction of fire occurrence is not without difficulties. Slash and burn is the most rational means of forest clearance for agriculture in places where forest is plentiful and where farmers thus use practices that maximise return over the most limiting production factors, i.e. labour and capital. But fires are not always caused by shifting cultivators. Pasture rejuvenation and accidental fires account for a significant proportion of fires in the Amazon (Nepstad *et al.* 1999). There is therefore some potential for reducing carbon emissions by improving fire management measures. These could include increasing awareness and education, fire-monitoring and rapid-response fire fighting, necromass removals, creation of fire breaks (e.g., around logged areas), and the use of prescribed, controlled fire to reduce the occurrence of more widespread stand replacement fires. However, there are a number of technical points that need to be addressed before the carbon impacts of fire prevention can be properly assessed:

- the extent to which fire protection measures prevent deliberate forest incendiary;
- where forest fires are part of the natural ecological cycle, fire prevention measures may simply delay ignition until the biomass fuel load has reached a critical level; and

- where forest ecosystems are adapted to fire, fire prevention might have long-term negative effects on carbon storage (e.g., prohibiting tree regeneration) or biodiversity conservation.

Where fires affect production forests and agricultural systems there are clear synergies between carbon conservation and direct economic benefits – timber and crops with economic value that would otherwise be lost are now saved. However, the extent to which fire control benefits the rural poor depends also on whose land is currently affected.

3.1.4 Reduced impact logging and improved forest management

Approximately 15 million hectares of tropical forests are logged yearly throughout the world (Singh 1993), with the majority of logging operations in tropical countries considered to be unsustainable and damaging (Poore 1989). Improved forest harvesting techniques, also termed reduced impact logging (RIL), which reduce collateral damage to the residual stand, have been promoted as a way of reducing ecological damage caused by logging activity.[12] Biodiversity values can be maintained, fire risks can be lowered, and topsoil integrity can be maintained. Furthermore, forests can continue to provide economic potential through continued production of timber resources in an environmentally sustainable manner. Recently the FAO and CIFOR (Centre for International Forestry and Research) have produced guidelines on environmentally sound harvesting techniques including the FAO's 'Model Code of Forest Harvesting' published in 1996 (FAO 1999).

Widespread adoption of RIL is likely to take time however, due to the technical and planning complications it entails (e.g., the need to cut vines some months before harvesting), and the frequent lack of skilled manpower to implement some of its measures (e.g., road planning).

By avoiding unnecessary destruction of biomass and consequent carbon release, and by enhancing rates of post-logging forest regeneration, reduced impact logging techniques also have significant potential as a carbon offset technique (Marsh 1993). This potential is greatest in areas where high volumes of timber are extracted in each cutting cycle (e.g., Southeast Asia, parts of Amazonia), and/or where there is a risk of fire (as in much of the tropical

12 A variety of studies have highlighted the potential for reducing forest damage, for example, by careful selective logging in Costa Rica (Romero 1999), and through vine management in eastern Amazonia (Vidal *et al.* 1997).

forest zone). Furthermore, as approximately half of the eventual GHG gains are realised over the first few years and are basically irreversible, the risk of failure for carbon offset investments, and thus their attractiveness to investors, is substantially lower for RIL operations than for e.g., conservation-oriented projects.

The opportunities for generating carbon offsets from better managing forest exploitation were highlighted by the Innoprise-NEP Project in Sabah, Malaysia (Putz and Pinard 1993), for which it was estimated that the introduction of RIL techniques in a 1,400 ha pilot area would generate net carbon savings of around 40 tC ha^{-1} over a 40 year period (Pinard and Putz 1996).

The livelihood benefits of such technology developments are likely to depend to a large extent on the way in which resource rent from forest exploitation is distributed. In the case of the Sabah project, the principal benefits of the new techniques were jobs and training for workers within both the concessionaire's forestry division and the subcontractor, including forest rangers, casual labourers, technicians, chainsaw operators, bulldozer operators, and site managers. For forest areas exploited under concessions, there may be little in the way of direct benefit to local people other than through employment. But for community-based forests, local people may receive direct skills benefits as well as the economic benefit of sustained income from forestry. In addition, the long-term benefits of improved forest management are likely to be the sustained and increased flow of tax revenue from the timber production (that would otherwise be exhausted) and the environmental services provided by the maintenance of closed forest.

3.1.5 Soil conservation and agricultural practices

Ongoing depletion of soil productivity in both intensive and shifting agricultural systems has drawn attention to more sustainable soil management practices, often associated with smallholder or extensive farming systems. Ongoing research is suggesting that such practices including no-burn or low temperature burning, minimum tillage, use of natural fertilisers, mulching or other plant residue coverings can also provide carbon benefits (e.g., Dixon *et al.* 1991). Thus, although the carbon dynamics associated with the practice of, for example, slash and burn agriculture are not well understood, there is nevertheless strong evidence that slash and burn practices reduce soil carbon – particularly the fraction of carbon held in micro-aggregates.

While the measurement of changes in soil carbon is more challenging than the measurement of changes to above ground biomass, there is a strong case for encouraging practices such as non-burning and minimum tillage agriculture in many areas where swidden systems appear to be leading to a gradual decline in soil fertility and organic matter content.

A major difficulty with estimating the uptake or loss of carbon by soils results from the small annual increments of carbon that occur relative to the total stock. Estimation is further complicated by the high degree of spatial variability in carbon content, even within soils of the same type.

Recent estimates give a range for tropical forest soil carbon of 76 – 162 tC ha^{-1} to a depth of 100cm. Soil carbon is reported to account for between 36 – 60% of total above and below ground carbon, although at the top end of this estimate leaf litter, wood detritus and below ground biomass may also have been included (Malhi *et al.* 1999; Watson *et al.* 1995; Brown 1992).

These estimates clearly demonstrate the importance of soil in the net carbon budget of a forest and the potential for losses to occur from soils through deforestation and land use change. Soil carbon will decline as a result of deforestation and cultivation through erosion, mechanical removal of the top-soil and by increased oxidation. It is estimated that conversion of primary forest to cultivated land could lead to a soil carbon loss of 40%, in contrast to a 20% loss for conversion to pasture. Quantitative estimates for tropical shifting cultivation soil carbon are in the range of 31 – 76 tC ha^{-1} (Brown 1992). This contrasts with the stated tropical forest range of 76 – 162 tC ha^{-1}, but is better than the losses from more permanent farming systems. More research is required to quantify the effects of improved soil management in terms of carbon conservation.

3.2 Carbon sequestration strategies

3.2.1 Global potential

Carbon sequestration strategies are based primarily on the active absorption of CO_2 from the atmosphere through photosynthesis, and its subsequent storage in the biomass of growing trees (and plants). Unsurprisingly therefore, carbon sequestration has tended to be equated to tree planting, both in natural forest and plantation contexts. Although there are many more options than simply afforestation or reforestation (see subsequent sections), estimates of the global potential of carbon sequestration have taken as their starting point the area of land available for afforestation. However, these should be treated with some caution.

Dixon *et al.*(1993) draw a distinction between land that is 'technically suitable' by being edaphically and climatically suitable for supporting forest systems, and that which is 'socio-politically available' by being technically suitable and available for the establishment of forest and agroforestry systems given prevailing social, economic and political conditions. Factors such as the future demand for agricultural land, the suitability of soils and climates for forestry, logistical problems and biodiversity impacts are likely to mean that the practical and economically viable potential is a small fraction of the biological potential. Estimates of land *technically suitable* in the tropics range from 865 to 3,125 million hectares whereas estimates of *socio-politically available* land range from 300 to 462 million hectares for the tropics, and 570 million hectares globally.

Forestry and other land use systems vary considerably in their potential to sequester carbon. While fast growing species take up carbon at a faster rate, it is ultimately the long-term carbon storage capacity of biotic systems that determines their ability to offset emitted carbon. In calculating long-term carbon storage, a host of other parameters come into play including: rotation length; biomass ratios between stem, crown and root; wood density; harvesting frequency and intensity; the lifetimes of wood products, *et cetera*. As Table 3.3 shows, the result is that species considered 'slow-growing' in conventional forestry terms (annual growth of merchantable timber, by volume) may not be quite as slow in carbon terms. Whilst plantation species have higher annual carbon sequestration rates, natural forest systems tend to have considerably higher long-term capacities.

3.2.2 Plantations for timber production and carbon sequestration

In plantation-based carbon sequestration projects, investing companies and organisations are likely to view carbon-based incentives as a complementary addition to their primary source of revenue. The Face Foundation funded Profafor project is one example of a carbon initiative that aims to establish trees for both timber production and carbon sequestration.[13] Afforestation

[13] Other examples of tree planting activities for carbon sequestration can be found in Dixon *et al.* (1993), and Faeth *et al.* (1994).

Table 3.3 Examples of the carbon storage characteristics of a variety of forest systems

Type of system	Average net annual carbon accumulation rate (tC $ha^{-1}yr^{-1}$)	Average carbon stored (t ha^{-1}) in:	
		all living biomass and forest products	litter, dead wood and soil to 100cm
Heavily logged evergreen rainforest	2.4	144	92
Selectively logged evergreen rainforest	2.9	207	102
Heavily logged semi-evergreen rainforest	1.1	76	76
Selectively logged semi-evergreen rainforest	2.0	151	98
Pinus caribaea plantations in Brazil and Venezuela	5.1	89	90
Mixed deciduous forest in central Europe	1.4	110	105

Source: Watson *et al.* (1995)

using Australian eucalyptus, *Pinus radiata* and *Pinus patula* is targeted at areas in the Andes between 2,400 and 3,500 metres, above the altitude range for viable agriculture and livestock farming. However, there are substantial areas that have been deforested, which are now susceptible to erosion and subsequent landslides. While the project currently uses exotic species that are known to produce good quality timber, Face and the Ecuadorian Forest Service are hoping to replace these, during the second rotation (20 to 30 years), with selected native species. The project offers farmers a planting grant of around US$100 per hectare plus planting material. Small farmers are encouraged to participate in 'community groups'. Large individual landowners are not included in the programme.

The livelihood benefits of projects such as this appear to be considerable: farmers obtain a direct payment for the carbon; they are free to sell the timber produced from the plantations; and they also gain some protection from soil erosion. In this case the carbon resource rent is being used to provide the capital investment required to establish what will hopefully become a sustainable and economically viable land use system.

Despite the apparent, positive externalities of projects such as FACE-Profafor, plantation establishment and management is regarded as one of the more controversial carbon offset strategies for two main reasons. Firstly, some proposals by commercial forestry plantation concerns have been criticised on the grounds of 'free-riding': in other words, a carbon upside to their business-as-usual activities is being claimed with no 'additional' carbon benefit (see Section 4 for discussions of additionality). Secondly, there is a high perceived risk that large-scale afforestation projects will displace natural habitats, local agricultural systems and even natural forests.

Whether such concerns are over-stated remains to be seen. Proposals for large-scale plantings are likely to face scrutiny from both official and non-government bodies, and existing rules governing the environmental impact of land use changes may be used to limit the afforestation of environmentally sensitive areas. Moreover, conventional carbon accounting methods already clearly indicate that the conversion of natural forests to plantations is very unlikely to yield any carbon benefits (e.g., Harmon *et al.* 1990).

The impacts of plantation establishment on rural livelihoods are less clear cut, and will differ widely between cases. However, as mentioned above, planted forests generating carbon offsets will not differ significantly from traditional plantations: hence, research findings from community/farm/outgrower schemes are applicable in this context.

3.2.3 Restoration of natural forests

In a mature forest, most of the biomass is accounted for by a small number of large trees.[14] Forest biomass is therefore strongly dependent on the degree of disturbance. A forest can appear intact on a satellite image whilst disguising the fact that in many areas a large proportion of potentially productive forests are partially or severely degraded (Phillips 1997; Nepstad 1999). Since degraded

14 For example, Pinard (1995) reports that in natural Dipterocarp forest in Malaysia, trees >60cm dbh comprise around 60% of above-ground tree biomass at a stem density of just over 20 per hectare, compared with over 100 stems ha^{-1} for the 20-40 dbh class, and nearly 300 stems ha^{-1} for the 10-20 dbh class, etc..

forests also have a lower economic value, forest restoration appears to have the potential of sequestering carbon and increasing the stock of natural capital.

Several of the pilot carbon sequestration projects initiated over the past five years include forest restoration as a major element. The Face Foundation supports a number that aim to restore forests that have been severely degraded or lost due to pollution (Krokonose, Czech Republic), logging damage (Sabah Malaysia), and clearance for temporary agricultural use (Mt. Elgon and Kibale, Uganda). The Malaysian project, for example, uses enrichment line planting of commercially-viable Dipterocarp species to enhance the restoration of heavily logged-over forests (Moura Costa *et al*. 1994a, b). The Scolel Té project in southern Mexico also incorporates restoration activities, in this case of degraded and semi-degraded pine-oak forests, mostly on communal land. This requires wide agreements on land use planning by the community over which areas should be prioritised for common grazing and which areas for forestry. Some areas earmarked for forestry may contain sufficient seed stock to allow regeneration, once browsing has been eliminated, whilst other areas may require re-planting. Communities are encouraged to develop their own plans for restoration, with details of the inputs required and the rights and responsibilities of the main stakeholders.

Most restoration projects appear to have the potential to provide both socio-economic and carbon benefits, particularly if the forest being restored will have direct use value to the local communities. However, there could be some conflict between stakeholders that wish to use the land for other purposes – particularly agriculture, and those who propose to re-establish forests. A further question to be addressed is the trade-off between long-term carbon storage and the extraction of products from the forest. Forests managed at an economic rotation length will generally have a lower carbon storage than forests that are left undisturbed or managed with long rotations.

As a footnote, although carbon sequestration is often discussed in the context of establishing new forests or restoring degraded ones, improving the growth rates of existing forests could also be a viable carbon management strategy in some situations, through silvicultural treatments such as thinning,[15] liberation treatments, weeding, or fertilisation (Hoen and Solberg 1994).

15 Thinning is sometimes a contested operation, as it deprives the forest from species that might have a potential market in the future.

3.2.4 Agroforestry

The term agroforestry covers a variety of land-use systems combining forestry with agriculture or range management, where there is significant interaction (sometimes negative, sometimes positive) between the woody perennials/trees and annual crops or animals. Agroforestry systems are often used for the purposes of making more effective use of scarce land, labour, water and nutrient resources. In many areas of the tropics there would also appear to be significant potential for increasing the carbon density of existing agricultural and pasture systems, while increasing economic productivity.

There are several examples of carbon sequestration project proposals based on agroforestry, of which the Scolel Té project in southern Mexico has developed the most complete model to date. Indigenous maize and coffee farmers in the moist tropical zone of northern Chiapas are trained and assisted to produce farm-scale plans that include agroforestry systems and small plantations. The most common systems chosen are 'improved fallows' – where tree species are planted and left to grow during the fallow phase of the maize production cycle; and *taungya* – where maize and beans are cultivated between rows of trees during the early phases of plantation establishment. Other systems include the production of timber trees within coffee plantations, home-gardens and wind-breaks. The long-term increase in carbon storage potential of these systems varies considerably depending on the density and type of trees grown, from about 40 tC ha^{-1} for systems sparsely populated with trees, to 150 tC ha^{-1} for the most popular *taungya* systems. Individual farmer's plans are bundled in groups and assessed for carbon sequestration potential before financial and technical assistance is offered. Farmers receive 60 – 80% of the total resource rent ($ 10 US tC^{-1}) in stages over the first rotation. The remaining 20 – 40% is used for monitoring, technical advice, training and administration.

The livelihood benefits of well planned agroforestry projects may be considerable, leading to improved economic returns to farming and a diversification of products. However, it is important to recognise that the combination of crops, animals and trees generally involves some trade-offs between the output of particular products. In the case of the Scolel Té project one of the most important considerations is the labour saved by combining the weeding and fertilisation of crops and trees. A further advantage of agroforestry systems and small-scale farm forestry is that since these technologies are generally under the control of farmers, there are fewer risks of engendering conflict between rural stakeholders (unless rural labourers lose employment as a result of changes to the agricultural system). Farmers will simply reject the technology if it doesn't work for them.

However, agroforestry systems also carry certain disadvantages for the investing entity. Foremost of these are the transaction costs associated with involving and managing large numbers of small family-run rural enterprises, particularly with regards to the various measurement, monitoring, verification, and reporting requirements of carbon offset projects. ICRAF, amongst others, is exploring ways in which such requirements could be 'piggy-backed' onto existing schemes for which record-keeping procedures are already implemented (Simons *et al.* 1998). Other disadvantages for the investor centre on the uncertainties and risks inherent in flexible (and often unpredictable) land use systems. However, new carbon accounting methodologies (see Appendix 1) may provide ways of deriving carbon benefits from changing land use management, as and when such benefits arise.

3.3 Carbon substitution strategies

3.3.1 Global potential

Carbon substitution comprises two main strategies: fuelwood can be used to replace fossil fuels as a source of energy or heat (*direct substitution*); and wood-based materials can be used to replace materials such as steel or cement that require high levels of energy and/or fossil fuels for their production (*indirect substitution*). In both cases, carbon savings are derived from storing carbon in unburnt fossil fuels, as long as there is a net, system-wide energy return (IPCC 1996).

As research on the complex accounting systems needed to quantify these carbon benefits is ongoing, no detailed quantitative estimates are available of carbon substitution strategies' global potential. However, there is a wealth of proxy evidence that suggests a range of opportunities. For example, it has been estimated that around half the total amount of wood harvested annually worldwide is used for fuel, and that about 90% of this total is harvested and consumed in developing countries (Kersten *et al.* 1998, FAO 1999). Moreover, demand for woodfuel is likely to rise by more than 1% per year. Effective management of the sourcing of this fuelwood demand, as well as the demand itself, may have great scope to generate carbon benefits.

Worldwide, current total biomass use for energy comprises about 50 EJ (Giga Giga Joule) *per annum*, equivalent to about 12% of all primary energy consumption (IEA 1998). Table 3.4 provides a range of estimates as to how this might grow in the future, accounting for both expanded use of energy crops, as well as greater use of biomass residues from forestry, agriculture, downstream processing industries, and municipal solid waste (estimated at a maximum potential 162 EJ *per annum*). Again, under appropriate management systems, there is potential for bioenergy to play a significant part in decoupling ever-rising energy demands from rising GHG emissions.

Table 3.4 Estimates of the role of biomass in future global energy use (in EJ)

Scenario	2025	2050	2100
Shell (1996)	85	200–220	–
IPCC (1996)	72	280	320
Greenpeace (1993)	114	181	–
Johansson *et al.* (1993)	145	206	–
WEC (1993)	59	94–157	132–215
Dessus *et al.* (1992)	135	–	–
Lashof & Tirpak (1991)	130	215	–

Source: Hall and Scrase (1998), reproduced in IEA (1998)

3.3.2 Fuelwood management

In some African countries, biofuels (fuelwood, crop and wood residues and dung) account for up to 97% of total energy consumption, and estimates suggest that more than 90% of households in Africa use open fires (Kgathi and Zhou, 1995). Fuelwood and charcoal use on a regional basis, as a percentage of total energy consumption, has been estimated as 57% in Asia, 82% in Africa, 66.5% in Central America and 35% in South America (Sattar, 1996).

There is a common perception that farmers and rural communities are the main fuelwood users. For example, Sattar (1996) describes different fuelwood uses as 'rural industrial activities' that are usually confined to, or near to, villages. Fuelwood use is categorised as 'small scale cottage activities', 'medium scale village enterprises' and 'large scale rural industries'. The medium scale village enterprise category includes bakeries, breweries, restaurants, black-smiths, potteries, lime processing, road tarring and brick manufacture, and is estimated to account for more than 50% of fuelwood consumption. Large scale rural industries include the processing of cash crops and are estimated to consume a lower proportion of fuelwood, although many of these activities could equally be described as urban uses and there is evidence of a large amount of trade in fuelwood between rural and urban areas (Chomitz and Griffiths, 1997). Further evidence indicates increasing charcoal production in some rural areas, which, due to higher energy density, can be more efficiently transported to urban areas.

In general, further research is required to determine quantitative use and value of firewood and other biogenic fuels in rural livelihood systems. In many places there is strong evidence to suggest that the sources of firewood are unsustainable, such that the fuel is not 'carbon neutral'[16] but a net source of emissions to the atmosphere. This is particularly so where fuelwood demand has been identified as a driver of natural forest conversion. As a result, fuelwood management and the cultivation of biomass for fuel have the potential to make a non-sustainable economic activity viable in the long term, whilst also reducing carbon emissions.

Woodfuel management, however, is likely to be a complicated organisational task since it often involves multiple stakeholders with informal linkages between them, as well as a complex set of drivers which must be addressed in order to avoid systemic leakage, which would undermine the project's carbon benefits. Carbon offset projects in this field have therefore tended to comprise highly integrated land-use energy management strategies.

The most prominent example is an AIJ (see glossary, Box 4.1) sustainable energy management project spread across 250 villages in Burkina Faso, co-sponsored by the World Bank and the governments of Norway and Denmark. In a country where 91% of total energy demand is from fuelwood, with 90% of consumption in households, the project components are designed to address the unsustainability of both the supply- and demand-sides of fuelwood

16 A closed energy plantation-bioenergy plant system would exemplify carbon neutrality. Carbon is absorbed from the atmosphere as the trees grow, is released back to the atmosphere as the biomass is burnt, and then is reabsorbed in the next phase of tree growth, etc.. The net carbon budget of the system remains approximately zero.

through: the management of 300,000 hectares of community forests (enhancing existing carbon sinks as well as providing a host of other externalities); the promotion of efficient charcoal processing technologies; the introduction of solar photovoltaic (PV) systems for household lighting and water pumping systems; and efficient kerosene cooking stoves to displace the use of fuelwood (AIJ Project Report, World Bank). Local communities will be involved in direct charcoal processing and selling on local and national markets. The PV systems and kerosene stoves will be acquired and distributed and sold by local communities. Furthermore, direct payments will be made to local communities involved in forest management schemes. Initiated last year, the project's progress, including its effects on local livelihoods, was to be reviewed in September 1999.

3.3.3 Bioenergy

Modern bioenergy options offer significant, cost-effective and perpetual opportunities for moving towards GHG emission reduction targets whilst meeting growing demands for energy in various forms (predominantly electricity), as well as providing ancillary benefits (IEA 1998). Currently, the main sources of biofuels are residues from forestry and agriculture, although the use of energy plantations is expanding, opening up new opportunities for agriculture and forestry in the energy market.

The impacts of bioenergy projects (excluding fuelwood management – see above) on rural livelihoods are unclear. Positive externalities may include employment and additional income generation; negative effects may include changes in land use patterns which, depending on land tenure regimes on a site-by-site basis, may marginalise poorer or landless communities, as well as potentially undermine food production systems.

However, there is also substantial scope for integrating bioenergy strategies into conservation or sequestration-oriented carbon offset projects. The relative carbon gains from storing onsite carbon in forests versus harvesting forests for a sustainable flow of wood products will depend on site-specific factors including forest productivity, harvesting and processing efficiency, wood product lifetime, etc. (Marland and Schlamadinger 1995). One advantage of bioenergy forest management is that the use of the accumulated carbon in forests and wood products for biofuels alleviates the critical issue of maintaining the biotic stocks over a long time (IEA 1998). Enhanced use of perennial biomass crops (e.g., sugarcane) can provide the double dividend of sustainable energy and increased levels of soil carbon storage.

4

Carbon offsets – technical, policy, market and institutional aspects

Summary: In this section, an overview is given of the various different facets of carbon offsets generated by land use activities. In Section 4.1, three of the main technical aspects or requirements of projects whose intended output is carbon offsets are reviewed. These are: additionality and baselines; emissions externalities; and monitoring and verification. More detailed technical discussion can be found in Appendix 1. In Section 4.2, the notion of carbon offsets is placed in its policy context. The various incentives that have motivated carbon offset investments thus far are discussed. These are principally: institutional remit to provide global environmental benefits; GHG liabilities stemming from the climate change policy agenda; and PR/corporate responsibility. Climate change policy is then discussed in greater detail, tracing its evolution from the 1992 Framework Convention on Climate Change, through to the 1997 Kyoto Protocol, and the ongoing debate over the use of project-level mechanisms such as Joint Implementation (JI) and the Clean Development Mechanism (CDM). Within this discussion, particular attention is given to the potential role and eligibility of land use activities as a carbon offset option. This role is currently characterised by great uncertainty. The section ends with a review of how the market for carbon offsets has evolved with ever-increasing degrees of financial sophistication, and a brief consideration of the national policy frameworks being implemented to facilitate this market development.

4.1 Carbon offsets – technical aspects

4.1.1 Carbon offset terminology

Carbon offsets are the result of any activity specifically taken to remove carbon dioxide (CO_2) from the atmosphere, and/or to prevent the release of CO_2 into the atmosphere, in order to balance CO_2 emissions from elsewhere. A host of technical and non-technical terms have been used to describe carbon offsets.[17] For the purposes of this report, carbon offsets and carbon offset projects are used as generic terms covering all the different technical formulations (including the outputs of those projects not explicitly related to international climate change policy). Specific terminology is used only as and when appropriate. Box 4.1 provides a full glossary of relevant terms, principally those stemming from the Framework Convention on Climate Change (FCCC) and the Kyoto Protocol. These international agreements and the policy mechanisms they spawned are further discussed in Section 4.2.

It should also be noted that carbon offsets can be generated by GHG emission reduction projects in the energy, construction, commercial, transport, industrial and other sectors. However, in this context of this report, carbon offsets are assumed to be produced by land use activities, spanning the range of forestry, agroforestry, and agricultural activities discussed in Section 3.

4.1.2 Additionality and baselines

Carbon offsets are based on the difference in GHG emissions between projected or business-as-usual practices (known as the baseline or reference scenario) and practices occurring due to project activities (known as the project scenario). This behavioural difference in GHG gas emissions is called additionality. Additionality is a requirement to ensure that projects result in real reductions in the current rate of GHG accumulation in the atmosphere. Not all projects that might appear to have positive GHG effects are additional. For example, renaming existing national parks, whose forests existed prior to the emergence of carbon offsets, as 'carbon offsets projects' does not involve any active removal of CO_2 from the atmosphere. Conversely, establishing new forests with the primary objective of sequestering carbon might rightly be considered as generating additional carbon offsets.

For carbon offsets to be acceptable under the terms of the Kyoto Protocol, no project can claim GHG emission reductions unless project proponents can reasonably demonstrate that the project's practices are 'additional' to the 'business-as-usual' or baseline scenario. The baseline scenario is broadly described as the collective set of economic, financial, regulatory and political circumstances within which a particular project is implemented and will operate. The validity of any particular project rests upon the case made that environmental performance – in terms of achieving GHG reductions – exceeds

[17] For example, Emission Reduction Units (ERUs), Certified Emission Reductions (CERs), and carbon credits have been used synonymously with carbon offset. These terms describe the outputs of projects undertaken under various different policy initiatives over the past 10 years, from the early pre-UNCED voluntary schemes to the current Joint Implementation (JI) Programme and Clean Development Mechanism (CDM) defined by the Kyoto Protocol.

Box 4.1 A glossary of terms related to climate change mitigation projects

Since the early 1990's, a variety of terms have been used to refer to different project-level climate change mitigation mechanisms and their outputs. The meanings of these terms have changed gradually. Below are some of the definitions that have been used. Most bear some relation to stipulations of the UN Framework Convention on Climate Change (UNFCCC) signed in 1992, whose provisions are fleshed out by the Kyoto Protocol, signed in December 1997.

MECHANISMS (1)–EARLY PRE-KYOTO DEFINITIONS

Joint Implementation (JI)

The concept of joint implementation (JI) was introduced by Norway into pre-UNCED negotiations in 1991. This was reflected in Article 4.2(a) of the UNFCCC which gives Annex I countries (see below) the option of contributing to the Convention's objectives by implementing policies and measures jointly with other countries. The investing participants in these projects could presumably claim emission reduction 'credits' for the activities financed, and these credits could then be used to lower greenhouse gas (GHG) related liabilities (e.g., carbon taxes, emission caps) in their home countries.

Activities Implemented Jointly (AIJ)

In the first Conference of the Parties (CoP 1) to the UNFCCC held in 1995 in Berlin, developing country dissatisfaction with the JI model was voiced as a formal refusal of JI with crediting against objectives set by the Convention (see text for full discussion). Instead, a compromise was found in the form of a pilot phase, during which projects were called Activities Implemented Jointly (AIJ). During the AIJ Pilot Phase, projects were conducted with the objective of establishing protocols and experiences, but without allowing carbon credit transfer between developed and developing countries. The AIJ Pilot Phase is to be continued at least until the year 2000.

MECHANISMS (2)–POST-KYOTO DEFINITIONS

The Kyoto Protocol of the UNFCCC created three instruments, collectively known as the 'flexibility mechanisms', to facilitate accomplishment of the objectives of the Convention. A new terminology was adopted to refer to these mechanisms, as detailed below. Note that because of the Kyoto Protocol's distinction between projects carried out in the developed and developing world, some AIJ projects may be reclassified as CDM or JI projects.

Joint Implementation (JI)

Set out in Article 6 of the Protocol, JI refers to climate change mitigation projects implemented between two Annex 1 countries (see below). JI allows for the creation, acquisition and transfer of 'emission reduction units' or ERUs.

The Clean Development Mechanism (CDM)

The CDM was established by Article 12 of the Protocol and refers to climate change mitigation projects undertaken between Annex 1 countries and non-Annex 1 countries (see below). This new mechanism, whilst resembling JI, has important points of difference. In particular, project investments must contribute to the sustainable development of the non-Annex 1 host country, and must also be independently certified. This latter requirement gives rise to the term 'certified emissions reductions' or CERs, which describe the output of CDM projects, and which under the terms of Article 12 can be banked from the year 2000, eight years before the first commitment period (2008-2012).

QUELRO (Quantified Emission Limitation and Reduction Obligations) trading
Article 17 of the Protocol allows for emissions-capped Annex B countries to transfer among themselves portions of their assigned amounts (AAs) of GHG emissions. Under this mechanism, countries that emit less than they are allowed under the Protocol (their AAs) can sell surplus allowances to those countries that have surpassed their AAs. Such transfers do not necessarily have to be directly linked to emission reductions from specific projects.

WHICH COUNTRIES IN WHICH MECHANISMS?

Annex 1 countries
These are the 36 industrialised countries and economies in transition listed in Annex 1 of the UNFCCC. Their responsibilities under the Convention are various, and include a non-binding commitment to reducing their GHG emissions to 1990 levels by the year 2000.

Annex B countries
These are the emissions-capped industrialised countries and economies in transition listed in Annex B of the Kyoto Protocol. Legally-binding emission reduction obligations for Annex B countries range from an 8% decrease (e.g., EC) to a 10% increase (Iceland) on 1990 levels by the first commitment period of the Protocol, 2008–2012.

Annex 1 or Annex B?
In practice, Annex 1 of the Convention and Annex B of the Protocol are used almost interchangeably. However, strictly speaking, it is the Annex 1 countries which can invest in JI/CDM projects as well as host JI projects, and non-Annex 1 countries which can host CDM projects, even though it is the Annex B countries which have the emission reduction obligations under the Protocol. Note that Belarussia and Turkey are listed in Annex 1 but not Annex B; and that Croatia, Lichenstein, Monaco and Slovenia are listed in Annex B but not Annex 1.

PROJECT OUTPUTS

Carbon offsets – used in a variety of contexts, most commonly either to mean the output of carbon sequestration projects in the forestry sector, or more generally to refer to the output of any climate change mitigation project.

Carbon credits – as for carbon offsets, though with added connotations of (1) being used as 'credits' in companies' or countries' emission accounts to counter 'debits', i.e. emissions, and (2) being tradable with the emission permit trading system.

ERUs (emission reduction units) – the technical term for the output of JI projects, as defined by the Kyoto Protocol.

CERs (certified emission reductions) – the technical term for the output of CDM projects, as defined by the Kyoto Protocol.

historical precedents, legal requirements, likely future developments, or a combination of all three. Establishing the baseline scenario thus requires knowledge of long term trends in land use change in the project area, the local socio-economic context, macro-economic trends that may affect the conventional outputs of a project, and other relevant policy parameters (see Appendix 1 for further details on baseline methodologies). However, in setting the baseline, these past trends and current situations must be projected into the future. Consequently, baseline scenarios are necessarily counterfactual, based on a range of assumptions.[18] Baseline setting is a highly uncertain area, especially as innovative projects have often been key levers to change policy and law – they often arise in response to the regulatory and policy environment and are not separate from it.

Once the baseline is established, the project must demonstrate that it results in direct reductions in GHG emissions relative to the baseline.[19] Different measures have been used to this end, although emission reductions are often viewed as key. The specific measures that led to emission reductions must be identifiable and documented. The element of intent must be proven to ensure that projects with coincidental GHG reduction benefits are prevented from receiving carbon offsets. Documentation of barrier removal (additional costs, new technologies, risk mitigation) has also been used for demonstrating additionality. A project might demonstrate additionality through financial analyses proving that the creation of carbon offsets is likely to involve additional incurred costs compared with those of comparable baseline activities. In most cases, a GHG emission reduction project will either provide a lower rate of return, or will involve higher risk than is conventional to that type of investment within the sector.

Conventionally, carbon offset projects must also demonstrate financial additionality in relation to already committed developmental and environmental assistance funds.[20] This applies to country level Official Development Assistance transfers, funding mechanisms under the Framework Convention on Climate

18 Note that the subjectivity of baselines is common to all GHG mitigation projects, both in the forestry and industrial sectors. In the energy sector, for instance, determination of additionality of a project depends on assumptions such as that the introduction of new, cleaner technologies would not have happened under a business-as-usual scenario, and consequently deserve ERUs as compensation for these 'additional' effects of the project investment.

19 There may also be indirect impacts on emissions, known as leakage. This is covered in the next section on Externalities.

20 The first Conference of the Parties (CoP1) of the UN Framework Convention on Climate Change (UNFCCC) ruled that "the financing of AIJ shall be additional to the financial obligations of Parties included in Annex II to the Convention within the framework of the financial mechanism as well as to current official development assistance (ODA) flows."

Change, and the various multilateral development bank and development agency activities. If funds from these sources are already committed to potential GHG emission reduction activities, resulting carbon savings would not count as additional to the baseline. However, at this stage, it is possible that ODA-type funds can be used for project-supporting activities or mechanisms such as monitoring, planning, or other capacity building (see Section 6).

4.1.3 Project externalities: leakage and slippage

Carbon offset projects may result in a range of both positive and negative externalities, including socio-economic effects on employment and livelihoods and environmental effects on soils, water, and biodiversity. Of interest here, however, are those unwanted emissions-related externalities that may reduce a project's overall GHG benefits. These can be categorised as 'leakage' and 'slippage'.[21]

Slippage occurs when the GHG benefits from a project are partially negated by increased GHG emissions from similar processes in another area, for example, the displacement of logging activities due to a carbon offset project in forest conservation. *Leakage* occurs when a project's activities and outputs create incentives to increase GHG emissions from processes taking place elsewhere. These processes may or may not be directly associated with the project.

Neither slippage nor leakage necessarily disqualify a project as a valid offset, unless projected increases in external emissions are so substantial as to negate much of the projected GHG savings. If a significant amount of leakage and slippage is expected, the scope of the project scenario analysis should be widened to account for potential losses. The project's predicted GHG emission reductions can then be discounted accordingly. In many cases it should be possible to adjust the design and management of the project to minimise the effects of leakage.

Leakage is a particular concern in countries that lack reliable national carbon inventory systems or have no emissions cap. Under these circumstances there is potential for the effect of the project to be over-estimated. In emissions-capped countries, excess GHG emissions will, in theory, be passed from one sector of the economy to another and be picked up in the national inventory. As with the issue of additionality, the uncertainties and difficulties of predicting leakage and slippage are considerable, especially in countries with insignificant data and abilities to assess the linkages between different sectors and land uses.

21 For definitions, see Moura Costa *et al.* 2000.

4.1.4 Verification, monitoring and certification

Various policy mechanisms require that carbon offset projects are approved and verified by different entities, including both investor and host countries, as, for example, occurred in the AIJ Pilot Phase (see Box 4.1). In addition, the Kyoto Protocol requires that for future carbon offset projects in the developing world under the Clean Development Mechanism (CDM – see Section 4.2), further approval may be needed from the CDM institution itself as well as independent third party certification of the projects' GHG and developmental benefits. Both verification and certification will require internal monitoring regimes to be in place as part of the project management.

Experience of carbon offset project approval to date suggests project verification will need to ascertain the following (see also Box 4.2):

- the validity of the carbon claims of a project and the calculation procedures used for producing these claims;
- the quality of the data and the procedures used for data collection;
- whether the emission reductions or carbon sequestration are additional to the baseline scenario;
- whether the project conforms to the sustainable development objectives of the host country and local stakeholders in question;
- the effects of the project in relation to its sustainable development objectives.

4.1.5 Carbon accounting

At the crux of many of the technical requirements of carbon offset projects introduced in this section lies the need for robust methods for calculating the carbon benefits of project-level land use interventions. Simplistically, this involves turning the difference between the emissions baseline (Section 4.1.2) and the actual verified project scenario emissions (Section 4.1.4) – once leakage effects have been taken into account (Section 4.1.3) – into a value that forms the basis of a tradable carbon commodity.

The quantitative aspects of this process can be termed 'carbon accounting'. Thus far, no one single carbon accounting method has been agreed, and projects under the AIJ Phase have used a variety of different approaches. Details of some of these are given in Appendix 1, which deals with a range of the more technical issues introduced here.

In relation to rural livelihood needs, there is potential for new carbon accounting methodologies being proposed (e.g., Tipper and de Jong 1998;

Box 4.2 Germany's criteria for defining and approving carbon offset projects under the AIJ Phase

While each of the industrial country AIJ programmes has slightly different priorities, mostly they reflect similar goals and ideals. By way of example, the following criteria are taken from Germany's programme:

- projects should be compatible with and supportive of national and developmental priorities;
- activities require prior acceptance, approval and endorsement by both countries' governments;
- projects should bring about real, measurable and long term environmental benefits related to the mitigation of climate change;
- the financing of projects should be additional to the financial obligations of developed countries under the FCCC's financial mechanism as well as to current foreign aid;
- during the pilot phase, credits to commitments shall not accrue to any Party from AIJ initiatives;
- projects can be related to all GHGs covered by the FCCC or combinations of anthropogenic GHGs as well as the creation of reservoirs and sinks; projects should contribute to the low cost achievement of global ecological advantages; projects should be accompanied by appropriate scientific research and should be well documented.

Chomitz 1998; Moura Costa and Wilson 2000) to dovetail with the flexible and adaptive needs of rural land use strategies. For example, the 'tonne-year' approach (see Appendix 1) suggests that the climatic benefits of carbon storage by forestry can be rewarded on a tonne-year basis (i.e. as multiples of the value of storing 1 tonne for 1 year). This can account for dynamic land-use systems in which the sizes of different carbon pools fluctuate – helping open-ended carbon management to allow for flexible land-use strategies (corresponding to changing needs), rewarding carbon benefits *ex post* if and when they are generated (and to the appropriate degree). This also implies that were carbon values to diminish and alternative incomes/commodities sought, there would be no debiting of credits or liabilities incurred if management regimes are altered. This assumes though that no long-term management contracts are entered into, guaranteeing the supply of x amount of carbon every year, etc.. The challenge in this sense therefore, is also to design and implement flexible carbon offset supply contracts.

4.2 Carbon offsets – incentives and policies

4.2.1 Incentives for carbon offset investments

The report thus far has reviewed a wide range of aspects of carbon offset projects, their impacts on rural livelihoods, their associated land use management strategies, and some of their technical requirements. Section 1 also introduced their underlying logic, in terms of the role of terrestrial sinks in mitigating or offsetting climatic change. But we have not yet considered the more specific motives which drive investors – be they governments, NGOs, or private companies – to contribute financial resources to the design and implementation of the projects themselves.

Broadly speaking, there are three main types of underlying incentive for carbon offset investments. The first is to *fulfil a particular mandate or remit which governs the investing institution*. Normally this will involve the provision of global environmental benefits, and would include institutions such as the GEF (Global Environment Fund) and many environmental NGOs. The World Bank, for example, has a number of carbon offset projects, including the Burkina Faso project mentioned in Section 3, which, although formally part of the AIJ Pilot Phase, are designed to generate experience in the field of climate change mitigation, which in turn comprises an important part of the Bank's environmental remit. A similar argument could be made of NGOs like The Nature Conservancy (TNC) in the US which has been involved in a number of carbon offset projects (including the Rio Bravo Project in Belize), again, to promote the global environmental benefits that can be generated from appropriate forms of land use management.

The second type of incentive for investors is *to meet either an actual or a future liability that is derived from climate change policies* requiring net reductions of GHG emissions. These in turn stem directly from the FCCC and the Kyoto Protocol, or from national-level policies through which these international agreements are implemented (see Section 4.2.2). There are a range of such policies, discussed in much more depth in Section 4.2.2. It is worth noting here though, that as many of the carbon offset policies and mechanisms are still to be implemented, and many of the required GHG reductions are yet to be imposed, action thus far under this type of incentive has been primarily to gain 'first mover' advantage, to build up experience and knowledge as a hedge against future liabilities.

The third incentive for carbon offset investors is to *demonstrate institutional responsibility to stakeholders* for whom environmental issues may be extremely important. This is particularly the case for those private sector companies responsible for substantial GHG emissions, who have voluntarily invested in carbon offset projects with a view to 'carbon neutrality'[22] and the positive PR it embodies. Examples of such investments include the

22 Carbon neutrality in this sense means basically that the emissions for which the company is responsible (e.g., in its manufacturing plants) are offset by carbon sequestered elsewhere in a land use project funded by the company.

International Automobile Association's involvement in the Scolel Té project, and Peugeot's interest in an integrated forest conservation project in Brazil. The significance of these moves is reflected in the emergence of at least two UK institutions – the Carbon Storage Trust and Future Forests – to tap this new market.

There is clearly much overlap between these 'drivers' of carbon offset projects. Were a GHG emitting company to invest in forest restoration on the other side of the world, would this be considered a move designed to influence government in its impending distribution of GHG reduction targets, or a statement to its shareholders of corporate responsibility? Given current levels of policy uncertainty with regards GHG emission reduction targets, it is very difficult to tell. However, it also seems clear, that whilst carbon offset projects of the 1990s were characterised by complex and shifting motives from the investors' perspective, the next decade will see GHG liabilities – particularly on companies – become ever-more real.

In the UK, for example, a climate change levy on the business use of energy has been announced and is scheduled to be implemented in 2001. In the meantime, a whole host of energy-using industries and companies are negotiating GHG reduction agreements with the government, whilst lobbying for a pilot emissions trading scheme as a way of bringing down the overall costs of meeting such agreements. The role that carbon offsets might play in these various policy mechanisms is still unclear. Many are arguing (and lobbying) that offsets generated under the so-called flexible mechanisms of the Kyoto Protocol should be eligible under any domestic system. Other countries, particularly outside the EU, have committed themselves to these types of interactions between domestic and international policy mechanisms.

The scale of the GHG reductions required in the developed world means that once policies are implemented (i.e. move from 'soft' to 'hard'), the demand for carbon offsets will rise rapidly, assuming that they are considered as viable options for reducing net GHG emissions. Faced with hard-and-fast financial liabilities, investors, particularly those in the private sector, will turn to mechanisms such as the CDM to take advantage of the cost-effective opportunities it offers. It is envisaged therefore, that the second type of incentive described above will be the dominant demand-side motive of the next decade. To understand this incentive better, a comprehensive review of the evolution of relevant climate change policies is presented in the sections that follow.

4.2.2 UNFCCC, JI and the AIJ Pilot Phase

On 11 December 1990, the 45th session of the UN General Assembly adopted a resolution establishing the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC). The completed FCCC was presented at the United Nations Conference on Environment and Development (UNCED) in Rio, 1992, and has since been ratified by over 170 countries. The Convention came into force in early 1995.

A series of economic instruments to promote reductions in GHG emissions was proposed by countries to help meet the commitments required by the FCCC. These included taxes on emissions, subsidies for emission reduction projects, tradable emission permits, and direct regulation of emission sources. The specific inclusion of so-called *flexible*, market-based instruments was predicated on the assumption that allowing businesses to seek out cost-effective emission reduction opportunities would be significantly more efficient than regulatory-led emission reduction measures. Indeed, it has been repeatedly estimated that GHG targets could be met at very substantial cost savings with the use of emissions trading and offsets (Barrett 1995).[23]

It has also been asserted that some of the most cost-efficient emission reduction opportunities are to be found in developing countries, where obsolete technologies are used for cost reasons despite their inefficient use of energy. To some, this represents a win-win scenario in which everybody benefits from economic transactions on a pathway to global sustainable development based on international co-operation and technology transfer. To others, such transactions represent a way for industrialised nations to avoid paying the full cost of their historic role in increasing the atmospheric concentration of greenhouse gases (GHGs).

While carbon offset mechanisms have been a part of the climate change negotiations since before the UNCED conference, the original 'Joint Implementation' or JI mechanism was challenged by many developing countries

23 Recent modelling work by MIT (Massachusetts Institute of Technology) for the World Bank, for example, suggests that the aggregate costs to Annex B Parties of implementing their Kyoto commitments would be around US$120 billion in a no trading scenario, reduced to US$54 billion with Annex B trading, and as low as US$ 11 billion with full global trading including developing countries (Ellerman *et al*. 1998). The assumptions behind this full global trading scenario are that developing countries take on voluntary emission caps and trade any surplus. This is clearly distinct from a global trading system in which developing country participation is through CDM credits which are generated by specific project activities. However, the cost reductions associated with developing country involvement through both emission entitlement trade and CDM trade have been shown to be of similar orders of magnitude.

for the reasons stated above (see Box 4.1 for definitions). It was also felt that developing countries were in danger of transferring all their inexpensive GHG reduction opportunities to industrialised countries during this initial policy phase. This would put them at considerable disadvantage in the future when they themselves might be bound by emission reduction targets under the Convention. Older arguments regarding 'terms of trade' re-emerged, highlighting the unfairness of transactions in which a commodity is only valuable to purchasing parties. In this light, some developing country observers consistently referred to JI as nothing short of 'eco-colonialism'.

In 1995 at the first Conference of the Parties (CoP1) of the FCCC, developing countries' opposition to JI led to a new compromise JI-type formula called the Activities Implemented Jointly or AIJ Pilot Phase (which was to end January 1 2000). AIJ projects were to be conducted so as to establish protocols and experiences, but without any formal carbon crediting allowed between developed and developing countries (see Box 4.1).

4.2.3 The Kyoto Protocol

In December 1997, the Kyoto Protocol was adopted during CoP3 of the FCCC. The most important clauses of the Kyoto Protocol are the binding commitments by 39 developed countries and economies in transition (the Annex B countries, see Box 4.1) to reduce their GHG emissions by an average of 5.2% on 1990 levels by the commitment period, 2008–2012. The Protocol also approved the use of three 'flexibility mechanisms' for facilitating the achievement of GHG emission reduction targets. These are QUELRO trading, Joint Implementation, and the Clean Development Mechanism (see Box 4.1 for definitions).

Another important output of the agreement was the recognition of land use and forestry activities as valid options for reducing net concentrations of atmospheric GHGs. While the language of the Protocol is somewhat contradictory[24] regarding the types of activities which are allowed, and by which parties, it seems clear that terrestrial sinks will be part of the equation at the Annex 1 national level.

The Kyoto Protocol was opened for ratification on March 16, 1998 and becomes legally-binding 90 days after the 55th government ratifies it, assuming that those 55 countries account for at least 55 per cent of developed countries emissions in 1990. As of 6 May 1999, 84 Parties had signed the Kyoto Protocol and nine had ratified it.

24 For a review of the legal issues stemming from ambiguities in the Protocol text on land use and forestry, see Schlamandinger and Marland (1998).

4.2.4 The Clean Development Mechanism (CDM)

The CDM is the only Kyoto flexibility mechanism of relevance to developing countries. It evolved out of an idea formulated by Brazil and Costa Rica called the Clean Development Fund, which proposed a tax on emissions from non-compliant industrial countries. The revenue raised was to be used to fund sustainable development projects with emissions reduction capacity in developing countries. As defined by the Protocol, the CDM's purpose is twofold: firstly, to assist developing countries (non-Annex I Parties) in making progress towards sustainable development and contributing to the FCCC's objectives; and secondly, to assist developed countries and economies in transition (Annex I Parties) in achieving their emission reduction targets. Non-Annex I Parties are supposed to gain the economic, developmental and environmental benefits from implemented projects that generate Certified Emission Reductions (CERs) for export.[25] An important facet of the CDM is that these CERs are supposed to be bankable from the inception of the CDM (probably 2000 or 2001). This creates a strong incentive for those in a position to act now to engage in CDM projects as early as possible.

Other features of the CDM include:

- project activities must be additional to policy actions that give rise to the same outcomes;
- the CDM is open to participation by either private or public entities, or combinations of the two;
- projects must have the express approval of the host government;
- the CDM itself will act as an international body to oversee projects;
- CDM projects must also be independently certified;
- the CDM also has a mandate to use a portion of its proceeds to assist those countries which are particularly vulnerable to climate change to adapt to those changes.

The role of the CDM is, needless to say, interpreted differently by many parties. Companies in developed countries see it as a means of achieving cost-effective emission reductions to offset domestic liabilities. Some developing country governments want to use the CDM to improve financial flows in their direction. Certain social and environmental advocates see it as a redistribution

25 Although how these benefits are distributed between relevant actors within the non-Annex 1 Party will differ on a project-by-project basis.

mechanism against historical development inequity. Some environmental groups see it as a way to enhance capital flows to forest conservation and sustainable forest management. Others fear it may threaten the poorest and most vulnerable in developing countries by restricting access to the land and forest assets on which they depend to meet their livelihood needs.

Many of these issues relate also to the operational structure of the CDM. While some see it as a fairly simple regulator of emission transaction projects, others view it as a direct financing participant in projects, along the lines of the Global Environmental Facility, that would return CER dividends to its investor participants. The nature of the institutions(s) or organisation(s) that will control the CDM is also under debate. It is likely to include a combination of developing and industrialised country representatives, as well as NGOs and possibly industry (see Michaelowa and Dutschke 1999).

It should be stressed that the CDM is not yet operational, and will not be so until the Kyoto Protocol enters into force (see above), and outstanding questions as to the CDM's form and structure resolved. A timetable for the former is highly uncertain, whereas at CoP4 in November 1998, a deadline for the latter was set for CoP6, due to take place at the end of 2000.

4.2.5 Are land use activities eligible under the CDM?

Although Article 3.3 of the Kyoto Protocol specifically mentions the role of afforestation, reforestation and deforestation (although not forest conservation) for reaching the targets agreed by Annex B countries, Article 12 on the CDM refers only to 'emission reductions' with no mention of any specifically eligible activities. This vagueness of the Protocol has allowed a disturbingly broad scope for interpretation, and totally opposite views have been put forward.

Countries that want forestry included have argued that Article 12 implicitly refers to the activities listed in the main body of the Protocol text (Articles 3.3 and 3.4), while those that do not want forestry included argue that only fossil fuel based emission-reduction activities should be allowed. Even among those promoting forestry, a further point of contention regards the specific types of forestry activities which should be allowed, with some countries proposing only those activities listed in Article 3.3 (afforestation, reforestation and deforestation), and others promoting a much wider range of land use activities as in the spirit of Article 3.4 ('other activities').

Contention over the inclusion of forestry in the CDM led delegates at the recent CoP4 to the FCCC in Buenos Aires, November 1998, to defer any decision until CoP6, scheduled for November 2000. In the meantime, an international collaborative research network of forest scientists under the auspices of the IPCC (Intergovernmental Panel on Climate Change), was commissioned to prepare a Special Report on Land Use, Land Use Change and Forestry. The report's objective is to provide policy makers with the necessary information to allow the Kyoto Protocol's references to forestry to become operational, by reviewing the requirements and outcomes of different policy options. The IPCC Special Report is due to be published in May 2000.

Since the CDM was initially proposed, many developing countries supported the inclusion of some types of land use activity. Latin American countries, and in particular Costa Rica, Argentina, and Bolivia, have been the most vociferous proponents of CDM forestry, though with the equally vocal exceptions of Peru and Brazil. Brazil, however, appears to have recently moved to supporting the inclusion of reforestation and afforestation, but remains opposed to activities involving reduced impact logging or forest conservation. Asian countries have been less active on CDM issues, but Malaysia and Indonesia appear to support the inclusion of forestry, while India and China are strongly against. Reasons for this opposition are essentially that India favours energy and technology transfer projects, with China opposing the use of any market-based instruments *per se*. African countries also tend to oppose carbon offset forestry, not so much due to a principled opposition to the issue, but more because their negotiating position focuses heavily on capacity building and developmental assistance. Uganda is an exception, already hosting two carbon offset projects.

Industrialised countries are also divided on their views of forestry in the CDM. The EU bloc, whilst not in complete opposition, is keen to maintain the current 'slow track' approach, deferring major policy statements until the IPCC Special Report is published. Within the EU however, the Netherlands is a relatively strong proponent (and indeed has led the way with carbon offset projects through the FACE Foundation), with Germany and the UK more cautious. The umbrella group of Japan, US, Canada, Australia, New Zealand, and Iceland, are all strongly in favour of a wide role for sinks in meeting the Kyoto commitments, the CDM included. Furthermore, the US is pushing strongly for agriculture and particularly agricultural soils to be included under the open-ended Article 3.4. The degree to which this will also apply to eligible land use activities under the CDM is unclear.

Polemic also prevails amongst the international NGO community. While some NGOs strongly favour forestry's inclusion in the CDM (e.g., The Nature Conservancy, Conservation International, Winrock Foundation, Sierra Club, etc.), other international NGOs are still quite uncertain and suspicious (e.g., WWF International, Greenpeace, Friends of the Earth). There is some support for the CDM from grass-roots organisations and local NGOs, who see the CDM as a potential source of funding for their programmes (e.g., see Letter of Brasilia, 1998; see also the variety of NGOs involved in ongoing carbon offset projects, e.g., Tipper, 1999), but others see it as another threat to the rural poor from the processes of globalisation (e.g., Centre for Science and Environment, India).

The eligibility of land use activities within the CDM is therefore subject to considerable uncertainties, making some solid analysis all the more necessary.

4.3 Carbon offset market evolution

Irrespective of the ongoing policy debates surrounding the CDM and the inclusion of land use activities within it, post-Kyoto investment flows are steadily increasing in CDM-type projects both within and outside the AIJ Pilot Phase. These flows are marked by an ever-increasing degree of sophistication in the financial aspects of carbon offset transactions. In part, this has to do with increasing private sector involvement in the emerging CDM market, not just in their principal role as project investors, but also as certifiers, transaction brokers, investment advisors and insurers, etc.. The original conceptualisation of bilateral, jointly-implemented projects between two defined parties with a formal exchange of resultant carbon offsets is rapidly evolving to that of a multilateral market in which the full range of financial products used in other investment scenarios are being applied. Indeed, one of the pivotal players in this market evolution has been Costa Rica, which structured its own supply-side framework for its own brand of carbon offsets called 'CTOs' or Certified Tradeable Offsets, which were then marketed internationally. Other examples of market sophistication include:

- supply-side market placements of carbon offsets;
- forward sales or options contracts for carbon offsets;
- bonds designed to stagger the release of carbon offsets during the commitment period;

- specially-tailored insurance products to address the various scientific and policy uncertainties and risks unique to CDM and emission reduction projects;
- equity-based carbon offset investment vehicles;
- pilot schemes to integrate carbon offsets into emission permit trading schemes.

Options for harnessing private sector flows to clearly-defined consensual objectives are currently being explored. In this regard, the UNDP has recently developed the concept of a sustainable forestry investment promotions agency aiming at leveraging private investment flows through the use of a limited amount of public resources and capitalising on forest externalities, such as carbon sequestration (Moura Costa *et al.* 1999).

4.4 National institutional frameworks

Parallel with the implementation of the Kyoto Protocol, many national institutions have been established and are developing their own programmes, regulations and methodologies that gradually will feed into the post-Kyoto processes.

The national regulatory bodies review, accept or reject projects according to a series of criteria developed by the countries themselves. While, in general, criteria aim at reflecting the main tenets of the FCCC, nations adapt their criteria according to the areas in which they would like to promote investment. While there is no internationally agreed standard for regulating carbon offset projects, a number of private sector companies such as the SGS Certification Services have expressed interest in verifying compliance with standards, once they have been established (Moura Costa *et al.* 1997; UNCTAD 1998).

The current list of developing countries with existing or planned carbon offset programmes includes Costa Rica, Sri Lanka, Poland, the Czech Republic, Mexico, Guatemala, Belize, Honduras, Ecuador, Nicaragua, Indonesia, Bolivia, Panama, Burkina Faso, Estonia, Latvia, Sri Lanka, Fiji, Vietnam and the Russian Federation. Other countries, such as Pakistan, Chile and some Central American countries, have signed statements of intent to promote the idea with specific trading partners. Central to the concerns underlying such programmes is that carbon offset revenue must not replace existing Overseas Development Assistance (ODA) flows, and that developing countries should not be pushed into accepting targets for GHG emission limitations for the foreseeable future.

A key challenge for developing countries is to find the appropriate role for CDM and to regulate CDM investments in order to foster national development priorities. While in the past, carbon offset initiatives have been initiated by the investors and only submitted to host countries for final approval, some host countries are already developing priority lists for CDM investments to establish what they see as a comparative advantage for when the CDM becomes operational (e.g., see Box 4.3).

Probably the most sophisticated developing country in this regard is Costa Rica. In 1996, this country established a national level GHG sequestration programme administered by a dedicated office, the Costa Rican Office of Joint Implementation (Oficina Costarricense de Implementación Conjunta – OCIC). This Office aims to generate offsets from a national programme of forest conservation and reforestation, and to sell these certificates of carbon offsets internationally, with the trade name CTOs – Certified Tradable Offsets (Tattenbach 1996; OCIC 1996). If CDM becomes a more permanent part of the environmental and development landscape of G77 countries, Costa Rica's system will likely serve as a model, or at least as a pioneer.

Box 4.3 To illustrate a national initiative to set priorities for carbon offset investments, here is list of target areas prepared by the Sri Lankan AIJ pilot programme:

- Reforestation of new and unproductive land
- Conservation of natural forests and forest soils
- Management of plantations and forests to optimise sequestration
- Rehabilitation of degraded agriculture land to improve soil carbon content
- Management of livestock to minimise emissions
- Wind-energy farms
- Rural electrification with photo-voltaic systems
- Micro/mini hydro-power plants
- Efficiency improvement of thermal power plants
- Demand-side management in power systems
- Vehicle fleet maintenance programme
- Rehabilitation of high-energy consuming industrial equipment
- Gas collection in sanitary land fills
- Low-emission waste-water treatment

5

Land use and livelihood issues arising from carbon offset schemes

Summary: Carbon offset schemes raise many issues of relevance to rural livelihoods. Global carbon management is long-term by nature. Thus it is potentially at odds with the short-term nature of livelihood systems. Carbon is just one of many commodities in rural livelihood scenarios. Thus it is important that 'production' of carbon offsets does not undermine the development of other resource sectors. If carbon offset schemes are implemented on a widespread basis, incremental costs and benefits will be affected by scale, perhaps prejudicing against the involvement of rural communities, which are often characterised by small land-holdings and weak organisation. The complex secondary or external effects of projects involving rural groups may be unpredictable, associated with leakage, and discourage investment. Marketing of carbon may affect power relations, equity and resource access within and between communities. Suggestions as to how to minimise potential risks to livelihoods and how to maximise opportunities are taken up in the next section.

5.1 Introduction

The role of terrestrial vegetation in the global carbon cycle, relationships between rural livelihoods and land use and types of activities that could be used to sequester and conserve carbon were covered in previous sections of the paper, as were current developments in climate change debates and policies. Building on the principal concern for rural livelihoods, this section highlights the issues (see Table 5.1) and possible implications for rural populations of any eventual policies or market developments that result in the expression of a market value for terrestrial carbon storage. The final section (Section 6) proposes a series of guidelines for integrating terrestrial carbon management policies and projects with rural livelihood development.

The issues raised here were discussed at an international workshop in Edinburgh, UK in September 1999. The purpose of the workshop was to bring together individuals with an interest in sustainable livelihoods in developing countries, carbon offset projects, and climate change policy to share facts and insights concerning the issues raised in a previous version of this document. Participating in the workshop were representatives from governmental, non-governmental and private sector organisations from Bolivia, Brazil, China, Ecuador, India, Mexico, Tanzania, UK, USA, and Zimbabwe. Some conclusions were evident, but many questions remain, and these are set out in Sections 5.2 – 5.14.

5.2 Balancing globalisation and localisation

The requirements for long-term global carbon management have dominated carbon offset policy debates to date. Local sustainable development requirements – resilient, multiple livelihood systems that can be flexible in the short-term – appear to have received less attention. The issues are familiar to those who are trying to make the most of globalisation. On the one hand, strong international pressures and market forces could result in the opportunity for local groups to exploit comparative advantage, and to gain technology and

Table 5.1 Issues considered in relation to carbon offset schemes and sustainable rural livelihoods

Issue relating to	Section	Issue
Global policies and schemes	5.2	Balancing globalisation and localisation
	5.3	Economies of scale
	5.4	Lack of carbon offset policy, definitions and standards
National concerns	5.5	Lack of policy and institutional coherence
	5.6	Lack of information and experience
Carbon offsets and land management	5.7	Carbon as a commodity in relation to multiple needs
	5.8	Long-term nature of carbon management
	5.9	Uncertainty and unpredictability
	5.10	External effects and leakage
Project design and rural communities	5.11	Transaction costs and local capacity
	5.12	Externally or internally driven?
	5.13	Benefit-sharing and property rights
	5.14	Security of land tenure

market access in order to earn income on a large scale by producing a commodity that is compatible with their other needs and aspirations. On the other hand, globalisation can result in pressure to produce carbon storage at the lowest possible cost, with simple blanket solutions and inadequate social and environmental investments. This could result in disenfranchisement, loss of access to capital assets and opportunities, increased local inequity, whilst transferring risk from corporations and governments to local people. Such negative effects may occur if carbon markets run ahead of an understanding of the broader economics of carbon management, globally and locally, and escape effective controls on externalities. While the Kyoto Protocol's Article 12 on the Clean Development Mechanism specifically mentions the need to comply with national development strategies, questions remain about *how* these aims are articulated and *who* sets the standards in specific cases:

- Will projects have to prove that they have positive livelihood impacts, or rather that they have no significant negative impacts?
- What should the entry conditions be for carbon offset projects at national and international levels?
- Who will set the entry conditions, and to what extent will local stakeholders have an influence?
- Who will assess compliance with the socio-economic criteria set for carbon projects?
- How will local concerns and priorities be incorporated into carbon offset policy frameworks?

Such questions have important implications not only for the economic impacts of carbon offset initiatives but also in the development of power relationships between local, national and international authorities. There are particular concerns within national authorities that international bodies may seek to intervene directly at local or regional levels, bypassing established decision-making hierarchies. There are also concerns among local groups that a 'technical elite', equipped with the analytical tools to assess the carbon value of new projects may wield excessive power or influence, because they are likely to become the 'gatekeepers' to the carbon resource rent.

5.3 Economies of scale

The magnitude of some top-down carbon market projections suggest that carbon offset schemes could be implemented on a widespread basis. In such a case, scale issues relating to the incremental costs and benefits of such schemes would need to be considered. Relevant questions include:

- How can we ensure that an overt focus on simple forestry models – as opposed to accommodating mixed land use – does not prejudice against livelihoods by encouraging a broad-scale transformation of rural landscapes to forestry?
- How can we overcome the potentially severe access problems of rural communities given the excellent organisation required to get farm-forest systems recognised and rewarded on a vast scale i.e. a market dominated by scale economies?

Clearly, some of these scale effects are positive, others negative. Managing and mitigating effects is likely to fall to existing national and local capacity. The design of carbon offset schemes, and the CDM in particular, will also determine the degree to which these scale issues arise.

5.4 Lack of carbon offset policy and standardisation

Many concerns related to the ability of carbon offsets in forestry to deliver tangible GHG benefits are founded in the lack of clear definitions and standardisation. This is particularly true in regard to accounting for carbon fluxes to and from the atmosphere, for example, determination of baselines, management of leakage, and units used for reporting benefits. Because baselines are by nature subjective, there is a risk that baselines may be manipulated to inflate the apparent benefits associated with a project. Also, if baselines are set project by project, it may be difficult to establish regional or national baselines that are in line with several independently derived baselines.

Leakage refers to the indirect impacts that a project or intervention may have on carbon storage in another place or time. In many pilot projects, leakage was used in the context of project boundaries but it is now recognised that leakage could occur across many other system boundaries (e.g., activity displacement, demand displacement). Accounting for leakage should become less of a problem as the scale of accounting increases. For example, regional level accounting should be more likely to capture leakage between sources than project-specific accounting but quantifying regional effects may be more difficult than quantifying discrete project activities.

Carbon storage in trees is not permanent. Indeed, many of the interventions that might be made in forestry and land use to reduce GHG emissions or to increase storage have a temporal dimension. This time dimension raises accounting problems – how can one equate temporary carbon storage with permanently avoided emissions of fossil fuel carbon? As introduced in Section 4.1.5, accounting methods have been developed that incorporate temporal issues, but a standardised approach to reporting carbon benefits must be established.

- To what extent do the units used for accounting carbon benefits restrict livelihood options or reduce the value of other aspects of natural capital?
- To what extent do carbon accounting procedures affect access to carbon resource rent by the poorest farmers?

5.5 Lack of national policy and institutional coherence

To be acceptable and sustainable, within the provisions of the UNFCCC and the Kyoto Protocol, carbon offset activities should be supportive of the goals and objectives of host countries. Within every country, goals and objectives for land use and development are likely to be well-defined and elaborated in a variety of documents. Also, control over land use and development issues is likely to involve a range of institutions and governmental divisions. As interest in carbon trading grows, conflicting policies, incompatibilities among institutions, and competition among organisations and levels of authority may arise.

- How can the development of supportive, enabling national policy related to carbon offsets be promoted?
- How can related issues of national concern (e.g., deforestation) be linked to sustainable development?
- How can synergies among existing initiatives related to land use and development be fostered?

5.6 Lack of information and experience

Many governmental organisations lack information about the opportunities and likely costs, benefits and risks associated with carbon offset programmes. Direct local experience is essential for increasing awareness and for identifying issues relevant to particular circumstances.

- What information is the most relevant, and what is the most appropriate form and avenue for dissemination?
- Can guidelines be developed to help governments, communities, and other groups assess their relative advantage for selling carbon offsets?

5.7 Carbon as a commodity in relation to multiple livelihood needs from land use

As discussed above, carbon storage is but one of many goods and services provided by forests that benefit society. Local groups seek multiple benefits from forests, for different purposes. The production of just a few or even one forest value could become out of balance with this. Various authors assert that emphasis on single commodities in forest areas has historically been associated with community disenfranchisement and poverty after a short boom (Hecht and Cockburn, 1989; Crosby, 1986). If land use is to be sustainable, local people are not going to want simply to 'plant trees' or 'protect forest', but secure a variety of goods and services in the landscape as a whole. To this end, well designed projects may use carbon revenue to finance the incremental costs of developing more productive and more sustainable land use systems – and thus underwrite the costs of producing other benefits.

- What are the trade-offs and synergies between carbon and other forest products and services?
- How can we anticipate and buffer against market cycles and carbon price fluctuations?
- What practical guidelines or standards may be developed to promote the use of carbon as an attraction for investment that supports rural livelihoods?

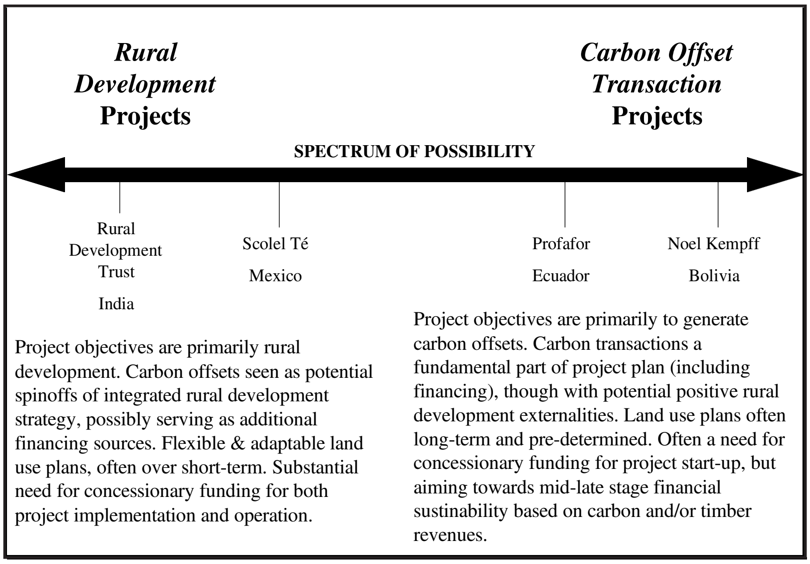
In the working group on local level issues, it became clear that were two main types of carbon offset project represented at the workshop. These types could be termed '*rural development projects*' and '*carbon offset transaction projects*' respectively. Many of the discussions and points of differences throughout the workshop stemmed from the fact that different people were representing different points on the spectrum of possibility within this typology.

One example to illustrate this point is to consider how different projects addressed the need to maximise the flexibility and adaptability of land use and land management strategies, given that this was agreed to be a key requirement to ensure positive stakeholder-led rural development. On the one hand, the Profafor project entailed 99-year legally-binding contracts, agreed with land users, but developed by carbon forestry technical experts. Profafor was designed as a *carbon offset transaction project*, to provide a stable and predictable stream of carbon offsets to the investing entity, FACE. Conversely, Scolel Té was designed as an integrated *rural development project* albeit with a strong carbon component with a view to exploring the potential role of carbon offsets in rural development. The Scolel Té project had relatively short-term land management plans developed and proposed by the land users, and reviewed/endorsed by a technical team.

The distinction between how the two types of project addressed flexibility simply represents the distinction between the objectives of the projects, and whether they are 'carbon maximising' or 'rural development maximising'.

A consensus emerged at the end of the workshop that livelihood-sustaining carbon offsets are most likely to be derived from rural livelihood projects that are well-informed about their offset potentials and implications, and able to capitalise on them.

Figure 5.1 Different types of carbon offset projects, with examples



5.8 The long-term nature of carbon management

The Kyoto Protocol requires that CDM projects result in '*long-term* benefits related to the mitigation of climate change' (Article 12(4b), author's italics). The long-term requirement to keep carbon in storage may conflict with the short-term needs of the poor to keep multiple options open with the flexibility to manage resources in ways that meet current needs. The opportunity cost of restricting land use management choices in areas designated for carbon offset is of particular concern. This could be further exacerbated if the market for carbon diminished over the long-term, leaving people with a commodity that no-one wants.

The need to prove long-term climatic benefits relates closely to the question of permanence: how long must carbon be stored for it to have a mitigating effect on climate change? Or more specifically, for how long must a unit of carbon be stored for it to become equivalent to a unit of avoided emissions? Although there is a perception that, in the forestry context, long-term implies *in perpetuity*, previous carbon offset projects have involved managed systems with fluctuating carbon stocks over much shorter timeframes.[26]

- To what extent will the vulnerability of certain regions to changing economic conditions – and the consequent need for land use and livelihood flexibility – affect the viability of carbon offsets?
- Who carries the risks inherent in projects?
- How can flexible carbon accounting methodologies enable open-ended adaptable management strategies to sit alongside investor requirements in terms of carbon revenue streams?

5.9 Uncertainty and predictability

Predicting the impact of carbon offsets on rural livelihoods and land use is difficult (see also Section 5.7), particularly because, in any one area, participants will have different livelihood strategies and thus will have different motivations when faced with a carbon offset scheme. Many policy, institutional, cultural and market forces affect people's decisions and these forces affect different groups in different ways. Thus the impacts of carbon

26 Note that existing carbon forestry projects under the AIJ Phase have lifetimes of between 25-60 years (reforestation) and 16-99 years (conservation) (Ellis 1999).

offsets will not be easy to predict especially if the 'target' group is disparate. The implications of this inherent uncertainty are that project objectives may not be met, or that the project causes unexpected detriment to community land management systems and products (note, of course, that it is also possible that unexpected outcomes may be positive).

- To what extent will the unpredictability of farmer responses to forestry projects in developing countries discourage investment?
- How to overcome any comparative disadvantages in the tropics of high risk, and paucity of management skills, infrastructure and land hunger?
- What mechanisms may be introduced at local, regional and national levels to reduce uncertainties for investors and service providers – and how to stop these enforcing a rigidity or uniformity which is unacceptable in local livelihood terms?

5.10 External effects and leakage

Carbon offset projects involving rural groups may have complex secondary or external effects that lie outside the frame of the project concept (see Section 4.1.3 and Appendix 1). In particular, leakage and slippage impacts with consequent greenhouse gas emission increases may result, for example, as tree-planting often occurs on land which landless people had depended upon for food/fibre/fuel cultivation and gathering. As a result, tree-planting for carbon may be correlated with increases in (itinerant) farming, possibly on forested land.

- What mechanisms and project designs may be introduced to reduce or manage the leakage of both carbon benefits and economic benefits?
- Can leakage effects be adequately incorporated into project carbon accounting without prejudice to rural livelihood projects?

5.11 Transaction costs and local capacity

The issue that rural development projects with carbon offset components would entail significantly higher costs than comparable plantation or natural forest projects with little or no human dimension arose repeatedly during the workshop. The reasons for this cost differential were many and varied, but largely centred on the time and resource costs associated with stakeholders. Stakeholders in rural development projects are each likely to have different requirements, and to be networked together with varying degrees of institutional and organisational structure. This is contrasted with a large-scale plantation project where a single agency, with secure land titles, implements the project.

There are many challenges in relation to the *transaction costs* of carbon offset projects, especially with many scattered groups with whom to negotiate, determine roles, reach access/management agreements, establish cost-benefit-sharing mechanisms (amongst stakeholders themselves as well as between them and the project proponent), conduct monitoring and verification, and continually review the arrangements. These transaction costs may be prohibitive if rural communities wish to participate in carbon offsets on an individual basis, a situation further exacerbated if they lack the requisite administrative, technical, and organisational capacity. Moreover, if the carbon market grows to the degree some expect, institutional capacity will also be needed to develop and market rural livelihood-based projects if the carbon offset products are to compete with comparable commodities from larger-scale suppliers with better access to key demand-side actors. Such capacities may be way beyond what is available now to poorer countries, even though they might otherwise have a comparative advantage for terrestrial offsets.

- Is it possible to develop generic management models that can be applied to large numbers of small producers or communities at low cost – or to build on existing government, civil society or market mechanisms such as extension services, rural development NGOs and 'brokerage' services?
- How can programme-level approaches that bundle together small-scale producers be developed to lower transaction costs and allow the rural poor to benefit from scale economies?
- What mechanisms may be introduced to maximise the proportion of carbon resource rent that is channelled to poor farmers?
- To what extent would such systems be compatible with the proposed institutions of the CDM (and *vice versa*)?

5.12 Externally or internally driven?

The necessity of participatory project design and implementation has been well-documented (see Section 2). Carbon offset mechanisms could easily constitute new developmental 'paradigms' imposed by outsiders. Many problems may be avoided or reduced if local needs and interests are incorporated *a priori* into the project design and implementation process. As noted in Section 2, there is much to be learnt from the experience of ‘people and parks’, participatory forest management and agroforestry development initiatives in this regard.

- What participatory (consultative and planning) models are applicable to carbon offsets, and are additional elements required?

5.13 Benefit-sharing and property rights

A key issue in the workshop discussion was ownership of the carbon – by the funder, the project, the individual farmer or the state.

Carbon land management in rural communities may benefit certain people and marginalise others, perhaps causing or exacerbating divisions, or even destabilising established hierarchies. Equity in benefit-sharing is also contingent on existing power relations and authority structures (which will affect any intervention), and re-distributive mechanisms. In terms of financial assets, with the exception of some well-known rural schemes, there is little precedent for the equitable sharing of resource rent. Moreover, sustainable livelihoods depend upon access to multiple assets, and not just income (financial assets). This is especially important for the poorest groups, who will never be in a position to purchase all their needs, and are most likely to need access to natural capital in any circumstance. Yet, some carbon offset schemes may emphasise financial income as a compensation for the restriction or even removal of such access.

Land ownership patterns are a further determining factor as complex arrangements for property rights over natural resources – and the services they provide – may be required. For example, open access land management regimes may prove problematic to reconcile with the need to allocate rights to environmental services. Well-functioning private – or common property management – regimes may be needed. This illustrates the importance of how the supply-side of carbon storage services is organised within the communities themselves. Suppliers could be private individuals, whole communities, community leaders or representatives, subgroups of communities depending on land ownership, *et cetera*. Vulnerable groups are likely to include landless labourers, women (who may be allocated extra work responsibilities whilst men receive the payments), and local processing industries (who may suffer from downstream effects of carbon land management policies).

In some cases, equity issues will arise in spite of – and not because of – carbon offset projects. This may particularly be the case where benefit-sharing is conditioned by long-standing intra-community dynamics or politics. In other cases, it is possible for equity considerations to be factored into the design of the requisite distributive mechanisms so as to minimise any negative effects. Successful precedents should be carefully considered in this regard as a basis for project design. In particular, the distributive mechanisms of successful micro-financing schemes should be examined, and replicable elements distilled.

- How is the marketing of carbon likely to affect power relations, equity and resource access within and between communities?
- What property rights regimes concerning carbon are best reconcilable with land and tree ownership patterns?
- What guidelines may be developed to reduce the potential for conflict over ownership of the carbon resource?
- How can we build on the lessons of effective common property management?
- What guidelines and structures may be required to ensure that carbon resource rents play a positive role in reducing poverty?

5.14 Security of land tenure

A further property rights issue relates to the security of land tenure, which may exacerbate difficulties for local communities as land is acquired for carbon management by more organised interests with resources and knowledge to access carbon offset financing. In this way, the local land production base or natural capital can be eroded.

Delineating and defining access to land should therefore be prioritised within national and local land use planning and development processes. Innovative ways of securing land tenure should also be explored. Alternatively, collectivised benefit disbursement mechanisms through village banks or equivalent could be developed to correspond to underlying common property regimes. Means of including vulnerable groups or those marginalised from the benefits of carbon management should be explored.

- How could landless groups gain improved access to resources through the intervention of carbon offset schemes?
- How can land tenure systems best be adapted to the needs of carbon offset interventions (and *vice versa*)?

6

Mechanisms to ensure that carbon offset projects meet rural livelihood needs

Summary: This final section puts forward a range of principles, for application at the global, national and local levels, for integrating rural livelihoods concerns in the decisions necessary for feasibility assessment, design and operation of carbon offset initiatives. Potential directions for aid assistance are also suggested, and priority areas for further research are recommended.

Our premise is that, if appropriate policies, institutions, community mechanisms and project procedures can be put in place, a reliable carbon-based commodity over the long term could assist local development in rural areas. The challenge would be to make this competitive, building on comparative advantage and existing mechanisms that work well in relation to multiple rural stakeholders.

6.1 Introduction

In Section 5, many issues were raised that are relevant to a consideration of carbon offsets in the context of the rural poor in developing countries. Without adequate responses, these issues have the potential to exacerbate clashes between carbon offsets and rural livelihoods, and to undermine possibilities for carbon offsets to contribute positively to sustainable rural livelihoods.

Given the wide variety of local situations, we consider the best initial response to be a set of principles upon which carbon offset projects that meet rural livelihood needs should be founded. As stressed in Section 5, sustainable carbon offsets are a matter of integrating global needs for carbon management services with local needs for multiple and changing livelihood requirements from land use as a whole. This puts a premium on the national level as a 'broker' between a global marketplace and local suppliers with their own particular needs and interests. The principles, likewise, tend to cluster into groups for attention at global, national and local levels (Section 6.2). In Section 6.3, recommendations are made as to the role the development community might play in implementing these principles.

For some of our suggested principles, knowledge is already advanced, and there is adequate information on good practice. In such cases, there is a need for better dissemination[27] of this *existing information*. Where of particular relevance, references are provided to the appropriate section in this document where this information has been introduced. For other principles, however, there is a requirement for research. Suggested areas of research are therefore outlined in Section 6.4.

In discussing the principles and research priorities for carbon offset projects, it is important to remember that specific projects or interventions will differ in their relative emphasis on rural development or carbon storage (Section 5.7). For example, whilst the principles suggested here aim to *integrate* carbon and rural development benefits as far as possible, there will inevitably be some *trade-offs* between them in any one project.

6.2 Suggested principles for carbon offset projects and policies

In this section, a series of principles is proposed, upon which carbon offset projects should be founded. These are categorised according to the scale at which they are most applicable. The global level principles mainly refer to the development of appropriate policies and methodologies stemming from the climate change policy agenda. The national level principles centre on the need for strong national institutional capacity, setting carbon offset opportunities within broader national policy frameworks so as to create an 'enabling environment' for both supply and demand-side initiatives. The local level principles also focus more specifically on the conditions needed for carbon offset interventions to benefit the rural poor, and how carbon offset projects can be most effectively managed to this end.

27 This is also one of the objectives of this report.

6.2.1 Global level principles and strategies

At this level, there is much to be done to ensure that evolving global regulations and schemes are well-informed about both good forestry/land use practice and livelihood realities:

A. In general, aim to integrate principles of sustainable livelihoods and sustainable land use into global carbon protocols and markets and to weed out perverse policy incentives:

(Sections 2.2, 2.3, 2.4, 4.2.4, 5.2, 5.9)

- Promote the use of current SFM criteria and indicator (C&I) sets and the sustainable livelihood framework in international carbon initiatives.
- Develop guidelines to define acceptable projects, particularly with regard to proposed projects' contributions towards sustainable development.
- Establish mechanisms that promote participation to bring potential stakeholders together before developing any scheme, mechanisms that put a premium on stakeholder analysis and assessment of stakeholders' land/livelihood links.

B. Ensure that policy, standards, and procedures are clear and not biased against the involvement of rural poor:

(Sections 2.2, 2.3, 2.4, 4, 4.1, 4.2.5, 5.2, 5.3, 5.4, 5.7, 5.8)

- Involve government forest/land use/rural development agencies and representatives of rural poor groups in developing standards and procedures, taking account of community heterogeneity.
- Develop standards and procedures that incorporate obligations to assess and help meet local livelihood requirements and social externalities.
- Reach international agreement over definitions, make clear policy statements and standardise the processes for establishing baselines.
- Define standards for quantification and crediting to ensure project comparability, legitimacy, and transparency.
- Put in place mechanisms for monitoring and verification of projects over appropriate time scales, at local, national, and international levels; ensure that they respect the complex and changing land use systems used by poor groups to secure multiple livelihoods.

C. Ensure that policy, standards, and procedures promote equitable benefit-sharing:

(Sections 2.3, 2.4, 4.3, 5.13, 6.2)

- Consider developing sizeable 'ethical' market niches whose objectives are to provide carbon returns from investments and interventions designed primarily with the needs of local communities in mind.
- Whilst structuring and regulating the market in such a way as to recognise that local interests and equity are essential, take care not to burden unnecessarily the development of a new market with conditions that end up prejudiced against the involvement of the rural poor.
- Encourage the use of equitable benefit-sharing mechanisms that have been proven to work in local circumstances.

6.2.2 National level principles and strategies

The national level is the obvious interface between global markets and local interests, and hence the best place to broker effective deals. A premium must be placed on strong policy and institutions at national levels that set the rules under which globalised carbon markets enter local situations. Those countries that provide clear guidance to project investors on eligible projects, within the context of national-level sustainable development strategies, land-use plans, or environmental action plans, will be more likely to benefit from resulting market stability and reduced project transaction costs.

A. Promote broad participation in the development of national carbon-related policies, institutions, and procedures:

- Incorporate mechanisms to promote equitable benefit-sharing and to reduce conflicts between regions, sectors, and communities.

(Sections 2.3, 2.4, 5.12)

B. Aim to integrate livelihoods and carbon offset options within wider national land use policy frameworks:

- Identify the types of land use and associated livelihood systems in the country which are potentially suitable for carbon offsets.
- Do not discriminate in favour of one type of forestry, as this may prejudice against the land use systems of the poor.

(Sections 5.4, 5.5)

C. Ensure that national institutions are capable of scrutinising carbon offset investment proposals in relation to the requirements of:

- national-level sustainable development strategies,
- land-use policy and plans,
- environmental action plans,
- local livelihood systems and their associated land uses, and
- likely costs and benefits to the rural poor.

(Section 5.11)

D. Consider ways to reduce the transaction costs of carbon offsets, for example:

- through using existing mechanisms with extensive links to rural people, such as extension systems, rural development banks, rural development NGOs, and agribusinesses with outgrower schemes,
- through bundling small-scale projects into programmes for implementation,
- through the development of sectoral baselines.

(Section 5.11)

E. Ensure forest and land use policies and institutions are strong, lest any carbon offset investment merely rewards bad practice:

- Good information on carbon offset schemes and implications is vital.
- Proof of improving land/forest policy in practice and institutions' activities may themselves be enough to form the basis of a nation-wide carbon offset scheme.

(Section 5.5, 5.11, 5.12)

6.2.3 Local level principles and strategies

Here it is important to structure carbon offsets around strong, equitable local institutions which support sufficient rights and responsibilities of participatory groups. An emphasis on local participation and monitoring is required to ensure local people really do benefit.

A. Carbon offset projects are unviable unless they increase capital assets of rural poor:

(Sections 2.3, 2.4, 5.13)

- Carbon offsets must increase the net capital assets available to the rural poor, and must not reduce natural capital which is particularly required for the resilience of the poorest groups.

B. Secure local rights and responsibilities:

(Sections 2.3, 2.4, 5.13)

- If stakeholders are to be effective stewards of carbon and meet their livelihood needs, all parties require reasonable bargaining power before starting the negotiation process on carbon offset projects at the local level.
- Further to this, they require adequate rights to the carbon 'product' and widely-accepted roles in its management.

C. Develop the capacities and comparative advantage of local institutions:

(Sections 2.3, 2.4, 5.11)

- Successful carbon offset projects in a rural livelihood context require substantial local capacity, awareness of opportunities, technical and administrative skills, etc.. Programmes should be developed to this end, with a general aim to reduce the transaction costs for the rural poor to access emerging carbon offset markets.

D. Incorporate flexible and dynamic implementation paths:

(Sections 2.2, 2.3, 5.7, 5.8, 5.13)

- Carbon offset projects should be developed with clear objectives, but with flexible and dynamic implementation paths so as to be robust to uncertain outcomes which emerge and to be able to accommodate changes in livelihood needs.
- This requires adaptive and participatory management systems and an emphasis on participatory and third party monitoring.

E. Project design and carbon accounting systems need to be developed both to minimise the negative impacts of leakage on a carbon offset project and to avoid leakage undermining the carbon benefits of interventions.

(Sections 4.1.3, 5.9, 5.10)

6.3 Potential role for development assistance and recommended applications

As discussed in Section 4.2.1, forestry-based carbon offsets from the developing world are playing, and will continue to play, a role in allowing different players to fulfil their obligations (be they voluntary or mandatory) under the various climate change policy regimes. Prominent amongst these is the CDM which is likely to evolve into a global carbon credit market.[28]

Within this broad context, concessionary finance from ODA sources should be carefully targeted to ensure that carbon offset activities support broader livelihood and developmental objectives. This requires development agencies to recognise that, in relation to market-based mechanisms, public sector finance is likely to occupy only a fraction of an otherwise private sector dominated market. To this end, ODA money could be channelled into *structural activities* that create an *enabling and equitable environment* for private sector investment, and sustainable private sector activities at both buyer and seller levels (see Moura Costa *et al.* 1999 for details of this terminology). This is particularly important in ensuring that blocs of countries with structural disadvantages in terms of competing in global markets are not marginalised from the possible benefits that carbon revenue might bring in rural livelihoods contexts and elsewhere. A similar case could be made for particular groups at a structural disadvantage. Put simply, there is unlikely to be a global level playing-field in the emerging carbon markets. At the most recent meeting of the technical bodies of the CoP/FCCC process, for example:

> *"the 'Africa Group' explained that insufficient infrastructure in many countries in Africa has hampered a successful implementation of many AIJ projects … The Africa Group called for capacity building to make the geographical distribution of AIJ projects more balanced … without proper measures to improve capacity building in host countries, CDM projects are not very likely to be implemented in the poorest developing countries."*
> (UNFCCC in JIQ, p3, Vol 5 (2), June 1999)

Ensuring that blocs of countries are not marginalised from inward investment flows driven by carbon offsets therefore falls – at least in part – *to concessionary finance for widespread capacity-building at both national and*

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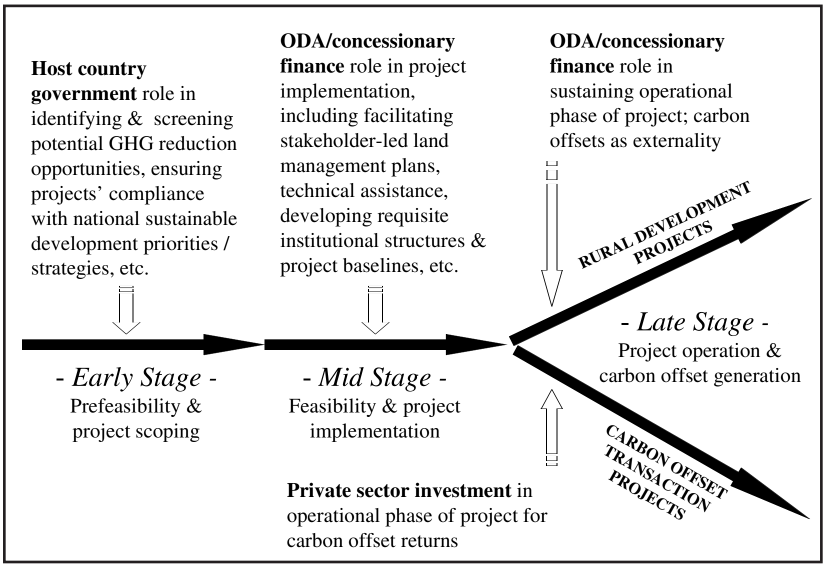
28 However, the role of land-use and forestry activities within the CDM remains unclear, and is currently opposed by the EU and the UK, pending the publishing of the IPCC Special Report – see section 4 for details.

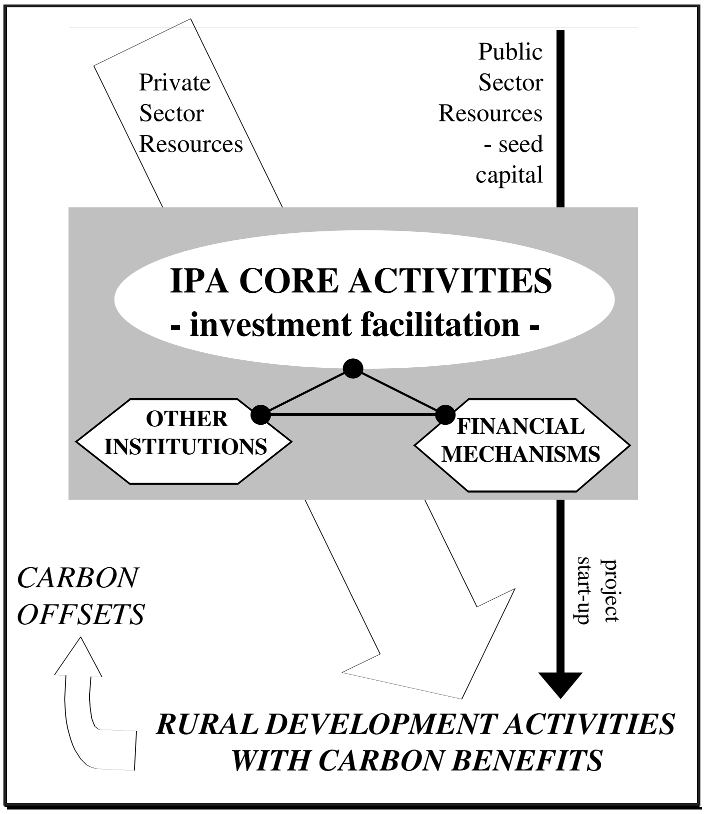
local levels. In the workshop, concern over transaction and start-up costs associated with rural development projects arose repeatedly. Both the case study experiences presented, as well as the resulting discussions, concurred on the need for concessionary finance of some kind – be it ODA, NGO resources, or low cost debt – to meet these higher start-up costs, if the resulting carbon offsets generated were to be competitive, and attractive to potential investors. The question was then raised as to potential public-private partnerships, using seed capital from concessionary sources to carry the projects through the implementation phase, subsequently *enabling* private sector investors to invest in the ongoing project operations with a view to securing the carbon offsets that would accrue (but within a strong rural development framework). Although care would have to be taken – in the case of CDM projects – not to contravene the need for financial additionality (see Section 4.1.2), this type of partnership between concessionary finance and private sector resources would greatly enhance the potential for rural development projects to attract investment, as the carbon offsets generated would be significantly more competitive on the market. A precedent of sorts also exists in the joint funding scheme where DFID matches project funding provided by UK NGOs through local partners in developing countries.

Figure 6.1 Carbon offset project timeline and possible roles of different actors



Clearly, this potential role for ODA resources represents a significant 'cultural' shift in the way that public money is applied for development, and indeed could be subject to criticism as effectively representing a subsidy to GHG-emitting entities in the private sector looking for cheap carbon offsets. However, without such a shift, the role of carbon offsets in rural development is reduced by an order of magnitude or more (given the comparative levels of ODA resources applied in the forestry sector and estimates of potential resource flows into the emerging carbon markets). A similar role could be fulfilled by a dedicated 'investment promotion agency' as proposed by Moura Costa *et al.* (1999) for UNDP. This could operate at a global scale within the context of the CDM, or nationally, capitalised by ODA and other public sector resources, within the frameworks of development banks or other development financing entities.

Figure 6.2 Potential role for a carbon offset Investment Promotion Agency (IPA)



The following sections contain some specific examples of how development assistance might be applied at the global, national, and local levels.

6.3.1 Applications of ODA at the global level

- Definition of principles and criteria (P&C) for rural development carbon offset projects, supporting especially participation of poorer countries and groups (note that experience of the FSC and other land use certification schemes would be useful in this regard)
- Dissemination of P&C into the global market place with a view to establishing market best practice supporting widespread information availability
- Application of principles to a portfolio of ODA funded projects to establish best practice supply-side case studies
- Creation of a sizeable market niche for rural development-based carbon offsets through promotion and/or requirement of P&C of demand-side actors

6.3.2 Applications of ODA at the national level

- Developing national capacity to assess carbon offset potentials and mainstream them in National Environmental Action Plans (NEAPs), National Sustainable Development Strategies (NSDSs), other land-use plans and rural development agencies
- Clear identification of opportunities for carbon offset investments so as to reduce risk and encourage both supply-side and demand-side initiatives
- Creating national frameworks for carbon offset projects
- Developing institutional capacity, e.g., national focal points or AIJ/CDM offices – these could be dedicated to opportunities in the land-use sector or across all sectors (i.e. an offset investment promotion agency)
- Support the development of national baselines, certification schemes, accreditation and certification bodies, and other institutional infrastructure consistent with global P&C
- Development of programme-level approaches (i.e. sub-national frameworks)
- Development of education and information materials to increase awareness of issues
- Supporting information exchange and networking between projects and institutions

6.3.3 Applications of ODA at the local/project level

- Capacity-building: institutional, technical and financial
- Project-level investments to help meet start-up costs, with concessionary finance, and to establish best practice in following types of activity: community forest management; integrated conservation management/land-use plans; agroforestry; sustainable/multiple end-use forest management; integrated energy and land-use systems
- Screening ODA portfolios (see also Section 6.3.1) to assess the role that carbon funding could play in e.g., ensuring project long-term financial sustainability

6.4 Research required to develop systems for sustainable rural livelihoods and carbon management

If carbon offset policy is to contribute positively to sustainable development, specifically for the rural poor and landless in developing countries, as elaborated above, many policies and mechanisms need to be put in place. The principles presented above are based on limited information and carbon offsets are operating in a highly dynamic environment. Therefore, research is needed to support the implementation and improvement of the principles. Priorities that have emerged include the following:

6.4.1 Global research

- Evaluation of the implications of different regulatory systems on feasibility and implementation issues of carbon trading
- Development of methods for baseline determination and setting of regional benchmarks
- Building a growing body of reviews of experience to date, that enables comparisons to be made for given rural livelihood situations, and making this widely available
- Micro-economics of carbon additionality in rural development projects
- Development of generic models for quantification and monitoring

6.4.2 National research

- Research to support assessment of relative advantages and disadvantages of investing resources into carbon trade

- Assessment of the best mechanisms for lowering transaction costs through e.g., extension systems, rural development banks and agencies, NGOs, and development projects
- Investigation of consistency among policies related to land use and linkages between local and national prerequisites
- Cost-benefit studies from perspectives of different stakeholders, to feed into a global body of information (6.4.1)

6.4.3 Local research

- Promotion of participatory appraisal of existing carbon offset projects to identify impacts on different groups, and related needs and priorities
- Identification of mechanisms that can ensure that a maximum proportion of carbon resource rent is channelled to poor farmers
- Evaluation of existing participatory rural development models for their applicability to carbon offsets
- Development of management models to contribute to needs for organisational strengthening among rural communities, to ensure the capacity for sustainable and equitable offsets.

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APPENDIX 1: Technical aspects of carbon offset projects – baselines, leakage and carbon accounting

A. Baselines

The emissions reduction associated with an intervention must be additional to what would have happened without the intervention (Section 4.1.2). The without project scenario that provides the standard for comparison is known as the baseline. Baselines are counterfactual or based on assumptions set within the socio-economic and regulatory environment in which the intervention takes places. Therefore, determination of baselines requires an understanding of many factors and their effects on terrestrial carbon storage.

In the pilot carbon offset projects, various approaches have been taken for baseline setting. The use of a reference year, or a fixed emission baseline, is fairly simple to apply but may not provide a credible measure of the business-as-usual case, as it assumes no change in carbon stocks in the absence of the project. Many projects have developed case-specific baselines that account for historical patterns of land use change and allow identification of subsequent land use decisions by the land holder(s). Where a time series of land use data are available, trend-based models may be developed to extrapolate from historical trends into the future. Process-based models have also been used for baseline setting, where emissions associated with land use change are predicted from models that allow one to simulate the impacts of interactions between various economic, technologic, and demographic factors. Baseline setting is challenging and problematic.

Baselines and additionality are particularly crucial to the CDM concept, because CDM projects will be able to create carbon offsets which can be used as extra emission credits adding to the pool of allowed amounts of emissions allocated to Annex B countries as set out by the Kyoto Protocol. This requirement for additionality is less important in the case of JI projects within Annex 1 countries, since any carbon offsets given to a project investor will be derived from an Annex B host country's allowed amounts of emissions, such that no extra credits are created.

B. Leakage and slippage

As discussed in Section 4, emissions externalities from carbon offset projects have been classified under the terms 'leakage' and 'slippage' (though increasingly leakage is being used as a catch-all term).

Slippage occurs when the GHG benefits from a project are partially negated by increased GHG emissions from similar processes in another area. The main sources of slippage are:

- *activity shifting* – activities causing emissions are displaced to another area (e.g.,

the displacement of logging activities due to a carbon offset project in forest conservation);
- *outsourcing* – activities on site continue much the same as in the baseline case, but with a change in ownership and thus responsibility, taking the associated emissions outside the boundaries of the project (e.g., contracting out goods and services that were previously produced or provided on-site).

Leakage occurs when a project's activities and outputs create incentives to increase GHG emissions from processes taking place elsewhere. These processes may or may not be directly associated with the project. The main sources of leakage are:
- *market effects* – higher emissions caused by shifts in residual demand (e.g., a reforestation project may result in over-supply of timber in a region, driving a drop in timber prices and a subsequent increase in wood consumption and associated waste (a non-associated form of leakage));
- *life cycle emissions* – often from emission changes in downstream processes (e.g., a project may inadvertently cause an increase in timber throughput at a highly inefficient processing mill, resulting in more wastage than prior to the project (an associated form of leakage).

C. Carbon accounting

Quantification of the carbon benefit associated with an intervention involves a comparison of the project case with the baseline. Various approaches have been used to quantify carbon benefits. Some are based on absolute measurements at a point in time, whilst others are based primarily on models. But generally the process involves identification of relevant pools and fluxes, quantification of these, and the prediction of future trends.

The carbon stores in forests that are likely to be relevant to carbon offset projects are plant biomass (trees and other vegetation, above- and below-ground), necromass (woody debris, standing dead trees, litter), and soil carbon (organic and mineral). In some circumstances, carbon stored in forest products (timber and/or non timber products), and energy resources are also likely to be relevant. The changes in carbon stores that are directly related to the intervention are often the focus of quantification efforts, but changes in all potentially important carbon pools need to be evaluated for their significance and vulnerability to change. More detail on approaches to measuring carbon can be found in (Sathaye *et al.* 1997, MacDicken 1997).

The method most commonly used for expressing carbon storage is based on quantifying the amount of carbon stored in a project at a given point in time, and deducting the expected amount of carbon that would have been stored in the baseline scenario. This is called the *stock change method* (also referred to as the *flow summation method*) (Richards and Stokes 1994), and measurements are usually expressed in tC ha^{-1}. Most estimates of carbon sequestration found in the scientific literature use this method. However, it is limited in so far as it provides only a 'snap shot' of the carbon fixed such that resulting values will vary depending on the often arbitrary decision of when to account for the project's benefits. For the same reason, it also does not provide a useful tool for comparison between projects.

To account for dynamic systems, in which planting, harvesting and replanting operations take place, an alternative approach has been used (e.g., Dixon *et al.* 1991, 1994), called the *average storage method* (Schroeder 1992). This method consists of averaging the amount of carbon stored in a site over the 'long-term' according to the following equation:

Equation (1)

$$\text{Average net carbon storage (tC)} = \frac{\sum_{t=0}^{t=n} \text{(carbon stored in project - carbon stored in baseline), in tC}}{n \text{ (years)}}$$

where *t* is time, *n* is the project time frame (years), and measurements are expressed in tC ha^{-1}. The advantage of this method is that it accounts for the dynamics of carbon storage over the whole project duration, not only at the times chosen for accounting. It is also useful for comparing different projects with different growth patterns.

Alternative approaches have been proposed to better address the temporal dimension of carbon storage. Most of these are based on adopting a two-dimensional measurement unit that reflects storage and time, i.e., the tC.year. The concept of an aggregate (tonne-year) unit has been proposed by several authors (Moura-Costa 1996; Fearnside 1997, Greenhouse Challenge Office 1997; Chomitz 1998; Tipper and de Jong 1998; Dobes *et al.* 1999; Moura-Costa and Wilson, 2000; Fearnside *et al*. 2000). The general concept of the tonne-year approach is in the application of a factor to convert the climatic value of temporal carbon storage to an equivalent amount of avoided emissions (this factor is referred to as the *equivalence factor*, or E_f, for the rest of this Section).

It has been proposed that the determination of equivalence parameters should be based on the length of time that CO_2 must be stored as carbon in biomass for it to prevent the cumulative radiative forcing effect exerted by a similar amount of CO_2 during its residence in the atmosphere, known as its Absolute Global Warming Potential or AGWP (IPCC 1992). In adopting the IPCC's GWPs (Article 5.3), and stipulating a 100-year reference time frame (Addendum to the Protocol, Decision 2/CP.3, para. 3), the Kyoto Protocol requires the AGWP for CO_2 to be calculated over the 100-year period following emission, as it is this timeframe which is used to relate the radiative forcing potential of the different GHGs. According to the Bern Model (used by the IPCC to calculate the forcing responses on which GWPs are based), CO_2 added to the atmosphere shows an initial fast decay over the first decades, followed by a more gradual decay thereafter (IPCC 1994). However, terrestrial carbon stocks, unlike atmospheric carbon, will hold constant and not decay. Moura Costa and Wilson, therefore, propose that the time required for reaching equivalence should be derived from the average concentration of a tonne of CO_2 in the atmosphere over a 100-year time period. The *equivalence time* (T_e) for 1 tonne of stored CO_2 should then be equal to the product of this average concentration and time (in this case, 100 years), and was calculated to be approximately 55 years, from which an *equivalence factor* (E_f) of 0.0182 tC.year was derived ($E_f = 1/T_e$; Moura Costa and Wilson, 2000).

Alternative methodologies have been proposed to generate these equivalence parameters. Tipper & de Jong, for example, base their calculations on the difference between current atmospheric concentrations and the pre-industrial 'equilibrium' concentration of CO_2 to derive a carbon storage period (T_e) of 42 to 50 years following initial sequestration, and an E_f of 0.02 to 0.023 (Tipper & de Jong 1998). Similar ranges have been proposed by the Greenhouse Challenge Office (1997, T_e = 60 years) and Chomitz (1998, T_e = 50 years). It should be stressed that these equivalence times are determined by the arbitrary 100-year reference time horizon adopted by the Kyoto Protocol.

Furthermore, how stored carbon released after T_e should be accounted for is uncertain, as the net benefit of delaying the radiative forcing effects of a unit emission through offsetting is unclear. Some authors argue that the release should not be accounted for as, under the terms of the Protocol, the $AGWP_{100}$ of a tonne of CO_2 is prevented by a tonne offset for T_e (Moura-Costa and Wilson, 2000). Others have examined the effects of the subsequent release as a delayed emission. Dobes *et al.* (1998), for example, use this approach in calculating that the storage of one tonne of carbon for one year is equivalent to avoiding the emission of 0.007 tC (E_f = 0.007).

Irrespective of the method used for determination of their value, these equivalence parameters could be useful for the accounting of GHG benefits of land use projects. Different applications have been proposed (Moura-Costa and Wilson, 2000), as follows:

- *Equivalence-delayed full crediting*, only recognising the full benefits of carbon sequestration after storage for a time period T_e ;
- *Equivalence-factor yearly crediting (tonne-years)*, by which a project is credited yearly with a fraction of its total GHG benefit, determined by the amount of carbon stored each year, converted using the equivalence factor E_f;
- *Equivalence-adjusted average storage*, using T_e as the denominator of equation (1) above.

The main advantage of using an *equivalence factor* tonne-year approach is that carbon storage could be credited according to the time frame over which storage takes place, consequently reducing the need for long-term guarantees and hence the risks associated with long time frames. If the forests storing this carbon pool suffer any damage, the proportion of carbon credits lost could be easily calculated. It would also allow a better comparison between projects, without introducing the subjectivity of time preference and discounting (see below). The main disadvantage of this method is that that there is still much uncertainty in relation to the permanence of CO_2 in the atmosphere, and consequently the values of the equivalence parameters T_e and E_f.