CHAPTER 10
INTRODUCTION AND A LAND-USE FRAMEWORK FOR THE NON-ENERGY SECTORS

10.1 INTRODUCTION

Chapters 10 through 14 of this book cover the three main land-based sectors—forestry, agriculture, and rangelands and grassland—and waste management. The land-based sectors are responsible for emissions of CO_2 associated with land-use changes, and they can also sequester carbon through photosynthetic processes. Together with the waste management sector, these sectors are also responsible for most of the anthropogenic emissions of the GHG methane, non-methane hydrocarbons, NO_x, and oxides of N_2. These sectors therefore provide opportunities for mitigating climate change through reduction of GHG emissions and/or through increased absorption and storage of carbon in perennial vegetation, detritus, soils, and in long-term biomass products.

In the forestry sector, the main mitigation options involve: 1) reducing emissions by maintaining existing carbon sinks through conservation and protection, efficiency improvements, and offsite fuel substitution, and 2) sequestering carbon by expanding vegetation cover and increasing carbon storage in soils and in long-term products.

In the agriculture sector, one option involves the adoption of agriculture practices that increase the amount of crop residue on or in ht surface soil layer; this reduces maximum temperatures and evaporation and increases organic matter in the soil, thereby trapping carbon in the soil Other agricultural options include reduction of GHG emissions from animal husbandry, rice production, and fertilizer application.

In rangelands and grasslands, most options are based on enhancement of carbon sinks through improved range management, wild fire management, animal husbandry, and biomass replenishment.

The main options in the waste management sector involve reducing methane emissions from landfills and waste-water treatment.

10.2 ESTABLISHING LAND-USE PATTERNS FOR MITIGATION ANALYSIS

The availability of land and its products shape the mitigation options in the non-energy sectors. Forests, range and grasslands, and agricultural lands together comprise most of a country's vegetative land area. Changes in the land-use pattern in one sector directly influence the magnitude of land available for the other sectors. Land conversion from forests to agriculture or to pasture lands is a common feature in many developing countries. Where afforestation programs are active, wastelands are being reforested to yield industrial wood products. Elsewhere, the construction of dams and urban sprawl are taking over what were once fertile agricultural lands. Ultimately, the amount of land area available in a country is fixed, and the bounty of the land has to be shared among its various users. Exactly how the lands are shared will be determined by land-use demand and supply factors, as moderated by land-use policy and law. Moreover, the options in each sector are influenced by cross sectoral issues rooted in the country's land use policy and law.

The regulations governing the distribution of land in one sector are often connected to those for the other sectors. Because of these interactions, it is important that the availability of land and its distribution for alternative activities be evaluated in a comprehensive manner with the participation of specialists on forestry, agriculture, and range and grasslands.

The existing models that incorporate land-use change are either small-scale, site-specific models for which applicability to the whole economy is difficult[1], or broad-based regional bio/physiochemical process models, the output of which can only be used as an intermediate input in simulating land-use redistribution among sectors.

For the purposes of mitigation analysis, the simple framework presented below can be used for tracking land use change over several decades. The framework requires exogenous inputs to relate current and future land use activity and product demand and supply. The most common factors that affect land use and its products include:

- Demographic variables such as human population and its growth rate, rural/urban distribution, and dependence on land resources

- Economic factors such as income level, technological development, dependence on export of land-based products, and rates of economic growth

- Type and intensity of land use, such as shifting versus permanent agriculture, or clear-cutting versus selective harvesting

- Biophysical factors such as soil productivity, topography, and climate.

Using this framework for a mitigation evaluation consists of two steps: 1) evaluating current and future land availability for the baseline and mitigation scenarios, and 2) determining the demand for land-use products and reconciling the availability of land to meet product demand.

Step 1: Evaluate land availability for the baseline and mitigation scenarios.

Step 1.1: It is useful to begin by describing the main policy and land tenure elements which determine the existing distribution among the three sectors, and to identify the likely trends in land-use change. The latter may include increased acquisition of forest land for agriculture or pasture, abandonment of agricultural land for pasture or to secondary forests, or loss of primary forest lands to severely or permanently degraded lands. The analyst should define a baseline scenario using these elements as a basis.

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[1] One such model is LUCS, which has a project-level focus, with a capability for cost-benefit analysis (Faeth *et al.*, 1994).

Table 10-1 shows the land area changes for a hypothetical country. In this example, range and grasslands are considered a subset of forest land. (This example is also used to illustrate the evaluation of the forestry sector mitigation options in Chapter 11.)

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Current land area statistics are organized as shown in the table. Government plans and other ongoing trends of afforestation, land conversion, etc. may be used to determine a baseline mosaic of future land use patterns. Plans for land area changes are usually not available beyond a 5-10 year time horizon. These may be extrapolated to estimate each type of land area up to 2030.

Step 1.2: A land-use pattern for a mitigation scenario may be constructed using the above baseline trends as a starting point. The example assumes future changes in land use in order to illustrate two types of forestry mitigation options. The first option is to protect 12,000 ha of current national park land, which is being depleted to 1000 ha in the baseline scenario by 2030. The second option is to reforest 40,000 ha of wastelands into forest land.

Step 2: Determine or estimate the demand for products (fuelwood, timber, crops, etc.) of land use and reconcile the land availability with the demand.

Step 2.1: The 1990 forest products demand is shown in the example (Table 10-2). Each type of land area is a source of several products. If mitigation options are to be successful, it is imperative that the future demand for these products be satisfied either through more intensive use of land or through imports of products. Alternatively, countries may also wish to pursue a strategy to replace non-wood products with wood ones. In our example, we illustrate such a scheme whereby wood produced from reforested wastelands is used to replace non-wood industrial products. Countries exporting timber products would also want to ensure that revenue earned from exports does not diminish because of the implementation of options.

The example shows fuelwood, industrial wood, agricultural products, livestock, and electricity generation (hydro) as the products that might be derived from land. The analyst should include products appropriate to his/her country.

For 1990, the example shows the absolute demand for, and the supply of, each product and its intensity of land use. It is important to ensure that the land-use intensity does not exceed well- known norms for each type of product. These norms may be obtained in consultation with specialists in the country.

Step 2.2: The baseline demand for these products may be projected to 2010 through the use of econometric models, end-use projections, and other techniques. Alternatively, estimates of demand may be obtained from experts in the field. For the baseline scenario, the example shows the absolute product demand and supply from various types of land use and the intensity of land use in 2010 for each product (Table 10-3).

Step 2.3: Table 10-4 shows the effect of the two forestry mitigation options on product supply for 2010. The non-wood industrial products in the baseline scenario are replaced by production from reforested wasteland in the mitigation scenario. The protection of national parks results in a loss of 40,000 tonnes of agricultural products which are imported in the mitigation scenario. The evaluation of these two options, reforestation and protection, is described in Chapter 11.

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Similar analyses should be conducted for 2030 for both scenarios. If the demand for the products cannot be met, then either the mitigation options will need to be modified or the product may need to be imported.

Use of the framework described above requires interaction among experts working in the forest, agriculture, range and grasslands, and energy sectors. Each sectoral specialist should construct his/her own baseline and mitigation scenarios and reconcile the projected overlapping use of land with experts from the other sectors. This process will yield a consistent set of baseline and mitigation land-use scenarios.

REFERNCE

Faeth, P., Cort, C. And Livernash, R. 1994. Evaluating the Carbon Sequestration Benefits of forestry Projects in Developing Countries. Washington, D.C.: World Resources Institute and U.S. Environmental Protection Agency.