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Preface

Concern about climatic warming has resulted in a number of international conventions that may influence land-use decisions in signatory countries. The United Nations Framework Convention on Climate Change (UNFCCC), together with the Kyoto Protocol ratified in early 2005, provide the framework for actions required of the signatory parties.

The objective of UNFCCC is to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. This level should be achieved within a time frame that allows ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable sustainable economic development. The above principles are further developed in the Kyoto Protocol, according to which each country has to establish its level of carbon stocks in 1990 and enable an estimate of changes in carbon stocks in subsequent years. It is also stated which additional human-induced activities related to changes in GHG emissions from agricultural soils and land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts. The parties to these conventions are required to develop, periodically update and publish national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases. Calculations should take into account the best available scientific knowledge.

In the European Union, the Kyoto Protocol to the UNFCCC was approved by a Council decision in 2002. The member states have to determine and report to the Commission each year the elements of the national inventory report necessary for the preparation of the Community GHG inventory report. Such information includes member state's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed, and steps taken to improve estimates, for example where areas of the inventory have been subject to adjustments. The member states shall also submit national inventories to the UNFCCC Secretariat each year.

Reporting by the member states follows the guidelines for the preparation of national communications by the parties, and reporting in the land-use sector will follow the *Good Practice Guidance for Land Use, Land-Use Change and Forestry* in 2003. The basis for the methodology is the assumption that the flux of CO_2 to or from the atmosphere equals changes in carbon stocks in existing biomass and soils, and changes in carbon stocks can be estimated by establishing rates of change in land-use and the practice used to bring about the change. This approach can be generalized and applied to all carbon pools, subdivided as necessary to capture differences between ecosystems, climatic zones and management practice. In the basic approach, the "activity data" are the areas of land use or land-use change. The generic guidance is to multiply the activity data by a carbon stock coefficient or "emission factor" to provide source or sink estimates. Greenhouse gas emissions and removals for each source can be estimated using one of three "tier levels", from the use of simple equations with default values to country-specific data in more complex national systems. The tiers progress from lower to highest levels of certainty in estimates as a function of methodological complexity, regional specificity of model parameters, and spatial resolution and extent of activity data. For higher tiers, inventory agencies may need to provide additional documentation to support their decision to use more sophisticated methodologies or country-defined parameters. Moving from lower to higher tiers will usually require increased resources, and institutional and technical capacity.

The importance of peatlands to global climatic change is attributable to the large carbon store that has accumulated in them over millennia. The carbon store of the ca. 450 million hectares of northern peatlands alone has been recently estimated at between 270 and 370 Pg, with an annual sink of approximately 0.66 Tg. Land-use change has been assumed to cause drastic changes in the carbon gas exchange between peat soils and the atmosphere. Global estimates of peatland area reclaimed for agriculture vary between 6 million hectares to 14 million hectares. In the 1960s in Finland, some 0.7 million ha of cultivated cropland was on peat but the area has clearly decreased since. Present estimates for cropland soils with organic matter contents above 20% are ca. 0.3 million ha. Reclamation for agriculture always brings about drastic changes in ecosystem functions, and consequently in the GHG balances.

Drainage for forestry production has been a major form of peatland land-use. Globally, the area of drained peatland forests is estimated at nearly 15 million ha. In Finland, the area of drained peatland forests is presently ca. 4.9 million ha, which excludes the area of shallow peat layer that is now classified as upland forest. Since changes in the ecosystem are relatively smaller after drainage for forestry, changes in soil carbon stores are expected to be smaller as well.

The area of energy peat harvesting in Finland is ca. 60 000 ha, varying annually somewhat with weather conditions of the summer period. As vegetation and surface peat layers are removed, changes in the peatland functions and GHG exchange are drastic. It has been estimated that some 40 000–45 000 ha of abandoned peat harvesting areas will be available for other uses by 2010. Most are likely to be afforested, but some of the area will be used for energy crops, such as *Phalaris arundinacea*, or restored to peat forming wetlands. These post-harvesting land-uses may return some of the carbon lost during the harvesting period and in combustion.

To comply with international climate change conventions, the Government in 2001 had prepared a National Climate Strategy of Finland to reduce GHG emissions and to meet Kyoto Protocol targets. According to the Climate Strategy, the principles and measures concerning peat with respect to the Convention on Climate Change and other international cooperation are as follows:

— The needs for supplementary research will be mapped out and a research programme will be launched based on this mapping for a life cycle analysis of the energy use of peat.
— If it is justified on the basis of the research findings, measures will be undertaken to influence the rules and definitions of the methodology used for calculating greenhouse gases by virtue of the international Convention on Climate Change. In this, the aim will be that the calculation methods subject to the Convention would take the greenhouse gas balance of peat into account during the entire life cycle and not just the emissions from combustion.
— To be able to influence the Convention on Climate Change, clear criteria, besides new research data, will be required for the energy use of peat. The criteria shall include the definition of those peatlands on which the production of energy peat will be directed, as well as the requirements for subsequent use of peat production areas. Based on the decisions in the National Climate Strategy, the research programme *Greenhouse impact of the use of peat and peatlands in Finland* aimed at producing emission factors for the life cycle of the energy use of peat (combustion excluded) was started in 2002.

The life cycle includes:

— Pre-harvesting situations, which in Finland comprise pristine, forestry drained or cropland peatlands.
— Harvesting period (production fields, stockpiles).
— Post-harvesting land-use, most often afforestation or restoration to wetland.

Besides providing data for the life cycle analysis, the programme also covers reporting needs, concerned with the LULUCF sector of organic (peat) soils, for the national GHG inventory and communications to the Commission and the Secretariat of the UNFCCC.

The programme was an umbrella that covered 10 research projects, closely coordinated to provide the desired result. Most of the projects covered a certain sector of land-use in peatland; some provided technical and methodological expertise. The projects included were:

— Coordination of the programme.
— Ecosystem and regional scale models on peatland gas exchange.
— Quality control of measurements.
— Net ecosystem exchange of carbon dioxide on forested peatlands.
— Radiative forcing and LCA models.
— Greenhouse gas balance of natural mires.
— Greenhouse gas balances in forestry drained peatlands.
— CO_2, N_2O and CH_4 balance of afforested fields and cutaway peatlands in Finland.
— Greenhouse gas emissions from cultivated and abandoned organic agricultural soils.
— GHG balances of the restored cutaway peatlands.

The main findings of the sectoral projects, together with dynamic emission factors derived from the data are presented in this issue of *Boreal Environment Research*. Besides the programme results, also reporting systems for the National Communications concerned with the LULUCF sector of organic soils, are described.

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