COFORD
NATIONAL COUNCIL FOR FOREST RESEARCH & DEVELOPMENT

Forests and climate change mitigation and adaptation

The earth's climate is warming at an alarming rate, due to anthropogenic emissions of greenhouse gases (GHG), mainly CO^2. About 75% of human-induced CO^2 emissions arise from fossil fuel use, with the remainder due to land-use change, particularly associated with deforestation in tropical and semi-tropical areas.

Attempts to reduce emissions have led, at the international level, to the agreement of the UN Convention on Climate Change (UNFCCC) and, in 1996, the Kyoto Protocol, which limits emissions in signatory countries in the developed world, to 5% below the 1990 level, over the period 2008-2012.

Given the rapid growth of the Irish economy over the past decade, GHG emissions are running well ahead of the 13% increase on the 1990 level (allocated to the country under the EU burden-sharing agreement). The latest year for which emission data are available, 2004, show them running at 23.1% above the 1990 level (EPA).

Under the terms of the Kyoto Protocol, carbon sequestration by forests may be used to offset greenhouse gas emissions. For the first commitment period, 2008-2012, net carbon sequestration and emissions by Article 3.3 forests[1] (including afforestation and deforestation) come under the protocol's accounting framework

Private and state afforestation expanded the forest estate by ~ 186,000 ha over the period 1990-2000. Assuming a business-as-usual-scenario, and based on current research, it is estimated that the contribution of Article 3.3 forests (just over 2 million tonnes CO^2 per annum) will account for ~ 16 % of the required reduction in emissions (13.05 Mt CO^2 equivalents per year over the period 2008 to 2012) in national emissions for Ireland to meet its Kyoto target (see Figure 1).

Research

The CARBiFOR project cluster, funded by COFORD, was established in order to provide improved estimates of biomass carbon (C) stocks and sequestration rates for the dominant forest type in Ireland. Based on inventory methods, the average C sequestration rate, over 45 years of the life cycle of a Sitka spruce chronosequence, was estimated to be 5.7 t C ha^{-1} yr^{-1}. Age-related changes in biomass increment and soil C stocks were associated with differences in leaf area index and litter inputs during stand development.

Cross-validation of standard inventory and real-time measurements (Figure 3) suggest that inventory-based estimates of C sequestration were slightly lower than 'full accounting' (eddy covariance, Figure 3) assessments. The lower inventory estimates may be associated with unaccounted C fluxes, including fine root production/turnover and below ground losses. Additional long-term assessments of C stock changes in different aged stands, and for different forest species, are required to provide a comprehensive assessment of emission factors and C pools, which are not accounted for when inventory methods are used.

Research, FIPS (forest inventory) and planting record data were used to develop a national carbon stock change reporting model (CARBWARE) to estimate national sequestration rates for both Kyoto (post-1990 afforested areas, Figure 1) and UNFCCC reporting on LULUCF[2] (all forest activities). These estimates were based on generalised conifer and broadleaf forest growth models and emission factors associated with decomposition and land-use change into forestry (Figure 2). The CARBWARE model is currently being modified to account for species and soil specific changes in C stock in all of the forest ecosystem and end products (see Figure 2).

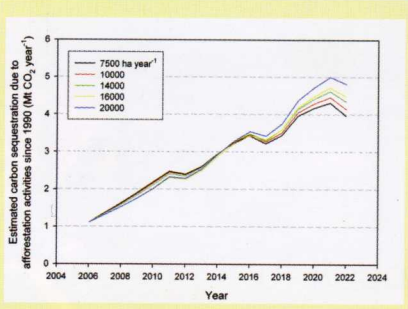

Figure 1: Estimated sink capacity of Irish forests under article 3.3 of the Kyoto protocol. The model (CARBWARE) assumes different afforestation rates (legend) since 2006. The current National afforestation target is 15000 ha per year. Declines in sequestration are related to projected wood harvest.

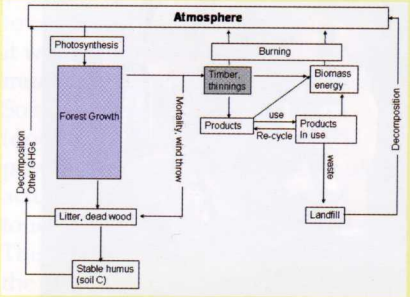

Figure 2: The conceptual of a carbon reporting model (CARBWARE) that simulates stocks and fluxes of carbon in a forest ecosystem and wood products and the role of forests in the global carbon cycle.

Figure 3: Real-time measurements of CO^2 exchange between the atmosphere and a forest ecosystem using eddy covariance equipment located above and below the forest canopy.

Future research

Work in the future will be aimed at:

- Developing a fundamental understanding of forest and harvested wood product carbon dynamics and cycling (Figure 2).
- Refining CARBWARE estimates of the sink capacity of Irish forests for reporting to the Kyoto Protocol and the UNFCCC, using National Forest Inventory data and new research techniques (Figure 3).
- Assessment of the impact of IPCC[3] climate change scenarios on forest ecosystems, the development of adaptation strategies, as well as the role of forests in overall climate change adaptation.

Dr Kevin Black, UCD
Email: kevin.black@ucd.ie
Tel: 01-716 2260

[1] Land-Use, Land-Use Change and Forestry
[2] International Panel on Climate Change
[3] Afforestation since 1990.