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**CLIMATE CHANGE, STABILISATION AND  
CARBON SEQUESTRATION**

**A STATEMENT FOR THE SECOND SESSION OF COP 6**

**AN IMPORTANT ENVIRONMENTAL CHALLENGE FOR  
EUROPEAN LAND MANAGERS**

**July 2001**

# European Landowners Organisation

## CLIMATE CHANGE, STABILISATION AND CARBON SEQUESTRATION

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#### AN IMPORTANT ENVIRONMENTAL CHALLENGE FOR EUROPEAN LAND MANAGERS

*The European Landowners' Organisation, (ELO), which is an observer to the UN Framework Convention on Climate Change, represents the landowners' associations of the European Union and maintains regular contacts with the associations of central and eastern European countries. Members of the national associations grouped together in ELO are actively involved in agriculture, forestry, fisheries, game, recreation and tourism in the countryside, biodiversity, and all forms of rural business and land management. The ELO therefore has a major interest in the potential impacts of climate change and policies for adaptation, mitigation and stabilisation. This has been further highlighted by the recent report by the Country Land and Business Association (CLA), representing England and Wales, in its report **Climate Change and the Rural Economy**, (July, 2001).*

#### **SUMMARY**

The European Landowners' Organisation (ELO), representing the national landowners' associations of fourteen EU member states, recognises and fully supports the overriding need to stabilise climate and to implement the Kyoto Protocol as a first step towards doing so. The principal task will be to achieve adequate real cuts in emissions but the correct management and development of carbon sinks must be an integral, complementary part of the strategy.

Contentious issues surrounding sequestration were among the principal reasons for the failure of the first session of COP 6 at The Hague in 2000. Evidently there is a risk of constructing an essentially spurious global carbon sequestration industry instead of actually reducing emissions. Nevertheless, the sheer importance of carbon sinks requires their effective integration in climate policy.

Issues of permanence and verification must be addressed in the context of land-management policy and accompanied by the development of robust and transparent systems of carbon accounting for land managers. Trading within the Kyoto framework should be correctly designed to avoid distortions and to preserve equity, but it could offer important support for the development of new (post-1990) carbon sinks. In the same way, national and European policies must recognise and support the management of sinks in general without compromising the 1990 Kyoto baseline. This should include payments for environmental benefits made under the Common Agricultural Policy and other national agricultural policies in Annex I countries.

## **CLIMATE CHANGE AND THE COP 6 NEGOTIATIONS**

The ELO attended the fifth Conference of Parties at Bonn in 1999 and the first session of the sixth Conference of Parties at The Hague in 2000. In its statement for COP 6 last year, the ELO stressed the potential impacts and implications of climate change in terms of:

- Stabilisation of greenhouse gases
- Sea-level rise
- Water, water availability and rivers
- Agriculture
- Forestry
- Land use, land-use change and forestry

In particular the ELO recalls that the Kyoto targets themselves, amounting to a 5.2% cut on 1990 emissions, can only be a first step towards fulfilling the objective of stabilisation of greenhouse gas concentrations in the atmosphere declared by Article 2 of the Convention. The Conference of Parties should select an initial target for stabilisation of atmospheric carbon not higher than 550 ppm, which itself would still imply warming of some 2.5°C, and indicate how successive commitment periods might achieve that, with the gradual acceptance of targets by Non Annex I countries during the process. **Failure to take adequate action under Article 2 inevitably raises profound issues of equity, and basic questions of compensation for life and property. The IPCC Third Assessment Report (2001) makes this plainer than ever.**

The first session of COP 6 broke down over a number of controversial but essential issues, and principally:

- The interpretation of 'additional, human-induced activities' in Article 3.4 of the Protocol in relation to the 1990 base-line, including the question as to whether the growth in the standing volume of timber in pre-1990 sinks could represent such an activity, and issues related to the inclusion of sinks in agricultural soils in the first commitment period.
- Associated issues of permanence and verification in relation to sinks.
- The inclusion of sinks in the Clean Development Mechanism, although Article 12 of the Protocol refers to emissions reductions and not to removals by sinks
- A cap on the use of sinks to meet commitments.
- A cap on the use of trading to meet commitments (supplementarity)
- The transfer of emissions reductions units to third parties (fungibility)
- Compliance

## **AGRICULTURAL AND FOREST SINKS**

The potential for additional carbon sequestration in woody biomass and soils has received considerable attention recently, (Watson and others, Land Use, Land-Use Change and Forestry (IPCC, 2000), Liski and others (2000) on trees as sinks in the EU, and Pretty and Ball (2001) on agriculture).

Agriculture contributes directly to greenhouse gas emissions through the use of fossil fuels (carbon dioxide), by the use of artificial fertilisers (nitrous oxide), by emissions from livestock and from rice paddies (methane), and through the release of soil carbon due to loss of organic matter during cultivations. However the use of reduced tillage, improved rotations, cover crops, fertility management, erosion control and irrigation management can accumulate soil carbon. In the USA, it has been calculated that the use of the mouldboard plough can result in annual losses of 0.105

to 0.460 tC/ha with continuous maize or wheat and 0.033 to 0.065 tC/ha in mixed rotations and cover crops, whereas zero tillage can achieve gains of 0.330 to 0.585 tC/ha annually under continuous maize or soya beans and 0.660 to 1.310 tC/ha with mixed rotations and cover crops, (Pretty and Ball, 2001). The planting of biomass crops for energy can also play an important role in substituting fossil fuel sources. Table 1 (adapted from Pretty and Ball (2001)) summarises options for reducing green house gas emissions from agriculture and increasing carbon sinks on estates. Table 2 (From Watson et al (2000)) shows how improved management can increase carbon sequestration under various land management systems.

Half the dry volume of woody biomass is carbon and forestry is potentially the most effective land use in terms of carbon sequestration, especially when management of the timber is integrated with that of the forest soil. The importance of this function in relation to existing woodland sinks is recognised by the requirement under Article 3 of the Kyoto Protocol to bring deforestation since 1990 into account in calculating emissions. There is, however, potential for a drop in the volume of timber in existing forests that falls short of deforestation.

Different species grow, and so accumulate carbon, at different rates but the effect of rotations based on clear-felling is broadly to equalise the rate of sequestration over time, (Cannell (1999) demonstrated 2 tC/ha in the UK context). However, in different situations, the same species will perform differently, rainfall being a critical factor, (*ibid.*). It is likely that continuous-cover, selection forest with mixed species continues to sequester further carbon for longer than most fixed-rotational forestry, as well as giving better protection to the forest soil. At Couvet, Switzerland, where conversion to the selection system (*jardinage*) began in the late nineteenth century, 'normal' forest is not expected to be achieved until the end of the present century. This is comparable only with some of the very long rotations (over 200 years) in certain continental oak forests. Selection forest does, however, require very high management skills in relation to the balance of species and ages, including the management of natural regeneration.

Forestry is also a source of emissions through the release of soil carbon, (with variation according to soil type), on planting or, under clear-fell systems, replanting, through dying or dead trees, whether caused by neglect (underthinning) or other causes (fire, disease, drought), through direct energy use and, to some extent, through fertiliser use to assist establishment.

Currently, the annual increment of woody biomass in most Annex I countries is not fully harvested, (*Temperate and Boreal Forest Resource Assessment 2000*, (UNFAO, 1999), Annex 3B.3 at pp. 169-70), the figure for EU15 indicates an annual increase of 63.21 TgC. However this masks important differences around the member states. Under UNFAO definitions, trees would be a net source of emissions for eight countries in 2008-2012, although under IPCC definitions this would be so in only three countries, the difference being due to the way reforestation is treated, (Liski and others, 2000). The total EU forest sink currently sequesters about 7% of annual EU anthropogenic CO<sub>2</sub> emissions, (*ibid.*), although for the UK the figure is less than 2%, (Cannell, 1999). The suitability of each species for the site is an important factor, and issues of native and non-native species and biodiversity require a careful and balanced approach.

**Table 1** – Land use options for reducing carbon and other greenhouse gas emissions and increasing carbon sinks

Options for reducing carbon and other greenhouse gas emissions from estates	Options for increasing carbon sinks on estates
<ul style="list-style-type: none"> <li>• Conserve fuel and reduce energy use</li> <li>• use conservation tillage to reduce CO<sub>2</sub>-emissions</li> <li>• grass-based grazing systems to reduce methane emissions from livestock</li> <li>• composting to reduce manure methane emissions</li> <li>• substitute biofuels for fossil fuels</li> <li>• reduce machinery use</li> <li>• reduce use of inorganic fertilisers</li> <li>• use targeted and slow-release fertilisers</li> <li>• develop wind farms</li> <li>• reduce the importance of unmanaged forest</li> <li>• replace tree species badly suited to their sites</li> <li>• improve efficiency and insulation of buildings</li> </ul>	<ul style="list-style-type: none"> <li>• reduce ploughing with conservation- and zero-tillage</li> <li>• use mixed rotations using cover crops and green manures</li> <li>• minimise summer fallows and periods with no ground cover</li> <li>• apply composts and manures to soil</li> <li>• improve pasture and rangelands through grazing and vegetation management</li> <li>• use perennial rather than annual grasses, as perennials have 60-80 % of biomass below ground compared with 20% for annuals</li> <li>• restore and protect wetlands (provided carbon sequestration is greater than methane production)</li> <li>• convert agricultural land to woodlands</li> <li>• adopt agroforestry in cropping systems</li> <li>• cultivate crops for biofuels (grasses, coppiced trees)</li> <li>• encourage managed forestry, including mixed, uneven-aged forest with continuous cover</li> <li>• develop biomass</li> </ul>

**Table 2** – Additional carbon sequestration due to improved management in various land use systems (typically declining to zero over 20 to 40 years from conversion or adoption, except in long-rotation or selection forest)

System	Rate of gain under improved management within land use (t C/ha/year)	Rate of gain with land use change (t C/ha/year)
Forest management	0.53	-
Cropland management	0.32	-
Grazing land management	0.53	-
Agro-forestry	0.50	~0
Rice paddy	0.1	-
Urban land management	0.3	-
Conversion of arable to grassland	-	0.8
Wetland restoration	-	0.4
Degraded land restoration	-	0.25

*Average values for Annex I (industrial) countries*

## **INTEGRATED LAND-BASED CARBON ACCOUNTING**

Farms and estates can integrate greenhouse gas and carbon accounting into their own management accounts to enable them to monitor performance and respond accordingly. The methodology is, however, still at an emergent stage and in particular requires further development as regards sequestration, especially in soil.

Many **agricultural emissions** can be calculated easily because they represent inputs which are already identified. Consumption of energy derived from fossil fuels can be computed from invoices, applying the appropriate coefficient to the number of units bought (kWh, therms or litres), following the IPCC Greenhouse Gas Inventory Reference Manual, Revised Guidelines for National Greenhouse Gas Inventories, to give emissions in kg CO<sub>2</sub>. In the case of ammonium nitrate fertiliser, the quantity is multiplied by the percentage nitrogen content (stated on the bag or container) and multiplied by 0.0125 to give kg nitrous oxide (N<sub>2</sub>O). In both these cases, if invoices are used, an adjustment for stock carried over should be made. The factors for enteric fermentation in adult livestock are 48 for cattle, 8 for sheep, and 2.5 for pigs per adult animal with a further factor for manure (6 for dairy cattle, 3 for beef cattle and pigs, 0.2 for sheep). Applied to the number of livestock on the holding, this gives the methane (CH<sub>4</sub>) emissions in kg per annum. (Source: Department for Environment, Food and Rural Affairs, UK). All greenhouse gas emissions are then converted to their CO<sub>2</sub> equivalent, multiplying the N<sub>2</sub>O figure by 310 and the methane figure by 21. The final total of emissions expressed in kg CO<sub>2</sub> can be converted to kg carbon by dividing by 3.67.

**Woodland inventories** currently rely on varied methodology from measuring every stem over seven cm diameter at breast height every seven years in some selection forests (Couvets) to the use of standard yield tables for even-aged monocultures. The annual increment (woody volume x specific gravity) is discounted by 50% to obtain carbon sequestration. Successive inventories would be required to establish the annual rate. The inclusion of trees planted for agroforestry, and hedgerow, parkland and amenity trees, would be significant in many cases. In clear-felling systems, subsequent rotations in principle simply replace harvest, unless a smaller or larger crop results. In continuous cover selection forest, this point would be reached when 'normal' forest is achieved.

The soil type is crucial to **sequestration in agricultural and woodland soils**. This would require monitoring by sample for each soil type represented. In agriculture, the risks of reversibility due to a change in farming practice or climatic events such as erosion are significantly greater. This is the area where methodology most needs development.

A number of factors potentially affect the eventual net emissions or sequestration balance on the farm or estate. These include lower energy use from greater efficiency or, seasonally, favourable weather conditions, the different fertiliser needs of individual crops, the extent of setaside or uncultivated land, stocking densities, the balance between arable land and pasture, the size, structure and management of the woodland area, and the inclusion or exclusion of domestic use. An estate would have to differentiate between land directly managed by the owner and land and buildings in other management or occupation, including tenanted farms, houses, and buildings. A separate carbon sequestration figure is needed in respect of post-1990 sinks.

Preliminary calculations based on mixed cereal and non-intensive livestock farming in the east of England suggests that such operations might have emissions of about 0.3 tC/ha annually, excluding any losses of soil carbon. Additional soil sequestration at the rates indicated earlier might therefore balance or exceed this figure until the soil sink reached optimum capacity. If one leaves farmland soil out of account, a proportion of woodland would be capable of bringing the property into carbon balance. Assuming the property was entirely farmland and woodland, then

approximately 13% woodland would be needed if 2 tC/ha were sequestered annually in the trees, woodland soil and litter, rising to 37% where the sequestration rate fell to 0.5 tC/ha. With the right land-management policy, a farm or estate that was currently in imbalance could use soil carbon to come into balance and woodland to remain there for the next fifty to hundred years.

## **CARBON TRADING**

Articles 6 and 17 of the Kyoto Protocol allow Annex I countries to trade among themselves in emission reduction units resulting from cuts in anthropogenic emissions or the enhancement of anthropogenic removals by sinks, provided such trading is supplemental to domestic action to meet their commitment. Such countries would effectively trade on a net basis in relation to their 1990 baseline and their Kyoto targets. However internal carbon trading markets are already beginning to develop in advance of agreement on the implementation of the Protocol.

It is plain that carbon trading systems should preserve transparency and equity, and avoid creating distortions, or potential obstructions to the implementation of new targets in successive commitment periods. The consistency, compatibility, accuracy, and verifiability of the accounting systems underlying them are fundamental. For trading under the Protocol, it would be adequate to include the 1990 baseline with subsequent changes in emissions and sinks, but a land manager's carbon accounts must be all-inclusive. It is currently a matter of some concern that individual landowners have been approached to sell carbon sequestration rights before any such systems are available and without having carried out their own carbon audits.

Currently, the price of carbon itself remains problematic. If it were based on the external cost of each tonne of carbon emitted with an assessment of damage, mitigation and adaptation costs, the value in Europe might be as high as US\$95 or \_ 110 per tonne, as quoted by Pretty and Ball (2001). It might however be based instead on the cost of implementing specific policies, or on the amount a business was willing to pay as an offset against its own emissions, in relation to the cost of meeting more exacting standards itself. Currently, trading systems are using values of between US\$ 5 to \$ 25 (\_ 6 to \_ 28) per tonne.

There are a number of questions of relevance for landowners here:

- How would a purely national or EU carbon trading system relate to a trading system established under the Kyoto Protocol? Would both systems incorporate the 1990 Protocol baseline?
- Some national schemes envisage the participation of industrial companies which can show they are making real cuts in emissions, but have no structures for including sinks. How is equity between industry and land management preserved in such cases?
- Would individual companies without any in-built sequestration capacity trade, like Annex I countries, on a net basis in relation to targets? Landowners with net emissions should presumably be in a similar position.
- Landowners would, however, often be able to show positive balances on their carbon accounts. Would they be able to trade net in relation to targets or in relation to their real carbon balances? (What about carbon taxes paid by them on their own emissions?)
- Should sequestered carbon be sold on an annual basis, or under a contract for a longer term?
- If the contract is a futures contract, how should non-delivery or supervening impossibility be treated?
- How should carbon inventory periods relate to contract periods?

- If timber (especially hardwood timber) is sold, how will the price reflect the carbon sequestration potential of the end use? Would that element be traded separately?
- After harvest in a clear-fell system, would an owner simply have to replant within Article 3 to go on trading carbon, or, would the carbon previously sequestered first have to be replaced, or would this depend on the overall balance of the estate owner's carbon account?
- How should market-failure be treated, for example where the price of carbon does not reflect the externalised cost of emissions?
- If eventually the transition to a low carbon economy is made, should the cost of residual anthropogenic emissions be fully internalised through trading?

## **CONCLUSIONS: SINKS MANAGEMENT, CARBON TRADING, AND THE KYOTO PROTOCOL**

It is recognised that certain agricultural and silvicultural practices contribute to emissions of greenhouse gases. Land managers share the responsibility to develop systems which reduce these emissions. However, it cannot be emphasised too strongly that sustainable agricultural and land management can make an important contribution to climate change mitigation through carbon sequestration. If practical ways can be found to resolve the market failure that occurs where there is no financial acknowledgement of the role of the individual land manager who sequesters carbon, a virtuous circle can be created. Carbon accounting becomes the land manager's own tool as a measure of sustainability. More environmentally conscious farming takes place and society benefits from the reduced emissions and the increased removals by sinks, as well as from better soil, water conservation and biodiversity. To complete the circle, the agricultural and silvicultural systems which result are more energy-efficient, particularly because of their lower reliance on fossil fuels and on inputs which are themselves energy-intensive to manufacture.

The ELO has no doubt that, even though the Kyoto Protocol is facing political pressures from the United States of America, the issue of climate change will still have to be addressed through the framework of the Convention. The underlying forces of climate change will not vanish on their own, and no satisfactory, binding and inclusive alternative to the Protocol is in place. It is essential therefore to resolve the issues surrounding sinks in a way which will permit the ratification of the Protocol and then allow the issue of future commitment periods to be tackled.

There are a number of reasons why credits should not be given under the Protocol for the increment in carbon sinks already existing in 1990. It would breach the Kyoto baseline and the increase is clearly influenced by natural growth cycles. Meanwhile, the Annex I countries' emissions have actually increased. A 5% cut on 1990 levels equates to roughly 0.225 Gt carbon compared with a current global annual increase of some 0.877 Gt carbon stored in woody biomass. To include at this stage such a large sink would destroy the calculations on which the cuts for the first commitment period were based. Other necessary decisions relate to a cap on the use of a nation's own sinks towards its targets, a cap on the use of trading, the CDM, and compliance.

That done, a robust, fair and transparent system of carbon trading must be developed under Articles 6 and 17, which will preserve equity, avoid creating distortions, and facilitate rather than obstruct future targets. The link between trading within the Protocol and internal carbon markets needs clarification. It is also plain that there should be an integrated, land-based approach to accounting.

Complementary to trading within the Protocol is the management of existing sinks. If such sinks are mismanaged there is enormous capacity for the resulting carbon emissions to outweigh the beneficial effects of Kyoto. While it is clear that all sequestration cannot be counted against Kyoto

targets, it is essential that national policies should recognise and support the role of sinks in general. This, indeed, would be a win-win approach, since carbon sequestration would be rewarded without each tonne sequestered enabling in practice a counterbalancing tonne of emissions elsewhere. It would also provide much-needed extra income for farmers at a time when agricultural policies are, in any case, in the slow process of switching from commodity to environmental support. In the EU therefore, there is a strong case for appropriate incentives for this good management, possibly through such mechanisms as reformed rural policy arising out of the CAP.

This offers a unique opportunity for EU decision-makers to go in the direction requested by the public and to meet the wishes for not only a more environmental friendly CAP, but also a more environmental friendly society. Challenges remain to solve the technical problems of defining contracts to deliver these benefits. The ELO proposes that EU decision makers consider joint support to increase carbon sinks through following mechanisms :

- 1) Embracing carbon-accounting as part of more general whole-estate, environmental audit under the compliance article of the Agenda 2000 Horizontal Regulation (1259/99) to raise awareness of land managers of the impacts of their activities on the environment.
- 2) The rural development scheme where good agricultural practices and afforestation fit perfectly well.
- 3) The establishment of a commercial trading system to include carbon sinks.

In addition member states must be encouraged to adopt appropriate fiscal credits to encourage environmentally appropriate uses of land, and ensure a level playing field in terms of the price of fossil fuels across the EU.

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