EXECUTIVE SUMMARY FOR POLICYMAKERS "PEATLANDS IN GLOBAL CHANGE"

Extent and importance

1. Peatlands cover an estimated area of 400 million ha, equivalent to 3% of the Earth's land surface. Most (c. 350 million ha) are in the northern hemisphere, covering large areas in North America, Russia and Europe. Tropical peatlands occur in mainland East Asia, Southeast Asia, the Caribbean and Central America, South America and southern Africa where the current estimate of undisturbed peatland is 30-45 million ha or 10-12% of the global peatland resource.

2. Peatlands represent globally significant stores of soil C that have been accumulating for millennia and currently, peatlands globally represent a major store of soil carbon, sink for carbon dioxide and source of atmospheric methane. In general, nitrous oxide (N_2O) emissions are low from natural peatlands but there is evidence that those used for agriculture are releasing significant amounts of this potent greenhouse gas. Losses of peatland C from storage result from changes in the balance between net exchange of CO_2, emission of CH_4, and hydrological losses of carbon (e.g. dissolved organic and inorganic C and particulate organic C). The greenhouse gas (GHG) balance of a peatland depends on relative rates of net CO_2 uptake or efflux and CH_4 and N_2O efflux.

3. In terms of GHG management, the maintenance of large stores of C in undisturbed peatlands should be a priority.

4. Temporal studies of peatlands reveal that they may act as CO_2 sinks in some years and sources in others, depending on climate. Emissions of CH_4 and N_2O are similarly variable in space and time.

5. When considering the role of peatlands in atmospheric GHG balances, it is important to consider that they have taken up and released GHGs continuously since their formation and thus their influence must be modelled over time. When this is considered, the effect of sequestering CO_2 in peat outweighs CH_4 emissions.

6. Contemporary GHG exchange in peatlands exhibits great spatial variability related to regional and local differences in ecology, hydrology, and climate and the impact of climate change is likely to be large. Some peatlands will emit more CO_2 to the atmosphere and change from net C sinks to become sources; other peatlands may exhibit increased CO_2 sequestration owing to elevated water tables and / or increased primary production as a result of changing vegetation.

7. In some parts of the world the peat C store is being reduced because of fire. Major increases in the area of peatland burned have been documented in recent decades and this may continue in the future if peatlands dry out as a result of climate change and anthropogenic activities. Fire will continue to play an important role in the fate of global peatland C stocks.

8. Climate change may threaten C stocks in unmanaged peatlands because of drought leading to peat oxidation, permafrost melting and fire. Owing to the variability in environmental conditions and GHG exchange across peatlands, predicting the overall response is not simple. Research aimed at improving peatland inventories and enhancing our understanding of the links between climate, hydrology, ecology, permafrost degradation, fire regimes and GHG balances will improve our knowledge of the state of current peat resources and predict the fate of this important store of carbon.

Impacts of peatland utilization

9. Agriculture, forestry and peat extraction for fuel and horticultural use are the major causes of peatland disturbance. As these land-use changes require alteration of peatland hydrology, peat oxidation results and the greenhouse gas balance of the peatland is altered.

10. About 14 – 20 % of peatlands in the world are currently used for agriculture and the great majority of these are used as meadows and pastures. For agricultural use, fens and raised bogs have to be drained in order to regulate the air and water conditions in the soil to meet the requirements of cultivated or pasture plants. In many European countries, GHG emissions from agricultural peatlands dominate national emissions of GHGs from peat sources.

11. The loss of water from the upper peat by drainage, followed by oxidation, leads to compaction and subsidence of the surface. Drainage of peat increases the emissions of CO_2 and N_2O but decreases the emission of CH_4. Emission rates depend on peat temperature, groundwater level and moisture content. Appropriate water management is important in order to minimise GHG emissions from agriculture on peatlands. Increasing the water table decreases emissions of CO_2 (by up to 20%) and N_2O, but may increase emissions of CH_4.

12. The utilization of peatlands for forestry is concentrated in Nordic countries (Norway, Sweden, and Finland) and Russia, where over 10 million ha of peatlands have been drained for this purpose. The climatic impacts of the use of peatlands for forestry are smaller than for agriculture because oxidation of organic matter in the surface peat is much less. Biomass and primary production increase during stand development, contributing also to soil carbon store through increased litter production. Simultaneously, however, the organic matter decomposition rate increases because of increased aeration and this leads to increased CO_2 emissions from soil.

13. The combination of these changed fluxes shifts the C balance of the ecosystem with some forested peatlands becoming sources of CO_2 to the atmosphere, while others remain or become even larger C sinks. These differences are related to climatic condition, site type, intensity of drainage and management regime.

14. Finland, Ireland, Russian Federation, Belarus and Sweden account for almost 90% of the world's production and consumption of energy peat. Peat is also used in horticulture, as a growing medium, but the volume used annually is only about half that of fuel peat. Germany and Canada account for over half of horticultural peat extraction.

15. The main greenhouse gas released as a result of peat fuel extraction and

burning is CO_2 but CH_4 and N_2O are also emitted. In the process of peat extraction, the GHG sink function of the peatland is lost. Emissions also arise in the preparation of the surface for cutting (removing vegetation and ditching), extraction of peat and its storage and transportation, combustion and after-treatment of the cutaway area. Combustion accounts for more than 90% of the greenhouse gas emissions.

16. As with the extraction of energy peat, horticultural peat extraction requires drainage of the peatland to accommodate machinery and facilitate drying of peat prior to extraction. This facilitates peat oxidation, increases CO_2 emissions and reduces efflux of CH_4. Although horticultural peat is not consumed instantaneously, it will decompose over time following extraction and result in CO_2 emissions.

Tropical peatlands

17 Carbon storage in SE Asian peatlands is in the order of 58 Gt. In the late 1980s 3.7 million hectares of Indonesian peat swamp forest were taken for agriculture, leading to an 18% decrease in peat swamp forest area with a consequent reduction in the C-fixation capacity of 5-9 Mt yr^{-1}. The development of palm oil and timber plantations, which require intensive drainage and cause the highest CO_2 emissions of all land uses, are major drivers of peatland deforestation and increases in CO_2 emissions.

18. Present and future emissions from natural and drained peatlands in Indonesia have been quantified recently using data on peat extent and depth, present and projected land uses and water management practices, decomposition rates and fire emissions.

19. Current CO_2 emissions (2005) caused by peat decomposition in drained peatlands are estimated to be over 600 million t yr^{-1}, which will increase in coming decades, and will continue well beyond the 21st century, unless land management practices and peatland development plans are changed. In addition, between 1997 and 2006 an estimated average of 1400 Mt yr^{-1} of CO_2 emissions was caused by fires associated with peatland drainage and degradation. The total current CO_2 emissions from tropical peatland of approximately 2000 Mt yr^{-1} equal almost 8% of global emissions from fossil fuel burning. Emissions are likely to increase every year for the first decades after 2000.

20. Overall, methane emissions from tropical peatland are very low irrespective of whether it is natural peat swamp forest or drained and degraded or used for agriculture. N_2O emissions from natural tropical peatlands are low but evidence is emerging that suggests that these increase following land use change and fire.

Restoration of peatlands

21. Peatland restoration is growing in importance in Europe and North America and is likely to remain important over the next half century. It is also gaining recognition in tropical peatland areas where some of the greatest challenges exist following inappropriate and unsuccessful development projects. While peatland restoration is primarily designed for global biodiversity protection, it can also play an important role in reducing GHG emissions.

22. In general, rewetting of peatlands reduces CO_2 emissions by creating anoxic, reducing conditions, although

it may lead to increase in CH_4 efflux at least for a time. Rewetting also inhibits nitrification, resulting in reduced emission of N_2O. Some restored boreal bogs have become net C sinks again following successful re-establishment of Sphagnum-dominated vegetation.

Peatlands and international climate change conventions

23. Peat-based GHG emissions reported under the United Nations Framework Convention on Climate Change (UNFCCC) are divided between several sectors: Energy, Agriculture and Land Use, Land-Use Change and Forestry (LULUCF). Only human-induced GHG emissions are included in reporting, therefore, emissions from undisturbed/virgin peatlands are not included.

24. While industrialized nations listed in Annex I of the UNFCCC submit annual GHG inventories and have emission limitation targets under the Kyoto Protocol, the heterogeneous groups of developing nations that are non-Annex I Parties are only required to provide information about GHG emissions in national communications. However, peatland fires and wetland degradation in many non-Annex I countries contribute significantly to global GHG emissions. The Clean Development Mechanism (CDM) may provide a means for mitigation of these problems.

25. Methodologies and guidance for estimating peat-based emissions in the good practice guidelines for LULUCF and the 2006 IPCC Guidelines are relatively few. There is a deficiency of data that can be applied to country, region or site-specific conditions with data availability varying for different climate regions and countries, while global scale knowledge of peat-derived emissions remains limited. Development of scientifically sound emission factors for peat soils is complicated and resource demanding owing to the variation between sites.

Mitigation of greenhouse gas emissions

26. Since peatland management generally involves lowering the water table, GHG emissions result from decomposition of stored organic matter and, particularly as has been observed in tropical peatlands, an increase in fire susceptibility. The most efficient method for reducing GHG emissions from peatland is to prevent future land use change although this is not always economically, socially or politically possible. If this is the case, land management strategies should focus on preventing degradation of additional peatlands where possible, and adjusting management practices on developed peatlands in order to reduce GHG impacts.

27. Using peat from peatlands that are large greenhouse gas sources, climatic impact of peat utilisation chain can be significantly reduced. Examples of such peat resources are cultivated peatlands and forestry drained peatlands.

28. It is essential that future land use of peatland incorporates the principles and practices of wise use in order to promote sustainable management, especially with respect to hydrology, water and carbon. Inevitably, however, every type of human intervention on peatland leads to impairment or even loss of natural resource functions (ecology, hydrology, biodiversity, carbon storage). Effective peatland management also requires engagement between scientists, policy makers and stakeholders.