assessment
on peatlands, biodiversity and climate change

executive summary

UNEP GEF Global Environment Centre WETLANDS INTERNATIONAL

introduction

This Executive Summary presents the key findings of the global Assessment on Peatlands, Biodiversity and Climate Change. The Assessment was prepared through a review of scientific information on the nature and value of peatlands in relation to biodiversity and climate change, the impact of human activities and potential sustainable management options. It responds to decisions by a range of global environmental conventions, including the Convention on Biological Diversity (CBD) (programmes of work on inland water, forest and mountain biodiversity as well as the cross cutting issue on biodiversity and climate change) and the Ramsar Convention on Wetlands (Guidelines for global action on peatlands). It also contributes to the implementation of the UN Framework Convention on Climate Change (UNFCCC) and the UN Convention to Combat Desertification (UNCCD). The Assessment has been specifically welcomed by the Conference of Parties of the CBD.

The Assessment was prepared in the period 2005-2007 under the coordination of a multidisciplinary international team of peatland, biodiversity and climate change specialists. Its preparation was supported by UNEP-GEF and a range of other supporters.

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major overall findings

Peatlands are important natural ecosystems with high value for biodiversity conservation, climate regulation and human welfare. Peatlands are those wetland ecosystems characterized by the accumulation of organic matter (peat) derived from dead and decaying plant material under conditions of permanent water saturation. They cover over 4 million km^2 worldwide, occur in over 180 countries and represent at least a third of the global wetland resource.

Inappropriate management is leading to large-scale degradation of peatlands with major environmental and social impacts. Rehabilitation and integrated management of peatlands can generate multiple benefits including poverty alleviation, combating land degradation, maintaining biodiversity, and mitigating climate change. Concerted action for the protection and wise use of peatlands should therefore be a global priority linking work at global regional and local levels.

Some of the major overall findings of the assessment are:

- Peatlands are the most efficient terrestrial ecosystems in storing carbon. While covering only 3% of the World's land area, their peat contains as much carbon as all terrestrial biomass, twice as much as all global forest biomass, and about the same as in the atmosphere.

- Peatlands are the most important long-term carbon store in the terrestrial biosphere. They sequester and store atmospheric carbon for thousands of years.

- Peatlands are critical for biodiversity conservation. They support many specialised species and unique ecosystem types, and can provide a refuge for species that are expelled from non-peatland areas affected by degradation and climate change.

- Peatlands play a key role in water resource management, storing a significant proportion of global freshwater resources. Peatland degradation can disrupt water supplies and decrease flood control benefits.

- Degradation of peatlands is a major and growing source of anthropogenic greenhouse gas emissions. Carbon dioxide emissions from peatland drainage, fires and exploitation are estimated to currently be equivalent to at least 3,000 million tonnes per annum or equivalent to more than 10% of the global fossil fuel emissions.

- Peatland degradation affects millions of people around the world. Drainage and fires in SE Asian peat swamp forests jeopardise the health and livelihoods of millions of people in several countries in the region. The destruction of mountain peatlands in Africa, Asia and Latin America threatens the water and food supply for large rural and urban populations.

- Climate change impacts are already visible through the melting of permafrost peatlands and desertification of steppe peatlands. In the future, impacts of climate change on peatlands are predicted to significantly increase. Coastal, tropical and mountain peatlands are all expected to be particularly vulnerable.

- Conservation, restoration and wise use of peatlands are essential and very cost-effective measures for long-term climate change mitigation and adaptation as well as biodiversity conservation.

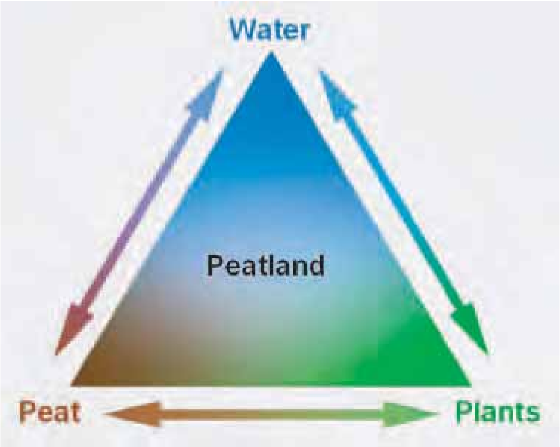
- Optimising water management in peatlands (i.e. reducing drainage) is the single highest priority to combat CO_2 emissions from oxidation and fires as well as address peatland degradation and biodiversity conservation.

- There is, in most countries, an urgent need to strengthen awareness, understanding and capacity to manage peatlands - to address peatland degradation, biodiversity conservation and climate change.

key characteristics of peatlands

Peatlands are wetland ecosystems that are characterized by the accumulation of organic matter (peat), which is derived from dead and decaying plant material under conditions of permanent water saturation. There are many different types of peatland, depending on geographic region, terrain and vegetation type. A major distinction is between bogs (which are fed only by precipitation and are nutrient-poor) and fens (which are fed by surface or ground water as well as precipitation and tend to be more nutrient rich). Peatlands may be naturally forested or naturally open and vegetated with mosses, sedges or shrubs. Peat formation is strongly influenced by climatic conditions and topography. In northern latitudes or high altitudes the temperature may be high enough for plant growth but too low for vigorous microbial activity. Significant areas of peatlands are found in tropical and sub-tropical latitudes where high plant productivity combines with slow decomposition as a result of high rainfall and humidity. In some cases peatlands were formed during wetter climatic periods thousands of years ago but, in the prevailing drier climate, may no longer accumulate peat.

- The major characteristics of natural peatlands include permanent water logging, development of specific vegetation, the consequent formation and storage of peat and the continuous (upward) growth of the surface.
- Peatland distribution, peat formation and storage are primarily a function of climate, which determines water conditions, vegetation productivity and the decomposition rate of dead organic material.
- Peatlands are found in almost every country, but occur primarily in the boreal, subarctic and tropical zones, as well as in appropriate zones in mountains. More detailed assessment of their extent, nature and status is needed. Many peatlands are not recognised as such but are classified as marshes, meadows, or forests.
- As a result of different climatic and biogeographic conditions, a large diversity of peatland types exists. However, because of similar ecohydrological processes, they share many ecological features and functions.
- In northern regions and highlands, peatlands and permafrost are mutually dependent.
- The complex relationship between plants, water, and peat makes peatlands vulnerable to a wide range of human interferences.



In peatlands, water, peat and plants are strongly interconnected. If any one of these components is altered, the nature of the peatland will change.

peat formation

Peat accumulates at a rate of about 0.5 - 1 mm per year (or 5-10 m over 10,000 years) with strong local variations. Peat can be formed from mosses, sedges, grasses, shrubs or trees. In northern regions, mosses are the main peat-forming plants while trees are the main ones in the tropics. Most peatlands that exist today formed in the last 15,000 years since the last Ice Age.

Top: Peat consists of accumulated dead plant material of which at least 50% is carbon

Left: Water saturation means that plant remains decompose slowly and form peat

peatlands and people

Peatlands and people are connected by a long history of cultural development. Humans have directly utilised peatlands for thousands of years, leading to differing and varying degrees of impact.

Forestry

Agriculture

Wild products (berries)

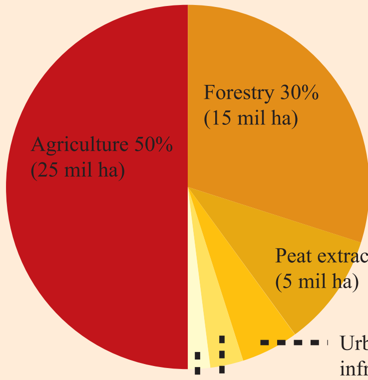
Peat extraction

Infrastructure construction

Nature protection and Ecotourism

Utilisation of peatlands

For centuries, some peatlands worldwide have been used in agriculture, both for grazing and for growing crops. Large areas of tropical peatlands have in recent years been cleared and drained for food crops and cash crops such as oil palm and other plantations. Many peatlands are exploited for timber or drained for plantation forestry. Peat is being extracted for industrial and domestic fuel, as well as for use in horticulture and gardening. Peatlands also play a key role in water storage and supply, as well as in flood control.



Main causes of the loss of natural peatlands in non-tropical regions (Source: Joosten and Clarke 2002)

- Many indigenous cultures and local communities are dependent on the continued existence of peatlands, but peatlands also provide a wealth of valuable goods and services to industrial societies such as livelihood support, carbon storage, water regulation and biodiversity conservation.
- The many values of peatlands are generally poorly recognised and this is one of the root causes of degradation or avoidable conflicts about uses.
- The main human activities that impact peatlands include drainage for agriculture and forestry, land clearing and burning, grazing, peat extraction, infrastructure and urban development, reservoir construction, and pollution.
- Drainage of peatlands is one of the main root causes of peatland fires. These affect significant areas of peatlands around the world and are a major source of carbon emission from peatlands.
- Deterioration of peatlands has resulted in significant economic losses and social impacts, and has created tensions between key stakeholders at local, regional and international levels.
- Peatlands are often the last expanses of undeveloped land in public ownership, so they are increasingly targeted by developments that need large areas of land, such as airports, plantations, windfarms and reservoirs.

Peat has a global dimension. Dutch flowers grown on Lithuanian peat are exported all over the world

peatlands and past climate change

The form and function of peatlands and the distribution of peatland species depend strongly on the climate. Therefore climate exerts an important control on ecosystem biodiversity in peatlands.

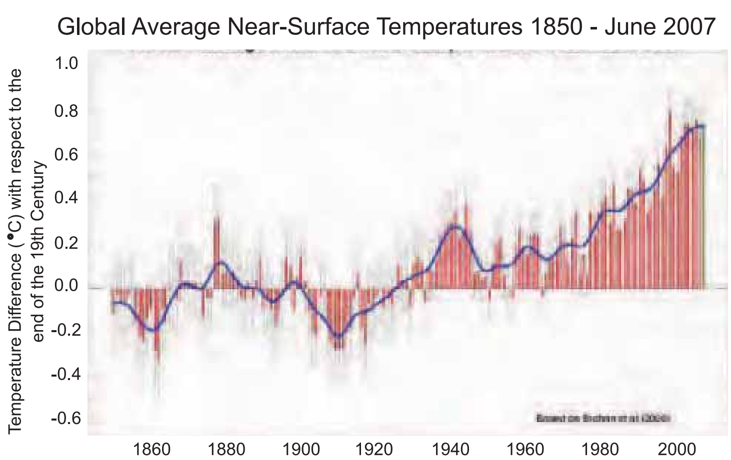
Climate change is a normal condition for the Earth and the past record suggests continuous change rather than stability. The last 2 million years of Earth history (the Quaternary period) are characterised by a series of cold glacial events with warmer intervening interglacial periods. Peatlands expanded and contracted with changes in climate and sea-level. Many current peatlands started growth following the warming after the last glacial maximum. The initiation of new peatlands has continued throughout the postglacial period in response to changes in climate and successional change.

- Climate is the most important determinant of the distribution and character of peatlands. It determines the location and biodiversity of peatlands throughout the world.

- The Earth has experienced many climate changes in the past, and peatland distribution has varied in concert with these changes. Most peatlands began growth during the current postglacial period. Peatland extent has increased over the course of the last 15,000 years.

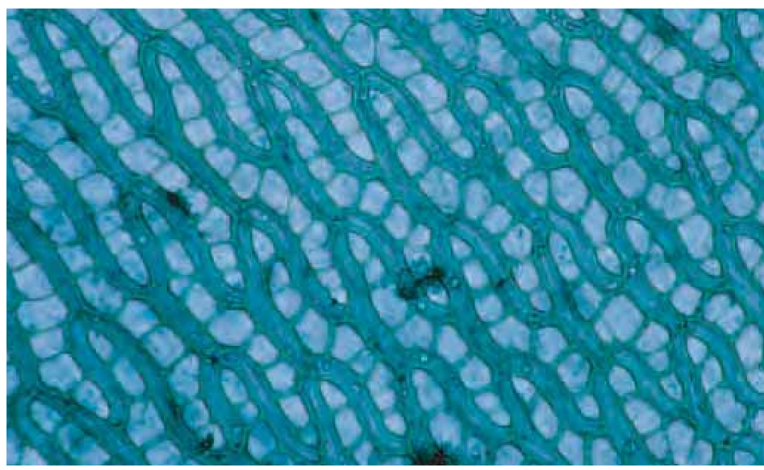
- In the constantly accumulating peat, peatlands preserve a unique record of their own development as well as of past changes in regional vegetation and climate.

- Records show that the vegetation, growth rate (carbon accumulation) and hydrology of peatlands were altered by past climate change. This information helps in making predictions of future impacts of climate change.



Temperature changes during the last 150 years based on instrument data (Source: Hadley Centre for Climate Change, UK Meteorological Office)

Plant and other organic materials are very well preserved in the saturated peat



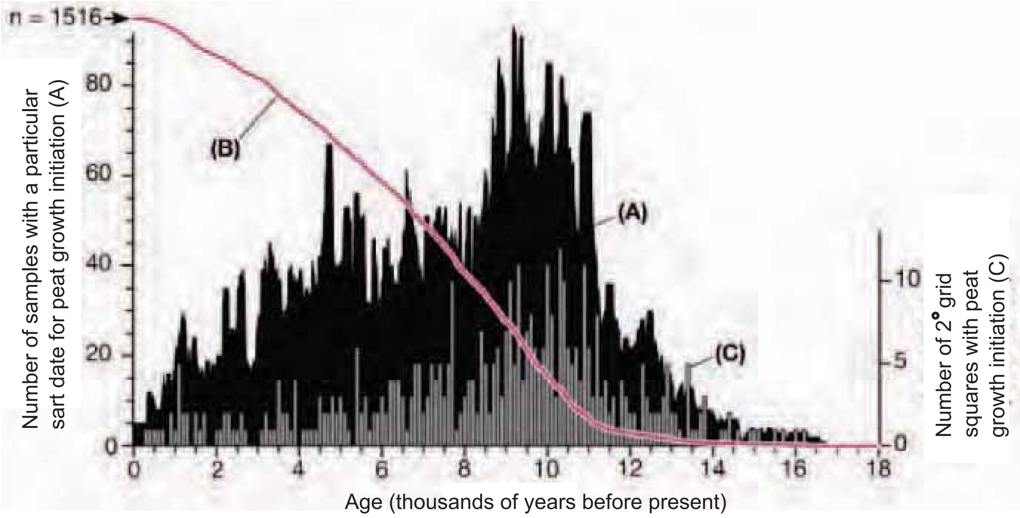
A close-up of Sphagnum cells from peat approximately 4000 years old

- Peatlands affect climate via a series of feedback mechanisms including sequestration of carbon dioxide, emission of methane, change in albedo and alteration of the micro- and mesoclimate.

- Natural peatlands were often resilient to climate changes in the past. However, the rate and magnitude of predicted future climate changes and extreme events (drought, fires, flooding, and erosion) may push many peatlands over their threshold for adaptation.

Peatlands have gradually expanded over the past 18,000 years. The figure shows the age of earliest peat growth in circumarctic peatlands as measured by radiocarbon dating. Line B shows the cumulative number of samples with different start dates for peat growth initiation

(Source: McDonald et al. 2006)



Peat stratigraphy may reflect past climate changes

- Some expected impacts of recent climate change are already apparent in the melting of permafrost peatlands, changing vegetation patterns in temperate peatlands, desertification of steppe peatlands, and increased susceptibility to fire of tropical peatlands.
- Human activities such as vegetation clearance, drainage and grazing have increased the vulnerability of peatlands to climate change.

Peat as a climate archive

Peatland ecosystems are important archives of past environmental change. In the constantly accumulating peat they record their own history and that of their wider surroundings. This enables the reconstruction of long-term human and environmental history. Pollen and spores provide information on the main changes in vegetation on and around the peatland; plant macrofossils show how the vegetation of the peatland itself has changed through time. A huge variety of remains of other small organisms is preserved in peat, including amoebae, diatoms, fungi, and invertebrates. These, as well as the degree of peat humification, allow the reconstruction of hydrological changes in peatlands. Heavy metals indicate changes in pollutant history; stable isotopes of carbon, oxygen and hydrogen help understand changes in hydrology and temperature.

Testing core samples from peatlands

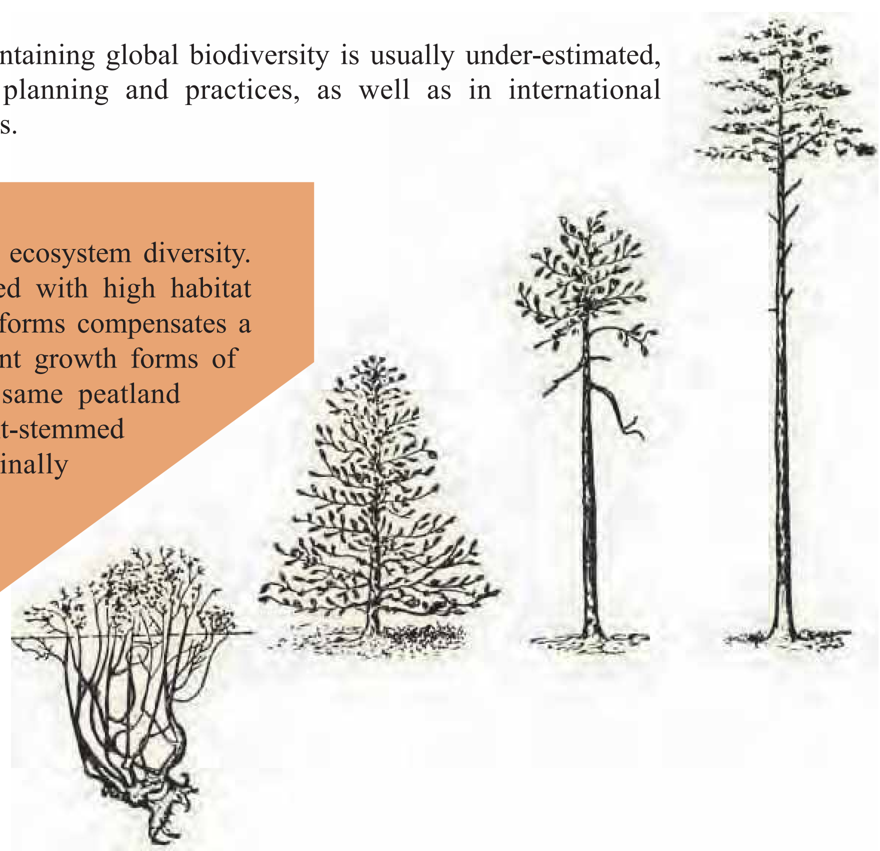
peatlands and biodiversity

Peatlands are unique, complex ecosystems of global importance for biodiversity conservation at genetic, species and ecosystem levels. They contain many species found only or mainly in peatlands. These species are adapted to the special acidic, nutrient poor and water-logged conditions of peatlands. They are vulnerable to changes resulting from direct human intervention, to changes in their water catchment and to climate change, that may lead to loss of habitats, species and associated ecosystem services. The biodiversity values of peatlands demand special consideration in conservation strategies and land use planning.

Peatlands play a special role in maintaining biodiversity, at the species and genetic level as a result of habitat isolation, and at the ecosystem level as a result of their ability to self-organise and adapt to different physical conditions.

- Although species diversity in peatlands may be lower, they have a higher proportion of characteristic species than dryland ecosystems in the same biogeographic zone.
- Peatlands may develop sophisticated self-regulation mechanisms over time, resulting in high within-habitat diversity expressed as conspicuous surface patterns.
- Peatlands are important for biodiversity far beyond their borders by maintaining hydrological and micro-climate features of adjacent areas and providing temporary habitats or refuge areas for dryland species.
- Peatlands are often the last remaining natural areas in degraded landscapes and thus mitigate landscape fragmentation. They also support adaptation by providing habitats for endangered species and those displaced by climate change.
- Peatlands are vulnerable to human activities both within the peatland habitats themselves and in their catchments. Impacts include habitat loss, species extinction and loss of associated ecosystem services.
- The importance of peatlands for maintaining global biodiversity is usually under-estimated, both in local nature conservation planning and practices, as well as in international convention deliberations and decisions.

Peatlands support both phenetic and ecosystem diversity. High phenetic diversity is associated with high habitat diversity. A large variety of growth forms compensates a smaller diversity of species. Different growth forms of Scots' pine trees occurring in the same peatland (from prostate 10-20cm tall to straight-stemmed several metres tall) were originally described by Carl Weber in 1902.



Spatial heterogeneity and ecosystem biodiversity are typical characteristics of peatlands

Peatlands are often the last remaining natural areas in degraded landscapes and a refuge for species from surrounding areas

The ecosystem diversity of peatlands depends on their strong autonomy, self-organisation, and integrity.

Peatlands provide habitats for a variety of characteristic species

peatlands and carbon

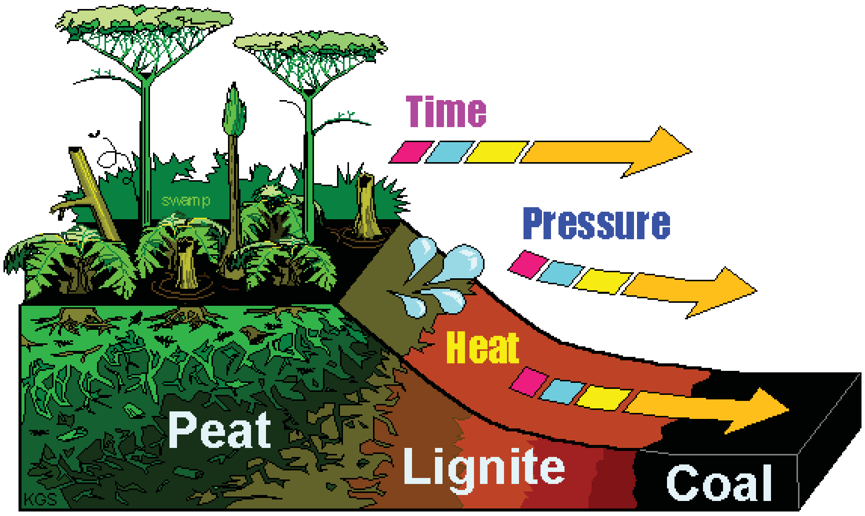
Peatlands are some of the most important carbon stores in the world. They contain nearly 30% of all carbon on the land, while only covering 3% of the land area. Peatland ecosystems contain disproportionately more organic carbon than other terrestrial ecosystems.

Peatlands are the top long-term carbon store in the terrestrial biosphere and - next to oceanic deposits - Earth's second most important store. Peatlands have accumulated and stored this carbon over thousands of years, and since the last Ice Age peatlands have played an important role in global greenhouse gas balances by sequestering an enormous amount of atmospheric CO_2.

Peatlands in many regions are still actively sequestering carbon. However the delicate balance between production and decay easily causes peatlands to become carbon sources following human interventions. Anthropogenic disturbances (especially drainage and fires) have led to massive carbon losses from peatland stores and generated a significant contribution to global anthropogenic CO_2 emissions. Peatland restoration is an effective way to maintain the carbon storage of peatlands and to re-initiate carbon sequestration.

- While covering only 3% of the World's land area, peatlands contain at least 550 Gt of carbon in their peat. This is equivalent to 30% of all global soil carbon, 75% of all atmospheric C, equal to all terrestrial biomass, and twice the carbon stock in the forest biomass of the world. This makes peatlands the top long-term carbon store in the terrestrial biosphere.
- Peatlands are the most efficient carbon (C) store of all terrestrial ecosystems. Peatlands contain more carbon per ha than other ecosystems on mineral soil: in the (sub)polar zone, 3.5 times, in the boreal zone 7 times, in the tropical zone 10 times as much.
- Peatlands store carbon in different parts of their ecosystem (biomass, litter, peat layer, mineral subsoil layer), each with their own dynamics and turn-over.

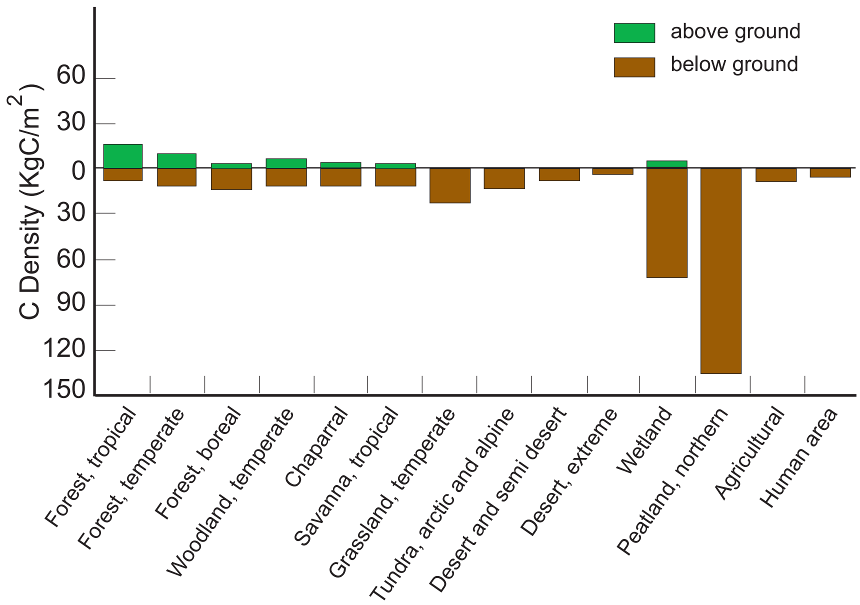
Peatlands store an enormous amount of carbon



A large part of our coals originated from the peatlands of previous geological epochs

(Source: www.uky.edu/KGS/coal/coalform.htm)

Stored carbon is quickly lost during peat fires



Peatlands have the highest carbon density among the terrestrial biomes
(Source: http://csite.esd.ornl.gov/faqs.html)

Carbon slowly accumulated in peatlands can be quickly removed by human activities

Drying of peat blocks, Argentina

Peat extraction, Sweden

The peat on the surface of this peat mine is 3700 yrs old

- The peat layer is a long-term store of carbon. Peatlands have accumulated and stored this carbon over thousands of years. Permanent waterlogging and consequent restricted aerobic decay is the main prerequisite for continued long-term storage of carbon in peatlands.
- Most coal and lignite and part of the 'mineral' oil and natural gas reserves originated from peat deposits in previous geological periods.
- Peat growth depends on a delicate balance between production and decay. Natural peatlands may shift between carbon sink and source on a seasonal and between-year time scale, but the accumulation of peat demonstrates that their long-term natural balance is positive.
- Human interventions can easily disturb the natural balance of production and decay turning peatlands into carbon emitters. Drainage for agriculture, forestry and other purposes increases aerobic decay and changes peatlands from being a sink of carbon to a source. Peat extraction (for fuel, horticulture, fertilizers, etc.) transfers carbon to the atmosphere even more quickly.
- Peatland drainage also facilitates peat fires, which are one of the largest sources of carbon released to the atmosphere associated with land management.
- Fluxes of dissolved (DOC) and particulate (POC) organic carbon constitute important carbon losses from peatlands that may substantially increase as a result of human impact and climate change.
- Carbon dioxide emissions from peatland drainage, fires and exploitation are estimated to currently be at least 3000 million tonnes a year equivalent to more than 10% of the global fossil fuel emissions.
- Peatland conservation and restoration are effective ways to maintain the peatland carbon store and to maximise carbon sequestration with additional benefits for biodiversity, environment and people.

peatlands and greenhouse gases

The world's peatlands influence the global balance of three main greenhouse gases (GHG) - carbon dioxide, methane and nitrous oxide (CO_2, CH_4, and N_2O). In their natural state, peatlands remove CO_2 from the atmosphere via peat accumulation and emit methane. The long-term negative effect of methane emissions is smaller than the positive effect of CO_2 sequestration. By sequestering and storing an enormous amount of atmospheric CO_2 peatlands have had an increasing cooling effect, in the same way as in former geological eras, when they formed coal, lignite and other fossil fuels.

When peatlands are disturbed, they can become significant sources of carbon dioxide and at the same time do not totally stop emitting methane. Methane may still be released from drainage ditches and in mining operations from milled peat surfaces and peat stockpiles. Drained peatlands, especially after fertilization, can also become an important source of nitrous oxide. Peatland restoration reduces net GHG emissions to the atmosphere, certainly over the long-term.

A variety of methods and techniques are applied for GHG flux measurements in peatlands

Tundra polygon mires, Russia

Tropical peat swamp forest, Indonesia

- Natural peatlands affect atmospheric burdens of CO_2, CH_4 and N_2O in different ways and so play a complex role with respect to climate.

- Since the last Ice Age peatlands have sequestered enormous amounts of atmospheric CO_2.

- GHG fluxes in peatlands have a spatial (zonal, ecosystem, site and intersite) and temporal (interannual, seasonal, diurnal) variability, which needs to be considered in assessment and management.

- Small changes in the ecology and hydrology of peatlands can lead to big changes in GHG fluxes through influence on peatland biogeochemistry.

- In assessing the role of peatlands in global warming, the different time frame and radiative forcing of continuous CH_4 emission and CO_2 sequestration should be carefully evaluated rather than using simple global warming potential calculations.

- Anthropogenic disturbances (especially drainage and fires) have led to massive increases in net emissions of GHG from peatlands, which now make a significant contribution to global anthropogenic emissions.

- Peatland drainage leads to increased CO_2 emissions in general and an increase in N_2O release in nutrient rich peatlands. It may not always significantly reduce CH_4 emissions.

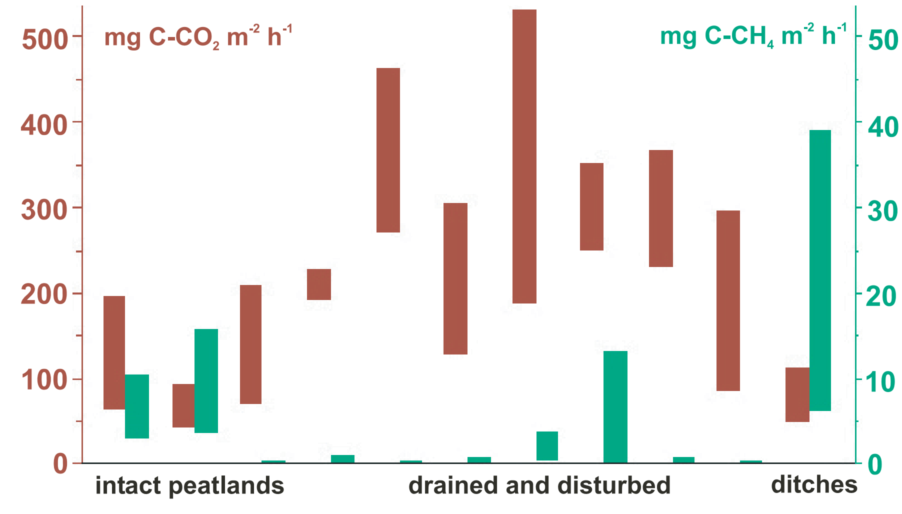
- Because of the large emissions from degraded peatlands, rewetting and restoring them is one of the most cost-effective ways of avoiding anthropogenic greenhouse gas emissions.

Peatland fires in Southeast Asia are the world's largest single source of carbon emissions

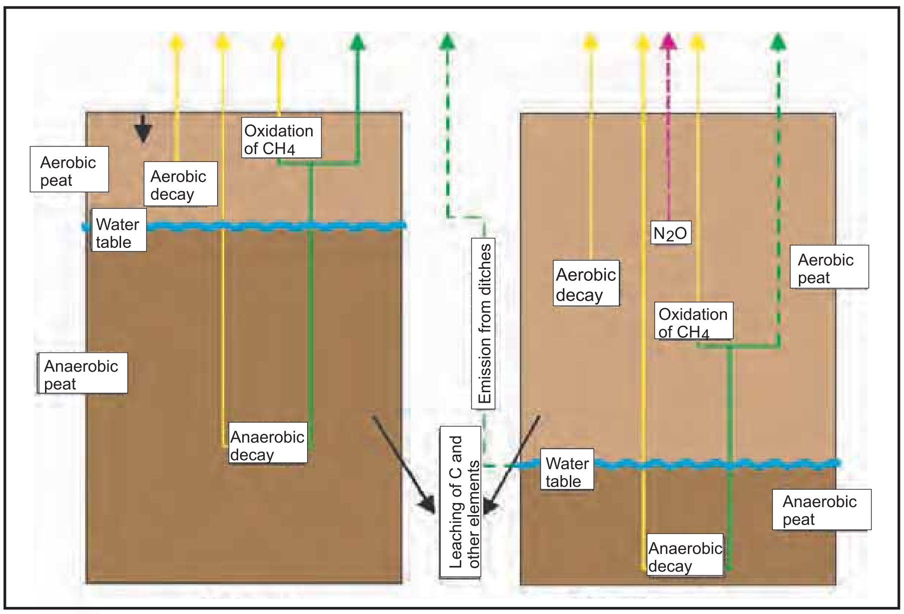
Peat oxidation from degraded peatlands leads to an annual CO_2 emission of over 3000 million tonnes, being equivalent to more than 10% of the global fossil fuel emissions. Fires and drainage in peatlands in Southeast Asia (primarily Indonesia), which cover less than 0.2% of the world's land surface, are currently responsible for two-thirds of these global peatland emissions.

Peatland emissions of methane are **not** a major contributor to climate change

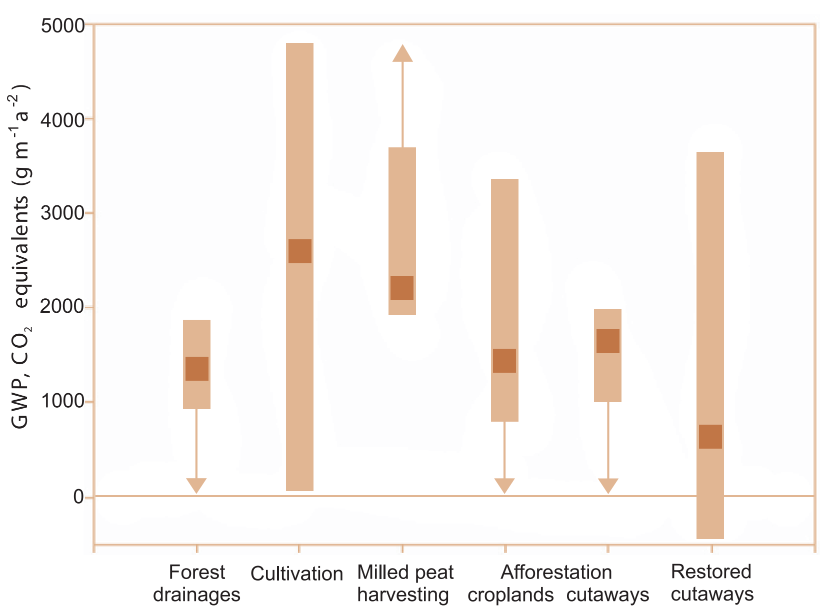
Peatlands are currently contributing 3-5% to the total global methane emissions. Larger global emissions are released by agricultural activities such as grazing and rice cultivation. The emission of methane from natural peatlands is part of the natural baseline and, because of the rapid turnover time of CH_4, it does not contribute to an increase in methane in the atmosphere. Peatlands have been a stable sink of atmospheric CO_2 over millennia and the overall climate impact of peatlands has been a net cooling.



Peatlands disturbed by human activities often become sources of CO_2 but do not totally stop emitting CH_4 which is released especially from drainage ditches. (Figures represent gross emissions; GHG sequestration by peat formation and vegetation growth not included)
(Source: Glagolev et al. 2007)



The different GHG fluxes of pristine (left) and drained (right) peatland sites (Source: Laine et al. 1996 - with changes)



Right:
The emission values from cultivated peatlands show large ranges of uncertainty. The average values (dark squares), however, illustrate that restored peatlands have lower GHG emissions than drained and cultivated sites. Downward arrows represent possible additional CO_2 sequestration by vegetation growth and peat accumulation; the upward arrow the possible additional CH_4 emission under warm and wet conditions
(Source: Alm et al. 2007)

impacts of future climate change on peatlands

The strong relationship between climate and peatland distribution suggests that future climate change will exert a strong influence on peatlands. Predicted future changes in climate of particular relevance to peatlands include rising temperatures, changes in the amount, intensity and seasonal distribution of rainfall, and reduced snow extent in high latitudes and in mountain areas. These changes will have significant impacts on the peatland carbon store, greenhouse gas fluxes and biodiversity.

- Global temperature rises of 1.1-6.4°C will be higher in northern high latitudes where the greatest extent of peatlands occurs.

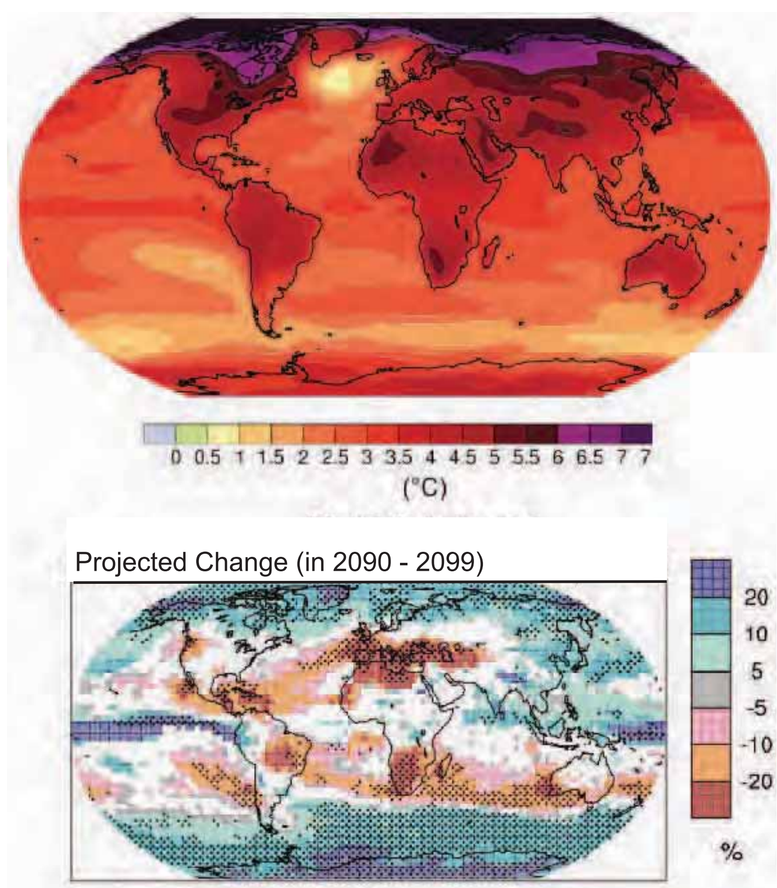
- High latitudes are likely to experience increased precipitation while mid-latitudes and some other regions may have reduced precipitation at certain times of the year. All areas may be susceptible to drought due to increased variability in rainfall.

- Increasing temperatures will increase peatland primary productivity by lengthened growing seasons. Decay rates of peat will increase as a result of rising temperatures, potentially leading to increased CH_4 and CO_2 release. Changes in rainfall and water balance will affect peat accumulation and decay rates.

- Tree lines in northern peatlands will shift poleward as a result of higher summer temperatures, and hydrological changes may result in increased forest extent on open peatlands. The resulting reduced albedo will positively feed back on global warming.

Climate warming leads to desiccation and desertification of peatlands in steppe regions such as in Central Asia, Mongolia. In the 1950s the pictured habitats were still described as impassable wet peatlands

Climate warming raises the probability of peat fires all over the world especially in peat swamp forests in SE Asia



Projected changes in temperature and precipitation indicate that peatlands will experience large climate changes over this century. Possible (top) mean annual temperature and (bottom) June-August precipitation change for 2090-2099.

(Source: Intergovernmental Panel on Climate Change 2007)

- Increased rainfall intensity may increase peatland erosion. This may be amplified by anthropogenic drainage and overgrazing.

- Greater drought will lead to an increase of fire frequency and intensity, although human activity is expected to remain the primary cause of fire.

- Hydrological changes, combined with temperature rises, will have far-reaching effects on greenhouse gas exchange in peatlands. Drier surfaces will emit less CH_4, more N_2O and more CO_2, and the converse for wetter surfaces.

- Melting permafrost will probably increase CH_4 emissions and lead to increased loss of dissolved organic carbon in river runoff.

- Inundation of coastal peatlands may result in losses of biodiversity and habitats, as well as in increased erosion, but local impacts will depend on rates of surface uplift.

- The combined effect of changes in climate and resultant local changes in hydrology will have consequences for the distribution and ecology of plants and animals that inhabit peatlands or use peatlands in a significant part of their life cycles.

- Human activities will increase peatland vulnerability to climate change in many areas. In particular, drainage, burning and over-grazing will increase the loss of carbon through oxidation, fire and erosion.

Peat washed down from eroded mountain peatlands in Mongolia

Climate change will enhance the incidence of peat fires. During extreme drought in 2002 even very wet raised bogs burned in European Russia

Melting of permafrost leads to degradation and destruction of palsas and expansion of fen peatlands with associated changes in GHG emissions and biodiversity, West Siberia, Russia

Sea level rise may lead to erosion of peatlands by wave action (Tierra del Fuego, Argentina)

Unsustainable use of peatlands, like overgrazing, could strongly increase peatlands' vulnerability to climate change

Peat erosion on the Shetland mainland (UK) after an exceptionally heavy rainstorm in September 2003


Overgrazing, China


Peat mining, Canada


Agriculture on peatland, Malaysia

Integrated management of peatlands is required...

Management of peatlands for biodiversity and climate change

The sustainable management of peatlands requires an integrated approach - developing common strategies for management of different uses within each peatland area. The requirements for biodiversity conservation, land rehabilitation and climate change mitigation/adaptation also need to be incorporated into management strategies. The close coordination between different stakeholders and economic sectors is also critical.

The Assessment has found that:

- The current management of peatlands is generally not sustainable and has major negative impacts on biodiversity and the climate.
- A wise use approach is needed to integrate protection and sustainable use and to maintain peatland ecosystem services despite increasing pressure from people and the changing climate.
- Strict protection of intact peatlands is critical for the conservation of biodiversity and will maintain their carbon storage and sequestration capacity and associated ecosystem functions.
- Changes in peatland management (such as better water and fire control in drained peatlands) can reduce land degradation and can limit negative impacts on biodiversity and climate.
- Optimising water management in peatlands (i.e. reducing drainage) is the single highest priority to combat CO_2 emissions from oxidation and fires as well as address peatland degradation and biodiversity conservation.
- Restoration of peatlands can be a cost-effective way to generate immediate benefits for biodiversity and climate change by reducing peatland subsidence, oxidation and fires.
- New production techniques such as wet agriculture ('paludiculture') should be developed and promoted to generate production benefits from peatlands without diminishing their environmental functions.

- Local communities have a very important role as stewards of peatland resources and should be effectively involved in activities to restore and sustain the use of peatland resources.

- The emerging carbon market provides new opportunities for peat swamp forest conservation and restoration and can generate income for local communities.

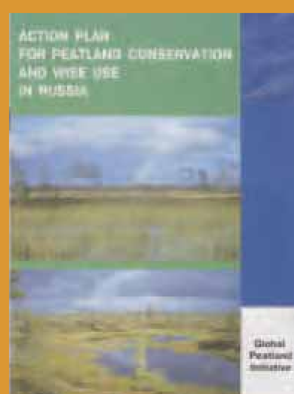
- Peatland management can be effectively integrated into land use and socio-economic development planning by taking a multi-stakeholder, ecosystem, river basin and landscape approach.

- Plans for integrated peatland management should be developed at local, national and regional level, as appropriate.

- Enhancing awareness and capacity, addressing poverty and inequity, and removing perverse incentives are important to tackle the root causes of peatland degradation.

Russian Peatland Action Plan

Peatlands cover more than 8% of the Russian Federation and represent 20% of the world's peatlands. Traditionally peatlands in Russia have been the concern of several different economic sectors - from agriculture to conservation to energy - each of which have developed separate approaches to peatland management leading to serious conflicts. To facilitate an integration of different sectors, an Action Plan for Peatland Conservation and Wise Use in the Russian Federation was developed and endorsed by the government in 2003.



ASEAN Peatland Management Strategy (2006-2020)

South East Asia has more than 25 million ha of peatlands or 60% of the known tropical peatland resource. However about two-thirds of the peatlands are heavily utilised or degraded and over the past 10 years more than 3 million ha have burnt for months on end - leading to smoke clouds covering up to five countries, economic losses of billions of dollars and major health and environmental costs. In November 2006, Ministers from the 10 ASEAN Member Countries endorsed the ASEAN Peatland Management Strategy (2006-2020) to provide a framework for the sustainable management of peatlands. The goal of the Strategy is to promote sustainable management of peatlands in the ASEAN region through collective action and enhanced cooperation to support and sustain local livelihoods, reduce risk of fire and associated haze and contribute to global environmental management. The Strategy includes 25 operational objectives and 97 Actions in 13 focal areas ranging from integrated management to climate change and inventory. Countries in the region are now in the process to develop and implement their respective national action plans.

Capacity building

Capacity building is critical to facilitating effective integrated management of peatlands. Without appropriate knowledge and skills among the different stakeholders involved in peatlands it will not be possible to implement integrated management. Capacity building can be undertaken through awareness raising, policy development, training for management staff and local communities and many other approaches. Efforts should take a multi-stakeholder approach and support the implementation of integrated management concepts.

Avoid ill-advised climate mitigation measures on peatlands

Climate mitigation measures such as hydropower, wind energy or biofuel production should generally not be implemented on peatlands to avoid negative impacts on biodiversity, carbon storage and greenhouse gas fluxes.

- Cultivation of biofuel crops such as oil palm, soya, sugar cane or maize in peatland areas normally leads to significantly more CO_2 emissions than are saved through substitution of fossil fuels by the resultant biofuel. Emissions of N_2O stimulated by fertiliser use on such peatlands may also be high.
- Projected GHG emission reductions from wind farms on peatlands may need to be reduced to account for the release of CO_2 from peatlands drained or impacted by the construction of the windmills and access roads.
- Flooding of peatlands for reservoirs as part of hydropower projects may lead to significant CH_4 emissions.

Windmills on peatlands

Oil palm plantation on peatlands

Rehabilitation of peatlands can generate multiple benefits for biodiversity, climate change and local communities...

Restored peatland (Ramsar site)

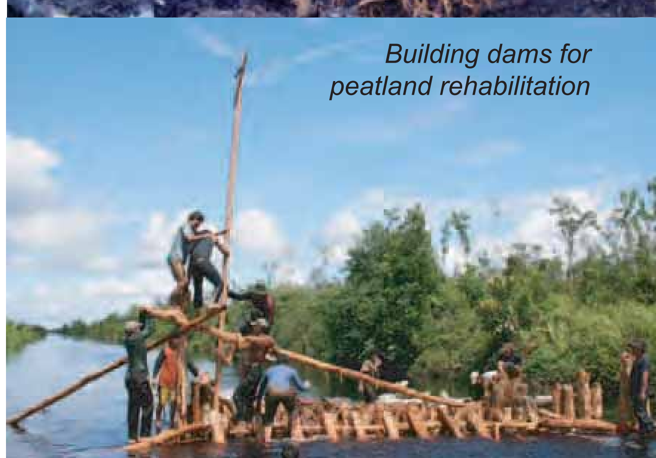
Belarus peatland management

Following an ongoing UNDP-GEF financed pilot project of 42,000 ha, Belarus aims at restoring an area of 260,000 ha of peatland to be followed by a larger area in the longer-term, to avoid emissions of several million tonnes of carbon dioxide and to improve the biodiversity of these highly degraded sites. The funds necessary for restoration and subsequent management are pursued through the planned sale of high quality carbon credits on the voluntary carbon market. This initiative unites in an exemplary way the interests of climate change mitigation, biodiversity conservation, degraded land rehabilitation and local livelihoods.

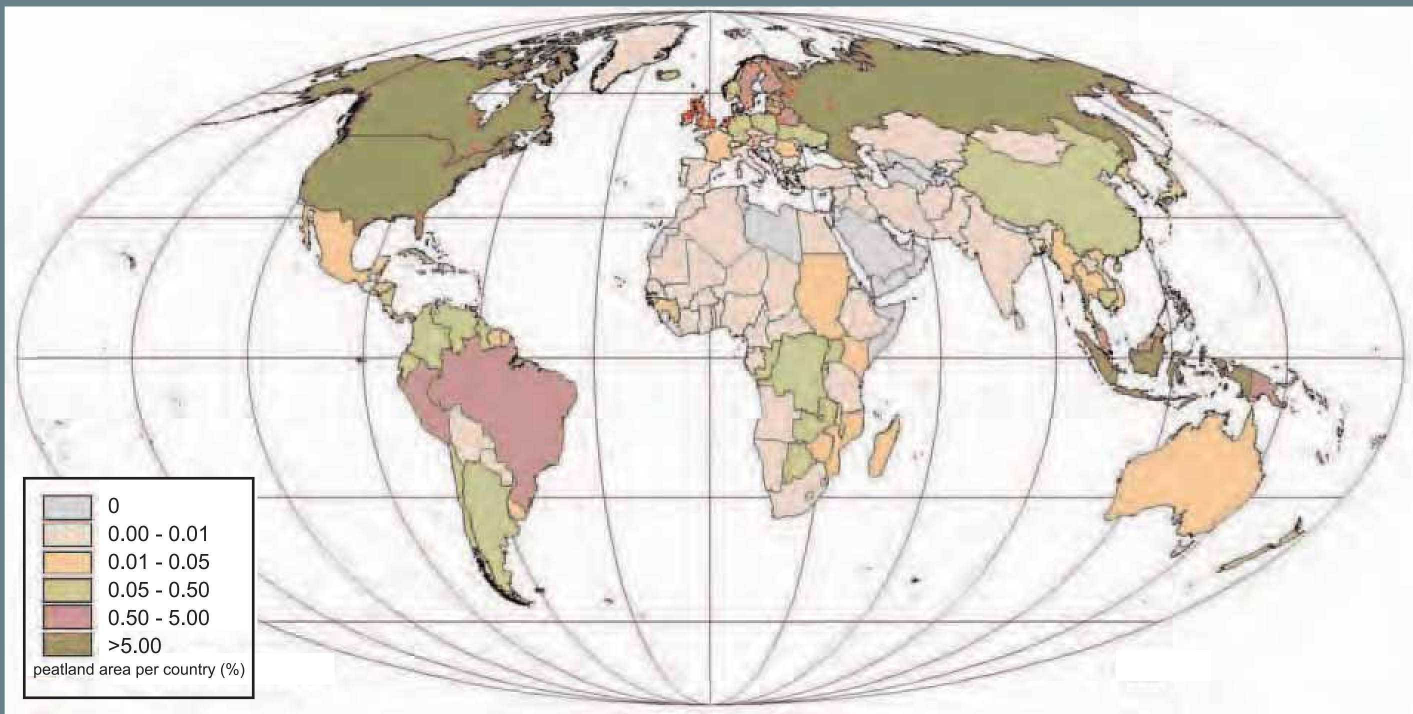
Community-based peat restoration In Indonesia

Local communities in Central Kalimantan, Indonesia have traditionally depended, for their livelihoods, on fish and non-timber forest products from the extensive peat swamp forests. They have been severely impacted by the clearance and degradation of peatlands, for example, the failed 1-million ha Mega-Rice Scheme abandoned in 1999 after 500,000 ha burnt in the 1997-98 El Nino event. The Climate Change, Forest and Peatland in Indonesia (CCFPI) Project assisted the local communities to block the abandoned drainage channels and to rehabilitate the peatlands. This has led to reductions in fires and GHG emissions and improvements in fish harvests. The restoration techniques developed - drawing on indigenous knowledge - have now been adopted for large-scale rehabilitation of peatlands in Indonesia and elsewhere.

Replanting burnt peat swamp forest



Building dams for peatland rehabilitation



Peatlands are found in almost every country of the world. Peatlands cover 4 million km^2 on Earth (some 3% of the land area)
(Source: Joosten and Clarke 2002)

Forested fen

Palsa

Sedge mire

Peat plateau mire

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Papyrus Swamp

Reference

Parish, F. Sirin, A., Charman, D., Joosten, H., Minayeva, T. and Silvius, M. (eds.) 2007. Assessment on Peatlands, Biodiversity and Climate Change: Executive Summary. Global Environment Centre, Kuala Lumpur and Wetlands International, Wageningen.

Available from: Global Environment Centre, 2nd Floor Wisma Hing, 78 Jalan SS2/72, 47300 Petaling Jaya, Selangor, Malaysia. Tel: +603 7957 2007, Fax: +603 7957 7003. Web: www.gecnet.info

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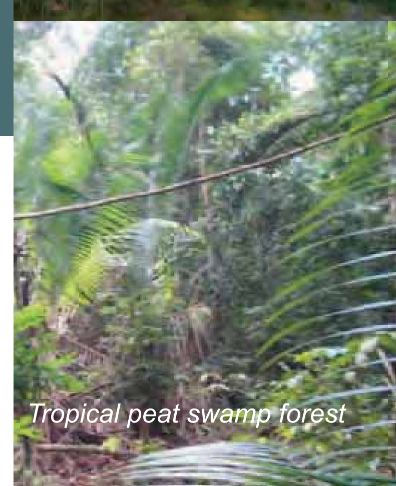

Tropical peat swamp forest

Peatlands are important natural ecosystems with high value for biodiversity conservation, climate regulation and human welfare. The global Assessment on Peatlands, Biodiversity and Climate Change reviews the key scientific information on peatlands in relation to biodiversity and climate change. Selected overall findings of the assessment include:

Peatlands are the most efficient terrestrial carbon-storing ecosystems. While covering only 3% of the World's land area, their peat contains as much carbon as all terrestrial biomass, twice as much as all global forest biomass, and about the same as there is in the atmosphere.

Peatlands are critical for biodiversity conservation and support many specialised species and unique ecosystems, and can provide a refuge for threatened species that are expelled from degraded non-peatland areas.

Degradation of peatlands is a major and growing source of anthropogenic greenhouse gas emissions. Carbon dioxide emissions from peatland drainage, fires and exploitation are estimated to currently be equivalent to at least 3,000 million tonnes per annum or equivalent to more than 10% of the global fossil fuel emissions.

Climate change impacts are already visible through the melting of permafrost peatlands and desertification of steppe peatlands. Impacts of climate change on peatlands are predicted to significantly increase in the future.

Conservation, restoration and wise use of peatlands are essential and very cost-effective measures for long-term climate change mitigation and adaptation as well as biodiversity conservation.

There is an urgent need to strengthen awareness, understanding and capacity to manage peatlands in most countries - to address peatland degradation and biodiversity conservation and climate change.