


APFP

ASEAN Peatland Forests Project

The Peatland Biodiversity Management Toolbox

A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia

IFAD
Enabling poor rural people to overcome poverty

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GLOBAL ENVIRONMENT FACILITY
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Global Environment Centre

ASEAN Peatland Forests Project (APFP)

Rehabilitation and Sustainable Use of Peatland Forests in Southeast Asia

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First published June 2011

ISBN 978-967-5554-05-6
Printed in Malaysia

This publication should be cited as:

Prentice, R.C. 2011. The Peatland Biodiversity Management Toolbox: A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia. A Compilation. **ASEAN Peatland Forests Project** - *Rehabilitation and Sustainable Use of Peatland Forests in Southeast Asia.* ASEAN Secretariat and the Global Environment Centre.

Publication supported by ASEAN Peatland Forests Project with funding from the European Union (EU), the Global Environment Facility (GEF), the International Fund for Agricultural Development (IFAD) and the ASEAN Centre for Biodiversity (ACB).

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Acknowledgements

This document was prepared with financial support from the ASEAN Centre for Biodiversity; and the ASEAN Peatland Forests Project (APFP).

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List of Acronyms and Abbreviations

AMS	ASEAN Member State
APMI	ASEAN Peatland Management Initiative
APMS	ASEAN Peatland Management Strategy
ASEAN	Association of Southeast Asian Nations
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
FSC	Forest Stewardship Council
GAP	Global Assessment of Peatlands project (see Parish *et al.*, 2008)
GEC	Global Environment Centre
GHG	Greenhouse Gas
HCVF	High Conservation Value Forest
IMCG	International Mire Conservation Group
IUCN	The World Conservation Union
NAP	National Action Plans for Peatlands under the APMS
NBSAP	National Biodiversity Strategy and Action Plan (CBD)
POME	Palm Oil Mill Effluent
REDD	Reducing Emissions from Deforestation and forest Degradation
RSPO	Roundtable on Sustainable Palm Oil
UNCCD	UN Convention to Combat Desertification
UNFCCC	UN Framework Convention on Climate Change

1. Introduction

Context

Southeast 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 utilized or degraded and, over the past 10 years, more than three million ha have burnt – generating smoke clouds covering up to five countries, causing economic losses of billions of dollars and triggering major health and environmental concerns. Deforested and drained peatlands in Southeast Asia are also a globally significant source of CO_2 emissions, equivalent to almost 8% of global emissions from fossil fuel burning (Hooijer *et al.*, 2006).

In February 2003, ten Member States of the Association of Southeast Asian Nations (ASEAN) endorsed the ASEAN Peatland Management Initiative (APMI) to act as a framework for collaborative activities to address peatland degradation and fires. Subsequently in November 2006, the ASEAN Ministerial Meeting on the Environment endorsed the ASEAN Peatland Management Strategy 2006-2020 (APMS) to guide the sustainable management of peatlands in the region.

The goal of the strategy is promote sustainable management of peatlands in the ASEAN region through collective action and enhanced cooperation to support and sustain local livelihoods, reduce the risk of fire and associated haze, and contribute to global environmental management. The strategy includes 25 operational objectives and 97 action points in 13 focal areas ranging from integrated management to climate change and peatland inventory. Countries in the region are currently in the process of developing and implementing their respective National Action Plans (Parish *et al.* (2008), Chapter 9).

This preparation of this handbook was initiated under the project on Conservation of Peatland Biodiversity in Southeast Asia (Phase 2) supported by the ASEAN Centre for Biodiversity (ACB) to support for the implementation of the APMS and associated National Action Plans. Under the ASEAN Peatland Forests Project (APFP), the Handbook was revised and finalised as part of the Project's aim to promote the establishment of a network of protected peatlands through awareness and outreach to various stakeholders.

Purpose of the Handbook

The handbook aims to advance biodiversity conservation issues within the framework of the APMS by expanding on some of the priority issues identified within the APMS, providing guidance to technical professionals and administrators on approaches and techniques for improved conservation and restoration of peatlands, as well as sustainable development practices and options including reducing the risks and impacts of land-uses in peatland areas.

The handbook summarizes information from existing scientific and technical literature and provides a reference to available guidance. The subject embraces such a wide range of technical fields that it is impossible to provide significant detail on all related issues in one document, therefore further information sources have been provided where necessary. It is hoped that the information will be maintained and updated on the Peat Portal (www.peat-portal.net) by the Global Environment Centre (GEC).

Peatland at Raja Musa, Malaysia (Photo: S.Y.Lew/GEC)

Overview of Contents

This handbook is divided into two parts. **Part 1** provides introductory material on the nature and characteristics of peatlands, their distribution and extent in Southeast Asia, peatland biodiversity, threats, and the international policy framework for their management and conservation. **Part 2** provides guidance on conservation approaches, minimising the impacts of land uses, and restoration and rehabilitation of peatlands.

In Part 1, **Section 2** provides a brief overview of peatlands and the significance of peatland biodiversity in Southeast Asia, as a reminder that a globally significant resource is at stake. This is followed in **Section 3** by an overview of the status of peatland biodiversity and the underlying causes for its progressive, serious loss and degradation. This underlines that the full commitment of national governments is required to tackle threats and put in place sustainable use practices for peatlands.

The framework of global and regional policies is described in **Section 4**, which are relatively comprehensive, but to be effective they need to be put into action on the ground through national policies, plans and programmes, such as the National Action Plans for Peatlands under the APMS, and integrated with other relevant policies (e.g. national wetland or biodiversity policies), plans and programmes.

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Peatlands in Vietnam (Photo: B.Perumal/GEC)

2. Overview of the Biodiversity Values of Peatlands in Southeast Asia

2.1 Definitions

International approaches to peatland science and policy are complicated by the multitude of terms, the inconsistencies in their definitions, and the different concepts behind similar terms in different languages and disciplines. Therefore a glossary is provided in **Annex 1** to provide a listing of terms with brief explanations. In addition, references such as Page *et al.* (2007) (see next section) review practical issues arising from the variety of definitions in use for terms such as "peat".

Parish *et al.* (2008) provides the following practical definitions:

- **Peat** is dead organic material that has been formed on the spot and has not been transported after its formation.
- A **peatland** is an area with a naturally accumulated peat layer at the surface.
- A **mire** is a peatland where peat is being formed.

2.2 Nature and Characteristics of Peatlands in Southeast Asia

2.2.1 What are Peatlands?

A peatland is an area with a naturally accumulated layer of dead organic material (peat) at the surface. In most natural ecosystems the production of plant material is counterbalanced by its decomposition by bacteria and fungi. In those wetlands where the water level is stable and near the surface, the dead plant material do not fully decay but accumulate as *peat*. A wetland in which peat is actively accumulating is called a *mire* (**Figure 2.1**, Joosten and Clarke, 2002). Where peat accumulation has continued for thousands of years, the land may be covered with layers of peat that are metres thick.

Peat swamps are an important component of the world's wetlands – the dynamic link between land and water, a transition zone where the flow of water, the cycling of nutrients and the energy of the sun combine to produce a unique ecosystem of hydrology, soils and vegetation. A **wetland** is an area that is inundated or saturated by water at a frequency and for sufficient duration to support emergent plants adapted for life in saturated soil conditions. The Ramsar Convention also includes all open fresh waters (of unlimited depth) and marine waters ("up to a depth of six metres at low tide") in its "wetland" concept.

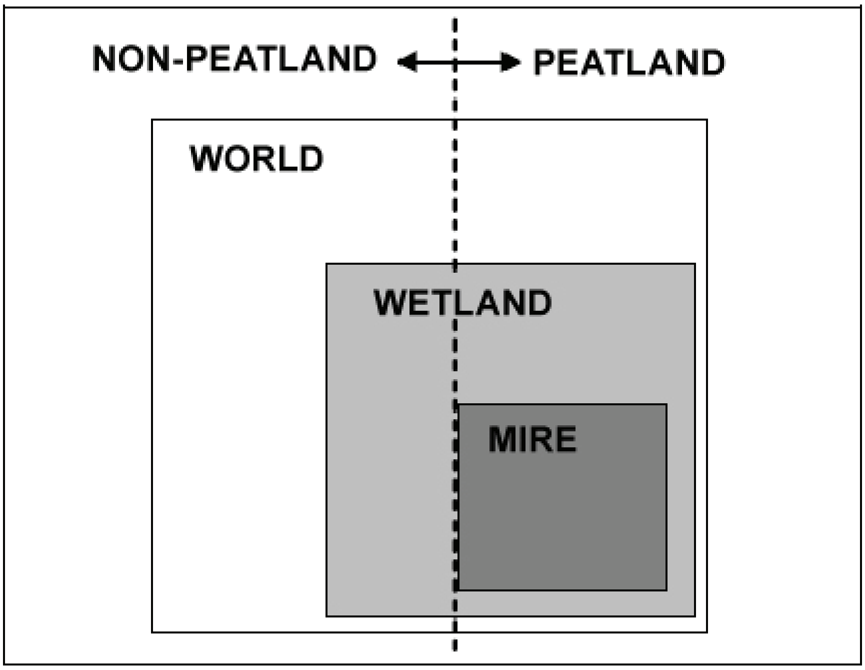

Figure 2.1: The relation between "peatland", "wetland", and "mire"
(adapted from Joosten and Clarke, 2002).

Wetlands can occur both with and without peat and, therefore, may or may not be peatlands. A mire is always a peatland. Peatlands where peat accumulation has stopped, for example, as a result of drainage, are no longer mires. When drainage has been particularly severe, they are no longer wetlands (**Figure 2.1**, Joosten and Clarke, 2002).

Peatlands are highly diverse and the peatland character of various ecosystem types is often not recognized. This is especially the case for types including tropical swamp forests, mangroves, highland cloud forests and rice fields, all of which may form peat and may have a peat soil (Joosten, 2004). Peatlands may occur in almost 20 of the wetland categories in the Ramsar Convention's wetland classification system.

2.2.2 Peatland characteristics

The major characteristics of natural peatlands are permanent water logging, the formation and storage of peat, and the continuous upward growth of the surface. These characteristics determine the specific goods, services, and functions associated with peatlands.

The special characteristic of lowland tropical peatland is peat swamp forest (part of the rainforest formation) growing on top of and contributing to the accumulation of a thick surface layer of peat which can exceed 20 metres in depth. The forest is the carbon allocating machinery that forms a biomass carbon store comparable to that of other rainforest types, whilst the waterlogged, acidic and nutrient deficient substrate, on which it grows, creates conditions under which the rate of biomass decomposition is reduced greatly and peat accumulates (Rieley, 2007). The continued survival of tropical peat swamp forests depends on a naturally high water level that prevents the soil from drying out to expose combustible peat matter. This harsh waterlogged environment has led to the evolution of many species of flora and fauna uniquely adapted to these conditions.

Formation and Development of Peatlands in Southeast Asia

The build-up of layers of peat and degree of decomposition depend principally on the local composition of the peat and the degree of waterlogging. Peat formed in very wet conditions accumulates considerably faster and is less decomposed than peat accumulating in drier places. The peat acts as a natural sponge, retaining moisture at times of low rainfall but, because it is normally waterlogged already, with a limited capacity to absorb additional heavy rainfall during periods such as a tropical monsoon.

Peat swamp forests develop on sites where dead vegetation has become waterlogged and is accumulating as peat (see **Figure 2.2**). Water in peat swamps is generally high in humic substances (humus and humic acids) that give a typically dark brown to black colour to the water. These conditions influence the types of vegetation that thrive in the covering forests and that, in turn, contribute to the character of the swamps.

Peat swamps are characterized by diverse features that relate to the:

- nature of the water supply, such as flooding by surface or groundwater, or solely from rainfall;
- type of landscape in which the peat swamp occurs, such as shallow depressions close to rivers;
- type of landscape that the swamp creates, such as accumulation of peat above groundwater level so that vegetation, often with prominent aerial roots, becomes wholly dependent on rainfall.

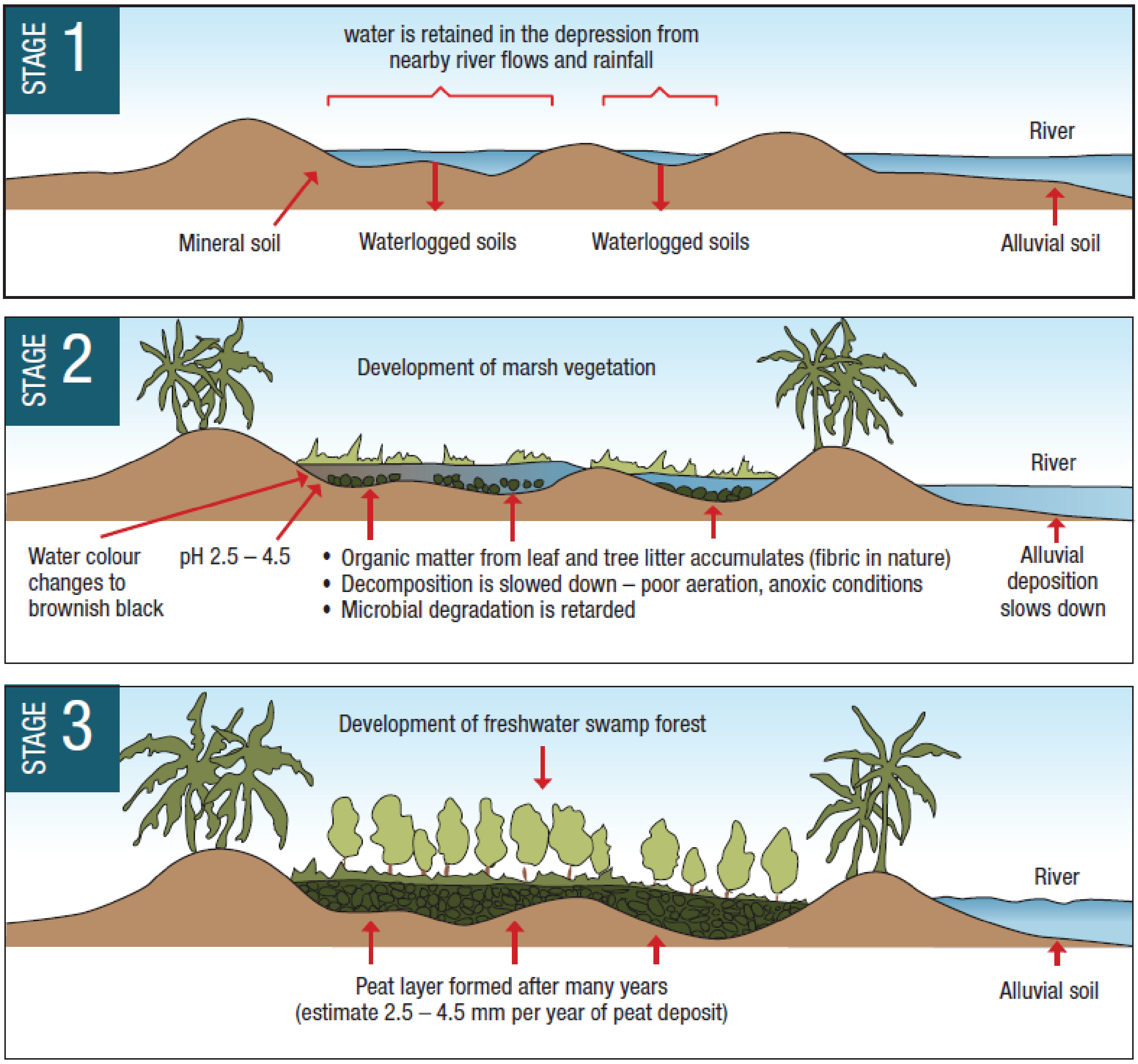

Figure 2.2 Stages in the development of tropical peat swamp forest (UNDP 2006).

A more technical description of tropical peat formation and preservation is provided by Wust *et al*. (2007): peat deposits are generally classified as organic soils (see above and **Annex 1** for definitions of the term "peat"). Peat accumulation on the spot is largely dependent on ever-wet conditions and environmental settings. The following conditions favour peat preservation:

1) primary production exceeds degradation;

2) low mineral sediment input (e.g. sand and clay);

3) stagnant water and low oxygen content in the upper peat producing layer (the acrotelm) because of bacterial and fungal respiration; and

4) organic sediment accumulation equals or exceeds subsidence rate.

High primary production of organic matter is characteristic of tropical environments in contrast to the slower growing peat deposits in temperate and boreal zones, which are dominated by plant associations of bryophytes, shrubs and herbs. In the lowland tropics, organic matter formation and preservation of peat depend on the subsurface input of organic matter, which is mainly through root mass of the peat forest trees with minor contributions by the above-ground components, including leaves, branches, and other organic detritus (Cameron *et al.*, 1989; Wüst & Bustin, 2003).

Organic matter accumulates where net organic production exceeds net organic decomposition, i.e. where primary productivity exceeds degradation by bacteria and fungi. Low temperatures, low pH and high water table reduce decomposition rates. In the tropics, high annual temperatures (22-35° C) coupled with high annual precipitation (1500- 3000 mm) favour prolific degradation of organic matter by bacteria and fungi. The same conditions, however, promote high primary production in tropical lowland environments, which may compensate for and exceed degradation rates, hence leading to net organic matter accumulation. In tropical rain forests, the dense canopy creates a microclimate with high air humidity owing to enhancement of transpiration and evaporation (Whitmore, 1998) that protects the forest floor from drought and thus reduces oxidation of organic material. In addition, higher degradation rates increase the amount of humic and fulvic acids in the water, which ultimately tend to lower the decay rate of plant material. An elevated groundwater level is thus a necessity for peat accumulation. In general, wetland systems regulate water flow and may compensate for low precipitation during inter-monsoonal times by slowly releasing stored water in the peat deposits. Precipitation must exceed evapo-transpiration in order to maintain the high water table and landscape hydrology necessary for net peat accumulation.

2.2.3 Values of Tropical Peatlands

There is a wealth of literature describing the values of tropical peatlands, including Andriesse (1988), James (1991), Rieley (2007) and Parish *et al*. (2008) *inter alia*.

Tropical peatlands can be valued according to their functions, which can be either, direct or indirect, products or attributes (Dugan, 1990; Maltby, 1997; Sugandhy, 1997). Direct functions include water flow regulation, protection from natural forces, recreation and education, and production of food and other resources for local communities. Indirect or ecological functions of peatlands include sediment retention, nutrient detention, and micro-climate formation and stabilization. Peatland products include provision of water supply to other ecosystems and human communities, forest resources ranging from fuel wood, timber and bark to resins and medicines, wildlife resources, agricultural and horticultural resources, and energy resources. Attributes (values, other than products that are related to environmental quality) include biological diversity, since tropical peatlands are important genetic reservoirs of certain animals and plants, unique locations for culture and heritage and habitats for the life cycles of flora and fauna. Tropical peatlands have long provided goods and services for local communities to fulfil their daily, basic requirements, for example, hunting grounds and fishing areas, food and medicines and construction materials. More recently, selective, semi-intensive timber extraction has been carried out, particularly in the peat swamp forests of Malaysia and Indonesia (Kalimantan, Sumatra and West Papua), providing employment, local income, new jobs and business opportunities, and contributing to national economies, but at the expense of the ecosystem and the environment (Rieley, 2007).

Carbon Storage

Peatlands worldwide are recognized to play a vital role in biosphere biogeochemical processes (Immirzi *et al.*, 1992). Peat soils globally, store about 30% of all terrestrial organic soil carbon, totalling 1,220 Gt (Immirzi & Maltby, 1992). Diemont *et al*. (1997) estimated that tropical peatlands contain up to 5000 t ha-1 of carbon with a total amount of at least 20 Gt while Page *et al.* (2004) suggest it could be as much as 70 Gt. Together, the vegetation and underlying peat constitute a large and highly concentrated carbon store (Sorensen, 1993; cited in Rieley, 2007).

Page *et al.* (2007) reviewed uncertainties and knowledge gaps regarding the distribution, extent and carbon storage for tropical peatlands. They noted that data on peat thickness are much more limited than data on area because the only reliable source of information is derived from time-consuming direct measurement in the field. For some countries a range of peat thickness values is available, but for many other countries, available thickness data are limited and estimates of peat volume must accordingly account for such data gaps. In the absence of accurate data on the thickness of tropical peats, authors presenting regional or global estimates for tropical peat volume have applied mean thickness values. Page *et al.* (2007) provided a range of estimates for the total tropical peatland carbon pool of 16.5-68.5 Gt. Further information will be made available through the Carbopeat project website, www.carbopeat.org.

There is a growing body of information concerning, and international interest in, the importance of tropical peat carbon stores and their role in environmental change processes. Unfortunately, they have also become a focus for large-scale land development projects that cause the natural resource functions of this important ecosystem to fail, changing it from a carbon sink to a carbon source. It is important to determine the role that tropical peatlands have played and continue to play in global environmental processes, especially those implicated in climate change through the ecosystem carbon cycle connected functions (Rieley, 2007).

In their natural condition most tropical peat swamp forests function as carbon sinks and stores, but forest clearance and drainage can convert them rapidly to carbon sources. This happens because destruction of the forest cover leads to a decrease in the amount of carbon allocated into the ecosystem. Agricultural practices require low water tables within the peat which increase further surface peat oxidation leading to peat subsidence and loss of stored carbon. One example of the carbon allocation reducing effect is from the late 1980s when 3.7 million hectares of Indonesian peat swamp forest were developed (Silvius *et al*., 1987). This led to an 18% decrease in natural peatland area with an estimated consequent reduction in the carbon fixation potential of 0.005–0.009 Pg yr-1 (Sorensen, 1993).

According to Hooijer *et al*. (2006), forested tropical peatlands in Southeast Asia store at least 42,000 Megatonnes of soil carbon. This carbon is increasingly released to the atmosphere due to drainage and fires associated with plantation development and logging. Peatlands make up 12% of the Southeast Asian land area but account for 25% of current deforestation. Out of 27 million hectares of peatland (see next section for more information the extent of peatlands in Southeast Asia), 12 million hectares (45%) are currently deforested and mostly drained. One important crop in drained peatlands is oil palm, which is increasingly used as a biofuel in Europe.

In the PEAT-CO_2 project reported in Hooijer *et al*. (2006), present and future emissions from drained peatlands were quantified using the latest data on peat extent and depth, present and projected land use and water management practices, decomposition rates and fire emissions. It was found that the current likely CO_2 emissions caused by decomposition of drained peatlands amounts to 632 Mt/y (between 355 and 874 Mt/y). This emission 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, over 1997-2006 an estimated average of 1400 Mt/y in CO_2 emissions was caused by peatland fires that are also associated with drainage and degradation. The current total peatland CO_2 emission of 2000 Mt/y equals almost 8% of global emissions from fossil fuel burning. These emissions have been rapidly increasing since 1985 and will further increase unless action is taken. Over 90% of this emission originates from Indonesia, which puts the country in third place (after the USA and China) in the global CO_2 emission ranking.

Hooijer *et al.* (2006) concluded that deforested and drained peatlands in Southeast Asia are a globally significant source of CO_2 emissions and a major obstacle to meeting the aim of stabilizing greenhouse gas emissions, as expressed by the international community. They therefore recommended that international action should be taken to help Southeast Asian countries, especially Indonesia, to better conserve their peat resources through forest conservation and through water management improvements aiming to restore high water tables.

2.3 Peatland Distribution in Southeast Asia

Variations in the definitions of peat and inventory methods have resulted in a variety of estimates of the area of peatland resources both worldwide, and in Southeast Asia. Page *et al*., 2008 review the information base and provide a range of estimates drawn from different sources, summarised in **Table 2.1**.

Table 2.1. Maximum and minimum values for area of tropical peatland (km^2)
(Source: Page *et al*., 2008)

Region	Area (km^2) Minimum	Maximum
Africa	26,607	88,657
Asia (Mainland)	622	6,245
Central America	14,465	25,935
Pacific	190	21,240
South America	37,136	96,380
Brunei	100	1,000
Indonesia	168,250	270,000
Malaysia	22,500	27,300
Papua New Guinea	5,000	28,942
Philippines	60	2,400
Thailand	394	680
Vietnam	100	1,830
Asia (Southeast) Total	**196,404**	**332,152**
Total	**275,424**	**570,609**

The total area of peatlands in Southeast Asia (including Papua New Guinea) is estimated to lie between approximately 19 and 33 million hectares, which is about 60 - 70% of the world's tropical peatlands and about a tenth of the total global peatland resource. The majority of the peatlands of Southeast Asia occurs in Indonesia, which has over 80% of the total peatland area in Southeast Asia. Other major peatland areas are found in Malaysia, Brunei Darussalam, Thailand, Viet Nam, and the Philippines.

Peatlands are usually found in low altitude, sub-coastal areas extending inland for distances up to 300 km. The depth of peat varies from 0.5 m to more than 10 m. Accelerated development, land conversion and degradation caused by land and forest fires have reduced the region's peatland resources significantly over the past few years (APMS, 2006).

In most Southeast Asian countries, peatlands are designated as conservation areas, production forests or agricultural lands; the proportion varies significantly between countries. The area of undisturbed/ pristine peatlands in the region is now very small. Currently, most ASEAN Member States (AMS) have recognised the need to use resources available from peatlands with a sustainable approach. In this respect, more emphasis is needed on recognizing the ecosystem services provided by peatlands in policies and development plans, including their values for biodiversity conservation, carbon storage and sequestration, and water regulation. This will aid in more sustainable and efficient management of peatland resources for current and future generations (APMS, 2006).

2.4 Peatlands and Biodiversity

2.4.1 Why Peatlands are Important for 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 the external impacts of changes in their river basins and to climate change, which may lead to the 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.

- Peatlands exhibit highly characteristic ecological traits and are unique, complex ecosystems. They are of global importance for biodiversity conservation at genetic, species and ecosystem levels.

- Although species diversity in peatlands may be lower, they have a higher proportion of characteristic (unique) species than dryland ecosystems in the same bio-geographic zone.

- Peatlands play a special role in maintaining biodiversity at the genetic level due to habitat isolation and habitat heterogeneity, and at the ecosystem level due to their ability to self-regulate and adapt to different physical conditions.

- Peatlands may develop sophisticated self-regulation mechanisms over time, resulting in high within-habitat diversity, such as forest vegetation gradients in domed peat swamps.
- Peatlands are important for biodiversity far beyond their borders by maintaining hydrological and microclimate 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, including local nature conservation planning and practices, national policies and development plans, as well as in international convention deliberations and decisions. Their unique attributes require special consideration within conservation strategies and land-use plans (Parish *et al.,* 2008).

2.4.2 Peatland Biodiversity in Southeast Asia

Ecosystems

A diversity of peatland ecosystems are represented within the Southeast Asian region, which are in need of systematic description, classification and registration at a regional level (see section on peatland inventory and assessment). Natural peatland ecosystems in the Southeast Asian region are mainly peat swamp forests and associated marshes. Representative areas of the different peatland ecosystems should be included in national protected area systems as well as international site networks such as the Ramsar Convention's List of Wetlands of International Importance.

Ecosystem diversity is influenced by factors including bio-geographical location, elevation (lowland or highland), local climate, topographical situation (e.g. coastal domed swamps, riverine swamps), underlying soil types, the depth of the peat layer, and its nutrient status. As a result, the region contains a diversity of peatland ecosystems, each with its own distinctive characteristics including variations in plant and animal communities.

Peat swamp forests are considered to be an ecological succession of freshwater swamp forests, where conditions are such that forest debris accumulates into a peat layer, which may raise the soil into a convex mound (Corner, 1978). Some of the most highly developed peat swamps occur in northern Borneo, where Anderson

(1963, 1964) distinguished six phasic communities in the development of the peat swamp forest. Corner (1978) studied the distribution of swamp forest trees around the "Riau pocket" - a vast basin between the Malay Peninsula, Sumatra, Java, the Riau Archipelago and western Borneo. He concluded that it was not clear that the peat of one floristic region is identical or ecologically equivalent with that of another – every area of swamp forest, therefore, needs its own particular investigation. This ecological and floristic heterogeneity of peat swamp forest has important implications for biodiversity conservation.

Species

Tropical peat swamp forests generally support a less rich flora than comparable areas of dryland forest, as a result of the challenging growing conditions – permanent or frequent flooding, unstable soil, and low nutrient availability apply in most cases. While 1800 – 2300 tree species are found in dry lowland forest of Sarawak and Brunei, 234 species have been recorded in peat swamp forests (Whitmore, 1984).

As an example, in Peninsular Malaysia while most of the tree families of lowland evergreen dipterocarp forest are found in peat swamp forest, species are restricted in number, and in general are not found outside this habitat. The shrub layer is, in general, rather sparse and the ground flora comparatively poor. The canopy height is lower than lowland forest on mineral soils and structural adaptations occur such as buttresses, stilt roots and kneed pneumatophores (protruding roots) (Wyatt-Smith, 1963). This gives some indication that peat swamp forests are significant for containing many species that do not occur outside this ecosystem, and also that peat swamp species are specially adapted to the peculiar environmental conditions.

Some commercially important tree species are mainly restricted to peat swamp forests, notably Ramin *Gonystylus bancanus* which is now listed in CITES due to its over-exploitation, Kempas *Koompassia malaccensis,* Durian *Durio carinatus* and some *Shorea* species (Meranti), such as *S. uliginosa, S. platycarpa and S. teysmanniana.* Globally threatened tree species occurring in Southeast Asian peat swamp forests include: *S. platycarpa, Dipterocarpus chartaceus* and *Hopea mengerawan* (all Critically Endangered), *S.albida* (Endangered) and *G.bancanus* (Vulnerable).

The wildlife conservation values of peat swamp forests can be summarized as follows:

- Populations of some globally threatened species occur in the peat swamp forests of this region, including: Orang-utan *Pongo pygmaeus*, Proboscis Monkey *Nasalis larvatus*, Leopard *Panthera pardus*, Tiger *Panthera tigris*, Flat-headed Cat *Prionailurus planiceps*, Otter Civet *Cynogale bennettii*, Hairy-nosed Otter *Lutra sumatrana*, Sumatran rhinoceros *Dicerorhinus sumatrensis*, Malayan Tapir

Tapirus indicus, Asian Elephant *Elephas maximus*, Malayan False Gharial *Tomistoma schlegelii*, Asiatic Softshell Turtle *Amyda cartilaginea,* Painted Terrapin *Callagur borneoensis,* Bornean River Turtle *Orlitia borneensis,* Storms Stork *Ciconia stormi*, Lesser Adjutant Leptoptilos javanicus, Wrinkled Hornbill *Aceros corrugatus*, White-winged Wood Duck *Cairina scutulata*, Asian Bonytongue *Scleropages formosus*, etc.

- Other rare or significant wildlife also occur in peat swamp forests, including raptors, hornbills and a diversity of monkey species.
- Peat swamp forests support specialized species and communities not found in other types of habitats (for example, blackwater fish communities). Diverse blackwater fish communities including endemic species such as *Betta* spp. and a number of species new to science have recently been described in peat swamp forest waters. Rare species such as *Chaca bankanensis* have been recorded.
- Peat swamp forests are heterogeneous, both in terms of flora and fauna, thus different areas support different species assemblages.
- The distribution of peat swamp forests cover a large geographical area, therefore bio-geographical differences in flora and fauna occur across the region.

Genetic Level of Biodiversity

At the genetic level, peat swamp forest species exhibit adaptations to the challenging swampy conditions (the stilt roots, pneumatophores, and other adaptations mentioned above), and isolation of peat swamps gives rise to a diversity of forms and the occurrence of species or sub-species that are specific to peat swamp habitats (see the example of *Shorea* tree species above).

Information Resources on Biodiversity

ASEAN Centre for Biodiversity - www.aseanbiodiversity.org

The **Biodiversity Information Sharing Service (BISS) under the Biodiversity Information Management of the ASEAN Centre for Biodiversity** provides an important regional resource. BISS is a web-based data management system envisioned to serve as the common sharing platform for the AMCs on biodiversity information. BISS is currently keeping only a minimal dataset on critical details, like species name lists and protected area network data. The bulk of the data comes from other data sources. The current BISS contains species by several taxonomic group and protected area information grouped into terrestrial, marine and ASEAN Heritage Parks. Additional data gathered from the ASEAN Member States and global and regional data sources will be added to the BISS platform.

In addition, the **ASEAN regional Clearing House Mechanism for biodiversity information (ASEAN CHM)** will facilitate consolidation, access, analysis and promotion of regional biodiversity information, issues and initiatives of the ASEAN Member States (AMS). The ASEAN CHM is envisioned to capture, organize and harmonize the common information that is publicly available in the CHMs of the AMS and provide the regional overview of biodiversity information. It will provide the primary access and single portal to all AMS biodiversity information resources and applications.

Regional resources on taxonomic groups

Asia Dragonfly Community: http://www.asia-dragonfly.net/

Asian Turtle Conservation Network: http://www.asianturtlenetwork.org/index.htm

Birdlife Asia Programme: http://www.birdlife.org/regional/asia/index.html

Global resources

Alliance for Zero Extinction: http://www.zeroextinction.org/

Birdlife International Datazone (information on bird species, important bird areas, endemic bird areas, state of the world's birds):
http://www.birdlife.org/datazone/index.html

CITES Species Database: http://www.cites.org/eng/resources/species.html

Fishbase: www.fishbase.org

Global Register of Migratory Species http://www.groms.de/

Save Our Species: http://www.sospecies.org/

The IUCN Red List of Threatened Species http://www.iucnredlist.org/

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Pitcher plant (Photo: S.Y.Chin/GEC)

3. Causes of Peatland Biodiversity Loss and Degradation

3.1 Introduction

The loss and degradation of peatland biodiversity has to be seen within the wider context of the loss of global biodiversity. In late 2010, the 10th Conference of the Parties to the Convention on Biological Diversity (CBD) met to review performance against the 2010 Biodiversity Targets and to set new targets for 2020, coinciding with the establishment of CBD's Strategic Plan for the period 2011 – 2020 (CBD, 2010a) and the launch of the UN Decade for Biodiversity (CBD, 2010b).

The target agreed by the world's Governments in 2002, "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth," has not been met. There are multiple indications of continuing decline in biodiversity in all three of its main components —genes, species and ecosystems — including:

- Species which have been assessed for extinction risk are on average moving closer to extinction. Nearly a quarter of plant species are estimated to be threatened with extinction.
- The abundance of vertebrate species, based on assessed populations, fell by nearly a third on average between 1970 and 2006, and continues to fall globally, with especially severe declines in the tropics and among freshwater species.
- Natural habitats in most parts of the world continue to decline in extent and integrity. Freshwater wetland habitats showed serious declines.
- Extensive fragmentation and degradation of forests, rivers and other ecosystems have also led to loss of biodiversity and ecosystem services.
- The five principal pressures directly driving biodiversity loss (habitat change, overexploitation, pollution, invasive alien species and climate change) are either constant or increasing in intensity.
- The ecological footprint of humanity exceeds the biological capacity of the Earth by a wider margin than at the time the 2010 target was agreed.

(Source: Secretariat of the Convention on Biological Diversity, 2010)

It is notable that freshwater wetland habitats and species have experienced particularly serious declines, and that the main pressures driving biodiversity loss still prevail or are increasing. This has profound implications for peatland management in Southeast Asia, indicating the urgent need for conservation efforts and more sustainable land use in order to reduce current rates of biodiversity loss.

Effective action to address biodiversity loss depends on addressing the underlying causes or indirect drivers of that decline. Therefore, the systematic analysis of threats to biodiversity is an important foundation for the design of conservation and sustainable use strategies, programmes and projects.

The Root Causes of Biodiversity Loss (Wood *et al*., 2000) provides the results of a project that aimed to understand the root causes of biodiversity loss and effecting responses to them. The project developed an analytical framework and conducted case studies in 10 countries. The broad conclusions emerging from the analysis including the following points: First, it is clear that understanding biodiversity loss involves looking well beyond local sites in order to understand and address underlying root causes. Secondly, the underlying socio-economic causes are two fold - the heavy reliance on natural resources to address domestic and external pressures, and the common acceptance of a development model in which such use of resources is promoted. Third, environmental management systems are inadequately designed and supported to address the resulting pressures on habitats and biodiversity. Fourth, in many of the case studies, it was necessary to address various socio-economic root causes to address biodiversity loss. Consequently, the current approach to environmental management, including the largely local approach to conservation followed by many international programmes, and the inadequate and poorly enforced management regimes of national governments, are inadequate to address the overwhelming threats to biodiversity. A more comprehensive approach to conservation is needed to address the wide variety of factors resulting in biodiversity loss.

Some tools are available to assist in the classification of threats and processes of threat analysis (for example conservation project management software such as Miradi: https://miradi.org/). For a classification of direct threats related to conservation planning, see: IUCN-CMP. 2006. Unified Classification of Direct Threats, Version 1.0.

http://conservationmeasures.org/CMP/Site_Docs/IUCN-CMP_Unified_Direct_Threats_Classification_2006_06_01.pdf

The same material can be viewed on the following dedicated website:
http://www.conservationmeasures.org/CMP/Site_Page.cfm?PageID=32

The global context regarding the progressive loss of wetland resources is summarized in the following extract from *Ramsar Resolution X.1: The Ramsar Strategic Plan 2009-2015.* This is directly relevant to peatlands, as types of wetlands.

In the 1960s the driving force behind the establishment of the Ramsar Convention was concerned over the continuing destruction of wetlands and the impact of this destruction on populations of waterbirds. Yet, almost 35 years on, in 2005 the Millennium Ecosystem Assessment (MA) http://www.maweb.org concluded that "degradation and loss of wetlands (both inland and coastal) is continuing more rapidly than for other ecosystems." It is clear that the underlying problem remains – economic development and consequent land-use change often remain higher priorities than ecosystem maintenance, despite the fact that these are closely interlinked and that continuing to destroy ecosystems and their services is essentially "biting the hand that feeds us." Among the key issues that are driving continued change, deterioration and loss of wetlands and their services, are:

- the inadequate availability of water to wetlands, in relation to wetlands' key roles in the global hydrological cycle;
- increasing demands for water abstraction, particularly for irrigated agriculture;
- the impacts of a changing and increasingly extreme and unpredictable climate; and
- the lack of a good understanding of the value of wetlands and their services (wetland valuation) to underpin sound decision-making and trade-offs.

There is, therefore, a key urgency for national environmental governance to shift from sectoral, demand-driven approaches to an **ecosystem-based approach;** to policy and decision-making that affect the wise use of wetlands and the maintenance of their ecological character; and to recognize the important role of wetlands in climate change mitigation and adaptation activities.

3.2 Loss and Degradation of Peatlands in Southeast Asia

The APMS identifies a number of common issues and concerns, including large-scale land conversion of peatlands for the development of plantations, agriculture and urban development, fire and transboundary smoke haze pollution, community/ smallholder impacts on peatlands, drainage of peatlands as a result of many kinds of development, over-exploitation of peatland products such as timber and harvesting of non-timber forest products, emissions of greenhouse gases as a result of unsustainable peatland management, and loss of biodiversity. Other issues include illegal hunting, soil erosion, occurrence of invasive species, etc.

An assessment of the status and trends of tropical forested peatlands revealed that the original area of such forests in Southeast Asia was about 30 million hectares (see **section 2.3** for further information), with losses over the last 20 years of an estimated 20 to 24 million hectares. In terms of threats, approximately 12 million hectares have been cleared and drained and a further 8-12 million hectares logged or degraded. Furthermore, in the past 10 years nearly three million hectares have burnt, leading to large-scale transboundary smoke haze, which has had serious environmental, economic and health impacts. Greenhouse-gas emissions from drainage and fires in Southeast Asia is estimated to contribute about 2 billion tonnes of carbon dioxide per annum or equivalent to about 8 per cent of global fossil-fuel emissions (Source: CBD Secretariat 2008; see also Hooijer *et al*., 2006).

As an illustration of such impacts, a study of the rates of forest clearing in **Indonesia** from 1990 to 2005 (Hansen *et al*., 2009) confirms significant loss of lowland forest cover, including peatland areas. Results show a dramatic reduction in clearing from a 1990s average of 1.78 million ha per year to an average of 0.71 million ha per year from 2000 to 2005. However, annual forest cover loss indicator maps reveal a near-monotonic increase in clearing from a low in 2000 to a high in 2005. Results illustrate a dramatic downturn in forest clearing at the turn of the century followed by a steady resurgence thereafter to levels estimated to exceed 1 million ha per year by 2005. The lowlands of Sumatra and Kalimantan were the site of more than 70% of total forest clearing within Indonesia for both epochs; over 40% of the lowland forests of these island groups were cleared from 1990 to 2005.

3.3 Human Use of Peatlands

Humans have directly utilised peatlands for thousands of years, leading to differing and varying degrees of impact. 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 and flood control.

- Many indigenous cultures and local communities are dependent on the continued existence of peatlands, and 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 not in private ownership, so they are increasingly targeted by development that needs large areas of land, such as airports, plantations, windfarms and reservoirs.

(Source: Parish *et al.*, 2008)

3.3.1 Fires

Drainage of peatlands for a variety of purposes (agriculture, logging operations, land reclamation for housing and industry, flood mitigation) also greatly increases their vulnerability to fire; one of the most significant courses of peat degradation and GHG emissions. Fire does not normally occur continuously, but when burning does take place it may lead to the emission of up to 4,000 tonnes of CO_2/ha in the tropics and 2,000 tonnes of CO_2/ha in temperate regions (Parish *et al.*, 2008).

Peatland fires are becoming more frequent in Southeast Asia. This is generally a result of accelerated rates of land clearance as well as the large-scale drainage of peatlands. More than 2 million ha of Southeast Asia's peatlands were burnt in the past 10 years. Fires were persistent, with many burning for between 1-3 months, leading to large CO_2 emissions. Indonesia is now considered to have the third highest CO_2 emissions globally, primarily as a result of persistent peatland fires (Hooijer *et al*., 2006).

The most vulnerable periods are during regional dry spells or droughts, usually associated with El Nino ENSO events. Huge fires engulfing enormous areas of peatlands (as well as dryland forests) took place during the intense El Nino events in 1981-2 and 1997-8, particularly affecting peat swamp forests on the islands of Borneo and Sumatra (for example, see Johnson (1984), Murdiyarso (1998), Potter and Lee (1999), Vayda (1999) and Schweithelm (1999). However, widespread smaller fires currently occur every dry season; these are related to land clearance for agriculture and plantation development or are accidental fires. Significant fires with associated transboundary haze took place in the relatively dry years of 2002, 2005 and 2006 (see Tacconi *et al*., 2006).

Ecological and socio-economic background on fire in Southeast Asia

The application of fire in land-use systems and wildfires in forests and other vegetation in Indonesia and neighbouring countries within the Southeast Asian region have reached unprecedented levels and have been leading to severe environmental problems and impacts on society. Traditional slash-and-burn systems in the shifting agriculture mode are increasingly replaced by modern large-scale conversion of forest into permanent agricultural systems which are partially maintained by fire, and into forest plantations. Wildfires escaping from land-use fires are becoming more and more regular. The impact of land-use fires and wildfires are detrimental to biodiversity and the regional atmospheric chemistry. In Indonesia and within the Southeast Asian region a joint, concerted approach is needed to cope with the problem of transboundary pollution caused by vegetation burning. However, since fire is an essential tool in land use in the tropics a response strategy must be developed in which the benefits from fire use would be encouraged, at the same time the negative impacts of fire be reduced. National and regional fire management plans and policies must take into consideration the complexity and diversity of fire uses in different vegetation types and land-use systems. A number of references can be downloaded on this subject at:

http://www.fire.uni-freiburg.de/se_asia/sea_back.htm

Further information on the impacts and control of peatland fires can be found on the GEC Peat Portal at: http://www.peat-portal.net/index.cfm?&menuid=140. This includes reports from the workshop on ASEAN Peatland Fire Prediction and Warning, Kuala Lumpur 13-14th July 2010; the technical meeting for the development of the ASEAN Peatland Fire Prediction and Warning System, 10 June 2010; amongst others.

3.4 Peatlands and 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.

- 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, erosion) may push many peatlands over their threshold for adaptation.
- 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.

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.

- 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.
- 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 rise, 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.
- 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 from oxidation, fire and erosion.

      (Source: Parish *et al*., 2008)

Land preparation practices through open burning should be discouraged
(Photo: F. Parish/GEC)

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4. Policy Framework for the Conservation of Peatland Biodiversity in Southeast Asia

The policy framework for the conservation of peatland biodiversity consists of global, regional and national policy levels.

4.1 Global Environmental Conventions

At the global level, a number of Conventions are of particular relevance to the management of peatlands and their biodiversity, in particular: the Convention on Biological Diversity, the Ramsar Convention on Wetlands and the UN Framework Convention on Climate Change. The status of ASEAN state membership in these conventions and other relevant conventions is shown in Table 4.1.

Table 4.1 Status of ASEAN state membership in global environmental conventions (as of November 2010: source – official websites of the listed conventions)

State	CBD	CMS	Ramsar	CITES	UNFCCC
Brunei Darussalam	Acs	-	-	-	Acs
Cambodia	Acs	IOSEA	Contracting Party	Party	Acs
Indonesia	Rtf	IOSEA	Contracting Party	Party	Rtf
Lao PDR	Acs	-	Contracting Party	Party	Acs
Malaysia	Rtf	-	Contracting Party	Party	Rtf
Myanmar	Rtf	IOSEA, Dugong	Contracting Party	Party	Rtf
Philippines	Rtf	Party, IOSEA, Dugong, Sharks	Contracting Party	Party	Rtf
Singapore	Rtf	-	-	Party	Rtf
Thailand	Rtf	IOSEA	Contracting Party	Party	Rtf
Vietnam	Rtf	IOSEA	Contracting Party	Party	Rtf
Total	**10**	**1**	**8**	**9**	**10**

Notes: CBD & UNFCCC: All terms, "ratification" (rtf), "accession" (acs), "approval" (apv) and "acceptance" (acp), signify the consent of a State to be bound by a treaty. The legal incidents/implications of ratification, accession, approval, and acceptance are the same. The treaty becomes legally binding on the State or the regional economic integration organization. All the countries that have either ratified, acceded to, approved or accepted the Convention are therefore Parties to it.

CMS: Signatories to the CMS MoUs on Turtles (IOSEA), Dugongs and Sharks are listed, although only the Philippines is a Party to the Convention.

4.1.1 Convention on Biological Diversity (CBD) www.cbd.int

The Convention on Biological Diversity has three main goals:

- The conservation of biodiversity,
- Sustainable use of the components of biodiversity, and
- Sharing the benefits arising from the commercial and other utilization of genetic resources in a fair and equitable way

The Convention is comprehensive in its goals, and deals with an issue so vital to humanity's future that it is a landmark in international law. It recognizes-for the first time-that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process. The agreement covers all ecosystems, species, and genetic resources. It links traditional conservation efforts to the economic goal of using biological resources sustainably. It sets principles for the fair and equitable sharing of the benefits arising from the use of genetic resources, notably those destined for commercial use. It also covers the rapidly expanding field of biotechnology, addressing technology development and transfer, benefit-sharing and biosafety. Importantly, the Convention is legally binding; countries that join it are obliged to implement its provisions.

The Convention's members regularly share ideas on best practices and policies for the conservation and sustainable use of biodiversity with an ecosystem approach (see **Part 2**). They look at how to deal with biodiversity concerns during development planning, how to promote transboundary cooperation, and how to involve indigenous peoples and local communities in ecosystem management. The Conference of the Parties has launched a number of thematic programmes covering the biodiversity of inland waters, forests, marine and coastal areas, drylands, and agricultural lands. Cross-cutting issues are also addressed on matters such as the control of alien invasive species, strengthening the capacity of member countries in taxonomy, and the development of indicators of biodiversity loss. The 10^{th} and most recent meeting of the

Conference of Parties was particularly significant, reviewing progress against the 2010 Biodiversity Targets and setting new targets in the CBD's Strategic Plan 2011-2020 (http://www.cbd.int/nagoya/outcomes).

Parties to the CBD are required to produce and periodically update National Biodiversity Strategy and Action Plans (NBSAPs). These can be downloaded from the CBD Website, together with national reports on implementation of the Convention. National measures for the conservation of peatland biodiversity should be integrated into national policies on biodiversity conservation and NBSAPs.

The importance of peatlands has been recognized by the Convention on Biological Diversity (CBD) though Decision VII/15 (http://www.cbd.int/decision/cop/?id=7752) and IX/16 on Biodiversity and Climate Change (http://www.cbd.int/doc/decisions/cop-09/cop-09-dec-16-en.pdf) and through CBD SBSTTA Recommendation XII/5.

CBD COP9/20 Cross-Cutting Issues – Progress Report and Consideration of Proposals for Future Action reports on various issues under consideration by SBSTTA, including the sustainable management of forested peatlands in Southeast Asia. This document notes the significance of peatlands for mitigation of climate change, and the significant threats that tropical forested peatlands are facing including conversion to oil palm plantations.

Other related CBD decisions and guidance are mentioned in other sections of these guidelines.

4.1.2 Ramsar Convention on Wetlands www.ramsar.org

The Ramsar Convention requires two principle obligations of its Contracting Parties – to make "wise use" of all wetlands in the country's territory, and to designate at least one wetland of international importance for the Ramsar List (according to criteria for qualification). These are reflected in the Goals for the Ramsar Strategic Plan 2009-2015 (http://www.ramsar.org/cda/en/ramsar-documents-resol-resolutions-of-10th/main/ramsar/1-31-107%5E21247_4000_0__):

GOAL 1. Wise Use. To work towards achieving the wise use of all wetlands by ensuring that all Contracting Parties develop, adopt and use the necessary and appropriate instruments and measures, with the participation of the local indigenous and non-indigenous population and making use of traditional knowledge, while at the same time ensuring that conservation and wise use of wetlands contribute to poverty eradication, mitigation of and adaptation to climate change, as well as prevention of disease and of natural disasters. (Delivers Articles 3.1, 4.3, 4.4, and 4.5 of the Convention.)

OUTCOME SOUGHT: The wise use of all wetlands being achieved in all Parties, including more participative management of wetlands, and conservation decisions being made with an awareness of the importance of the ecosystem services provided by wetlands.

"*Wise use*" of wetlands is defined by the Convention as "*their sustainable utilisation for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem.*" Substantial guidance is provided on implementation of the "wise use" of wetlands, and some of this is referred to in subsequent chapters on specific management approaches and issues.

GOAL 2. Wetlands of International Importance. To develop and maintain an international network of wetlands that are important for the conservation of global biological diversity, including waterbird flyways and fish populations and for sustaining human life, by ensuring that all Contracting Parties appropriately implement the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* and by appropriate management and wise use of those internationally important wetlands that are not yet formally designated as Ramsar sites but have been identified as qualifying through domestic application of the *Strategic* Framework or an equivalent process. (Delivers Articles 2.1, 2.2, 2.5, 2.6, 3.1, 3.2, 4.1 and 4.2 of the Convention.)

OUTCOME SOUGHT: Parties designating and managing Ramsar sites within their territories with a view to supporting an international network of Wetlands of International Importance, fully implementing their reporting commitments under Articles 3 and 8.2, and using the Montreux Record as part of the Convention's governance process, as appropriate.

The Ramsar Sites listed by ASEAN countries that include peatlands are indicated in **Table 4.2**.

Table 4.2 Ramsar sites including peatlands in the Southeast Asian Region (as of 15 November 2010). Sources – Ramsar Convention Website and Ramsar Sites Information Service**:** http://ramsar.wetlands.org/

Contracting Party	Number of Ramsar Sites	Number of Ramsar Sites including peatlands	Name and area of Ramsar Sites including peatlands
Cambodia	3	0	
Indonesia	3	3	Berbak (162,700 ha) Danau Sentarum (80,000 ha) Wasur National Park (413,810 ha)
Malaysia	6	2	Tasek Bera (38,446 ha) Lower Kinabatangan-Segama Wetland (78,803 ha)
Myanmar	1	0	
Philippines	4	1	Agusan Marsh Wildlife Sanctuary (14,836 ha)
Thailand	10	2	Kuan Ki Sian of the Thale Noi Non-Hunting Area (494 ha) Princess Sirindhorn Wildlife Sanctuary (Pru To Daeng Wildlife Sanctuary). 20,100 ha
Vietnam	2	0	
Total	**29**	**8**	

The Ramsar Strategic Plan urges Contracting Parties to apply the Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance (Ramsar Handbook 14: http://www.ramsar.org/pdf/lib/lib_handbooks2006_e14.pdf) and by 2015, to have prepared, using the *Strategic Framework,* a national plan and priorities for the designation and management of Ramsar sites, including where appropriate for shared wetlands in collaboration with neighbouring Parties.

The *Strategic Framework* specifically identifies peatlands as being amongst the wetland ecosystems that are most vulnerable and threatened by habitat loss and degradation, and thus in need of urgent priority action to ensure their conservation and wise use. It recognizes peatlands as being under-represented in the existing global network of Ramsar Sites, and provides guidance on the identification and designation of peatlands as Wetlands of International Importance. It notes that peatlands (as well as a few other wetland types) have been identified as being particularly vulnerable and threatened by habitat loss and degradation. Thus the identification and designation of threatened ecological communities, as well as threatened species, under Ramsar Criterion 2 will often be of particular importance.

Large areas of peatlands are normally of higher importance than small areas for their hydrological, carbon storage and palaeoarchive values and because they incorporate macro-landscapes: these should be afforded high priority for designation. Consideration should also be given to the capacity of the peatland system to influence regional climate.

Where appropriate and desirable**,** peatlands designated as Ramsar sites should include entire catchments, so as to maintain the hydrological integrity of the peatland system.

In addition to the above considerations regarding the designation of peatlands as Ramsar Sites, there are other Ramsar Resolutions that concern the conservation and management of peatlands, including the **Guidelines for Global Action on Peatlands (GGAP)**, adopted as the Annex to Resolution VIII.17 by the 8th Conference of the Contracting Parties, Valencia, Spain, 2002. http://www.ramsar.org/cda/en/ramsar-documents-resol-resolutions-of-8th/main/ramsar/1-31-107%5E21367_4000_0_

This followed on from Recommendation 6.1, which encouraged further cooperation on wise use, sustainable development, and conservation of global peatlands, and Recommendation 7.1, which requested cooperation from Contracting Parties and other interested bodies to refine the "*Draft Global Action Plan for the Wise Use and Management of Peatlands.*"

Taken together the guidelines provide:

a) a framework for national, regional and international initiatives to promote the development of strategies for peatland wise use, conservation, and management;

b) guidance on mechanisms to foster national, regional and international partnerships of government, the private sector, and non-government agencies to fund and implement actions in support of such strategies; and

c) approaches to facilitate adoption and support for implementation of global action on peatlands through the Ramsar Convention, the CBD, the UNFCCC, and other appropriate national, regional or international instruments.

Section C of the Ramsar guidelines covers policy and legislative instruments, including a number of recommendations, as follows:

C.Policy and legislative instruments

21. Ramsar Resolution VII.7 provides guidelines for reviewing laws and institutions to promote the conservation and wise use of wetlands (Ramsar Handbook No. 3). These guidelines are designed to assist Contracting Parties in ensuring that they have in place the appropriate legal and institutional framework for effective delivery of their commitments under the Ramsar Convention for the wise use of wetlands (which include, inter alia, peatlands), and that other sectoral measures, for example water management mechanisms and legislation, are harmonized and consistent with their wise use objectives.

22. Contracting Parties have recognized that peatlands are an under-represented wetland type in the Ramsar List of Wetlands of International Importance and have afforded priority to the designation of peatlands as Ramsar sites. To assist Contracting Parties in the identification and designation of such sites, COP8 has adopted additional guidance on their designation (Resolution VIII.11).

Guidelines for Action

C1. Contracting Parties should review their present frameworks of national policies, laws and incentive programmes relevant to peatlands utilizing the Ramsar Guidelines for reviewing laws and institutions to promote the conservation and wise use of wetlands (Ramsar Handbook No. 3) so as to identify the main barriers to, and opportunities for, making wise use of peatlands more effective. These measures should be strengthened where peatlands are at significant risk owing to resource development or other pressures.

C2. Contracting Parties should endeavour to ensure that national legislation and policies relating to peatlands are compatible with other international commitments and obligations.

C3. Contracting Parties should ensure that the particular importance and requirements of peatland wise use are fully incorporated into national wetland and biodiversity strategies and plans and land use planning instruments, and that national wetland policies developed in line with the guidelines adopted by Ramsar Resolution VII.6 (Ramsar Handbook No. 2) fully incorporate the implementation of the wise use of peatlands.

C4. Reviews of national networks of peatland protected areas should be undertaken. Where there is a currently incomplete network of peatland sites within a national system of protected areas, as appropriate, the number of peatland reserves, parks or other types of protected peatlands should be increased.

C5. The conservation of nationally, regionally and globally important and representative peatland types should be further secured through the expansion of the global network of Ramsar sites, applying the *Guidance for identifying and designating peatlands, wet grasslands, mangroves and coral reefs as Wetlands of International Importance* adopted by COP8 (Resolution VIII.11).

C6. Contracting Parties should, in line with Resolution VII.17, establish policies to implement peatland restoration and rehabilitation, where appropriate seeking the assistance of countries, and the private sector, with knowledge in these fields, utilizing the *Principles and guidelines for wetland restoration* adopted by COP8 (Resolution VIII.16).

4.1.3 UN Framework Convention on Climate Change (UNFCCC)

http://unfccc.int/2860.php

A total of 194 countries around the world are parties to this international treaty, which sets general goals and rules for confronting climate change. The Convention has the goal of preventing "dangerous" human interference with the climate system.

The Convention sets an ultimate objective of stabilizing greenhouse gas concentrations **"at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system."** It states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."

Countries ratifying the treaty -- called "Parties to the Convention" -- agree to take climate change into account in such matters as agriculture, industry, energy, natural resources, and activities involving sea coasts. They agree to develop **national programmes to slow climate change.**

The Convention recognizes that it is a "framework" document - something to be amended or augmented over time so that efforts to deal with global warming and climate change can be focused and made more effective. The first addition to the treaty, the Kyoto Protocol, an international and legally binding agreement to reduce greenhouse gas emissions worldwide was adopted in 1997 and came into force on 16 February 2005.

The most recent decisions were made at the 15th Conference of the Parties in December 2009.

4.1.4 Convention on the Conservation of Migratory Species of Wild Animals (CMS) www.cms.int

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an **intergovernmental treaty**, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 114 Parties (as of 1 August 2010).

Migratory species threatened with extinction are listed on **Appendix I** of the Convention. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. Besides establishing obligations for each State joining the Convention, CMS promotes concerted action among the Range States of many of these species.

Migratory species that need or would significantly benefit from international co-operation are listed in **Appendix II** of the Convention. For this reason, the Convention encourages the Range States to conclude global or regional Agreements.

In this respect, CMS acts as a framework Convention. The Agreements may range from legally binding treaties (called Agreements) to less formal instruments, such as Memoranda of Understanding, and can be adapted to the requirements of particular regions. The development of models tailored according to the conservation needs throughout the migratory range is a unique capacity to CMS. At the present time, none of the agreements and MoUs under CMS relate specifically to migratory species dependent upon peatlands in the Southeast Asian region.

CMS is directly relevant, in that migratory species form part of the fauna of peat swamp forests (mainly birds), although ASEAN Member States involvement with this convention has mainly concerned marine species to date.

4.1.5 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) http://www.cites.org/

CITES is an international agreement between governments, aiming to ensure that international trade in specimens of wild animals and plants does not threaten their survival. It currently has 175 parties.

Annually, international wildlife trade is estimated to be worth billions of dollars and to include hundreds of millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist curios and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction. Many wildlife species in trade are not endangered, but the existence of an agreement to ensure the sustainability of the trade is important in order to safeguard these resources for the future.

Because the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. CITES was conceived in the spirit of such cooperation. Today, it accords varying degrees of protection to more than 30,000 species of animals and plants, whether they are traded as live specimens, fur coats or dried herbs.

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one (or more) Management Authority in charge of administering that licensing system and one (or more) Scientific Authority to advise them on the effects of trade on the status of the species.

The species covered by CITES are listed in three Appendices, according to the degree of protection they need:

- Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

- Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party is entitled to make unilateral amendments to it.

The CITES Appendices cover a number of species occurring in the Southeast Asian peatlands, including the important timber tree Ramin *Gonystylus spp.*,, all wild orchid species, and wild animals such as the Malayan Sunbear *Helarctos malayanus*, Orang-utan *Pongo pygmaeus*, Proboscis Monkey *Nasalis larvatus*, all rhinoceros and tapir species, Panther *Panthera pardus*, hornbills, crocodile species such as the Malayan False Gharial *Tomistoma schlegelii* and fish such as the Asian Arowana *Scleropages formosus.* For further information, see the CITES Species Database: http://www.cites.org/eng/resources/species.html

4.1.6 UN Convention to Combat Desertification (UNCCD)

http://www.unccd.int

The UNCCD's definitions of desertification and land degradation focus mostly on arid, semi-arid and dry sub-humid areas. However, the Convention recognizes that the magnitude of soil erosion and the resulting loss of biodiversity and agricultural productivity are increasingly threatening both the ecological and the economic base of many countries in Southeast Asia. Concerted action is needed to halt the emerging trends. The 1996 Delhi Conference and the 1997 Beijing Ministerial Conference endorsed the principle of cooperation across climatically different regions in order to prevent further land degradation.

A number of countries have used the UNCCD framework and its synergy with the other Rio Conventions to address problems of peatland degradation. For example, GEF Funding under land degradation and biodiversity has recently been approved for rehabilitation and sustainable use of peatland forests in Southeast Asia through IFAD-GEF.

4.2 Statements of International Meetings

At the global level, a number of international meetings concerning the management of peatlands have resulted in declarations, which although voluntary and non-binding, have directly or indirectly supported the decisions and resolutions of the global conventions and development of regional and national policies. Many of these are presented on the IMCG website and the GEC Peat Portal, and listed at the end of this section.

4.3 ASEAN Regional Policy

ASEAN regional policies related to peatland management are summarized in the ASEAN Peatland Management Strategy (APMS) (ASEAN Secretariat 2007).

ASEAN cooperation on the environment has been guided by the ASEAN Vision 2020, the medium-term plans of action, and meetings of the ASEAN Ministers on Environment. ASEAN Vision 2020 specifically calls for "…a clean and green ASEAN with fully established mechanisms for sustainable development to ensure the protection of the region's environment, the sustainability of its natural resources, and the high quality of life of its peoples…" (ASEAN Secretariat 2007)

ASEAN Peatland Management Initiative (APMI)

The concept for this initiative was developed through discussion with a broad range of agencies in 1999-2001. The goals of the APMI are to promote sustainable management of peatlands in the ASEAN region through collective actions and enhanced cooperation to support and sustain local livelihoods, reduce the risk of fires and associated transboundary haze pollution, and contribute to global environmental management. The objectives are:

- To enhance understanding and build capacity on peatland management issues in the region
- To reduce the incidence of peatland fires and associated haze
- To support national and local level implementation activities on peatland management and fire prevention
- To develop a regional strategy and cooperation mechanisms

In November 2006, the 10 member countries of the Association of Southeast Asian Nations (ASEAN) adopted the ASEAN Peatland Management Strategy 2006-2020 (APMS) to act as a framework to guide the sustainable management of tropical peatlands in Southeast Asia. In response to the APMS, the member countries are undertaking assessments of their peatland resources and/or developing national action plans on peatlands.

4.4 ASEAN Country National Policies

To date, no country in the Southeast Asian region has developed a national policy on peatlands. However, peatlands are a type of wetland and as such are generally covered by national wetland policies and plans where these exist. The conservation of peatland biodiversity will also be included in national policies on biodiversity conservation, as well as NBSAPs (see section on CBD above).

National peatland action plans (NAPs) under the ASEAN Peatland Management Strategy are being developed within the context of national conservation and sustainable development policies and plans (including NBSAPs), and national protected areas system development plans. The development of NAPs for the ASEAN countries are at various stages of development; in the Philippines the NAP has been developed and adopted by the Senate and in Malaysia the final draft will be presented for Cabinet approval in early 2011. Brunei Darussalam, Indonesia and Viet Nam have final drafts of the NAPs, some of the actions are already being implemented. In Indochina, more information on peatlands is needed to develop the NAP.

4.5 Discussion of Peatlands in Relation to Policy Processes

4.5.1 Recognition of peatlands in policy frameworks

Policy frameworks tend to treat peatlands either as forests or marshes, and often fail to recognize the special eco-hydrological characteristics of peatlands which are so important for their sustainable management.

Policy makers and sectoral agencies (e.g. forestry, agriculture, water resources agencies) often do not specially recognise peatlands as a separate landform or ecosystem type needing special consideration. Peatlands are generally classified by sectoral agencies as grasslands, forests or wetlands. As a result the special management issues and requirements of peatlands are not recognised. Even the Ramsar Convention on Wetlands classifies peatlands as either marshes or forested wetlands and does not provide peatlands with a class of their own.

There are also few countries that have national or local peatland policies or strategies which specifically include separate management prescriptions for peatlands. There are around 40 countries globally with National Wetlands Policies, of which only some specifically mention peatlands. Peatlands are often not mentioned or not recognized as a priority for biodiversity conservation in many national Biodiversity Conservation Strategies either. The limited prioritisation of peatland conservation in the overall context of biodiversity conservation may be partly due to their relatively low species biodiversity in some regions of the world. This may be combined with a lack of awareness of their high degree of biological diversity at habitat level and the relative high occurrence of characteristic species and endemics. Sometimes it may even be linked to a lack of awareness of the existence of peatlands and their special management needs.

In many countries relevant policies and government regulations are clearly conflicting and can lead to confusion. It would be pertinent to review policies in this light, and to develop guidelines for land-use planning and management of peatlands taking into account their multi-functionality and their ecological and hydrological characteristics. In this regard it is important to note the particular applicability of an ecosystem approach for peat swamp management, as intervention in one part of the ecosystem can have significant impacts on other parts. Moreover, the management of separate peat land areas cannot be seen as separate from the management of their surroundings and the ecological and hydrological interconnections between the different habitats and land-uses within the entire water catchment. (Source: Parish *et al*., 2008; Section 9.4)

4.5.2 Addressing root causes and enhancing implementation mechanisms

In developing countries and countries in transition where poverty may be a root cause of unsustainable peatland resource exploitation, development may be the only way to create opportunities for peatland conservation.

On the other hand, where development of peatlands coincides with the need for drainage and mining, it will generally be unsustainable and non-conducive to the conservation of the peatland carbon stores and biodiversity. Without appropriate economic alternatives and incentives it may often be impossible to maintain and manage conservation areas or invest in rehabilitation of degraded peatlands. Poor people must have a livelihood before being able to refrain from over-exploitation of natural resources. In poverty-stricken regions, governments argue that they often need to generate sufficient economic growth - even by unsustainable means - before being in a position to take the environment into consideration. Therefore, incentives for short-term unsustainable development, including for instance, logging and land conversion, remain high. Development is therefore central to peat swamp forest conservation and the sustainable management and rehabilitation of degraded peatlands.

There is a pressing need to enhance alternative income opportunities for local rural populations. In the meantime it is important to ensure that their land and resources are no longer degraded, and where agriculture and plantation forestry is practiced on peat, that it is optimised in terms of sustainability. Without sufficient revenue from the land, poor people may be forced to go for the cheapest but not necessarily the most sustainable land-use management options. For example, this could include the use of fire for land clearance. (Source: Parish *et al*., 2008; Section 9.4).

4.5.3 Harmful subsidies, policies and taxes

Peatlands have been negatively impacted by a wide array of perverse and harmful incentives in the form of policies and subsidies.

In many countries peatland drainage is still encouraged under various kinds of policies, subsidies and tax breaks. Sometimes land tenure is linked to productive use of peatlands, providing a disincentive to conservation and restoration. In Indonesia, for instance, there are local policies that require clearance of land every three years, without which the land tenure can be lost. This creates an incentive for burning as it is the cheapest option for land clearance.

In recent years, most important negative impacts on peatlands globally have come from policy incentives and subsidies for biofuel production – which were originally designed to enhance environmental protection. (Source: Parish *et al*., 2008; Section 9.4)

4.5.4 Synergy between conventions to develop integrated policy frameworks

Peatlands are a habitat where current global priorities in climate change mitigation, combating land degradation, stopping the loss of biodiversity and reducing poverty come together.

The Global Assessment of Peatlands has indicated in various ways the disproportionate relevance of peatlands in relation to climate change mitigation, combating land degradation, biodiversity conservation and poverty reduction, and as such the need to consider peatlands within the context of the major global policy platforms, including the UNFCCC, UNCCD, World Water Forum, CBD, Ramsar Convention on Wetlands, and the Commission on Sustainable Development. The synergy between the conventions and policy platforms in this regard calls for enhanced coordination and cooperation. The donor community is increasingly recognising the need for integration of these agendas, but current global policy processes fall short of sharing lessons learned and best practices regarding the development of inter-sectoral approaches to the conservation and wise use of peatlands worldwide. Table 4.3 below illustrates that integrated peatland management can simultaneously address a variety of problems and generate multiple benefits.

Table 4.3 Benefits arising from integrated peatland management in relation to MEAs.

	Integrated peatland management can generate benefits in relation to:	Primary inter-governmental agreements involved:
Win 1	Climate Change	UN FCCC; also CBD and Ramsar *inter alia*
Win 2	Land Degradation	UNCCD
Win 3	Loss of Biodiversity	CBD, Ramsar Convention; CMS; CITES
Win 4	Poverty	Commission on Sustainable Development

4.5.5 New emerging innovative options

Conservation and rehabilitation of peatlands can provide a major opportunity to reduce current global greenhouse gas emissions.

The huge, but only recently recognised, CO_2 emissions from tropical peatland deforestation and degradation represents one of the single largest but also most concentrated sources of greenhouse gas emissions from the land use/ agriculture sector (see Hooijer *et al.,* 2006).

Whereas tropical deforestation in general covers hundreds of millions of hectares worldwide and generates annual emissions of 1-2 billion tonnes of CO_2, the degradation of peat swamp forests which is mainly confined to 12 million ha of degraded peat swamps in Southeast Asia, leads to a larger total emission. Hence this should be considered as a global priority for reducing emissions from deforestation and forest degradation (Silvius *et al.,* 2006; Hooijer *et al.,* 2006). Linkages to poverty issues (see above) and biodiversity loss ties it to two other globally recognised priorities.

Some newly-emerging possibilities for conserving peatlands, particularly for their carbon storage function, are payments for Reduced Emissions from Deforestation and Degradation (REDD), as currently being developed by Parties to the UNFCCC.

The **UN-REDD Programme** is the United Nations Collaborative initiative on Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing countries. The Programme was launched in September 2008 to assist developing countries prepare and implement national REDD+ strategies, and builds on the convening power and expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).
The Programme currently supports REDD+ readiness activities in nine pilot countries, spanning Africa, Asia and the Pacific and Latin America: Indonesia, Papua New Guinea and Viet Nam included from Southeast Asia. To-date, the

UN-REDD Programme's Policy Board has approved a total of US$42.6 million for eight of the Programme's nine initial pilot countries. These funds help to support the development and implementation of national REDD+ strategies. National programmes in four UN-REDD pilot countries (DRC, Indonesia, Tanzania and Viet Nam) are now in their implementation phase.

Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

It is predicted that financial flows for greenhouse gas emission reductions from REDD+ could reach up to US$30 billion a year. This significant North-South flow of funds could reward a meaningful reduction of carbon emissions and could also support new, pro-poor development, help conserve biodiversity and secure vital ecosystem services.

Further, maintaining forest ecosystems can contribute to increased resilience to climate change. To achieve these multiple benefits, REDD+ will require the full engagement and respect for the rights of Indigenous Peoples and other forest-dependent communities.

To "seal the deal" on climate change, REDD+ activities in developing countries must complement, not be a substitute for, deep cuts in developed countries' emissions. (Source: UN REDD Programme www.un-redd.org)

The World Bank and other institutions are exploring options to establish REDD funding mechanisms to support pilot schemes, including the option of carbon fund payments to national and local governments which need to be based on a national baseline monitoring, and the option for payments to private and community stakeholders and beneficiaries for their "environmental services". As peatlands cut across all forest management, conservation and land use (production, industrial and agricultural) types, maintaining the welfare of traditional local communities in peatlands is a major concern.

Carbon financing linked to REDD is being developed in Indonesia, through the Indonesia-Australia Forest Carbon Partnership signed in June 2008. See:

http://www.climatechange.gov.au/government/initiatives/international-forest-carbon-initiative/~/media/publications/international/indonesia-australia.ashx

Under this agreement, a Sumatra Forest Carbon Partnership was launched in March 2010 focusing on Jambi province, joining the Kalimantan Forests and Climate Partnership launched in 2007, as a second major Australia-Indonesia REDD demonstration programme.

See: http://www.climatechange.gov.au/government/initiatives/international-forest-carbon-initiative/~/media/publications/international/kalimantan.ashx

The Kalimantan project will focus on the protection and rehabilitation of large areas of deforested peatland and at-risk peatland forests, and also improve livelihoods for forest-dependent communities and promote biodiversity by restoring and protecting habitat of endangered species such as Orang-utans. Source: www.redd-plus.com

Parallel to this are numerous private sector initiatives. This indicates a strong interest in investment in avoiding emissions through peatland rehabilitation and reforestation as a means to compensate for industrial emissions elsewhere. Some investors see opportunities for trade in "Carbon futures". These interests could well provide the local people in peatlands with opportunities to develop a new community-based public service. According to Butler (2007) preserving tropical forest and peat swamp that would otherwise be converted and collecting the resulting recurrent revenue provided by the carbon offset market may be more lucrative for landowners in some areas than conversion to palm oil. With a carbon emission reduction price range of US$14- US$22/tonne, similar level profits may be derived over a period of 25 years.

However, much will depend on how the funding is used and how much of it can be channelled to local stakeholders. The carbon market provides a significant opportunity for a pro-poor approach, in which consideration should be given to the equitability of the development in terms of revenue sharing between investors and local stakeholders.

Funding schemes that will enhance the access of local stakeholder groups to carbon funding, for example, through special REDD micro-financing facilities, could create new economic incentives and help to empower these stakeholders. This would increase the chances of successful development of an innovative community-based environment management service sector as part of the voluntary carbon market.

Carbon financing mechanisms (CDM): Under Article 3.4 of the Kyoto Protocol, activities that enhance carbon sequestration in agricultural soils can be counted towards emission reduction targets, and can be traded on the international carbon market via the Protocol's "flexibility mechanisms". Since a large proportion of peatlands are extensively grazed or under some form of agriculture, money from this source could be used to finance drain and gully blocking on a far larger scale than is currently possible. (Source: Parish *et al*., 2008; Section 9.4)

The option for local communities to provide services to the emerging carbon market in terms of peat swamp forest conservation and

***restoration represents a major opportunity for linking climate change mitigation to poverty reduction*.**

It also enhances options for other types of strategies or combinations, particularly relevant to countries with no substantial agricultural subsidies. These include for instance, the development of **innovative financial instruments such as Bio-rights** (Silvius *et al.*, 2002). The Bio-rights approach involves establishment of business contracts, providing micro-credit for sustainable development in exchange for the conservation or rehabilitation of globally important biodiversity or environmental values. The business partners are "the global community" (represented by a broker, e.g. an NGO or bank) and a local partner (e.g. a local community or a major community-based stakeholder group). The local (community) business partner will pay interest over the micro-credit not in the form of money, but in terms of biodiversity conservation services – defined by mutually agreed environmental or biodiversity related indicators.

One frequently used indicator is the survival rate of planted tree seedlings after 5 years of reforestation. The micro-credit level is linked to the opportunity costs of sustainable use and conservation of the natural resource base and biodiversity. As such, the Bio-rights approach removes the incentive for unsustainable development and allows the public value of key biodiversity wetland/peatland areas to be transferred over time to local stakeholders as a direct economic benefit. The incentive can be increased by allowing the credit itself also to be repaid through such services, enabling the development of community-based revolving funds for sustainable development. This again will trigger community-based monitoring, as the whole community will stand to lose out if the activity is unsuccessful.

The Bio-rights approach can also include such indicators as carbon store conservation and carbon sequestration, as well as the maintenance of wider ecosystem services such as water management and biodiversity values. As the micro-credit levels in the Bio-rights approach are directly related to the opportunity costs of sustainable development and conservation, the approach does not require economic valuation of biodiversity or the ecosystem services that are maintained. This distinguishes it from the Payments for Environmental Service (PES) approach.

Biorights schemes are operational in the buffer zones of the Berbak national park in Jambi, Sumatra, and are also used in many other community-based wetland restoration projects in Indonesia, such as in the Tsunami hit region of Aceh (involving sustainable coastal development and mangrove reforestation) (See www.bio-rights.org). (Source: Parish *et al*., 2008; Section 9.4)

Evidence has been accumulating that in many cases, natural peatland habitats generate marked economic benefits, which exceed those obtained from habitat conversion.

Economic costs associated with damage to ecosystem services can be substantial. For example, the damage of the 1997 Borneo fires to timber, tourism, transport, agriculture, and other benefits derived from or linked to the forests, is estimated at $4.5 billion - in addition to the actual cost of fighting the fires (Tacconi, 2003). Significant investments are often needed to restore or maintain non-marketed ecosystem services, such as the costs of flood prevention in down-stream areas.

Payments for Ecosystem Services (PES) are already operational in many parts of the world, but so far not yet practiced in peatlands. In some regions these innovative payment schemes are supported by policies and trust funds. However, techniques and local capacity for monetising ecosystem functions are generally underdeveloped. Some ecosystem functions cannot be valued because their precise contribution is unknown and indeed, unknowable, until they cease to function. Other functions cannot be monetised because there is no equivalent to put in their place. Intrinsic values are, by definition, without price. Consequently, any weighting can only be partial and whole ranges of values, benefits or disadvantages escape monetary evaluation. Studies valuing multiple functions and uses, and studies which seek to capture the 'before and after' states as environmental changes take place, are rare. By and large it is the latter types of analyses that are most important as aids to more rational decision making in ecosystem conservation versus development situations involving different stakeholders (local, national and global).

Aggregate (global scale) estimates of ecosystem values are problematic, given that only 'marginal' values are consistent with conventional decision-aiding tools such as economic cost-benefit analysis. Despite these difficulties, valuation data are useful in decision-making by illuminating tradeoffs.

Valuation studies of industrialised countries focus on recreational and existence values held by urban consumers (travel cost models, contingent valuation). In developing countries, on the other hand, ecosystem values related to production and subsistence remain relatively important, although this is changing in regions characterized by rapid urbanization and income growth. In general, valuation data provide support for the hypothesis that net ecosystem service values diminishes with biodiversity and ecosystem loss. (Source: Parish *et al*., 2008; Section 9.4)

4.5.6 The need for local policy embedding of innovative mechanisms

There is an urgent need to create an enabling policy environment for innovative mechanisms such as the emerging market in Verified Emission Reductions from peatlands and forests.

In order to provide the necessary basis for long-term commitments from all stakeholders and management frameworks that will give carbon buyers sufficient guarantees that their investments – represented by the preserved and rehabilitated sub- and above-soil carbon store – are safe, new policy environments are needed. This will require more than the usual five-year plans, and commitments must be binding well beyond the legislative periods of current elected authorities.

Also, for carbon projects that are based on business deals at the local – community – level, such long-term commitments are needed. For instance, investment in reforestation of community-owned buffer zones adjacent to protected areas needs the development of contracts that are binding to future as well as present generations. This poses considerable new challenges, as it is impossible to predict the incentives or disincentives that may arise in the future and tip the balance leading to a change in priorities of local stakeholders.

Many other risks need to be assessed in relation to the selling and buying of avoided emissions from peatlands, including the risk of fires. This risk has particularly predominated Southeast Asia during the recurring El Niño drought events, but also occurs in large parts of Eastern Europe. Such risks may need to be covered by new government policies and legislation, and perhaps involving also new types of insurance that caters for this sector.

Current developments under REDD and private sector initiatives are now being pilot tested, although it has to be acknowledged that these ideas and initiatives are still developing and carry the risk of project and investment failures that emphasize that this remains an emerging sector at this time. These risks have so far not been part-and-parcel of community and government-based natural resource management planning. It is very important that any voluntary carbon credit scheme will adhere to a common set of standards and criteria.

For peatlands, with their special eco-hydrological character and management requirements, as well as their complex social and economic setting, these criteria have not yet been developed. Pilot schemes will be needed, and therefore there is a strong need for coordination and sharing of lessons learned between all projects and efforts that relate to peat CO_2 management and the promise this holds for poverty reduction, biodiversity conservation and climate change mitigation.

It is now widely recognised that the peatland issue is part and parcel of the REDD Plus agenda. This creates a strong basis for international cooperation and support. There are many signals of strong interest to assist from both the donor community as well as private sector, and many initiatives are being developed at present. A new market is emerging that can be supplied by a community-based service sector. It will create significant opportunities for local community development as well as private sector investments. However, there is an urgent need to create an enabling policy environment for these developments. Voluntary carbon initiatives will require certain guarantees that the investments will not be in vain and can be efficiently channelled to where they can be most effective. For effective development of the REDD market, long-term commitments are needed, backed up by policies and legislation. (Source: Parish *et al*., 2008; Section 9.4)

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The Peatland Biodiversity Management Toolbox

A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia

Part 2

IFAD
Enabling poor rural people to overcome poverty

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

European Union

Global Environment Centre

Overview of Contents

This handbook is divided into two parts. **Part 1** provides introductory material on the nature and characteristics of peatlands, their distribution and extent in Southeast Asia, peatland biodiversity, threats, and the international policy framework for their management and conservation. **Part 2** provides guidance in the form of modules on conservation approaches, minimising the impacts of land uses, and restoration and rehabilitation of peatlands.

Module 1 provides guidance on the principles, strategies and action for the conservation of peatland biodiversity, with an emphasis on promoting integrated management involving stakeholders at various levels, the adoption of the ecosystem approach, and the use of river basins or catchments as management units for peatlands. It covers a wide range of technical subjects, providing entry points for sourcing more detailed information.

Module 2 provides guidelines for the main forms of land use in peatland areas, with the aim of improving their sustainability and minimising their impacts on peatland biodiversity. It covers agriculture, forestry, plantations, mining, infrastructure, urban and industrial development, and water engineering projects.

Module 3 provides guidance on measures for the restoration and rehabilitation of peatland biodiversity, both at the ecosystem level, and for components of peatland biodiversity.

References and guidance materials are provided at the end of each module, most of which is available online.

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PART 2

The Peatland Biodiversity Management Toolbox

A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia

Module 1:

Conservation of Peatland Biodiversity: Principles, Strategies and Operational Guidance

Module 1: Conservation of Peatland Biodiversity - Principles, Strategies and Operational Guidance

5.1 The Wise Use of Peatlands

The current management of peatlands is generally not sustainable and has major negative impacts on biodiversity and the climate. The main causes of the loss and degradation of peatlands are reviewed in **section 3 of Part 1**. A systematic wise use approach is needed to integrate protection and sustainable use to safeguard the peatland benefits from increasing pressure from human uses and the changing climate. The key principles, strategies and operational guidance for a wise use approach are described in this section, including the protection of intact peatlands through their inclusion in protected area systems. A key point is that the sustainable management of peatlands requires the integration of approaches for biodiversity, water, climate change and land degradation and close coordination between different stakeholders and economic sectors.

Relatively simple changes in peatland management (such as better water management and fire control in drained peatlands) can both improve the sustainability of land use and limit negative impacts on biodiversity and climate (see **Module 2** for sectoral guidelines). The rehabilitation and restoration of peatlands (see **Module 3**) can be a cost-effective way to generate immediate benefits for biodiversity and climate change by reducing peatland subsidence, oxidation and fires. (Source: Parish *et al*., 2008, Chapter 9)

A number of guidelines and manuals on the wise use and sustainable management of peatlands are available, listed at the end of this section. There are also various workshop reports on this subject (see references for Part 1). At the global level, Ramsar Resolution VIII.17e (Ramsar Convention Secretariat, 2002) provides Guidelines for Global Action on Peatlands, which calls on Contracting Parties and all other bodies and organizations involved in peatland management and exploitation to:

- give priority to the wise use management, restoration and rehabilitation of peatlands;
- consider the need for management guidelines and action plans at regional, national and catchment levels;
- apply wise use principles through assessing the effectiveness of incentive measures, and by enabling the equitable sharing of the costs and benefits of different management options

- share best practices in peatland management, restoration and rehabilitation;
- develop strategies and policies for the wise use of peatlands, and management planning for peatland sites, taking cultural heritage into consideration;
- develop local and community-based peatland wise use initiatives and actions through land use planning programmes utilizing the *Ramsar Guidelines for establishing and strengthening local communities' and indigenous peoples' participation in the management of wetlands* (Ramsar Handbook no. 5); and
- undertake measures to restore peatland functions in those systems that have been degraded through human activity, drawing on experience and best management practices from different regions.

Basic Principles for Sustainable Peatland Management

In defining requirements for management of peat swamp forests, the following basic principles should be considered when planning interventions in peatland areas.

Precautionary Approach

In the planning of land-use in peatlands, it is advisable to use the precautionary approach. Large -scale developments in peatlands should be pursued only after considerable research and after the successful completion of pilot projects. Numerous expensive failures testify to the need for this approach. The precautionary approach should be applied in decision-making in cases of scientific uncertainty when there is a risk of significant harm to biodiversity. Higher risks and/or greater potential harm to biodiversity require greater reliability and certainty of information. The reverse implies that the precautionary approach should not be pursued to the extreme; in case of minimal risk, a greater level of uncertainty can be accepted. Guidelines for applying the precautionary principle to biodiversity conservation and natural resource management have been developed under the Precautionary Principle Project at: http://www.pprinciple.net/.

Ecosystem Approach

Land-use planning in peatlands should follow the ecosystem approach, taking special account of the hydrological vulnerability of peat domes and the ecological relationships with the surrounding habitats and land-uses. Particular regard should be given to the place of the area within the water catchments/ watershed, and the potential impacts of and on upstream and downstream habitats and land-uses (including potential land-uses). It may even be necessary to consider multi-river basin complexes, as multiple watersheds may be dependent on shared peat domes, so the impacts on one river basin may affect the shared hydrological basis. Further information is provided in **Section 5.4**.

Integrated Approach to Land Use Planning

Wise management of peatland ecosystems requires a change in approach from sectoral planning (e.g. for agricultural development) to integrated, holistic planning strategies, involving all relevant sectors and stakeholders to ensure that consideration is given to potential impacts on the ecosystem as a whole. Land-use planning in peatlands should involve all relevant sectors and major stakeholder groups, including local people, from the outset of development planning. A precondition for successful integrated planning is the (enhancement of) awareness of the various groups regarding peatland ecology and hydrology, and the full scale of values that peatlands may have. See **Section 5.6** below for details of integrated management.

Allocation of Land-Use Status

Allocation of land-use status in peatlands should consider the hydrological vulnerability of peat swamp forests, their susceptibility to subsidence and oxidation (leading to CO_2 emission), their vulnerability to fires and their values for biodiversity conservation, water retention and climate change mitigation.

Environmental Impact Assessment

The use of a peatland for a specific purpose may have considerable environmental and social impacts and all other functions must be taken into account in the full assessment of the suitability of a particular use. Ideally this should be undertaken through formalized environmental impact assessment (EIA) or strategic EIA approaches involving appropriate expertise. See **Figure 5.1** below for a flowchart of the key steps in an EIA procedure. The Ramsar Convention provides significant guidance on environmental impact assessment and wetlands (see Ramsar Convention Secretariat 2007 vol 13). Biodiversity considerations for EIA concerning developments and land use changes in peatland areas are given in the references at the end of this section.

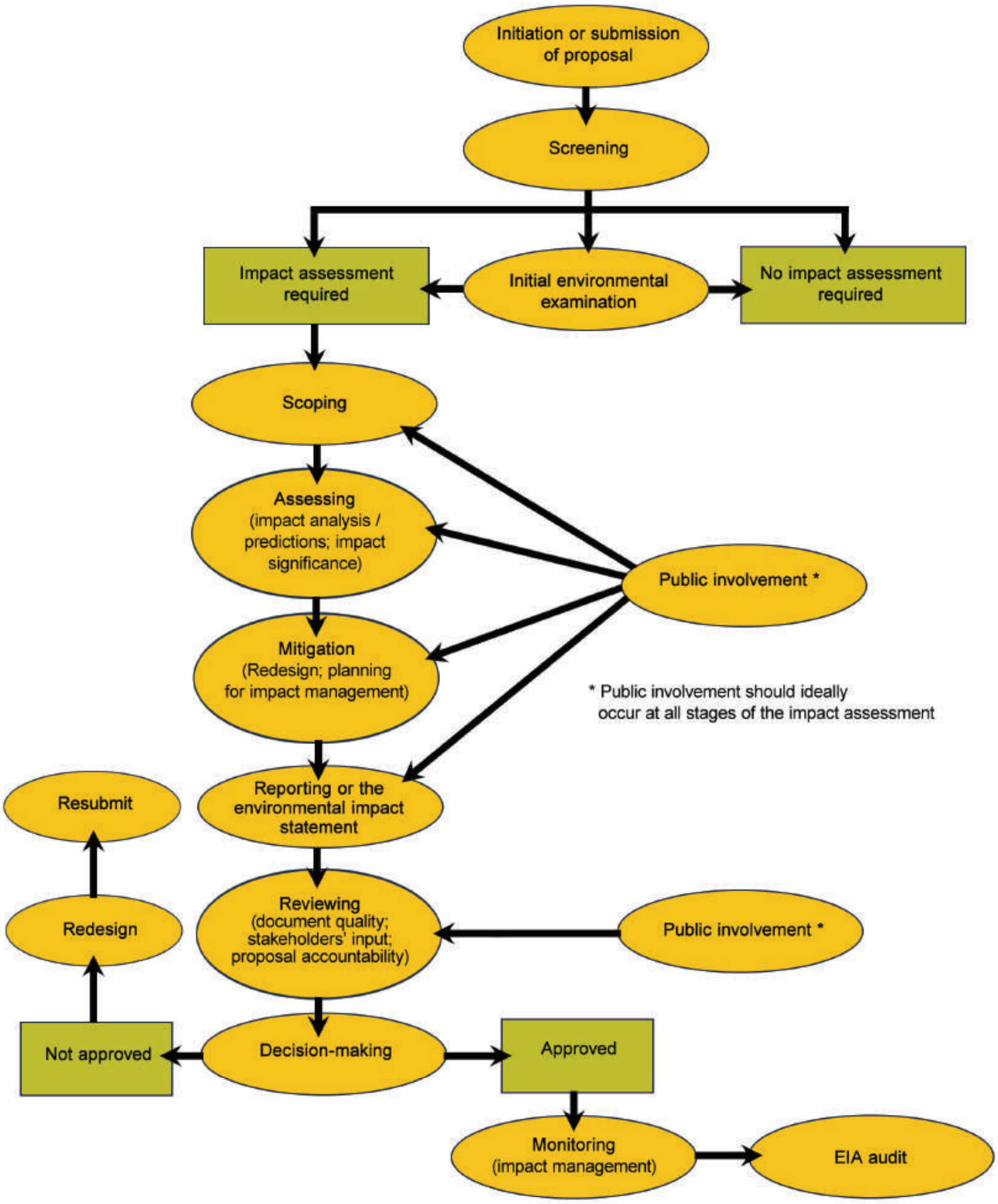


Figure 5.1
Flowchart of key steps in the environmental impact assessment procedure (from UNEP/CBD/SBSTTA/7/13, November 2001)

Conservation Approaches

General directions for the conservation and sustainable management of peatlands are set out in the APMS and wise use guidelines referred to above. Conservation embraces policy, legal and regulatory fields, governance and the practical management of natural resources. It also spans a huge range of technical subjects. Some of the approaches and resources available are indicated in this section, and more can be found through the websites of conservation organizations (see Annex 2).

Various tools are available concerning the project management cycle and conservation strategies, including: Conservation Measures Partnership (October 2007). Open Standards for the Practice of Conservation. Version 2.0.

http://www.conservationmeasures.org/CMP/Site_Docs/CMP_Open_Standards_Version_2.0.pdf Updated versions of these standards will be posted on the Conservation Measures Partnership (CMP) website: http://www.conservationmeasures.org/CMP/

The goal in developing the *Open Standards for the Practice of Conservation* was to bring together common concepts, approaches, and terminology in conservation project design, management, and monitoring in order to help practitioners improve the practice of conservation. In particular, these standards are meant to provide the steps and general guidance necessary for the successful implementation of conservation projects. Further to these standards, tables comparing the project management approaches of CMP component organizations (including useful definition of terms) is shown at: http://conservationmeasures.org/Rosetta2/

Also from the CMP, following the unified classification of direct threats (see **Section 3 of Part 1**), there is a corresponding unified classification of conservation actions: IUCN-CMP. 2006. *Unified Classification of Conservation Actions, Version 1.0.*

http://conservationmeasures.org/CMP/Site_Docs/IUCN-CMP_Unified_Actions_Classification_2006_06_01.pdf

There were three main reasons for developing this classification of conservation actions:

- To help practitioners figure out what actions to take at their site. A project team can scan this classification and see if they find any actions that they may be overlooking in their analysis of what to do at their site.
- To create general summaries or "roll-ups" for broader organizational purposes and/or use by senior managers, fundraisers, and external affairs staff. Summaries can tally the frequency of the use of a given type of action across projects at various organizational scales or be combined with other information for more detailed summaries.
- To facilitate cross-project learning and the development of a science of conservation. A common classification of conservation actions enables practitioners to search a database of conservation projects and find projects employing similar actions for similar conservation problems.

5.2 Inventory, Assessment, Monitoring and Research

A comprehensive suite of guidelines has been developed by the Ramsar Convention covering the interlocking subjects of wetland inventory, assessment and monitoring (it also extends to aspects of management and research). The available guidance is summarized in **Figure 5.2** below:

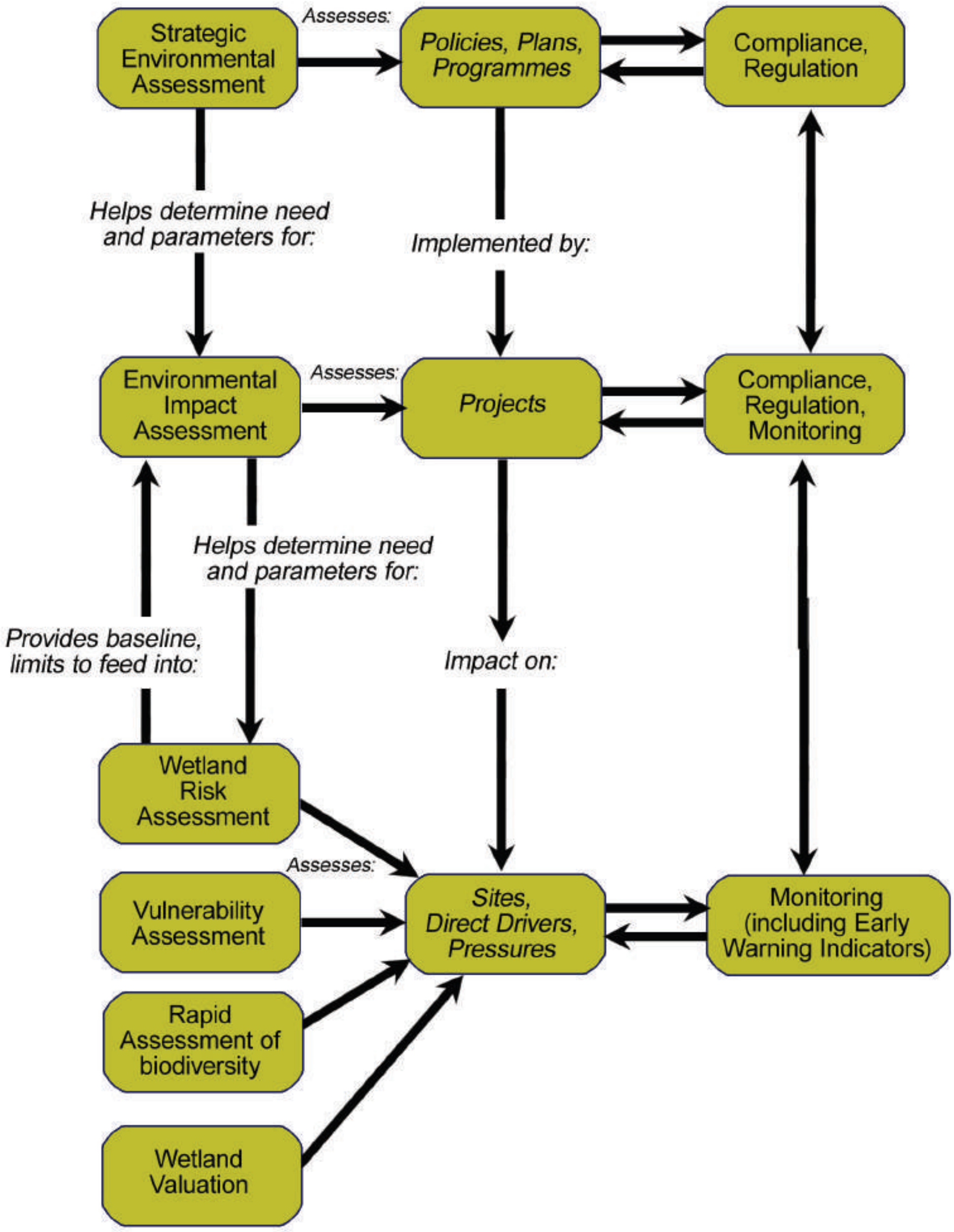


Figure 5.2: The relationships among the different wetland assessment tools available through the Convention.

(source: Ramsar Convention Secretariat 2007 vol 11, on Inventory, Assessment and Monitoring.)

5.2.1 Inventories

The inventory of peatlands is an essential first step towards effective resource management. While most countries in the region conducted basic inventories of their most important wetland sites for conservation under the Asian Wetlands Inventory project (Scott, 1989) or soon afterwards, this information is in need of updating and harmonization to allow comparative analysis across the region. The Asian Wetland Inventory programme (see Finlayson *et al*., 2002) attempted to address this need, and developed a harmonized framework that could be applied at different scales. National rapid assessments of peatlands are being supported under the APFP and SEApeat projects providing the most recent information available (see Peatlands in Southeast Asia – A Profile, GEC, 2011 for initial information on peatlands in SOUTHEAST ASIA). In most countries, there remains a need for a comprehensive assessment and monitoring system to provide a basis for management and tracking trends in the status of the resource. The need for national efforts on the inventory, monitoring and reporting on peatlands is indicated in Ramsar Resolution VIII.17 Guidelines for Global Action on Peatlands:

14. CALLS ON Contracting Parties also to give priority to supporting the inventory and evaluation of peatlands of all types and, as appropriate, to designate further peatlands within their territories for inclusion in the List of Wetlands of International Importance;

15. REQUESTS Contracting Parties to include information on the status and trends of their peatland resources in their National Reports prepared for the meetings of the Conference of the Parties to this and other conventions, as appropriate.

Managing Scale in Inventory, Assessment and Monitoring

The choice of the scale at which to undertake inventory, assessment and monitoring work and the choice of appropriate methods for each scale are key issues for implementation. Ramsar Handbook 11 (Ramsar Convention Secretariat 2007 vol 11) advocates a multi-scalar approach, as follows:

Wetland assessment, as with inventory and monitoring, can be undertaken at discrete spatial scales using (different) appropriate techniques for each. Whenever possible, an integrated inventory, assessment and monitoring programme should be developed and conducted at a single appropriate scale. This can be achieved when an integrated analysis encompassing inventory, assessment and monitoring components is planned and implemented. However, these components are typically planned or undertaken separately. Wetland assessment should be undertaken at a spatial scale compatible with the scale of information contained within the wetland inventory. Subsequent monitoring should also be undertaken at a scale compatible with the assessment.

Since much wetland inventory, assessment and monitoring will be constrained by the scale and availability of information, practitioners are encouraged to aggregate data wherever possible rather than attempt to disaggregate data. This is possible when subsequent analyses draw on data from larger scales (e.g. combining data collected at 1:10,000 scale to represent a composite image at 1:50,000 scale) rather than smaller scales where issues of accuracy and precision will likely constrain effective analysis.

The issue of scale has so far been most fully addressed in methodologies for wetland inventory, and this is summarized below, using the Asian Wetland Inventory method as an example. However, many of the scale issues for inventory are equally relevant for the application of wetland assessment and monitoring, but further evaluation of options for these elements of the overall process may be necessary.

Wetland inventory has been carried out at a number of spatial scales, with specific purposes at each scale. These cover:

i) **global** – purpose: presence/absence of wetlands in continents and islands;

ii) **continental** – purpose: distribution of regions dominated by wetlands within continents or islands;

ii) **regional** – purpose: range of specific wetland types;

iv) **local** – purpose: characteristics of individual wetlands; and

v) **site** – purpose: variability within individual wetlands.

The different scales are summarized in the following Figure 5.3:

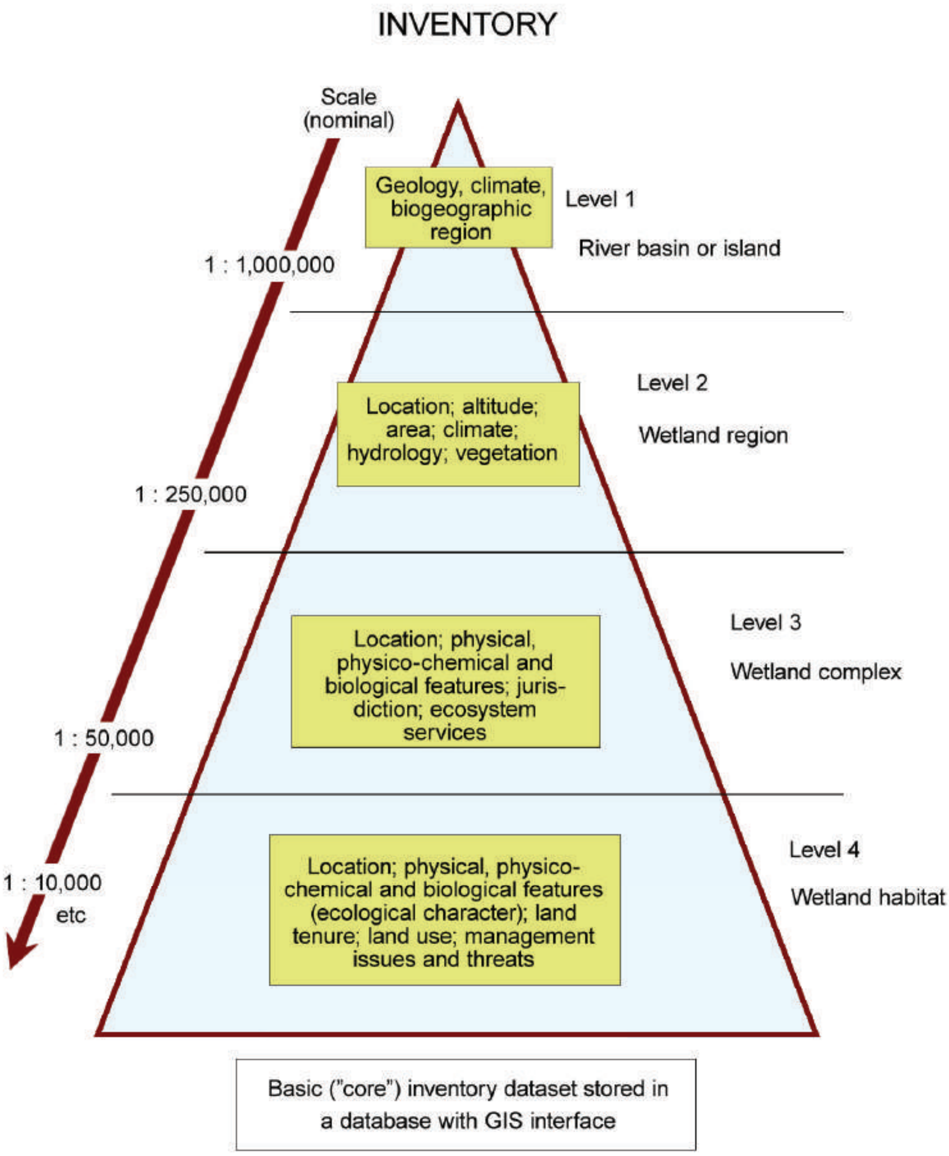


Figure 5.3: The hierarchical approach to wetland inventory.
Data fields most appropriate for each level are shown with the most data being collected at level 4 (shown at the base of the triangle).

At all levels of analysis the usefulness of existing information is first assessed and used as a basis for determining whether or not further analysis or collection of information is necessary. In many instances, analyses will be undertaken as follows:

Level 1 – desk study to describe the broad geologic, climatic and ecological features of each geographic region using existing datasets, increasingly available on the Internet;

Level 2 – desk study to identify the wetland regions within each geographic region using information already collated on geology, climate, hydrology, and vegetation;

Level 3 – fieldwork and analysis to identify the physical, physico-chemical and biological features of wetland complexes within each wetland region; and

Level 4 – detailed fieldwork and analysis to describe the physical, physico-chemical and biological features of each wetland habitat within each wetland complex. This includes information on plant and animal assemblages and species, land and water use and wetland management.

Data collection and analysis is based on standardised procedures and data management formats, although flexibility is not discouraged where necessary. Proforma data sheets for each level of analysis have been developed and are accompanied by guidelines for collecting the required information.

Similar multi-scalar procedures can be developed for wetland assessment and monitoring. These procedures will most likely build on the multi-scalar information collected under the inventory process and provide managers and others with analyses suitable for the scale of investigation.

Definition and classification of peatlands

As recognized in the APMS, one of the problems in managing the region's peatland resources arises from the lack of common definition and classification of peatlands in the region which in turn leads to problems in clearly delineating the peatlands and developing common management guidelines. See **Section 2 of Part 1** and the **Glossary (Annex 1)** for the definitions used in this document.

In brief, peatlands are a category of wetland, and there are many different types of peatlands which can be classified according to different criteria relating to their origins, soil characteristics, topography, hydrology, vegetation, etc. Consequently, there are many different ways of classifying wetlands and peatlands that vary according to the purposes of the classification. Within the Southeast Asian region, work has also been done on classifying peatlands and the ecological communities they support (for example, different communities of peat swamp forest).

Peatlands are highly diverse and the peatland character of various ecosystem types is often not recognized. Peatlands are often unrecognized and overlooked. This is especially the case for mangroves, salt marshes, paddy/rice fields, cloud forests, tropical swamp forests, highland sedge fens (pastures) and spring mires, all of which may form peat and may have a peat soil (Joosten 2004). Peatlands may occur in almost 20 wetland categories in the Ramsar Convention's wetland classification system (Parish *et al*., 2008).

Ideally, a unified classification system should be developed for the types of peatland found in the Southeast Asian region through a consultative process involving national and regional experts.

At the global level, Ramsar Resolution VIII.17e Guidelines for Global Action on Peatlands provided guidelines for action on the development and application of standardized terminology and classification systems. This acknowledged that there is a range of different terminologies that have been developed to define peatlands and peatland processes. When seeking to describe the character, extent and status of peatland resources worldwide, an essential step is to seek to compare and harmonize terminologies and classifications as the basis for achieving a globally consistent view of these resources. It recommended the formation of a Working Group on Peatland Terminology, Classification and Biogeography, involving peatland conservation organizations, Contracting Parties, and other interested bodies. International workshops and symposia should be convened by the Working Group to review and build consensus on terminologies, classifications, and biogeography, and a Glossary of Peatland Terms should be developed. Finally, the Convention should review the Ramsar Classification System for Wetland Types with regard to peatlands in light of the Working Group's report on standardized terminology and classification systems.

Ramsar Resolution VIII.17e also provides guidelines for action on the inventory of peatlands, towards establishing a global database of peatlands (now in preparation – see Joosten, 2004).

17. Inventory and assessment information on peatlands varies from country to country. It is generally patchy, inconsistent, and often difficult to access for those needing to use this vital baseline material for ensuring the wise use of their peatlands. This hinders the recognition of the importance of the peatland resource, its values and functions, and the application by contracting parties of measures to ensure the wise use of their peatlands, including the identification and designation of peatlands as wetlands of international importance.

18. Ramsar Resolution VII.20 on priorities for wetland inventory urged Contracting Parties to give highest priority to undertaking inventory activities for those wetland types identified as at greatest risk or with poorest information in the Global Review of Wetland Resources and Priorities for Wetland Inventory (GroWI) report. The GRoWI report identified peatlands as a priority wetland type noting, in particular, that they are threatened by drainage for agriculture and afforestation in

Europe, Asia and North America despite their importance as a global carbon sink and economic resource. Peatlands are relatively poorly known in tropical regions such as Southeast Asia.

The following guidelines for action are given:

- A global database of peatlands should be established and made widely accessible. The database should be compiled in the first instance from sources of existing information, brought into line with the agreed standardized terminology and classification systems for peatlands, and should include baseline information on the distribution, size, quality, ecological characteristics and biological diversity of the resource.

- Contracting Parties are urged to provide national information on carbon stored in their peatlands for incorporation in this database, and report on their progress in this matter.

- The data and information compiled in the global peatlands database should be made available to, and used by, Wetlands International in its role of advising the Convention on the application of the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance*. This advice should be designed to assist Contracting Parties in their identification and designation of peatlands as Ramsar sites, noting that peatlands have been identified by the Convention as under-represented in the Ramsar List and urged as a priority for future designations. To assist in such further designations, the database should include information on the biogeography of peatlands.

Inventories of peatlands in the region have been conducted from a **conservation** viewpoint in the context of regional and national wetland inventories (initially through the Asian Wetland Inventory project). However, peatland inventory data are also often available through **national soil surveys** in relation to agricultural development. National classifications of **forest types** provide another source of information on peatlands.

The Freshwater Ecoregions of the World http://www.feow.org/index.php provides a new global biogeographical regionalization of the Earth's freshwater biodiversity (see Abell *et al.*, 2008). Covering virtually all freshwater habitats on Earth, this first-ever ecoregion map, together with associated species data, is a useful tool for underpinning global and regional conservation planning efforts, particularly to identify outstanding and imperilled freshwater systems; for serving as a logical framework for large-scale conservation strategies; and for providing a global-scale knowledge base for increasing freshwater biogeographic literacy.

Freshwater Ecoregions of the World (FEOW) is a collaborative project providing the first global biogeographic regionalization of the Earth's freshwater biodiversity, and synthesizing biodiversity and threat data for the resulting ecoregions. A freshwater ecoregion is defined as a large area encompassing one or more freshwater systems that contains a distinct assemblage of natural freshwater communities and species. The freshwater species, dynamics, and environmental conditions within a given ecoregion are more similar to each other than to those of surrounding ecoregions and together form a conservation unit.

The freshwater ecoregion map encompasses 426 units, whose boundaries generally - though not always - correspond with those of watersheds (also known as drainage basins or catchments). Within individual ecoregions there will be turnover of species, such as when moving up or down a river system, but taken as a whole an ecoregion will typically have a distinct evolutionary history and/or ecological processes. Ecoregions are delineated based on the best available information, but data describing freshwater species and ecological processes are characterized by marked gaps and variation in quality, and improved information in the future may warrant map revisions.

The biodiversity data synthesized for ecoregions include richness and endemism numbers for freshwater fish, amphibians, turtles, and crocodiles, derived in nearly all cases from either species lists or digital distribution data. Additional information about species will be found within the individual ecoregion descriptions, which also will include details on ecoregion boundaries, topography, climate, habitats, ecological and evolutionary phenomena, and other features.

The ecoregions in Southeast Asia containing peatlands can be located from the website.

5.2.2 Wetland and Biodiversity Assessment & Monitoring Frameworks

At the global level, Ramsar Resolution VIII.17e indicates the following guidelines on detecting changes and trends in the quantity and quality of the peatland resource:

Since peatlands have been recognized by the Ramsar Convention as a particularly threatened wetland type, priority should be given to monitoring changes in their status and trends so as to assist Contracting Parties in taking the necessary actions to safeguard their wise use. In addition to on-the-ground assessment and monitoring, modern earth observation remote sensing techniques offer considerable potential for such appraisals over large geographical scales, using a variety of techniques.

Guidelines for action:

- A standardized monitoring system should be established for use by Contracting Parties in determining the status of, and detecting change in, their peatland resource.
- Reporting the status and trends in national peatland condition should form an element of the triennial National Reports prepared by Contracting Parties for each Ramsar COP. Such information should be also made available by Contracting Parties for inclusion in the global peatlands database.
- Opportunities for developing remote sensing tools and analyses to assess large-scale status and trends in peatland quality and quantity should be explored with earth observation organizations and agencies, as well as other expert in this field.
- Based on the information provided on the status and trends in the peatland resource in National Reports, and the information available in the global peatlands database, regular summary reports of the status and trends of the global peatlands resource should be prepared for consideration by Contracting Parties.

Assessment of High Conservation Value Forest and Other Habitats

All forests contain environmental and social values, such as wildlife habitat, watershed protection or archaeological sites. Where these values are considered to be of outstanding significance or critical importance, the forest can be defined as a High Conservation Value Forest (HCVF).

The key to the concept of High Conservation Value Forests is the identification of High Conservation Values (HCVs), because their presence determines whether a forest is designated a High Conservation Value Forest. High Conservation Values were first defined by the **Forest Stewardship Council** www.fsc.org for use in forest certification, but the concept is increasingly being used for other purposes, including conservation and natural resource planning and advocacy, landscape mapping, plantation development and in the purchasing policies of major companies. It has recently begun to appear in the discussions and policies of government agencies and institutional donors. The HCV concept has also been applied in the Roundtable on Sustainable Palm Oil www.rspo.org Principles and Criteria for Sustainable Palm Oil Production.

This rapid uptake reflects the elegance of the concept, which has moved the debate away from definitions of particular forest types (e.g. primary, old growth) or methods of timber harvesting (e.g. industrial logging) to focus instead on the values that make a forest particularly important. By identifying these key values and ensuring that they are maintained or enhanced, it is possible to make rational management decisions that are consistent with the protection of a forest area’s important environmental and social values.

High Conservation Value Forests are those areas of forest that need to be appropriately managed in order to maintain or enhance the identified High Conservation Values. A High Conservation Value Forest may be a small part of a larger forest, for example a riparian zone protecting a stream that is the sole supply of drinking water to a community or a small patch of a rare ecosystem. In other cases, the High Conservation Value Forest may be the whole of a forest management unit, for example when the forest contains several threatened or endangered species that range throughout the forest. Any forest type – boreal, temperate or tropical, natural or plantation can potentially be a High Conservation Value Forest, because High Conservation Value Forest designation relies solely on the presence of one or more High Conservation Values.

Significant guidance is available on the application of the HCV concept through the 'HCVF Toolkit' (Jennings *et al*., 2003). This includes case studies and a practical methodology to be used at a national (or regional or sub-national) level for defining High Conservation Values. Note that this approach can be used for other ecosystems and habitats besides forests.

High Conservation Value Forest (HCVF) is defined as: The forest necessary to maintain or enhance one or more High Conservation Values (HCVs):

- HCV1 - Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species).
- HCV2 - Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
- HCV3 - Forest areas that are in, or contain rare, threatened or endangered ecosystems.
- HCV4 - Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
- HCV5 - Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).
- HCV6 - Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

(Jennings *et al*., 2003)

Biodiversity Assessments

There are numerous resources on the assessment of different elements of biodiversity, on different scales, much of which can be applied to peatland biodiversity. See also **Section 2.4.2 of Part 1**. **At the global level,** the following are of particular value (including a wealth of catalogued reference material on different subjects):

- Anon., 2006. Guidelines for the Rapid Ecological Assessment of Biodiversity in Inland Waters, Coastal and Marine Areas.
- Springate-Baginski *et al*., 2009. An Integrated Wetland Assessment Toolkit: A guide to good practice.
- Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being.
- Integrated Biodiversity Assessment Tool

Global information sources on taxonomic groups and species include the following:

Alliance for Zero Extinction: http://www.zeroextinction.org/

Birdlife International Datazone (information on bird species, important bird areas, endemic bird areas, state of the world's birds): http://www.birdlife.org/datazone/index.html

CITES Species Database: http://www.cites.org/eng/resources/species.html

Global Fish Database: www.fishbase.org

Global Register of Migratory Species http://www.groms.de/

National Biodiversity Indicators Portal: http://www.bipnational.net/

Save Our Species: http://www.sospecies.org/

The IUCN Red List of Threatened Species http://www.iucnredlist.org/

Regional Information Resources on Biodiversity

ASEAN Centre for Biodiversity - www.aseanbiodiversity.org

The **Biodiversity Information Sharing Service (BISS) under the Biodiversity Information Management of the ASEAN Centre for Biodiversity** provides an important regional resource. BISS is a web-based data management system envisioned to serve as the common sharing platform for the AMCs on biodiversity information. BISS is currently keeping only a minimal dataset on critical details, like species name lists and protected area network data. The bulk of the data comes from other data sources. The current BISS contains species by several taxonomic group and protected area information grouped into terrestrial, marine and ASEAN Heritage Parks. Additional data gathered from the ASEAN Member states and global and regional data sources will be added to the BISS platform.

In addition, the **ASEAN Regional Clearing House Mechanism for Biodiversity Information (ASEAN CHM)** will facilitate consolidation, access, analysis and promotion of regional biodiversity information, issues and initiatives of the ASEAN Member States (AMS). The ASEAN CHM is envisioned to capture, organize and harmonize the common information that is publicly available in the CHMs of the AMS and provide the regional overview of biodiversity information. It will provide the primary access and single portal to all AMS biodiversity information resources and applications.

Regional Resources on Taxonomic Groups

Asia Dragonfly Community: http://www.asia-dragonfly.net/

Asian Turtle Conservation Network:
http://www.asianturtlenetwork.org/index.htm

Birdlife Asia Programme: http://www.birdlife.org/regional/asia/index.html

5.3 Protected Area System Development

This section focuses on protected area systems, with the management of individual protected areas, various governance options and community participation covered later in section 1.6. The main centre of policy guidance for the development of protected area systems is the Convention on Biological Diversity (CBD), through its Articles (2 and 8), Decisions (VII.28 and X/31, amongst others), and Programme of Work on Protected Areas (also Programmes of Work on thematic subjects including forests). The most recent decisions were taken at CBD COP10 in October 2010, setting the basis for the current Programme of Work on Protected Areas (POWPA), see: http://www.cbd.int/protected/pow/learnmore/intro.

Articles of the Convention on Biological Diversity concerning protected areas include (but are not restricted to) the following:

The term "protected area" is defined in Article 2 of the Convention as "a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives." Articles 8(a) and 8(b) state that a system of protected areas forms a central element of any national strategy to conserve biological diversity.

CBD Decision X/31 on Protected Areas provides guidance on strategies for strengthening implementation of the POWPA at national, regional and global levels. These include:

- Enhancing the coverage and quality, representativeness and, if appropriate, connectivity of protected areas as a contribution to the development of representative systems of protected areas and coherent ecological networks that include all relevant biomes, ecoregions, or ecosystems;
- Promote the application of the ecosystem approach that integrates protected areas into broader land and/or seascapes for effective conservation of biological diversity and facilitate, in accordance with their management objectives, sustainable use within protected areas;
- Expedite establishment, where appropriate, of multi-sectoral advisory committees for strengthening inter-sectoral coordination and communication to facilitate the integration of protected areas in national and economic development plans, where they exist;
- Consider standard criteria for the identification of sites of global biodiversity conservation significance, when developing protected-area systems drawing on the IUCN Red List of Threatened Species, established criteria in other relevant processes including those of the UNESCO Man and Biosphere Programme, the World Heritage Convention, the Ramsar Convention on Wetlands, threatened ecosystem assessments, gap analysis, Key Biodiversity Areas and Important Bird Areas, and other relevant information;

It also provides recommendations on issues that require further attention, including sustainable finance, climate change, management effectiveness, invasive alien species management, inland water protected areas, restoration of ecosystems and habitats of protected areas, and valuing protected areas costs and benefits including their ecosystem services. The recommendation on **inland water protected areas** is of particular relevance to peatland conservation:

Further encourages Parties to increase the coverage, quality, representativeness and connectivity, where appropriate, of inland water ecosystems and their key hydrological features in their protected-area systems through the designation or extension of inland-water protected areas and to maintain or enhance their resilience and sustain ecosystem services including through the use of existing designation mechanisms available and being applied under biodiversity related conventions, such as the World Heritage Convention and the Ramsar Convention on Wetlands.

The recommendations on **restoration of ecosystems and habitats of protected areas** are also highly relevant to peatlands:

Increase the effectiveness of protected area systems in biodiversity conservation and enhance their resilience to climate change and other stressors, through increased efforts in restoration of ecosystems and habitats and including, as appropriate, connectivity tools such as ecological corridors and/or conservation measures in and between protected areas and adjacent landscapes and seascapes; and

Include restoration activities in the action plans of the programme of work on protected areas and national biodiversity strategies;

Other relevant CBD guidance includes the **Annex to COP 6 Decision VI/22 on the expanded programme of work on forest biological diversity** (Goal 3: To protect, recover and restore forest biological diversity, Objective 3: Ensure adequate and effective protected forest area networks):

a. Assess the comprehensiveness, representativeness and adequacy of protected areas relative to forest types and identify gaps and weaknesses.

b. Establish (in accordance with Article 8(j)) with the full participation and with respect for the rights of indigenous and local communities, and other relevant stakeholders, comprehensive, adequate, biologically and geographically representative and effective networks of protected areas.

c. Establish, in a similar manner, restoration areas to complement the network of protected areas where needed.

d. Revise in a similar manner and ensure the comprehensiveness, adequacy, representativeness and efficacy of existing protected area networks.

e. Assess the efficacy of protected forest areas for the conservation of biological diversity.

f. Ensure that relevant protected areas are managed to maintain and enhance their forest biodiversity components, services and values;

The protection of intact peatlands through inclusion in protected area systems is critical for the conservation of biodiversity and will maintain their carbon storage and sequestration capacity and other associated ecosystem functions. The **Ramsar Convention** has recognized that peatlands are under-represented in global conservation networks in the **Annex to Ramsar Resolution VIII.17:**

22. Contracting Parties have recognized that peatlands are an under-represented wetland type in the Ramsar List of Wetlands of International Importance and have afforded priority to the designation of peatlands as Ramsar sites. To assist Contracting Parties in the identification and designation of such sites, COP8 has adopted additional guidance on their designation (Resolution VIII.11). Guidelines for action include the following:

- Reviews of national networks of peatland protected areas should be undertaken. Where there is a currently incomplete network of peatland sites within a national system of protected areas, as appropriate, the number of peatland reserves, parks or other types of protected peatlands should be increased.
- The conservation of nationally, regionally and globally important and representative peatland types should be further secured through the expansion of the global network of Ramsar sites, applying the *Guidance for identifying and designating peatlands, wet grasslands, mangroves and coral reefs as Wetlands of International Importance* adopted by COP8 (Resolution VIII.11).

The Ramsar Convention's Strategic Framework (Handbook 14) specifically identifies peatlands as being amongst the wetland ecosystems that are most vulnerable and threatened by habitat loss and degradation, and thus in need of urgent priority action to ensure their conservation and wise use. It recognizes peatlands as being under-represented in the existing global network of Ramsar Sites, and provides guidance on the identification and designation of peatlands as Wetlands of International Importance. It notes that, as peatlands (as well as a few other wetland types) have been identified as being **particularly vulnerable and threatened by habitat loss and degradation, the identification and designation of threatened ecological communities, as well as threatened species, under Ramsar Criterion 2 will often be of particular importance.**

A large area of peatlands is normally of higher importance than a small area for its hydrological, carbon storage and palaeoarchive values and because its incorporates macro-landscapes: these should be afforded high priority for designation. Consideration should also be given to the capacity of the peatland system to influence regional climate.

Where appropriate and desirable**,** peatlands designated as Ramsar sites **should include entire catchments, so as to maintain the hydrological integrity of the peatland system**.

The design of protected areas systems should also take into account the connections between protected areas and wider landscapes – in particular seeking to maintain habitat connectivity across landscapes and avoiding fragmentation. This is of particular importance in maintaining the viability of populations of species that require large ranges (e.g. tiger, hornbills), and also for maintaining the biodiversity of individual protected areas in the long term. Peat swamps are particularly vulnerable to fragmentation by canals, ditches and linear developments such as roads, and this should be avoided as far as possible through planning policies, management plans and restoration measures.

One of the first regional protected areas reviews for Southeast Asia was conducted by MacKinnon and MacKinnon (1988), covering the Indo-Malayan Realm. This review identifies gaps in the protected areas system including the coverage of peat swamps, and makes recommendations for additional protected area coverage. Brockelman (1988) also provides information on ASEAN Heritage Parks and Reserves. More recently, the ASEAN Centre for Biodiversity has worked with partners to conduct a regional protected area gap analysis (Birdlife International and IUCN – WCPA South-East Asia, 2007; ACB, 2008), and to develop a Regional Action Plan for ASEAN Heritage Parks and Protected Areas (ACB, 2007).

The design and improvement of national protected area systems should take full account of international studies that have been conducted in relation to global ecoregions, the distribution of globally threatened species, important bird areas (IBAs), wetlands of international importance, High Conservation Forests, and the recommendations of the biodiversity-related conventions.

Information on the current status of protected areas is available through the World Database on Protected Areas: http://www.wdpa.org/ and http://www.protectedplanet.net/

The IUCN World Commission on Protected Areas provides a global framework for protected areas management (see: http://www.iucn.org/about/union/commissions/wcpa/). WCPA East Asia has developed a regional action plan for protected areas in East Asia. This plan outlines the key protected areas issues in the region and defines 13 priority projects. The Government of Japan, through its Environment Agency, generously agreed to support four of these priority projects:

Project 1: **Guidelines for financing protected areas in East Asia.** This resulted in the preparation of a document on guidelines for financing protected areas in East Asia.

Project 2: **Exchange programme for protected areas.** This project component supports the participation of East Asian participants at relevant working groups and conferences in the region related to protected areas. An option paper for the implementation of an exchange programme is also being developed for the East Asia region.

Project 3: **Tourism and protected areas**. This project resulted in the preparation of guidelines on tourism and protected areas in East Asia, in 2001. This is based on practical case studies within the region and will offer guidance for the future development of tourism in East Asia.

Project 4: **Directory of protected area personnel and organisations**. A directory of protected areas personnel and organisations in East Asia. In addition to these priority projects, the WCPA East Asia hosts an annual meeting on a protected areas topic. The location for this meeting rotates among the countries within the region.

Once an area has been protected, it needs to be effectively managed in order to achieve biodiversity conservation goals. Integrated management, participatory management and management planning are all key approaches, described below.

5.4 Ecosystem Approach

It is recognized that the ecosystem approach, underpinned by the Malawi Principles and adopted as a framework for implementation of the CBD, provides a valuable approach for implementation of the *Guidelines for Global Action on Peatlands.* This is consistent with CBD Decision IV/15 and Ramsar Resolution VII.15 referring to the use of an ecosystem approach.

The ecosystem approach emerged early as a central principle in the implementation of the Convention on Biological Diversity. At its second meeting, held in Jakarta in November 1995, the Conference of the Parties adopted the ecosystem approach as the primary framework for action under the Convention.

The CBD provides extensive guidance on the application of the Ecosystem Approach, including guidelines, a beginner's guide, an advanced user's guide and a searchable online ecosystem approach sourcebook, which can be used to find information on case studies and tools which have met some or all of ecosystem approach principles.

https://www.biodiv.org/programmes/crosscutting/ecosystem/sourcebook/search.shtml

In summary, the ecosystem approach is a tool; it provides a framework that can be used to implement the objectives of the Convention on Biological Diversity, including the work on, *inter alia*, protected areas and ecological networks. There is no single correct way to apply the ecosystem approach to management of land, water, and living resources. The principles that underlie the ecosystem approach can be translated flexibly to address management issues in different social, economic and environmental contexts. Already, there are sectors and governments that have developed guidelines that are partially consistent, complementary or even equivalent to the ecosystem approach.

Description of the Ecosystem Approach

1. The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

2. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among

organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.

3. This focus on structure, processes, functions and interactions is consistent with the definition of "ecosystem" provided in Article 2 of the Convention on Biological Diversity: "'Ecosystem' means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." This definition does not specify any particular spatial unit or scale, in contrast to the Convention definition of "habitat". Thus, the term "ecosystem" does not, necessarily, correspond to the terms "biome" or "ecological zone", but can refer to any functioning unit at any scale. Indeed, the scale of analysis and action should be determined by the problem being addressed. It could, for example, be a grain of soil, a pond, a forest, a biome or the entire biosphere.

4. The ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning. Ecosystem processes are often non-linear, and the outcome of such processes often shows time-lags. The result is discontinuities, leading to surprise and uncertainty. Management must be adaptive in order to be able to respond to such uncertainties and contain elements of "learning-by-doing" or research feedback. Measures may need to be taken even when some cause-and-effect relationships are not yet fully established scientifically.

5. The ecosystem approach does not preclude other management and conservation approaches, such as biosphere reserves, protected areas, and single-species conservation programmes, as well as other approaches carried out under existing national policy and legislative frameworks, but could, rather, integrate all these approaches and other methodologies to deal with complex situations. There is no single way to implement the ecosystem approach, as it depends on local, provincial, national, regional or global conditions. Indeed, there are many ways in which ecosystem approaches may be used as the framework for delivering the objectives of the Convention in practice.

Source: Secretariat of the Convention on Biological Diversity (2004).

The Twelve Principles of the Ecosystem Approach

1: The objectives of management of land, water and living resources are a matter of societal choice.

2: Management should be decentralized to the lowest appropriate level.

3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

(a) Reduce those market distortions that adversely affect biological diversity;
(b) Align incentives to promote biodiversity conservation and sustainable use;
(c) Internalize costs and benefits in the given ecosystem to the extent feasible.

5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

6: Ecosystems must be managed within the limits of their functioning.

7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

9: Management must recognize that change is inevitable.

10:The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

11:The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

12:The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Source: Secretariat of the Convention on Biological Diversity (2004).

5.5 Integrated Management of Water Resources

The effective management of water resources is the single most important issue for the sustainable management of peatlands. Drainage has many impacts, including the oxidation of the peat soil, release of greenhouse gas emissions, the subsidence of the peat surface, and increased risk of fire. Water management directly affects the functioning of peat swamps as ecosystems and their biodiversity.

The management of water resources in relation to peatlands must take account of key principles including the following:

- Water management should be undertaken at the river basin level, or sub-basins (catchments) where these are clearly defined.
- Allocation of water resources at river basin level should take full account of the environmental flows needed to maintain fully functioning peat swamp ecosystems.
- The natural hydrological regime should be preserved or re-created as far as possible in order to maintain the functioning of peat swamp ecosystems. Seasonal floods are often an important part of the ecology of swamps, providing influxes of nutrients, flushing out the system, and allowing aquatic animals to disperse over wider areas. Annual breeding cycles are usually linked to seasonal climatic and hydrological changes.
- Fragmentation of peat swamp ecosystems should be avoided as far as possible during development planning.
- Drainage of peat soils should be avoided as far as possible, and minimized or mitigated where development has already occurred.
- The restoration of near-natural water tables through the blocking of artificial channels is the first priority in any peatland restoration or rehabilitation project.

The Ramsar Convention's Handbooks for the Wise Use of Wetlands (3rd Edition) provide a comprehensive framework on the management of water resources for wetlands. See:

- **Handbook 6. Water-related guidance:** An Integrated Framework for the Convention's water-related guidance.
- **Handbook 7. River basin management:** Integrating wetland conservation and wise use into river basin management.
- **Handbook 8. Water allocation and management.** Guidelines for the allocation and management of water for maintaining the ecological functions of wetlands.
- **Handbook 9. Managing groundwater.** Managing groundwater to maintain ecological character.

(See references for links to the Ramsar website for downloading)

There has been significant research and management experience relating to hydrological management of peatlands in Southeast Asia (see references). This experience has been conducted in various contexts, including management of intact peatswamp forests, rehabilitating and restoring peatlands in various degrees of degradation (see Module 3 in Section 7), managing water levels for various land uses (see Module 2 in Section 6), mitigating the environmental impacts of landuses (Module 2 in Section 6), and fire prevention and response (see also Module 3 in Section 7).

Wosten *et al.* (2010). provide guidance on water management for major land uses on peat soils. They note that the challenge for land uses in peatlands is to strike a balance between a sufficiently high water table to reduce subsidence and thus CO_2 emissions, and a water table sufficiently low to permit crop growth. Importantly, the fire susceptibility of peatlands increases dramatically when the water table drops below a critical threshold value of 40cm. Therefore appropriate water management is critical for mitigating peat carbon losses resulting from drainage and fire. They distinguish between major land uses:

- Natural peat swamp forest with constantly high water tables;
- Agricultural areas, often over-drained and in need of controlled water management;
- Plantations with controlled water management.

Each of these land uses has specific water management requirements in terms of low or high water tables being constant or variable, requiring specific operational water management.

For natural peat swamp forest, they note that the objectives are to maintain high water levels in semi-pristine and lightly logged forests by aiming for zero drainage and the restoration of their former hydrology by blocking existing drainage canals (see section on restoration). Please refer to Wosten *et al.* (2010) for details of water management requirements and operational water management.

For agricultural land uses, the aim of water management is to maintain a constant water table throughout the year. This assumes that some of the surplus rainfall from the wet season is stored in the peatland to compensate for water deficits in the dry season. The effect will be that flooding is prevented in the wet season while in the dry season, low groundwater tables are avoided thus reducing fire risk.

Plantations require a complex water management system in order to provide adequate moisture for the plants, reduce peat subsidence and allow transport of the harvested products. Groundwater table control is vital and can be achieved by integrating drainage, subsurface irrigation and water conservation. Advanced plantation management practices that aim to minimise carbon loss should be promoted and extended, including advanced water and peat management systems, development of integrated hydrological management plans at river basin level (including involvement of other stakeholders), and active fire prevention.

The importance of engaging in participatory processes in water management (rather than simply informing or consulting stakeholders and the public), including practical guidance on these processes suitable for working with groups is given in HarmoniCOP (2005). See next section for more information on participatory management processes.

5.6 Integrated Management

Uni-sectoral planning of peatland management/use is one of the root causes of peatland degradation. Therefore peatlands must be planned and managed in an integrated manner. In most countries there is significant conflict or competition between different user groups or economic sectors such as forestry, agriculture, water supply, industry and also between government, private sector and local communities over the development and management priorities and strategies for peatlands. These contrasting interests lead to conflicting decisions and ad-hoc planning. This is further complicated by the fact that large peatlands are single hydrological units that may cover up to one million ha, but which may be subdivided by different administrative boundaries and land use zones. Since each part of the peatland is interconnected, drainage or vegetation clearance on one site will have an impact on other portions of the same zone. It is therefore imperative that each hydrological unit is addressed as a single entity for the purposes of development planning and management and care should be taken that activities approved for different parts of the peatland are compatible (Parish *et al.,* 2008, Section 9).

5.6.1 Governance Options, Community Participation and Sustainable Livelihoods

Evidence from case studies and other experiences in participatory management indicates that local and indigenous people's involvement can, if carried out within the full framework of actions encouraged by the Ramsar Convention and CBD, contribute significantly to maintaining or restoring the ecological integrity of wetlands, as well as contributing to community well-being and more equitable access to resources. The breadth of the term "involvement" (or "participation") from consultation to devolution of management authority, and the variety of local contexts, means that there are few if any prerequisites to establishing participatory management. One consistent factor, however, is a commitment to the beliefs and values that support the Ramsar concept of "sustainable utilization" (Ramsar Convention Secretariat 2007 vol 5).

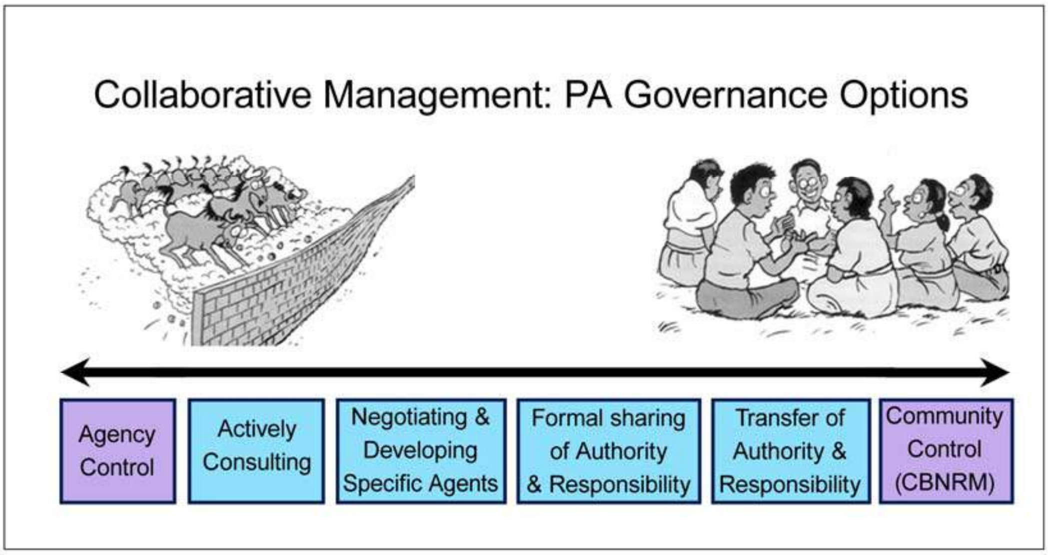
Peatlands across the world are managed by a number of different people and groups, each with different aims, values and goals. It is increasingly recognised that local communities are critical stakeholders within peatland management systems. Community-based approaches can be used to raise awareness about biodiversity conservation and climate change and the key role that appropriate peatland management can play. Local involvement can also promote sustainable management and avoid conflicts, as different stakeholders familiarize themselves with the views of others. Vitally, local participation in peatland management can also achieve social goals; contributing towards poverty alleviation, increased livelihood sustainability and social empowerment (Middendorf and Busch, 1997).

Communities can be included in peatland management through use of a number of different methods and mechanisms. In helping decision-makers and researchers learn about different uses and understandings of peatland areas, methods such as transect walks with land managers, livelihood analyses and the development of participatory resource maps can be useful. Local knowledge about the peatland can be used to complement more technical scientific knowledge and together, combined knowledge can contribute to more acceptable, appropriate, and ultimately more sustainable management and policy (Berkes, 1999; Kelsey, 2003). Communities can also be involved in monitoring and assessment exercises. These kinds of activities can provide decision-makers with important information on the rate and nature of any changes to the peatland, assisting the development of policies for more sustainable use of the resource.

Despite benefits, participatory approaches are not without their problems. Participatory approaches have certain constraints (see Cooke and Kothari 2001, Hickey and Mohan 2004, Stringer *et al.,* 2006). For example, by involving local communities, expectations can be raised. If these expectations are then not fulfilled, it can lead to disillusionment. Participatory approaches also acknowledge diversity and complexity, rather than helping to simplify environmental management situations. Although this is one of the main strengths of the approach, and by involving local people in the analysis and interpretation of results, errors can be avoided, taking several different diverse viewpoints in account can make the results difficult to analyse and interpret. Finally, there is a danger that participatory methods can be applied mechanically, without an appreciation of underlying principles. This can prevent the benefits of participatory approaches from being realised.

Generally, a combination of top-down and bottom-up peatland management approaches is favoured, since it is sometimes necessary to increase local awareness of changes and threats to the peatland, and build local capacity for monitoring and more sustainable management.

In terms of **governance**, the following diagram summarizes options available for conservation areas. Although these options are shown as boxes, in reality it is a gradient with a multitude of subtle differences in practice. Collaborative management should be seen as a broad concept spanning a variety of ways in which the management agency and stakeholders develop and implement a partnership.



In relation to the above diagram, it should be noted that:

- There is no "right position" in the spectrum of participation – the approach needs to fit each specific historical and social context
- No matter which position a conservation initiative may start at, its position may change:
  - Due to legal, political, socio-economic factors
  - Learning by doing can lead to better recognition of needs and opportunities for stakeholder participation
- Potential advantages and problems for conservation exist in all types of management arrangements
- Are the conditions right for co-management? Is it feasible in legal, political, institutional, economic & social terms?

Source: IUCN CEESP-WCPA TILPECA (2003)

Regional experience and guidance on governance and community participation is available through the following references: ASEAN Centre for Biodiversity, Haribon Foundation, IUCN-WCPA in Southeast Asia and BirdLife International (2008), and ASEAN Centre for Biodiversity and the Protected Areas and Wildlife Bureau-DENR (2008), Colchester, M. & Erni, C. (1999).

Significant advice and publications are available from IUCN's website on Governance, Communities, Equity, and Livelihood Rights in Relation to Protected Areas (TILCEPA): http://www.iucn.org/about/union/commissions/ceesp/wg/tilcepa/

5.6.2 Management Planning

Wetlands are dynamic areas, influenced by both natural and human factors. In order to maintain their biological diversity and productivity, and to permit the wise use of their resources, there is an urgent need to conserve them through well focused management actions. For management to be effective, the following information is needed:

- An understanding of the habitats and species occurring;
- How these interact to form ecosystems;
- The natural processes that sustain them; and
- Threats to these processes.

In particular, management must understand past and present human usage, its current or future impact, and the means by which optimum (sustainable) usage can be achieved. Effective management therefore, means understanding the full spectrum of measures and actions necessary to sustain the site. It also has to place the site positively within the community context and be able to respond to any potentially threatening development that may take place in the surrounding area.

To achieve these things effectively, a common understanding, and sometimes an agreement, is needed between the various managers, owners, occupiers and others whose activities link to, or are affected by the wetlands – the stakeholders. The management planning process provides the mechanism to achieve this understanding and agreement. It is also fundamentally a process designed to increase the awareness of all the people or organizations involved with the site and thus enhance a collective commitment to act together to conserve the wetland.

Neighbours and local people should be actively involved in this process. There are essentially two products that come from a good planning process: the plan itself, but usually more importantly, stakeholder empowerment and engagement in informed, strategic, management actions.

Guidelines on wetland management planning are available through Ramsar Convention Secretariat (2007 vol 16) and Chatterjee *et al.* (2008), while Chan *et al.* (2001) focuses on wetlands in Southeast Asia and Safford and Maltby (1998) covers lowland peatlands in Southeast Asia.

Significant guidance and resources on management planning for nature conservation are available through the UK-based *CMS Consortium* (CMSC), a group of conservation organisations whose aim is to raise standards in conservation and countryside management. The key ways that the CMS Consortium achieves this aim are by producing planning guidelines and software tools to make the whole process as simple as possible. These are available from the CMSC website at: http://www.cmsconsortium.org. The resources include the revised CMS Management Planning Guide (Alexander, 2010), Core Management Planning Principles for conservation sites and example management plans, all available from the website.

The current version of the CMS software is *CMS 7* or *CMS NaturaPlan*. Used by hundreds of organisations, CMS helps you write your management plan and uniquely integrates recording of work done with the plan. This in turn improves future planning as the past history of management is integrated with the plan but also aids reporting and corporate management of data. CMS 7 is highly customisable allowing it to be used in different languages and there are hundreds of users across the British Isles, the rest of Europe and beyond.

The main steps in preparing a management plan can be represented as follows (source: Ramsar Handbook 16):

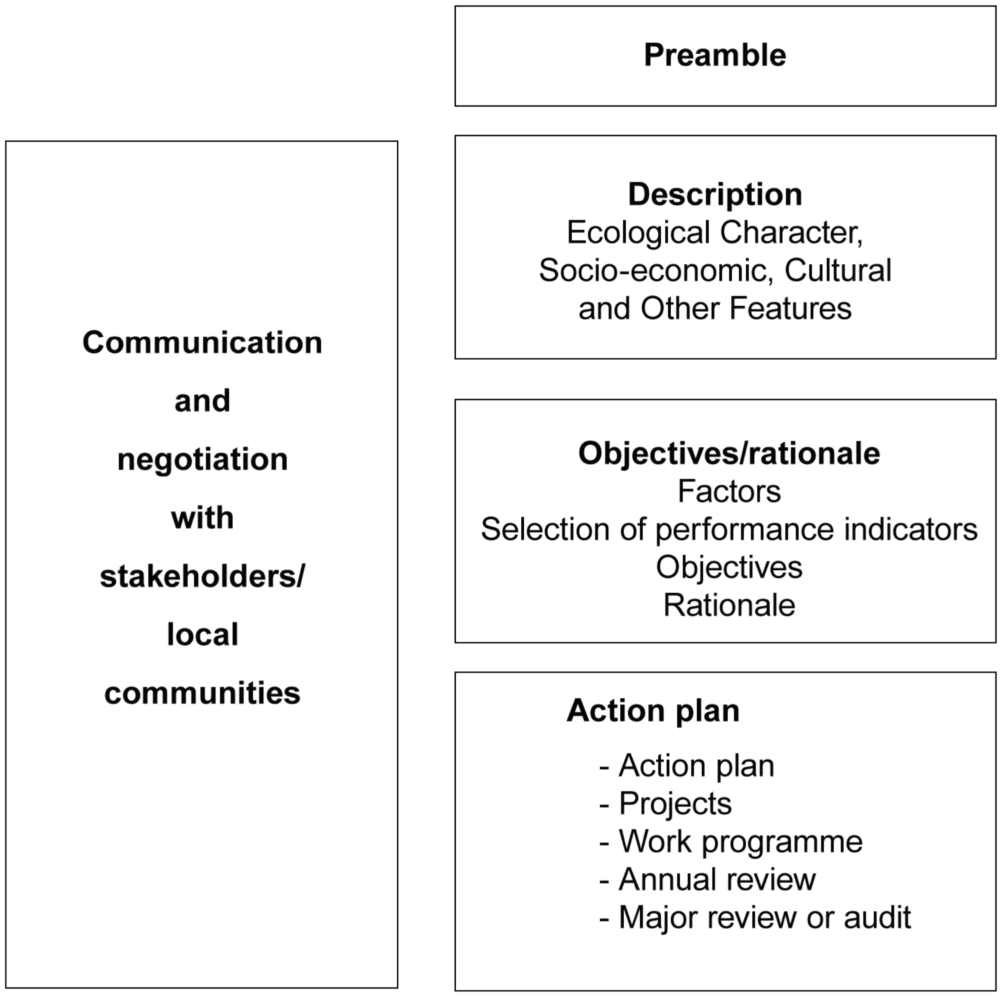


Figure 5.4
Overview of steps in management planning (Ref. Ramsar HB8)

5.6.3 Management Effectiveness

Once conservation areas have been established for peatlands, there is a need to ensure that they are managed effectively. A simple tool has been developed for this purpose, which is now being widely used for projects supported by WWF, the World Bank, GEF and other organizations. This provides a rapid assessment of the current status of management of a protected area and the steps needed to improve its management. Protected Areas Management Effectiveness can be defined as: ***the assessment of how well the protected area is being managed - primarily the extent to which it is protecting values and achieving goals and objectives.***

For extensive information see the Protected Areas Management Effectiveness Information Module: http://www.wdpa.org/ME/Default.aspx

This website has been developed to help the conservation community share experiences and ideas on management effectiveness, as well as provide 'lessons learned' from these assessments. The Management Effectiveness Tracking Tool and other methodologies and publications can be downloaded from this site.

Southeast Asian experience is available through reports on the above website, and also in the workshop proceedings available from the ASEAN Centre for Biodiversity website: ASEAN Centre for Biodiversity and BirdLife International (2008) and ASEAN Centre for Biodiversity (2008).

5.7 Climate Change Adaptation and Mitigation

Considerable work has been done on climate change mitigation for peatlands, in view of the significant emissions resulting from the drainage and burning of peat soils (e.g. the IFAD/GEF ASEAN Peatland Forests Project

http://www.aseanpeat.net/, CARBOPEAT project
http://www.geog.le.ac.uk/carbopeat/ and UNEP/GEF Global Assessment of Peatlands project - see the Peat Portal www.peat-portal.net).

Environmentally sustainable management ("Wise Use") of natural peat swamp forests, and peatlands under other appropriate land-uses (including limited drainage and fire prevention) together with the rehabilitation and restoration of degraded peatlands are critical for the mitigation of emissions arising from peatland land uses and land changes. This subject is not dealt with in further detail here, as the main focus of these guidelines is on peatland management for biodiversity conservation.

Climate change adaptation needs to be factored into policies, strategies and plans for peatland management, taking account of predicted climate changes as far as possible. This approach aims to increase the resilience of both ecosystems and human communities to the impacts of climate change, by identifying vulnerabilities and putting place measures to address these as far as possible.

Peatlands can play an important role in climate change adaptation through "Ecosystem-based Adaptation", through which the ecosystem services provided by peat swamp forests can help to mitigate the impacts of climate change on human communities and economies (especially through their hydrological services of flood mitigation and water regulation). The restoration of degraded peat swamps – especially their hydrological conditions (see section 7) – should be included in national and regional climate change adaptation and mitigation plans.

The UNDP/GEF Adaptation Learning Mechanism (ALM) project has established a Global Knowledge Sharing Platform at http://www.adaptationlearning.net/

The ALM is mapping good practices, providing information, building knowledge and networks on climate change adaptation and significant resources are accessible through this website categorized by locations, themes, types of resources and keywords.

A guidance manual on adapting to climate variability has been prepared by USAID (USAID, 2007) to help project planners understand and address the climate's impacts on their project. There is a six-step approach for assessing vulnerability and identifying and implementing climate change adaptations which follows a developmental path parallel to the more general project cycle. The six steps include:

- Screening for vulnerability
- Identifying adaptations
- Conducting analysis
- Selecting a course of action
- Implementing adaptation
- Evaluating adaptation

5.8 Fire Prevention Control and Monitoring

Burning Peatlands

Controlled burning has been used effectively as a peatland management tool in various parts of the world without any major negative effects, but events in Southeast Asia in recent years have highlighted the fact that extensive and uncontrolled burning can have serious direct effects on human health. For example, the largely deliberate burning for land-clearing and local peatland management in 1997-1998 in Southeast Asian peatlands affected around 70 million people in six countries. Some 200,000 people were hospitalized with respiratory, heart, and eye and nose irritations, and an estimated 12 million people required health care for respiratory problems. Significant burning events since then have continued to impact the health of large numbers of people often in neighbouring countries or even further afield. Indeed, once peatlands have become significantly altered by fire and deforestation, they become very susceptible to repeated burning.

The effects on local communities of large-scale, uncontrolled burning are not restricted to the direct and immediate effects on health: the burning can also result in the loss of income from crops and benefits from natural resources previously available such as fish, reptiles, weaving materials, fuelwood, timber, etc., as well as the loss of income from tourism in the region. The value of these diverse services provided by peatlands are usually underestimated and may exceed the value from converted peatlands, such as for rice growing or oil palm cultivation.

Economic costs associated with damage to ecosystem services can be substantial: the damage of the 1997-8 Southeast Asian fires to timber, tourism, transport, agriculture, and other benefits derived from or linked to the forests has been estimated at US$4.5 billion in addition to the actual cost of fighting the fires. And that is above and beyond the direct and indirect medical costs associated with the effects of burning on the population.

In the longer term, peatland burning and drainage activities have led to massive increases in the emissions of greenhouse gases as well as contributing significantly to climate change. The burning in 1997-8 is estimated to have contributed an amount of carbon equivalent to 13–40% of the mean annual global carbon emissions from fossil fuels – so while the health impacts upon humans were regional, the impacts upon the Earth’s health were global. (Ramsar Convention Secretariat 2008).

The 1997-8 fire episodes are estimated to have burned at least 11.69 million hectares of land in Indonesia alone, of which 2,124,000 ha was peat and freshwater swamp forest (Tacconi, 2003). This was not the first such huge fire event related to an El Nino (ENSO) event, between September 1982 and July 1983 an immense area of forest on Borneo was affected by drought followed by fire, estimated at 3.5 million hectares including some 550,000 ha of peat swamp forest, mainly in East Kalimantan (Johnson 1984). ENSO events since 1997-8 have also resulted in increased fires and related smoke haze as the dry conditions facilitate land clearing activities and the incidence of forest fires.

ASEAN-led Responses to Peatland Fires and Transboundary Haze Pollution

As part of the *ASEAN Agreement on Transboundary Haze Pollution (AATHP)*, the ASEAN Environment Ministers endorsed the *ASEAN Peatland Management Strategy (APMS)* in November 2006 which was to act as a framework to guide the sustainable management of peatlands for the period 2006-2020. One of the key strategies under the APMS is *Fire Prevention, Control and Monitoring* which aims to reduce and minimize the incidents of fire and associated haze. Initial steps to develop a regional peatland fire prediction and warning system were taken at a meeting in Singapore in February 2008 with support from the ASEAN-Australia Development Cooperation Program (AADCP).

A preparation group consisting of experts from the Malaysian Meteorological Department (MMD), Forestry Department Peninsular Malaysia (FDPM), Forestry Department Selangor (FDS) and the Global Environment Centre (GEC) as well as from the ASEAN Specialised Meteorological Centre (ASMC) was formed to initiate the development of the System in June 2010, and initial outputs from the preparation meeting were reviewed at a technical workshop in July 2010 to follow up on the earlier initiatives.

The technical workshop on fire prevention, control and monitoring in July 2010 was organised to support the implementation of the ASEAN Peatland Management Strategy 2006-2020 as part of the ASEAN Peatland Forests Project (APFP). Expert presentations were given on the nature and significance of peatland fires in the ASEAN region; current status of fire danger rating and hotspot monitoring programmes; experience in fire prevention and control in peatlands. Working groups focused on strengthening peatland fire prediction and warning systems and enhancing fire prevention measures in peatlands. A number of case studies and presentations are included in the workshop report (Global Environment Centre, 2010). Important outcomes of the workshop discussions were as follows:

- Fires in peatlands are the most serious type of land and forest fires and over 90% of transboundary haze in the southern portion of Southeast Asia is linked to peatland fires.
- Governments in the ASEAN region have developed key strategies and plans and are making initial progress to reduce peatland fires.
- Fire danger rating systems especially the Drought Code Index is a good predictor of peatland fire risk but is currently not widely used.
- Fire danger rating should preferably be used in conjunction with fire susceptibility or fire risk maps based on fire history, land use, drainage and other factors.
- Hotspot monitoring is an effective monitoring tool to help detect fires – but initial analysis indicates that peatland fires may be harder to detect by hotspot monitoring compared to dryland forest fires especially at the early stage.
- Although peatlands cover 25 million ha in the region – the fire prone peatlands cover less than 10% and are primarily those areas that have been opened up and drained especially areas that may not be under prudent management.

- Poor water management (i.e. over-drainage) combined with periods of low rainfall are key factors enhancing hazard and risk of peatland fires.
- Important measures for peatland fire prevention include enhanced water and peatland management, awareness raising, promotion of zero burning agriculture and law enforcement.
- For fire prevention measures - it is essential to involve a broad range of local stakeholders including government, local community and land owners or the private sector.
  - Fire prevention for peatlands is more cost effective than peatland fire suppression – but local agencies often face resource constraints; in addition proper incentive mechanisms are needed to encourage the participation of other stakeholders.
  - Capacity building related to prediction, monitoring and prevention of peatland fires should be enhanced and coordination and sharing of information and experience between agencies should be strengthened.

The workshop called for relevant agencies, the private sector, research institutions and CSOs in the ASEAN region to strengthen efforts to enhance prediction and prevention of peatland fires in an integrated manner.

The workshop identified proposals to:

- Expedite the establishment of an enhanced Peatland Fire Prediction and Warning System (PFPWS) by combining information on peatland distribution and fire risk with FDRS and hotspot monitoring.
- Improve the effectiveness of prediction through refining thresholds and indices for hot spot monitoring using FDRS and enhanced feedback between prediction and operation.
- Set up an effective outreach programme to disseminate fire danger alerts to fire prone peatlands through web, SMS and media.
- Establish a network of pilot sites in ASEAN countries (including APFP pilot sites) with fire prone peatlands for the testing of the PFPWS.
- Develop susceptibility and risk maps and fire prevention plans for all fire prone peatlands.
- Increase the availability of data for prediction of fires through both automatic and manual weather stations in fire prone peatlands (including APFP pilot sites) and remotely-sensed data sources.

- Require the active involvement of local community and private sector in fire prevention programmes including participation in fire patrols and fire control activities.
- Establish proper water management systems for agriculture and plantations in peatland areas to optimize production and avoid over-drainage and degradation.
- Strengthen conservation of remaining intact peatlands for their biodiversity, carbon and water resources and promote the integrated management of adjacent areas.
- Identify and rehabilitate degraded peatlands no longer under active use by improving water management and restoring vegetation or allocating for agricultural use.
- Establish, enhance or disseminate Standard Operating Procedures (SOPs) for peatland fire prevention to guide the work of government, private sector and communities.
- Strengthen enforcement while supporting resolution of land disputes and providing incentives for zero burning and sustainable livelihoods.

Case Study: APRIL's Fire Management Efforts for Protecting HTI Fiber Plantations
Bradford Sanders, APRIL Fire & Sustainability Head

APRIL is the leading developer of fiber plantations and manufacturer of pulp & paper in the region with 311,000 ha of fiber plantation in Riau, Sumatra since 1993 producing 0.75 million tons paper annually. APRIL is the first and only fiber plantation company in Indonesia to commit to and implement the Fire Management Guidelines of the UN-FAO Fire Management Actions Alliance on a voluntary basis. The fire prediction and prevention measures undertaken by APRIL's operation use the FDRS indices and hotspot maps generated by the ASMC. The FDR serves as a tool for fire managers to assess the day to day "fire-business" (preparedness) and empower the fire managers to make decisions which include: (i) when, where, how to conduct fire patrols, (ii) the number of fire-fighters on stand-by for initial attack, (iii) the equipment needed for the initial attack, and (iv) the equipment needed for constructing fire breaks. APRIL customized the FDRS to cater to the fire prevention in its plantations across Riau. The system has been found to be useful and effective so far. The implementation of a No Burn Policy is also part of the company's fuel management measures; this means that the company does not use fire for land preparation, but instead uses only mechanical methods (excavators) to clear the land. Specifically for plantations on peatlands, APRIL has introduced the 'Integrated & Science-Based Land, Water and Fire Management' which involves the delineation of conservation areas, and practices water management that minimizes fire susceptibility, and avoids CO_2 emissions. This also means that water level are set at different heights for different purposes such as 40-90cm for plantations, 20-40cm as the hydro buffers, and 0-20cm for conservation zones.

Source: Global Environment Centre (2010).

ASEAN Agreement on Transboundary Haze Pollution

In June 2002 the ASEAN Ministers for the Environment signed the ASEAN Agreement on Transboundary Haze Pollution. The agreement entered into force on 25 November 2003. Indonesia has not yet ratified the agreement. ASEAN Agreement on Transboundary Haze Pollution

The Coordination and Support Unit of the Regional Haze Action Plan (RHAP) is based at the ASEAN Secretariat in Jakarta. The ASEAN Haze Action Online website provides a number of documents that introduce the fire problem and provide information on political activities and policies that address the fire problem. http://www.haze-online.or.id

Guidelines for the implementation of the ASEAN policy on zero burning: www.peat-portal.net

Regional Southeast Asia Wildland Fire Network:-

http://www.fire.uni-freiburg.de/GlobalNetworks/SouthEastAsia/ASEAN-FireNet.html

At the beginning of the 21st Century the application of fire in land-use systems and wildfires in forests and other vegetation in the Southeast Asian region are still contributing to the degradation of the environment and the atmosphere, jeopardizing the sustainability of land-use systems, and threatening human populations, especially human health. Countries that are members of the Association of Southeast Asian Nations (ASEAN) and the international community have increased their efforts to reduce the occurrence and negative impacts of fires. In conjunction with the World Conference on Land and Forest Fire Hazards (Kuala Lumpur, Malaysia, 10-13 June 2002) and the 9th ASEAN Ministerial Meeting on Haze (11 June 2002) it was decided that the ASEAN countries, based on their long-term efforts and agreements to cooperate in the field of fire and smoke pollution management, join the global network of Regional Wildland Fire Networks under the auspices of the United Nations International Strategy for Disaster Reduction (ISDR) and the Global Fire Monitoring Center (GFMC).

There is also the International Peatland Fire Network under the Global Wildland Fire Network: http://www.fire.uni-freiburg.de/GlobalNetworks/PeatlandFireNetwork/peatland.html This is an initiative of the the Global Fire Monitoring Center (GFMC) and the Global Environment Centre (GEC), who are calling for cooperation to address the peatland fire problem at the international level. The Website of the International Peatland Fire Network aims to provide first-hand information on the cultural history of peatland fires, peatland fire problems in countries around the world, and related regional to global phenomena (atmospheric pollution).

The Fire Information for Resource Management System (FIRMS) integrates remote sensing and GIS technologies to deliver global MODIS hotspot/fire locations to natural resource managers and other stakeholders around the World. FIRMS is funded by NASA and builds on Web Fire Mapper, a web mapping interface that displays hotspots/fires detected by the MODIS Rapid Response System and delivers near real-time hotspot/fire information to international users and support fire managers around the World.

Fire Information for Resource Management System:
http://maps.geog.umd.edu/firms/

5.9 Communications, Education and Public Awareness (CEPA)

In order to ensure that the importance of peatlands as a global wetland biodiversity resource is fully understood, it is important to develop and implement environmental education, training and public awareness programmes focusing on peatlands at different levels.

Guidelines for Action

National or sub-national agencies responsible for environmental education should incorporate peatlands as an environmental theme in education programmes targeted at formal, continuing and outreach education, business and industry, as an important element of their implementation of the Ramsar Convention’s Communication, Education, Participation and Awareness Programme.

Teaching, learning and training resources on peatlands should be developed and promoted, which should explore the associated values of peatlands as well. The materials developed should include a broad base of understanding, experience and skills, with contributions from local communities, women and indigenous people, particularly in areas where peatlands form a significant component of the landscape and culture.

Programmes focusing on peatlands should be developed and promoted for professional and in-service training of wetland planners and managers, at both practitioner and trainer levels, including through the development of training modules in the Ramsar Wetland Training Service, once established.

People should be provided with information and educational materials that will enable them to make informed choices concerning lifestyle and consumer behaviour compatible with the wise use of peatlands.

Source: Ramsar Resolution VIII.17e - Guidelines for Global Action on Peatlands

The Ramsar Convention's Communication, Education, Participation and Awareness Programme (Resolution VIII.31) provides a comprehensive framework for the development and enhancement of wetlands education and public awareness through which peatland education and public awareness can be delivered. The Ramsar Convention's CEPA programme includes links to useful websites, national contact points, and email discussion forum, resource materials and other assistance. See: http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-63-69_4000_0_

The Ramsar Convention's *Guide to Participatory Action Planning and Techniques for Facilitating Groups* (Ramsar Convention Secretariat 2008) is also valuable for CEPA programmes.

The Convention on Biological Diversity also provides significant guidance on CEPA, with a dedicated support website maintained by IUCN: CBD / IUCN CEC ToolKit CEPA Website: http://www.cepatoolkit.org/ . See also Hesslink (2007).

Regional Information

The most up to date and specific guidance available is provided by the ASEAN Peatland Management Strategy Communication Plan (GEC, 2011), which has been prepared to guide the ASEAN Member States when planning communication, outreach and information-related activities to enhance the understanding of stakeholders on the issue of peatland management.

There are also a number of awareness and educational materials produced by GEC and other organizations available through the *Peat Portal*. These include:

- The *Peat Profile* booklet and video produced under the APFP project (Feb 2011)
- The brochure *Peatlands – Do you care?*
- The poster *Fiery Southeast Asia*

Wetlands International www.wetlands.org have an active communications programme on peatland management issues lobbying for policy improvements, and have produced awareness materials on peatlands at global, regional and national levels.

At the national level, government agencies, NGOs and other organizations including peatland projects such as the UNDP/GEF *Conservation and Sustainable Use of Tropical Peat Swamp Forests and Associated Wetland Ecosystems in Malaysia* have implemented CEPA programmes producing a variety of educational and awareness materials.

5.10 Research

In order to improve implementation of the wise use of peatlands, it is necessary for countries to review and ensure that they have in place the necessary institutional capacity. It is also necessary to provide peatland managers and those responsible for policy related to the wise use and exploitation of peatlands with improved access to information and training facilities, in order to enhance their capacity.

The Ramsar Wetland Training Service being established by Wetlands International will provide a mechanism for developing training in peatland management and wise use, so as to support the priority afforded to peatlands under the Convention as a globally threatened wetland type that is under-represented in the Ramsar List of Wetlands of International Importance.

Guidelines for Action

Networks for research and programme cooperation should be established, involving research institutes and other peatland scientific organizations so as to share knowledge and information and improve understanding of the biodiversity, ecological character, values, and functions of the world's peatlands.

Research institutes and other peatland scientific organizations should seek opportunities for the development of cooperative scientific and management studies to fill the identified gaps in the knowledge required to implement peatland wise use.

Opportunities should be sought for cooperative research to further elucidate the role of peatlands in mitigating the impacts of global climate change, in line with the gaps in knowledge identified by the comprehensive review of "*Wetlands and climate change: impacts and mitigation*" submitted to Ramsar COP8.

The creation of Regional Centres of Expertise in the wise use and management of peatlands should be promoted for training and the transfer of knowledge in order to assist developing countries and those with economies in transition to increase their capacity for implementation of wise use of peatlands.

Peatlands suitable for restoration and rehabilitation should be identified following the procedures outlined in the *Principles and guidelines on wetland restoration* adopted by Ramsar COP8 (Resolution VIII.16), and research and transfer of technologies for peatland management and the restoration and rehabilitation of appropriate peatlands should be facilitated, particularly for local community use in developing countries and countries with economies in transition.

National governments should encourage the establishment and activities of national and local organizations with expertise in peatland management.

Research into, and development of, appropriate sustainable alternatives to peat in, for example, horticultural use, should be encouraged.

Source: Ramsar Resolution VIII.17e - Guidelines for Global Action on Peatlands

The significant number of international workshops and conferences on the subject of peatlands in Southeast Asia have also identified areas where further research is needed (e.g. through the CARBOPEAT project, RESTORPEAT project, programmes coordinated by GEC, etc.)

Some key areas where research is needed in the Southeast Asian region include:

- Classification of peatland types within the Southeast Asian region
- Detailed mapping and documentation of peatlands of different types within the Southeast Asian region
- Regional harmonized framework and methodology for monitoring the condition of peatlands
- Assessment of biodiversity, with special attention to lesser known groups, and the distribution of species of global conservation importance (globally threatened and endemic species)
- Assessment of the impacts of various types of land use in peatland areas on peatland hydrology, ecology and ecosystem functions, including maintenance of biodiversity
- Development and improvement of land use techniques that have low impact on peatland hydrology, ecology and ecosystem functions, including maintenance of biodiversity
- Restoration and rehabilitation techniques including water management, re-establishment of natural vegetation and re-introduction of fauna
- Valuation of peat swamp forest ecosystem services
- Development of economic models for sustainable peat swamp forest management factoring in the values of their ecosystem services

5.11 Nature-based Tourism and Recreation

Global guidelines on nature-based tourism and recreation are available from a number of sources (see references section), including the CBD Guidelines on Biodiversity and Tourism Development (Secretariat of the Convention on Biological Diversity, 2004). In Southeast Asia, the ASEAN Centre for Biodiversity has produced some guidance on ecotourism (see references) and since 2006, Wild Asia has been promoting responsible tourism (see website section on responsible tourism at: http://www.wildasia.org/main.cfm/RT) through their *Responsible Tourism Awards*, sharing the best of these practices with their *Leaders in Destinations* scheme, offering guidance to tourism operators across Asia, and mapping exemplary tourism operators located around Asia.

Peat swamp forests have limited recognized value for tourism and recreation; due to a number of reasons (e.g. see James 1991):

- Remaining natural areas of peat swamp forests are usually remote from major population centres and tourist routes.
- Access is generally difficult owing to natural high water tables, flooding and the soft substrate.
- Areas which are more accessible due to mining, logging or agricultural uses are often degraded and lack natural or scenic values that would make them attractive to tourists.
- Viewing wildlife such as large mammals is generally difficult due to access difficulties, dense forest and low wildlife densities. Aquatic fauna is also difficult to view.
- Flora is diverse and specialised, but appeal to the general public is limited.
- Other sites and habitats can offer similar attractions with easier accessibility and less discomfort.

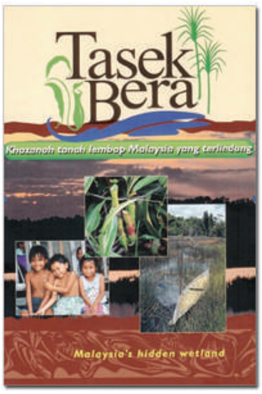
Despite these constraints, tourism has been developed at some peat swamp forest sites (especially protected areas with some management capacity), capitalizing on the adventure/exploration features of visiting relatively unknown areas, the cultural and traditional knowledge and livelihoods of local populations, the use of boat transport or boardwalks for access, recreational fishing, birdwatching, photography and nature education.

Tourism development has the potential to provide a sustainable livelihood option or at supplementary income for local communities living in peatland areas through providing opportunities for guiding, homestay and catering, land and boat transport, sale of handicrafts and forest produce, and cultural performances. Often some form of development assistance is needed to build capacity for the provision of such services through training programmes, provision of facilities and credit, and to provide market access and to promote the sites through tourism agencies.

Nature-based Tourism Development at Tasek Bera, Malaysia

Tasek Bera is located in the central lowlands of Peninsular Malaysia, in the state of Pahang. Designated as Malaysia's first Ramsar Site in 1994, a technical assistance project supported by the Government of Denmark (DANCED) and led by Wetlands International was implemented from 1996-1999 to develop the framework for integrated management of the area. Tourism development at the site was a major interest of the Pahang State Government, and the project supported a systematic approach including the preparation of a **Nature-based Tourism Development Strategy** (Scott Wilson (Malaysia), 1999). This included an analysis of the development context, a marketing plan including a marketable "identity" for the site (*the hidden wetland at the heart of Malaysia*) and promotional needs and targets. The development plan section addressed key themes, such as increasing accommodation for tourists, developing surrounding towns as "gateways" to the site, developing a range of on-site attractions and facilities, interpretive programme, creating opportunities for local people to provide services, and improving accessibility. The final section addressed implementation, prioritizing a list of costed proposals and identifying the relevant organizations responsible for each.

The project supported the development of a visitor centre complex, including interpretive displays featuring the landscapes, fauna and flora of the site as well as the indigenous *Semelai* culture. A small shop selling Semelai handicraft was included in the centre. Posters and information materials on the ecology and wildlife were developed, and some specific materials for visitors - a **visitor guide booklet** that provided bilingual information about the site's ecology, wildlife and culture, available visitor activities, map of the site's attractions, contact details for accommodation, directions and public transport, and information and services.



Two nature trails were designed around the visitor centre with bilingual interpretive leaflets that could be easily photocopied for use by visitors and school parties. One focused on lowland forest decomposition processes using marked positions along the trail while the second focused on Semelai traditional knowledge and uses of the forest, including some cultural sites.

The project also prepared and started implementation of a community development strategy for the Semelai at Tasek Bera. This included capacity building and organization of ecotourism activities, through the establishment of SABOT – the Semelai Organization for Boats and Tourism and agreeing its membership, objectives, rules and activities. Guidelines were developed including a code of ethics for tourists who were visiting Semelai villages, and for households providing homestay facilities. Facilities were prepared, including a traditional house to host visitors, a jungle camp in the swamp for overnight stays, and jungle trails. Training of Semelai guides was done first by a knowledgeable Semelai on their own territory, then through a professional ecotourism guide accreditation course. Some of the challenges involved communications – both in terms of language and equipment on site, sustaining the community-based organisation as circumstances changed over time, and integration of community-based approaches into government-led tourism development. This work was subsequently followed up by support from the UNDP/GEF Small Grants Programme, providing training and other support to ensure the sustainability of SABOT and community-based tourism at the site.

Further Reading: Please refer to References Section

5.12 International cooperation

Global Cooperation

At the global level, Ramsar Recommendation 6.1 encouraged further cooperation on wise use, sustainable development, and conservation of global peatlands, and Ramsar Recommendation 7.1 requested cooperation from Contracting Parties and other interested bodies to refine the "*Draft Global Action Plan for the Wise Use and Management of Peatlands*". These were followed by the more comprehensive **Guidelines for Global Action on Peatlands (GGAP)**, adopted as the Annex to Resolution VIII.17 by the 8th Conference of the Contracting Parties, Valencia, Spain, 2002. Taken together the guidelines provide:

a. a framework for national, regional and international initiatives to promote the development of strategies for peatland wise use, conservation, and management;

b. guidance on mechanisms to foster national, regional and international partnerships of government, the private sector, and non-government agencies to fund and implement actions in support of such strategies; and

c. approaches to facilitate adoption and support for implementation of global action on peatlands through the Ramsar Convention, the CBD, the UNFCCC, and other appropriate national, regional or international instruments.

These Guidelines note that in order to assist and coordinate between Contracting Parties, the bodies of the Convention, specialist peatland organizations and others in developing actions for their implementation, it will be necessary to establish communication and coordination mechanisms, and for these to review regularly progress and future priorities for global action on peatlands under the Convention and report these to the meetings of the Conference of the Parties.

See **Part 1, Section 4.1.2** for further information.

ASEAN Regional Cooperation on Peatlands

Institutional mechanisms for the sustainable management of peatlands in Southeast Asia have been well established through the ASEAN Peatland Management Initiative (see **Part 1, section 4.3** for details). In November 2006, the 10 member countries of the Association of Southeast Asian Nations (ASEAN) adopted the ASEAN Peatland Management Strategy 2006-2020 (APMS) to act as a framework to guide the sustainable management of tropical peatlands in Southeast Asia. In response to the APMS, the member countries are undertaking assessments of their peatland resources and/or developing national action plans on peatlands.

Transboundary Management

Effective approaches to peatland management problems can be developed in regions with shared management issues or transboundary problems related to peatland management. There is a need to develop mechanisms to harmonise or integrate approaches to the management of peatlands across regional or national boundaries or within river basins. The need for transboundary cooperation is needed where the peatland physically crosses the boundary, or where there are issues of common concern on peatland management that can be shared and discussed between neighbouring countries. There is also a need to explore the options for the transfer of resources between different stakeholder groups that play a role in the management of peatlands. For example, upstream pastoralists or farmers could moderate peatland management practices to benefit downstream users of the water supply. (Source: Parish *et al.,* 2008, Section 9.3).

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PART 2

The Peatland Biodiversity Management Toolbox

A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia

Module 2:

Reducing Environmental Impacts of Land Use on Peatland Biodiversity

Module 2: Guidelines for Reducing Environmental Impacts of Land Use on Peatland Biodiversity

6.1 Introduction

Commercial activities on peatlands lead to both obvious and initially invisible but incremental or cumulative impacts on peatland biodiversity. Peatland biodiversity is influenced by a wide range of economic sectors such as agriculture, forestry, industrial peat extraction, construction (water engineering, roads, industrial and civil), the oil and gas industries, harvesting of wild natural products, tourism and others. These activities can lead to both direct and indirect impacts, including conversion or degradation of natural habitats, changes in hydrological regime, as1 pollution, drying and changes in peat soils, fires, the introduction of invasive species and declines in productivity. Some impacts that have long-term effects on biodiversity may not become apparent for many years, and others may be difficult to identify due to our incomplete knowledge of ecosystem functions and values.

Peatlands have been used for a long time to harvest biological resources. The maintenance of peatland ecosystems in their natural state is the key condition for the availability of such peatland bio-resources. The harvesting of non-timber forest products in natural peatlands plays a significant role in livelihood strategies in Southeast Asia, including medicinal herbs, fruits, rattans, materials, firewood, fish and bush meat. Where exploitation pressure is not intense, these uses are sustainable and compatible with conservation. These traditional uses are often of importance to local communities but are rarely considered in development planning that looks only at commercial interests. The conversion of peat swamp forest for other land uses will usually involve the loss or severe degradation of these local uses. (Parish *et al*., 2008)

Most countries have environmental impact assessment (EIA) policies and legislation, which aim to reduce the negative impacts of development projects on the environment. However, such policies and legislation do not provide a guarantee of sustainable development processes, planning and implementation – even in the most developed countries. In developing countries, the challenges are greater due to limited capacity for effective implementation of such policies and legislation, and EIA is rarely practised following the ecosystem approach necessary for peatlands. There is also a need for strategic environmental assessment (SEA), which is commonly understood as being proactive and sustainability-driven, whilst EIA is often described as being largely reactive. SEA is referred to as “a family of tools that identifies and addresses the environmental consequences and stakeholder concerns in the development of policies, plans, programmes and other high level initiatives". In more specific terms, SEA is a tool to:

- Structure the public and government debate in the preparation of policies, plans and programmes;
- Feed this debate through a robust assessment of the environmental consequences and their interrelationships with social and economic aspects;
- Ensure that the results of assessment and debate are taken into account during decision making and implementation.

The precautionary approach should be applied in decision-making in cases of scientific uncertainty when there is a risk of significant harm to biodiversity. Higher risks and/or greater potential harm to biodiversity require greater reliability and certainty of information. The reverse implies that the precautionary approach should not be pursued to the extreme; in case of minimal risk, a greater level of uncertainty can be accepted. Guidelines for applying the precautionary principle to biodiversity conservation and natural resource management have been developed under the Precautionary Principle Project at: http://www.pprinciple.net/.

(Ramsar Convention Secretariat 2008)

Guidelines for integrated management of peatlands are given in **Section 1.1** above, and policies and planning should take a holistic view of the values, benefits and productive uses of peatlands to society, not only to individual sectors or business interests. Key principles for planning and management therefore need to be taken into account (for example, see Safford & Maltby 1998), as well as related policies relating to wetlands, biodiversity and national development.

6.2 Water Management in Peatland Areas (Cross-sectoral)

Improved water management is a critical step to support the sustainable management of peatlands. Water is probably the most fundamental component of a peatland, with most peatlands being approximately 90% water. The extent, nature and depth of the peat are frequently a function of water extent and depth. Drainage thus has one of the most important and long-lasting impacts on peatlands. Drainage of temperate and tropical peatlands which lowers the water table by 1m, leads to a CO_2 emission of between 30 and 100 tonnes of CO_2/ ha/ year respectively (Wosten 2006).

Drainage has greatly improved the ability to use peatlands for farming, plantations and other land uses, but it leads to loss and subsidence of peat soils. A balance between drainage and conservation is needed in order to protect peatland soils. Drainage can lead to significant subsidence of peat soils (depending on the drainage period and depth and temperature), as well as large amounts of CO_2 being lost to the atmosphere. Excessive drainage of peatlands can also cause the shrinkage or loss of wetland area, as well as the reduction of water levels in adjacent wetlands and mineral soils.

Drainage and gully erosion are major causes of peatland degradation and associated losses of carbon storage, biodiversity and ecosystem services around the world. Gully erosion occurs when vegetation cover is lost, for example due to inappropriate burning or overgrazing. The effects of gully formation and drainage are similar, though the problems associated with gully formation tend to be more severe.

By lowering the water table, drainage and gully formation increase the air-filled porosity of the peat, leading to shrinkage, cracking and subsidence, increasing decomposition rates and altering microbial processes. These changes have important implications for peatland hydrology, water quality and ecology. For example, aerobic decomposition in drained peat enhances the mineralization of nutrients, leading to significant losses of carbon, phosphorus, nitrogen and sulphur, which may affect soil fertility. Water flow paths through and over peatland soils are altered leading to a complex hydrological response (Holden *et al.,* 2004). This includes increased loss of particulate and dissolved organic carbon in stream water, and has implications for the carbon balance of drained or eroding peatlands. As outlined earlier, as the water table is lowered, peatland fires become more of a risk. This is a problem that can only get worse under projected climate change scenarios and is likely to further contribute to carbon losses in a possible positive feedback loop (Hogg *et al*., 1992). Thus, drainage and gully formation can lead to environmental problems of increased fire risk, increased incidence and severity of down-stream flooding, carbon loss, water colouration, changes in peatland ecology including reduced biodiversity, and the sedimentation of reservoirs and fish spawning beds. Careful management is therefore paramount in ensuring the adequate control of these practices.

Blocking drains and gullies in peatlands can stem carbon losses, and sequester and store carbon as channels re-vegetate. Blocking drains and gullies in peatlands can reduce subsidence and fires and hence stem carbon losses by sequestering and storing carbon as degraded peat and channels re-vegetate (Worrall *et al.,* 2003). Ditches and gullies are blocked to raise the water table to its former level and to re-wet the peat. If this does not lead to natural re-vegetation, reseeding or the planting of wetland species can be undertaken (Price 1997, Evans *et al*., 2005).

As peat subsides, the depth of the fertile topsoil also decreases and risk of flooding increases. This means that further drainage, cultivation and pasture renewal are needed to maintain productivity, therefore increasing the cost to land users. When managed properly, peat is a valuable and highly productive resource. To be able to cultivate crops on peat soils over the long term, users must find a balance between keeping the water table low enough for production, but high enough to minimise peat losses and CO_2 emissions. It is possible to use peatlands for agriculture without significant drainage by using appropriate crops such as sago palm, or yams in the tropics or by maintaining natural peatland sedges for hay production in temperate regions.

(Source: Parish *et al*., 2008)

Please see **Section 1.5** on integrated water management and **Section 3.2** on hydrological measures for peatland restoration (and the related reference sections) for further information and guidance.

6.2.1 Pollution Impacts

Air pollution and water contamination have the potential to change the geochemical regime of a peatland with consequent impacts on biodiversity. However, human impact is mostly caused by drainage, with pollution in second place**.** Peatlands are altered by air pollution from industrial and energy sources as well as by water contamination. Addition of nitrogen leads to subtle changes in the dynamics of species and changes in species composition. The effect of water pollution is generally limited to fens and minerotrophic swamp forests, because they depend at least partly on the inflow of water from elsewhere, whereas bogs and ombrotrophic swamp forests (e.g. on raised domes) solely depend on rainwater. Any discharge of nutrient-rich water into a river with valley fens downstream has a comparable effect.

Pollution by metal or toxic compounds can have dramatic effects on peatland ecology and its related biodiversity. Aquatic life (fish and invertebrates) are highly sensitive to pollution by toxic metals (including aluminium and copper) released from mining and extraction activities (see **Section 2.6**), as well as to agrochemicals (fertilizers, fungicides, herbicides and pesticides) that may be used in plantations or other agricultural areas. Severe pollution by saline water or oil can kill or physically destroy peatland vegetation. Surface pollution from roads and waste water from livestock farms and urban areas can also have serious effects on peatland biodiversity. Appropriate management is critical to maintain the water purification, flood control and water supply functions of peatlands. Although it is not ecologically appropriate for peatlands to be deliberately used for water purification in heavily-polluted areas, in some regions they may be found downstream of polluting operations and absorb some of the pollutants, improving water quality.

Source: Parish *et al*., 2008.

Land clearing for new plantations, re-planting of plantation crops and plantation operations can result in significant pollution inputs to inland wetlands. At Tasek Bera in Pahang state, Peninsular Malaysia, some 32,000 ha of the buffer zone around the lake and peat swamp system is under oil palm and rubber plantations, with significant impacts on the ecology and water quality of the wetland. The most important pollutants are sediments, nutrients and pesticides. Average soil erosion rates for oil palm in Malaysia are 200 t/ha/yr for newly cleared oil palm, 110t/ha/yr for immature oil palm and 20-30 t/ha/yr for mature oil palm (Economic Planning Unit, 1993). The impacts of soil erosion and sedimentation include: sediment smothers wetland habitats, reduced water storage capacity and related increased flood risk, introduction of nutrients and other chemical pollutants, aquatic insects and fish may be killed off.

The principal nutrients found in agricultural runoff are nitrates and phosphorus. Excessive quantities can lead to nutrient enrichment and eutrophication of water bodies, leading to algal blooms, plant death, de-oxygenation of water and fish kills. Plantation management requires the use of fertilizers, in the region of 1.8 t/ha/yr for oil palm. Pesticides can enter water in soluble form or attached to organic substrates, with negative impacts such as killing fish and wildlife, destroying natural habitats and accumulating in the food chain (O'Connor, 1999).

Karang Agung Scheme in South Sumatra, Indonesia

Roggieri (1995) pp194-198 provides a case study by L.P. van Lavieren on the development of the Karang Agung Scheme in South Sumatra, Indonesia, where monitoring and evaluation was conducted for the development of a transmigration site, where people were being resettled from overpopulated parts of the country. Officially, 300,000 ha of peat swamp were cleared in this province for resettlement from 1969-84. The Karang Agung scheme started in 1981 and involved 54,317 ha of land, including tidal swamps. A range of environmental impacts were reported, although not all of these related to peatlands. However, the following impacts are relevant and significant:

1. After removal of the forest, the exposed peat layers, if not kept permanently saturated, rapidly subside, oxidize and eventually disappear. This is particularly true when these layers are shallow, as in this case. The subsidence and disappearance of the peat modify the elevation of the terrain, reduce the capacity of the soil to store water and affect the hydrological balance of the area. Rainfall is no longer intercepted by vegetation and runoff can increase five to six-fold. Consequently, wet season agricultural production may be impaired by water-logging and flooding, whereas water shortages may occur during the dry season. Excess water could be drained, but the construction of an adequate drainage system in a flat tidal swamp requires major investment.

2. In places where the clay subsoil contains large quantities of pyrites, the drainage and disappearance of the peat layers enhance the formation of acid sulphate soils. This acidification process seriously hampers agricultural and fish production. It can be prevented by permanent flooding, which is impossible when agricultural production is the objective, or by continuous flushing, which requires large quantities of irrigation water and intensive drainage, and maintaining the water table at a sufficiently high level during the dry season. Common practices such as burning peat after forest clearance greatly increase the risk of acid sulphate soil development; therefore extension advice for smallholders is essential.

3. The salinity of the water may increase as a result of dry season saline intrusion, release of dissolved salts in drainage water from cultivated fields, and increased evaporation.

4. Forest clearing and canal construction give rise to an increase in the sediment load of rivers, especially where soft clay canal banks are involved.

5. Agricultural development on cleared forest lands can lead to enrichment of surface water through the release of organic and mineral residues in drainage water, in particular when fertilizers are used. When such enriched waters stagnate, aquatic weeds such as Water Hyacinth *Eichhornia crassipes* may rapidly proliferate and block canals, leading to dissolved oxygen depletion.

6. The peat soils proved marginally unsuitable for wet rice cultivation, marginally suitable for dryland crops and unsuitable for tree crops. Adverse soil conditions included low base saturation, high aluminium content, the presence at shallow depth of potential acid sulphate soil layers and very low potassium content.

6.3 Agriculture (excluding plantation crops)

In Southeast Asia, development of peatland for agriculture has been best documented in Indonesia, Malaysia and Thailand. Some areas with deep peat in Malaysia have been used with mixed success for agriculture for almost a century. However, the rapid increase in use of peatlands for agriculture in recent decades has occurred largely because the demand for agricultural land cannot be met by areas with more suitable soil capability. In the short term, agricultural productivity can be very high on drained peat, but this cannot be sustained because drainage causes the peat to rapidly degrade, the land to subside, and increasing water management challenges. The depth of the peat, underlying soil types and hydrological regime determine the agricultural potential of a peatland area. (Safford and Maltby, 1998)

An assessment of land use potential should take into account both the characteristics of the peat as a growing medium and the character of the peat swamp as a whole. In peat soils the improvement of drainage is usually the first step toward the creation of good growing conditions for crops. Artificial drainage, however, has several undesirable impacts, which affect the physical and economic feasibility of peat reclamation on a sustained basis. A proper evaluation of the suitability of peat for a particular crop under fixed conditions first requires judgment on which characteristics of the peat and the peatswamps should be taken into account. The nature and range of any limitations for a certain use can then be assessed. Because of the dramatic changes that take place with peat wastage, it is sensible to evaluate the potential use of the mineral soil beneath the organic materials taking into account the predicted environmental conditions after wastage. These can be markedly different from the original ones.

Andriesse (1988) provides detailed guidance on the potential of tropical peat soils for agricultural development. Before cropping commences the farmer has to make important decisions which profoundly affect the subsequent operational management. First he has to choose the crop; the operational requirements generally follow from this. Such operational requirements at farm level include:

i. Water management in relation to crop moisture requirements.

ii. Tillage and land preparation.

iii. Liming or acidity control.

iv. Fertilizer use.

v. Crop protection

Crop choice is dependent upon many factors of which suitability of soil is but one. For most farmers profitability is the over-ruling factor, but in the case of reclaimed peatswamps there are a number of factors which influence or limit the freedom of choice and which are beyond the control of the farmer. In large schemes, the depth to which the groundwater is maintained in the reclaimed area largely controls and limits the choice of crop.

Peat soils are remarkably versatile in their suitability for crop growth. They have few inherent qualities which limit growth, although they require intensive and often costly improvement to natural conditions to make cropping profitable. Profitability is again largely dictated by the local economy. Peat is a good stoneless rooting medium; it has large moisture retention capacity and hence transplanted crops establish themselves much faster than on mineral soils. Cultivations are easier than on mineral soil, even under exceptionally wet conditions. There are, however, also serious limitations to cropping:

i. Waterlogged conditions, requiring drainage.

ii. Very low chemical fertility, requiring large applications of fertilizers.

iii. High acidity, requiring liming.

iv. Low trafficability, preventing intensive mechanized farming.

Most of these limitations can be remedied but sometimes only with capital investment. In some localities improvements are economic but in others the necessary improvements are prohibitively costly. Although factors mentioned play an important role in crop choice, they are specific to a locality and should be studied and evaluated for each site. Cropping options relating to near-natural water conditions – avoiding extensive drainage – are discussed in **6.3.2 below**.

6.3.1 Environmental Impacts of Agricultural Development in Peatland Areas

In the late 1980s, 37,000 km^2 of Indonesian peat swamp forest were developed for agriculture, plantations and settlement (Silvius *et al*., 1987), leading to an 18% decrease in peat swamp forest area with a consequent reduction in the C-fixation capacity of 5-9 Mt/yr (Sorensen, 1993). Deforestation, drainage and conversion of peatland in Indonesia and Malaysia continued throughout the 1990s and are still continuing. The Mega Rice Project in Kalimantan was the largest of these peatland development schemes – see the box below (Muhamad and Rieley, 2002).

Conversion of natural peatlands for agriculture is one of the main root causes of the loss of peatland biodiversity and functions. In both the tropics and the temperate zone there is often strong agricultural pressure on lowland peatlands in particular, the alteration of which damages both terrestrial and aquatic biodiversity. In terms of the area of peatland affected, the most extensive impacts on natural peatlands have come from the drainage and utilisation of peatlands for agricultural purposes. Agricultural use generally involves the drainage of peat by 30cm-1.5m, and the replacement of the natural vegetation with crops such as vegetables, oil palm, maize or pineapples. The selection of species depends on the climatic and ecological situation and water levels (degree of drainage) as well as the macro-economic and agriculture commodity situation of the time.

Estimates of annual peat growth today vary between 0.5 and 1.0 mm and the subsidence rates of drained peat are of the order of 1.5-3.0 cm annually (Andriesse, 1988). As such, agricultural activities that involve peatland drainage will lead to the loss of peatlands and their associated functions, and cannot be classified as sustainable. Any agricultural practice that involves drainage of peatland will lead to loss of the peat layer through oxidation, compaction and erosion. In addition the natural processes which lead to peat formation stop so that no further growth of the peat layer takes place. As a result, drained peatlands will continually subside and eventually (providing drainage continues) the entire peat layer will be lost, exposing the underlying mineral soil.

Agricultural drainage in peatland areas is frequently badly designed and leads to peat degradation as well as reduced agricultural yields. In many places the agricultural drainage system may be too deep and have inadequate water management systems. This can lead to over-drainage of the peatlands. In Malaysia for example, most of the drains developed in peatland areas were based on the designs of drains in mineral soils. As a result, water levels were lowered too much and led to rapid subsidence. The peatlands of West Johor in Peninsular Malaysia were drained in the 1970s with funding and technical guidance from the World Bank. As a result of poor design and a lack of water management structures there was over-drainage and severe subsidence, leading to the collapse of most of the infrastructure, failure of the agricultural projects, flooding of coastal towns, acidification of water supply and other problems.

Source: Parish *et al*. (2008).

Environmental Impacts of the Mega Rice Project in Central Kalimantan, Indonesia

Many of the agricultural development schemes in Indonesian peatland areas have failed. The largest and most disastrous example is the Ex-Mega Rice area in Central Kalimantan, which started in 1996. The project did not succeed, and was eventually abandoned in 1999 after causing considerable damage to the environment. The project is an example of the failure of peatland ecosystem management and development that ignored scientific advice and sustainable management principles and rules. One million hectares of rain-fed peatland forest was felled and subjected to large-scale drainage in a scientifically unsound attempt to convert it to ricefields. The project, with the aim of growing one million hectares of rice, did not provide good results and had severe ecological impacts as a result of the deforestation and drainage it led to. A network of canals was built with a combined total length of 4,400 km and a depth in places of 10m. Thousands of people were moved to the area as part of a transmigration programme. The intention was to accelerate development, but it only transferred poverty from one location to another, with additional impacts such as poverty-driven illegal logging in areas that were not designated, or appropriate for conversion. Improved access allows small-scale cultivation and animal husbandry, leading to frequent fires that hamper the re-establishment of secondary natural vegetation on unused areas. Drainage of the peat has made the area extremely vulnerable to forest fires, resulting in massive carbon emissions (Hooijer *et al.*, 2006). In the El Niño year 1997 it contributed to roughly 2 million hectares of peat swamp forest going up in smoke. In addition to emissions from fires, more invisible subsidence and decomposition of the peat has occurred at a rapid rate releasing further emissions. The peatland destruction in the Ex-Mega Rice area had a major negative impact on the livelihoods of people in the area. It also caused major smog related health problems amongst half a million people, who suffered from respiratory problems. The smoke haze even affected neighbouring countries such as Singapore and Malaysia.

Clearfelled peatswamp forests often remain as wasteland

Photo: Marcel Silvius. Source: CKPP Consortium (2008)

6.3.2 Modification of Agricultural Practices

Agricultural production techniques that maintain or increase peatland carbon stores need to be developed and promoted. Agricultural or agro-forestry activities that do not involve the drainage of peatlands, that maintain natural water levels and that can maintain or increase the natural carbon stores should be developed or promoted, over and above those techniques that drain or lead to the loss of carbon storage (Parish *et al*., 2008).

The most successful agricultural methods used on peatlands are those that have been adapted, often by indigenous societies, to suit the swamp forest environment. Their success is due to careful site selection and complex farming systems, including the use of exchange labour, wage labour, unrestricted land tenure, and a learning system for new entrants. The possibility of adopting, adapting or developing these methods for wider application in sustainable agricultural systems needs to be explored. Small-scale agriculture can be one component of a multi-use sustainable management plan, but the crop and site need to be carefully chosen. Small scale cultivation of suitable crops may allow some of the functions of natural wetlands to be maintained, for example, conserving the organic matter in peat soils, avoiding acidity development in acid sulphate soils and limiting hydrological impacts. This is especially likely if cultivation is carried out in response to seasonal shallow flooding and as part of a landscape mosaic (Safford and Maltby, 1998).

Andriesse (1988) describes the following options for crop selection under natural drainage conditions, aiming towards finding suitable swamp-adapted plant species of economic value. The main crops suited to such conditions are:

Sago

Sago (*Metroxylon sagus*, a smooth variety, and *Metroxylon rumphii*, the thorny variety) is grown in the natural peatswamps of Sarawak and elsewhere in the Malay-Indonesian archipelago under wild and semi-wild conditions. For example the Mentawaians, a Protomalay group, the more numerous swamp forest people of West Papua (Indonesia) and other ethnic groups in Borneo, subsist on sago palm. With good organization, sago plantations can provide year round food supplies (Safford and Maltby, 1998). There is evidence that the crop could give reasonable returns, and organized production on a large scale could be lucrative. The produced starch can be used, as a food, by industry and as a raw material for the production of methanol. As a result of better vegetative dry matter production per day and a longer period of closed canopy, the sago palm is superior in potential to cassava and rice (Ahmed and Sim 1976). Research is being conducted in Sarawak into the suitability of Sago as a productive crop that can be combined with sustainable peatland management and rehabilitation (see UNIMAS 2006).

Raffia

The raffia palm (*Raphia* spp.) and papyrus (*Cyperus papyrus*), indigenous species in African peatswamps, can be grown commercially provided that local markets are available and the range of its industrial use can be widened.

Rice

Rice is probably the most swamp-adapted foodcrop. Wild rice (*Zizania aquatica* and *Zizania palustris*), of which a number of varieties are commercially grown in North America, even as far south as Florida, appears to offer good possibilities under the right climatic conditions in natural peatswamps. Wild rice needs some regulation of water-tables for optimum growing conditions although it thrives in waterlogged conditions. Aeration of the water is however essential and regular flooding with oxygenated water is beneficial. The optimum pH is between 7.5 and 8.0 which excludes most tropical peats unless they occur near a brackish water source in the fringe areas between mangroves and freshwater swamp forest. For a number of reasons the domesticated rice (*Oryza sativa*) requires very good water-table control and is therefore not suitable for peatswamps. It is discussed under the section dealing with conditions of shallow drainage.

Wetland taro

Another starch foodcrop, wetland taro (*Colocasia esculenta*, var. *aquatilis*) has many wetland cultivars. It is grown in and around the Pacific as well as in India and Africa in similar locations to wetland rice. Larger plantings require field levelling, puddling by ploughing, disking, harrowing and grading. It is also necessary to have constant water circulation to avoid footrot. Since many tropical peatswamps, particularly in their centres, have deoxygenized water, favourable conditions only occur near their edges where peat merges into mineral deposits. Nutritionally taro is a better choice of crop than rice, as the amino acid content is as high as in potatoes and the crop should be grown more widely in wetlands.

Miscellaneous crops

Water celery (*Oenanthe javanica*), water spinach (*Ipomoea aquatica*), and the Chinese water chestnut (*Eleocharis tuberosus*) when grown commercially, require some expertise and the vegetable crops are limited by location and marketability. Water chestnuts, like rice, are grown in fields covered with 5-10 cm depth of water. Tubers can be eaten in salads and soups, the juice has antibiotic uses and the sedge can be made into matting although it is not very durable. Most crops, including those mentioned above, require a plentiful supply of oxygen in the water, and relatively eutrophic conditions for good growth. The true tropical lowland peats of an oligotrophic nature are often not suitable and the best conditions are found in shallow peat and in those with an appreciable amount of mineral matter.

6.4 Plantations

6.4.1 Environmental Impacts of Plantation Development in Peatland Areas

Large areas of tropical peatlands in Southeast Asia have been converted for plantation crops during recent decades and the process continues today. This land conversion profoundly changes their natural ecosystem functions as reservoirs of biodiversity, carbon stores and hydrological buffers (see section on Agriculture above – the impacts are essentially the same depending on the level of drainage). The current deforestation rate of peatland in Indonesia is currently 2.2% per year, mainly as a consequence of conversion to oil palm and pulp tree plantations but also for resettlement schemes, such as the ex-Mega Rice Project in Kalimantan (Langner *et al*., 2007). In 2006, there were 121,000 km^2 of deforested peatland in Southeast Asia (about 50% of the total peatland area) and deforestation of peatlands amounted to 25% of all deforestation in Southeast Asia in the year 2005 (Hooijer *et al*., 2006). About 20% of the oil palm plantations in Southeast Asia (total 110,000 km^2) are on peatlands, but this figure masks a range that includes 25% for Indonesia and 6% for Malaysia (Singh, 2008). Source: Wosten *et al*. (2010). While a breakdown by soil and forest types is not provided, Broich *et al.,* 2011 determined that the total forest cover loss for Sumatera and Kalimantan 2000–2008 was 5.39 million ha, which represents 5.3% of the land area and 9.2% of the year 2000 forest cover of these two islands (Sumatra and Borneo). At least 6.5% of all mapped forest cover loss occurred in land allocation zones prohibiting clearing. An additional 13.6% of forest cover loss occurred where clearing is legally restricted.

Greenhouse Gas Emissions from Plantations

Peatlands constitute one of the world's greatest and most efficient carbon stores; containing more carbon than any other ecosystems combined. The continual conversion, degradation and drainage of tropical peatlands for palm oil plantations leads to a rapid decomposition of the organic carbon of peat, and contributes an equivalent to 8% of current global fossil fuel emissions. Peat swamps constitute one of the world's greatest carbon stores; containing a soil of up to 12 meters of organic carbon. The drainage of these peatlands to enable oil palm to grow leads to a rapid decomposition of the organic carbon of the peat. Every year, 10% of the drained soil is oxidized forming CO_2, causing emissions of up to 100 tonnes CO_2 per year per hectare. Peat swamps are among the last remaining areas in Indonesia and Malaysia that are still relatively uninhabited. For this reason, these areas are attractive to establish huge plantations.

History of RSPO and discussions on Greenhouse Gases

Understanding and managing emissions of greenhouse gases (GHGs) is an issue of global importance and the palm oil industry is no exception. Palm oil has been the focus of particular attention because of the potential emissions of GHGs from land-use change for new plantations, as well as emissions from existing plantations and processing and production facilities.

The RSPO Principles and Criteria include a general requirement to address GHG emissions (5.6), but there has been concern and some criticism, particularly from NGOs and consumers, about the lack of detailed requirements for managing and reducing GHG emissions.

In response to this concern, in November 2008, the RSPO Executive Board established a Greenhouse Gas Working Group (GHG WG1). The GHG WG1 was given the mandate to review all stages of the palm oil supply chain, with an emphasis on understanding GHG emissions from the development of new plantations which is widely considered to be the greatest source of GHG emissions. The expected outputs were a literature review and analysis of the dimensions of GHG emissions from the different stages in palm oil production and, based on this, recommendations for changes to the RSPO P&C together with guidance to RSPO members on best management practices for reducing GHG emissions from oil palm production.

The GHG WG1 agreed on many issues, specifically support for voluntary actions to reduce emissions. However, the GHG WG1 was not able to reach consensus on the dimensions of GHG emissions, particularly those related to the establishment of new plantations and land-use change. The GHG WG1 did, however, recommend that RSPO develop a framework for reducing GHG emissions, which takes into account all relevant sources of GHG emissions.

A draft document produced by RSPO was put out for public consultation: **GHG emissions from palm oil production: Literature review and proposals for amendments of RSPO Principles & Criteria. Draft for public consultation dated 10 July 2009.** A summary table of GHG emissions is provided in this draft document (see below). The draft text draws the following conclusion regarding the table: The above calculation clearly indicate that converting high biomass carbon stocks to oil palm plantation, i.e. forests and/or peatlands, causes by far the highest GHG emissions. This confirms the conclusion of most literature, e.g. Zah *et al.* (2007). who in a life cycle assessment of various biofuels (including palm biodiesel), concluded that '*…most of the environmental* *impacts of biofuels are caused by agricultural cultivation. In the case of tropical agriculture this is primarily the slash-and-burning of rainforests which sets great quantities of CO_2 free, causes air pollution and has severe impacts on biodiversity'.*

GHG emissions from palm oil production, including emissions from carbon stock changes (all emissions on a kg CO_2-eq/ha and kg CO_2-eq/tonne CPO basis).

GHG emission factor	**Emissions per ha** *(kgCO_2-eq/ha* annum)*	**Emissions per tonne CPO***(kg CO_2-eq/tonne CPO)*	**Note**
1.Operations			
1a. fossil fuel use transport & machinery	+180 to + 404	+45 to + 125	-
1b. fertilizer use	+1,500 to +2,000	+ 250 to + 470	-
1c. fuel of mill & utilization of mill by-products	0	0	-
1d. POME	+2,500 to +4,000	+ 625 to + 1,467	-
Total operations	*+4,180 to +6,225*	*+920 to + 2,007*	-
2.Emissions from carbon stock change			
2a. 25 year discounted GHG emission from conversion of grass land/forest	+1,700 to + 25,000	+425 to +7,813	Based on a carbon stock change of 11.5 – 171 tonnes C/ha, which is discounted over 25 years and expressed as CO_2
2b. Annual carbon sequestration by oil palms	- 7,660	-1,915 to -2,393	Henson [22]
2c. Emissions from oil palm on peat	+18,000 to + 73,000	+4,500 to +22,813	-
Total emissions related to carbon stock change	*+12,040 to +90,340*	*+3,010 to + 28,233*	-
Total	*+16,220 to 96,565*	*+3,930 to +30,240*	-

Note: a positive sign indicates a net GHG emission

The summary of conclusions from the literature review in this document states the following:

The literature review has identified major categories of GHG emissions from palm oil production, and –based on the variety of data available- indicated robust orders of magnitude for each category. A number of conclusions can be drawn:

- In plantation and mill operations, GHG emissions from POME* far exceed other GHG emissions, such as from fertilizer use and diesel use;

- Various proven technologies exist which can significantly reduce GHG emissions from POME, and consequently overall emissions from operations;
- If palm oil production is located on peat, continuous GHG emissions resulting from oxidation of peat far exceed those from operations;
- Development of new production areas at the expense of high above and/or underground carbon stocks, results in GHG emissions which takes many oil palm cycles to compensate through carbon sequestration in oil palms. These timeframes by far exceed the lifetime of an average (plantation) company;
- If new production areas are developed in areas which are not high in carbon stocks, palm oil production may lead to net carbon sequestration.

**Palm Oil Mill Effluent*

RSPO GHG WG2

The second greenhouse gas working group (GHG WG2) was convened at the end of 2009 to review the findings of the GHG-WG1 and to establish a process so that all RSPO members can reduce GHG emissions via a voluntary mechanism consistent with the existing RSPO P&C. The process will be based on a framework approach where emission reductions are to be measured against a reference case for operational corporate units and actions are to be taken on a voluntary basis subject with the intent of achieving continuous improvement over time. The GHG WG2 will also address issues of public policy and business strategies, in order to develop a process that will lead to meaningful and verifiable reductions in GHG emissions from the palm oil supply chain.

The GHG WG2 is composed of 11 members of the RSPO Executive Board (EB) and 20 non-RSPO EB members, with representation from each of the different membership sectors. The group is led by two co-chairs: Jeremy Goon (MPOA) and Tim Killeen (Conservation International), and is facilitated by Ruth Nussbaum (Proforest) and Pavithra Ramani (Proforest).

The GHG WG2 had its first meeting in February 2010 where the work of the group was agreed and organized into six Workstreams, each of which will contribute to the overall objectives of the group. The six different workstreams will focus on the following GHG components:

Workstream #1: Operational emissions

This workstream is producing a harmonized GHG calculating framework which RSPO members can use to measure, monitor and report GHGs within their operations. This framework will consist of boundaries, toolkits, definitions, default values, in addition to identifying voluntary actions on GHG management. The lead author of this workstream is Dr Cecile Bessou from CIRAD who is working with experts in this field from RSPO member organisations including producers, manufacturers and end users.

Workstream #2: Peatland working group (PLWG)

This workstream was set up in response to a motion agreed at RT7. It is focusing on emissions related to operational management of peat with objectives which include (1) to identify environmental and social impacts related to oil palm plantations on peat; (2) to identify best practices for managing oil palm plantations on peat soils; (3) to identify practical methodologies for assessing and monitoring carbon stocks and key GHG emissions from oil palm plantations on peat soils; (4) to evaluate options and constraints for the rehabilitation of degraded peatlands. The co-chairs of this workstream are Rosediana Suharto (IPOC) and Faizal Parish (Global Environmental Centre).

Workstream #3: Scientific panel

The scientific panel, consisting of leading scientists from several countries with expertise covering ecosystem ecology, forest science, soil science and geography, is undertaking a comprehensive review of existing information about land use and land use change and its impact on GHGs including identifying gaps and areas of uncertainty in the current body of information. This workstream will be responsible for several outputs, which include (1) an analysis of GHG fluxes under different land covers and management systems for mineral and peat soils; (2) synthesis of carbon stock of oil palm under different ages, variety, soil and management systems; (3) developing a practical tool for calculating carbon stock in oil palm trees in plantations. The lead author of this workstream is Dr Fahmuddin Agus (IAARD, GAPKI).

Workstream #4: Policy panel

The purpose of this panel of experts will be to focus on the legal, institutional and policy barriers to implementing strategies to reduce GHG emissions – particularly those related to land-use change. The GHG WG2 are in the process of finalizing the scope of policy issues that should be addressed by the panel.

Workstream #5: Emissions from other RSPO members

This workstream is focusing on the activities being undertaken by RSPO membership categories other than producers and processors, including groups such as financial institutions and NGOs to reduce and manage their emissions.

Workstream #6: Engagement with RSPO members

This workstream is collecting information on the voluntary actions which RSPO members are already planning or implementing to better understand and manage GHGs from production and processing. The data collected for this workstream will feed into workstream #1. This workstream hopes to capture information about best management practices that are currently being employed by producers and processors to address GHG emissions.

Timeline:

The GHG WG2 plans to complete its work within two years, providing a report on the first year at RSPO RT8 and presenting the final outputs at RSPO RT9.

RSPO and regulatory requirements on GHG emissions for biofuels

One of the many different uses of palm oil is as biodiesel. In some countries, particularly within the EU, there are specific legal requirements about GHG emissions from feedstocks used to manufacture biofuels. In order to meet these requirements, RSPO is in the process of developing a voluntary add-on which can be used in conjunction with the RSPO P&C by companies wishing to demonstrate compliance with the biofuels regulations.

Source: RSPO: http://www.rspo.org/

6.4.2 Modification of Plantation Practices

Oil Palm Plantations

The leading initiative in the development of environmentally sustainable and socially responsible practices in the oil palm plantation industry is the **Roundtable on Sustainable Palm Oil (RSPO)**, which has now certified 25,000 oil palm farmers. Please refer to the RSPO website www.rspo.org for progress updates, including reports of the RSPO Round Table meetings and newsletters. RSPO has established **Principles and Criteria for Sustainable Palm Oil Production** (RSPO, 2007). The Principles and Criteria are applicable to all palm oil growers and millers that are members of RSPO and cover a wide range of subjects of which some are of particular relevance, including points relating specifically to peatlands. Please see **Annex 4** for extracted material of particular relevance to peatlands (including TOR for the RSPO Peatland Working Group). These include:

Principle 4: Use of appropriate best practices by growers and millers

Including criteria concerning: control of erosion and soil degradation; maintenance of the quality and availability of surface and ground water; use of Integrated Pest Management (IPM) techniques to control pests, diseases, weeds and invasive introduced species; safe use of agrochemicals.

Principle 5: Environmental responsibility and conservation of natural resources and biodiversity

Including criteria concerning: environmental impacts of plantation and mill management; conservation of rare, threatened or endangered species and high conservation value habitats; responsible waste management; energy efficiency; best practice regarding restricted use of fire according to the ASEAN guidelines; reduction and monitoring of pollution and emissions, including greenhouse gases.

Principle 6: Responsible consideration of employees and of individuals and communities affected by growers and mills

Including criteria concerning: identification, monitoring and mitigation of social impacts; methods for communication and consultation with stakeholders; compensation system for loss of legal or customary rights; contributions to local sustainable development.

Principle 7: Responsible development of new plantings

Including criteria concerning: social and environmental impact assessment for establishing new plantings or operations, or expanding existing ones; soil surveys and topographic information are used in the establishment of new plantings; extensive planting on steep terrain, and/or on marginal and fragile soils [including peatlands], is avoided; no new plantings on local peoples' land without their free, prior and informed consent; compensation of local people for any agreed land acquisitions and relinquishment of rights; restricted use of fire according to the ASEAN guidelines; regular monitoring, review and continuous improvement in key operations.

Some of the above RSPO criteria make reference to national interpretations for indicators (e.g. High Conservation value (HCV) habitat definitions, fragile soil types). Such national definitions should take full account of available scientific information, as well as global best practice methods and standards (for example, the global toolkit and other resources on High Conservation Value Forest http://www.hcvnetwork.org/).

RSPO Resolution 6h: "HCV in non-primary forests was passed in November 2010. A RSPO position statement reiterating the value of all HCVs is posted on www.rspo.org.

Resource materials such as the Sustainable Palm Oil: Good Agricultural Practice Guidelines by Unilever are available through the RSPO website. http://www.rspo.org/?q=page/863

Other programmes offering support for sustainable oil palm production include the Stepwise Support Programme provided by Wild Asia and Proforest http://www.wildasia.org/main.cfm/SSP/About_SSP

This programme aims to provide support and guidance to RSPO member plantations to understand certification requirements, assess current performance, and implement action plans. The programme is designed for producers who want to achieve certification but may not have the in-house capacity to ensure that all the requirements are met. The Programme has been designed to:

(a) assist producers to achieve RSPO certification; and

(b) assist producers to demonstrate their commitment and progress to the rest of the supply chain.

Wild Asia also offers RSPO endorsed training modules, training on Biodiversity for Busy Managers, including online information resources, and an advisory service for sustainable plantation management.

Tree Plantations

Improvement of management measures for forest plantations on peatlands can reduce losses of biodiversity and GHG emissions while at the same time reducing risks for production. In Indonesia large-scale tree plantations have been developed in peatlands in Sumatra to supply pulp and paper mills, covering over 800,000 ha. The main tree planted is *Acacia crassicarpa* which is not an indigenous peat swamp forest species. The peatlands are thus drained to a depth of 0.8-1.5 metres to enable the trees to grow and minimize the chance of rotting of the root mass. Although the trees are relatively fast growing and achieve canopy closure in one year, they are harvested on a 4-5 year cycle which leads to regular clearance and opening up of the land. High levels of peat subsidence linked to drainage have led to significant management problems which are now being assessed.

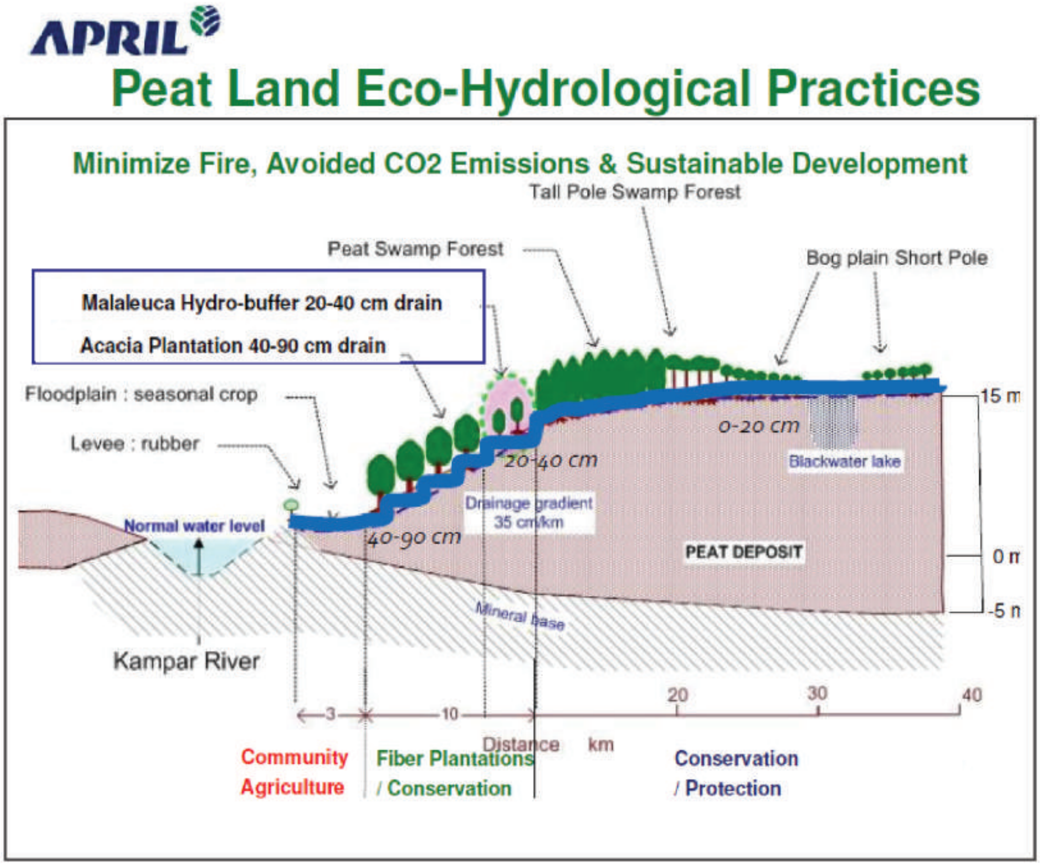
Management of Acacia Plantations on Peat in Riau, Sumatra Indonesia by APRIL

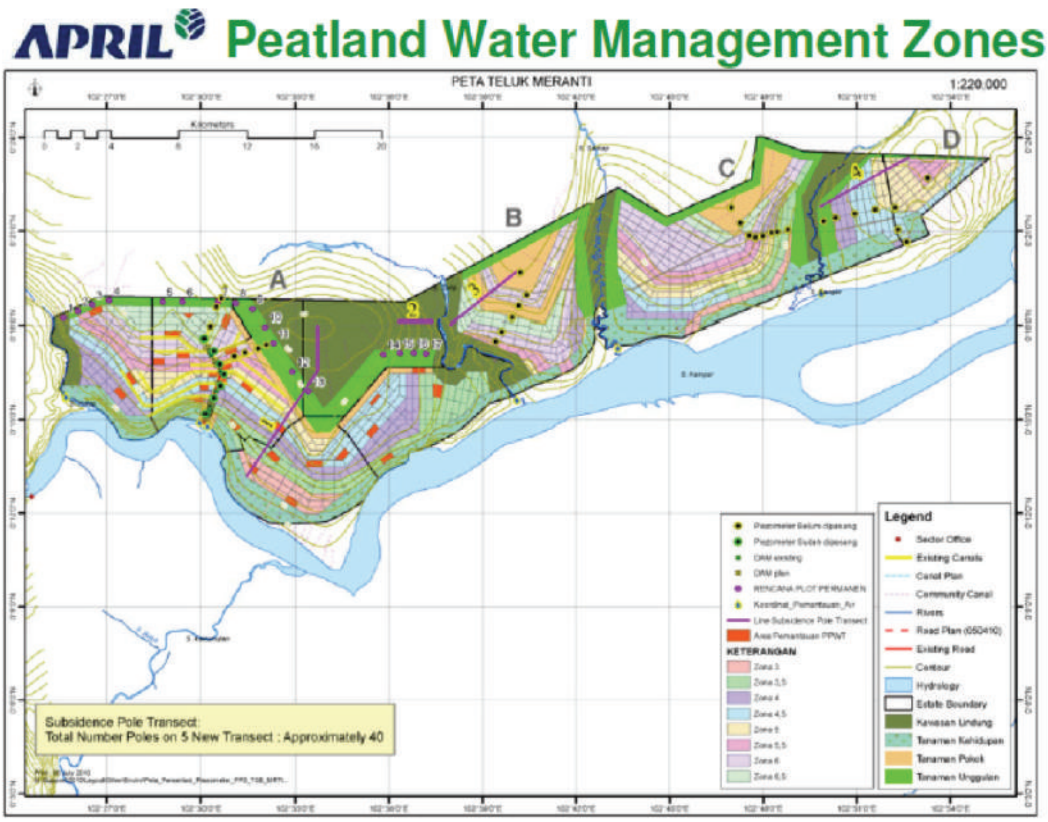
Peatlands in Indonesia have, over the last 20 years, been developed for large-scale Acacia plantations for pulp for paper production. Plantations covering hundreds of thousands of hectares have been developed in Riau and South Sumatra provinces, particularly by Riau Andalan Pulp and Paper (RAPP, APRIL) and Asian Pulp and Paper (APP, Sinar Mas, Indah Kiat). Plantations by APRIL were until recently quite deeply drained by 1-1.5m but recently the company has altered its water management strategies by raising water levels to decrease subsidence and greenhouse gas emissions from the peat. In some areas the plantations have been established in already deforested or heavily degraded peatlands, whereas in other areas they were developed in peat swamp forest areas. The company's management capacity could be used for monitoring as well as for fire control. (Parish *et al.*, 2008).

APRIL is a major developer of fiber plantations and a manufacturer of pulp & paper, based in Riau, Sumatra since 1993. It currently manages 311,000 ha of fiber plantation, producing 10.5 million tons wood/year, 2.65 million tons pulp/year and 0.75 million tons paper/year. APRIL managed land holdings totalled 900,596 ha in 2010, of which 50% was peatland. About 55% of the total area is plantable by regulation, 27% conservation area and 18% villages and infrastructure.

APRIL implements the FAO voluntary guidelines for fire management (FAO 2006) and has established a sophisticated and well-resourced fire prevention and management system for its plantation holdings. This has included a no-burn policy for land clearing since 1994 (only mechanized methods are used) fire prevention and rapid fire response. In 2010, about 56 fire incidents were recorded on APRIL managed land (82% due to land-clearing) of which 35 were peat fires (63%), burning 149 ha (132 ha peat, 89%). The average size fire was 2.7 ha and all fires were extinguished within 3-days of initial attack. About 93% of fires extinguished at less than 10 ha (4 large fires occurred); 68% of fires were extinguished at less than 1 ha.

Land and water management practices are employed to improve the sustainability of fibre production and to reduce fire occurrence, including water level management, hydrological buffer areas and conservation areas. APRIL claims that 70-90% of emissions are avoided by careful land use planning through these measures. Land and water management delineates conservation areas from developable areas based on peat topography (see the figures below). In the plantation areas, the water-level is managed to within 40-90cm of the surface to maintain peat moisture.





Source: Sanders (2010).

While the RSPO Principles and Criteria specifically concern the oil palm industry, the Forest Stewardship Council (FSC) have provided guidance regarding forest plantations http://www.old.fsc.org/plantations/ It notes the following:

Plantation management is a critical issue for the world's forests. Whether viewed as a sustainable fibre supply, a carbon sink, a means for taking pressure off native forests or a chemical-dependent tree farming method, plantations are controversial and often divisive. The Forest Stewardship Council provides a forum to bring these divergent perspectives together and strengthen the global standard for responsible management of plantations.

Plantations shall be planned and managed in accordance with FSC Principles 1-10 and their Criteria. Principle 10 notes that while plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

More than 7 million hectares of plantations and 30 million hectares of mixed forest have been certified to FSC standards. FSC recognizes that the implementation of the FSC Principles and Criteria for plantation management is open to a range of interpretations and can be controversial. FSC members have agreed that FSC's experience with plantations must be reviewed to further improve global management of plantations. FSC is reviewing the implementation of the FSC Principles and Criteria in plantations. As of January 2009, the status of review was as follows:

Two expert teams have made proposals for revisions of the **Principles and Criteria** based on the recommendations in the final report of the Policy Working Group of the Plantations Review (see resources section of the FSC website). Additionally, based on the Policy Working Group recommendations, the teams have developed an Outline for an Ecosystem Integrity Guidance and a draft Social Management Handbook. The proposed revisions of the Principles and Criteria will now be provided as input to the Review and Revision of the Principles and Criteria. The draft Social Management Handbook and Outline of and Ecosystem Integrity Guidance will need some more work before completion.

A third expert team has developed an Integrated Pest Management Guide which contributes to the implementation of the FSC Pesticides Policy and an Online Resource designed for companies to share strategies for reducing, removing or replacing highly hazardous pesticides. Draft versions of the guide and the online resource had been subject to field trials stakeholder consultation respectively.

A fourth expert team has completed analysis of conversion issues and the current cut-off date and possible alternatives to the current approach. The final report is now in the process of being completed. The report will also be provided as input to the Review and Revision of the Principles and Criteria.

6.5 Forestry (excluding plantations)

6.5.1 Environmental Impacts of Forestry Operations in Peatland Areas

Forestry has one of the largest impacts on peatland biodiversity. Biodiversity is influenced by logging in peat forests, by forest drainage aimed to enhance tree production and for establishing new plantations (see last section), by digging canals for timber transportation, and by other related activities.

Very often forest management hardly distinguishes between forest stands on mineral and peaty soils. However, forest on peat requires special management, not only from a technical point of view (e.g. for harvesting) but also because of the fragility of peatland ecosystems. Forestry on peatlands not only involves the felling of any native trees, but also drainage to improve productivity or for planting, digging of canals for transport etc., as well as the introduction of exotic/ alien tree species, often in monoculture. All these activities increase the general anthropogenic pressure on the peatland and increase the probability of catastrophic events like fire. They also involve the loss of habitats for birds, mammals, fish, insects, plants, fungi and microbes that were part of the native ecosystem but which cannot function under the new environmental conditions or form associations with the introduced tree species. The expansion onto peat swamp forests in the tropics of vast timber estates feeding enormous paper pulp mills has posed a major threat to their biodiversity – see last section (Whitten *et al.,* 2001).

Logging in forested peatlands affects the species composition of the tree stand. Partial or total removal of the trees can lead to changes in water level, insolation (a measure of solar radiation energy received on a given surface area in a given time), light regime and microclimate, with further effects on biodiversity. The process of tree harvesting especially using heavy machinery causes additional damage to biodiversity. Forests on peaty soils have often been harvested for timber. Peat swamp forests in the tropics are a principal source of high-quality wood. Logging affects tree species composition especially when selective felling is applied. Total or partial removal of trees reduces interception and increases the effective precipitation reaching the ground so that the water level may rise. The removal of trees also changes the insolation, light regime and microclimate. All these factors affect biodiversity. Impacts may vary depending on the natural characteristics of the site and the forestry methods applied. Clear-cutting of peat swamp forest usually leads to fundamental ecological changes with major losses of biodiversity. The use of modern mechanised forestry techniques can destroy ground vegetation, seriously alter peat soils and disturb animal populations. Even if forest re-generation begins afterwards, it can take a long time for the original vegetation to be restored.

During logging operations, peat swamp forests are fragmented by ditches used to transport harvested timber out to the nearest river or road. The resulting drainage changes the ecology of the peatland and paves the way for the penetration of various anthropogenic impacts to its internal reaches. This has both direct and indirect impacts on biodiversity. The vast tropical peat swamp forests of Southeast Asia have traditionally been used for logging. Excavated channels, which naturally fill with water, provide the easiest route for access and for transporting out the harvested timber. The small hand-dug channels that were made in previous decades generally had limited impact on the ecosystem, but modern techniques provide possibilities for the construction of large channels that penetrate further into the peatland and so extend the reach of a range of human impacts. For examples of the above impacts see DANCED (2003), Hooijer *et al*. (2006), Kumari (1997), Prentice (1990), and Prentice and Parish (1992).

Escalation of the intensity of both legal and illegal logging is promoted by policy initiatives which increase populations above the carrying capacity of the forest for traditional livelihoods and at the same time reduces the area of forest available through the allocation of large tracts to commercial enterprises. Thus, the selective felling of valuable and rare tree species is expanding, and because the water regime has been altered by the channels, the same species do not always replace the extracted trees. Moreover, peat fires occur more frequently and people begin to plough felled areas for agriculture. Thus, these peatland ecosystems are gradually losing their biodiversity value (Rieley *et al.,* 1994; Rieley & Page, 1997). Source: Parish *et al*. (2008).

6.5.2 Modification of Forestry Practices

Management or rehabilitation of natural forest on peatlands is an important management strategy. Peatlands in many regions of the world are naturally forested. They therefore need to be properly managed in order to provide sustainable economic benefits while at the same time maintaining their ecological functions and biodiversity values.

Clear felling, over extraction and high impact logging techniques in forested peatlands are a major cause of peatland degradation, leading to a loss of biodiversity and reduction in carbon storage. Clear felling and over extraction of trees in forested peatlands may lead to changes in the peatland water balance, as well as degradation and the loss of biodiversity. In tropical peat swamp forests, large-scale harvesting leads to the drying of surface peat layers and increases the chances of fire. In addition, the open conditions are often unsuitable for the growth of most peat swamp forest species, leading to the development of secondary forests dominated by a limited number of pioneer species. High impact log extraction techniques include the use of heavy excavators. These compact peat, and alter the drainage of peatlands prior to logging in order to facilitate access. Logs may also be extracted via drainage canals. Such logging techniques have been shown to significantly reduce the chances of natural regeneration, while the drainage leads to significant subsidence and enhanced fire risk (DANCED, 2003).

Forest resources from peatlands that are naturally forested can be sustainably harvested using low impact logging/extraction techniques. These techniques help maintain biodiversity and carbon storage. Resources can be sustainably harvested using low impact logging/ extraction techniques, while also maintaining biodiversity and carbon storage. For example, in Southeast Asia, peat swamp forest has been logged in many places using the so-called "kuda-kuda" system, where trees are hauled along skid tracks by manual labour or winched to railway lines placed on logs laying on the peat surface. The rail systems do not involve any drainage and so do not induce subsidence or other problems. Source: Parish *et al*. (2008).

A number of international projects and programmes have looked at sustainable forest management including peat swamp forests, producing guidance on methods and approaches (e.g. DANCED, 2003; Havmoller *et al.,* 1997), although few if any peat swamp forest areas under commercial timber production use are currently recognized to be under ecologically sustainable management. General guidance on sustainable forest management in relation to biodiversity conservation is available through the CBD Programme of Work on Forests (www.cbd.org) and guidance such as the good practice guide on sustainable forest management, biodiversity and livelihoods (Secretariat of the Convention on Biological Diversity, 2009).

Best practice in sustainable forest management can be promoted through the promotion and participation in certification schemes at national and global levels. Purbawiyatna and Simula (2008) review and assess progress in the comparability and equivalence of forest certification systems, in view of the proliferation of both certification schemes and the market requirements for such systems in the public and private sectors of tropical timber importing countries. They review five certification systems operating in tropical timber-producing countries. Among the points made is that current forestry standards have a tendency to treat ecological and social aspects of sustainable forest management independently despite the fact that these are interlinked. Also, they comment that certification standards should be viewed as evolving tools in an adaptive management system, the ultimate aim of which is sustainability. Regardless of the differences between individual standards, overall their achievement has had a positive impact on forest management. A number of recommendations are made for the different actors involved in certification schemes.

One of the most widely recognized global certification schemes is **the Forest Stewardship Council www.fsc.com** scheme. FSC is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests. Established in 1993 as a response to concerns over global deforestation, FSC is widely regarded as one of the most important initiatives of the last decade to promote responsible forest management worldwide.

FSC is a *certification system* that provides internationally recognized standard-setting, trademark assurance and *accreditation* services to companies, organizations, and communities interested in responsible forestry. The FSC label provides a credible link between responsible production and consumption of forest products, enabling consumers and businesses to make purchasing decisions that benefit people and the environment as well as providing ongoing business value. FSC is nationally represented in more than 50 countries around the world.

FSC's international standards provide the framework for the development of national standards throughout the FSC network to ensure consistency in all FSC national and regional standards. To ensure appropriate implementation of FSC Principles and Criteria at the local level, FSC accredits national, sub-national and regional standards. FSC's standard-setting process is transparent, democratic and inclusive with many opportunities for the interested public to participate. It is this process that has allowed FSC to become an important and recognized forum where innovative solutions have become possible with the equal support of environmental and social groups, as well as the corporate sector.

Periodic review of the standards allows FSC certification to remain effective, relevant and applicable in ever-changing market conditions, while still remaining true to FSC's core values. FSC is the only certification system in forestry recognized by the International Social and Environmental Accreditation and Labelling Alliance (ISEAL) to follow best-practice in standard setting – the international reference for setting credible voluntary social and environmental standards.

FSC has defined ten principles that describe how forests have to be managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations. FSC's standards are the highest social and environmental requirements in the forestry sector and they have been proven to work across continents, forest types, sizes and ownership. These are defined in the FSC International Standard: **FSC Principles and Criteria for Forest Stewardship FSC-STD-01-001 (Version 4-0)** available from the FSC website.

FSC Principles for Forest Stewardship

1. Compliance with laws and FSC principles
2. Tenure and use rights and responsibilities
3. Indigenous people's rights
4. Community relations and worker's rights
5. Multiple benefits from the forest
6. Assessment of environmental impact
7. Management planning
8. Monitoring and assessment of management impact
9. Maintenance of high conservation value forests
10. Responsible management of plantations

The Programme for the Endorsement of Forest Certification Schemes (PEFC) www.pefc.org PEFC is a framework for the assessment and endorsement of **national forest certification systems** that have been developed based on internationally recognised requirements for sustainable forest management. Since its launch in 1999, PEFC has become the largest forest certification umbrella organisation covering national systems from all over the world.

While the certification movement has its origins in efforts to protect tropical forests, over 90% of the world's certification today takes place in the temperate forests of Europe and North America according to PEFC. Yet tropical forests in the Southern hemisphere offer the most benefits to tackling some of society's biggest challenges, including climate change, combating deforestation and forest degradation, and maintaining the world's precious biodiversity.

Malaysian Timber Certification Council (MTCC) www.mtcc.com.my

The MTCC was established to develop and operate a voluntary national timber certification scheme, now known as the Malaysian Timber Certification Scheme (MTCS), in order to provide independent assessments of forest management practices to ensure sustainable forest management in Malaysia as well as to meet the market demand for certified timber products. Currently, nine Forest Management Units (FMUs) accounting for a total area of 4.84 million hectares of Permanent Reserved Forests (PRFs) in Malaysia are certified under the MTCS. 141 timber manufacturers and exporters have been awarded the chain-of-custody certificate which qualifies them to supply MTCS-certified timber products to the market. The Malaysian Timber Certification Scheme (MTCS) has become the first tropical timber certification scheme in the Asia Pacific region to be endorsed by the PEFC.

MTCC criteria, indicators and standards can be found at:
http://www.mtcc.com.my/documents.asp

Conservation of Globally Threatened Tree Species

Sustainable forest management should take into account the conservation of globally threatened tree species. These are included in the IUCN Red List of Threatened Species (www.redlist.org) and include a number of commercially important tree species that are largely restricted to peat swamp forests, including Shorea platycarpa, Dipterocarpus chartaceus and Hopea mengerawan (all Critically Endangered), Shorea albida (Endangered) and Gonystylus bancanus (Vulnerable). Conservation measures should include the establishment of protected areas of adequate size to maintain viable populations of such species, protection of these species in production forests, programmes for restocking and rehabilitation to enhance population recovery, and introduction of national legal measures to control trade in these species.

Further information on selected Southeast Asian tree species and international trade is presented in WCMC (2007): http://www.unep-wcmc.org/forest/timber/workshops/pdf/SEAsia_2007_V2.pdf

The sustainable management of the CITES – listed* Ramin *Gonystylus bancanus* has attracted particular attention and has been the subject of a research and monitoring programme in Sarawak (see van der Meer et al., 2005, FRIM undated).

*CITES SC54 Doc. 31.2 on Ramin in Malaysia
http://www.cites.org/eng/com/SC/54/E54-31-2.pdf

6.6 Mining and Peat Extraction

6.6.1 Environmental Impacts of Mining and Peat Extraction in Peatland Areas

Peat Extraction

The global area of peat extraction is not large, but peat extraction leads to total destruction of peatland biodiversity in the zone of extraction and often affects the biodiversity of the surroundings. Peat is extracted for different purposes using a variety of methods. When practiced at a commercial scale, this can eradicate entire peatlands along with their habitats and species, together with other goods and services. Moreover, by altering groundwater levels and microclimates, peat extraction can affect habitats on adjacent land. In temperate parts of the world where commercial peat extraction was a very dominant feature in the landscape (parts of Europe, North America and Central European Russia), peat mining activities can lead to serious loss of peatland and biodiversity at a regional level.

The long-term impact of peat extraction on biodiversity very much depends on landscape planning and the after-use options for ex-mining areas. From a biodiversity conservation point of view, it is preferable to avoid peat extraction but sometimes there is an overriding socio-economic justification for this industry. Moreover, as it may be driven from several economic sectors – e.g. horticulture, agriculture, energy, chemistry and so on – it is not always easy to identify and influence demand. In order to minimise detrimental impacts on biodiversity, it is necessary first to divert peat extraction away from the areas that are most valuable for biodiversity and to plan works to avoid landscape and habitat fragmentation. Secondly, areas from which peat has been excavated must be restored in such a manner that the maximum positive effects for biodiversity are achieved (see Section 3).

Use of peat as a substrate for horticulture is a significant source of peatland degradation and carbon emissions. This problem can be reduced through the careful selection of extraction sites and development of appropriate alternative growing media (such as coconut fibre). The extraction of peat for horticulture has led to significant impacts on conservation sites in some countries and has led to long-term conflicts. This has, in turn, stimulated consumer boycotts of horticultural peat in some countries. In response the peat industry has developed codes of practice which ensure that mining is focused on those sites with little conservation value, including abandoned agricultural land. In addition, in some countries the peat industry has actively developed post-mining restoration techniques. Development of alternatives to peat for use in horticulture, such as compost or coco-peat (from processed coconut husk fibres), is also underway.

In Southeast Asia, peat extraction may occur in association with other land-uses. At Batang Berjuntai (now Bestari Jaya) in Selangor, Malaysia, peat has been extracted industrially for horticultural use in association with a tin-mining concession area. The peat-mining takes place on land that has already been prepared for tin-mining, that is, it has been drained and the forest cleared. Thin surface layers of peat (c.2.5cm) are removed by successive vacuum pump harvests. The peat is then milled and bagged up. The mining of peat on a much larger scale for energy production has been proposed in Southeast Asia, and this would have significant environmental impacts if implemented, including large scale habitat destruction and biodiversity loss, and significant GHG emissions. It should be noted that peat is not a renewable energy resource, as estimates of annual peat growth today vary between 0.5 and 1.0 mm (Andriesse, 1988).

Tin-mining

Tin-mining was a significant contributor to the Malaysian economy for a large part of the 20th Century, some of which took place in peatswamp areas (for example in parts of Perak and Selangor states on the west coast of Peninsular Malaysia). Mining in peat areas was generally conducted using huge dredging machines (one can be seen at the Paya Indah Wetland Sanctuary in Selangor).

The main problems caused by tin-mining are the destruction of natural habitats and formation of wasteland, as well as damage to natural drainage and water pollution. The main source of pollution occurs when tailings from tin mines or water from the mines enters a river.

A 10,000 ha tin-mining concession at Batang Berjuntai in Selangor encroaches significantly on the North Selangor peat swamp forest, involving three companies. The mining activities experienced some operational problems with local flooding from adjacent reclaimed peatswamp land, which is expensive to alleviate through drainage works. This was an indication of the need for integrated water management for this peat swamp (Prentice, 1990).

Appropriate management is critical to maintain the water purification, flood control and water supply functions of peatlands. Although it is not ecologically appropriate for peatlands to be deliberately used for water purification in heavily-polluted areas, in some regions they may be found downstream of polluting operations. As a result, they play an important role in the removal of pollutants from streams. For example in the river systems of South Africa's highveld, peatlands downstream of industries and mines are important for filtering out and temporarily storing pollutants such as uranium from gold mining operations. As a result, subsequent degradation of peatlands or extraction of peat for use in horticulture may lead to significant pollution (Wyatt 2006). Source: Parish *et al*., (2008).

6.6.2 Modification of Mining and Peat Extraction Practices

Ramsar Resolution X.26 on Wetlands and Extractive Industries provides guidance on such activities affecting wetland areas, including attention to environmental impact assessment and strategic environmental impact assessment procedures, valuation of wetland resources at an early stage of such procedures, to fully consider upstream and downstream impacts, to raise awareness of the wise use of wetlands for those involved in this sector, review of regulatory and permitting procedures in order to control or mitigate environmental impacts, consideration of alternative sites, compensation for environmental damage, collect baseline inventory information on the related wetland resources, engage with stakeholders, and other actions.

Andriesse (1988) provides information on the environmental impacts of developing tropical peat soils and also includes a section on approaches to peat extraction. As stated above, peat extraction is not considered to be a sustainable use of the resource and is not a form of renewable energy.

Impacts of mining operations can be mitigated through appropriate legislation which requires mining companies to carry out restoration work after they have mined a parcel of land. Discharge of waste from mines into rivers should be controlled to prevent pollution impacts. Due to the presence of metals in the soil, there may be food safety issues in using ex-tin mining land for agricultural purposes. However, the large pools that result from mining can be effectively landscaped for urban development, recreational use or rehabilitated for nature conservation purposes (for example at Paya Indah Wetland Sanctuary in Selangor, Malaysia).

6.7 Infrastructure, Industrial and Urban Development

6.7.1 Environmental Impacts of Infrastructure, Industrial and Urban Development in Peatland Areas

Industrial and civil construction lead to total transformation of the peatland areas, losses of significant peatland biodiversity and the transformation of biodiversity of adjacent areas .Peatlands are traditionally regarded as areas with very low land values, because no account is taken of the ecosystem services that they provide, including their biodiversity capacity. Many peatlands have been destroyed by industrial and civil construction, especially in highly populated areas. Peatlands are often the last unused areas close to population centres, and so become the obvious locations for vast new constructions such as airports. Fens and swamps occupying flat, moist lowlands that have previously been unsuitable for building are the peatland types that are most frequently altered in this way.

In peatland areas, the construction of roads and other linear constructions like oil and gas pipelines and canals affects biodiversity through landscape fragmentation and changes to the water regime along their routes. The linear form causes the fragmentation of landscapes and habitats isolating populations of plants and animals such as amphibians and reptiles which are unable to cross the obstacle.

Linear constructions can significantly alter the hydrology of the peatland itself and of adjacent areas, by, for example, causing ponding of water upslope and unnatural water deficit downslope, which in turn leads to vegetation changes. Movements of fish and other aquatic fauna may be blocked. Further consequences for biodiversity may arise depending on the peatland type. One common example is the death of trees as a result of waterlogging on the upslope side of a road. This can lead to secondary effects such as infestations of insects that attack adjacent forest stands.

6.7.2 Modification of Infrastructure, Industrial and Urban Development in Peatland Areas

The considerations are similar to those listed for mining and extractive industries (see section 6.6.2 above). In addition, the physical difficulties of undertaking construction in peatland areas needs to be fully taken into account during development planning – peat soils are unstable and are liable to shrinkage following drainage, which has been the cause of numerous failed construction projects in the past. By their nature, peatland areas are also prone to flooding, therefore the construction of industrial and urban developments in such areas is subject to such risks. In general, peatland areas are not suitable for such types of development and alternative sites on more stable mineral soils should be found where possible.

6.8 Water Engineering Projects

6.8.1 Environmental Impacts of Water Engineering Projects

Many water reservoirs now cover peatlands that occupied lower-lying positions in landscape. Inundation leads to the disappearance of peatland types, the formation of new ecosystems and shifts in biodiversity. Land flooding by dam construction also has a long-term indirect impact on peatlands by shifting land use and pressure to peatland areas. The construction of dams to form reservoirs has several consequences for peatland biodiversity. This activity most often eradicates valley peatlands, which are valuable because they support characteristic vegetation and species, provide habitat for waterfowl, and are used as migration corridors by birds and other animals. On the other hand, the filling of reservoirs causes the water table to rise around the new shoreline, where ecosystems and biodiversity also change as a consequence. (Source: GAP) The formation of new wetland areas around shallow flooded margins of reservoirs is possible, although fluctuations in water levels are likely to constrain this.

As mentioned for mining and infrastructure projects, a wide range of issues related to the environmental impacts of water engineering projects need to be taken into account. These especially concern the impacts of such construction on water levels in the peat swamp, on natural fluctuations in water levels (for instance by upstream river regulation), and the water quality of impounded areas. In addition, fish communities usually include species that move between the peat swamp and adjacent rivers as part of their life cycle, which can be interrupted by water engineering projects.

6.8.2 Modification of Water Engineering Projects

See **Sections 1.5 and 2.2** for principles and guidance on integrated water resource management approaches.

Substantial guidance is given on the assessment of impacts from water engineering projects on wetlands and the minimisation of impacts in the Ramsar Convention's series of handbooks on the wise use of wetlands (see references).

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PART 2

The Peatland Biodiversity Management Toolbox

A Handbook for the Conservation and Management of Peatland Biodiversity in Southeast Asia

Module 3:

Peatland Rehabilitation and Restoration

Module 3: Peatland Rehabilitation and Restoration

Peatland rehabilitation and restoration are important management options for the significant areas of peatlands in Southeast Asia that have been damaged through drainage, fire, failed agricultural schemes and other developments, as well as for post-mining land uses. Rehabilitation can be defined as the process of returning to a previous or alternative condition, while restoration is returning to an original state. Over time, the rehabilitation of ecosystem processes can lead to the restoration of ecosystem structure and composition (Page & Graham, 2008).

Peatland restoration is a much more expensive and technically challenging management option than preserving peatlands in their original natural condition, and it would be unrealistic to assume that restoration can always be successful, depending on the degree of degradation and constraints for restoration. However, it should be considered where peatland areas have been degraded and are currently not in viable productive use or providing an optimum level of ecosystem services.

Rehabilitation and restoration measures provide the opportunity to restore at least some ecosystem functions of the original undisturbed peatland, especially in relation to hydrological functions. If water tables are restored to near pre-development levels, the continued release of greenhouse gas emissions related to oxidation of drained peat layers can be mitigated and conditions re-established for the possible regeneration or reintroduction of native peatland flora and fauna.

Before any restoration project is started, there are some key questions:

- What are the restoration goals?
- What benefits will be provided to local communities?
- What are the ecological and social constraints?
- What are the key ecosystem elements and functions to be restored?
- Will the restored ecosystem be sustainable?
- What are the financial constraints?
- What administrative and legislative instruments are available to promote restoration?

(After Page & Graham, 2008)

An extensive literature exists on the broader subject of wetland (c.f. peatland) restoration, and many of the principles of designing restoration projects are similar to those of wetland management planning. Some sources of information on wetland restoration are given at the end of this section.

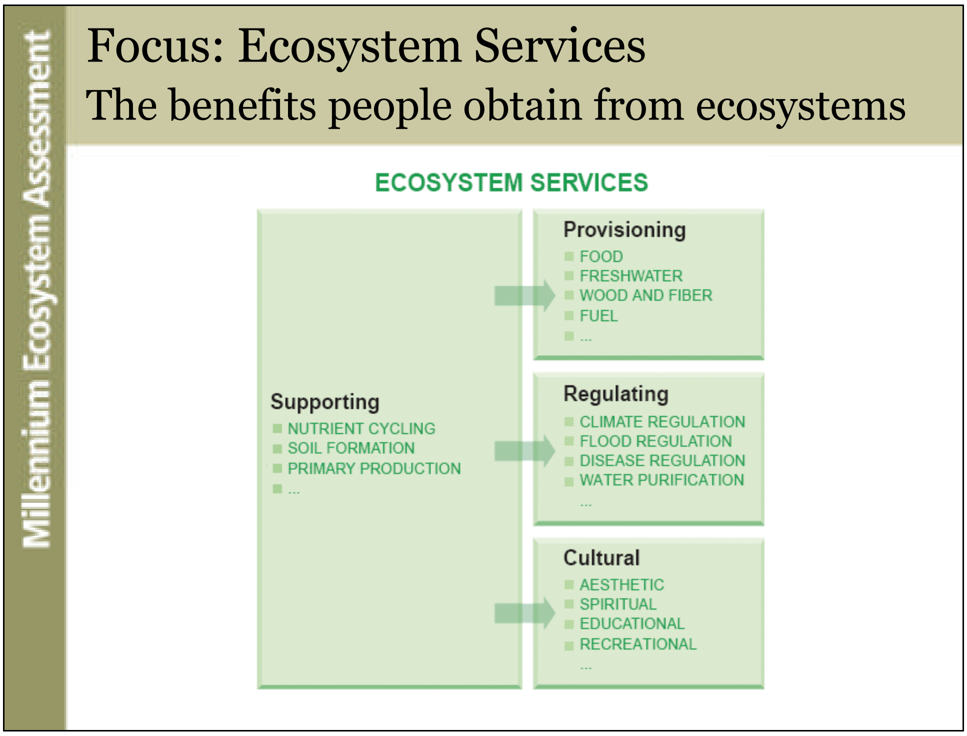
Experience of peatland restoration *per se* is more limited, and much of this experience comes from temperate peatlands in Europe and North America, especially relating to the rehabilitation of sites where peat extraction has taken place. While these temperate peat bogs are different in many ways from tropical peat swamp forests, there are similarities – especially in the fundamental importance of restoring hydrological conditions across the site. Peatland restoration research and practice has been gaining momentum in Southeast Asia during the last decade or so, including international assistance through the EU supported RESTORPEAT PROJECT and other initiatives (see http://www.restorpeat.alterra.wur.nl/p_download.htm). Guides to peatland restoration at global and regional levels are also given at the end of this section.

At the outset, it should be emphasized that an integrated approach is necessary, involving the wide range of stakeholders with interests in the many issues related to peatland management. Also the approach should be participatory, providing opportunities for the involvement of local communities and other stakeholders in the planning and implementation of restoration, and including consideration of benefits to local communities as a means towards long term sustainability.

7.1 Objectives of Peatland Restoration

The objectives of any peatland restoration project must be clearly defined as a basis for monitoring success. These include whether the project aims to restore the original peat swamp forest ecosystem, or an alternative state; whether to focus on selected ecosystem functions or to reinstate the whole ecosystem; and what land uses and economic benefits are desirable to meet local community or wider socio-economic needs? A consultative process is needed to involve the related stakeholders in deciding on the objectives and in determining roles in the process.

Ecosystem services can be categorized as follows:



Source: Millennium Ecosystem Assessment *www.maweb.org*

While restoration may attempt to restore all ecosystem services back to a peatland area (depending on its present condition), working towards specific objectives provides a more systematic and measurable approach, considering for example:

- Restoring hydrological functions
- Mitigating emissions of greenhouse gases
- Biodiversity conservation (or specific components such as increased tree cover, reintroduction of rare species, etc.)

- Productive uses such as agriculture, forestry and use of non-timber forest products
- Poverty alleviation and sustainable livelihoods for local communities

The restoration objectives and design need to take into account ecological, social and economic constraints. These will vary substantially between sites and need to be assessed on a case-by-case basis. Some of the ecological constraints include:

- Impaired hydrology, increasing risks of flooding and drought
- Loss of forest canopy and change in microclimate
- Loss of seed sources, seed dispersers and pollinators
- Loss of faunal re-colonization sources
- Changes in soil physical and chemical properties
- Changes in ecosystem nutrient dynamics
- Increased risk of fire
- Longer term sustainability issues related to predicted climate change impacts

Social constraints can also be significant, including:

- Lack of understanding and support
- Lack of technical capacity to implement restoration
- Conflicting stakeholder views
- Continued unsustainable land use practices (e.g. drainage, logging, fire)
- Focus on short term benefits versus long term restoration goals

(After Page & Graham 2008)

Economic constraints may include limited available funding to support restoration efforts, although the involvement of stakeholder agencies in discussions can open up opportunities related to national or regional development efforts, and technical inputs can be supported through involvement of NGOs, research institutions and/or international donors.

Finally, issues related to land tenure, traditional rights for natural resource use, government policies and development priorities, and international initiatives and opportunities related to the environment and development need to be considered during the planning of restoration projects.

Overall, a sound scientific/ technical understanding of the site's conditions is important as a basis for restoration, coupled with a strong social and economic basis with the support of key stakeholder groups. A progressively implemented approach involving small steps and the opportunity for learning and adaptation at each step is likely to yield the most sustainable results over time.

7.2 Restoring Hydrological Conditions

As described in **Module 1 (Section 5.5) and Module 2 (Section 6.2)** of these guidelines, peatlands need to be managed at the level of catchment areas (large hydrological units) through the "ecosystem approach". There is little point in attempting to restore one section of a large peatland area if you are unable to control the hydrological conditions across the whole area. As peatland hydrology is a primary factor underlying other ecological components (e.g. peatland vegetation is generally sensitive to hydrological conditions), this affects many different restoration objectives and therefore the hydrological restoration needs to come first.

Most forms of human economic activity in peatlands affect the hydrology, such as canals for extracting logs, drainage for agricultural schemes and plantations, installation of infrastructure such as roads and bridges, flood control dykes and water release structures. Therefore peatland restoration efforts need to be tackled through a holistic approach and included in regional development plans.

Dommain *et al*. (2010) review the self-regulating hydrological conditions in domed peat swamps in Southeast Asia, and the challenges these pose for conservation and restoration. They emphasise that restoration should recognize the inter-dependence of plants, water and peat in peatlands. The plants determine the surface hydrology and the hydraulic properties of the peat that is formed. Water levels determine which plants will grow, whether peat will be accumulated and stored, and how strongly decomposed it will be. The plant cover and peat structure determine how the water will flow and how the water level will fluctuate. These close interrelations imply that when any one of these components is degraded, the others will also deteriorate. Not necessarily all at once, but inevitably in the longer term.

They recommend that when vegetation and hydrology are severely altered, up-to-date three-dimensional models with small contour interval should assess whether a hydrologically viable shape is still present in domed peatswamps, if this will spontaneously re-develop (e.g. by decomposition of dry protuberances), or can easily be restored. Based on such models and on data on local climate and hydraulic conductivity, surface flow paths with their specific discharge rates have to be identified in order to place dams in the most effective way (Edom *et al*., 2007). With respect to dam placement it is important to think in terms of coherent systems rather than of single dams.

One should keep in mind that enormous volumes of water *have* to leave the dome, even in pristine peat swamp forest. It is thus senseless to make dams fully impermeable and to dam up as much water as possible.

Restoration measures should be designed to allow the surplus water to leave the dome without causing damage (Ritzema & Wösten 2006), while retaining a sufficient store for drier periods. Canal blocks should force the water to spread out over the surface of the peatland to re-wet as wide an area as possible. This approach will often mean that a dense network of cascading dams with small head differences must be constructed (Ritzema & Wösten 2006; Edom *et al.,* 2007). To disperse the water, damming should proceed starting from the centre of the dome. By spreading the water over the largest possible area, flow velocity and erosive power are reduced, flood-tolerant plants (e.g. *Pandanus* spp., *Combretocarpus rotundatus*) can re-establish more easily in the channels (self-recovery by terrestrialisation), and pressure on downstream dams decreases (Edom *et al., 2*007).

Much of the restoration experience to date has focused on the construction of dams across ditches and canals in peatland areas in order to raise water levels to a near natural condition. This is technically challenging, as peatlands are difficult terrain for the construction of infrastructure, therefore it is necessary to choose methods that are appropriate for the area using local materials such as wooden planks and clay. Some of the best experience to date is in Central Kalimantan (see Roh 2003; Suryadiputra *et al*., 2005, Central Kalimantan Peatlands Project Consortium 2008, Limin *et al*., 2008 and Ritzema *et al*., 2008). These references provide information on techniques for dam construction and other aspects of peatland restoration.

Community involvement during the planning, implementation and maintenance of dams is recommended as a key measure for sustainability. Changes in water levels will directly affect local communities, therefore they need to be consulted. Dam construction and maintenance can provide local employment, and related development benefits such as improved fishing opportunities and water supply can contribute to local livelihoods.

Another key point is that re-greening of barren peatlands is necessary to allow the hydrology to recover, by providing shade and maintaining soil moisture, thus preventing the soil surface from drying out.

Recommendations for Dam Construction

Source: Wosten, Ritzema & Rieley (2010).

- It is recommended that dam construction starts in the relatively small drainage canals in the upper-catchment area and progresses towards the bigger canals further downstream. In this way, pressure is gradually taken off the system, which reduces the risk of failure of larger and more expensive dams in the downstream area in period of peak water discharge.

- It is recommended that relatively simple dams are built in the small drainage canals in the upper-catchment area and bigger, more expensive dams are constructed in the downstream area.

- Simple dams constructed from locally-available materials (timber and peat) prove to be effective in maintaining high water tables. An additional benefit of using light timber and peat material is that expensive foundations are not required.

- The distance between adjacent dams depends on the gradient of the peat dome, which in the central part is often less than 0.5m/km, increasing to more than 2m/km near the edges. Consequently the distance between dams in the central part of the dome can be as far as 1-2km, whereas this must be less towards the edges.

- As dams restrict water flow rather than stop all water movement they do not have to be watertight and thus construction can be relatively simple.

- Under optimal water management, it is impossible to maintain high water levels in the dry season, because even in natural forest, water levels can drop as low as 1m below the peat surface under drought conditions.

- Computer simulations show that a cascade of closely-spaced dams is most effective for water control.

- The differences in water levels over each dam should be limited to about 50cm to reduce seepage and to prevent erosion.

- Dams have to be adapted to the characteristic high hydraulic conductivity (high water flow) and low load bearing capacity (structurally weak) of tropical peat.

Use of Dams to Restore Peatlands in the Mega Rice Project area of Central Kalimantan

Source: Ritzema and Limin (2006).

Objectives of Restoration:

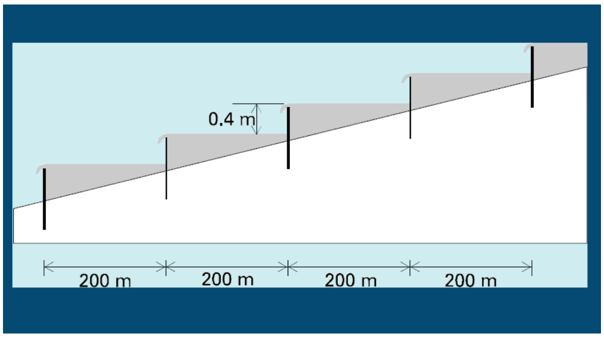
- To restore the pre-drainage situation
- Increase the groundwater level
- Reduce outflow by blocking canals and re-growth of vegetation
- Reduce incidence of peat fires

Challenges faced by the project:

- Low bearing capacity - dams cannot create much head difference (between upstream and downstream water levels)
- High permeability - dams cannot store much water, will mainly act as an extra barrier to flow (i.e. increase flow resistance)
- Irregular rainfall, average yearly rainfall varies between 2000 to 4000 mm - big variation in discharge, therefore the dams should be designed as weirs to allow overtopping without causing too much structural damage
- Canals are also used for navigation/ transport - are alternative transport facilities needed/required? If not will local people damage or surpass the structures?

Suggested Solutions:

- Avoid too much head difference – use a cascade of weirs (see Fig. 3.1)
- Avoid too much discharge - start blocking the drainage canal at the upstream end
- Avoid too much load/weight -use indigenous materials: timber, (compressed) peat, etc.
- Avoid expensive foundations - “floating” weirs
- Sustainable solution - involvement of local population



Left: Cascade of weirs proposed as restoration approach; Right: Dam construction in the former Mega Rice Project (Ritzema & Limin, 2006)

7.3 Facilitating Forest Recovery

The impacts of forestry operations in peatlands and guidelines for improved forestry practices are described in Module 2 (Section 6.5). The impacts can be severe, involving networks of log extraction and drainage canals, fragmentation of the peatland by logging roads, compaction of the peat surface by heavy logging machines, and large areas of the forest damaged by logging yards and access roads.

In such cases, natural regeneration of the forest may occur to some extent over time if the hydrological conditions can be restored, but likely stands of pioneer species (e.g. *Macaranga* spp.) will dominate in the seriously damaged areas, almost like monocultures in some cases.

Two main situations need to be addressed in replanting efforts:

1) Where canopy remains but it has been fragmented

2) Where no canopy remains

The former can largely be addressed through enrichment planting and monitoring (except where serious damage has occurred). The second requires replanting. Wibisono (2003) provides recommendations for application of silviculture techniques in four categories of degraded peatland areas: burnt areas, land-cleared areas, forest with medium degradation and forest with low degradation, including suggestions for tree species. See also the Central Kalimantan Peatlands Project Consortium (2008) for further information on strategies for replanting, choice of tree species, and community involvement.

Extensive research experience through the Pikulthong Royal Development Study Project in Thailand has provided the basis for a Manual on Peat Swamp Forests Rehabilitation and Planting in Thailand (Nuyim, 2005).

There are clear benefits of involving local communities in replanting efforts, as this is likely to provide the most sustainable outcomes as well as to support local livelihoods. The case studies mentioned in Section 7.6 below and pilot testing of the Biorights approach (see Eijk & Kumar, 2009) provide some examples of this.

Replanting should take local community interests into account during choice of tree species (i.e. species of some commercial or local benefit should be used, such as Jelutong *Dyera loowi*). Similarly, species of value to wildlife (such as orang-utan food plants) can be used in or around nature reserves, or to support reintroduction efforts.

7.4 Species Translocation and Reintroduction Measures

As described in **Part 1**, peatlands in Southeast Asia support a diverse flora and fauna including a number of globally threatened species. Strengthening existing populations by translocating individuals from other areas (for instance that have been burned in forest fires) or returning confiscated animals to the wild is one option. Where existing populations have been lost from a particular area, reintroduction may be an option.

Reintroduction is not a simple task, requiring careful investigation, planning and monitoring to be successful. Comprehensive guidelines for species reintroductions have been developed by the IUCN Species Survival Commission (SSC): http://www.kew.org/conservation/RSGguidelines.html(Falcon, undated).

A Reference List for Plant Re-introductions, Recovery Plans and Restoration Programmes can be found at: http://www.kew.org/conservation/main.html (Atkinson *et al*., 1995)

Further information can be obtained from the IUCN SSC Re-introduction Specialist Group website: http://www.iucnsscrsg.org/

Examples of points to consider include:

- The reintroduction site should be secure and safe from hunting, fires and other threats
- The habitat at the reintroduction site should be as similar as possible to the original habitat for translocated animals, especially with regard to food sources

- Supplementary feeding may be required to enable released animals to survive and to prevent them from wandering away from the release site
- Released animals should be marked, and monitored on a regular basis

7.5 Restoration of Peatlands after Peat Extraction

The restoration of extracted peatlands has various impacts on biodiversity and needs careful planning to achieve eventual restoration and to avoid losses and significant changes. Over the last 20 years or so, significant advances have been made in the development and introduction of peatland restoration techniques in temperate regions as integral components of the peat extraction process. Rewetting and further recovery of ground vegetation protects the land from erosion, peat fires and carbon emissions, and leads to positive changes in local hydrology. However, the restoration of peatland habitats is rarely effective in bringing back their original species and genetic diversity because fragmentation and a lack of habitat corridors prevent remote populations from re-colonising the restored area. As a result, the genetic diversity of founder populations is low and the homogeneity of the restored habitats will lead to further loss of genetic diversity, making populations less resistant to future impacts. In some cases, re-wetting of peatlands has resulted in water level rise in areas adjacent to their boundaries, with negative consequences for biodiversity in neighbouring ecosystems. Thus, the restoration of extracted peatlands has a differential impact on biodiversity and needs careful planning to ensure that the aim of peatland restoration is ultimately achieved, as well as to avoid losses and significant changes in neighbouring ecosystems (for example see: Wheeler and Shaw, 1995; Wheeler *et al.,* 1995; Pfadenhauer and Grotjans, 1999; Bakker *et al.,* 2000). Source: Parish *et al.* (2008).

While the above text refers to experience in temperate countries, there has been some experience of peatland restoration after peat extraction in Southeast Asia (for example at Paya Indah in Selangor, Malaysia, where a wetland park was developed on ex-tin mining land). However, little published information is available.

7.6 Rehabilitation after Fires

There has been some significant experience in the region of rehabilitating forests in areas affected by fires (see references at the end of this section). **See also Part 1 section 3.3.1** on the impacts of fires, and P**art 2 section 5.8** for information on fire control and monitoring.

The same issues and constraints for restoration projects described above apply for post-fire rehabilitation. In particular, the impacts of the fire (or repeated fires) on vegetation and peat soils need to be carefully considered (Takahashi *et al.*, 2008 describe the dynamics and effects of peatland fires) together with prevailing hydrological conditions. Experience with rehabilitation of peatlands after fires generally includes an important objective – to prevent further fire occurrence in the same areas. Fire susceptibility of peatlands increases dramatically when the water table drops below the critical threshold value of -40 cm (Wosten *et al.,* 2010). Therefore rehabilitation usually involves raising water tables by blocking man-made canals and ditches amongst other measures (e.g. see Wosten & Ritzema, 2006; Wosten *et al*., 2010). Recent experience includes a series of case studies presented at the Technical Workshop on the Development of the ASEAN Peatland Fire Prediction and Warning System (GEC, 2010). The rehabilitation and fire prevention measures taken included:

1. Blocking selected existing canals with the involvement of NGOs and local communities,
2. Enhancing the law enhancement programme to prevent encroachment,
3. Rehabilitating degraded areas by replanting trees in burnt areas, involving volunteers from NGO and community groups.

(Raja Musa Forest Reserve, Selangor Malaysia – See GEC 2010, Annex 12)

1. Canal blocking and water storage wells for fire prevention and control,
2. Enhancing Outreach & Partnership Development,
3. Training & Socialization (Formal and Informal) for peat-land management,
4. Development of Awareness Materials, and
5. Community Patrolling Teams for fire prevention and control. The involvement of the local community in fire prevention efforts was deemed the most strategic and effective as they were identified as the main actors for problem resolution.

(Rokan Hilir, Riau, Indonesia – See GEC 2010, Annex 13)

In Sabah, the local communities adjacent to peatlands were involved in rehabilitation efforts, whereby State forest departments provide subsidies such as commodity seedlings (rubber) to assist poor communities develop their respective lands. These communities also participate in forestry-oriented activities, i.e. restoration, seedlings maintenance, for replanting of degraded peat swamp areas etc. (See GEC 2010, Annex 15)

The current Peatland Management Programme in Malaysia under the Department of Environment currently covers four states (Selangor, Johor, Pahang and Sarawak). Three key elements in the programme are (i) Check dams – construction of dams to maintain minimum water level in peatlands, (ii) Tube wells – establishment of tube wells to extract groundwater and help maintain minimum water level in peatlands, as well as to act as water sources for fire suppression, and (iii) Watch towers – construction of watch towers to monitor fire in peatlands or areas nearby. Various agencies have been tasked to undertake certain procedural measures during the dry season, such as the Department of Mineral and Geoscience to extract groundwater from tube wells and fill into the drain, serving as reservoir/water supply for fire suppression if needed. On the other hand, personnel from the Drainage and Irrigation Department are to ensure that the check dams maintain the minimum water level and stop excess water flow that will lead to dry conditions in the peatlands. Forest rangers and DOE personnel will man the watch tower to detect burning on peat soils and areas nearby. In order to improve the effectiveness of this programme, further studies on the national water regime and the effectiveness of the programme are needed. This inter-agency coordination is important for effective peatland management and fire control, and the preparation of tube wells to extract groundwater is a valuable contingency measure that could be considered for fire-prone areas elsewhere (See GEC 2010, Annex 16).

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Annex 1

Glossary

Biological diversity: The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. (see Convention on Biological Diversity, 1992)

Biological diversity values: The intrinsic, ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components. (see Convention on Biological Diversity, 1992)

Bog (raised bog): Mire raised above the surrounding landscape and only fed by precipitation.

Customary rights: Patterns of long standing community land and resource usage in accordance with indigenous peoples' customary laws, values, customs and traditions, including seasonal or cyclical use rather than formal legal title to land and resources issued by the State. (From World Bank Operational Policy 4.10). (RSPO)

Cut-away peatland: What remains of a peatland after all the peat which can be economically removed has been extracted.

Ecosystem: A community of all plants and animals and their physical environment, functioning together as an interdependent unit. (FSC)

Endangered species: Any species which is in danger of extinction throughout all or a significant portion of its range. (FSC)

Exotic species: An introduced species not native or endemic to the area in question. (FSC)

Environmental Impact Assessment: a process of predicting and evaluating the effects of an action or series of actions on the environment, then using the conclusions as a tool in planning and decision-making. (RSPO)

Fen: Peatland receiving inflow of water and nutrients from the mineral soil. Distinguished from **swamp forest** by a lack of tree cover or with only a sparse crown cover. Indistinctly separated from **marsh** (which is always beside open water and usually has a mineral substrate). **See also minerotrophic peatland.**

Flood mires: Mires in which periodical flooding by an adjacent open water body (sea, lake, river) enables peat accumulation.

Fluvial mires: Mires associated with rivers.

Geogenous peatland: Peatland subject to external flows.

High Conservation Value Forest (HCVF): The forest necessary to maintain or enhance one or more High Conservation Values (HCVs):

- HCV1. Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species).
- HCV2. Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
- HCV3. Forest areas that are in or contain rare, threatened or endangered ecosystems.
- HCV4. Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
- HCV5. Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).
- HCV6. Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

(See: 'The HCVF Toolkit' – available from www.hcvnetwork.org)

Infilling, terrestrialization: The process whereby peat develops on the margins and into the centers of ponds, lakes, or slow-flowing rivers.

Landscape: A geographical mosaic composed of interacting ecosystems resulting from the influence of geological, topographical, soil, climatic, biotic and human interactions in a given area. (FSC)

Limnogenous peatland: Geogeneous peatland that develops on the ground along a slow-flowing stream or a lake.

Marsh: Develops mostly on mineral soil, but could be a peatland. Beside open water, with standing or flowing water, or flooded seasonally. Submerged, floating, emergent, or tussocky vegetation.

Mesotrophic peatland: Intermediate peatland between minerotrophic and ombrotrophic.

Minerotrophic peatland: Peatland receiving nutrients through an inflow of water that has filtered through mineral soil.

Mire: Synonymous with any peat-accumulating wetland. A peatland where peat is currently forming and accumulating.

Mire complex: An area consisting of several hydrologically connected, but often very different, mire types; sometimes separated by mineral soil uplands.

Mixed mire: A mire type with **bog** and **fen** features or sites in close connection.

Native species: A species that occurs naturally in the region; endemic to the area. (FSC)

Natural vegetation: Areas where many of the principal characteristics and key elements of native ecosystems such as complexity, structure and diversity are present. (RSPO)

Oligotrophic peatland: Peatland with poor to extremely poor nutrient levels.

Ombrotrophic peatland: Peatland receiving water and nutrients only from atmosphere. Also called ombrogenous. See **Bog.**

Paludification: The formation of marsh or waterlogged conditions: also refers to peat accumulation which starts directly over a formerly dry mineral soil.

Peat: Fibric organic sedentarily accumulated material with virtually all of the organic matter allowing the identification of plant forms; consists of at least 30% (dry weight) of dead organic material. [Note: as used by Parish *et al*. (2008), other definitions are discussed in Section 2]

Peat extraction: The excavation and drying of wet peat and the collection, transport and storage of the dried product.

Peat swamp forest: peatland areas with significant remaining natural tree cover including pristine /undisturbed forested areas and areas which may have been logged or partly degraded but which still have tree cover. (Source: Draft Malaysian NAP)

Peatland: An area with or without vegetation with a naturally accumulated peat layer at the surface of at least 30 cm depth. The term "peatlands" includes both peat swamp forests and all areas with peat soil which may have been converted for agriculture or other uses or degraded and no longer have forest cover. (Source: Malaysian draft NAP)

Plantation: Forest areas lacking most of the principal characteristics and key elements of native ecosystems as defined by FSC-approved national and regional standards of forest stewardship, which result from the human activities of either planting, sowing or intensive silvicultural treatments. (FSC)

Primary Forest: A primary forest is a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. Also included as primary, are forests that are used inconsequentially by indigenous and local communities living traditional lifestyles relevant for the conservation and sustainable use of biological diversity. The present cover is normally relatively close to the natural composition and has arisen (predominantly) through natural regeneration. National interpretations should consider whether a more specific definition is required. (From FAO Second Expert Meeting On Harmonizing Forest-Related Definitions For Use By Various Stakeholders, 2001, http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/Y4171E/Y4171 E11.htm). RSPO

Primary peat formation: The process whereby peat is formed directly on freshly exposed, wet mineral soil.

Pristine mire: Mire which has not been disturbed by human activity in a way which damages its ecosystem.

Quaking bog (quagmire, quaking mat, floating mat): Mire in which the peat layer and plant cover is only partially attached to the basin bottom or is floating like a raft.

Raised bog: Deep peat deposits that fill entire basins, develop a dome raised above ground water level, and receive their inputs of nutrients from precipitation.

Re-introduction: an attempt to establish a species (2) in an area which was once part of its historical range, but from which it has been extirpated or become extinct (3) Source: IUCN SSC

Riparian peatland: Peatland adjacent to a river or stream, and, at least periodically, influenced by flooding.

Sloping mire: Mire with a sloping surface.

Soligenous peatland: Geogenous peatland that develops with regional interflow and surface runoff.

Spring mire: Mire that is mainly fed by spring water.

Stakeholders: An individual or group with a legitimate and/or demonstrable interest in, or who is directly affected by, the activities of an organisation and the consequences of those activities. RSPO

Swamp: Usually forested minerotrophic peatland. Separate from wooded fens due to a denser tree canopy. Also peat swamp forest.

Terrestrialisation: The accumulation of sediments and peats in open water. See **infilling**.

Topogenous peatland: Geogenous peatland with a virtually horizontal water table, located in basins.

Wetland: Land with the water table near the surface. Inundation lasts for such a large part of the year that the dominant organisms must be adapted to wet and reducing conditions. Usually includes shallow water, shore, marsh, swamp, fen, and bog.

Wetland (Ramsar definition): Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static, flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters.

Main source:

Parish, F., Sirin, A., Charman, D., Joosten, H., Minaeva, T., Silvius, M. and Stringer, L. (Eds.) 2008.

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See the online glossary at: http://www.peat-portal.net/index.cfm?&menuid=163

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Mitsch W.J. and Gosselink J.G. 2000. Wetlands. Third Edition. John Wiley and Sons.

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The Ramsar Convention on Wetlands http://www.ramsar.org/

Annex 2

Websites of Key Organizations Concerned with Peatlands in Southeast Asia

ASEAN Centre for Biodiversity
http://www.aseanbiodiversity.org/

ASEAN Secretariat
http://www.aseansec.org/

Haze Online Website: http://www.haze-online.or.id

ASEAN Peatland Forests Project (IFAD/GEF)
http://www.aseanpeat.net/

Carbopeat Project: http://www.geog.le.ac.uk/carbopeat/
Conservation Measures Partnership
http://www.conservationmeasures.org/CMP/

Conservation International
http://www.conservation.org/Pages/default.aspx

Convention on Biological Diversity
http://www.cbd.int

Convention on the Conservation of Migratory Species of Wild Animals (CMS)
www.cms.int

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) http://www.cites.org/

Convention on Wetlands (Ramsar Convention)
http://www.ramsar.org

Fauna and Flora International
http://www.fauna-flora.org/

Forest Stewardship Council
www.fsc.org

Global Environment Centre
http://www.gecnet.info/

Peat Portal: http://www.peat-portal.net/
River Basin Initiative: http://www.riverbasin.org/

International Peat Society
http://www.peatsociety.org/

Global Fire Monitoring Centre
http://www.fire.uni-freiburg.de/

International Mire Conservation Group
http://www.imcg.net/

International Peatland Fire Network
(Global Fire Monitoring Center (GFMC) and the Global Environment Centre (GEC))
http://www.fire.uni-freiburg.de/GlobalNetworks/PeatlandFireNetwork/peatland.html

IUCN – The World Conservation Union
http://www.iucn.org

IUCN Species Survival Commission
http://www.iucn.org/about/work/programmes/species/about_ssc/

Malaysian Timber Certification Council (MTCC)
http://www.mtcc.com.my

Peat Portal (maintained by the Global Environment Centre)
www.peat-portal.net

Programme for the Endorsement of Forest Certification schemes (PEFC)
www.pefc.org

Roundtable on Sustainable Palm Oil
www.rspo.org

Restorpeat Project:
http://www.restorpeat.alterra.wur.nl/p_frameset.htm

Restorpeat project download area:
http://www.restorpeat.alterra.wur.nl/p_download.htm

The Nature Conservancy
http://www.nature.org/
http://www.nature.org/wherewework/asiapacific/indonesia/

WWF International:
http://www.panda.org

United Nations Development Programme (UNDP)
http://www.undp.org

United Nations Environment Programme (UNEP)
http://www.unep.org
Regional Office for Asia Pacific: http://www.roap.unep.org/

UN Convention to Combat Desertification (UNCCD)
http://www.unccd.int

UN Framework Convention on Climate Change (UNFCCC)
http://unfccc.int/2860.php

Wetlands International: www.wetlands.org
http://www.wetlands.org

Annex 3

Extracted Information from the Principles and Criteria for Sustainable Palm Oil Production

The leading initiative in the development of environmentally sustainable and socially responsible practices in the oil palm plantation industry is the **Roundtable on Sustainable Palm Oil (RSPO)** www.rspo.org . RSPO has established **Principles and Criteria for Sustainable Palm Oil Production** (RSPO, 2007). The Principles and Criteria are applicable to all palm oil growers and millers that are members of RSPO and cover a wide range of subjects of which the following extracted material is of particular relevance, including points relating specifically to peatlands. Please refer to the actual guidelines available from the RSPO website for comprehensive information.

Principle 4: Use of appropriate best practices by growers and millers

Criterion 4.3 Practices minimise and control erosion and degradation of soils.

Indicators include: Subsidence of peat soils should be minimised under an effective and documented water management programme.

Guidance: Techniques that minimise soil erosion are well-known and should be adopted, wherever appropriate. This may include practices such as ground cover management, biomass recycling, terracing, and natural regeneration or restoration instead of replanting.

For existing plantings on peat, water table should be maintained at a mean of 60cm (within a range of 50-75cm) below ground surface through a network of appropriate water control structures e.g. weirs, sandbags, etc. in fields, and watergates at the discharge points of main drains (see also Criterion 4.4 and 7.4).

Smallholders should be able to demonstrate that they have an understanding of the techniques required to manage their soils and that they are being implemented. **National interpretation** should refer to national guidance, and identify the best management practices and appropriate techniques for maintaining soil quality in local conditions, including guidance on soil types, and any appropriate performance thresholds, such as maximum acceptable slope gradient for planting.

Criterion 4.4 Practices maintain the quality and availability of surface and ground water.

Indicators include:

- An implemented water management plan.
- Protection of water courses and wetlands, including maintaining and restoring appropriate riparian buffer zones.

Guidance includes:

National interpretation should refer to national guidelines or best practice and where appropriate include performance thresholds for requirements such as the size and location and methods of restoration of riparian strips or acceptable maximum runoff levels.

Criterion 4.5 Pests, diseases, weeds and invasive introduced species are effectively managed using appropriate Integrated Pest Management (IPM) techniques.

Criterion 4.6 Agrochemicals are used in a way that does not endanger health or the environment.

Principle 5: Environmental responsibility and conservation of natural resources and biodiversity

Criterion 5.1 Aspects of plantation and mill management, including replanting, that have environmental impacts are identified, and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continuous improvement.

Indicators: Documented impact assessment.

- Where the identification of impacts requires changes in current practices, in order to mitigate negative effects, a timetable for change should be developed.

Guidance includes:

Environmental impact assessment should cover the following activities, where they are undertaken:

- Building new roads, processing mills or other infrastructure.
- Putting in drainage or irrigation systems.
- Replanting or expansion of planting area.
- Disposal of mill effluents (see criterion 4.4);
- Clearing of remaining natural vegetation.

Impact assessment may be a non-restrictive format e.g. ISO 14001 EMS and/or EIA report incorporating elements spelt out in this criterion and raised through stakeholder consultation. Documented management action plans addressing issues raised from the above impact assessment, which is monitored annually.

Environmental impacts may be identified on soil and water resources, air quality (see criterion 5.6), biodiversity and ecosystems, and people's amenity (see criterion 6.1 for social impacts), both on and off-site.

Stakeholder consultation has a key role in identifying environmental impacts. The inclusion of consultation should result in improved processes to identify impacts and to develop any required mitigation measures.

National interpretation should consider any national legal requirements together with any other issues that are not required by law but are nevertheless important, e.g. Independent SEIA for replanting may be desirable under specific situations.

[Note: The Ramsar Convention also provides significant guidance on environmental impact assessment and wetlands. See Ramsar Handbook 13 on Environmental Assessment: Guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment
http://www.ramsar.org/pdf/lib/lib_handbooks2006_e13.pdf]

Criterion 5.2 The status of rare, threatened or endangered species and high conservation value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and their conservation taken into account in management plans and operations.

Indicators:

Information should be collated that includes both the planted area itself and relevant wider landscape-level considerations (such as wildlife corridors). This information should cover:

- Presence of protected areas that could be significantly affected by the grower or miller.
- Conservation status (e.g. IUCN status), legal protection, population status and habitat requirements of rare, threatened, or endangered species that could be significantly affected by the grower or miller.
- Identification of high conservation value habitats, such as rare and threatened ecosystems, that could be significantly affected by the grower or miller.

If rare, threatened or endangered species, or high conservation value habitats, are present, appropriate measures for management planning and operations will include:

- Ensuring that any legal requirements relating to the protection of the species or habitat are met.
- Avoiding damage to and deterioration of applicable habitats.
- Controlling any illegal or inappropriate hunting, fishing or collecting activities; and
- Developing responsible measures to resolve human-wildlife conflicts (e.g. incursions by elephants).

Guidance: This information gathering should include checking available biological records, and consultation with relevant government departments, research institutes and interested NGOs if appropriate. Depending on the biodiversity values that are present, and the level of available information, some additional field survey work may be required. For individual smallholders, a basic understanding of any applicable species or habitats, together with their conservation needs, will be sufficient.

For **national interpretation**, appropriate sources of information include government or international lists of threatened species ('red data lists'), national wildlife protection legislation, authorities responsible for protected areas and species, or relevant NGOs.

Criterion 5.3 Waste is reduced, recycled, re-used and disposed of in an environmentally and socially responsible manner.

Criterion 5.4 Efficiency of energy use and use of renewable energy is maximised.

Criterion 5.5 Use of fire for waste disposal and for preparing land for replanting is avoided except in specific situations, as identified in the ASEAN guidelines* or other regional best practice.

Indicators:

- Documented assessment where fire has been used for preparing land for replanting.

Guidance:

Fire should be used only where an assessment has demonstrated that it is the most effective and least environmentally damaging option for minimising the risk of severe pest and disease outbreaks, and with evidence that fire-use is carefully controlled. Use of fire on peat soils should be avoided.

Extension/training programmes for smallholders may be necessary.

National interpretation should identify any specific situations where such use of fire may be acceptable, for example through reference to 'Guidelines for the implementation of the ASEAN policy on zero burning*', or comparable guidelines in other locations.

** The guidelines are available here:*

http://www.rspo.org/Guidelines_for_the_Implementation_of_the_ASEAN_Policy_on_Zero_Burning_(2003).aspx

Criterion 5.6 Plans to reduce pollution and emissions, including greenhouse gases, are developed, implemented and monitored.

Indicators:

- An assessment of all polluting activities must be conducted, including gaseous emissions, particulate/soot emissions and effluent (see also criterion 4.4).

Significant pollutants and emissions must be identified and plans to reduce them implemented.

- A monitoring system must be in place for these significant pollutants which goes beyond national compliance.

- The treatment methodology for Palm Oil Mill Effluent is recorded.

Note: RSPO aims to address all issues relating to Greenhouse Gas emissions, as set out in the Preamble to the **Principles and Criteria for Sustainable Palm Oil Production. [This is particularly significant for plantations on peatland areas, in view of their globally significant role in storing and sequestering Carbon, and the huge quantities of GHGs released as a result of drainage, oxidation and burning of peat.]**

Principle 6: Responsible consideration of employees and of individuals and communities affected by growers and mills

Criterion 6.1 Aspects of plantation and mill management, including replanting, that have social impacts are identified in a participatory way, and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continuous improvement.

Criterion 6.2 There are open and transparent methods for communication and consultation between growers and/or millers, local communities and other affected or interested parties.

Criterion 6.4 Any negotiations concerning compensation for loss of legal or customary rights are dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions.

Criterion 6.11 Growers and millers contribute to local sustainable development wherever appropriate.

Principle 7: Responsible development of new plantings

Criterion 7.1 A comprehensive and participatory independent social and environmental impact assessment is undertaken prior to establishing new plantings or operations, or expanding existing ones, and the results incorporated into planning, management and operations.

Indicators:

- Independent impact assessment, undertaken through a participatory methodology including external stakeholder groups.
- Appropriate management planning and operational procedures.
- Where the development includes an outgrower scheme, the impacts of the scheme and the implications of the way it is managed should be given particular attention.

Guidance:

See also criteria 5.1 and 6.1.

The terms of reference should be defined and impact assessment should be carried out by accredited independent experts, in order to ensure an objective process. Both should not be done by the same body. A participatory methodology including external stakeholder groups is essential to the identification of impacts, particularly social impacts. Stakeholders such as local communities, government departments and NGOs should be involved, through the use of interviews and meetings, and by reviewing findings and plans for mitigation.

The potential impacts of all major proposed activities should be assessed prior to development. The assessment should include, in no order of preference, as a minimum:

- Assessment of the impacts of all major planned activities, including planting, mill operations, roads and other infrastructure.

- Assessment, including stakeholder consultation, of High Conservation Values (see criterion 7.3) that could be negatively affected.

- Assessment of potential effects on adjacent natural ecosystems of planned developments, including whether development or expansion will increase pressure on nearby natural ecosystems.

- Identification of watercourses and assessment of potential effects on hydrology by planned developments. Measures should be planned and implemented to maintain the quantity and quality of water resources.

- Baseline soil surveys and topographic information, including the identification of marginal and fragile soils, areas prone to erosion and slopes unsuitable for planting.

- Analysis of type of land to be used (forest, degraded forest, cleared land).

- Analysis of land ownership and user rights.

- Analysis of current land use patterns.

- Assessment of potential social impact on surrounding communities of a plantation, including an analysis of differential effect on women versus men, ethnic communities, migrant versus long-term residents.

Assessment of above and below ground carbon storage is important but beyond the scope of an EIA. This aspect will be considered by an RSPO Greenhouse Gas Working Group. [**Note – this is of great significance for peatlands]**

Plans and field operations should be developed and implemented to incorporate the results of the assessment. One potential outcome of the assessment process is that the development should not proceed because of the magnitude of potential impacts.

For smallholder schemes, the scheme management should do this. For individuals, it does not apply.

National interpretation should identify the relevant accreditations for independent experts.

National interpretation should consider setting a minimum threshold of the size of new plantings, e.g. 50 ha, above which an SEIA is required. Consider listing unacceptable negative social impacts (e.g., displacement, loss of the food security of local people, etc.) in the national context.

Criterion 7.2 Soil surveys and topographic information are used for site planning in the establishment of new plantings, and the results are incorporated into plans and operations.

Indicators:

- Soil suitability maps or soil surveys adequate to establish the long-term suitability of land for oil palm cultivation should be available.
- Topographic information adequate to guide the planning of drainage and irrigation systems, roads and other infrastructure should be available.

Guidance:

These activities may be linked to the SEIA (7.1) but need not be done by independent experts. Soil suitability maps or soil surveys should be appropriate to the scale of operation and should include information on soil types, topography, rooting depth, moisture availability, stoniness, fertility and long-term soil sustainability. Soils unsuitable for planting or those requiring special treatment should be identified. This information should be used to plan planting programmes, etc. Measures should be planned to minimise erosion through appropriate use of heavy machinery, terracing on slopes, appropriate road construction, rapid establishment of cover, protection of riverbanks, etc.

Assessing soil suitability is also important for small-scale producers, particularly where there are significant numbers operating in a particular location. Information may be collected and provided by a smallholder organisation or mill that purchases FFB from individual smallholders.

National interpretation should specify the local or national code of practice or other guidelines that should be followed; or set out what 'good practice' constitutes within the local and national context. [This should include specific reference to avoiding new plantations on peatland – see 7.4 below]

Criterion 7.3 New plantings since November 2005, have not replaced primary forest* or any area required to maintain or enhance one or more High Conservation Values.

[See www.hcvnetwork.org]

Indicators:

- An HCV assessment, including stakeholder consultation, is conducted prior to any conversion.
- Dates of land preparation and commencement are recorded

Guidance:

This activity could be integrated with the SEIA required by 7.1. This criterion applies to forests and other vegetation types. This applies irrespective of any changes in land ownership or farm management that have taken place after this date. High Conservation Values (HCVs) may be identified in restricted areas of a landholding, and in such cases new plantings can be planned to allow the HCVs to be maintained or enhanced.

The HCV assessment process requires appropriate training and expertise, and must include consultation with local communities, particularly for identifying social HCVs. HCV assessments should be conducted according to the National Interpretation of the HCV criteria, or according to the Global HCV Toolkit if a National Interpretation is not available.

Development should actively seek to utilise previously cleared and/or degraded land. Plantation development should not put indirect pressure on forests through the use of all available agricultural land in an area.

Where landscape level HCV maps have been developed, these should be taken into account in project planning, whether or not such maps form part of government land use plans.

National interpretation should refer to existing national definitions of HCVs (or where these do not exist refer to definitions in the annex) or equivalent landuse/conservation plans or consider how growers and the audit team can identify High Conservation Values. This may involve collaboration with other bodies.

See Section 1 for definition of 'High Conservation Values'.

*** The RSPO Principles and Criteria define Primary Forest as follows:** A primary forest is a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. Also included as primary, are forests that are used inconsequentially by indigenous and local communities living traditional lifestyles relevant for the conservation and sustainable use of biological diversity. The present cover is normally relatively close to the natural composition and has arisen (predominantly) through natural regeneration. National interpretations should consider whether a more specific definition is required. (From FAO Second Expert Meeting On Harmonizing Forest-Related Definitions For Use By Various Stakeholders, 2001, http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/Y4171E/Y4171 E11.htm).

Criterion 7.4 Extensive planting on steep terrain, and/or on marginal and fragile soils, is avoided.

Indicators:

- Maps identifying marginal and fragile soils, including excessive gradients and peat soils, should be available.
- Where limited planting on fragile and marginal soils is proposed, plans shall be developed and implemented to protect them without incurring adverse impacts.

Guidance:

This activity may be integrated with the SEIA required by 7.1. Planting on extensive areas of peat soils and other fragile soils should be avoided (see also Criterion 4.3).

Adverse impacts may include hydrological risks or significantly increased risks (e.g. fire risk) in areas outside the plantation. (Criterion 5.5).

National interpretation should consider including specific controls and thresholds, such as slope limits, listing soil types that on which planting should be avoided (especially peat soils), the proportion of plantation area that can include marginal/ fragile soils, and/or definitions of ‘extensive’, ‘marginal’ and ‘fragile’.

Criterion 7.5 No new plantings are established on local peoples’ land without their free, prior and informed consent, dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions.

Criterion 7.6 Local people are compensated for any agreed land acquisitions and relinquishment of rights, subject to their free, prior and informed consent and negotiated agreements.

Criterion 7.7 Use of fire in the preparation of new plantings is avoided other than in specific situations, as identified in the ASEAN guidelines or other regional best practice.

Indicators:

- No evidence of land preparation by burning.
- Documented assessment where fire has been used for preparing land for planting.

- Evidence of approval of controlled burning as specified in ASEAN guidelines or other regional best practice.
- This activity should be integrated with the SEIA required by 7.1.

Guidance:

Fire should be used only where an assessment has demonstrated that it is the most effective and least environmentally damaging option for minimising the risk of severe pest and disease outbreaks, and with evidence that fire-use is carefully controlled.

Extension/ training programmes for smallholders may be necessary.

National interpretation should identify any specific situations where such use of fire may be acceptable, for example through reference to 'Guidelines for the implementation of the ASEAN policy on zero burning', or comparable guidelines in other locations. *[See Criterion 5.5 above]*

Criterion 8.1 Growers and millers regularly monitor and review their activities and develop and implement action plans that allow demonstrable continuous improvement in key operations.

Indicators:

The action plan for continual improvement should be based on a consideration of the main social and environmental impacts and opportunities of the grower/ mill, and should include a range of indicators covered by these principles and criteria. As a minimum, these must include, but not necessarily be limited to:

- Reduction in use of certain chemicals (criterion 4.6).
- Environmental impacts (criterion 5.1).
- Waste reduction (criterion 5.3).
- Pollution and emissions (criterion 5.6).
- Social impacts (6.1).

Guidance:

National interpretation should include specific minimum performance thresholds for key indicators (see also criteria 4.2, 4.3, 4.4, and 4.5). Growers should have a system to improve practices in line with new information and techniques and a mechanism for disseminating this information throughout the workforce. For smallholders, there should be systematic guidance and training for continuous improvement.

Some of the above RSPO criteria make reference to national interpretations for indicators (e.g. HCV habitat definitions, fragile soil types). Such national definitions should take full account of available scientific information, as well as global best practice methods and standards (for example, the global toolkit and other resources on High Conservation Value Forest http://www.hcvnetwork.org/).

Terms of Reference for RSPO Peatland Working Group

1. Identify the environmental and social impacts related to oil palm plantations on peatlands.

1.1 Conduct a review of literature/ other information sources to identify

a. the environmental impacts of oil palm plantations on peatlands with focus on GHG, but including other issues (biodiversity etc);

b. social and economic impacts of oil palm plantations developed on peatlands;

c. impacts of oil palm plantations on peatlands at a landscape level – e.g. impacting adjacent lands through drainage.

1.2 Assess the long-term effect of subsidence on the viability of oil palm cultivation on peat.

2. Identify best practices for managing oil palm plantations on peat soils in order to minimize GHG emissions and enhance sustainability.

2.1. Conduct review of literature/ other information on best management practices for oil palm plantations on peat.

2.2. Compile/ prepare case studies on best practices in oil palm plantations.

2.3. Organize field visits to a selection of oil palm plantations on peat with different management regimes.

2.4. Collate and compare current practices of peat management with other production systems on peat soils.

2.5. Develop best practice guidelines on oil palm plantations on peat.

2.6. Develop a strategy for promotion of best practices on peatlands.

3. Identify practical methodologies for assessing and monitoring carbon stocks and key GHG emissions from oil palm plantations established on peat soils

3.1. Compile information on practical methodologies to document and monitor carbon stocks and GHG flux from oil palm plantations on peat.

3.2 Work with GHG WG2 (Workstream 3) to develop practical procedures applicable in peatlands to estimate changes in GHG flux following enhanced management.

4. Evaluate options and constraints for the rehabilitation of degraded peatlands.

4.1. Collate information on the experience of rehabilitation of degraded peatlands.

4.2. Assess the changes in carbon stocks and flows (and flux of other GHG) that would occur from rehabilitated peatlands.

4.3. Compile information on potential of carbon finance and other mechanisms to avoid peatland degradation and support peatland rehabilitation.

4.4. Identify options and constraints for rehabilitation or sustainable use of degraded peatlands, land cleared or earmarked for oil palm (but not planted) and after use of oil palm plantations.

4.5. Evaluate the cost and feasibility of rewetting degraded/drained peatlands.

ISBN 978-967-5554-05-6

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