ALTERRA
WAGENINGEN UR

Sustainable Peat Supply Chain

Report of the ad hoc working group Enhancing the Sustainability of the Peat Supply Chain for the Dutch Horticulture

Alterra report 2167
ISSN 1566-7197

M.G. Bos, W.H. Diemont and A. Verhagen (eds.)

WAGENINGEN UR
For quality of life

Sustainable Peat Supply Chain

This research was commissioned by the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) within the framework of BO programme International Cooperation, theme Scarcity and Distribution.
Project code BO-10-011-117/5237844-01 Sustainable Peat Chains.

Disclaimer

This report was commissioned by the former Ministry of Agriculture, Nature and Food Quality which has become part of the present Ministry of Economic Affairs, Agriculture and Innovation of The Netherlands. The content of the report does not necessarily reflect the views of the ministry. Wageningen UR is responsible for the content of the main report, whereas the responsibility of the content of the annexes is in the hands of various organizations as reflected by the logos attached to the annexes.

Sustainable Peat Supply Chain

Report of the ad hoc working group Enhancing the Sustainability of the Peat Supply Chain for the Dutch Horticulture

M.G. Bos, W.H. Diemont and A. Verhagen (eds.)

Alterra report 2167

Alterra, part of Wageningen UR
Wageningen, 2011

Abstract

Bos, M.G., W.H. Diemont and A. Verhagen (eds.). *Sustainable Peat Supply Chain; Report of the ad hoc working group Enhancing the Sustainability of the Peat Supply Chain for the Dutch Horticulture*. Wageningen, Alterra, Alterra report 2167. 132 pp.; 2 fig.; 1 tab.; 7 ref.

The project deals with the future sustainability of the peat supply chain for Dutch horticulture. This means securing long term availability of high quality peat and/or alternatives for the sector, dealing appropriately with biodiversity issues and taking climate change into account.
The project goals are: 1) Gaining insight into the impacts of peat extraction and peat trade on biodiversity in Europe (including CO_2/climate related issues), based on information on production, trade, technologies used with the focus on the role of the Dutch private sector in the international context; and 2) Exploring options for improving extraction methods and the use of alternative basis materials for producing growing media for horticulture and possibilities to define indicators, criteria and standards for sustainability.

Keywords: peat supply chain, sustainable peat chain, biodiversity, climate change.

Photos cover: After use- Photo Wetlands International. Peat bricks in Latvia, Photo RHP

ISSN 1566-7197

The pdf file is free of charge and can be downloaded via the website www.alterra.wur.nl (go to Alterra reports). Alterra does not deliver printed versions of the Alterra reports. Printed versions can be ordered via the external distributor. For ordering have a look at www.rapportbestellen.nl.

Alterra report 2167
Wageningen, April 2011

Table of contents

Preface

The project 'Sustainable Peat Supply Chain' is commissioned as part of Dutch Government's policy programme 'Biodiversity 2008-2011'. The horticulture Sector in The Netherlands is an important importer, trader and exporter of peat and peat products.

Project team

Lead:
- Herbert Diemont, associate expert Alterra, Wageningen UR

Members:
- Hein Boon, RHP
- Marinus G. Bos, Bos-Water
- Reinier de Man, Sustainable Business Development
- Marcel Silvius, Wetlands International
- Jan Verhagen, Plant Research International, Wageningen UR
- Raymond Schrijver, Alterra, Wageningen UR
- Henk Wösten, Alterra, Wageningen UR
- Henk Zingstra, Centre for Development Innovation, Wageningen UR

Acknowledgements

The team thanks Jan Water and Gerard van Dijk of the Dutch Ministry of Economic Affairs, Agriculture and Innovation for their guidance and Sandra Clerkx, Alterra for managing the project. Prof. Jack Rieley (IPS) helped to improve the text. Mr Guus van Berckel (chairman of The Netherlands National Committee of the International Peat Society, Nederlands Veengenootschap) facilitated a most inspiring field visit in Germany. The report gained very much from the inputs of the participants of the stakeholder meetings, reported in the annexes.

Executive Summary

This report explores options for enhancing the sustainability of the peat supply chain for Dutch horticulture. The main results of this report on Project Phase 1 regarding the impacts of peat extraction and peat trade on biodiversity in Europe are:

– Introduction (Chapter 1)

The project deals with the future sustainability of the peat supply chain for Dutch horticulture. Sustainability here means:

a. securing long term availability of high quality peat and/or alternatives for the sector,
b. dealing appropriately with biodiversity issues and
c. taking climate change into account.

– The Dutch Horticulture Sector and Peat (Chapter 2)

The Dutch horticulture sector is an important and internationally competitive sector of the economy. Growing media based on peat are very important for the Dutch horticulture sector. Peat is an excellent material and the sector has a long experience of how to achieve optimal results and to minimise risks using peat-based growing media. There are options available to replace peat in certain applications, but the sector as a whole will not freely accept a short-term switch to other materials.

– Peatlands, Biodiversity and Carbon (Chapter 3)

Peatlands contain highly important natural values: not only do they contain highly valuable and threatened biodiversity, they also store major quantities of carbon.
Part of the European Union's high conservation value peatland can be found in countries where new peat mining is being developed. They now occupy an important position in Europe as targets of the peat mining sector. There have been immense losses of natural peatland habitat (mires) in Western and Southern Europe, so that the remaining resource of mire habitat has now assumed greater importance for the maintenance of biodiversity.

– Impacts of Peat Extraction on Europe's Peatlands (Chapter 4)

Peat extraction involves the total removal of the mire vegetation, significant drainage and levelling of the extraction area. After extraction, these areas need to be restored to meet the selected after-use (nature, agriculture, recreation).

Biodiversity

The effects of peat extraction on European peatlands are primarily dependent on the natural values still present. With respect to biodiversity, a distinction has to be made in:

– Already strongly deteriorated peatland, which do no longer contain a particular biodiversity value. Peat extraction in this category has only limited or moderate ecological effects. Active restoration of such areas after finishing extraction can help restore valuable biodiversity and introduce new biodiversity which in time may be comparable with the original mire system.

– Peat areas with high biodiversity
  - High biodiversity natural peatland (mires)
    Peat extraction from this category of peatland may lead to substantial biodiversity losses and could threaten the last representative areas or unique European mire habitats.
  - Semi-natural peatland with high conservation and cultural values
    These peatlands have important biodiversity values, on which extraction may have substantial negative impact. Many, but not all, and varying by country, peatlands in the EU enjoy a high level of protection on the basis of European legislation, including the Habitat and EIA Directives. However, in practice, implementation is sometimes still a problem .

Carbon

With respect to carbon, all peat extraction, both from degraded and from still intact peat areas, removes stored carbon. Eventually all carbon present in the extracted peat will be converted into CO_2 and will be emitted into the atmosphere. In addition, CO_2 is being emitted from the extraction area, as long as drainage takes place. The carbon footprint of peat extraction is therefore the carbon content of excavated peat to which the in-situ emissions caused by drainage are to be added. The carbon footprint of $1m^3$ peat is about 0.25 ton CO_2. The carbon footprint of peat use for growing media in horticulture in The Netherlands is $0.22x10^6$ ton per year CO_2; this is about 0,15% of the total Dutch emissions . Taking in account consumer and outdoor markets the carbon emission doubles, whereas the carbon emission related to again exported volumes of peat is of a similar amount.
Taking into account consumer and outdoor markets the carbon emission doubles, whereas the carbon emission related to again exported volumes of peat is of a similar amount.

– Enhancing Sustainability of the Horticulture's Peat Supply Chain (Chapter 5)

From the foregoing chapters, it is concluded that there is no convincing argument to refrain from using peat in professional horticulture as growing media in the short term. Instead, a strategy consisting of five elements is proposed:

1. exclude the use of peat from high biodiversity value peat areas;
2. allow peat extraction from degraded peatland, but only if best practice measures are taken both during and after extraction;
3. create transparency in GHG emissions related to peat based products and peat extraction, compensating for the CO_2 footprint , if there is an industry willingness to do so;
4. ensure that the future extraction of peat is only from degraded peatland;
5. develop alternatives to peat in the long term.

It is concluded that the final responsibility for the conservation of high value peat areas lies with governments but that, in addition, the peat extraction sector and the peat supply chain sector have an interest to take their own responsibility, to make sure that, independently of the effectiveness of national and local government policies, extraction does not take place in high biodiversity value peatland areas. It is recommended that the Dutch horticulture sector and stakeholders in its peat supply chain explore options for:

– creating full transparency in the peat supply chain;
– agreeing on criteria for biodiversity, based on existing legislation and existing industry initiatives;
– including these criteria into existing quality assurance schemes, such as RHP;
– creating a business case for a more climate friendly peat supply chain.
– exploring options for using (steamed) degraded peat.

– From Analysis to Action (Chapter 6)

On the basis of the second stakeholder workshop, during which four selected action fields were discussed, a proposal for three follow-up action was defined:

– Transparency and Implementation of Responsibility Criteria in the Peat Supply Chain (with RHP in the lead, in cooperation with IPS and a number of stakeholders);
– Best Practices for Peatland After-Use (with IPS in the lead, in cooperation with a number of stakeholders, including ENGOs and industry);
– Scenarios for the Future Availability of Peat (with Wageningen UR Alterra in the lead, in cooperation with the IPS Chapters of The Netherlands and Germany, industry, NGOs and others).

1 Introduction

1.1 Research Questions

In the framework of the Biodiversity Policy Plan 2008-2011 the Dutch Government is working on agreements with selected Dutch trade sectors on enhancing sustainability in supply chains. One of them is the peat supply chain linked to the Dutch horticulture sector.
In that context, Alterra (Wageningen UR) and partners have agreed to carry out a project with two project goals:
1) Gaining insight into the impacts of peat extraction and peat trade on biodiversity in Europe (including CO_2/climate related issues), based on information on production, trade, technologies used, etc.
   The focus is on the role of the Dutch private sector in the international context;
2) Exploring options for improving extraction methods and the use of alternative basis materials[1] for producing growing media for horticulture and possibilities to define indicators, criteria and standards for sustainability.[2]

A Sustainable Supply Chain
This project explores possibilities for making the peat supply chain for Dutch horticulture more sustainable. Sustainability in the context of this project means:
(a) securing the long term supply of high quality peat to the horticulture sector or alternatives to peat;
(b) making sure that biodiversity impacts of peat extraction are reduced to agreed levels;
(c) reducing the supply chain's impact on climate change (notably its carbon footprint).

1.2 Report Structure

This report has the following structure:
– In Chapter 2, the question is asked how important the horticulture sector is for the peat issue, and how important peat is for the sector.
– Chapter 3 explores the (remaining) availability of peatland and peat extraction capacities. Further, it deals with the natural values of peatland that may suffer from extraction with particular attention given to biodiversity and carbon storage.
– Chapter 4 deals with the impacts of peat extraction on biodiversity, carbon storage and the future availability of peat for the horticulture sector.
– Chapter 5 explores the role the Dutch (and European) peat supply chain for horticulture industry could play in contributing to enhancing the sustainability of the peat supply chain.
– Chapter 6 contains recommendations for practical follow-up actions.

---

[1] This part of the goals was not reached because data on the effect on biodiversity and on CO_2 emission of alternative materials are not available.
[2] For the complete Terms of Reference, see: Projectplan Verkenning Verduurzaming van Veenketens, Alterra, Wageningen UR, 20 November 2009.

2 The Dutch Horticulture Sector and Peat

2.1 The Dutch Horticulture Sector and its Peat Supply Chain

2.1.1 Dutch Horticulture

Dutch horticulture has a turnover of more than € 4 billion. Related products by industrial suppliers may easily boost this amount to € 6 billion. The export value is even higher: cut flowers (€ 2.2 billion), container plants and tree crops (€ 2.2, 1.9 and 0.4 billion, respectively). For the Dutch horticulture sector, the continued availability of peat as a growing medium is of utmost importance.

2.1.2 Peat Extraction and Consumption in Europe

Peat extraction in the EU is about 65 million ton/year (2005). Most of the peat extracted in Finland and Ireland is used for energy purposes. A total of $68x10^6$ m^3/year peat is used in the EU, of which about $3x10^6$/year (<4%) is imported. The largest overall peat producing countries in the EU are Finland, Ireland and Germany (24, 14 and $8x10^6$ m^3/year, respectively), harvesting 74% of the total production. About 50% or $34x10^6$ is used for energy, mainly in Sweden, Finland, and Ireland. Horticulture uses 42% or $29x10^6$ m^3/year of peat.

2.1.3 Peat and the Dutch Horticulture Sector

Dutch potting soil producers import 4.2 million m^3 peat per year from Germany, the Baltic states (Estonia, Latvia and Lithuania), and Ireland. Roughly one third is used in horticulture, one third for the outdoor/ consumer market and one third is exported as growing medium. More insight in these figures may be subject to future work.

2.2 Importance of Peat and Options for Substitution

2.2.1 Peat Based Growing Media

Peat has excellent properties for use in the horticultural sector whose experts emphasise that there are hardly any alternative materials that are as attractive as peat in the full spectrum of its high demanding applications. The sector will not freely accept a forced replacement of peat by other materials unless it can be shown that peat extraction leads to strongly negative (environmental) impacts that can neither be avoided nor justified.

High Quality, High Added Value

Peat-products have proven to be constant in quality with respect to the requested characteristics and specifications (as shown in Table 1) and therefore offer continuity for the final user. Peat has favourable chemical and physical characteristics i.e. a low pH which enables the production of growing media which meet the specific needs of the plant, by adjusting the pH by adding lime. Low nutrient level: bog-peat hardly contains any nutrients, which allows them to be added to obtain the specific nutrient levels required in the growing medium during the production process. Peat also permits the preparation of specific types of growing media from either milled-peat or sod peat. Peat-based growing media provide sufficient air and structural stability that ensure the physical properties of the growing medium for several years. Peat products are available in large volumes. Peat is very uniform and constant in its properties. The circumstances under which peat is formed, ensures phyto-sanitary clean products. As from its nature of development peat contains no organisms which can be harmful for crops as long peat is not from degraded sources.

Table 1
Listing of four properties of growing media and their constituents to pertain quality (Schmilewski 1998).

Physical	Chemical	Biological	Economical
Structure and structural stability	pH	Weeds, seeds and viable plant propagules	Availability
Water holding capacity	Nutrient content	Pathogens	Consistency of quality
Air capacity	Organic matter	Pests	Cultivation technique
Bulk density	Noxious substances	Microbial activity	Plant requirements
Wetting ability	Buffering capacity	Storage life	Price

In horticulture the cost of the growing media is a relatively small fraction of the total cost of the final product. The added value, however, is considerable. In The Netherlands, peat is by far the most important constituent of growing media creating a high added value as compared to its costs.

2.2.2 Alternatives to Peat

In this project, the alternatives to peat as a material for growing media have not been studied. Therefore, it is impossible to judge the acceptability of alternative materials based on coir, bark or wood fibre and many other materials. We do not have sufficient information on their biodiversity impacts, carbon footprint or the social problems connected to them. None of the alternative materials so far is a suitable replacement for peat. The (Dutch) horticulture sector has a strong preference to continue using peat in the majority of applications, not only because of its excellent characteristics, but also because of the sector's long experience with this material. Switching to other materials will inevitably create the need for investments in new systems and time for optimising them. As long as peat of good quality from reliable and ecologically acceptable sources is available, there is no need for a forced transition from peat to other materials in the short term. Eventually availability problems will inevitably play a role. More stringent criteria on biodiversity and CO_2 issues will, sooner or later, create supply problems. It is therefore in the interest of the sector to actively explore alternatives to peat.

3 Peatland, Biodiversity and Carbon

3.1 Europe's Remaining Peatland

Water-logged, acid and low-nutrient conditions are prerequisites for the accumulation of dead plant organic material in peat bogs. Therefore most peatlands are distributed over a wide range of cold, temperate and tropical climatic conditions, which have in common a relatively high rainfall. The distribution of organic soils in Europe shows a strong northern bias (Figure 1). Outside the former Soviet-Union, almost one third of the European peatland is in Finland, and more than a quarter is located in Sweden. Substantial areas of peatland are also found in Poland, UK, Norway, Germany, Ireland, Estonia, Latvia, Netherlands and France. Small areas of peatland and peat-topped soils are also present in Lithuania, Hungary, Denmark and the Czech Republic.

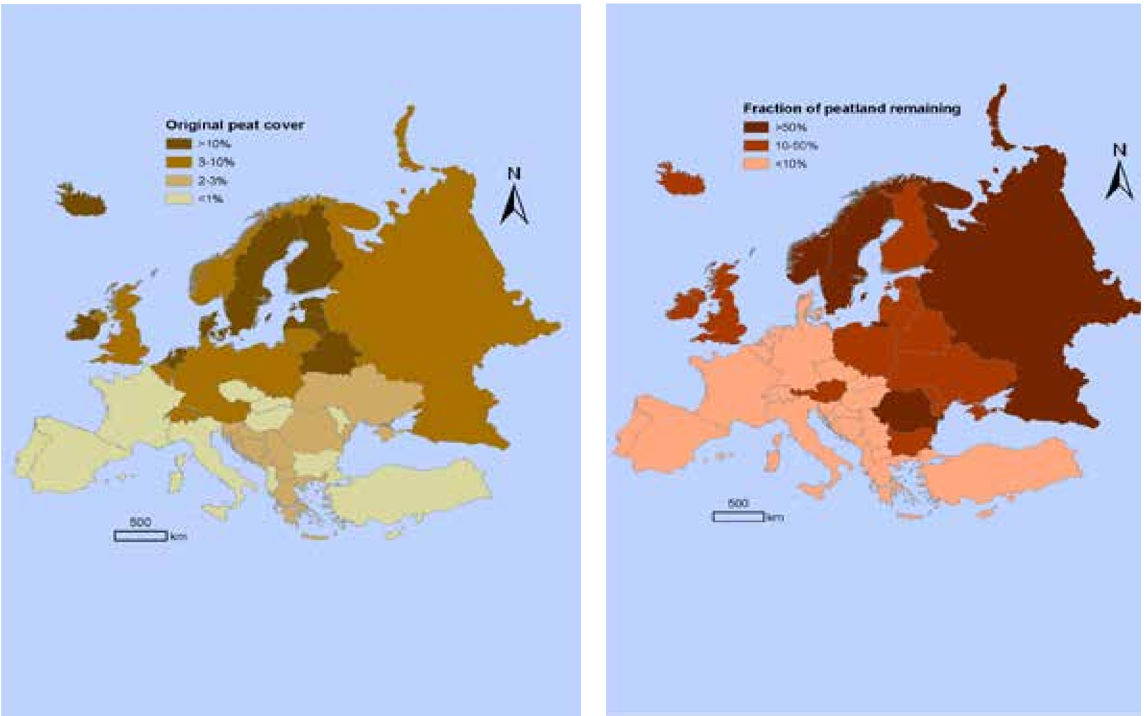


Figure 1
Distribution of peat in Europe and the remaining fraction of pristine peatland (Bragg et al, 2003).

A large fraction of the original peatland area has disappeared (Figure 1), mostly through drainage for agriculture and forestry and partly as a result of peat extraction (Chapter 4). In The Netherlands and Denmark (Figure 1) pristine peat bogs have virtually disappeared because of human activities and all their pristine bogs as well as some degraded bogs have become nature reserves. In Germany, about 10% of the original pristine natural peat areas still remain, and it is no longer allowed to develop pristine peat bogs. In the UK, substantial peat resources are still available, but extraction is much reduced owing to NGO and Government action. Whereas new openings of pristine bogs in some countries is prohibited, many of the current extraction sites that supply peat to The Netherlands were developed in high biodiversity areas, and without implementation of an EIA. To enhance sustainability of the Dutch peat supply chain, these areas should be subject to an EIA to assess possible needs for adjustments to current practices to limit environmental impacts (e.g. with ecologically linked high biodiversity areas).

3.2 Biodiversity

World-wide, peatland forms unique features in the landscape. They contain a specific biodiversity, which reflects their specific environmental conditions. Peatland in the main source countries of the peat that is traded and/or used in The Netherlands occupy a specific and highly valuable segment of European biodiversity. They represent 13 of a total of 43 indicative bio-geographic regions of Central Europe (stretching from the Baltic sea to the Black Sea including eight countries). They show a particularly high occurrence of various bog types compared to other regions. Therefore, they appear to be very important for the conservation of representative areas of bog habitats. Their role as permanent refugia is increasingly important in landscapes that suffer from aggravating anthropogenic pressure. Peatland supports in particular an intra-specific biodiversity. Two categories of peatland possess high conservation values: natural, largely undisturbed peatland (mires) and semi-natural peatland.

Natural Peatland (Mires) with Unique Biodiversity
There have been losses of the habitat through agriculture and forestry over a long period of time from western, west-central and southern Europe. As a result, the rich resource of peatland that remains in the Baltic countries has now assumed even greater importance for maintenance of the continent's biodiversity.

Semi-Natural Peatland with High Biodiversity
These are peatlands that have lost part of their natural character through agriculture and forestry but nevertheless contain substantial biodiversity and/or cultural values. In addition, they often contain important landscape values. More details are found in Appendix 1.

3.3 Carbon Storage and Other Values

3.3.1 Carbon Storage

Peatland globally constitutes a major carbon store. Approximately 400 to 500 million ha (about 3% of the land area of the world) is peatland. About 480 to 600 Gt of the terrestrial carbon is locked in peatland, or twice the amount of carbon stored in the world's forests. The amount of carbon in all living green biomass is 650 Gt. While the potent greenhouse gas methane is formed under anaerobic conditions as found also in pristine peatland, the net greenhouse gas balance of these areas is positive for most natural peatland. They are CO_2 sequestering ecosystems that act as carbon sinks. At present, peatland in the tropics have become a global source CO_2 owing to land use change and drainage. World-wide CO_2 emissions from peatlands amount to about 2 Gt per year. For more details see Appendix 4.

3.3.2 Other Values: the surroundings of the extraction site

If the horizontal resistance to flow is decreased through artificial drainage, the local lowering of the groundwater table may influence adjacent hydrologically connected peatland or other adjacent nature areas. Where drainage is installed in part of a peat deposit, over time this drainage will affect the hydrological equilibrium of the entire hydrological system. See also Section 4.2.1.

4 Impact of Peat Extraction on Europe's Peatland

4.1 Use of Peat Land

4.1.1 Peat Extraction

There are different extraction methods that result in different qualities of peat for different applications. The reader is referred to Appendix 2 for details. Main peat types are (1) sphagnum peat, (2) white peat, (3) transitional peat, (4) frozen black peat (actually an extraction method) and top spit and (5) black peat. Typical peat profiles are given in Figure 2.

The different peat types have different properties, one of the most important being the water holding capacity as a function of the degree of decomposition, which determines their suitability for certain applications (Appendix 2). Certain types of peat are gradually becoming scarce, such as white peat and (frozen) black peat from Germany, which necessitates the peat industry looking for alternative sources, e.g. in the Baltics.

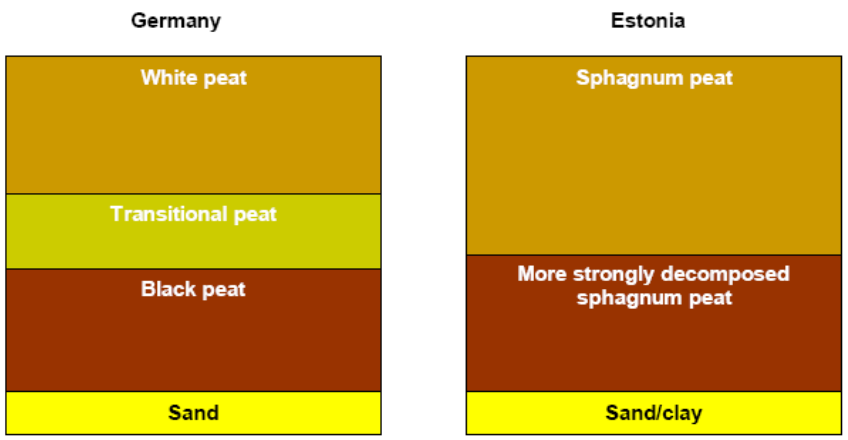


Figure 2
Example of common peat profiles in Germany and in the Baltics.

4.1.2 After Extraction

When the peat reserves in a particular extraction site are exhausted or close to exhaustion, there are several options for what will happen to the landscape. Common options are conversion to agriculture (possibly by using remaining peat for soil improvement), forestry, rehabilitation (nature restoration) or other land uses.

4.2 Impacts of Peat Extraction on Biodiversity

4.2.1 Peat Extraction and Biodiversity

As a rule, industrial extraction of peat involves the total removal of the mire vegetation, significant drainage and subsequent removal of the upper layer of peat. During the extraction process, this results in large areas of bare peat.

Peat Extraction from Areas with High Conservation Value
Many peatlands, but not all, and varying by country, with particular biodiversity values enjoy a high level of protection on the basis of European legislation (e.g. Natura 2000 - EU Habitats and Birds Directives - and EU Water Framework Directive) and/or international conventions (e.g. Ramsar convention). Delays in implementation and/or lack of enforcement create a situation in which high conservation value peat areas are still being threatened by extraction. For details, see Appendix 1.

Peat Extraction from already degraded Peatland
Peat extraction from degraded peatland (which have lost their peatland biodiversity through agriculture and forestry) may ultimately enhance biodiversity if appropriate rehabilitation measures, such as re-wetting, are taken after extraction (Section 4.2.2). The main threats to biodiversity are not at the European sites that are producing from formerly degraded peatlands but those locations where pristine peatland is still being opened for extraction. Measures to protect biodiversity should therefore focus on locations with high biodiversity, whereas new extractions should focus on degraded peatlands(Chapter 5).

Impacts on surrounding areas
If the horizontal resistance to flow is decreased through artificial drainage, the local lowering of the groundwater table may influence adjacent hydrologically connected peatland. Where drainage, being installed in part of a peat deposit, is not isolated from the surrounding area, this drainage will gradually affect the hydrological equilibrium of the upstream hydrological system. The related lowering of the water level will negatively affect peat accumulation and associated pristine bog vegetation.

4.2.2 Peatland rehabilitation and biodiversity

Areas used for peat extraction can recover significant biodiversity value if, after extraction, good rehabilitation projects are put in place, involving rewetting and re-vegetation through natural regeneration and replanting. They can also reduce or stop GHG emissions from remaining drained peat areas. One of the difficulties in restoring former extraction sites appears to be the irregular levels of the new peat surface in combination with the current policy to restore all parts of the area to the same type of landscape. This requires zones with different (artificial) groundwater levels.

4.3 Impacts of Peat Extraction on Carbon Storage

Peat extraction removes carbon stored in the peat system. Eventually, all carbon from the extracted peat will be freed into the atmosphere as CO_2. A rough calculation shows that 1 m^3 of peat, which is equivalent to 140 kg of soil, contains 81 kg C, which is then oxidised into about 0.25 ton CO_2. If 15% of the peat remains in the soil. the carbon footprint of the Dutch horticultural sector (importing $4.2x10^6 m^3$ peat per year) is somewhat less than 0.22 million ton/year CO_2 if all exports of peat and peat products are subtracted. This contribution of the peat supply chain to the national carbon emissions is ca 0.15% of overall Dutch emissions (excluding in-situ emission, Appendix 4).

4.4 Future Availability of Peat

Within the next ten years there is most likely sufficient peat of different qualities available from existing extraction sites. Thereafter, supply bottlenecks may develop. A rough inventory, for example, shows that the present extraction sites in Estonia will be depleted in 2020. We foresee the following developments:

- Production from degraded peatland without particular biodiversity values will continue. Some of the sites will gradually become depleted. The production of particular peat qualities will diminish.
- Tighter environmental controls (on biodiversity) in the EU and improvements in implementation on the national level will restrict the opportunities for opening up new peat extraction areas. This will also lead to a decreasing availability of those peat qualities that are associated with pristine peat areas.
- Lack of opportunities to open up new peat extraction in the EU will divert peat extraction to countries outside the EU, such as Belarus.

If the (Dutch) horticulture sector wishes to import peat from 'responsible' sources only, it must exclude all peat from high conservation value areas, whether in the EU or not. This requires a strategy that concentrates on the use of peat from degraded peatland, including using peat from land that has been converted to agriculture and forestry combined with the use of technologies to upgrade the quality of peat from less favourable sources to make it suitable for higher quality applications (e.g. realising sanitary quality requirements through steaming).

5. Enhancing Sustainability of the Horticulture's Peat Supply Chain

5.1 Responsible Peat Strategy for the Horticulture Sector

5.1.1 Continued Supply of Responsible Peat

The central question is how the peat supply chain to (Dutch) horticulture can be made 'more Sustainable'.[3] Our particular interest is in reducing the supply chain's impact on biodiversity and climate change processes (through GHG emissions). From the foregoing sections, it is concluded that there are no compelling arguments to argue for refraining from the use of peat as growing media in the near future. The shorter term strategy should focus on 'excluding the unacceptable', promoting best practice extraction and rehabilitation, and possibly on compensating for the peat's CO_2 footprint. In the longer term, substitution of peat with alternative materials may become a priority.

5.1.2 Five Pillars of Enhancing Sustainability in the Peat Supply Chain

Biodiversity

1. Excluding the Unacceptable
Peat cannot be 'responsible' if it is extracted from peatlands with high biodiversity value, either natural peatland (mire) or semi-natural peatland with high biodiversity and cultural values. In operational terms, these are peatlands that should be excluded from extraction. Peat from extraction sites for which no EIA has been carried out is unacceptable.

2. Promoting Best Extraction and Rehabilitation Practice
Peat that is not classified in the first category ('unacceptable') can only be classified as 'responsible' if sufficient guarantees can be given on following best practice both during and after exploitation. At least, a rehabilitation plan should be available already during the extraction phase.

Carbon

3. Reducing the carbon footprint
The carbon footprint of the Dutch peat supply chain for horticulture is 0.15% (Section 4.3). However, the peat supply chain may have good reasons to voluntarily compensate for its carbon footprint.

---

[3] Peat extraction will never be 'sustainable' as it results in irreversible loss of natural systems, including CO_2 storage. Therefore we rather use 'responsible peat', peat that is being extracted more responsibly. This follows the Strategy for Responsible Peatland Management facilitated by IPS.

Availability

4. Securing Peat Supply
As a result of ongoing exploitation and stricter ecological regimes, supply bottlenecks are likely to emerge, especially for pristine peat. Technologies for using peat from degraded peatland in high quality applications (e.g. involving steaming) could contribute to avoid these bottlenecks. Another option to explore for reducing biodiversity and environmental impacts is the avoidance of application of peat in growing media for the less demanding consumer markets and the hobby sector. This will also help to extend the lifetime of current source areas for supply to the valuable Dutch horticultural sector.

5. Exploring Substitution
As eventually the availability of 'responsible peat' at the right price and with the right quality and logistics will become a bottleneck, substitution of peat should be the fifth pillar of the horticulture sector's strategy for growing media. However, the acceptability of alternatives (and their impact on biodiversity and carbon footprints are outside the scope of this project.

5.2 Sourcing Responsible Peat for Growing Media

5.2.1 Securing Continued Peat Supply: Keeping a 'Licence to Operate'

The (Dutch) horticulture sector, and its peat supply chain, have a strong business interest to guarantee continued supply of peat and peat-based products in the future. However, ongoing discussions on the sustainability of peat extraction and related production of peat-based products may become a threat to future peat supply. To keep its 'licence to operate', the sector has an interest to show that it operates responsibly. Therefore it could be advisable to implement an industry standard (a set of criteria) for 'responsible peat', related to the biodiversity and carbon issues addressed in this report. The sector should make sure that the standard is being implemented in all its supply countries, independently of national laws and the quality of their implementation. The preliminary ideas described below are an input into the discussion during Project Phase II.

5.2.2 Making the Peat Supply Chain Transparent

The implementation of an industry standard for 'responsible peat' requires transparency throughout the peat supply chain. It should enable to identify the source of peat brought onto the (Dutch) market for 'responsible' peat-based products and to disclose all relevant site-specific information on legal aspects, Environmental Impact Assessment, biodiversity and nature protection status of the area. There is no need for complete traceability from end product to extraction site. However, the transparency system should make it possible to guarantee that only 'responsible peat' is entering the supply chain. It should enable any party with doubts about the responsible character of peat to have a look at the production sites where the peat is coming from.

5.2.3 Inclusion of Biodiversity Criteria in (existing) certification systems

Exclusion of the Unacceptable and Best Practice of the Acceptable

If the industry decides to define a standard for 'responsible peat', it should focus on the exclusion of peat from areas with high biodiversity value. In addition, it should contain a number of criteria for 'responsible' extraction outside these high conservation areas, including obligations on reclamation of the area for after-use.

Existing Legislation as the basis

EU legislation contains good elements on which the standard can be built, so that time-consuming discussions on defining 'high conservation value' can be avoided. This legislation includes the EIA Directive, the Birds and Habitats Directives and the Water Framework Directive. In addition, the industry standard may build on existing initiatives, especially on EPAGMA's Code of Practice for Responsible Peat Management (2009) and the Strategy for Responsible Peatland Management, an initiative facilitated by the International Peat Society (IPS). Application of these standards in enhancing the sustainability of the peat supply chain should be independent of the quality and the speed of implementation in the peat producing countries and be equally valid for peat from countries outside the EU.

Inclusion in Existing Quality Assurance Schemes

Various option for implementing these criteria for 'responsible peat' are still available. One promising option, which should be discussed in any case, is to add a number of criteria on 'responsible peat', possibly derived from existing initiatives, to already existing quality certification systems. For The Netherlands, inclusion into the RHP quality assurance system may be the best option.

5.2.4 Compensating for the Carbon Footprint?

In addition to implementing the above mentioned biodiversity criteria, the industry could decide that it is in its own interest to compensate for the carbon footprint of their peat-based products. With a carbon footprint of 0.25 tons CO_2 per m^3 peat, and, a voluntary market price of € 6/ton CO_2, the offset would be € 1.50 per m^3 peat. For example, if 1 m^3 is used to grow 1,500 plants, the costs per plant would be 0.1 cent.

5.2.5 Steaming Degraded Peat Resources

The conclusions and recommendations in this report might lead to a decrease of the availability of current sources and types of peat. The availability of volumes and qualities required by Dutch horticulture can probably be secured by making use of degraded agricultural peat resources. The peat industry has already developed methods to steam peat from degraded resources, in order to meet sanitary quality requirements. In Germany, for example, more than 100,000 ha of former peat bog is used for agricultural purposes, whereas this peat still offers the potential to be used for certain applications in growing media for both the professional and hobby market. During the second stakeholder meeting (Appendix 5), the need to make a more precise analysis of the availability of different peat qualities and the extent to which sanitation through steaming could be useful was brought forward.

6 From Analysis to Action

6.1 The Second Stakeholder Workshop

During the second stakeholder workshop (Wageningen, November 18, 2010), a draft version of this report was discussed. Subsequently, four action fields were proposed:

- Action field 1
  Implementing sustainability criteria in the supply chain;
- Action field 2
  Improving After-Use Measures;
- Action field 3
  Taking Responsibility for Carbon and Climate;
- Action field 4
  Increasing Peat Production from Severely Degraded Peat lands.

The discussion on Action Field 1 led to a remarkable high level of agreement, which is a good basis for coming actions, see below. Similarly, the discussion on Action Field 2 showed a high level of support for developing a systematic framework for best after-use practices. The interest in the carbon and climate issues did not appear to find sufficient support for starting immediate work. The discussion on action Field 4 revealed that the issue needs more careful consideration and that a much better picture of the availability of peat in different qualities is needed.

6.2 Three Project Initiatives

The discussion during the second stakeholder workshop (November 2010) of four action fields led to agreement on the following three project initiatives:

- Project 1
  Creation of transparency in the peat supply chain and implementation of 'responsibility criteria' is a first priority. The criteria should be in line with the work on responsible peatland management carried out by IPS and the Dutch industry (led by RHP) can start a pilot on supply chain transparency, standard implementation and verification.
- Project 2
  The development of best practices for peatland after-use should be encouraged. A project led by IPS should be formulated.
- Project 3
  A much better quantitative basis for discussing the future availability of peat (different types, different qualities) is needed. Further research, possibly led by Wageningen UR Alterra, was welcomed.

Appendix 6 gives a first draft for the Terms of Reference for these three project initiatives.

References

Clarke, Donal and Jack Rieley (eds). Strategy for Responsible Peatland Management, 2010. International Peat Society.

Global Change Biology,2010, doi: 10.1111/j.1365-2486.2010.02279.x.

Joosten, H. and D. Clarke, 2002. Wise use of mires and peatlands. Background and principles including a framework for decision making.

Bragg O. and R. Lindsay (main editors), 2003.Strategy and Action Plan for Mire and Peatland Conservation in Central Europe. Central W. European Peatland Project (CEPP). Wetlands International , Publication 18, 93 pp.

Page S.E., J.O. Rieley and C.J. Banks. Global and regional importance of the tropical peatland carbon pool, Department of Geography, University of Leicester, University Road, Leicester LE1 7RH, UK, School of Geography, The University of Nottingham, University Park, Nottingham NG7 2RD, UK

Page, S.E., F. Siegert, J.O. Rieley, H.-D.V. Boehm, A. Jaya and S. Limin, 2002. The amount of carbon released from peat and forest fires in Indonesia during 1997. Nature 420, 61-65.

Schmilewski, G. (editor), 1998. Peat in Horticulture: Its Use and Sustainability, Proceedings of the International Peat Conference, International Peat Society.

Glossary

1. **After-use of peatland**
   The planned rehabilitation, restoration or conversion of a peatland following drainage for economic use. After-use may include restoration of peatland ecosystem functions including biodiversity, rehabilitation of peatland processes and/or services or changing the management of a peatland for other purposes, e.g. agriculture, forestry, bird-watching areas, angling, nature walks or construction development.
2. **Biodiversity**
   The variability of living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and adherent ecosystems. Synonym to Biological diversity (United Nations Convention on Biological Diversity (1992).
3. **Certification**
   An attestation by an independent body that a product or process meets specified criteria: the system whereby such a statement is audited, verified and communicated. In the case of peatlands certification would give assurance that a particular peatland was managed to meet the social, economic and ecological needs of present and future generations and that products or services originating from the peatland also met those needs.
4. **Conservation**
   The act of keeping something entire, keeping unchanged, preservation from loss. Used in the sense of a deliberate or political decision to preserve.
5. **Degraded peatland**
   A peatland which had lost its original functions, whose peat-forming and/or ecosystem functions have been damaged or destroyed (this can be man-induced or naturally through climate change) (Joosten and Clarke 2002).
6. **Ecology**
   (a) The science of the relationships between organisms and their environments;
   (b) the relationship between organisms and their environment (Joosten and Clarke 2002).
7. **Economic use**
   Any use of a peatland which contributes to economic benefits (Joosten and Clarke 2002).
8. **Ecosystem services**
   Services provided by the natural environment that benefit people.

These benefits include:

- Resources for basic survival, such as clean air and water;
- A contribution to good physical and mental health, for example through access to green spaces, both urban and rural, and genetic resources for medicines;
- Protection from hazards, through the regulation of our climate and water cycle;
- Support for a strong and healthy economy, through raw materials for industry and agriculture, or through tourism and recreation; and Social, cultural and educational benefits, and wellbeing and inspiration from interaction with nature. While there is no single, agreed method of categorising all ecosystem services, the Millennium Ecosystem Assessment MEA) frame work is widely accepted and is seen as a useful starting point. The MEA identifies four broad categories of ecosystem service which all lead to different benefits: Provisioning services: we obtain products from ecosystems such as food, fibre medicines;
- Regulating services: we benefit from the results of ecosystem processes such as water purification, air quality maintenance and climate regulation;

- Cultural services: we gain non-material benefits from our interaction with the natural environment such as education and well-being;
- Supporting services: functions that are necessary for the production of other ecosystem services from which we benefit, such as soil formation and nutrient cycling (www.defra.gov.uk/environment/policy/natural-environ/ecosystems/index.htm).

9. **Environmental**
The interaction of a peatland with the surrounding area, including the peatlands' biodiversity value, ecosystem services and climate impacts. As used in this document the word includes 'ecological'.
10. **Good governance**
This term is used by the United Nations to describe how public institutions conduct public affairs and manage public resources in order to guarantee the realization of human rights. According to the UN, good governance has 7 characteristics:
    1. Consensus orientated;
    2. Following the rule of law;
    3. Effective and efficient;
    4. Accountable;
    5. Transparent;
    6. Responsive;
    7. Equitable and inclusive.
11. **Greenhouse gas (GHG)**
Any gas in the atmosphere that contributes to the greenhouse effect. These include carbon dioxide, methane, ozone, nitrous oxide, CFCs, and water vapour. Most occur both naturally as well as being created by human activity (http://unfccc.int/resource/cd_roms/na1/ghg_inventories/english/8_glossary/Glossary.htm).
12. **Interested party**
A person or group having an interest in the policies and operations of an activity or business with a willingness to participate in related decision-making and/or implementation at an appropriate level. Interested parties include peatland managers, industry, non-governmental organizations (NGOs), social groups, relevant government bodies, etc.
13. **Local people**
Local people are any individuals or groups of people in the area who are affected directly or indirectly by peatland management decisions.
14. **Mire**
A peatland where peat is currently being formed and accumulating.
15. **Mitigation**
Any process which seeks to reduce negative environmental consequences of an intervention in a peatland.
16. **Monitor**
To periodically review whether the plan for a peatland has been followed, compare the actual outcomes with those planned, and to take remedial action where necessary.
17. **Paludiculture**
The cultivation of biomass on wet and re-wetted peatland.
18. **Peat**
Sedentarily accumulated material consisting of at least 30% (dry weight) of dead organic material.
19. **Peatland**
An area with or without vegetation with a naturally accumulated peat layer at the surface.
20. **Peatland rehabilitation**
The reparation of ecosystem processes, productivity and services of the former peatland, but does not imply the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure (SERI 2004).

21. **Peatland restoration (or reclamation)**
The process of assisting the recovery of peatland that has been degraded or damaged to as near as possible its original natural condition (SERI 2004)
22. **Protection**
Preservation, maintenance and enhancement of specific biological, social or cultural value.
23. **Public consultation/participation**
A regulatory process by which the public's input on matters affecting them is sought, a consultation process in which all stakeholders can actively participate
24. **Responsible peatland management**
Responsible peatland management is implementation of Wise Use of peatland through safeguarding their environmental, social and economic functions and respecting local, regional and global rights and values.
25. **Resource**
An available supply that can be drawn on when needed.
26. **Semi-natural peatland**
Peatland that have been used and/or drained in the past or that are partially drained but which retain some peat-forming characteristics or potential and/or peatland ecosystem functions'.
27. **Stakeholders**
All persons and organizations having a direct interest.
28. **Uses of peatland**
Covers all uses including conservation and non-use.
29. **Wise use of peatland**
Use of peatland for which reasonable people now, and in the Future, will not attribute blame. Use includes conscious non-use (e.g. conservation).

Appendix 1 Legislation and Impacts of peat extraction on nature

Marcel Silvius[1] and Henk Zingstra[2]

[1] Wetlands International
[2] Centre for Development Innovation

Table of contents

Summary

Biodiversity importance of peatlands

1. Peatlands make a significant contribution to European biodiversity, especially mires that are actively accumulating peat. Despite their relatively low species diversity, peatlands contain a high proportion of rare and endangered species and provide refuges for them. For example, a large proportion of all European orchids occur in transition mires of the temperate zone.
2. The role of peatlands as permanent refugia is increasingly important in landscapes suffering from extreme anthropogenic pressure but their increasing isolation causes an 'island effect'. Peatlands support an intra-specific biodiversity. Isolation of peatlands causes an 'island effect' and a related polymorphism.
3. The peatlands of Central and Eastern Europe consist of a larger number of bog and fen types (Bragg *et al*, 2003) than other regions of Europe making them very important in terms of nature and wildlife conservation. Central European peatlands harbour large populations of breeding and migrant birds and provide overwintering sites for many bird species of European and global conservation importance. The vast majority of the mire areas in the Baltic countries are designated as (proposed) Sites of Community Interest bearing proof of the importance of their biodiversity.
4. Because of the large losses of peatland habitat in western, west-central and southern Europe, peatlands in the Baltic countries now occupy a 'frontier position' in terms of mire conservation and are therefore of even greater importance for maintenance of the continent's biodiversity
.
5. In some rare cases peat excavation may contribute to biodiversity conservation during mining operations. An example is the provision of breeding habitat for the threatened southern population of Golden Plover in north-west Germany which used to breed in primary bog habitat but now appears to be strongly dependent on the de-vegetated active peat mining areas for suitable nesting sites.

Threats from peat extraction

6. Most industrial extraction of peat uses the milling technique (either for energy or for use as a component in growth media), which is carried out over a period of many years and involves the total removal of the mire vegetation, drainage and levelling of the extraction area, followed by removal of the upper layers of less humified peat. These result in large areas of bare peat on which the natural resource functions of the natural peatland, including biodiversity, ecology and hydrology are impacted severely (Charman, 2002).
7. The greatest threat to peatlands in Europe lies in the potential opening up of new peat extraction sites in Lithuania, Latvia and Estonia. An additional threat is the diversion of new extraction developments to Belarus once the easily accessible (e.g. near harbours) resources in the Baltic countries are depleted or permits become difficult to obtain because of stricter protection regulations.
8. There is evidence that some of the peat extraction activities in the Baltic States take place on or in the vicinity of Natura 2000 areas, e.g. in Lithuania, although permissions may have been granted before N-2000 designation. In Estonia there is always a buffer zone between mining areas and Natura 2000 sites. There is lack of overview of the location of current and planned peat extraction sites in relation to areas of international importance for biodiversity conservation. It is also unclear if there is an appropriate representation of rare and endangered peatland types and dependent species in current protected areas in the Baltic countries. Estonia, for example, has an overview of all peat deposits and peat extraction sites in its Environmental Register (but other countries do not). (http://geoportaal.maaamet.ee)

9. Although the EU Habitats Directive and the establishment of a European Network of Sites of Community Interest presents a significant step forward in the protection of valuable biodiversity the classification system used to identify habitat types of European significance is not well adapted to identify the most precious mire habitats. As a result, some mire habitats are not recognized as such but recorded as woodland and forest because tree species are used as the main criterion for habitat classification. As a consequence, areas important from the perspective of peatland protection are not always identified.
10. The Convention on Wetlands (Ramsar 1971) explicitly acknowledges the need for identification of appropriate bio-geographical units for peatland ecosystems in general, and for the use of this classification as the basis of designation of important sites. Whereas the Baltic countries already appear to have a clear classification in terms of bio-geographic units, they are not consistent in their approaches in that some display 'mire regions' and others 'geo-botanical regions' or vegetation maps. It would be sensible to achieve consistency in this respect and determine the location of current and prospective peat extraction sites in the Baltic countries within such a unified bio-geographical context and in relation to present inclusion of peatlands in the protected area systems.
11. Peatlands play a role in water regulation and their degradation can lead to increased surface run-off which may affect water quality and contribute to flooding downstream. Direct hydrological impacts of peat extraction are most severe on adjacent hydrologically connected peatlands where drainage/extraction is taking place on only part of a peat deposit. It is clear that over time peat extraction will affect the hydrological equilibrium of the entire peatland. There are no data available to enable assessment of the significance of this either in situ or downstream or of possible accumulative effects.
12. There are many examples, however, of protected peatland areas that are impacted through drainage caused by peat extraction located in the same hydrological system (bog).
13. Current and former extraction areas may impact on aesthetic landscape values, thus affecting potential tourism.

Peatland rehabilitation

14. Three distinct phases can be identified in the life cycle of production peat bogs, namely, pre-production, in-production and post-production. During all three phases, responsible management requires information on, inter alia, the spatial patterns, and the physical and chemical characteristics of the land cover at the time (McGovern et al., 2000).
15. Areas damaged by peat extraction may recover significant biodiversity value if after extraction good rehabilitation projects are carried out, involving rewetting and re-vegetating through natural regeneration and replanting. These projects are also needed to reduce or stop GHG emissions from drained peat areas. However, the original biodiversity values of the areas as representatives of particular habitats within a bio-geographical region and the specific dependent species and intra-specific biodiversity linked to such areas may be lost for centuries or forever (species extinctions, extinction of intra-specific variability). During recent years peat rehabilitation activities have been intensified in Estonia using specific guidelines available in the homepage of the Ministry of the Environment (http://www.envir:ee/79947).
16. One of the difficulties in restoring former extraction sites appears to be the irregular levels of the new peat surfaces, which constrain the possibilities for full rewetting of affected areas. Current and future extraction techniques and planning should take these into account to optimise restoration potential.

Overview of peat excavation per country

Estonia

17. The original extent of mires in Estonia was 1,009,100 ha of which currently only about 325,000 ha remain in a natural state, representing a loss of 67%, mostly to agriculture and forestry. Presently 19,524 ha (1.9%) is impacted by peat excavation activities including 10,000 ha of abandoned sites. Estonia still has a significant area of specific and rare mire types including ombrotrophic raised bogs with a peat thickness up to 18m. A total of 69 vascular plant species, 25 bryophytes and 22 animals from the Red Data book occur in Estonia's mires. There are 24 habitat types and 15 subtypes described. Peatlands directly impacted by extraction since 1913 cover an estimated 30,000 ha, including 15,000 ha of abandoned sites .Another 30,000 ha is affected indirectly by drainage caused by peat cutting (Leivits 2001). Currently, Estonia is the third largest exporter in the world of horticulture peat. In recent years the amount of annual peat extraction has been 1.2-1.5 million tons, or two to three times the annual growth of peat in Estonia. The main areas of mires affected by peat excavation are concentrated in the Pärnu and Harju counties. Estonian government and regional authorities are under considerable pressure from developers to permit peat extraction on virgin peatland. However, there are only 25-30 bogs (total area ca. 10,000 ha) where the slightly humified Sphagnum peat preferred for horticultural use can be found. Any new designation for extraction will thus have considerable impact. However, there have been no new permits for extraction of peat in virgin peatlands issued recently. Inventories on the extent and distribution of peatlands have been carried out by Paal (1997) and at present this inventory is being updated and is planned to be ready in 2011.
18. The Estonian State Audit Report (2005) mentions that 'Since the extraction volumes exceed the increment of peat, the usage of peat resources is organised in a non-sustainable manner. Ilomets (2001) noted that peat excavation exceeds peat growth by two to three times.
19. Peat excavation is directly impacting on Natura 2000 sites. An example is the Õmma bog: Just before its designation a licence was provided to a peat extraction company, excluding the north-western half of this intact bog in the designation. The peat extraction is expected to impact the rest of the bog as a result of drainage. In an effort to limit the impact of peat extraction, water basins are created on the border of the mining areas. Other valuable bogs (in terms of biodiversity and traditional use) currently threatened by extraction and/or applications for new extraction areas include Illaste bog (Rapla County), Raäma bog (near Pärnu), Soosaare bog (Viljandi county), Tõrva bog (Valga county), Lavassaare (Maima, Elbu), Rae and Sausti bogs (near Tallinn). The applications for permits to extract peat on Illaste, Rääma, Soosaare, Tõrva (or Helme bog), Maima, Elbu, Rae, and Sausti bogs were suspended on environmental grounds. According to the State Audit Report (2005) the Minister of Environment of Estonia is planning to convert permits for extracting peat reserves in Natura 2000 sites from active to passive.

Latvia

20. The original extent of mires in Latvia was 672, 204 ha, of which currently only 316,712 remain, indicating a loss of 53%. The protected peatlands in Latvia do not adequately represent the eight geobotanical districts. Of all areas designated for peat extraction about 25% is currently under extraction. About 9% of Latvia's raised bogs (37 bogs with a total area of 70,000 ha) are affected by peat extraction and 20,000 ha are nearly exhausted. A total of 536 peatlands are still available to be opened up for peat extraction.
21. Ilomets (2006) reports that peat extraction has become the major threat for near natural bogs.
22. Germany and the Netherlands are the biggest importers of low decomposed peat from Latvia.
23. Impacts of peat extraction on protected areas:
    - Liepa *et al* (2003) reports that at least 64% of 67 potential Natura 2000 bog areas with Black Grouse population are significantly influenced by drainage: Out of these 13 areas (19%) are being extracted for peat.

- A study by the Latvian State Forestry Research Institute 'Silava', in the Palsu bog, a protected area, noted that the 'intact' raised bog part was seriously affected by the adjacent peat extracting area and its drainage ditches.
- Lārmanis (2003) reports that the Seda marsh' in North Vidzeme Biosphere Reserve, an Important Bird Area and proposed Natura 2000 site has been significantly affected by peat extraction (6,500 ha of the original 9,000 ha).

24. There are indications of limited interest in 'recultivation' of exhausted peatlands from private companies and it is reported that state organisations do not have the instruments necessary to enforce re-cultivation. Up to 15,000 ha of former extraction areas have not been rehabilitated.

Lithuania

25. The original extent of mire in Lithuania was 609,700 ha including 12-13% bogs. Currently only 235,700-258,700 ha remain, thus indicating a loss of 58-61 % of mires. 12% of the larger peatlands were exploited, mainly for energy. However, since the early 1990s, Lithuania has started to extract horticultural peat, mainly for export (52%), while only 5% is used for energy (Lithuanian Geological Survey, 2009; www.lgt.lt). Currently, approximately 95 percent of extracted peat is exported. The Red Data Book of Lithuania includes at least 107 species associated with or restricted to peatlands. 108-131 thousand ha of natural or near-natural peatland is still without protection, while 117 peatlands covering 59,367 ha are being explored for peat extraction.
26. From Lithuania's Natura 2000 designated sites, eight bogs have been impacted by former extraction, and at least five (Aukstumala, Laukesa, Rekyva, Tyruliai, Sulinkiai) are still actively threatened or impacted by extraction. This includes impacts of drainage by peat extraction in one part of the bog on the other (protected) parts. In 1998 more than 1,000 ha of peatland protected by the Law on Protected Areas were extracted.

Ireland

27. Peatlands cover 13,470 km² or 16.2% of Ireland. There are three main types of peatland in Ireland - fens, raised bogs and blanket bogs. Two main types of blanket bogs occur - those at elevations of less than 200 m called Atlantic blanket bogs, and those found in the mountains above 200 m called Mountain blanket bogs. 80% of Ireland's bogs and fens have been destroyed (for forestry, agriculture, peat extraction for energy production and horticulture), and have lost their wildlife and conservation value.
28. Despite the EU Directive on EIA, there has never been an EIA carried out for any peat extraction scheme in Ireland and yet, 36 sites have been damaged by extraction. In the case of 5 sites the area developed exceeded the 50 ha threshold that makes implementation of an EIA mandatory and these thus proceeded without an EIA being conducted. A ruling at the EU court of justice in 1998 concluded that Ireland had failed to apply correctly the EIA Directive (case C 392/96). The issue reappeared again in 2002 with the environment ministry proposing stronger protection of sensitive peatlands on 18 December 2002.
29. The EU court ruled that even small peat extraction projects (i.e. < 50 ha) on peatland might be deemed to have significant impacts if located in an environmentally significant area.

Data gaps

30. There are many data gaps in relation to the location, extent, potential duration of current excavation on many sites, planned expansion or planned opening up of new areas, extent of drainage impacts, coverage of key areas by current protected area networks, etc. There is even less known about these items in

relation to Dutch peat imports. The Dutch peat chain remains rather non-transparent, rendering it impossible to identify the extent and impact of the ecological footprint of Dutch demand for imported horticultural growing media.

31. This current paper does not include information on impacts on peatlands of Germany, Sweden and Finland, three other countries that export horticultural peat to the Netherlands.
32. Bragg et al (2003) recommended that it would be beneficial to compile a 'Red List' of peatland sites for central Europe. Such a list would highlight important areas that, on the basis of their natural heritage character, are 'non-negotiable' in terms of development proposals.

1 Legislation and Impacts of peat extraction on nature

1.1 Background

Natural peatlands provide important ecosystem services, including carbon storage and sequestration (peat accumulation), biodiversity, and water regulation. Carbon stored in peat represents one quarter of the world's soil carbon pool, and up to 70% of all carbon stored in biotic systems. Peatlands store twice the amount of carbon stored in the world's forests even though they cover only 3% of the global land surface. Peat degradation, which is caused by some types of peatland management, especially agriculture and forestry and, to a lesser extent, peat extraction, releases some of the stored carbon back to the atmosphere.

Peatlands are major components of local and regional hydrological systems and can mitigate soil erosion. Peat has the ability to purify water by removing pollutants. Moreover, peatlands influence surface water flow and ground-water level, and may alleviate drought and prevent floods in the surrounding and downstream landscapes. Peatlands also have a role in water supply to industry and people. Peatlands thus are of considerable value to human societies as well as to other ecosystems for the goods and services they provide. Through their ecological processes, peatlands help maintain food resources that are important for human consumption, medicinal purposes and the maintenance of other biological communities, both within the peatland itself and adjoining systems. For example, iron-rich water flowing from peatland may stimulate fish productivity in downstream coastal areas. In some parts of the world peatlands provide a source of sustainable timber. They are also valuable for education and research, since they contain important archives of archaeological, cultural, environmental and biogeochemical information reaching back more than 10,000 years, with evidence of human activities and land use change in the immediate vicinity of the peatland and even distant from it.

1.2 Biodiversity

Besides being an important reservoir of carbon and water, peatlands are major contributors to global biodiversity at several levels. They are components of the optimal natural biodiversity for extensive parts of the temperate, boreal, sub-arctic and tropical regions. They are important sources of biological material and genetic richness, as they contain specialised organisms which contribute significantly to the global gene pool. The variety of peatland types likewise provides a rich source of ecosystem and habitat diversity with a large range of functions.

The peatlands of Central and Eastern Europe occupy a 'frontier position' because there have been massive losses of the habitat in western and southern Europe and they are therefore of even greater importance for the maintenance of the continent's biodiversity. Central Europe still harbours many excellent examples of peatland types that are virtually extinct further west. In the Baltic countries living bogs are still rather numerous, whereas living fens have become scarce.

Despite their relatively low species diversity, peatlands contain a high proportion of rare and endangered species and may be the last refuge for some. The greatest proportion of orchids in the flora of vascular plants is found in transition mires of the temperate zone. Globally threatened vascular plants of mires within the focal area include fen orchid *(Liparis loeselii)*, bog orchid *(Hammarbya paludosa)*, common spotted orchid *(Dactylorhiza fuchsii)* slender cotton grass *(Eriophorum gracile)* and bog-hair grass (Deschampsia *setacea*). Central and eastern European peatlands play an important role in global and international protection of species. They harbour valuable breeding populations and play a central role as migration and wintering areas for migrating birds.

Peatlands present many terrestrial species, especially birds, with temporary habitats that provide food, shelter, and breeding grounds and, in addition, play an increasing role as permanent refugia for species suffering from increasing anthropogenic pressure in the surrounding landscape. The small number of species inhabiting peatlands is often associated with a narrow ecological range of habitats. Ecological specialisation of peatland species explains the higher proportion of characteristic species. For many species, peatlands are the only habitat available within a biogeographic region and even globally. With their specific environmental conditions and (with some exceptions) relative resilience to climate change, peatlands host numerous azonal and intrazonal species. This is especially evident under anthropogenic transformation of landscapes, climate change and related environmental changes. Peatlands support an intra-specific biodiversity. Isolation of peatlands causes an 'island effect' and a related polymorphism.

1.3 Peat resources in the Baltic countries and origin of peat imported into the Netherlands

Table 1
Overview of the area of peatland in eastern Baltic countries and that drained for agriculture, forestry and peat extraction (hectares).

Country	Total area of peatlands	Drained total	Agriculture, forestry	Protected mire area
Estonia	1,009,100[1]	688,000	430,000	245,160
Latvia	672,204[2]	186,200		38,000
Lithuania	609,700[3]	307,600	406,000[4]	78,357

[1] A quick scan of Peatlands in Central and Eastern Europe (2009).
[2] Strategy and Action Plan for Mires and Peatlands in Central Europe (2003).
[3] Lietuvos pelkių ir durpynų tausojančio naudojimo strategija (2010).
[4] Lietuvos pelkių ir durpynų tausojančio naudojimo strategija (2010).

1.4 Overview of the area holding peat deposits and areas of mire per country

Overview of the peat resources in each of the three eastern Baltic States and the amounts suitable for peat extraction.

Table 2

Overview of peat resources and amounts available for mining; Data extracted from the Strategy and Action Plan for Mires and Peatlands in Central Europe (2003).

Country	Peat resource (in tonnes)	suitable for mining (in tonnes)
Estonia	1,484,000,000	775,000,000
Latvia	1,500,000,000	333,000
Lithuania	1,774,000,000[5]	119,000,000

Vast areas of peatland were drained in the 1970s and 1980s to be used for agriculture, forestry or peat extraction. Much of this area has been abandoned because of the high economic cost of maintaining drainage systems and purchasing fertilizer. As a result, the water levels in these abandoned areas are now far below the surface leading to increased organic soil mineralisation and release of large amounts of CO_2 to the atmosphere. Also because of mineralization more peat is lost annually than is being excavated.

According to data provided by the RHP the origin of peat imported in the Netherlands is as follows:

Country	%
Germany	32
Estonia	26
Latvia	13
Lithuania	6
Russia	1
Sweden	5
Finland	8
Ireland	10
Poland	1

These data do however not imply that these percentages are also excavated in the countries mentioned because a German trader might have imported the peat from Estonia and exported it again to the Netherlands.

[5] Lietuvos pelkių ir durpynų tausojančio naudojimo strategija (2010). (It would help if Baltic state language references were also translated into English.)

1.5 Overview of applicable legislation and policies per country

Estonia

Peat extraction is carried out on an estimated 1.5 % of the total Estonian peatland area.
Of the total amount of peat extracted about 80% is used for horticulture and 20% for fuel. Peat is the second most important strategic energy source in Estonia after oil shale. Estonia is the 3rd or 4th biggest exporter world-wide in peat products used in horticulture.
So far the Estonian Government has considered peat as a renewable natural resource. Comparison of preliminary estimates indicates that peat extraction exceeds peat accumulation by more than five times.
Since 01 January 2001, an environmental impact assessment (EIA) has been required by law for new areas of peat extraction exceeding 150 ha. For smaller areas, the Ministry of the Environment and the environmental authorities decide if an EIA is necessary, on a case-by-case basis. In 2005 the State Audit Office carried out an audit of the activities of the State in planning the use of peat resources and managing their extraction. According to the audit report permissions were issued for peat extraction on an area of 19,500 ha. It also showed that compulsory EIAs had not always been carried out before extraction permits were granted and that no EIAs had been required for any area smaller than 150 ha. The State Audit Report also remarked that the limit of 150 ha was inadequate because the excavations always impacted on much larger areas as a result of lateral drainage. It thus appears that the EIA legislation in Estonia is inadequate and its implementation unsatisfactory. In 2008 the new Environmental Impact Assessment and Environmental Management System Act entered into force which requires EIA of planned open cast mining, underground mining or mechanised peat extraction affecting a surface exceeding 25 hectares (Section 5, subsection (1), point 28).

This legislation also recommends the Government directs peat extraction to abandoned, non-exhausted production areas, and to suspend until 2025, issuing of new extraction permits in case of peatlands and parts of peatlands not yet affected by extraction. This is compatible with the objectives of the Long-term Public Fuel and Energy Sector Development Plan. There are also recommendations to initiate necessary amendments to legal acts, including the Earth's Crust Act, in order to deliver objectives of the development plan. In addition, the report recommends rehabilitation of degraded State-owned peatlands whose re-exploitation is not feasible.

According to the audit report the Minister of Environment of Estonia is planning to convert permits for extracting peat reserves in the quarries located in Natura 2000 sites from active reserves to passive. He also announced that guidelines for preparing a programme and reporting on environmental impact assessment, including environmental impact assessment of peat extraction areas, are under preparation. The Minister further agreed to the proposal to initiate an amendment to the Earth's Crust Act so that the considerable environmental impact resulting from extraction should be a sufficient legal basis for refusal to grant an extraction permit.

In addition, he agreed that there is a need to review the extraction permits issued until today because of the need to specify environmental and rehabilitation conditions provided in the permits. Preparations for rehabilitation of abandoned peat production areas have been initiated. A round table of scientists, peat producers and other stakeholders advises the Ministry of Environment on basic ideas for sustainability of peat production, best use of resources of already opened mining areas, restoration of abandoned mined peatlands etc. A manual for mined peatland restoration has been compiled and is available on the Internet.

Estonia has paid a lot of attention to the implementation of the Birds and Habitats Directives and a significant area of Estonia's mires and peatlands have been included in the proposed Natura 2000 network. The habitats Directive has effectively been transposed into national legislation so that it can be concluded that the areas designated under the Habitats Directive are well protected (see table below).

Latvia

More than half of the peatlands in Latvia are relatively little disturbed by human activities and the remainder have been drained or used for peat cutting. About 12% of them are state protected within 336 Natura 2000 sites, which encompass raised bogs, fens and peatlands near lakes.

Nationally, peatland conservation and use is regulated by 16 official documents relating to environmental protection and the use of natural resources. Three documents that relate specifically to peatlands have been endorsed, namely: The Strategy for Peatland Biodiversity Conservation, approved by the Ministry of the Environment; The Strategy for Peat Resource Conservation, which contains specific recommendations for the development of wise use guidelines for extracted peatland; and The Action Plan for Peatland Conservation and Management.

The rare and protected species found on Latvian peatlands include 34 vascular plants, 25 bryophytes, 15 invertebrates, 2 reptiles, 25 birds and 8 mammals. Also, several peatland plant species meet here at the most eastern (*Myrica gale, Erica tetralix*) and the most western (*Chamaedaphne calyculata*) extremes of their distributions.

Lithuania

52% of the peat extracted in Lithuania is exported. Only 5% is used for energy (data of 2009, source Lithuanian Geological Survey (www.lgt.lt).

Lithuanian protected areas (state strict nature reserves, national and regional parks, various reserves) include 821 mires with a total area of 78,357 ha (18.9% of the total mire area for Lithuania).

Currently Lithuania is preparing a 'Strategy for Sustainable use of Mires and Peatlands' which will be ready in draft in April 2010. The preparation of the Strategy is coordinated by the Lithuanian National Ramsar Committee established by order of the Minister of Environment. This will provide a full overview of peat resources, protection status and policies. The final document is planned to be ready by the end of July 2010. The strategy will be published in Lithuanian, with an English summary.

The Law on Environmental Protection (1992) sets out the legal basis for mire protection while other aspects are covered by various laws adopted by the Lithuanian Parliament (Seimas), including the Law on Protected Areas (1993, 2003), Law on Land (1994), Law on Forests (1994), Law on Territorial Planning (1995), Law on Environmental Impact Assessment (1996), Law on Wildlife (1997), Law on Protected Plant, Animal and Fungi Species and Communities (1997) and others, which are all being progressively revised as the social/economic situation changes. The national priorities for mire conservation are provided by the Lithuanian Strategy for Sustainable Development, which was approved by the Government of the Republic of Lithuania in 2003, and in the Biodiversity Conservation Strategy and Action Plan prepared by the Ministry of the Environment (1998). In these documents, one of the priority goals at ecosystem level is 'to conserve wetland ecosystems by prohibiting new exploitation of them, by restoring peatlands, and by delineating measures for the conservation of valuable habitats'. The so called 'Nature Frame', which will cover more than half of Lithuania is defined in the Master Plan of the Republic of Lithuania (to 2020), which was adopted by Parliament in 2002, and will be realised through the combined efforts of all of the Lithuanian institutions, together with the population. The Nature Frame will include most protected areas and ecologically significant natural areas including mires, lakes, river valleys, forests and meadows.

1.6 Mire and bog areas (ha) in the Baltic countries designated as Natura 2000 sites

Code	Habitat Type	Estonia	Latvia	Lithuania*
7110	Active raised bog	142,500	+	17,800
7120	Degraded raised bog capable of natural regeneration	2,000	+	10,000
7140	Transition mires and quaking bogs	15,000	+	12,000
7160	Fennoscandian mineral rich springs	7,160	+	800
7210	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae	1,100	+	150
7220	Petrifying springs with tufa formations		+	50
7230	Alkaline fens	10,700	+	3,000
9080	Fennoscandian deciduous swamp woods	31,800		65,800
91D0	Bog woodlands	34,900	+	50,800
Totals		245,160		160,400
Total area covered with mire		325,000	316,712	54,700
Total area with peat deposits		1,009,100	672,204	508,400

1.7 Impacts of peat extraction

The international peat trade deals almost exclusively in peat for horticultural purposes.

Declining domestic peat resources in Western Europe and political changes in central and Eastern Europe have resulted in an increase in exports of horticultural peat from the eastern Baltic countries to satisfy other markets in the EU. In 1992, sales of peat products in the European Union and its applicant countries exceeded ECU 700 million, and direct employment was over 10,000 person years. The Netherlands, which has lost almost 100% of its own natural peatlands, is the biggest peat trader in Europe. The international peat trade promotes concentration of peat extraction near markets and transport. In the past, it has seriously interfered with the conservation of peatlands. In future, the demand for both horticultural and fuel peat may fall (for both practical and environmental reasons) in favour of alternatives but, in the meantime, some western and central European countries appear, in practice, to be working against this trend. For example, Russia, Estonia, and Ukraine have announced plans to increase their usage of fuel peat; whilst the horticultural market in Western Europe appears now to be actively promoting large-scale extraction of central European peat.

The impacts of peat extraction on nature should be considered at three levels:
a. Direct impacts on the site where extraction takes place
b. Impacts on the surrounding areas and landscape
c. Impacts on regional and global biodiversity and climate change

1.7.1 Direct impacts on nature in the area where extraction takes place

Most industrial extraction of peat uses the milling technique (either for energy or for use as a component in growth media), which involves the removal of the mire vegetation, followed by drainage and levelling of the extraction area and progressive scraping away of the upper less humified peat over many years. The end result of commercial peat extraction is large areas of bare peat, with minimal biodiversity, and greatly reduced functional and societal values (Charman, 2002). Moreover, the areas may be prone to fire and dust storms

(Minaeva and Sirin, 2009). Other extraction techniques include the 'hydrotorf' technique, which causes less disturbance of the hydrology and offers greater potential for natural regeneration after use (see under rehabilitation). The greatest threat to nature and wildlife from peat extraction lies in the potential opening up of new areas in Latvia and Estonia and diversion of new extraction developments to Belarus once the more easily accessible (e.g. near harbours) resources in the former are depleted. In addition, there are clear indications that some of the peat extraction in the Baltic States takes place in or in the vicinity of Natura 2000 areas. For Estonia and Latvia there is no good overview of the location of current and planned extraction sites in relation to the geo-botanical districts, or an appropriate representation of rare and endangered bog types and dependent species in current protected site frameworks. In addition, consideration should be given to the resilience of the current protected areas in relation to climate change, and whether expansion of the protected area system is warranted to mitigate this issue.

1.7.2 Impacts on surrounding areas and landscape

In mires the bulk of the peat is saturated with water and only a minor flexibility in water storage exists in the acrotelm. The water table in pristine bogs generally fluctuates no more than 40-50 cm even during extreme droughts, and under normal circumstances it may be as little as 5 cm (Bragg *et al.*, 2003). Peatland degradation can lead to increased surface run-off, which may contribute to downstream flooding. Direct hydrological impacts are most significant on adjacent peatland within the same catchment, e.g. where drainage/extraction is targeting part of a bog, over time this will affect the hydrology of the entire ecohydrological system. Drainage around the edge of a raised bog results in a lowering of the groundwater mound in the interior. The general reduction in height of the ground water mound and the shifting of the location of the highest point in the mire leads to drying of the surface peat and associated structural changes (Charman 2002). There are no data available that enable proper assessment of how significant this issue may be in relation to current and envisaged/proposed peat extraction for horticulture in and around individual extraction sites or about any possible accumulative impacts. This would require a review of all environmental impact assessments for each extraction site, assuming that these have taken off-site impacts into account.

1.7.3 Impact on regional and global biodiversity

There still remain many key information gaps regarding the coverage of current protected area systems of biogeographic units of peatlands in the Baltic States. The Convention on Wetlands (Ramsar 1971) explicitly acknowledges the need for identification of appropriate biogeographical units for peatland systems in general, and for the use of such classification as the basis of designation of important sites in particular. Whereas the Baltic countries already appear to have a clear classification in terms of biogeographic units, they are not consistent in their approaches in that some display 'mire regions' and others 'geo-botanical regions' or vegetation maps. It would seem pertinent to improve the consistency in this respect and investigate the location of current and prospective sites for peat extraction in the Baltic countries in such a biogeographically context and in relation to present coverage of these by the protected area systems. Without such an analysis it is impossible to draw conclusions regarding the potential impact of the current and envisaged extraction activities on regional and global biodiversity.

Eastern Baltic countries contain important peatland ecosystems, which support a wide range of biodiversity, many species of which are rare and endangered. This biodiversity value should be considered at local, regional, European and global levels and taken into account when assessing peatland sites for potential peat excavation. The eastern Baltic countries contain 13 of a total of 43 indicative biogeographic regions of Central Europe (stretching from the Baltic sea to the Black sea and including 8 countries), with a particularly high occurrence of various bog types (Bragg and Lindsay, 2003). They thus appear to be disproportionately important in terms of conservation of representative areas of peatland habitats. It is inevitable that some anthropogenic development, including for fuel and or horticulture, will take place on some of these peatlands for the foreseeable future. And therefore it would be beneficial to compile a 'Red List' of peatland sites for Central Europe. This would highlight important areas that, on the basis of their regional biodiversity and natural heritage character, would be excluded from development. Such a supra-national approach is in accord with the principles of both the Ramsar Convention and of Natura 2000, both of which explicitly seek to ensure that regional overviews inform the selection of site-protection networks.

The definitions regarding bio-geographic regions and the sometimes synonymous 'bioregions' make it clear that individual regions will often include territory that belongs to more than one country, and that different bioregions may be appropriate for different wetland types. Article 1 of the EU Habitats Directive defines 'natural habitat types of Community interest' as those which: *present outstanding examples of typical characteristics of one or more of the five following biogeographic regions: Alpine, Atlantic, Continental, Micronesian and Mediterranean.* Therefore, first and foremost, the Central European Red List must reflect regional biogeography. This means that it cannot be constructed simply as an amalgam of values determined solely at national level by the individual focal countries. Furthermore, experience from EU Habitats Directive implementation indicates that, in drawing up the Red List, it may be necessary to highlight that individual countries have special responsibility for particular peatland types and/or biogeographic regions whose ranges are centred on, concentrated within, or even restricted to, these countries' territories.

A Red List should be drawn together by first reviewing the set of sites that are considered to be nationally or internationally important on the basis of individual country lists, in terms of peatland quality, peatland character (according to criteria set out in, for example, Appendix 1 of the present report), bio-geographical region, and overall spatial distribution within the central European region. On this basis, the highest-quality examples of the suite of site types that most effectively represents the character of peatlands belonging to each bio-geographical region would be selected to form the core of the List. These would be supplemented by examples of site types that are azonal (*i.e.* occur largely without reference to bio-geographical constraints) or important in expressing the full natural bio-geographical range of a site type or species, together with sites that support viable populations of rare or locally/regionally endemic species. The composition of the List might also be moderated and supplemented through consultation with those responsible for identifying potential Natura 2000 sites, Special Protection Areas, and Important Plant Areas.

However, the original biodiversity values of the areas as representatives of particular habitats within a bio-geographical region and the specific dependent species and intra-specific biodiversity linked to such bogs may be lost for centuries or forever as a result of peat extraction (species extinctions, extinction of intra-specific variability).

1.8 Peatland restoration

Areas damaged by peat extraction may recover significant biodiversity value if afterwards good rehabilitation projects are put in place, involving rewetting and re-vegetation through natural regeneration and replanting. Such projects are also needed to reduce or stop CO_2 emissions from remaining drained peatland areas. Some key peatland restoration projects are currently being implemented in former extraction sites in Belarus. One of the objectives of these projects is to reduce CO_2 emissions resulting from peatland degradation (continued oxidation from desiccated peat surfaces). A difficulty in restoring former extraction sites is the irregular topography of the surface following peat extraction, which presents problems for full rewetting of affected areas. Moreover, frequent inundation of re-vegetated areas may result in high methane emissions. Current and future extraction techniques and planning should take these aspects into account to optimise restoration potential.

2 Evaluation and conclusions

The global peatland carbon balance is heavily biased towards increasing net emissions. Currently the total global emissions from peatland degradation is estimated at 2 giga ton (6% of global human induced emissions), including at least 1.3 giga tonnes from drainage (excluding fires and peat extraction). The EU is contributing 174 million tonnes to this (Joosten 2009). Annual drainage related peat emissions (i.e. not extraction) in Estonia decreased between 1990 and 2008 from 14 Mt to 9.6Mt CO_2, in Latvia from 5.2 Mt to 4.2 Mt and in Lithuania there was a slight increase from 5.9Mt to 6.1 Mt CO_2. The decrease in Estonia and Latvia was mainly due to decreased agriculture on peat.

In the frame of the EU Habitats Directive much work has been done to develop a common parameter based European habitat classification framework. The aim has been to develop a common language for the description of habitats throughout Europe, based on sound science with clear definitions. The habitat classification should be based on the EUNIS classification which in its turn is based on the Palaearctic habitat classification. Examination of the EUNIS classification reveals that it suffers from the same problems as virtually all attempts at regional or global descriptions of peatlands, namely the lack of both an agreed and consistent set of terminology and a coherent set of classification.

Although the EU Habitats Directive and the establishment of a European Network of Sites of Community Interest presents a significant step forward in the protection of valuable biodiversity the classification system used to identify habitat types of European significance is not well adapted to identify the most precious mire habitats. As a result, some mire habitats are not recognized as such but indicated as woodland and forest owing to the fact that in the classification tree species are used as the main criteria for habitat classification. As a consequence, some areas important from the perspective of peatland protection are not identified and it is unclear to what extent the proposed SCI's really reflect the full range of peatland habitat types despite the fact that a significant share of the bog and mire areas has been included in the proposed lists of Sites of Community Interest that have been drawn up by the Baltic countries.

It would thus be beneficial to compile a 'Red List' of peatland sites for central Europe. Such a list would highlight important areas that, on the basis of their natural heritage character, are 'non-negotiable' in terms of development proposals. The second function of this list is that it avoids the inevitable parochialism that results from consideration of sites country-by-country. The list would instead highlight the characteristic range of peatland diversity that is displayed at the regional level.

In terms of mire conservation, the peatlands in the eastern Baltic countries, which are the main suppliers of peat to the Netherlands, now occupy a 'frontier position' in Europe.

Peat excavation has a local impact on the peatlands involved. Before any excavation activity can start the site has to be drained which causes the immediate start of an oxidation process through which enormous amounts of CO_2 are released into the air contributing to the climate change process. According to the Estonian State Audit Office the amount of CO_2 originating from the drained peatlands exceeds, for example, the amount of CO_2 from the traffic approximately nine times.

Peat excavation itself destroys all vegetation and habitat for animal species that are depending on the specific peatland habitat conditions.

Last but not least the role peatlands play in the regional hydrology by storing water and peatland degradation can lead to increased surface run-off which may add to floods downstream.

There are many data gaps in relation to the location, extent, potential duration of excavation in current sites, planned expansion or planned opening up of new areas, extent of drainage impacts, coverage of key areas by current protected area networks, etc. There is even less known about these items in relation to Dutch peat imports. The Dutch peat chain remains rather non-transparent, rendering it impossible to identify the extent and impact of the ecological footprint of Dutch demand for imported horticultural growing media.

A possible way to indicate the ecological foot print of the import of peat to the Netherlands is to calculate the surface of the area that has to be excavated to cover the amount of peat imported.

Table 1
Import and export of peat substrates in Europe in 2003 in 10^3 tonnes (EUROSTAT data (see European peat trade (in Wetlands International 2006).

	NL	D	Be	UK	Es	Lat	Lit	Anders	Total
Import	1,542	775	546	524				2,221	5,608
Export	825	2,094	246	30	915	660	356	1,813	6,939

References

Bragg, O., Lindsay, R., Risager, M., Silvius, M, and H. Zingstra (eds). 2003. Strategy and Action Plan for Mire and Peatland Conservation in Central Europe. Wetlands International, The Netherlands.

Charman, D. 2002. Peatlands and environmental change; Wiley, Chichester, 2002, pp. 301.

Ilomets M. (2001): Mis saab jääksoodest? Eesti Loodus 6: 218-221.

Ilomets M., Animägi J. & R. Kallas (1995): Estonian peatlands, a brief review of their development, state, conservation, peat resources and management. Ministry of Environment, Tallinn, 48pp.

Joosten, H. 2009. The Global Peatland CO_2 Picture. Peatland status and drainage related emissions in all countries of the world. Wetlands InternationaL, Ede, www.wetlands.org.

Lārmanis, V. 2003. Evaluation of Threats to Biodiversity and Preparation of Conservation and Management Plan for Nature Reserve 'Seda marsh' in North Vidzeme Biosphere Reserve. Research study in the framework of the UNESCO Programme on Man and the Biosphere, Final report. Latvia, Riga.

Leivits A (compiler) 2001. *The Central European Peatland Project – Country Report for Estonia*. Report compiled in the framework of Wetlands International's project. Nigula Nature Reserve Administration, Kilingi-Nõmme. 32 pp.

Liepa, V., Racinskis, E., Kalvans, A and H. Hofmanis. 2003. Action Plan for the Conservation of Black Grouse Tetrao tetrix in Latvia. Latvian Ornithological Society. Riga.

McGovern, E.A. et al., 2000. *Resources, Conservation and Recycling* 28: pp 67-83.

Minayeva, T and A. Sirin. 2009. A quick scan of peatlands in central and eastern Europe. Wetlands International, The Netherlands.

(Paal *et al* (1997) 'Wetlands Inventory', Tartu.

Palejs, M. The impact of drainage and peat extraction on hydrology in Palsu bog. Instytut Badawczy Leśnictwa (Forest Research Institute).

State Audit Office Estonia (2005); Use of the peat resources. – Audit report No. OSIV-2-6/05/71 of 14 July 2005. The State Audit Office of Estonia. - http://www.riigikontroll.ee/audit_en.php

Annex 1 Definitions

Peat is partly decomposed plant material that has accumulated *in situ* (rather than being deposited as a sediment) as a result of waterlogging. This leads logically to the definition of 'peatland': a **peatland** is an area where peat has accumulated *in situ.* By convention, peatlands are recognised as entities. An entity may be as small as a spring-head a few metres across or as large as an entire landscape. A **mire** is an area that supports at least some vegetation known to form peat, and usually includes a peat layer. For some purposes it is helpful to distinguish two or three types of mire on the basis of nutrient status and vegetation characteristics. **Bogs** receive their water supply exclusively from precipitation, a poor source of plant nutrients; whilst **fens** _receive not only precipitation but also water that has been in contact with soil or rock, and so has higher nutrient status. Intermediate types, termed **transitional mires**, may also be recognised.

Judgements about relative values of peatlands are made using criteria, and the two key criteria that define biodiversity are **naturalness** and **diversity Naturalness** has one key component – freedom from human interference. This can be expressed either as the lack of evident human disturbance; or as a full display of all expected components of natural diversity.
Diversity embraces a wide range of peatland characteristics, as reviewed above, but when these come to be evaluated they can be grouped according to two broad criteria, namely rarity and representativeness (typicalness).

Major sources of peatland diversity

- vegetation
- fauna
- water source – whether the sites are rain-fed or groundwater fed
- hydromorphology – the overall shape of the peatland
- water chemistry – both the chemistry of the peatland water and the effect of peatland waters on other parts of the landscape;
- small-scale surface patterns – related to growth forms such as hummocks and hollows
- larger-scale surface patterns – the overall 'fingerprint' of the peatland surface
- peat matrix –carbon stored in peat
- peat archive –history stored in the peat
- habitats
- ecosystems and ecological complexes.

Renaturalisation and rehabilitation

There are two distinct approaches to the restoration of damaged natural habitats, namely renaturalisation and rehabilitation. Renaturalisation involves full restoration of all the natural components of the ecosystem, together with their interactions and self-regulatory functions. This option is not always available. For example, a worked-out peat deposit cannot be renaturalised because it is impossible to regenerate the peat that has been removed within the foreseeable future.

Unlike renaturalisation, the process of rehabilitation does not require restoration of all components of the initial system. The main aim is to restore the ability of the components to perform their ecological and economic functions. The most important objective of ecological rehabilitation is to restore the biological functions that ensure ecological stability, maintain environmental parameters, and support plant and animal variety (biodiversity) – for example reproductive capacity and preservation of the gene pool. In the course of ecological rehabilitation, ecosystem services as the pertinent biological functions are restored. During the process of rehabilitation, it is acceptable for a new ecosystem type to replace the one that was destroyed. The main criteria are that its composition and structure should be capable of performing, as closely as possible, the same functions as the system that has been replaced; and that ecological character is restored.

Appendix 2 Peat production for growing media

Hein Boon

Stichting RHP

Peat

production for

Growing Media

This information is a selection from the brochure
'Potting soil and Substrates', issued by RHP foundation 2003

Table of contents

1 Peat

1.1 Introduction

The peat types used to compose potting soil and peat substrates are known as raised bog peat. Raised bog peat was formed under the influence of rainwater with a low nutrient content. That shows in the chemical composition. The peat is acid (pH 3.2 - 4.4) and it hardly contains any plant nutrients. Salt content levels are low. Raised bog peat, also referred to as oligotrophic peat, has mainly been formed by Sphagnum (bog moss). It also contains remains of other peat-forming plants such as wool grass and heather.

1.2 The origin of peat

Peat is composed of plant remains that have partly been converted in a low-oxygen (anaerobic) environment. If the environment has high oxygen content (aerobic), the plant remains decompose almost completely and there will be only little material left. Usually, a high groundwater level is the cause of the anaerobic environment in which plant remains accumulate and are converted into peat. In fact the peat formation process is the start of a coal formation process. Under ideal circumstances sphagnum can grow 1 cm a year and after this has settled about 1 mm of material remains. That means it takes at least 1,000 years to form a peat layer of 1 metre thick.

Although the processes that occur in an anaerobic environment are the most important ones for the formation of peat, it still appears that the processes occurring in a more aerobic environment cannot be left out of consideration. All parts of the peat layer have at some time been above the water and, consequently, once were the surface of the peat bog. In many cases this surface was the place where, during a certain period, aerobic processes played a part, while the bog mosses were already starting to decompose. Often this was caused by changing water levels during peat formation. These processes had an influence on the nature of the peat that was created. This development is a little different for young bog moss peat. During its growth stages the young moss peat is continually more or less saturated with water and when it dies, the plant remains directly end up in an anaerobic environment. Moreover, bacterial conversions in this oligotrophic environment are strongly inhibited. As a result of these processes, combined with the low temperatures in Northern Europe, the bog mosses as a whole were very well preserved.

1.3 The raised bog peat profile

Unlike what most people think, the difference between 'raised bog peat' and 'low moor peat' is only minor. The successive peat types in the profiles of raised bog peat and low moor peat were formed similarly, but the peat quality differs as a result of the quality of the water that influenced the area. This is illustrated in Table 1.1 with a schematic overview of the place of the peat types in the 'raised bog peat profile'.

Table 1.1
Schematic overview of peat types.

Layer thickness (cm)	Material
0-30	top spit (sward + decomposing layer)
30-200	young moss peat
200-300	transitional peat
300-400	old moss peat (black peat)
400-450	wood peat
450-500	reed-sedge peat
500-510	humic transition layer
>510	mineral subsoil

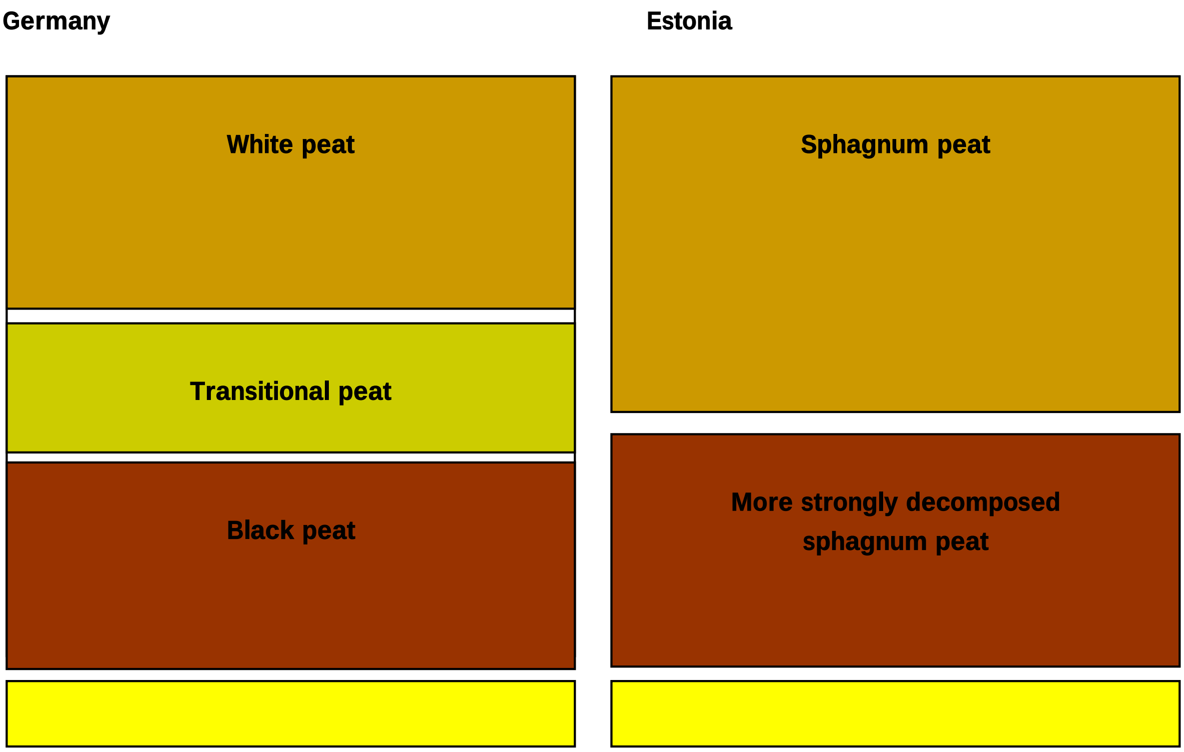


Figure 1.2
Peat profile in Germany and Baltic States.

As these raised bog peat areas developed in relatively low-lying parts of the elevated diluvial sand landscape, there has hardly ever been any influence of eutrophic water, so here we mainly find low-nutrient peat types. Therefore, it would be better to talk about elevated and low-lying peatlands, in which the classification focuses on the location. When low moor peat and raised bog peat are mentioned, people usually refer to the difference in peat type.

The raised peatlands are characterised by the composition of moss peat without added minerals. As bog moss contains water cells, it does not depend on groundwater for its development. The lowest parts of the sand landscape became filled with groundwater peat such as bog and reed-sedge peat. At a certain level above the groundwater the sphagnum vegetation takes over from the sedge peat vegetation. Then from the now filled low parts this sphagnum can overgrow the surrounding sand landscape as a smothering blanket. Consequently, the basis of most raised bog peat profiles is sphagnum peat sitting on sand. This development continues as long as it rains sufficiently.

When a drier climate period begins, first the bog moss stops growing and then the plant material starts to decompose. If it rains again after a period of extreme draught, the sphagnum peat can start growing once more and the peat formation will continue.

As a result of such a succession of periods, several boundary sheets may develop in the peat. This can often be observed in cut blocks and sods. Figure 1.3 shows the formation of peat.

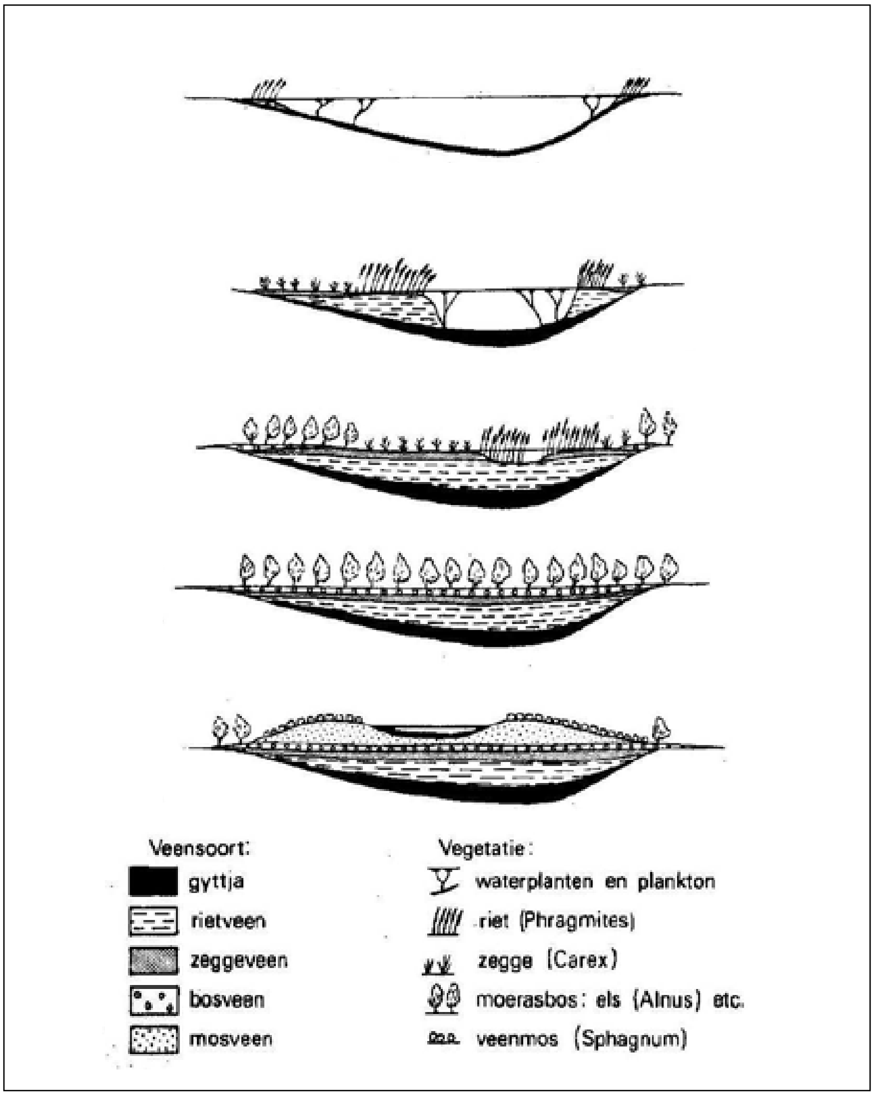


Figure 1.3
Peat formation in five stages.

1.4 Peat types

1.4.1 Sphagnum peat (peat type 1)

Sphagnum peat can be described as young, little decomposed peat. Its colour is light and it consists of virtually nothing but Sphagnum species. The decomposition degree of this peat is H1 - H3 (see Table 1.12). Dry sphagnum peat can take up an amount of water of at least nine times its own weight (water capacity after drying 9 $g.g^{-1}$). This product comes from Norway, Sweden, Finland, the Baltics and Canada. It is found in northern parts where the growth rate can be very high during the long summer days. In the extraction areas the decomposition rate of sphagnum peat is very low because the youngest peat is always frozen in winter. Sphagnum peat can be extracted horizontally (milled peat) or vertically (blocks/sods).

1.4.2 White peat (peat type 2)

White peat or peat dust is extracted in more southern areas such as Germany, Poland and Ireland. This peat is extracted from the topmost layer of the peat profile. It is darker than sphagnum peat and it consists of a mixture of bog mosses. The decomposition degree is classified as H3 - H5. Because it is a little more decomposed, it cannot hold as much water as sphagnum peat (water capacity 7 $g.g^{-1}$). The available supplies of white peat in Germany are almost exhausted. There are still many possibilities in Ireland, but because of the weather conditions there the possibilities for the production of dry peat blocks are limited. Ireland annually produces substantial amounts of horizontally extracted white peat. The Irish peat is decomposed a little more and has a lower water capacity. In fact it can be classified as transitional peat.

1.4.3 Transitional peat (peat type 3)

The layer between white peat and black peat is referred to as transitional peat. This peat is more decomposed. The colour is between white peat and black peat as well. For that reason it is referred to as transitional peat. The decomposition degree is classified as H4 - H6. Transitional peat retains even less water than sphagnum peat and white peat (water capacity 6 g.g-1). The white peat products from Ireland and Germany can generally be considered transitional peat.

1.4.4 Frozen black peat and top spit (peat type 4)

Frozen black peat is produced exclusively in Germany from the bottom section of the peat profile after removal of the white peat and, if applicable, the transitional peat. The black peat must freeze over in wet condition on the peat drying fields. When waterlogged peat freezes, ice crystals slowly grow in the peat. The crystals partly break up the superfluous bonds (contact points) between the solid material particles in the mass. That makes the average pore diameter increase. The remarkable thing is that this condition is maintained when the peat thaws, provided that the melt water is directly carried off, for instance because it is taken up by the underlying soil. If subsequently the peat is air-dried to a moisture content of for instance 75 % (by mass) some shrinkage does occur but it is much less than without previous freezing. The resulting peat product is porous, can take up and release sufficient quantities of water and hardly smears anymore. Because the peat also has coarse pores, the air supply is ensured. It is observed in many cases that the influence of freezing on the peat lying in a lower section in the water is only little. The result of a minor influence of freezing is, that the original unfavourable structure condition of the peat largely returns if it stays in the water after thawing. A black peat layer of 10 cm should preferably be subjected to a continuous freezing period of at least three days at an average temperature of -5ºC, of course without insulating snow cover. The quality not only depends on the

degree of freezing, but the extraction method also has a major influence. In addition, over the past decade it has appeared that the processing intensity before, during and after winter also has a major influence on the quality of the produced frozen black peat.
The value of the water capacity is a measure for the degree to which the black peat has been frozen. Non-frozen black peat can take up roughly 100 grams of water per 100 grams of dry matter (water capacity 1 $g.g^{-1}$), that means it cannot take up more than its own weight in water. This value increases as the peat has been frozen more intensely. In fully frozen material water capacity figures of 5 $g.g^{-1}$ are found. According to the standards, frozen black peat must have a water capacity of not less than 4 $g.g^{-1}$. Top spit can be described as white peat that has been dug up in earlier years and replaced on the bog bottom. The peat digger calls this backfilling. On digging out the peat it has crumbled a little and, moreover, as oxygen could enter some decomposition took place. Top spit has a darker colour than white peat because of the higher percentage of fine peat particles and a lower percentage of dried black peat. Top spit must have a water capacity of not less than 4 $g.g^{-1}$. The available supplies of top spit in Germany are almost exhausted. In some cases in Germany the remains of a layer of white peat are milled and marketed as top spit.

Due to the dwindling supply of frozen black peat and black peat from Germany, alternative peat products have been on the market for many years now, imported from Finland, Russia and the Baltics. These peat products come from the deeper layers of the peat profile and can be considered as strongly decomposed sphagnum peat. This 'frozen black peat' in many cases has slightly different properties compared to German frozen black peat, in particular in that it has partly or fully lost its bonding properties. As a pure peat product this material is not suited for blocking substrate, but it can be used in combination with Germany frozen black peat. Expectations are that within 5 to 10 years the supply of frozen black peat from Germany will have been greatly reduced and that a substantial part of the black peat will be coming from other countries.

1.4.5 Black peat (peat type 5)

Black peat is extracted from the bottom layer of the peat profile and in fact it is insufficiently frozen peat. It shrinks more than frozen black peat and after drying it will take up little water. It has a lower water capacity than frozen black peat. It is suitable as raw material, in particular for blocking substrate, if the water capacity after drying is >3.5 $g.g^{-1}$. This type of black peat comes from Germany.

Another black peat product is the peat extracted for pressed peat/fuel peat that is shredded and sieved for the production of fractions. This material comes from Ireland, Sweden, Finland, the Baltics and Germany. This black peat product can be considered as an addition to or alternative for fractions from blocks and sods, in particular during periods of low supply. Further specifications and requirements are still to be drawn up for this type of black peat.

2. Extraction methods

2.1 Milled peat (horizontal extraction)

In many countries sphagnum peat and white peat are extracted horizontally through grubbing out or milling. Various types of machines are used for this purpose. Usually that is a cultivator or in some cases a milling machine. Peat extracted using these methods has a rather fine structure. The quality may be influenced by the type of machine being used, but in particular by the weather conditions. Under high precipitation conditions the procedure for drying must be repeated several times which usually results in a finer material.

The moisture content during picking up also influences the degree of fineness, just like the type of machine used for picking up. As a rule, milled peat is produced with a moisture content of 50 - 60 % (by mass). A lower moisture content makes the product finer.

2.2 Sods and blocks (vertical extraction)

Sods and blocks are cut from the peat profile and they are used for the production of fractions for coarse potting soil and peat substrates. Blocks and sods are cut in Ireland, Sweden, Russia (Kaliningrad), Latvia, Lithuania, Poland and sometimes in Germany. Hydraulic cranes are used in Sweden and in some cases also in Ireland. The bucket of this crane has several compartments, so a number of blocks are cut at the same time. In the other countries mentioned here usually a (peat) digging machine is used (see Figure 1.5) for cutting sods. The size of the sods or blocks may vary between 15 and 50 litres dependent on the type of digging machine.

The quality of the blocks/sods is determined by a large number of factors:

<u>Dewatering of the peat extraction site</u>
In a well-dewatered peat extraction site settlement increases, resulting in peat with a higher density and, consequently, a firmer structure.

<u>Sphagnum type</u>
Dependent on the land and the peat extraction site, the peat may have been formed by finer or coarser Sphagnum types. Another factor that influences the quality is the presence of wool grass and/or heather roots.

<u>Moisture content of the peat</u>
Dependent on the size of the block and the required drying period, the moisture content is important for the production of good fractions. Generally a moisture content not exceeding 50% can be called satisfactory.

<u>Decomposition degree of the peat</u>
The decomposition degree must not exceed H5 to H6, otherwise on producing the fractions too many small particles will be created which have an adverse influence on the physical structure of coarse substrates.

Time of digging

The time of digging may have an influence on the quality and the drying rate. Blocks that have been cut in the fall and have frozen over in winter, may have a softer structure than blocks cut in spring.
To make the blocks dry more quickly, they are stacked in 'rings' in the form of ridges, banks or pyramids of blocks. In Sweden the blocks are placed on pallets and covered with plastic hoods to promote the drying process. In many other countries this is not the habit, making the drying process completely dependent on the summer period. This is the reason that the supply of sods and blocks strongly depends on the weather. Consequently, there are years with great shortages. The entire potting soil industry benefits by a more continuous production of blocks and sods.

2.3 Frozen black peat

Frozen black peat is obtained by having black peat freeze over. It is very important to choose a method that offers the maximum guarantee that the black peat freezes as thoroughly as possible, even in unfavourable winters. There are various methods for extraction and production of frozen black peat.

Horizontal extraction

Horizontal extraction takes place by milling or ploughing the black peat. Generally, it is a cheap method but the drawback is that the quality of the produced material varies constantly. As the deeper layers of the black peat package are reached, the composition of the peat changes with the fibre percentage.

Vertical extraction

Vertical extraction offers the possibility to have the entire mixed peat profile freeze over, if required mixed with top spit. That guarantees the purchaser a uniform product throughout the years. Vertical extraction may be done using the dredger that is also used for the production of pressed peat and with the dragline method. The advantage of the production of frozen black peat using the dredger is that the peat can freeze over more quickly on the field, which may be an advantage in mild winters. In addition, it is increasingly tried at the peat extraction sites to carry out a cultivator treatment in winter, preferably during a period of frost, to enhance the freezing effect This makes it possible to largely compensate for the adverse effect of the production method. After winter the frozen black peat is dried using a cultivator and collected on large ridges in the field and/or at a storage site. It is vital that the drying and collecting activities remain limited to the peat layer that has actually been frozen. Usually that is no more than 10 to 15 cm. It is tempting for peat producers to go deeper, but that will irrevocably affect the quality because material will be included that has not been frozen.

3. Self-heating

3.1 Introduction

Self-heating in peat is very detrimental to the peat quality. Certain properties are affected, in particular physical ones. Potting soil produced with peat in which self-heating has occurred may cause problems in use.

3.2 Self-heating in peat

Self-heating in stock heaps has long been known in Germany, but it never was a general problem. However, due to the increased use of sphagnum peat from Finland, Sweden, the Baltics, Russia and Canada, the problem of self-heating during the storage period has increased. Self-heating may render the peat useless for the production of potting soil. Peat in which self-heating has occurred can be recognised by its typical heating smell. However, after extensive aeration this smell disappears. Self-heating in peat is caused by microorganisms that produce heat, causing the temperature to rise. The cause of the phenomenon cannot always clearly be identified. Knowledge about the self-heating process is highly important in order to prevent self-heating. The damage caused by self-heating can be very substantial.

3.3 Factors influencing self-heating

From research as well as from practical experience a number of factors have appeared that may promote self-heating.

- The extraction method is relevant. Sphagnum peat from horizontal peat extraction is more sensitive to self-heating than peat cut in sods or blocks.
- The age of the peat has an influence. Younger peat is more sensitive than strongly decomposed peat, so peat from Scandinavia and the Baltics is more sensitive, but occasionally self-heating has also been found in German white peat.
- The presence of green plant material may cause self-heating to start. Self-heating can be stimulated by the presence of parts of green plants such as heather plants, purple moorgrass, etc. This plant material is the source of nitrogen for the microorganisms. Another known fact is that wood or many fibres in the peat make it more sensitive to self-heating.
- Difference in moisture content in a stock pile influences self-heating. The difference in moisture content causes moisture transport (heat transport) in a pile.
- Differences in botanical composition of the peat are a factor. Peat composed of various sphagnum types is more sensitive to self-heating than peat with a homogeneous composition.

3.4 Chemical changes in peat caused by self-heating

The odour of peat does not change up to a temperature of 40°C. From this temperature it starts to smell like sewage and from 55°C the odour becomes stronger, smelling like maggi. The colour of peat that has been hotter than 67°C gets darker. Self-heating causes chemical as well as physical changes in the peat. As a result of decomposition of hot peat various compounds such as humic acids, lignin and phenols may be released. These compounds may be poisonous to plants and inhibit germination. Research has shown that growth of

young plants in heated peat is inhibited considerably. It is also known that heated peat may have a lower pH and a higher salt content. In addition, there are indications that the iron content of the peat has an influence on self-heating.
Research has shown that peat that has been hotter than 50°C is no longer suitable to be used in potting soil.

3.5 Physical changes in peat caused by self-heating

Self-heating makes the structure finer. The cell walls of the various particles are broken down and get thinner, peat particles are reduced in size. That makes the peat dry and dusty. Basically, the water capacity decreases, but the air content increases, the peat can even become water repellent.

The chemical and physical changes in peat in which clearly self-heating has occurred, render it unsuitable for use in potting soil. It has become too fine, nothing is left of the original structure. There are indications that use of such peat in potting soil stimulates decomposition. As a result of the temperature increase, bacteria have become active that promote rapid decomposition of the peat. However, this aspect still has to be investigated further.

4. Applications

4.1 Sphagnum peat

Sphagnum peat is usually extracted horizontally, so it has a rather fine structure. In a number of countries such as Sweden and the Baltics, sphagnum peat is cut in blocks or sods. When these are broken and sieved, coarse fractions are produced. Today sphagnum peat is an important raw material that has largely replaced white peat. What applications sphagnum peat is used for largely depends on the coarseness. Rather coarse sphagnum peat is mainly used to compose potting soils for growing potted plants and trees. The finer sphagnum peat is used for sowing, pricking out and propagating soils, but also in quality blocking substrates, for instance for chrysanthemum cuttings.

4.2 White peat

When white peat is cut in sods, those can be broken and sieved to get coarse fractions. After horizontal extraction it is also possible to sieve out lumps, but in many cases the percentage of coarse material is not higher than 10 to 15 % (volume fraction). White peat is mainly used in soil for sowing, propagating and pricking out, and the coarse fractions in potting soils for potted plants and hydroponics culture. The applications can vary widely dependent on the gradation.

4.3 Transitional peat

Transitional peat produced in sods is highly suitable for the production of fractions. The somewhat higher degree of decomposition makes this material very stable and particularly suitable for substrates that have to be used for an extended period. The same applies to peat products from pressed sods that can also be considered a kind of transitional peat. Horizontally extracted transitional peat, for instance Irish white peat, is highly suitable for use in soil for sowing, pricking out and propagating, because of the high air content and draining capacity.

4.4 Frozen black peat

Frozen black peat still is an important peat product in The Netherlands. Frozen black peat is mainly used for:
- potting soil for raising vegetable plants;
- potting soil for raising bedding plants;
- potting soil for floricultural products;
- potting soil for the hobby sector.

Frozen black peat is not suitable for potting soils used under very wet conditions (ebb and flow or flood and drain). The air content is too low for that purpose because it contains too many fine particles. Frozen black peat is particularly used for blocking substrate because of the bonding properties of this material. Peat fibres are sieved from the frozen black peat, mainly at the peat extraction site on delivery. Increasingly this material is used to be mixed in coarse potting soils for growing potted plants and trees.

4.5 Black peat

Black peat is mainly used for blocking substrates because of the strong bonding properties of this peat product. Insufficiently frozen black peat shrinks strongly and after drying it will take up little water. This application has become topical because of the requirements made upon the firmness of a substrate block for machine transplanting.

Appendix 3 Stakeholder Meeting on Sustainable Trade in Peat and Peat Products

Report of the meeting held in Wageningen on April 28, 2010

Reinier de Man[1], Wouter Pronk[2] and Jerphaas Donner[2]

[1] Reinier de Man, Sustainable Business Development
[2] Milieukontakt International

Stakeholder meeting on sustainable trade in peat and peat products

Target group and Participants:
Stakeholders in the peat supply chain

Date : April 28th

Place : Atlas Building Wageningen University

By : Wouter Pronk[2], Jerphaas Donner[2] and Reinier de Man[1]

[1] Reinier de Man, Sustainable Business Development
[2] Milieukontakt International

Table of contents

1. Introduction

The workshop *Stakeholder meeting on sustainable trade in peat and peat products* was organized in the context of a research project on Sustainable Trade in Peat and Peat Products. This project is part of the Dutch Government's policy program named Biodiversity 2008-2011. The aim of the program is that, by the end of 2011, the government will have realized arrangements for a transition towards biodiversity in the peat chain with the parties involved in peat. The Netherlands is an important importer, trader and exporter of peat and peat products, especially for the horticulture sector.
A group of scientists, with Alterra (Wageningen UR) in the lead, has been invited by the Dutch Ministry of Agriculture, Nature and Fisheries (LNV) to perform the research project. Halfway through the project, a workshop was organized to gather information and to share views among all stakeholders in the peat supply chain.
The aim of the project is to gain a thorough insight into practices in the peat chain and the potential to create more sustainability if there appears a need to do so. As the global context is an important factor, the project is also looking at the relevance of peat use by the horticultural sector for the total availability and use of peat in the world and the influence of the use and degradation of peatlands on the climate and vice versa.
The project consists of two parts (phases). Within each part, a stakeholder-workshop is planned. This report briefly describes the first workshop, which took place on April 27, 2010. This workshop looked at the problems related to peat production and peat use, and was prepared and facilitated by Jerphaas Donner and Wouter Pronk (Milieukontakt, Amsterdam) on behalf of *Reinier de Man sustainable business development.*
The second workshop will focus on solutions.
Phase 2 will look at adjustments needed to create more sustainability in the peat supply chain. Such adjustments may include alternative methods for peat extraction, the use of alternatives to peat and changes in patterns of trade and consumption.

2. Workshop

2.1 Chatham House Rule

After a brief introduction of the facilitators Wouter Pronk and Jerphaas Donner[4], Wouter Pronk explained that the workshop would be held according to the Chattam house rule:
'When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed'.
The Chatham House Rule originated at Chatham House with the aim of providing anonymity to speakers and to encourage openness and the sharing of information. It is now used throughout the world as an aid to free discussion.
Then all participants were invited to introduce themselves: their professional affiliation, their reasons for their presence and their expectations on the results of the meeting.

2.2 Participants

The following stakeholders presented themselves:

- **Jose van der Klauw**, Tuinbranche Nederland - branche organization for garden centres.
- **Arthur van den Berg**, LTO Groei service.
- **Sandra Clerkx**, Alterra. Ms Clerkx has a background as forest ecologist and is project manager of Alterra's research project.
- **Herbert Diemont**, Alterra. Mr Diemont is the project leader of Alterra's research project.
- **Chris Blok,** Wageningen Greenhouse Horticulture research group.
- **Rien Bos,** retired professor working for Bos Water. Mr Bos takes part in the research project.
- **Raymond Schrijver** works for Alterra as an economist, takes part in the research project with a focus on economy.
- **Marcel Silvius,** director of the NGO Wetlands International. Mr Silvius takes part in the research project as a nature conservation stakeholder.
- **Gerald Schmilewski,** executive board member of the European Peat and Growing Media Association EPAGMA.
- **Hein Boon,** director of the RHP Foundation takes part in the research project.
- **Jan Water,** works with LNV, The Netherlands Ministry of Agriculture, Nature and Food Quality, which funds the project.
- **Gelare Nader,** works with LNV, The Netherlands Ministry of Agriculture, Nature and Food Quality, which funds the project.
- **Jan Verhagen**, works with Wageningen International. Mr Verhagen takes part in the research.
- **Jack Rieley**, independent consultant, worked as a researcher, worked also for the International Peat Society.
- **Henk Wösten**, works for Alterra and is a project team member.

[4] Milieukontakt International Amsterdam, on behalf of Reinier de Man, sustainable business development.

- **Roelof Huisman**, works with Vereniging van Potgrondfabrikanten Nederland - VPN (Dutch Potting Compost Producers Society).
- **Guus van Berckel**, works with Het Nederlands Veengenootschap (the Dutch Branch of the International Peat Society).
- **Ted Vollebregt**, works with Vereniging van Potgrondfabrikanten Nederland - VPN (Dutch Potting Compost Producers Society).
- **Dion ten Have**, works with LTO Groeiservice.

Participants concluded that unfortunately there were not many NGOs present at the meeting and suggested that apparently the issues related to peat production and peat use in Dutch horticulture were not yet an important issue for Dutch NGOs.

2.3 The participants' general expectations

It appeared that for many stakeholders from the horticulture sector the main reason to take part in this meeting was their wish to be informed about and have a say in the development of new government policies for peat and peat products.
The participants' general feeling was that open discussion on potential steps towards policy development for more sustainability in the peat supply chain should be welcomed. However, they emphasized that such a discussion should be based on facts and figures rather than on emotions. They therefore stressed the importance of a better common understanding of how the peat supply chain really works. The participants brought forward that the development of new policies should be based on common sense, mutual trust and understanding.
When introducing themselves, the participants from the horticultural sector used the opportunity to present their point of view that peat is such an excellent product for Dutch professional growers that it cannot easily be replaced by anything else.

2.4 Introduction to the project by Herbert Diemont

Herbert Diemont gave a short introduction of the project:
Since the Dutch horticultural sector is an important importer of peat from the Baltic states, *The Netherlands Ministry of Agriculture, Nature and Food Quality* (LNV) took the initiative to assess the sustainability of the production and use of peat products.
As part of the Dutch Government's policy program Biodiversity 2008-2011, LNV asked Alterra to research the trade in peat and peat products. For phase 1 of this project, a fact finding paper is being prepared. According to Dr Diemont, the project has to carefully take into account the business interests involved, as peat is an important input into an important sector of agriculture. It also has to take the biodiversity issue seriously. The Dutch (many of whom are active member of nature conservation organizations) expect their government to become active. The envisaged goal of the project is therefore to find sustainable solutions that contribute to both continued profitability of the horticulture sector and helps improve the peat chain's sustainability.
In principle there is a good legislation and policy in The Netherlands and in Europe to protect valuable nature reserves and biodiversity. Natura 2000 for instance guarantees the conservation of large territories in Europe of valuable biodiversity and nature reserves. Implementation, however, can be a problem. Especially in important peat exporting (new) member states like Estonia, Latvia and Lithuania.

2.5 Peat products in horticulture: what makes peat so excellent?

The participants were requested to write down on a sheet of paper the two characteristics that make peat such an excellent product in horticulture.
The participants wrote down qualities like: availability; natural product; high water holding capacity; strong phytosanitary qualities (carries no diseases); many different sorts of peat are available with different possible applications in different cultures; peat can be used as a vehicle for other products; peat can be used in many cultures: to replace peat you would need many different sorts of substrates; peat has a homogeneous quality; peat will be consumed (is reusable); peat is perishable; peat is cheap and is a low cost product for the users (if you double the costs it still will be used in horticulture).
Summarizing the qualities participants concluded that peat as a natural product has excellent biological, chemical, physical and economical qualities:

- peat is stable and does not fall apart quickly;
- peat is constant in quality;
- peat has a very strong water carrying capacity;
- peat's availability on the market is constant;
- peat is save to use (does not transmit diseases);
- peat is not expensive;
- peat is can be fine-tuned according to the needs of different cultures;
- peat is reusable and disappears eventually: it will be totally consumed during use.

Participants were asked to list possible alternatives and the amount of alternatives available. There are around sixty alternatives, but only four of them are worthwhile considering.

- Coir (cocos)
- Bark (schors)
- Perlite (steen)
- Compost
- Hydroculture
- Wood residues

Participants asked questions about the status of the discussion results. They were assured that all reports will be circulated amongst participants before they will be made public.
For many participants that are working in the peat supply chain the outcome of this session on alternatives was quite obvious.
After the coffee break, one of the participants summarized what kind of alternatives for peat have been developed over the years and concluded that many alternatives are available but that none of these alternatives until now can replace peat. The alternatives need further development.
In 2000, 89 percent of growing media was peat. Today 80 percent is peat. An overview of data on the use of peat and other growing media can be found at the website of Epagma (www.epagma.org) 80 percent of the peat that is used in The Netherlands is produced for professional use. Twenty percent of the peat is used in The Netherlands is produced for the consumer market. Remains of pesticides are found in non RSP certified growing media.

2.6 Environmental problems related to peat extraction. How can they be reduced?

2.6.1 Presentations of problems

The participants were asked to define the five main problems of peat extraction for biodiversity, nature an environment. The participants were divided into two groups. After taking the time to discuss the main problems, the participants were asked to present their findings with the help of a flipchart.

2.6.1.1 Group one

According to group one there are four problems and these problems are interlinked.

1. **hydrology**
   - impact on site, on the habitat
   - impact on the adjacent habitat
   - increased sedimentation
   - loss of water storage capacity
   - water pollution
   - Increased flood risk

2. **habitats, biodiversity**
   - potential loss of species
   - less migration of species
   - reduction in habitat areas
   - loss of (unique) biodiversity

3. **climate change, carbon stores**
   - transport increases the carbon footprint of the excavation product
   - CO_2 emissions
   - Loss of carbon store from peat by net CH4 (methane) emission

4. **loss of cultural scientific information, archives, landscape change**
   - loss of pollen
   - loss of geochemical information
   - loss of wilderness
   - loss mystical wild nature

2.6.1.2 Group two

Group two came up with a long list of problems
Before starting a new project of peat extraction in the Baltic states Environmental Impact Assessment (EIA) is obligatory. Participants doubted whether this EIA is always well implemented. Furthermore they listed possible problems of peat extraction in the Baltic states:

- Problems of water level changes, hydrological impact;
- Loss of biodiversity;
- Limited awareness in The Netherlands of the environmental impact of peat extraction;
- Limited knowledge on the possibilities of rational peat extraction resulting in a win-win situation for the use of peat and for nature conservation;
- Lack of clear geographical information on the location of valuable peat bogs from a biodiversity point of view;

- Limited understanding of effects of peat extraction on biodiversity;
- Lack of information on the amount of pristine bogs that are threatened;
- Lack of information on the amount of already degraded peat lands in the Baltic states;
- Lack of information on how much peat land needs to be preserved to maintain a sustainable reserve of valuable biodiversity;
- Lack of information on the amounts needed for the use in horticulture;
- Lack of information the energy consumption for peat extraction and use in horticulture;
- Lack of information on the impact of dust emissions as a result from extraction and use in horticulture;
- No clear answer to the following questions: who's problem is peat extraction and its use in horticulture? Is it a Dutch, German or Baltic problem? How long is the duration of an excavation, what happens exactly with CO_2 during and after the extraction?;
- Lack of transparency.

The following problems are according to group two the most important problems:
1. Lack of transparency;
   Lack of knowledge and awareness;
2. Hydrological impacts of extraction;
   Not sustainable methods/planning;
3. No clear answer to the following questions: how much peat needs to be preserved?
   How much loss is acceptable?;
4. Lack of a good policy on rehabilitation after peat extraction and lack of the implementation of such a policy;
5. Negative impact on the environment of GHG emissions;
   Loss of carbon store.

A discussion on the relationship between promoting sustainability at home (The Netherlands, Europe) and asking for more sustainability in foreign countries developed during the meeting. According to many participants, it would not be credible to require that palm oil from South East Asia complies to sustainability standards (including the limitation of planting oil palm on peat), if the sustainability of European peat chains would not be taken care of. 'If you tell somebody else you have to clean up your own house.'
This discussion then led to the question how to deal with Dutch and foreign peat in the Dutch CO_2 account. Some argued that only peat losses in The Netherlands should be accounted for.
Furthermore it was stated that it would be important to diversify between drainage peat lands and pristine peat lands. This in order to come to a more rational use of peat without damaging valuable biodiversity reserves in the Baltic states. Extracting peat in drainage peat lands could result in a win-win situation. By extracting the peat only in the drainage peat lands that lost their value already you could leave the pristine peat lands untouched.

2.7 First ideas on how to enhance sustainability in the peat supply chain

In the second part of the project, concrete ideas will be developed for enhancing sustainability in the peat supply chain. They will be selected on the basis of their potential contribution to sustainability and their feasibility of implementation. During this workshop a first and preliminary brainstorming of first ideas took place. The participants were asked to share their ideas.
The ideas are listed below and grouped into different stakeholder groups:

The Peat Supply Chain should work on:
- Restoration of peat bogs after extraction;
- Development of alternatives to peat products;
- Look for alternatives places for extraction, if this enhances sustainability;
- A policy to abolish extracting in Natura 2000 areas;
- Developing sustainability criteria for import / export
- Certification;
- Carbon offsetting / compensation;

The Government should work on:
- Stimulation of land use planning (EU)
- Developing a long term planning to enhance sustainability in the peat supply chain;
- Making data on land use and planning accessible;
- Creating a level playing field for the peat sector.

NGOs should work on:
- Research on the development of alternatives for extraction;
- Stimulating a long term planning to enhance sustainability in the peat supply chain;
- Monitor the governmental sustainability policy and planning to enhance sustainability;
- Contribution to the development of creative solutions to come to enhanced sustainability in the supply chain;

Science should work on:
- Enhanced understanding of habitat change;
- Enhanced understanding of the environmental impact of peat extraction;
- Developing alternatives to peat use.

Conclusions

The outcomes of this workshop are a good starting point for Phase II. The main conclusions can be summarized as follows[5]

1. Not surprisingly, the excellent properties of peat for use in the horticultural sector were repeatedly and strongly confirmed.
2. It was also emphasized that there are hardly any alternative materials that are as attractive as peat in the full spectrum of its applications.
3. From these two argument, the inescapable conclusion is that a forced replacement of peat by other materials is highly unwelcome and that such a replacement should only be considered if peat extraction leads to strongly negative (environmental) effects that can neither be avoided nor justified.
4. However, the discussion of the negative effects of peat extraction on the environment (including biodiversity and climate issues) yields a mixed picture.
5. A clear distinction should be made between peat extraction from pristine peat areas (generally with high nature value) and peat extraction from areas that have already lost much of their original value.
6. Peat extraction from pristine and high nature value areas should be systematically avoided. No peat from such areas should be used by Dutch horticulture in the future. There is no need to do so as there are sufficient other sources available, see next point.
7. Peat extraction from already degraded peat systems can be continued. If this extraction is appropriately followed up by restoration measures, biodiversity values can, to a certain extent, increase after the extraction period.
8. The Dutch peat supply chain will need to demand that does not originate from pristine high biodiversity value areas and that is extracted from degraded peat systems where restoration measures can be guaranteed.
9. This strategy will allow for many years of continued peat supply without major environmental damage. There is ample time to develop alternatives to peat in the meantime.
10. In principle, existing legislation in the extraction countries (all in Europe) provides sufficient protection against extracting peat from pristine peat areas with high biodiversity value. However, gaps in implementation do still pose some real threats to these areas.
11. Supplementary to the efforts of government on all levels (Europe, national and regional governments), the peat supply chain can add the elements mentioned here (no peat from high value areas, obligation to restore extracted peat areas) into their voluntary standards and certification systems. This is the subject of the second workshop.

[5] This summary was not presented during the workshop. It was written after the workshop on the basis of the workshop results.

Appendix 4 Peat Balance

Henk Wösten[1] and Jan Verhagen[2]

[1] Alterra, part of Wageningen UR
[2] Plant Research International, part of Wageningen UR

Table of contents

Peat Balance

The aim of this section is to present a first estimate of a global peat balance. Based on a short review, estimates of the extent and amount of peat are presented, followed by a summary of common threats to peatlands as well as the role of the Dutch horticultural sector.

Summary

Because the genesis of peat is typically linked to water-logged, acid and low-nutrient conditions (factors that hamper the decomposition of plant material) most peat areas are found in the (sub)arctic, boreal, and temperate climate zones. Peatlands are found on all continents, however, from the tropical lowlands to the Siberian tundra. The distribution of organic soils in Europe shows a strong northern bias. Outside the former Soviet-Union, almost one-third of the European peatland resource is in Finland, and more than a quarter is located in Sweden. Substantial areas of peatland are also found in Poland, the UK, Norway, Germany, Ireland, Estonia, Latvia, The Netherlands, and France. Small areas of peatland and peat-topped soils are also present in Lithuania, Hungary, Denmark and the Czech Republic.

The most recent reviews estimate that approximately 400 - 500 million ha (2.5-3.5% of the land area of the world) is covered with a peat layer deeper than 0.3 m (Maltby & Immirzi, 1993; Lappalainen, 1996; Joosten & Clarke, 2002). Despite the lack of an accurate inventory data Gruber et al. (2004) estimated that about 450 Gt C of the soil carbon is locked in wetlands and peatlands against 3,150 Gt C in the soil and 650 Gt C in living biomass.

Most if not all agricultural uses of peatland are accompanied with drainage. An inventory by Joosten (2009) shows that global CO_2 emissions from drained peatlands have increased from 1.058 Gt in 1990 to 1.298 Gt in 2008 (>20%). This increase has particularly taken place in developing countries of which Indonesia, China, Malaysia and Papua New Guinea are the fastest growing top emitters. This estimate excludes emissions from peat fires (conservative estimates amount to at least 0.4 Gt/CO_2-eq./yr for south-east Asia) and also covers only heterotrophic decomposition of soil organic matter; root respiration is excluded. Appendix 1 countries have reduced their peatland emissions since 1990 but are still responsible for more than 0.5 Gt of CO_2 emissions. With 0.174 Gt, the EU (27) is after Indonesia (0.5 Gt) and before Russia (0.161 Gt) the World's 2nd largest emitter of drainage related peatland CO_2 (excl. extracted peat and fires). Total CO_2 emissions from the worldwide 50 million ha of degraded peatland may exceed 2 Gt (including emissions from peat fires). Globally an area of 0.2 million ha is actively being used by the peat industry for peat extraction, with 0.12 million ha in the EU alone (www.epagma.org). In 2005 peat extraction in the EU totalled a volume of 65 106 m3. A total of 68 10^6 m^3 peat is used in the EU, meaning an import of about 3 10^6 m^3 from outside the EU. About 50% or 34 10^6 m^3 is used for energy, mainly in Sweden, Finland, and Ireland. Horticulture claims 42% or 29 10^6 m^3 peat.

Peat is mined for horticulture and energy. The very nature of mining is destructive to the environment. Regrowth of sphagnum peat would allow for restoration of a bog, however, the rate of peat accumulation is too slow to replace the mined peat within a reasonable time horizon of for instance a century.

Annually Dutch potting soil producers import 4.2 million cubic metres peat from the Baltic states (Estonia, Latvia and Lithuania), Sweden, Finland, Ireland and Russia. Roughly one third is used in glasshouse horticulture, one third for the outdoor/consumer market and one third is directly exported. The monetary value of the peat import is over 170 million euro. The annual emission of carbon dioxide from this peat import for horticulture in The Netherlands is 0.2-0.3 Mton. This is about 0.15% of the overall national carbon dioxide (CO_2) emissions.

An additional 0.1 Mton is emitted by peat extraction, transport, and packaging. More than half of the imported peat is re-exported and thus not included in the Dutch emission reports.

Global peatland distribution

Because the genesis of peat is typically linked to water-logged, acid and low-nutrient conditions (factors that hamper the decomposition of plant material) most peat areas are found in the (sub)arctic, boreal, and temperate climate zones. Peatlands are found on all continents, from the tropical lowlands to the Siberian tundra. The scarcity of peatlands in the southern hemisphere is due to the absence of land in the relevant ecological zones (Figure 1).

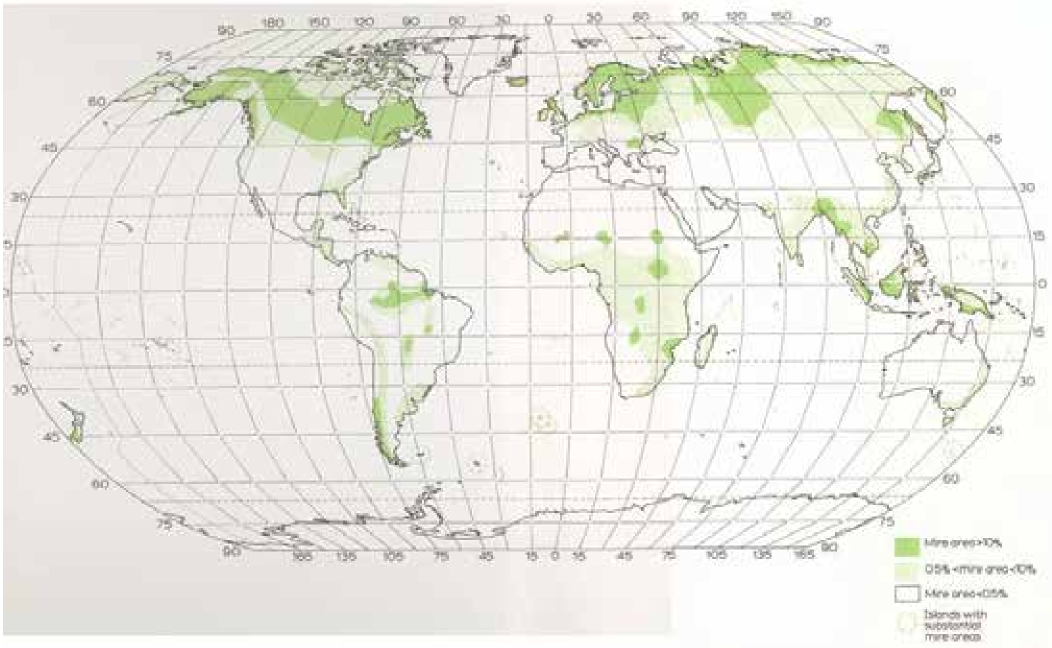


Figure 1
Peatland distribution worldwide (Gore, 1983).

Europe

The distribution of organic soils in Europe shows a strong northern bias. Outside the former Soviet-Union, almost one-third of the European peatland resource is in Finland, and more than a quarter is located in Sweden. Substantial areas of peatland are also found in Poland, the UK, Norway, Germany, Ireland, Estonia, Latvia, The Netherlands, and France. Small areas of peatland and peat-topped soils are also present in Lithuania, Hungary, Denmark and the Czech Republic (Montanarella et al., 2006; Figure 2).

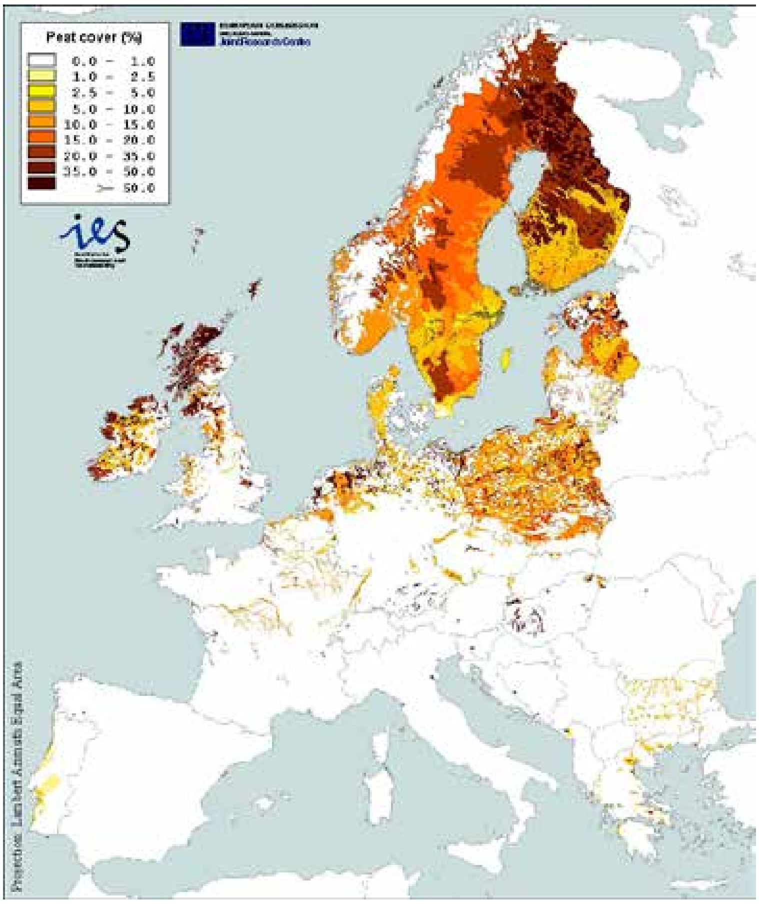


Figure 2
Peatland distribution in Europe (Montanarella et al., 2006).

Peat and the carbon budget

The most recent reviews estimate that approximately 400 - 500 million ha (2.5-3.5% of the land area of the world) is covered with a peat layer deeper than 0.3 m (Maltby & Immirzi, 1993; Lappalainen, 1996; Joosten & Clarke, 2002). Rieley et al. (2008) estimate the area of tropical peatland to be 30 - 45 million ha. Most of it is still under forest cover, but large parts have been selectively logged.

Because of the diversity in land cover (varying from forest, shrubland, to open grassland) peatlands are extremely difficult to map using remote sensing. Assessing peatlands merely on the basis of the vegetation and other surficial landscape characteristics is error-prone, presented data ranges in literature on global peatland area are merely compilations of different estimates. Assessing the carbon stocks in peatland using remote sensing is impossible. Here the inventory relies fully on field mapping and extrapolation. For most countries no such field data are available. And even the best investigated country in the world, Finland, has only mapped a quarter of its peatland area in detail.

The lack of accurate inventory data results in a range of estimates of the amount of carbon stored in peatlands. According to Gruber et al. (2004) about 450 Gt C of the soil carbon is locked in wetlands and peatlands against 3,150 Gt C in the soil and 650 Gt C in living biomass. Parish & Canadell (2006) estimated a carbon store for tropical peatlands in SE Asia of about 50-90 Gt C, with a carbon store in Indonesian peatlands of up to 70 Gt C. More recently, Jaenicke et al. (2008) presented an estimated carbon store of 55 ±10 Gt for Indonesian peatlands.

Bulk density (dry weight) is perhaps the most important characteristic of peat because it links to other physical and chemical properties. Andriesse (1988) and Boelter (1974) indicate a large range of bulk densities (on a dry weight basis) from around 50 kg m^{-3} for fresh peat to about 200 kg m^{-3} for well-decomposed material, Andriesse reports a maximum of 500 kg m^{-3}. Bulk densities are mainly related to the moisture regime and the proportion of clastic (mineral) material. Drainage of peat results in changes in bulk density and hence changes in the physical and chemical characteristics of the peat.

The organic carbon content of peat may range from 12 to 60% (Andriesse 1988). This value is of particular importance when determining CO_2 emission based on the loss of peat material, as has been the case in tropical peatlands. Melling et al. (2005) reports a value range of 45-48% C for peats in Sarawak, Kool et al. (2006) used a C content of 50%. Hooijer et al. (2006), referring to Page et al. (2002), took a C content of 60%. Watson et al. (2000) suggest as default for IPCC guidelines a 50% C content for woody species; for plant material values in the range of 45 - 50% are common.

The soil organic carbon pool to 1-m depth ranges from 30 10^3 kg ha^{-1} in arid climates to 800 10^3 kg ha^{-1} in organic soils in cold regions with as predominant range of 50 10^3 to 150 10^3 kg ha^{-1} (Lal, 2004). In mineral soils the surface layers normally contain more carbon than the subsoil layers. In peatland carbon contents remain high throughout the peat profile.

The concentrated carbon reservoirs that peatlands represent require special attention as their disturbance may result in large carbon emissions to the atmosphere. Peatland drainage and peat fires are perhaps the best know factors in this but grazing and peat extraction result in carbon emissions as well. As most human interventions in peatlands start with draining the land, human interventions almost always turn peat into significant sources of greenhouse gases. After drainage peat compaction and oxidation result in lowering of the surface with consequences for buildings, infrastructure, agriculture and water management. Conventional agriculture requires an aerated root zone and a dry soil to avoid trampling by cattle and to allow the use of agricultural machinery, so water management is crucial to allow continuation of agricultural production.

The process of peatland degradation after drainage is largely irreversible. Emission of carbon continues until the peat is rewetted. Deep drainage will result in larger losses over shorter periods of time, but even shallow drainage may result in large losses over time (Fokkens,1970; Schothorst,1982; Van den Akker et al., 2008; Hooijer et al., 2006). With increasing temperatures and longer periods of drought oxidation of peat will increase considerably (Hendriks et al., 2007).

Restoring peat formation is difficult, even with a restored hydrology. In most peatlands slowing down or stopping degradation is the best achievable option. This, however, comes at a cost for current land use systems. On the other hand, very destructive types of land management can be replaced by less damaging land use systems to slow down the peatland degradation process (e.g. conversion of arable land into permanent grassland, use of perennial crops, paludiculture or wet reforestation).

The potent greenhouse gas methane is formed under anaerobic conditions as found in wet peatlands. Northern peatlands are large sources of methane with an estimated annual emission of 0.02 and 0.05 Gt C (Mikaloff Fletcher et al., 2004a, b). Methane production by bacteria is strongly temperature-driven, with higher temperatures resulting in higher methane emissions. This will especially be critical for permafrost peatlands (Walter et al., 2006). The net greenhouse gas balance is, however, positive for most natural peatlands implying that these peatlands sequester CO_2 and that they act as carbon sink. Human and natural disturbance of peatlands (e.g. increased temperatures, draining, burning, grazing and mining) will turn these large carbon stocks into carbon sources.

Threats and peatland degradation

Peat is mined for horticulture and energy. The very nature of mining is destructive to the environment. Regrowth of sphagnum peat would allow for restoration of a bog, however, the rate of peat accumulation is too slow to replace the mined peat within a reasonable time horizon of for instance a century.

The next most common use of peatland is agriculture. Most if not all agricultural uses of peatland are accompanied with drainage. Peatland drainage results in substantial emissions of carbon dioxide and nitrous oxide that urgently should be addressed in a post-2012 climate policy framework. The global figures presented until now do not clearly show the challenges and opportunities on regional and national levels. An inventory by Joosten (2009) shows that global CO_2 emissions from drained peatlands have increased from 1.058 Gt in 1990 to 1.298 Gt in 2008 (>20%). This increase has particularly taken place in developing countries of which Indonesia, China, Malaysia and Papua New Guinea are the fastest growing top emitters. This estimate excludes emissions from peat fires (conservative estimates amount to at least 0.4 Gt/CO_2-eq./yr for south-east Asia) and also covers only heterotrophic decomposition of soil organic matter; root respiration is excluded. Appendix 1 countries have reduced their peatland emissions since 1990 but are still responsible for more than 0.5 Gt of CO_2 emissions. With 0.174 Gt, the EU (27) is after Indonesia (0.5 Gt) and before Russia (0.161 Gt) the World's 2nd largest emitter of drainage related peatland CO_2 (excl. extracted peat and fires). The inventory by Joosten (2009) shows that the responsibility for better peatland management for climate change mitigation is indeed global and not limited to a few selected countries.

Total CO_2 emissions from the worldwide 50 million ha of degraded peatland may exceed 2 Gt (including emissions from peat fires).Taking into account that only part of this area is available for rewetting and that CO_2 reduction may be partly annihilated by re-installed CH_4 emissions, peatland rewetting may globally reduce greenhouse gas emissions with several hundred Mt CO_2-eq./yr. Whereas Appendix 1 countries can stick to the base year 1990, this base year is clearly unfavourable for non-Appendix 1 countries, where major peatland drainage has occurred since 1990. Mining and draining peat will have a negative impact on the carbon stock. The potent greenhouse gas methane is formed under anaerobic conditions as found also in pristine wet peatland. The net greenhouse gas balance is, however, positive for most natural peatlands implying that these peatlands sequester CO_2 and that they act as carbon sink.

Dutch Horticultural sector

Globally an area of 0.2 million ha is actively being used by the peat industry for peat extraction, with 0.12 million ha in the EU alone (www.epagma.org). In 2005 peat extraction in the EU totalled a volume of 65 10^6 m^3. A total of 68 10^6 m^3 peat is used in the EU, meaning an import of about 3 10^6 m^3 from outside the EU. About 50% or 34 10^6 m^3 is used for energy, mainly in Sweden, Finland, and Ireland. Horticulture claims 42% or 29 10^6 m^3 peat. Updated, average values are presented in Figure 3.

The gross annual import quantity of peat to The Netherlands is about 4.2 million cubic meters (Mm^3) from the Baltic states (Estland, Letland and Lituania), Sweden, Finland, Ireland and Russia. Slightly more than one third of this is used in glasshouse horticulture, slightly less than one third for the retail or consumer market, and one third is directly exported (Verhagen et al. 2010). The total peat consumption in the EU is almost 70 million cubic meters, of which half is used for energy production (Figure 3).

The annual emission of carbon dioxide from this peat import for horticulture in The Netherlands is 0.2-0.3 Mton. This is about 0.15% of the overall national carbon dioxide (CO_2) emissions. An additional 0.1 Mton is emitted by peat extraction, transport, and packaging. More than half of the imported peat is re-exported and thus not included in the Dutch emission reports. In comparison heating glasshouses is responsible for about 4% of the total CO_2 emissions. The total Dutch carbon dioxide emission in 2005 was 220 Mton carbon dioxide (CBS, 2005).

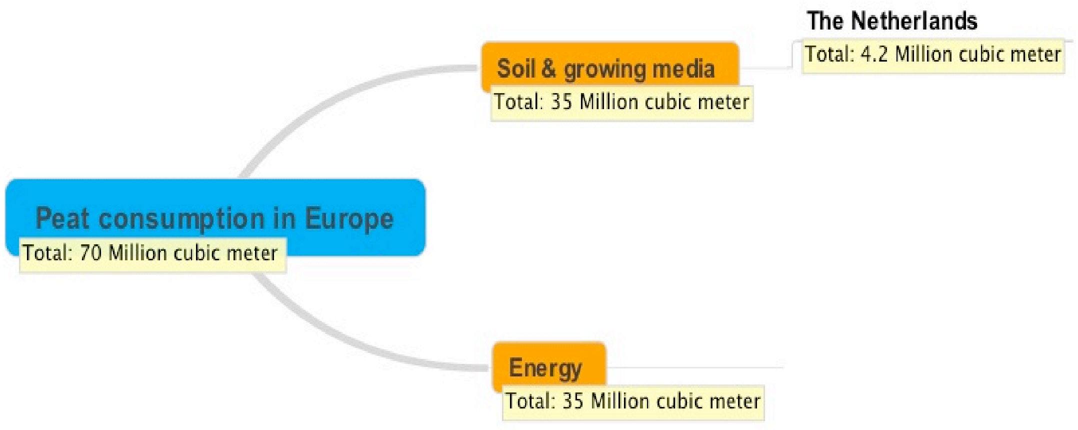


Figure 3
Peat flows in Europe.

Options for dealing with CO_2 emissions

Although the greenhouse gas emissions related to peat extraction for Dutch horticulture are low it is clear that the use of peat has a negative impact on the carbon balance. Options to deal with this negative impact are considered in this section.

By trading carbon, industries actually pay for the right to emit. The carbon market is an attempt to set a market mechanism in place to reduce the concentration of greenhouse gasses in the atmosphere. It allows industries and consumers to pay for using the atmosphere. Already the peat industry is addressing the issue by making the greenhouse emission profile of peat and peat based products explicit (Epagma: www.epagma.org).

Although emission trading does exist it remains in revision and issues related to the risks and high transaction costs in land use system are still on the table. The voluntary market is moving at a different pace as compared to the official certified market. So far credits from the voluntary and certified market are not merged. Also whether trading short and long term emissions or terrestrial and non-terrestrial carbon reductions should be handled on an equal basis is still unclear. Inclusion of biological sinks in a trading system complicates the issue even further because of the non-permanence character of these sinks. Segmentation of the carbon market will most likely hamper price development and investments.

In general high risk and high transaction costs will reduce the incentive for buyers. This will typically be the case with credits from land use systems, where monitoring and verification are difficult. In any case the industry has a responsibility to alleviate the impacts of their activities. This is not different for the peat industry. Several options to take responsibility are discussed below.

First and foremost because peatlands are space-effective carbon stocks, conservation of undisturbed peatlands and the use of already degrading peatlands can be effective ways to avoid emissions. Conservation of peatlands as long term stocks is a logical strategy but risks will remain high. This is because storing carbon in land use systems is non-permanent by nature and lasting benefits to the atmosphere are more risky in these systems when compared to efforts in the energy sector.

Making the carbon footprint of peat based products explicit is an important step in allowing consumer and producer to choose between products. To facilitate this choice a clear framework to assess and benchmark emissions from different products is needed. So far such a framework does not exist for peat-based products. Therefore it should be designed to increase consumer transparency and serve as a basis to benchmark peat and non-peat products.

References

Andriesse, J.P., 1988. Nature and management of tropical peat soils. FAO Soils Bulletin No. 59, 165.

Boelter, D.H., 1974 The hydrologic characteristics of undrained organic soils in the Lake States. In: *Histosols, their characteristics, classification and use* (Ed .. M. Stelly), Soil Science Society or America Special Publication No. 6: 33-46.

CBS (2005).

Fokkens, B., 1970. Berekening van de samendrukking van veenlagen uit het gehalte aan organische stof en water. De Ingenieur, 82: 13, pp 23-28

Gore, A.J.P., 1983. Mires : Swamp, bog, fen and moor : General studies / Elsevier, Amsterdam.

Gruber, N., P. Friedlingstein, C. B. Field, R. Valentini, M. Heimann, J. E. Richey, P. Romero-Lankao, D. Schulze & C.-T.A. Chen, 2004 The vulnerability of the carbon cycle in the 21st century: An assessment of carbon-climate-human interactions, In: Toward CO_2 Stabilization: Issues, Strategies, and Consequences, Eds: C.B. Field and M. R. Raupach, Island Press.

Hendriks, D.M.D., Van Huissteden J., Dolman A.J. & Van der Molen M.K., 2007. The full greenhouse gas balance of an abandoned peat meadow. Biogeosciences, 4, 411-424,

Hooijer, A., Silvius, M., Wösten, H. & Page, S., 2006. PEAT-CO_2, Assessment of CO_2 emissions from drained peatlands in SE Asia. Delft Hydraulics report Q3943.

Jaenicke, J. Rieley, J. O., Mott, C., Kimman, P. & Siegert, F., 2008. Determination of the amount of carbon stored in Indonesian peatlands. Geoderma 147: 151-158

Joosten, H. & D. Clarke. 2002. Wise use of mires and peatlands. Background and principles including a framework for decision making.

Joosten, H. 2009. The global peatland CO_2 picture. Peatland status and drainage related emissions in all countries of the world. Wetlands International, Ede, The Netherlands.

Kool, D.M., Buurman, P. & Hoekman, D.H., 2006. Oxidation and compaction of a collapsed peat dome in Central Kalimantan. Geoderma 137: 217-225.

Lal, R., 2004. Soil Carbon Sequestration Impacts on Global Climate Change and Food Security. Science 304: 1623 - 1627

Lappalainen, E., 1996. Global peat resources, International Peat Society, Jyväskylä.

Maltby, E. & P. Immirzi, 1993. Carbon dynamics in peatlands and other wetland soils regional and global perspectives introduction. Chemospherc, Vo1. 27, No. 6, pp 999-1023, Melling, L., Hatano R. & Goh K.J., 2005. Soil CO_2 flux from three ecosystems in tropical peatland of Sarawak, Malaysia. Tellus 57 B:1-11.

Mikaloff Fletcher, S. E., Tans, P. P., Bruhwiler, L. M., Miller, J. B. & Heimann, M., 2004a. CH4 sources estimated from atmospheric observations of ch4 and its c-13/c-12 isotopic ratios: 1. Inverse modeling of source processes, Global Biogeochem. Cy., 18(4), GB4004, doi:10.1029/2004GB002223,

Mikaloff Fletcher, S. E., Tans, P. P., Bruhwiler, L. M., Miller, J. B. & Heimann, M., 2004b. CH4 sources estimated from atmospheric observations of ch4 and its c-13/c-12 isotopic ratios: 2. Inverse modeling of ch4 fluxes from geographical regions, Global Biogeochem. Cy., 18(4), GB4005, 30 doi:10.1029/2004GB002224

Montanarella, L., R.J.A. Jones & R. Hiederer, 2006. The distribution of peatland in Europe. Mires and Peat, Volume 1.

Page, S.E., Siegert F., Rieley J.O., Boehm H.-D. V., Jaya A. & Limin S., 2002. The amount of carbon released from peat and forest fires in Indonesia during 1997. Nature 420, 61-65.

Parish, F. & Canadell, P., 2006. Vulnerabilities of the Carbon-Climate System: Carbon Pools in Wetlands/ Peatlands as Positive Feedbacks to Global Warming. Final report for APN project 2005-12-NSY-Parish.

Rieley, J.O., Wüst, R.A.J., Jauhiainen, J., Page, S.E., Wösten, H., Hooijer, A., Siegert, F., Limin,S.H., Vasander, H. & Stahlhut, M., 2008. Tropical Peatlands: carbon stores, carbon gas emissions and contribution to climate change processes. Chapter 6: pp:148-18. In: Strack, M. (editor). Peatlands and climate change. International Peat Society.

Schothorst, C.J., 1982. Drainage and behaviour of peat soils. Proceedings of the symposium on peat lands below sea level. International Institute for Land Reclamation and Improvement. Publication No. 30: 130-163.

Van den Akker, J.J.H., P.J. Kuikman, F. de Vries, I. Hoving, M. Pleijter, R.F.A. Hendriks, R.J. Wolleswinkel, R.T.L. Simões & C. Kwakernaak, 2008. Emission of CO_2 from agricultural peat soils in The Netherlands and ways to limit this emission. In: Farrell, C & J. Feehan (eds.). Proceedings of the 13th International Peat Congress *After Wise Use - The Future of Peatlands, Vol. 1 Oral Presentations, Tullamore, Ireland, 8 - 13 June 2008.* International Peat Society, Jyväskylä, Finland. ISBN 0951489046. pp 645-648.

Verhagen, A., Van den Akker, J.J.H., Blok, C., Diemont, W.H., Joosten, J.H.J., Schouten, M.A., Schrijver, R.A.M., Verweij, P.A. and Wösten, J.H.M. 2009. Peatlands and carbon flow. Outlook and importance for The Netherlands. Climate change scientific assessment and policy analysis. WAB report 500102 027. 50 pp.

Walter, K.M., S.A. Zimov, J.P. Chanton, D. Verblya & F.S. Chapin III, 2006. Methane bubbling from Siberian thaw lakes as a positive feedback to climate warming', Nature Vol. 443, 7 September,

Watson, R.T., Noble, I.R., Bolin, B., Ravindranath, N.H., Verardo, D.J. & Dokken, D.J., 2000. Land use, Land-use change, and forestry, A Special Report of the IPCC, Cambridge University Press, Cambridge.

Appendix 5 Stakeholder Meeting on Sustainable Trade in Peat and Peat Products

Report of the second stakeholder meeting, Wageningen, November 18, 2010

Reinier de Man[1] en Wouter Pronk[2]

[1] Reinier de Man, Sustainable Business Development
[2] Milieukontakt International

Second Stakeholder meeting on sustainable trade in peat and peat products

Date : November 18th, 2010

Place : Wageningen University, Lumen Building

By : Reinier de Man and Wouter Pronk

Table of contents

1 Introduction

The workshop *Stakeholder meeting on sustainable trade in peat and peat products* was organized in the context of a research project on Sustainable Trade in Peat and Peat Products. This project is part of the Dutch Government's policy program named Biodiversity 2008-2011. The aim of the program is that, by the end of 2011, the government will have realized arrangements for a transition towards biodiversity in the peat chain with the parties involved in peat. The Netherlands is an important importer, trader and exporter of peat and peat products, especially for the horticulture sector.
A group of scientists, with Alterra (Wageningen UR) in the lead, has been invited by the Dutch Ministry of Agriculture, Nature and Fisheries (LNV) to perform the research project. The aim of the project is to gain a thorough insight into practices in the peat chain and the potential to create more sustainability if there appears a need to do so.
The project consists of two parts (phases). Within each part, a stakeholder-workshop took place. The first workshop took place on April 27, 2010. During that workshop general problems and opportunities related to peat production and use were discussed. During the second workshop (part of project phase 2, reported here) on November 18, 2010, options for creating more sustainability in the peat supply chain were discussed on the basis of concrete proposals for action.
The workshop was facilitated by Dr Reinier de Man, assisted by Wouter Pronk (co-facilitator) and Andrés Pardo (protocol).

2 Workshop Part 1: Introductions

2.1 Chatham House Rule

The meeting took place under 'Chatham House Rules', in order to create an atmosphere of free information exchange between the stakeholders. Participants were not supposed to formally represent their organisations in endorsing any decisions or plans.
The Chatham House Rule originated at Chatham House with the aim of providing anonymity to speakers and to encourage openness and the sharing of information. It is now used throughout the world as an aid to free discussion:

'When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.'

2.2 Participants

Name	Organisation	Stakeholder group
Arjen Brinkmann	Brinkmann Consultancy	Industry: other
A.J. Schilstra	Nederlands Veengenootschap	Industry: peat supply chain & horticulture
Dion ten Have	LTO Groeiservice	Industry: peat supply chain & horticulture
Chris Blok	Wageningen UR	Horticulture research group
Jack Rieley	IPS	Research, Peat NGO
Gerard Schmilewski	Klausmann-Deilmann and executive board member of the *European Peat and Growing Media Association EPAGMA*	Industry: peat supply chain & horticulture and Peat NGO
Arthur van den Berg	LTO Groeiservice	Industry: peat supply chain & horticulture
Rard Metz	Tuinbranche Nederland	Industry: peat supply chain & horticulture
Henk Simons	IUCN Nederland	NGO
Hein Boon	RHP	Industry: peat supply chain & horticulture
Rien Bos	ex Wageningen UR / consultant	Research & consultancy
Herbert Diemont	ex Wageningen UR, Triple E	Research & consultancy
Reinier de Man	Sustainable business development	Rresearch & consultancy
Marcel Silvius	Wetlands International	Wetlands International NGO
Jan Verhagen	Wageningen UR	Research & consultancy
Jan Water	EL&I (LNV)	Government
Henk Wösten	Wageningen UR	Research & consultancy
Henk Zingstra	Wageningen UR	Research & consultancy
Gerard van Dijk	EL&I (LNV)	Government
Guus van Berckel	Veengenootshcap Netherlands chapter	Peat NGO
Roelof Buisman	Association of Dutch Substrates Manufactures	Industry

The participants shared the common interest to create conditions for making the peat supply chain more sustainable (some preferred 'responsible'). Depending on the interests the different stakeholders represented, they emphasized the importance of saving the last remaining 'undisturbed' peat lands in Europe or the importance of securing the availability of high quality peat as an important input into high added value horticulture. It was also brought forward that it is important to assess the possibilities of replacing peat by alternative materials, especially for less demanding applications or less demanding users (hobby gardeners, for example). The chair decided not to go into the alternatives issue into any detail, as this would have required better preparation and more discussion time than available. However, the issue should be on the table during a next phase in the stakeholder discussions.

2.3 Summary of the Report by Jan Verhagen

Jan Verhagen summarised the objectives of the project and the main findings of the report.
He distinguished between the two phases of the project. In Phase I the impacts of peat extraction and peat trade (in Europe) on biodiversity and carbon emissions were assessed, whereas in Phase options for enhancing the sustainability of the peat supply chain were developed.
He stressed the importance of peat for horticulture (high quality, high added value), the impacts on biodiversity (unique and vulnerable ecosystems) and the relevance for the carbon and climate issue (peat is carbon).
Solutions for making the peat supply chain more sustainable were proposed in four directions:

- Selection of sites:
  - Exclude protected areas;
  - Focus on already degraded areas.
- Extraction methods:
  - Focus on rehabilitation and after use;
  - Technologies to upgrade low quality peat (steaming).
- Management of the value chain:
  - Transparency needed for checks and balances.
- Look for alternatives to peat:
  - To secure the availability of high quality growing material.

The attractiveness of different options for 'availability', 'biodiversity' and 'carbon' were summarised in the table below.

	Availability*	Biodiversity	Carbon
Exclude exploitation in protected areas	-	+	+
Extraction methods (focus on after use and technology)	+	+	+
Transparency in the value chain	+/-	+	+
Search for alternatives	+	+/-	+

2.4 Short Discussion Round on the Draft Report

The main topics in the short discussion round were:

- A general lack of references to literature, especially in those cases where there are contradictory references available.
  - It was explained that detailed references can be found in the annexes to the report, which were not yet sent to the workshop participants;
  - The annexes would be sent to the participants as soon as possible;
  - Literature references will be added to the main text where required.

- Lack of precision in terminology:
  - Imprecise concepts, confusing and contradictory terminology: 'sustainable', 'responsible', 'degraded', etc. Advice to stick to conventions already made in other circles such as IPS.
  - It was decided to add a list of concepts to the final version of the report.

- No sufficient quantitative basis for a number of statements
  - Figures for peatland areas, production quantities, different types of peat, impacts on nature etc. etc.
  - Confusing CO_2 figures were mentioned as well.
  - The usefulness of quantitative scenarios for alternative options was argued.
  - It was concluded that many of the required figures are not there (yet) and that it does not make sense to try to get the full picture on the basis of incomplete data. The priority for the near future: create transparency in the entire peat supply chain.

- Lack of attention to alternatives to peat (see also remarks above); The need for looking at alternatives was recognised by most participants, but it was also agreed that this project had to focus on the acceptability of peat exploitation;
  - If stricter rules for peat exploitation will lead to peat scarcity, the pressure on using alternatives will necessarily become higher.
  - Similar assessments as for peat should be made for any alternative that will be used at a significant scale. This project cannot make any valid statement on the ecological or social acceptability of alternatives to peat, neither on their technical qualities.

- Lack of attention to social sustainability
  - this issue was stated but not discussed in any detail.

- Learn from comparable supply chain sustainability initiatives;
  - It was brought forward that for the development of criteria for sustainable peat and their implementation in the supply chain, many lessons are available from other commodity initiatives (palm oil, timber, soya, etc.).

3 Workshop Part 2: From Analysis to Action

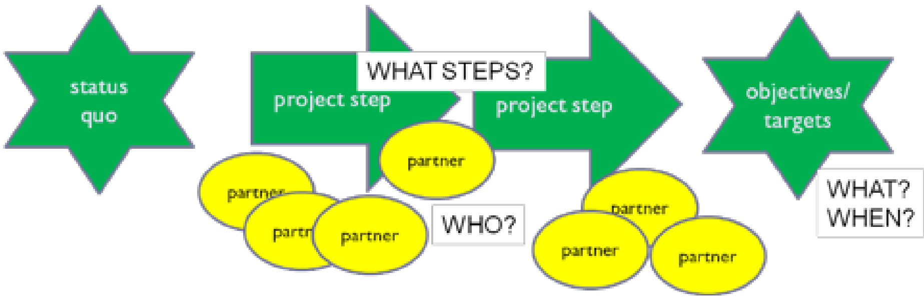
3.1 From Analysis to Action (by Reinier de Man)

Reinier de Man explained the focus of workshop discussions during part 2.
There is a growing body of knowledge on the biodiversity and carbon aspects of peat exploitation. Moreover, there is a growing consensus on how one might define 'responsible peat' (IPS, EPAGMA, this project) and on the actions required. For this reason the facilitator asked the participants

- to contribute to next steps from analysis to action;
- not to focus on theoretical discussions;
- but on actions needed to make present ideas more concrete and to put them into action.

He asked the participants to be clear about objectives, project steps and project partners:

- Objectives:
  - What is the intended result?
  - When should the objectives be realised?
- Project steps
  - What should be done and when?
- Project partners
  - Who should carry out the work?
  - Who should play other roles?
  - What cooperation is required?



3.2 Four Action Fields (by Henk Wösten)

The discussion about a potential action agenda was structured into four so-called action fields, which were presented by Henk Wösten:

- Action field 1
  Implementing sustainability criteria in the supply chain;
- Action field 2
  Improving After-Use Measures;

– Action field 3
  Taking Responsibility for Carbon and Climate;
– Action field 4
  Increasing Peat Production from Severely Degraded Peatlands.

A proposal to add a fifth action field (on alternatives to peat) was not accepted, as the issue would have required more preparation and would have taken more time than available. It was agreed to address the issue at a future meeting.

3.3 Action Field 1: Implementing sustainability criteria in the supply chain

Presentation

Action field 1 was introduced by Hein Boon. In his presentation, he emphasised the opportunities for industry and its stakeholders to take the initiative. The initiative would embrace two challenges:
A. to create full transparency in the supply chain;
B. to implement clear and acceptable criteria.

Criteria have not yet been fully defined but future criteria can build on work being done in the framework of IPS and EPAGMA. Hein Boon proposed as a task for the shorter term to base criteria for the peat supply chain both on current legislation (Habitat and Bird Directive, Natura 2000, EIA etc.) and on existing industry and multi-stakeholder initiatives (EPAGMA, IPS).
Longer term tasks would include an assessment of possibilities to use other constituents than peat, including carrying out LCA studies for these alternatives. The development of a common vision on carbon would also be part of a longer term agenda.

Discussion

The discussion concentrated on the questions:
A. How to create transparency in the supply chain and
B. How to define and implement criteria for 'sustainable' or 'responsible' peat.

Transparency

The remarkable conclusion of the discussion on this issue was that, in principle, there are no major obstacles for creating transparency in the supply chain. In the context of present quality requirements, much information is already available (at least to those directly involved in commercial transactions) on the peat excavation areas, the peat operators, the implementation of existing (government) regulation, etc. On the basis of existing information flows, a good start with creating transparency in the supply chain can be made. Evidently, there are still major issues with confidentiality of commercial data, access rights to different stakeholders, etc., but there was a feeling that these things can be sorted out.
It was remarked that transparency is the pre-condition for doing any substantial work on standards implementation and verification. Transparency is needed for good quantitative scenarios for the future availability of peat in different qualities.
Although the ultimate goal should be to create transparency in all European peat supply chains, the idea to start with a Dutch pilot project (possibly with RHP taking the lead), was fully supported.

Criteria

There was a general feeling that duplication in the development of criteria for responsible/sustainable peat should be avoided and that any initiative should take the existing work on 'responsible peatlands management' into full account. The discussion led to the conclusion, shared by most participants, that the criteria should be based on existing legislation and knowledge about best practices produced by IPS and EPAGMA. By involving IPS, important stakeholders are already on board and there is no need for setting up a new multi-stakeholder initiative.
A discussion developed about government and private sector responsibilities. Some argued for a stronger role of the government (regulation) and not to leave the issue to industry self regulation. However, in the present political context, not much regulatory activity (if possible at all in the context of free trade arrangements) can be expected (yet) on the part of Dutch government. Dutch government, however, appears to be willing to provide certain forms of facilitation. The ongoing project is an example of that government role.

3.4 Action Field 2: Improving After-Use Measures

Presentation

IPS as basis

Action Field 2 was introduced by Marcel Silvius, who based his argumentation on the IPS Responsible Peatland Management Strategy:

- Peatlands should not simply be abandoned in a degraded state when their economic use ceases.
- Obligation to develop and implement rehabilitation or other after-use plans:
  - specified in planning consent & license to operate
- Prevent further drainage and degradation of abandoned peatlands:
  - strong focus on rehabilitation, including rewetting
- After-use determined by the relevant planning authority

Requirements on after-use are an important element of the IPS strategy:

- Wise Use of Peatlands for economic purposes requires planned after-use, e.g.:
  - agriculture, forestry, recreation, wildlife habitat & biodiversity.
- Peatland rehabilitation:
  - returning degraded peatlands to conditions in which ecosystem functions are as close as possible to natural conditions,
  - within constraints of practicality and at reasonable cost.
- Options for carbon emission reduction & sequestration (à action field 3).
- After-use depends on peatland type & former management & condition of the 'used' peatland.

Actions

Three actions were proposed by Marcel Silvius:

1. By 2012 no import of peat from areas for which no approved after-use plans are available:
   - Who? Industry.
2. Inclusion in certification:
   - Who? RHP à action field 1.

3. Development of best practice:
   - Cost-benefits assessments of different levels extraction versus rehabilitation/after-use.
   - Who?
     - Plans & implementation - Industry
     - Review plans - Science/NGOs
     - Policy - Government
     - Monitoring - RHP & Government

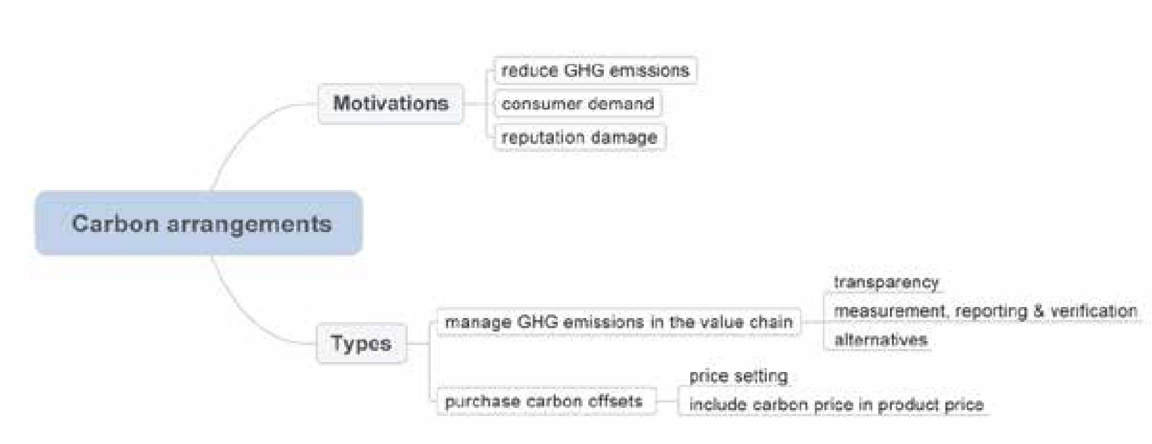
Discussion

There was general agreement that the first two actions should be included into sustainability/responsibility criteria for peat. There was no discussion on the question whether 2012 is a realistic date. However, there was strong agreement on the need for having a much better insight into present after-use practices (there is just no reliable information on many former extraction sites), the options for after-use realistically available and best practices to be followed in the future.
According to the majority of participants, the discussion on after-use should not be restricted to peatland restoration in the sense of trying to return to original conditions of a living peat system. Alternatives, such as creating other natural or semi-natural systems with interesting biodiversity and/or recreational values should be included.
The workshop participants felt that IPS is the most appropriate forum for coordinating research on this issue.

3.5 Action Field 3: Taking Responsibility for Carbon and Climate

Presentation

Jan Verhagen gave a systematic introduction into Action Field 3. Verhagen distinguished different motivations for taking action on reducing Greenhouse Gas (GHG) emissions. There may be an intrinsic drive to reduce GHG emissions or there may be external pressure, either from society (GHG emissions are needed to create good reputation or to prevent reputation damage) or from consumers, who expect the company to reduce its carbon footprint.
As to the potential actions a company can take, Verhagen distinguished between 'managing GHG emissions in the value chain' and 'purchasing carbon offsets'. In the first case, the company or the industry reduces its real carbon footprint throughout the value chain. In the second case, the emphasis is not on reduction but on compensation.



As 'peat is carbon' (its main dry weight consists of carbon), managing GHG emissions in the value chain will only reduce a smaller part of total GHG emissions (such as emissions caused by drainage of peatland), as virtually all carbon contained in the peat produced will be converted to CO_2 sooner or later. If the industry want to create a 'carbon neutral' peat supply chain, this can be done by purchasing carbon offsets and by including the associated costs in the price of peat, peat products and end products based on peat (e.g. products from horticulture).

Discussion

One of the central questions in the discussion was about the urgency of the carbon issue for the peat (products) supply chain. It became evident that there are discussions going on in industry at the moment and first assessments and studies have been made or are being made. However, there is no industry consensus yet on the way to go. Neither is there any pressure from (Dutch) government, comparable with the pressure in the UK situation, yet. One problem mentioned was the absence of consumer pressure in the (professional) peat supply chain, which is basically a B2B chain. Some participants argued that there may be important opportunities (not only costs and risks!) that should not be overlooked. Investments in peatland conservation or peatland restoration (re-wetting projects etc.) can show relevant positive CO_2 balances. The peat-based industry can, according to some participants, play a major role in compensating their CO_2 footprint by having a positive stake in such peatland management projects. Not only will this improve their overall CO_2 balance, but also their reputation amongst their stakeholders.
It was agreed that at this stakeholder meeting, no immediate action plans on the issue could be agreed upon, but that initiatives may develop in the near future.

3.6 Action Field 4: Increasing Peat Production from Severely Degraded Peat lands

Presentation

Rien Bos presented Action Field 4 and explained the basic idea: upon depletion of the useable peat from present concessions, the supply of peat to the horticultural industry could be safeguarded by using peat from peatlands that have been degraded through agriculture.
Rien Bos recommended:

1. to optimise methods for treating peat from degraded areas to make it suitable for highly demanding applications (steaming, …).

2. to research <u>alternative methods for peat excavation</u>. The selection criteria for an alternative excavation method are:
   - The effect of groundwater lowering in adjacent areas (e.g. nature) should be reduced.
   - The CO_2 emission from the concession area will be reduced.
   - Various modes of after-use of the concession area are facilitated.

Discussion

During the workshop only the first item of Bos's recommendations were discussed. There was strong criticism on the oversimplification of the issue and the use of confusing terminology:

- The terminology 'degraded' and 'severely degraded' is confusing and should be used with care, if at all. Please refer to IPS for more appropriate terminology.
- It is not correct to assume that all superior quality peat (e.g. highest standards with regards to fungi, bacteria, etc.) is produced from areas that have the highest nature values.
- It is not correct to assume that all peat from so-called degraded peatlands (that has been converted into agriculture) has inferior quality and therefore needs special treatment (such as steaming). There are fractions of this peat, however, that may cause serious risks. A problem mentioned in the discussion is the ability to properly assess those risks at an early stage by good detection methods. To avoid any risks, nowadays certain peat fractions are probably being excluded from high quality applications, even if they will not show any real risks if a more precise analysis is carried out.
- It is not correct to assume that, after steaming, 'sanitised peat' will necessarily have the same superior qualities as peat that does not need this treatment. Steaming, for example, kills all life in the peat, which will therefore become less resistant against certain contaminations. 'Sanitised peat is no general replacement for peat from other sources'.
- It was emphasised that the cost factor of steaming should taken into consideration. It adds some 5 EUR to the normal production costs of about 16 EUR per m^3

All in all, the discussion revealed a systemic confusion between two separate distinctions. On the one hand, one may distinguish peat on the basis of 'technical qualities' for the peat industry. On the other hand, one may distinguish between different 'biodiversity qualities' of the peatlands under consideration. It cannot be concluded that there is a one-to-one correspondence between the best natural quality ('pristine', etc.) and the best technical quality peat. There is not.
Once again this discussion showed the need for a much better insight into the present and future availability of different peat qualities and their suitability for different more or less demanding applications. The question, whether horticulture could limit its peat supply chain to peat from 'severely degraded peatlands' only, was answered negatively by a number of participants, but not on the basis of clear quantitative assessment of available peat qualities and quantities.

4 Conclusions: Three Actions

Discussion Results

The discussion of the four action fields led to clear agreements on the following three project initiatives:

1. Creation of transparency in the peat supply chain and implementation of 'responsibility criteria' is a first priority. The criteria should be in line with the work on responsible peatland management carried out by IPS and the Dutch industry (led by RHP) who can start a pilot on supply chain transparency, standard implementation and verification.
2. The development of best practices for peatland after-use should be encouraged. A project led by IPS should be formulated.
3. A much better quantitative basis for discussing the future availability of peat (different types, different qualities) is needed. Further research, possibly led by Wageningen UR Alterra, was welcomed.

Below, a first idea for the Terms of Reference for these three project initiatives has been formulated by the facilitator. These are preliminary ideas, based on the agreements reached during the workshop, but not yet discussed with the participants. The organisations proposed in the following tables are yet to formally confirm their interest in participating in the projects.
A fourth project activity could be added: creating better understanding of the options for replacing peat by alternative materials. Such a project should not be started before project no. 3 (future availability of peat) has produced first results.

Transparency and Implementation of Responsibility Criteria

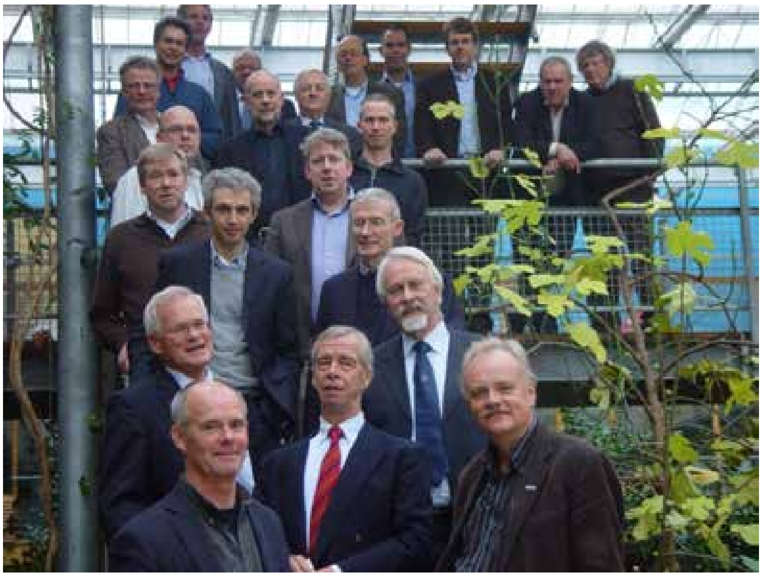
Project Title	Transparency and Implementation of Responsibility Criteria	
Project Objectives	1. to create full transparency in the peat supply chain from peat exploitation until end-use 2. to formulate criteria for 'responsible peat', based on IPS's and EPAGMA's work 3. to test the application of the responsible peat criteria 4. to include the criteria into RHP verification/certification	
Project Start - End	March 2011	September 2013
Project Leader	RHP	IPS
Project Partners		Baltic stakeholders (government, NGOs, industry) Dutch NGOs (Wetlands International / IUCN NL, Milieukontakt) External facilitation support by external research / consultants as needed
Finance	Industry + government support (facilitation)	

The Development of Best Practices for Peatland After-Use

Project Title	The Development of Best Practices for Peatland After-Use	
Project Objectives	1. to obtain a thorough and detailed insight into past and present after-use practices (after-use practice data-base) 2. to assess the values created and destroyed in the after-use period (economic/social values, ecological values) 3. to identify viable win-win solutions for after-use practices 4. to define a set of best practices for after-use to be included in responsible peat management criteria (project 1)	
Project Start - End	March 2011	March 2012
Project Leader	IPS	EPAGMA, RHP
Project Partners		Wetlands International, …
Finance	Dutch government, EU finance, …	

Scenarios for the Future Availability of Peat

Project Title	Scenarios for the Future Availability of Peat	
Project Objectives	1. to create a thorough and detailed database of past and present quantities and qualities of peat produced 2. to identify European (EU, Belarus) peat concessions and production sites in development, their impacts on future availability 3. to create scenarios for the availability of different peat qualities under more and less stringent ecological regimes	
Project Start - End	March 2011	September 2012
Project Leader	Wageningen UR Alterra	IPS, EPAGMA, RHP
Project Partners		ENGOs, government in Baltic States, …
Finance	Dutch government, EU, …	



Appendix 6 Draft Terms of Reference for three project initiatives

Project 1: Transparancy and sustainability criteria

During the second stakeholdermeeting of the project 'Enhancing sustainability of the Peat Supply Chain for the Dutch Horticulture', RHP and VPN (Association of Growing media producers in The Netherlands) have expressed that the initial focus of the Dutch industry will be on:
- achieving full transparency in the peat chain;
- complying with clear and acceptable criteria.

The development and implementation are foreseen in the following project

Lead
RHP, 's-Gravenzande, The Netherlands

Project objectives
1. Establishing practical criteria
2. Development of a certification-scheme
3. Communication in NL and Europe

Activities, output, cost and financing
1. Organising full support of industry, users and other stakeholders. This should result in an agreement between parties (likely communicated in a convenant)
   Action: RHP and industry
2. EU-legislation, unambiguous interpretation and implementation of legislation in the various regions
   Action: RHP, Alterra, national organisations in the countries (governmental as well as non-governmental organisations)
3. Matching current initiatives of IPS 'Strategy for Responsible Peatland Management', EPAGMA 'Code of Practice' and EU-legislation. The outcome is certification-scheme which should have international (EU) acceptance
   Action: RHP, IPS and EPAGMA
4. Communication of the industry policy and agenda regarding responsibly produced peat and growing media
   Action: industry VPN, RHP and partner organisations

The cost of the project transparency and sustainable criteria totals at estimated € 140,000. The industry will take up the major part of the costs incurred. The industry however requires commitment and support from the government by financial participation in the project amounting to € 57,500.

's-Gravenzande, 8 december 2010

Project 2: The Development of Best Practices for Peatland After Use

Lead
International Peat Society

Project Objectives
1. Provide a data base of and guidelines for peatland after use practices
2. Define values of peatlands before and after use and formulate criteria for responsible peatland afteruse
3. Identify win-win situations in pilot areas across a range of regulatory, socio-economic and environmental conditions and assess the potential for mainstreaming

Time frame medio 2011- 2013 (2 years)

Activities/output
Ad 1. Video on after use and International workshops on 1) status quo after use and 2) integrating socio-economic and environmental objectives in after use. Output: video on after-use, workshop reports and IPS communication leaflets.
Ad 2. High Level Expert Seminar of key policymakers, NGOs and science. Output: document which identifies the role of changes in the appreciation of values of peat in the past, present and future. Such a document should provide the necessary insight how to deal with responsible business in a changing world.
Ad 3. After use pilot projects endorsed by industry and stakeholders in Ireland, Baltics, Finland, Germany , Canada and The Netherlands[6] demonstrating that expenditure made for after use has a positive effect i.e. are an investment in the local economy. Output: Case Studies and Guidelines for Afteruse of Peatlands.

Justification
Responsible after use of peatlands is a condition of most peat extraction in Europe and in Canada, but the results of afteruse so far have not been mainstreamed. The question is how to mainstream past and present afteruse projects and how to identify future priorities? The answer is that this requires a much more integrated approach involving environmental, social and economic stakeholders, which are the three cornerstones of responsible/sustainable development in general. By taking on board such an integrated 'after use' can become an 'opportunity' for investment and rural development, different from the present situation where after-use is mostly a liability as well as a cost to industry. Costs paid either by the private sector, as in the case of afteruse of peatlands, or the public purse, for agri-environmental payments in Europe, have much in common. It does not matter who is paying, but for what? In both cases it is essential that money spent can also be considered as an investment in the local region in order to generate sustained economic growth. The International Peat Society through its wide network of partners from industry, environmental NGOs and science has already taken important steps forward in this field through the recently published Strategy for Responsible Peatland Management and this proposed project could become an important milestone in the implementation of the Strategy.

[6] In the case of The Netherlands it is noted that peat extraction is needed in order to achieve Natura 2000 objectives.

Project 3: Scenarios for the future Availability of Peat

Lead

Wageningen University and Research (Alterra /PRI) / Nederlands Veengenootschap - DMGH

Project Objectives

1. Assess future availability of peat as a substrate in Europe (Alterra Wageningen UR)
2. Identify for increasing high quality peat substrates using degraded peat (Veengenootschap &DMGH)
3. Develop a vision on the production of responsibly produced substrates (Plant Research International)

Time frame medio 2011- 2014

Activities / output

Ad 1. The project should provide:

a. a database of peat resources in Europe;
b. a GIS supported model of the present resources and expected increase of peat increments and losses due to the use of peat as a substrate, for energy purposes, and uncontrolled losses due to drainage and uncontrolled fire on a country base increment on a country level.

Ad 2. This part of the project should provide: a) an agreement with German stakeholders and the Dutch industry on the use of degraded (agricultural) used drained peat. b) make a start with a pilot project in Germany.

Ad 3. This part of the project should deliver:

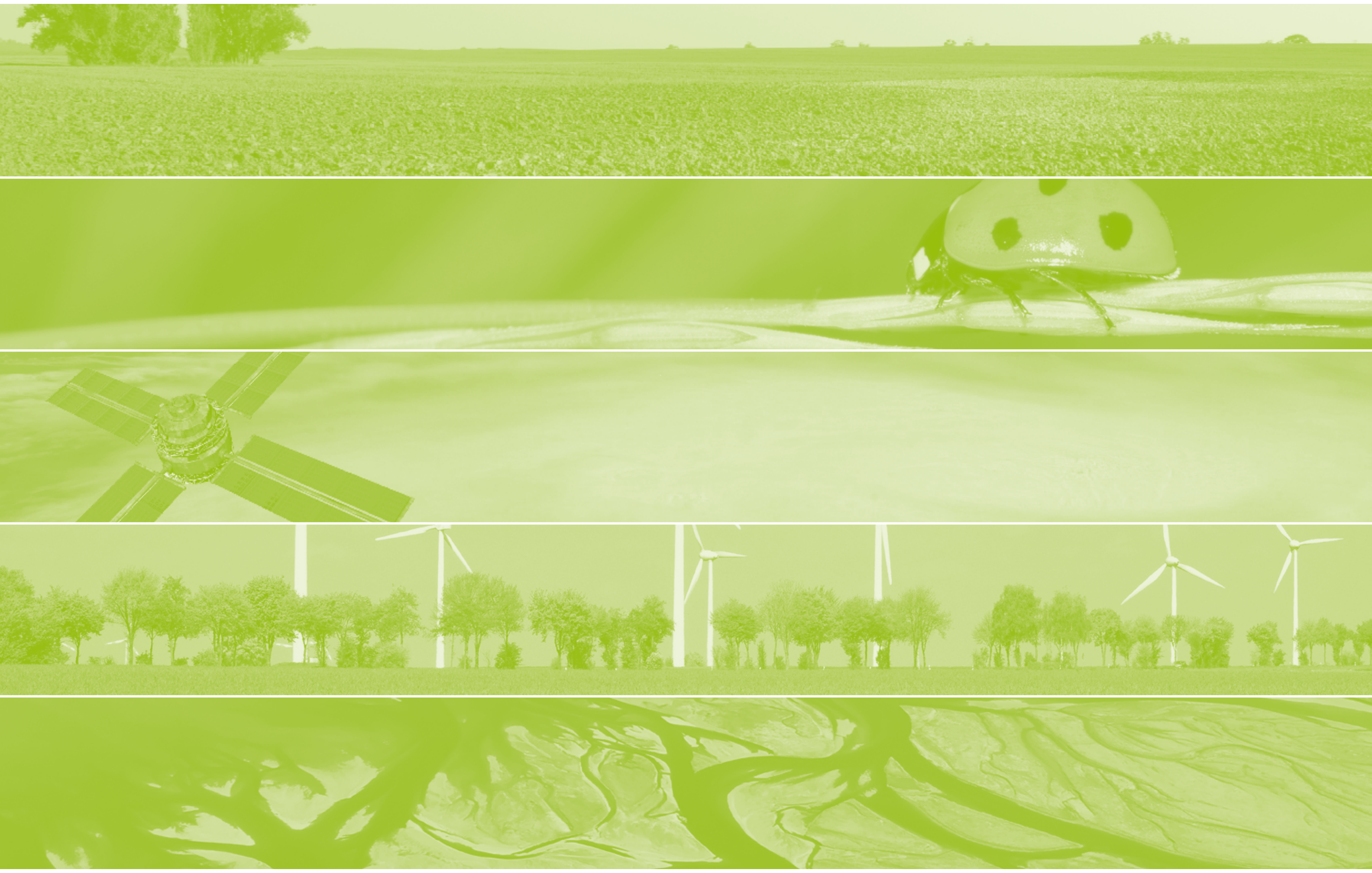
a. a quantitative overview of plant and substrate driven requirements for alternatives to peat as a substrate, taking into account the possibilities to supply these alternatives from recycling g streams, by Sphagnum culture and others.
b. organize two stakeholder meetings to discuss the results.

Justification

There is no overview yet for the long term availability of peat as a substrate imported from elsewhere in Europe for Dutch horticulture. Taking in account that this multibillion sector still depends for 90 percent on peat resources there is a need to assess the peat volumes in Europe and provide a GIS based model, which allows to estimate how much peat can be made available in the coming decades, taking also in account peat resources set aside for nature conservation, use for energy, loss from drainage and uncontrolled fires, but also economic viability (Action 1).

In Germany 100,000 hectares of drained peatland are used for farming, which could provide a considerable increase of available peat. If this peat resource could be used it would have a major positive effect on CO_2 emissions from the sector and could increase significantly the biodiversity value of these areas, which have a low biodiversity under present conditions (Action 2).

Action 3 on alternatives is becoming important for the sector because of the rapid changes in horticulture. New techniques increase productivity, decrease labour input, and may contribute to more nutrient efficient and environmental responsible business.



Alterra is part of the international expertise organisation Wageningen UR (University & Research centre). Our mission is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine research institutes – both specialised and applied – have joined forces with Wageningen University and Van Hall Larenstein University of Applied Sciences to help answer the most important questions in the domain of healthy food and living environment. With approximately 40 locations (in the Netherlands, Brazil and China), 6,500 members of staff and 10,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the exact sciences and the technological and social disciplines are at the heart of the Wageningen Approach.

Alterra is the research institute for our green living environment. We offer a combination of practical and scientific research in a multitude of disciplines related to the green world around us and the sustainable use of our living environment, such as flora and fauna, soil, water, the environment, geo-information and remote sensing, landscape and spatial planning, man and society.

More information: www.alterra.wur.nl/uk