

# Peatlands - guidance for climate change mitigation through conservation, rehabilitation and sustainable use



5

MITIGATION OF CLIMATE CHANGE IN AGRICULTURE SERIES

Second edition



ERNST MORITZ ARNDT  
UNIVERSITÄT GREIFSWALD



Wissen  
lockt.  
Seit 1456



# Peatlands - guidance for climate change mitigation through conservation, rehabilitation and sustainable use

Second edition

Hans Joosten, Marja-Liisa Tapio-Biström & Susanna Tol (eds.)

Published by  
the Food and Agriculture Organization of the United Nations  
and  
Wetlands International

Mitigation of Climate Change in Agriculture (MICCA) Programme  
October 2012

## Contact

FAO, Mitigation of climate change in agriculture programme,  
Marja-Liisa Tapio-Biström, Senior Climate change officer, micca@fao.org

Wetlands International,  
Marcel Silvius, Head of Programme and Strategy – Wetlands & Livelihoods, marcel.silvius@wetlands.org

University of Greifswald,  
Hans Joosten, Professor of Peatland Studies and Palaeoecology,  
Institute of Botany and Landscape Ecology, joosten@uni-greifswald.de

The first edition of this publication was originally published by the Food and Agriculture Organization of the United Nations and the Wetlands International in 2012 and it is available at <http://www.fao.org/docrep/015/an762e/an762e.pdf>

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or of the Wetlands International concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO or Wetlands International in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO or Wetlands International.

ISBN 978-92-5-107302-5

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to [copyright@fao.org](mailto:copyright@fao.org) or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO,  
Viale delle Terme di Caracalla, 00153 Rome, Italy.

© FAO and Wetlands International 2012

# Executive Summary

Peatlands provide many important ecosystem services, including water regulation, biodiversity conservation, and carbon sequestration and storage. To safeguard these services and mitigate climate change, these highly sensitive areas should be protected from further degradation. Peatlands and organic soils contain 30 percent of the world's soil carbon but only cover 3 percent of the Earth's land area. Fifteen percent of peatlands are drained and used for agriculture, grazing, peat mining and forestry, especially for bioenergy plantations. Including emissions from peat fires, these drained peatlands emit almost 6 percent of anthropogenic CO<sub>2</sub> emissions. This represents almost 25 percent of emissions from the entire land use, land use change and forestry sector. Once the peat carbon is lost, the losses are virtually irreversible. Peatland conservation, restoration and improved management are low-hanging fruit for climate change mitigation.

This report provides information on management and finance options to achieve emissions reductions and enhance other vital ecosystem services from peatlands. A decision support tree guides users through options for the management of both cultivated and uncultivated peatlands. The report also summarizes the methodologies and data available for quantifying greenhouse gas emissions from peatlands and organic soils. Practical approaches are presented concerning measuring, reporting and verification, and accounting of greenhouse gas emissions. Country-specific case studies illustrate the problems, solutions and opportunities associated with peatland management. This report is a handbook for policy-makers, technical audiences and others interested in peatlands.

## 10 elements of strategic action:

1. **Identify occurrence and status** (pristine, drained, abandoned, under productive use) of all peatlands worldwide.
2. **Improve assessment** of greenhouse gas emissions from peatlands. Improve methodologies for measuring, reporting and verifying (MRV).
3. **Conserve** all reasonably intact peat swamps.
4. **Prevent** further degradation of already degraded peatlands through a range of activities, including:
  - halting the intensification of artificial drainage in already drained areas;
  - installing hazard monitoring and mitigation schemes to avoid and restrain uncontrolled fires and soil erosion;
  - halting the expansion of agricultural practices that require drainage (shift land use activities currently carried out on peatlands, such as oil palm and pulpwood plantations, to mineral soils and practice paludiculture); and
  - halting uncontrolled, selective and illegal logging.
5. **Restore** degraded peatlands by rewetting, reforestation (in the tropics), and subsequent conservation or paludiculture. Restoration of peatlands reduces emissions, improves water regulation, benefits biodiversity and opens up other income options.
6. **Target** financial resources to peatland conservation, restoration and improved management.
7. **Stimulate and apply** existing and developing climate financing mechanisms on the compliance market (Kyoto Protocol, REDD+, NAMAs), the voluntary market (private sector investment in peatland rehabilitation) and from other sources.
8. **Support** local communities at the earliest stage and stimulate community development to overcome their opportunity costs and dependence on unsustainable peatland use.
9. **Ensure** that greenhouse gas criteria are integrated into credible certification and subsidy schemes for products derived from drained peatlands, including biofuels, palm oil, wood pulp, and other products from agriculture, horticulture and forestry. Each country that imports such products should review their domestic policies for these products.
10. **Share** experiences and expertise on peatland conservation, restoration and improved management among countries rich in peatlands and organic soils, especially those in need of capacity building.

This report provides guidance for these actions. The main strategies are:

- Secure undrained peatlands to prevent emissions.
- Rewet drained peatlands to reduce emissions.
- Adapt management of peatlands that cannot be rewetted.



# Contents

<b>Executive Summary</b>	<b>C</b>
<b>Abbreviations and acronyms</b>	<b>J</b>
<b>1. Introduction</b>	<b>3</b>
<b>2. Implementation</b>	<b>9</b>
2.1. Keep wet peatlands wet: conservation	11
2.2. Keep wet peatlands wet: paludiculture	11
2.3. Rewetting and restoration of drained peatlands	13
2.4. Adapted management of drained peatlands in productive use	16
2.5. Hazard control on abandoned drained peatlands	18
2.6. Conflicts and synergies	20
<b>3. Finance options</b>	<b>23</b>
3.1. Reducing emissions from peatlands within the UNFCCC framework	24
3.2. Climate initiatives for peatlands under the European Union	28
3.3. Voluntary carbon market	29
3.4. Global Environmental Facility (GEF)	31
3.5. Policy recommendations to overcome obstacles to finance options	32
<b>4. MRV and practical solutions</b>	<b>35</b>
4.1. What are peatlands and organic soils	36
4.2. Recent reviews of peatland emissions	36
4.3. IPCC guidance	36
4.4. Guidance provided by the voluntary market	39
4.5. Practical solutions for challenges	40
4.6. Practical solutions for meeting REDD+ safeguard commitments in peatland areas	42
<b>5. Country-wide overview of opportunities</b>	<b>47</b>
5.1. Southeast Asia: Indonesia and Malaysia	47
5.2. European Union: Poland and the United Kingdom	53
5.3. Eastern Europe: Belarus, the Russian Federation and Ukraine	59
5.4. Central Asia: China and Mongolia	66
5.5. Africa: Congo Basin and Uganda	71
5.6. Amazon Basin: Brazil, the Guyanas and Peru	77
<b>References</b>	<b>87</b>

## Tables

- Table 1. Examples of paludicultures tested in Central Europe
- Table 2. Conflicts and synergies of various peatland utilization options
- Table 3. Summary of climate finance for peatland conservation, rehabilitation and sustainable use
- Table 4. Peat swamp forest (PSF) cover estimates for Indonesia
- Table 5. Land cover distribution on peatland in western Indonesia (Sumatra, Kalimantan) in 2007
- Table 6. Land cover distribution and related annual CO<sub>2</sub> emissions in 2007 from drainage related peat oxidation in western Indonesia (Sumatra and Kalimantan)
- Table 7. Peat swamp forest cover estimates for Malaysia
- Table 8. Extent of industrial plantations on peat in Malaysia in 2010
- Table 9. Data on organic soils in national GHG inventory year 2010 (EU 27)
- Table 10. Extent of organic-rich soils and bogs and fens in the UK
- Table 11. Peat-covered wetlands in European part of the Russian Federation
- Table 12. Areas of “good quality” and “degraded peatland” on the Ruergai Plateau in 1977 and 2007
- Table 13. Forest types of “insufficiently drained soils” of Suriname

## Figures

- Figure 1. The Ruergai peatlands on the Tibetan Plateau are crucial for regulating water supply
- Figure 2. Decision support tree for management of peatlands and organic soils
- Figure 3. The unworkable gears of drained peatland utilization
- Figure 4. Extent of peatland in Peninsular Malaysia, Sumatra, and Borneo
- Figure 5. Distribution status of peat swamp forest in Sibu Division, Sarawak (Malaysia)
- Figure 6. Biogeographical regions in Poland and distribution of peatlands larger than 2 km<sup>2</sup>
- Figure 7. The globally threatened aquatic warbler
- Figure 8. Peat and peaty soils of the United Kingdom
- Figure 9. Distribution of peatlands in Belarus
- Figure 10. Map of fen mires in southwest Belarus existing in 1977 and remaining in 1995
- Figure 11. a) Peatland (mire) area within administrative regions of the European part of the Russian Federation  
b) Distribution of main peatland (mire) types in the European part of the Russian Federation
- Figure 12. Peat fires burning under snow in Russia, November 24, 2010
- Figure 13. Peatland distribution in Ukraine
- Figure 14. Severely degraded and abandoned peatland in the Chernihiv region (Ukraine)
- Figure 15. Distribution of “mires” in China
- Figure 16. Distribution of good quality and degraded peatlands on the Ruergai Plateau
- Figure 17. Peatland distribution in Mongolia
- Figure 18. The soil carbon content of Africa
- Figure 19. Congo: Interfluvial swamp forest between the Likouala aux Herbes and the Ubangui River
- Figure 20. Wetland probability map of the central Congo Basin
- Figure 21. Distribution of permanent and seasonal wetlands in Uganda in 1996
- Figure 22. Pristine peatlands in Uganda
- Figure 23. Densely drained peatlands in southwest Uganda
- Figure 24. The delimitation of Amazonia *sensu stricto* and four peripheral subregions Guiana, Andes, Planalto and Gurupí
- Figure 25. Peat domes of the Central Amazon between the Amazon and the Putumajo River
- Figure 26. Vegetable growing on beds by Japanese settlers on 1.5 m thick peat in Brazil
- Figure 27. *Mauritia flexuosa* peatland in the Peruvian Amazon
- Figure 28. Soil map of part of the Kaw Marshes in French Guiana
- Figure 29. Major wetlands of French Guiana. Rectangles mark wetlands which include larger peatlands
- Figure 30. Vegetation map of Guyana showing selected vegetation types
- Figure 31. Wetlands of Suriname, which might harbour extensive peatlands
- Figure 32. Geological map of the coastal plain of Suriname

## Boxes

- Box 1 Ecosystem services of peatlands: the Ruoergai Plateau
- Box 2 Subsidence
- Box 3 Paludiculture in Indonesia
- Box 4 Restoration and conservation
- Box 5 Towards sustainable grazing on peatlands
- Box 6 Building land use NAMAs: example from Indonesia
- Box 7 Emissions reductions from peatlands in Belarus through the voluntary market
- Box 8 Where to find information on organic soils in your country
- Box 9 Emissions from peatlands
- Box 10 Peat swamp forests: ecology and biodiversity
- Box 11 Wet agriculture for conserving a little brown bird
- Box 12 Peatland administration in Russia
- Box 13 Decision Support System for peatland management in the Russian Federation





# Acknowledgements

We are grateful to the many people who have contributed directly or indirectly to the preparation of this report. We would especially like to thank everyone who has contributed to the expert meeting on the role of organic soils and peatlands in climate change mitigation, which took place on 3 and 4 April, 2012 in FAO, Rome. We hope that the information provided in this report supports efforts to make a meaningful contribution to combating climate change through the conservation, rehabilitation and sustainable use of peatlands. We would welcome any feedback to this report. We thank the Ministry for Foreign Affairs of Finland, the Ministry of Foreign Affairs of Norway, the German Federal Ministry for Food, Agriculture and Consumer Protection through the Monitoring and Assessment of Greenhouse Gas Emissions and Mitigation Potential in Agriculture Project, a component of the MICCA Programme, and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in the framework of the International Climate Initiative on 'Capacity development for sustainable energy and climate policies' for funding this publication. This is the second edition of the report, which was first published in May 2012 in Bonn, Germany for a side event at the thirty-sixth session of the Subsidiary Body for Scientific and Technological Advice (SBSTA) held during the United Nations Framework Convention Climate Change (UNFCCC) Conference.

The following people contributed to this report:

Clifton Bain – IUCN UK Peatland Programme  
Uwe Ballhorn – RSS - Remote Sensing Solutions GmbH Baierbrunn  
Alexandra Barthelmes – Greifswald University  
Aletta Bonn – IUCN UK Peatland Programme  
Steve Chapman – James Hutton institute  
Andrew Coupar – Scottish Natural Heritage  
John Couwenberg – Greifswald University  
Rene Dommain – Greifswald University  
Igino Emmer – Silvestrum  
Andreas Haberl – Michael Succow Foundation  
Robert O'Sullivan – Climate Focus  
Jan Peters – Michael Succow Foundation  
Mark Reed – Birmingham City University  
Florian Siegert – RSS - Remote Sensing Solutions GmbH Baierbrunn  
Marcel Silvius – Wetlands International  
Franziska Tanneberger – Greifswald University  
Pat Thompson – RSPB  
Moritz von Unger – ATLAS Environmental Law Advisory  
Wendelin Wichtmann – Michael Succow Foundation  
Wu Ning – ICIMOD The International Centre for Integrated Mountain Development

Invaluable support to the editing team has been given by Gordon Ramsay and Maria Nuutinen – MICCA Programme, FAO.

Rome, October 2012, Hans Joosten, Marja-Liisa Tapio-Biström & Susanna Tol



# Abbreviations and acronyms

<b>AAU</b>	<b>Assigned Amount Unit</b> The Units are issued to industrialized countries under the Kyoto Protocol in an amount equal to the caps they assumed.
<b>Annex 1</b>	<b>Annex I to the UNFCCC</b> Industrialized countries are listed in Annex I to the UNFCCC to differentiate obligations these countries have under the UNFCCC from those of developing countries. Most of the Annex I countries also agreed to binding caps under the Kyoto Protocol.
<b>CAP</b>	<b>Common Agricultural Policy</b> A system of European Union agricultural subsidies and programmes
<b>CBD</b>	<b>The Convention on Biological Diversity</b> An international legally binding treaty. The Convention has three main goals: conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources.
<b>CDM</b>	<b>Clean Development Mechanism</b> Mechanism created under the Kyoto Protocol to finance climate mitigation projects in developing countries via creating CERs
<b>CEH</b>	<b>The Centre for Ecology &amp; Hydrology</b>
<b>CERs</b>	<b>Certified Emission Reductions</b> Offsets created by CDM projects that can be used by industrialized countries to meet their emission reduction commitments under the Kyoto Protocol
<b>CM</b>	<b>Cropland Management</b> Type of activities that a country can choose to include in their LULUCF accounting under the Kyoto Protocol
<b>CMP</b>	<b>Conference of the Parties serving as the Meeting of the Parties</b> The annual UN conference and decision making body for the Kyoto Protocol
<b>COP</b>	<b>Conference of the Parties</b> The annual UN conference and decision-making body for the UNFCCC
<b>CSA</b>	<b>Climate-smart agriculture</b>
<b>CUPP</b>	<b>Conservation of Undrained or Partially drained Peatland</b> VCS project category that would cover for example activities to protect a peatland from being drained.
<b>DO</b>	<b>Domestic Offsetting</b> Mechanism to create domestic offsets in the EU under the EU ETS.
<b>DSS</b>	<b>Decision Support System</b>
<b>ERU</b>	<b>Emission Reduction Unit</b> Offset credits created by JI projects that can be used by industrialized countries to meet their emission reduction commitments under the Kyoto Protocol. ERUs are created by either converting an AAU or RMU into an ERU.
<b>EU</b>	<b>European Union</b>

<b>EU ETS</b>	<b>European Emissions Trading Scheme</b> Emissions trading scheme established in the EU.
<b>FM</b>	<b>Forest Management</b> Activities that involve the management of forests. This could include activities such as changing the logging rotation in a forest to increase the average carbon stock stored in the forest.
<b>GCF</b>	<b>Green Climate Fund</b> Climate fund and UNFCCC financial mechanism recently established under the UNFCCC to finance climate mitigation and adaptation.
<b>GEST method</b>	<b>Greenhouse gas Emissions Site Types method</b> The GEST approach is a method for assessing greenhouse gas fluxes from peatlands using vegetation and water level as a proxy.
<b>GEF</b>	<b>Global Environmental Facility</b> Facility to provide finance under UNFCCC and other environmental treaties (Convention on Biological Diversity, UN Convention to Combat Desertification, and Stockholm Convention on Persistent Organic Pollutants).
<b>GHG</b>	<b>Greenhouse gas</b> The six greenhouse gases / groups of gases listed in the Kyoto Protocol are Carbon dioxide (CO <sub>2</sub> ), Methane (CH <sub>4</sub> ), Nitrous oxide (N <sub>2</sub> O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF <sub>6</sub> ).
<b>GM</b>	<b>Grazing land Management</b> Type of activities that a country can choose to include in their LULUCF accounting under the Kyoto Protocol.
<b>IMCG</b>	<b>International Mire Conservation Group</b> An international network of specialists having a particular interest in mire and peatland conservation.
<b>JI</b>	<b>Joint Implementation</b> Mechanism created under the Kyoto Protocol to finance climate mitigation projects in industrialized countries via the creation of ERUs.
<b>KP</b>	<b>Kyoto Protocol</b>
<b>LULUCF</b>	<b>Land use, land-use change and forestry</b> An umbrella term that covers a range of different types of activities affecting land, land use change and forestry, such as forest management, grazing land management etc.
<b>M.a.s.l.</b>	<b>Metres above sea level</b>
<b>MICCA</b>	<b>Mitigation of Climate Change in Agriculture Programme of FAO</b>
<b>MRV</b>	<b>Measuring, reporting and verification</b>
<b>NAMA</b>	<b>Nationally appropriate mitigation action</b> Action undertaken in developing countries to mitigate climate change under the UNFCCC.
<b>NAPs</b>	<b>National Adaptation Plans</b> National plans developing countries are to develop to support adaptation to climate change.

<b>Non-Annex 1</b>	<b>Developing countries</b> See explanation of “Annex I”.
<b>NTFP</b>	<b>Non-timber forest products</b>
<b>OTOP</b>	<b>Polish Society for the Protection of Birds</b>
<b>PRC</b>	<b>Peatland Rewetting and Conservation</b> VCS project category that sets rules on accounting for emission reductions or removals from peatland rewetting or conservation projects.
<b>RDP</b>	<b>Rewetting of Drained Peatland</b> VCS project category related to projects that re-wet drained peat, e.g. by damming drainage canals.
<b>REDD+</b>	<b>Reducing Emissions from Deforestation and Forest Degradation</b> Topic being negotiated under the UNFCCC related to conservation and enhancement of forest carbon stocks and sustainable management of forests.
<b>RMU</b>	<b>Removal Unit</b> Units that are issued by Annex I countries if they generate net removals from their LULUCF accounting under the Kyoto Protocol.
<b>SAC</b>	<b>Special Areas of Conservation</b> Defined in the European Union’s Habitats Directive (92/43/EEC), also known as the Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora. The Special Areas of Conservation protect the 220 habitats and approximately 1000 species considered to be of European interest.
<b>SSSI</b>	<b>A Site of Special Scientific Interest</b> A conservation designation denoting a protected area in the United Kingdom. SSSIs are the basic building block of site-based nature conservation legislation.
<b>SPA</b>	<b>Special Protection Area</b> A designation under the European Union Directive on the Conservation of Wild Birds. Under the Directive, Member States of the European Union (EU) have a duty to safeguard the habitats (for example peatlands) of migratory birds and certain particularly threatened birds.
<b>UNCCD</b>	<b>United Nations Convention to Combat Desertification</b>
<b>UNDP</b>	<b>the United Nations Development Programme</b>
<b>UNFCCC</b>	<b>United Nations Framework Convention on Climate Change</b>
<b>UNICEF</b>	<b>The United Nations Children’s Fund</b>
<b>VCS</b>	<b>Verified Carbon Standard</b> Voluntary market standard used to quantify emission reductions or removals.
<b>WDR</b>	<b>Wetland Drainage and Rewetting</b> Activities that a country can choose to include in its LULUCF accounting under the Kyoto Protocol.





Zoige Plateau, the largest peatland in the Tibetan Plateau (altitude 3 500 m), where eco-tourism has been developed by local communities.  
Photo: Wu Ning