Ecosystem-based Adaptation Measure and Activity Catalog – Wetland Ecosystems

Wetlands are embedded in other ecosystems and are thus, in a sense, part of them. Many measures aimed at the functional efficiency of marshes, bogs, fens, and other wetlands depend on the use of wetlands themselves or must be implemented on the surrounding land or have a significant influence on it. Yet, very relevant measures that primarily contribute to water retention, reduction of surface runoff, and cooling of the landscape can be achieved within the spheres of wetland conservation, restoration, and use. The surroundings target vegetated riparian fringes and protective buffers to enable self-regulated development of wetlands. Wetlands also benefit from actions in other ecosystems, especially forest and open land. Rewetting peatlands and other wetlands is a system-wide action with a very high priority throughout all the considered areas.

Without comprehensive peatland rewetting and restoration, climate mitigation and adaptation targets cannot be achieved. At the same time, peatland rewetting provides many additional benefits for society through a variety of ecosystem services. Therefore, as many peatlands as possible should be rewetted as soon as possible. A large number of measures must be implemented in cooperative efforts in various areas of society by a wide range of actors. A special task - due to the large share of peatland-related emissions - is agriculture. At present, activities that are harmful to the climate from a social and economic point of view are still receiving unrestricted financial support. Where nature conservation and water management conditions allow, peatland management should be converted to *Paludiculture*. In recent years, pilot and demonstration projects have shown practical and economically promising methods for peat conservation, which, however, need to be tailored to the region, further developed, and upscaled.

The main ecosystem services provided by peatlands that play a role in climate change adaptation: Water retention function, flood protection by peatlands, evaporative cooling of peatland, soil protection within paludicultural uses.

EbA Measures and Activities in Wetland Ecosystems
1 Conservation of existing, functional ecological structures and (self-) regulating capacity
1.1 Conservation and protection of existing wetlands
1.1.1 Place existing, functional wetlands under protection
1.1.2 Do not alter wetlands or riparian areas to improve only the water quality at the expense of their other functions
1.1.3 Introduce a ban on all types of melioration works on swamps
1.1.4 Prohibit and avoid the construction of drainage systems
1.1.5 Establish protected areas around wetlands and create protection zones
1.1.6 Organization of systematic monitoring of the ecological state of swamps and the state of their biodiversity to determine the level of functionality in climate change ((humidity, temperature, PH, peat features, etc)
1.2 Conservation and protection of (near-) natural green and water structures with corresponding wetland buffer zones and riparian strips
1.2.1 Require ecological transition areas or buffers adjacent to wetlands
1.2.2 Control and regulation of invasive species within wetland ecosystems - Allow harvesting within natural and strictly protected wetlands only to control the invasion of exotic plants
1.2.3 Conservation of protective, natural riparian vegetation
1.2.4 Conservation of protective forests and other natural structures around wetlands
1.2.5 Prevent infrastructure development, soil sealing, and increasing access to wetlands
1.2.6 Protection of beaver populations to support the natural development of swamp ecosystems
1.2.7 Prohibit and control grazing of farm animals
1.2.8 Prohibit and control sanitary tree felling
1.2.9 Minimize and limit the use of pesticides to combat pests and plant diseases
1.2.10 Prohibit and control the burning of standing grass, which creates a danger of forest fires
1.2.11 Prohibit and control all types of clear cutting
1.3 Avoidance of intensification of use
1.3.1 Avoid the location of surface water runoff ponds or sediment retention basins in wetland systems
1.3.2 Avoid and prohibit extensive dredging and plant harvesting as part of nutrient or metals management in natural wetlands
1.3.3 Melioration measures must only be permitted for water retention and rewetting measures (installation of dams, weirs, supply lines)
1.3.4 Prohibit and prevent additional melioration, drainage, and peat extraction in wetland areas

2 Reduction of direct anthropogenic ecological stress drivers limiting (self-) regulatory capacity
2.1 Dismantling or reduction of drainage structures in swamps, mires, peatlands, bogs, marshes, and other wetlands
2.1.1 Deconstruction of existing artificial drainage and hydrological structures if it serves restoration of a natural water regime
2.1.2 Use of existing drainage systems not for drainage, but for water retention by blocking of outflow if viable
2.2 Dismantling or redesign of transverse structures and other water engineering structures
2.2.1 Deconstruction of existing water regulation structures to reestablish the natural water regime
2.2.2 Use existing transverse structures to retain water and rewet wetlands
2.3 Deconstruction of building structures in buffer zones and riparian strips
2.3.1 Deconstruction of paths and roads through wetlands
2.3.2 Deconstruction of buildings and unsealing of paved areas
2.4 Reduction of biomass extraction
2.4.1 Reduction of the extraction and use of peat (both industrial and private)
2.4.2 Reduce extensive dredging and plant harvesting as part of nutrient or metals management in natural wetlands
2.5 Reduction of use intensity
2.5.1 Conversion from intensive, drainage-based agricultural land to extensive, wet-condition Paludiculture (see 3.4)
2.5.2 For intensively used agricultural land on peatland sites, the minimum goal should be to raise the water level with the option of further adapted agricultural use (see 3.4)
2.5.3 Adaptation of paludiculture practices, and livestock farming practices to (small-scale) local site conditions (see 3.4)
2.5.4 Land management on peatland soils should only include grassland and wet permanent crops and should be carried out using techniques that are gentle on the soil; fertilization and the use of pesticides must be in line with water protection and may not be possible (see 3.4)
2.5.5 Reduction of intensive tillage / cultivation
2.5.6 Reduction of vehicle access
2.5.7 Ban or at least reduction of access by heavy machinery for harvesting or construction works
2.5.8 Detection and termination of plowing and overgrazing in wetland buffer areas
2.5.9 Introduction of water-saving technologies in agricultural production in wetland buffer areas
2.5.10 Use appropriate preliminary treatment practices such as vegetated treatment systems or detention or retention basins to prevent adverse impacts on wetland functions: 1) multiple pond systems 2) grassed swales combined with detention ponds 3) grassed swales leading to vegetated filter strips, followed by infiltration trenches
2.5.11 Develop standards for the regulated collection of berries and mushrooms in swamps to prevent their anthropogenic degradation and transformation
2.5.12 Assess the state of and determine sustainable volumes for collecting berries, medicinal plants, and other types of plant resources growing naturally in wetland ecosystems

3 Restoration and targeted development of (self-) regulatory capacity

3.1 Rewetting, restoration, and (near-) natural development of swamps, mires, bogs, peatlands, marshes, and other wetlands

3.1.1	Site characterization and data collection as initial steps for any restoration effort
3.1.2	Identify methods that allow nature to do the work (passive versus active restoration)
3.1.3	Plan restoration adjacent to or as part of naturally occurring aquatic ecosystems
3.1.4	Develop specific objectives for hydrology, soils, and biota appropriate to the wetland type being restored
3.1.5	Identify conflicting goals and uses and strive for joint solutions
3.1.6	Begin partnership involvement and refine objectives
3.1.7	Resolve conflicts over ownership and acceptance that prevent implementation of restoration efforts
3.1.8	Coordination of actions with the owners and stakeholders of wetlands and drainage systems
3.1.9	Make use of natural or (if necessary) bioengineering methods, no structural engineering methods
3.1.10	Reduction of water losses in peatlands through: - Embankments and ditch filling - Increasing the overflows of dams and sluices - Blocking watercourses with trees, rocks, vegetation, or beaver dams - Incapacitating subsurface drainage systems - Removal of trees in originally tree-free marshes, preventing heavy evapotranspiration - Hydrologic buffer zones with higher water levels in the surrounding area
3.1.11	Increase water supply by: - Reducing groundwater extraction and/or increasing groundwater recharge in the area of influence. - Diverting water to the area - Active watering of the area - Perforating humified and highly compacted peat so that water can be diverted to groundwater - If water is discharged, consider water quality. Sulfate-rich water should be avoided as it increases peat degradation
3.1.12	Increase water storage by: - Installation of dams/weirs - allowing more water to be held on the surface - Creating cascades (cf. rice paddies) to wet sloping marshes - Maintenance/creation of depressions - Dams and depressions must not be too large, otherwise, there is a risk of wind or wave erosion.
Target: Renaturation of drained bogs	
3.1.13	Restore native plant species and soil substrate preferably via natural succession or, if necessary, via the introduction of native plant and soil materials
3.1.14	For forested systems, chose planting of one native tree species, one shrub species, and one ground-cover species and then allow natural succession to add a diversity of native species over time
3.1.15	Select deeply rooted plants (may work better than certain grasses for transforming nitrogen because the roots will reach the water moving below the surface of the soil)
3.1.16	Gradual deconstruction (dismantling) of built infrastructure to reestablish a natural hydrological regime
3.1.17	Mowing and extraction of non-native, invasive weeds
3.1.18	Apply minimal, typical maintenance activities such as maintaining buffer zones, preventing soil erosion and sedimentation, inspecting and nurturing plantings, and controlling exotic species

3.2 Creation of retention areas and natural intermediate water storage

3.2.1	Identification and declaration of water retention areas that can be flooded over short or longer periods
3.2.2	Water runoff deceleration (e.g. through the planting of trees, an increase of beaver population)
3.2.3	Protection of beaver populations to support swamp ecosystems

3.3 Creation of near-natural structural elements, buffer zones, and forested edges

3.3.1	Creation and maintenance of protective forests around wetlands
3.3.2	For the creation of ecologically resilient plantations give maximum assistance to the process of natural regeneration
3.3.3	Reforestation works only with the use of local species of trees and shrubs, e.g. alder
3.3.4	Creation of deciduous forest edges along shorelines with native species
3.3.5	Regulation and formation of the composition of the living ground cover, taking into account the fact that vegetative mobile grasses and shrubs have the greatest anti-erosion properties

3.3.6	Develop a strategic plan on the agricultural lands adjacent to water-protective forests, the restoration of the optimal structure and species composition of forest shelterbelts
3.3.7	Creation of new forests on abandoned agricultural lands in proximity to wetlands (afforestation)
3.3.8	Consider re-establishing natural riparian vegetation, which involves planting trees, shrubs, forbs, or grasses to replace species that have been lost
3.4	**Diversification and adaptation of Paludiculture practices, agriculture crops, and livestock to local site conditions**
3.4.1	Water-tolerant cultivated paludiculture species such as reeds (Phragmites australis), bulrush (Typha spec.), reed canary grass (Phalaris arundinacea), black alder (Alnus glutinosa) that require a selective establishment
3.4.2	Paludiculture on fen peatlands, e.g. Cultivation of Cattail (Typha), Production of biomass fuel for the heating plant is produced on wet fen meadows
3.4.3	Extensive livestock farming on bog and fen sites - Well suited for water buffalo (Bubalus arnee) husbandry are shallow, rewetted fens and the transition areas from fen to mineral soil sites.
3.4.4	Wide-scale production of paludiculture bioenergy crops, such as Phragmites australis (Common Reed)
3.4.5	Other uses of harvested biomass (e.g. incorporation into building materials, return of biomass carbon to the soil in unreactive forms (such as biochar)
3.4.6	Sphagnum farming: production of Sphagnum crops which can be harvested and processed
3.4.7	Some wetland (cultivated) plants are already food sources, such as celery and watercress, while some novel food crops may have the potential to be grown on wet peatland soils
3.4.8	Growing of construction materials: Perennial reed grasses, particularly Phragmites spp.
3.4.9	Extensively used fresh meadows can, depending on the nutrient supply, be used as one- to three-rotation forage meadows or further for energy or material utilization
3.4.10	Shallow, degraded, wet agricultural land on lowland moorland - especially marginal areas of rewetted land - is in principle suitable for short rotation coppice plantations – e.g. Willow (salix spec.)
3.4.11	Shallow, degraded, rewetted areas on fen, especially marginal areas of rewetted areas, are suitable for alder coppice management
3.4.12	For extensive management of wet lowland grassland with lower carrying capacity than more drained fresh grassland, robust cattle breeds with low weight are suitable
3.4.13	Extensively used wet meadows can be used either as single-row litter meadows or two- to three-row forage meadows, depending on the nutrient supply. In addition, energetic utilization seems viable.
3.4.14	On flooded sites, reed canary grass (Phalaris arundinacea; prefers nutrient- and oxygen-rich water) can form high-yielding pure stands- use as structure-rich animal feed and energetic resource
3.4.15	Tall sedge meadows (carex spec.) can be made passable at high water levels. Sedges prove tolerant of overwater and alternating wetness. They can be used as either single-row litter or double-row forage meadows. A new possibility is the energetic utilization of biomass.
3.4.16	Sites with a good supply of nutrients and moving soil water are ideal for alder-value wood. This also applies to wet and deep bog sites.
3.4.17	Larger rewetted fen areas in complex with dry areas are suitable for keeping wildlife and horses (as well as robust cattle, sheep, goats in mixed husbandry) in agricultural enclosures

4 Development of enabling factors facilitating lines of action I-III

4.1 Development of the legal and policy framework and status of wetland and grassland ecosystems

Target: Adjustments and amendments to existing laws, regulations, and programs

4.1.1 Continue and enhance the program of wetland restoration and renaturalization ongoing from 1999

4.1.2 To develop and include in the current legislation of Ukraine an increase in responsibility for pollution and littering of swamps with industrial and consumer waste, pollution with oil products, pesticides, and other harmful substances

Target: Regulation of use and use intensity

4.1.3 Enact a binding regulatory framework of 1. Adverse impacts on wetlands should be avoided when possible; 2. When they cannot be avoided, impacts should be minimized; and 3. Where impacts still occur, a compensatory effort is required

4.1.4 Specifications for the use of peat substitutes in procurement guidelines for public contracts in gardening and landscaping

4.1.5 Introduce a ban on the extraction of peat in swamps located in the water protection zone

4.1.6 Develop and introduce a legal framework concerning the creation and restoration of wetland protection strips/belts with local and mixed species

4.1.7 Draft and pass a Law on “Swamps and wetlands". This law must regulate:
1. extraction of peat and other natural resources
2. drainage of swamps
3. dismantling of drainage and water-removal structures
4. responsibilities of landowners and communities to protect swamps
5. water conservation rules for the use of agricultural and forest lands and other important for the conservation of swamps provisions and regulations.

4.1.8 Develop a program for establishing protected status on individual swamps, swamp systems, river sources.

4.1.9 Establish by law the obligation to create buffer (protection) zones around swamps

4.2 Institutional development (Law enforcement, internal and external organizational management & administration, alliances, financing)

4.2.1 Establish, maintain, and strengthen regulatory and enforcement programs. Where allowed by law, choose to include conditions in permits and licenses

4.2.2 Legal and financial strengthening of water authorities and water-soil associations, (e.g., for plan development to increase water levels in peatlands and implementation, promotion of acceptance and participation procedures for target setting).

4.2.3 Counties must enforce procedures under water law

4.2.4 Provide a mechanism for private landowners and agencies in mixed-ownership watersheds to develop, by consensus, goals, management plans, and appropriate practices and to obtain assistance from oblast and state agencies

4.2.5 Make land sales financially attractive for owners, prevent concerns about loss of value

4.2.6 Establish challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects

4.2.7 Install a mitigation bank that can bring together financial resources, planning, and scientific expertise

4.2.8 Establishment of a "peatland climate fund" for research, development, and pilot projects and funding for land purchase.

4.2.9 Reorientation of peatland use requires economic incentives for water management, adapted agricultural technology, and the development of downstream areas of exploitation. and marketing

4.2.10 Research and develop markets for paludiculture products

4.2.11 Make Paludiculture financially viable (also support via subsidies that reflect the wider societal value of peatland protection)

4.3 Area designation and planning (land acquisition, resource rights, zoning of utilization,site infrastructure etc.)

4.3.1 Obtain easements or full fee acquisition rights for wetlands and riparian areas along streams, bays, and estuaries

4.3.2 Transfer of territories to the nature reserve fund through buy-back

4.3.3 Determine the framework of binding swamp-maintaining and restoration activities on wetlands

4.3.4 Restrict activities that have a negative impact on wetlands and riparian areas through implementation of special area zoning and transferable development rights

4.3.5 Reduce small-scale ownership structures that prevent the implementation of rewetting, since water management can usually only be meaningfully adapted at the (sub)watershed level

4.3.6 Establishment of a land pool to provide land for exchange. The exchange of land could take place within the framework of agrarian structural measures such as land readjustments or land consolidation.

4.3.7 Provide a mechanism for landowners to obtain wetlands assistance

4.3.8 Incentives that encourage private restoration of fish and wildlife productivity

4.3.9 Economic incentives for sustainable use of wetlands with high water levels

4.4 Development of research and monitoring
4.4.1 Organizing and conducting joint research and monitoring of swamps with international partners
4.4.2 Evaluate wetland potentials on a watershed or landscape scale
4.4.3 Conducting population studies of rare and typical plant species as indicators of the sustainable and stable state of existence of wetland ecosystems
4.4.4 Identify existing functions of those wetlands
4.4.5 Identify impediments to wetland protection such as excessive street standards and setback requirements that limit site-planning options and sometimes force development into wetlands
4.4.6 Develop wetland water quality standards
4.4.7 Develop tools for determining proper buffer widths
4.4.8 Creation of system of early detection of fires
4.4.9 Exchange of experience between the peatland-rich regions of Europe to develop regionally tailored solutions
4.5 Development and promotion of awareness, education, and training (formal education; capacity building)
4.5.1 Holding an international conference on the protection of wetland ecosystems in Ukraine. The date of the conference is to coincide with February 2 - International Day for the Conservation of Wetlands.
4.5.2 Train farmers and other landowners on swamp conservation technologies.
Target: Awareness raising
4.5.3 Involve the public in the problem of endangered peatlands etc.
4.5.4 Informing the population about the fire danger in peat bogs
4.5.5 Establishment of demonstration areas and demonstration Paludicultural farms
4.5.6 Environmental activities in educational institutions
4.5.7 Raise awareness of schoolchildren and students about the importance of protection of swamps and about their climate regulating role
4.5.8 Installation of warning and educational posters
4.5.9 PR campaigns on social media and local press
Target: Education and Training
4.5.10 Knowledge transfer must be directed to all relevant stakeholders in a target group-specific manner – regarding Farmers, residents, businesses, water, and soil, land management, and conservation associations, agency administrators
4.5.11 Educate farmers, urban dwellers, and federal agencies on the role of wetlands and riparian areas in protecting water quality and climate regulation potential
4.5.12 Teach courses in simple restoration techniques for landowners (peatland-specific knowledge)
4.5.13 Brings together students, conservation NGOs, youth organizations, citizen groups, corporations, landowners, and government agencies to provide environmental education through projects that restore wetlands
4.5.14 Make use of local and regional wetlands guides. Developed wetlands guides to assist landowners in protecting wetland and riparian areas according to their different needs
4.5.15 Advise and inform land users on the use of peat substitutes and alternatives

Compiled by: Kevin Mack, Centre for Econics, Eberswalde USD, November 2021

In collaboration with:

Centre for Econics and Ecosystem Management

Eberswalde University for Sustainable Development

Succow Stiftung

Деснянський біосферний резерват

Шацький національний природний парк

West Polesie

"Розточчя" біосферний резерват

Biosphere reserve "Roztochya"

Ministry of Environmental Protection and Natural Resources of Ukraine

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

IKI International Climate Initiative