Ecosystem-based Adaptation Measure and Activity Catalog – Agricultural and Settlement Ecosystems

The open landscape – in potentially forested regions - represents functionally more impaired ecosystems than forests. Intensive use, especially by agriculture, causes the situation that many open lands are severely degraded and constantly lose their natural bioproductive capacity. This is especially related to physical and chemical as well as biological soil changes. For the adaptation of open land to climate change, i.e., for the restoration and strengthening of the (self-) regulating capacity, there are two starting points in the open land: the adaptation of management and the adaptation of landscape structure. In terms of management, the protection and building up of soil and its water retention capacity should be in focus, and a diversification of crop areas, species, and varieties should be aimed at. Structurally, the open land should be enhanced by (permanent) green structures such as grove islands, hedges, or even individual trees. If possible, native plants that spontaneously establish themselves should be used. Both the structural diversity itself and the associated build-up of biomass increase the functional efficiency of the open land. In addition, they also serve, among other things, to connect forests in the ecosystem network. As a rule, new sealing should be avoided (e.g., no new road construction, no commercial or residential development "in the field"), and existing built structures, especially drainage ditches and roads, should be deconstructed where possible. Agroforestry systems offer a promising and varied mixed approach in which land structures are also significantly reshaped by changing the way land is managed.

The functional efficiency of settlement and urban space depends above all on the existing green volume, i.e. green areas and structures and their productivity (biomass build-up). These should therefore be preserved and, if possible, enlarged or increased and designed to be as biomass-, species- and structure-rich as possible. Wilderness islands and set-aside areas should be given space as valuable cores of ecological functionality, also in the settlement centers. The proportion of woody plants in the city, which should be allowed to grow old, must be increased, both in existing green spaces and along streets, in yards and squares. In principle, preference should be given to native species with a rich supply of non-double flowers. Woody plants and perennials are preferable to annual plantings. Edible and otherwise usable woody plants and perennials can increasingly be used. Depending on the location, heat- and drought-tolerant woody plants from other regions can also be tried out, especially if they are edible and otherwise usable. Areas should be unsealed or at least partially unsealed where possible. Fresh air corridors should be considered and (re)established. All strategic goals are relevant for urban areas.

EbA Measures and Activities in Agricultural land and Settlement Ecosystems	
1 Conservation of existing, functional ecological structures and (self-) regulating capacity	
1.1 Conservation of existing trees, woody plants, and other near-natural green structures	
1.1.1	Protection and maintenance of individual trees as well as tree and plant communities in cropland and urban settings
1.1.2	Protection of functional buffer zones in and between cropland (individual trees and tree communities, hedges, shrubs, wild areas)
1.1.3	Conservation of ancient trees and tree communities on agricultural and in urban areas
1.1.4	No conversion of wilderness islands, wild hedgerows, flower meadows, forest to cropland or settlement area
1.1.5	Creation of (wild) protected recreation areas in urban settings
1.2 Conservation of small mosaic structures of various open land systems	
1.2.1	Setting aside areas in currently cultivated lands for further overgrowth
1.2.2	Support existing small-scale, multi-crop farming and agroforestry practices increasing structural diversity (see 3.2)
1.3 Conservation of existing water bodies and wetlands with corresponding buffer zones or riparian strips	
1.3.1	Enforce compliance with environmental and land legislation in riverain protection zones
1.3.2	Enlarge and widen buffer zones and riparian strips along rivers, lakes, and other water bodies. Exclude from the use by agriculture.
1.3.3	Prevent water bodies from overgrowing with invasive species
1.3.4	Support and protect native, diverse, and wild greenery to increase shading
1.3.5	Prohibit and control input of debris and other materials causing gradual filling and siltation
1.4 Conservation of existing unsealed and undeveloped areas	
1.4.1	Place under protection green spaces and structures in urban and settlement areas
1.4.2	Prevent road construction and other building infrastructure on previously unsealed and undeveloped areas
1.4.3	Prevent infrastructure development, soil sealing, and increasing access
1.4.4	Focus infrastructure and building development on already sealed or built-up areas (urban (re-)densification)
1.4.5	Place under protection a maximum of unsealed areas in urban and settlement areas for natural development
1.4.6	Protection and connection of existing green areas and patches to increase overall protected greenery in agricultural and urban areas

2	**Reduction of direct anthropogenic ecological stress drivers limiting (self-) regulating capacity**
2.1	**Dismantling of drainage systems**
2.1.1	Deconstruction of melioration and land reclamation systems
2.2	**Dismantling/deconstruction of soil-sealing and vertical built structures**
2.2.1	Reduction of artificial soil cover (in urban areas) - unsealing
2.2.2	Replacement of asphalt surfaces with water-permeable paving, e.g. water-bound cover, pavers with grass joints, where appropriate (e.g. footpaths, car-parking areas, access roads)
2.2.3	Use of ecological paving (permeable and biomass-rich surfaces)
2.2.4	Parking lot unsealing/reduction
2.3	**Reduction of vehicle access to land**
2.3.1	Reduce access by heavy machinery, tractors, and trucks for plowing, soil treatment, and transport
2.3.2	Closing of field roads and paths – focus on a few, main roads to decrease overall pressure by compaction, etc.
2.3.3	Closing of existing concrete roads (where possible) and unsealing of soil surface
2.4	**Reduction of fertilizer and pesticide use**
2.4.1	Minimization and ban of chemical substances used in agriculture
2.4.2	Limiting of mineral fertilizer
2.4.3	Increase share of organic fertilizers
2.4.4	Replacement of pesticides with biological means
2.4.5	Natural fertilization of the roadside greenery 1) Pyrolysis of green waste 2) Application of plant charcoal on green strips
2.5	**Reduction of use intensity and intensive soil cultivation**
2.5.1	Reduce agricultural use of drained peatlands
2.5.2	Reduce row cropping to a minimum
2.5.3	Reduce water extraction for agricultural, private, and commercial use
2.5.4	If viable, make use of drip irrigation with minimal water use
2.5.5	Apply split and organic fertilization instead of chemical fertilizers
2.5.6	Less harsh mechanical tillage
2.5.7	Apply delayed tillage
2.5.8	Conservation tillage or "No-till" system implementation – prefer direct sowing/seeding
2.5.9	Apply strip or contour strip cropping
2.5.10	Consider terracing where necessary and viable
2.5.11	Reduction of areas with water-absorbing crops
2.5.12	Return of illegally plowed pastures and hayfields to their intended use
2.5.13	Control of burning (arson) of dry vegetation
2.5.14	Counter illegal plowing of slopes

3 Restoration and targeted development of (self-) regulating capacity	
3.1 Creation of durable vertical green structures	
3.1.1	Transform monocultures to **agroforestry systems**: Woody perennials (trees, shrubs) are grown in association with herbaceous plants (annual or perennial crops, or pastures) and/or livestock
3.1.2	Allow for a **natural succession** of trees and shrubs
3.1.3	If necessary, initial sowing and planting of durable native trees, groves, woody plants, shrubs, and grasses capable of long-term development. Introduce preferably broadleaved trees
3.1.4	Creation/Active planting of protective forests, hedges, and shrubs (windbreaks)
3.1.5	Tree plantings, including suitable fruit (climaplastic), along dirt roads and field edges
3.1.6	Rounding off of groves and planting of hedges along roadsides
3.1.7	Tree planting in communal areas and educational institutions
3.1.8	Fostering conversion of grass vegetation into shrubs and tree plantations
3.1.9	Promote overgrowth or afforestation of slopes where erosion is probable
3.2 Establishment and development of small-scale mosaic structures	
3.2.1	Arrangement of boundaries between fields (planting trees and hedgerows on big fields)
3.2.2	Planting tree, shrub & bush rows that break up large fields into smaller pieces
3.2.3	Establish flower-rich structures between field tracks and arable land or grassland, on south- or west-exposed sites on hedges or woodland edges, in urban areas: along roads and pavements, on roundabouts, in city parks, front gardens, and schoolyards, in car parks, and graveyards, but also on rooftops or along brownfield
3.2.4	Creation and maintenance of buffer areas (flowering strips, forest strips, hedgerows, perennial grasses, etc.)
3.2.5	Creation of species-rich flowering strips (species-rich mixtures where there is a high proportion of herbs, sown species are not only typical for certain habitat types but also geographically indigenous)
3.2.6	Species-rich seed mixtures should contain only seeds of wild plants from regional seed propagation
3.2.7	Minimum width of 5 m to minimize disturbances and encroachment of unwanted species by clonal growth
3.2.8	Permanent wildflower strips within Agri-Environmental Schemes on well-kept arable land can be sown with a density of 0.7-0.8 g/m²
3.2.9	Existing species-poor grass swards must be heavily disturbed for the creation of establishment niches for introduced target species
3.3 Enable and support continuous land cover	
3.3.1	Continuous vegetation cover on fields by adequate cropping and crop rotation schemes
3.3.2	Prefer the use of multi-field crop rotations with the inclusion of crops of perennial grasses, which protect soils from water and wind erosion
3.3.3	Make use of cover crops in multiannual crop rotations
3.3.4	Leave greater and varying amounts of crop residues on the soil surface
3.3.5	Mulching
3.3.6	Initial planting of native perennial grasses

3.4	**Diversification and adaptation of agricultural practices, crops, and livestock to changing site conditions**
3.4.1	Apply multi-cropping systems instead of monoculture farming
3.4.2	Use keyline cultivation (keyline design) where possible - Goal: water retention on cultivated areas
3.4.3	Closed-loop biomass recycling at farms
3.4.4	Finding and usage of sustainable/persistent (native) species
3.4.5	Use diversified and site-adapted cultivar
3.4.6	Crop rotation and plant type renewal: Rotations with forage legumes allow for a higher content of soil organic matter compared with non-leguminous row crops (e.g. (e.g. 5 years of lucerne, good humus increase)
3.4.7	Apply Intercropping and relay intercropping (e.g. with legumes)
3.4.8	Catch-crop cultivation
3.4.9	Composting
3.4.10	Use of green manure plants in crop rotations
3.4.11	Use of mycorrhiza (Leguminosae)
3.4.12	Preferably use direct seeding into living cover crops or mulch
3.4.13	Promotion of fertile soils with Terra Preta (Production of Terra Preta/ use of plant charcoal for humus buildup)
3.4.14	Make use of multi-field crop rotations with the inclusion of crops of perennial grasses which protect soils from water and wind erosion
3.4.15	Transverse plowing on steep slopes (>12 °) to increase water retention during rainfalls
3.5	**Conversion of intensively used areas into more extensive areas**
3.5.1	Conversion of arable land into (semi-open) hayfields and pastures
3.5.2	Conversion of fields to grassland → extensive husbandry models with cows, sheep; under-sowing for fodder; etc.
3.5.3	In intensively used agricultural areas as well as in urban areas it is necessary to actively introduce wild target plants from regional origin via sowing or by transfer of seed-rich material from suitable donor sites (seed-rich green hay or from on-site threshing)
3.5.4	Increase the area of supporting mycorrhiza
3.6	**Conversion of cropland into forest areas**
Target: Afforestation and reforestation	
3.6.1	Creation of new forests on cropland (afforestation)
3.6.2	Selection of species by zonal aspects – native and preferably broadleaved species
3.6.3	Formation of natural native stands by natural succession or active seeding of native, mixed tree species
3.6.4	Promoting the natural regeneration of forest species
3.6.5	Afforestation of non-productive (transformed) land
3.6.6	increasing the forest cover via agroforestry
3.6.7	Planting native trees and shrubs as forest strips/belts

3.7	**Rewetting of small water bodies and wetlands as well as the creation of near-natural buffer zones and riparian strips**
3.7.1	Renaturation of (small) water bodies
3.7.2	Remove debris and other materials causing gradual filling and siltation
3.7.3	Identification of promising and least conflicting areas for the restoration of the (near) natural hydrological regime
3.7.4	Active creation of a mini close to nature pond (wild, native species, and appropriate materials)
3.7.5	Cleaning of springs
3.7.6	Creation of buffer strips (water protection zone) around springs and watercourses with preservation of natural vegetation
3.7.7	Creation of primarily wooded riparian structures (native and diverse species)
3.7.8	Riparian buffers may be constituted by any type of vegetation along riverbanks, lakeshores, or other adjacent lands to other surface waters
3.7.9	Support and establish 10+ m wide buffer strips for watercourses on cultivated land. Based upon fish migration criteria the recommended width of a buffer is 10 m for upland streams and 100 m for lowland
3.8	**Creation of semi-natural small water bodies and retention areas**
3.8.1	Redesigning flat gardens into concave ones
3.8.2	Use of rainwater to feed wetlands and infiltration swales
3.8.3	Renaturation of silted-up water areas
3.9	**Conversion of high-maintenance, species- and structure-poor green spaces into richer, extensive ecosystems**
3.9.1	Connecting fragments of green space to ecological corridors
3.9.2	Planting and seeding with native wild plants
3.9.3	Allow or actively introduce roots and dead wood
3.9.4	In urban areas, especially on nutrient-poor soil, gravel, or sandy sites, a sowing density of 1.0-1.5 g/m² is sufficient
3.9.5	Most sown species should be forbs, optimally 25-30 species
3.10	**Extension and new development of green wilderness and open spaces**
3.10.1	Planting of zonal tree and shrub species (resistant to pollution)
3.10.2	If necessary, top up with a layer of nutrient-rich soil
3.10.3	Seeding/introduction of perennial grasses
3.10.4	Positioning (alignment) of slopes
3.10.5	Greening (planting native species plants, grasses, hedges, shrubs) between/alongside streets
3.10.6	Sowing of lawn grasses between paving
3.10.7	Introduction of flowering and fruiting woody plants
3.10.8	Plant road-side zones with greenery, whose specific design allows retention, storage, and filtering of rainwater
3.11	**Greening of vertical structures**
3.11.1	Greening the facades of buildings (schools, kindergartens, community centers, commercial buildings, etc.)
3.11.2	Establishment of solitary trees to create vertical, shading forms, habitats, and as a climbing aid
3.11.3	Install wooden trellises attached to walls for climbing plants
3.11.4	Erect or develop privacy screens made of living willow wickers
3.11.5	Erect or develop organically shaped dry stone walls
3.11.6	Create (wild) wine arbors

3.12	**Roof and yard greening (urban wilderness)**
3.12.1	Vegetation should be a mix of native plant species
3.12.2	Create and develop wild herbaceous borders, flower meadow strips, wild shrub beds, berry bushes
3.12.3	Sowing or planting of native (wild) small fruit trees
3.12.4	Greened pathways
3.12.5	Flower herb lawn – mixed and native wild species
3.12.6	Make use of natural materials such as stones, chippings, gravels, and sands as well as non-polluting recycled materials
3.12.7	Used wood should be untreated and come from regional, sustainable forest management
3.12.8	Greening of buildings in combination with infiltration boxes
3.12.9	Selective weeding of especially invasive neophytes – never chop/hack the soil areawide
3.12.10	Composting in private and municipal gardens
3.12.11	Prohibit and ban synthetic pesticides, fertilizers, soil additives, peat, as well as (PVC-containing) plastics
3.12.12	Greening of roof surfaces (in existing and new buildings) of residential and commercial buildings with a substrate density of at least 10cm
3.12.13	Choice of a near-natural green roof with native wild plants, deadwood, and water areas
3.13	**Greening of sealed ground surfaces (streets, squares, parking lots) by superimposed structures**
3.15.1	Conversion of areas into home gardens/ farm gardens on sealed and fallow surfaces (cultivation of vegetables, berries, fruits on low-function land)
3.13.1	Native (small) shrubs, herbaceous perennials, and seedlings planted on mineral concrete and pit sand
3.13.2	Erect dry wall-raised bed with herbs
3.13.3	Install raised wooden beds for vegetables
3.14	**Increase the proportion of dead plant biomass**
3.14.1	Instead of burning (for cleaning land) plant residues make use for compost or reincorporate
3.14.2	Enhance recycling of biomass to support organic matter decomposition and nutrient cycling over time

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

4.1 Development of the legal and policy framework of cropland and settlement ecosystems

4.1.1	Adoption of the state program on afforestation
4.1.2	Regulation at the legislative level through the introduction of a CO_2 emission tax
4.1.3	Product pricing policy (adequate prices for organic products)
4.1.4	Harmonization of state legislation with European norms
4.1.5	Legal regulation of water intake by agriculture and private households
Target: Changes/amendments to existing legislation and regulations	
4.1.6	Introduction of changes to the Law of Ukraine according to agroecological and EbA conformity: - "On Farming" - the Land Code of Ukraine - "On Private Farming" - "On Beekeeping" - "On Basic Principles and Requirements for Food Safety and Quality" - “On Production and Distribution of Organic Agricultural Products and Materials - “On State Support of Agriculture in Ukraine " - Criminal Code of Ukraine
4.1.7	Revision of the State Building Norms according to microclimatic and biodiversity necessities in climate change. Learn from international experiences
Target: New legal requirements for soil, water, and fauna protection	
4.1.8	Establishment and implementation of infrastructure development regulation (decrease anthropogenic pressure)
4.1.9	Prohibition of construction in water-protection zones (on floodplains)
4.1.10	Restrictions on the tillage of existing hayfields and pastures
4.1.11	Enforce compliance with riparian law
4.1.12	Prohibition of the use of herbicides, pesticides, etc.
4.1.13	Prohibition at the legislative level of conversion of the existing pastures and hayfields into arable lands.

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

4.2.1	Incentive programs for the development of organic farming
4.2.2	Compensation of price difference for the manufacturer (of organic products)
4.2.3	State support/tax benefits for small-scale organic farms and animal husbandry
4.2.4	Development of a state program for afforestation of meadows
4.2.5	Develop incentives and financial support for agroforestry systems
4.2.6	Organized involvement of local stakeholder networks from the private, public, and voluntary sectors
4.2.7	Promote green roofs via investment in incentive programs, which provide subsidies for green roof installation and natural gardens
4.2.8	Increase the responsibility and punishment for intentional fires (arson)
4.2.9	Impose heavy fines for damages to the environment
4.2.10	Dialogue between producers - authorities - local communities
4.2.11	Establish a coordination office for the implementation of various climate adaptation measures
4.2.12	Support solidarity agriculture: Farmers and consumers of products form an alliance in which consumers guarantee the purchase of products in certain quantities and at reasonable prices for the farmer. Products should be chosen so that their production process improves the climate adaptation of agricultural land. Learn from experiences of existing examples

4.3	**Area designation and planning (land acquisition, resource rights, use zoning, site infrastructure, etc.)**
4.3.1	Inventory of areas of hayfields and pastures that existed in 1990.
4.3.2	Creation of a community seed bank with native and site-adapted cultivars
4.3.3	Increase areas for organic production
4.3.4	Prevent the establishment of large agricultural holdings
4.3.5	Termination of economic stimulus for large agricultural complexes
4.3.6	Creating a staff position in OTG personally for environmental issues at the local level
4.3.7	Proper organization of field roads
4.4	**Development of research and monitoring**
4.4.1	Modeling and monitoring of the hydrological situation
4.4.2	Drought probability modeling based on long-term meteorological observations
4.4.3	Development of management plans for desertification / drying risks
4.4.4	Create a farmer research team and participatory action research (good and efficient practice)
4.5	**Development and promotion of awareness, education, and training (formal education; capacity building)**
4.5.1	Explanatory and legal work with communities
4.5.2	Reorientation of farmers to ecological methods of farming
4.5.3	Demonstrative organic fields (organic demo-fields)
4.5.4	Educational activities for organic farming
4.5.5	Exchange between farmers (field trips and training) to deepen knowledge on ecological principles, equity, farmers associations, and marketing
4.5.6	Experience exchange, training (with international partners)
4.5.7	Make use of "nudging": behavioral economics method for stimulating behavior change via training opportunities
4.5.8	Conducting conferences, fairs, round tables
4.5.9	Involvement of schools, public organizations, churches
4.5.10	Improve fire education (fire-prevention literacy)
Target: Ecological/Environmental education of locals	
4.5.11	Eco-educational, legal work with the population and management structures on ecologically oriented agricultural activity
4.5.12	Promote rational water use
4.5.13	Development of projects for community development with mandatory inclusion of actions for “ecologization” of agricultural production
4.5.14	Mandatory and activity-based school lessons of ecological education
4.5.15	Creation of publicly accessible (school) gardens, community gardens that encourage participation
4.5.16	Practical examples of the use of environmental knowledge in real life
Target: Environmental awareness-raising in the population	
4.5.17	Conducting information seminars and training
4.5.18	Ecological bulletin for informing the local population on climate change and adaptation options in agriculture and urban settings
4.5.19	Dissemination of information on ecosystem-based approaches through mass media

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