Annex 1.

Tables 1.1 - 1.11 present the results of the review of climate change adaptation indicators for each sector respectively. Indicators marked as typical climate change indicators in the tables were excluded from further analysis.

Table 1.1. Climate change adaptation indicators for agriculture

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Annual growing season heat sum (>5 deg C per day)		+					
Temperature rise					+		
UV radiation					+		
Increase in winter precipitation					+		
Reduction in summer precipitation					+		
Decrease in snow thickness and number of days with snow cover					+		
Increase in heavy rainfall (> 10 mm per day)					+		
Increase in humidity in cold seasons, decrease in humidity in warm seasons					+		
Wind speed fluctuations					+		
Frequency of hazardous meteorological phenomena (such as storms, hail, hurricane, etc.).					+		
Proportion of agricultural land requiring adaptation to climate change				+			
Abstraction of water for irrigation							+
Irrigated area of vine production				+			
Soil health index at farm level							+
Area of agricultural land at significant flood risk							+
Arable land at significant risk of flooding							+
Stormwater sensitive areas		+					
Area of land at risk of drought				+			+
Agricultural area vulnerable to drought		+					
Area of prime agricultural land (Land capability)							+
Risk of Fasciola hepatica in cattle and sheep							+
Growing area under glass or plastic structures							+
Changes in wheat and spring barley yields (due to warmer springs); Changes in potato yields; Changes in winter barley yields (due to wetter winters) / Crop yields						+	+
National agricultural crop portfolio and diversity index							+
Number of outbreaks of potato blight							+
Proportion of farmland (Utilised Agricultural Area) under High Nature Value farming systems							+
Trends in breeding farmland birds							+
Index of butterflies on agricultural land							+
Index of bats on agricultural land							+
Overall productivity factor							+
Changes in phenology (development phases) of crop plants							+
Maize varieties by maturity group						+	
Quality of products collected						+	
Hail damage in agriculture						+	

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Pest invasion		+				+	
Organic matter content of soils				+			
Losses in agriculture due to animal and plant pathogens (development of pathogens due to improved living conditions)		+					
Seed diversity		+					
Vulnerability and resilience of agricultural, horticultural and forestry land to climate change		+					
Introduction of new crops and varieties, e.g. spring wheat, expansion of winter wheat, oilseed rape, -beans into new or currently unproductive areas		+					
Occurrence of aphids		+					
Increased population migration due to agricultural disruption					+		
Residents in flood-prone areas					+		
Residents in drought-prone areas					+		
Residents of coastal risk areas (due to storms and cyclones)					+		
Residents of food insecure areas					+		
Change in soil structure and soil nutrient retention capacity as a result of climate change and increased precipitation (indicators: soil organic matter, soil carbon stock, winter vegetation cover, drainage of arable and horticultural areas, nitrogen and phosphorus emissions to water, change in nutrient balance on arable land)		+					
Proportion of protected habitats in agricultural areas							+
Area under agri-environmental schemes	+				+		
Organic land and organic farms	+						
Agricultural production methods which reduce erosion risk (Proportion of arable land cultivated with reduced/zero tillage; with soil cover maintained)							+
Abstraction of water for irrigation	+			+		+	+
Use of climate adapted crops	+					+	
Area of insured agricultural land	+						
Adaptation of management processes						+	
Adaptation of the spectrum of varieties						+	
Use of plant protection products						+	
Inputs for agriculture and forestry (inputs include seeds, fertilisers, pesticides, machinery)		+					
Changes in farming practices			+				
Area under targeted agri-environmental schemes/ Proportion of farmland (Utilised Agricultural Area) under High Nature Value farming systems	+						+
Citizens' willingness to insure crops		+					

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.2. Climate change adaptation indicators for energy efficiency

Indicator	Country

	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
–Climate change indicators							
Not found							
Climate change impact indicators / Vulnerability indicators							
Energy demand for heating in residential and non-residential buildings							+
Energy-efficient communities / regions	+						
Adaptation action indicators							
Uptake of energy efficiency measures							+

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.3. Climate change adaptation indicators for energy infrastructure

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Not found							
Climate change impact indicators / Vulnerability indicators							
Number of households in fuel poverty							+
Electricity supply disruption due to flooding							+
Electricity supply disruption (number and timing) caused by severe weather events	+	+				+	+
Number of main (or auxiliary) power stations in areas at flood risk							+
Customers reliant on electricity substations in areas at flood risk							+
Electricity consumption during hot weather	+						
Overhead power lines in forests		+					
–Resilience indicators							
Diversification of electricity generation	+					+	
Potential and actual wind energy production						+	
Flood resilience of power substations with permanent safeguards							+
Diversification of final energy consumption for heating and cooling						+	
Electricity storage options						+	
Water use efficiency of thermal power plants						+	
Response indicators (R) - Adaptation action indicators							
Primary energy from renewable and local sources				+			
Electricity production by thermal power plants as a function of ambient temperature						+	
Investment in improving the reliability of the electricity network		+					

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.4. Climate change adaptation indicators for construction, spatial planning and housing

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Not found							
Climate change impact indicators / Vulnerability indicators							
Share of paved areas in the permanent settlement area	+						
Area and average intensity of urban heat islands				+			
Retention areas	+						
Proportion of buildings in disrepair due to climate change							+
Dampness & condensation in housing stock							+
Property at risk of flooding	+						+
Use of settlements in flood risk areas						+	
Settlement and transport areas at risk of flooding						+	
Number of households/people falling below the SHQS & Tolerable Standard							+
Proportion of residential and non-residential buildings in each energy efficiency class				+			
–Resilience indicators							
Number of properties protected from coastal erosion							+
Proportion of green areas in the urban environment	+	+					
Areas reserved for nature and landscape conservation						+	
Areas reserved for groundwater protection and drinking water abstraction						+	
Areas reserved for flood protection purposes						+	
Areas reserved for special climate functions						+	
Adaptation action indicators							
Net change in urban green space and blue zones					+		+
Number/area of green roofs installed in urban areas							+
Surface area of permeable paving applied to properties					+		+
New housing supply							+
Affordable housing supply							+
People displaced due to climatic events				+			
Proportion of newly built facilities equipped with systems to prevent the effects of heat waves					+		
Integrating climate change adaptation into the legal framework conditions	+						
Consideration of gravitational natural hazards in land use planning regulations	+						
Inclusion of climate change adaptation criteria in building support programmes	+						
Construction and renovation of public buildings including aspects relevant to adaptation	+						
Number of projects for infrastructure, residential and non-residential premises taking into account changes in meteorological conditions as a result of climate change and impact on human health					+		
Sustainability and green infrastructure planning of settlements, urban areas and spaces, ecosystem services assessment, nature conservation and resilience					+		
Number of spatial planning documents addressing climate change adaptation issues	+				+		

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Availability of an up-to-date assessment of the territory's vulnerability (at municipal level) to the effects of climate change, Inclusion of measures to manage risks and hazards caused by climate change in municipal action plans					+		
Number of municipal climate change adaptation plans developed					+		
Cities with more than 20,000 inhabitants / municipalities that have developed urban greening plans					+		
Loss ratio and loss-cost ratio for comprehensive homeowners' life insurance						+	
Weather-related business insurance claims						+	+
Proportion of residential buildings covered by extended insurance against natural hazards						+	
Average compensation per claim for extraordinary (weather) risks				+			
Citizens' willingness to insure property		+					

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.5. Climate change adaptation indicators for transport

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Not found							
Climate change impact indicators / Vulnerability indicators							
Road network at risk of flooding							+
Rail network at risk of flooding							+
Disruption risk to railway services as a result of flooding							+
Failure of communication networks due to power cuts		+					
Risk of traffic disruption as a result of flooding							+
Road and rail bridges vulnerable to scour							+
Damage to transport infrastructure due to extreme events	+						
Landslide events affecting the road network							+
Navigability of inland waterways					+		
Weather-related road accidents					+		
Reliability of the transport network (disruptions to the communication network caused by "messy" roads and flooding)		+					
Adaptation action indicators							
Rail network benefiting from flood protection							+
Road network benefiting from flood protection							+
Increasing the share of walking, cycling and public transport (excluding taxis)							+

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Integration of climate change adaptation into transport planning instruments	+						
Pavement repairs on heavily trafficked road sections	+						
Investment in improving the reliability of transport infrastructure		+			+		
Increasing the resilience of transport infrastructure to temperature changes					+		

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.6. Climate change adaptation indicators for nature and biodiversity conservation

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Number and area of reported wildfires in forests and key habitats			+				+
Development of tropical and subtropical species					+		
Forest fires					+		
Climate change impact indicators							
Proportion of notified habitats and species in 'positive' condition							+
Protected areas at national and international level	+					+	+
Farmland bird population							+
Abundance and productivity of breeding seabirds							+
Abundance of wintering water birds							+
Natural Capital Asset Index							+
Abundance/frequency of specialist and generalist species: butterflies							+
Proportion of notified habitats and species in 'positive' condition							+
Condition of key habitats: Proportion of notified habitats in unfavourable condition							+
Number of reported freshwater habitat features with invasive non-native species							+
Abundance/frequency of specialist and generalist species: snow-bed species							+
Extent of key semi-natural habitats: 1) terrestrial, 2) coastal, 3) deep peat							+
Proportion and area of pine woodland exposed to Dothistroma needle blight (DNB)							+
Forest bird species index							+
Forest butterfly species index							+

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Indicator of breeding wetland birds							+
Bird distribution and wintering grounds		+					
Status and trends of selected climate-sensitive species and habitat types	+						
Changes in the flora on Alpine summits	+						
Projects and measures that contribute to improving water ecology	+						
Ecological and chemical status of surface waters	+						
Phenological changes (in developmental stages) in wild plant species						+	
Temperature index in the bird species community						+	
Species composition of trees	+						
Viability of forest stands	+			+			
Soil condition	+						
Tree species composition in natural forest reserves						+	
Threatened spruce stands						+	
Increment of timber						+	
Damaged wood						+	
Wood damage and extent of expansion caused by the wood bark beetle			+			+	
Occurrence of the pine weevil		+					
Threats from the oak bark beetle						+	
Fire hazard of forest areas						+	
Area affected by major forest fires				+			
State of the forests						+	
Mixed stands						+	
Conservation of forest genetic resources						+	
Humus resources in forest soils						+	
Occurrence of heat-adapted species in inland waters						+	
Outbreaks of West Nile fever in equids				+			
Endangered wild species				+			
Invasive alien species				+			
Proportion of ancient woodlands with declining overall suitability for lichen epiphytes							+
Proportion of coniferous woodland on the National Forest Estate with a high/medium-high risk of wind throw							+
Proportion of Natura 2000 sites where climate change is a pressure factor				+			
Dangerous, new and easily spreading animal diseases and pests		+					
Losses in forestry due to plant and animal pathogens (development of pathogens due to improved living conditions)		+					
Municipalities where the presence or establishment of the mosquito Aedes albopictus has been detected				+			
Increase in the proportion of deciduous trees in mixed forests		+					
Extent of storm damage and forest owners' efforts to deal with damage		+					
Climate severity index			+				
Number of moths and occurrence of multi-generational species		+					

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Number of species for which climate change has been identified as a major threat		+					
Distribution of warm-adapted marine species						+	
Adaptation action indicators							
Area of local sites or habitats under "adaptive" management							+
Proportion of old-growth and native forest land under management and annual PAWS restoration area, on and off the public forest estate							+
Number of newly identified invasive species							+
Change in the number and range of invasive non-native species established in the country							+
Annual planting statistics							+
Landscape resilience index							+
Area of land under landscape scale conservation							+
Peatland restoration area							+
Amount of natural regeneration in native woodlands							+
Proportion of forest land certified as sustainably managed							+
Integrating climate change adaptation into nature and landscape conservation instruments	+					+	
Restoration of natural floodplains						+	
Availability of information on adaptation in forestry						+	
Area of reconstructed endangered spruce stands						+	
Research and monitoring projects on the services and values provided by ecosystems, integrating ecosystem services assessment into decision-making processes					+		
Expenditure on measures to prevent the spread of invasive species due to the effects of climate change					+		
Number of projects to restore the hydrological regime of wetland forests					+		
Projects implemented by owners and managers of commercial forests to conserve and protect elements of biodiversity					+		
Expenditure on measures to provide effective forest protection measures against fires and pests, the conservation of small forests, spring areas, small rivers, wetlands, forest meadows and other forest ecosystems important for the conservation of biodiversity					+		

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.7. Climate change adaptation indicators for water management

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Water leakage and losses (quantity)							+

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Domestic and non-domestic water usage				+		+	+
Quantitative groundwater status						+	
Meteorological drought - number of standard deviations of cumulative waste in a given period with respect to the average				+			
Drought index in metropolitan areas			+				
Water and food contamination (contamination with biotoxins and pathogens)					+		
Average ocean levels measured by satellite altimetry			+				
Dangerous extreme hydrological phenomena (floods, storms, droughts, intense rainfall, etc.).					+		
Climate change impact indicators / Vulnerability indicators							
Occurrences of low summer flow in rivers Summer low flow events in rivers (Normalised Flow Index)							+
Average flow in rivers						+	
Status and distribution of climate-sensitive species: abundance of Arctic charr (Arctic char) in freshwater lakes							+
Number of reported freshwater habitat features with invasive non-native species							+
Changes in average sea surface temperature			+			+	+
Number of harmful algal blooms (HABs)						+	+
Groundwater quantity and quality	+						
Retention areas	+						
Ecological and chemical status of surface waters	+						+
State of water resources				+			
Number/frequency of floods		+				+	
Flooding outside risk areas		+					
Water outflow						+	
Standing water temperature						+	
Duration of thermal stratification (thermal layer system) in still waters						+	
Sea level						+	
Storm tide intensity						+	
Episodes related to the occurrence/elimination of microcystins in drinking water				+			
Outbreaks of water-borne diseases associated with droughts and floods				+			
Number of situations of prolonged drought				+			
Number of residents in flood risk areas		+					
Population at risk within the floodplain		+					
Reliability of raw water supply in water utilities, especially in emergency situations		+					
Reliability of the waste water disposal system		+					
Sea salinity			+				
Increased population migration due to flooding					+		
Residents of areas with limited access to water					+		
Adaptation action indicators							
Projects and measures contributing to water quality improvement	+						
Number of freshwater monitoring stations							+

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Progress towards achieving the environmental objectives of the river basin management plans							+
Number of local flood strategies							+
Number of staff assigned to local flood risk management							+
Investment in coastal protection						+	
Compensation paid by insurance companies for floods (rain floods, storm floods)		+					
Investment in improving the reliability of water supply		+					
Flood protection measures for all residents in flood-risk areas					+		
Level of implementation of flood risk management programmes					+		
Improving the management of surface water, groundwater and the Baltic Sea and ensuring good water quality					+		
Upgrading surface (rainwater) wastewater management infrastructure and ensuring its development in urban areas to protect urban areas from excess water and prevent the release of pollutants into the environment					+		
Reduction of the negative impact of rising water levels and natural and catastrophic hydro-meteorological phenomena on the Baltic Sea coastal zone through natural coastal management measures					+		
Implementation of the flood risk management plan		+					

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.8. Climate change adaptation indicators for industry

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Not found							
Climate change vulnerability indicators							
Non-fluvial water intake for fish farming							+
Office space supply (local)							+
Availability of industrial sites (local)							+
Water intensity of the manufacturing sector						+	
Climate change impact indicators - Vulnerabilityindicators							
Water treatment works in areas at flood risk							+
Wastewater treatment works in areas at flood risk							+
Proportion of fish stocks managed sustainably							+
Sale of goods and services for climate change adaptation							+
Patents registered by companies for water-related adaptation measures							+
Energy supply disruption for businesses	+						
Reduction in performance caused by high temperatures						+	
Economic damage caused by coastal storms				+			
Changing latitudinal range of industries in response to changing optimum conditions for species-specific growth, e.g. aquaculture							+
Adaptation action indicators							
Expenditure on co-financing the adaptation of infrastructure to climate change	+						
Integration of adaptation aspects into environmental management systems	+						
Expenditure and projects related to reducing the impact of catastrophic meteorological phenomena on industry					+		
Cancellation of fish farming due to unfavourable weather conditions							+

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.9. Climate change adaptation indicators for the health sector

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Temperature rise					+		
Number of days with ozone concentrations: ≥ 100 μg/m^3			+				
Number of days with ozone concentrations: ≥ 120 μg/m^3			+				
Annual concentration of PM2.5			+				
UV radiation					+		
Status indicators (S) - Exposure indicators							

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Proportion of the population directly or indirectly exposed to risks related to climate change: avalanches, cyclones, storms, forest fires, floods, etc.			+				
Population exposed to the effects of a changing climate (taking into account the vulnerability of age groups and the number of hot and cold days)		+	+			+	
Number of temperature exceedances above warning thresholds (severity)			+				
Concentration of potentially allergenic pollen in the air						+	
Length of pollen season (including birch, walnut, hay, willow, alder)		+	+	+			
Atmospheric concentrations of allergenic fungal spores				+	+		
Climate change impact indicators							
Allergic diseases: dermatitis, eye inflammation, skin sensitivity/irritation	+				+		
Diseases caused by blood-sucking insects: malaria, dengue fever, yellow fever, West Nile fever, West Valley fever, tularemia, Chikungunia virus, syndicate virus, Tahyna virus					+		
Diseases caused by other insects: visceral and cutaneous leishmaniasis, chandipura virus, Sicilian virus, tularemia, Tuscan virus, Neapolitan virus					+		
Tick-borne diseases: Lyme disease, tick-borne encephalitis, ehrlichiosis, Mediterranean spotted fever, Crimean-Congo haemorrhagic fever, tularemia		+		+	+		
Diseases caused by protozoa: visceral leishmaniasis; schistosomiasis					+		
Rodent-borne diseases: leptospirosis, Hanta virus, haemorrhagic fever (with HFRS syndrome), plague, vasculitis and meningitis virus, smallpox virus, Lhasa virus					+		
Autochthonous cases of dengue				+			
Indigenous cases of Chikungunya virus disease				+			
Cases of Mediterranean rash fever (exothermic)				+			
Impact of floods on mental health							+
Indigenous cases of malaria				+			
Indigenous cases of West Nile virus				+			
Pathogen carriers						+	
Blue algae contamination in bathing waters						+	
Emergency room visits for hyperthermia/heatstroke			+				
Hospital admission due to effects of hot weather				+			
Emergency hospital admissions for chronic obstructive pulmonary disease				+			
Emergency hospital admissions for allergic asthma				+			
Water-borne epidemics and heat wave caused by climate change (number of food poisoning outbreaks by pathogen, e.g. salmonella, Campylobacter)		+					
Morbidity and mortality from cardiovascular and respiratory diseases, kidney disease, diabetes, mental illness and behavioural disorders					+		
Food- and water-borne diseases					+		

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Heat shock injury, starvation, exhaustion, death					+		
Skin cancer, cataracts of the eye					+		
Diseases of the stomach, digestive system, liver disease, kidney disease diabetes, mental and behavioural disorders					+		
Diseases caused by parasites: fascioliosis, gardenia. Diseases caused by viruses and bacteria: hepatitis A, E, diarrhoea, cholera, legionellosis, typhoid fever, shigellosis, campylobacteriosis, E. coli rotovirus, salmonellosis, botulism, cryptosporidiosis, yersiniosis					+		
Oncological diseases					+		
Patients with tuberculosis, exhausted by starvation, patients with infectious diseases, patients with chronic diseases, patients with mental or physical disabilities					+		
Health disorders caused by insufficient water and deteriorating water quality					+		
Changes in public health as a result of forest fires					+		
Health disorders related to hunger, malnutrition and important trace element loss					+		
Increased health risks during rest					+		
Anxiety and depression over economic losses due to drought					+		
Increased mortality due to lack of food, heat, suicide, outbreaks of violence					+		
Summer mortality due to high temperatures							+
Winter mortality due to low temperatures							+
Mortality from exposure to excessive natural cold				+			
Number of rescues per year due to natural phenomena		+					
Mortality due to high ozone concentrations (2 groups: ≥ 100 $\mu g/m^3$, ≥ 120 $\mu g/m^3$)			+				
Mortality due to PM2.5 concentrations ≥ 10 $\mu g/m^3$			+				
Excess of observed overall mortality over expected mortality				+			
Mortality rate from respiratory causes				+			
Cardiovascular mortality rate				+			
Fatalities from forest fires, floods and coastal storms				+			
Average duration of rescue operations due to natural phenomena and total duration of		+					
Adaptation action indicators							
% of clinical areas covered by thermal monitoring							+
% of health care providers reporting adaptation to change in annual reports							+
Number of overheating risk assessments carried out in clinical areas of NHS trust (required when temperature exceeds 26 degrees C)							+
Monitoring and early warning systems	+				+		
High temperature warning service			+			+	
Heat warning system activity						+	
Pollen information						+	
Activity of the coastal warning system				+			
Improve public information on climate change and the risks it poses to human health					+		

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Pollen monitoring and forecasting, ticks, phenological observations and indicators relevant to determining the impact of climate change on human health					+		
Increase in the number of nursing staff in the region		+					
Increase in the length of cycle ways and number of cycle parking facilities							+
Prevention of diseases that can arise and spread as a result of climate change					+		

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.10. Climate change adaptation indicators for tourism

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
Snow cover for winter sports						+	
Climate change impact indicators / vulnerability indicators							
Seasonal schedule of accommodation	+						
Accommodation in a coastal tourist area						+	
Seasonal accommodation in German tourist regions						+	
Seasonal concentration of tourist traffic				+			
Accommodation in winter sports centres						+	
Preferences for places of rest						+	
Cultural heritage in flood risk areas							+
Ecotourism	+						
Bathing temperatures at the coast						+	
Heat stress in climatic spas						+	
Episodes related to the occurrence/elimination of microcystins and/or cyanobacteria in bath water				+			
Adaptation action indicators							
Integration of climate change adaptation into the tourism concept/strategy	+						
Mainstreaming climate change adaptation into tourism subsidies	+						

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.11. Climate change adaptation indicators for risk management

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change indicators							
No							

Indicator	Country						
	Austria	Finland	France	Spain	Lithuania	Germany	United Kingdom
Climate change impact indicators / Vulnerabilityindicators							
Hours of operation in case of weather and weather-related damage						+	
Active disaster relief workers						+	
Adaptation action indicators							
Civil society and local preparedness (local preparedness of people for emergencies - number of people working in regional voluntary civil protection organisations)	+	+					
Volunteering to protect against hazards	+	+					
Training to improve the competencies of those involved in disaster management	+						
Civil protection exercises						+	
Integration of climate change adaptation into disaster protection legislation	+						
Information on natural hazards	+						
Information on behaviour in the event of a disaster						+	

Source: Authors work based on [Broniewicz et al., 2021].

The results of the quantitative assessment are presented in Tables 2.1. to 2.11.
Each criterion was scored on a scale 1-3, except for the prevalence. For this criterion the number of points represents the number of countries where the respective indicator (or a similar one) was identified.
Indicators with the maximum number of points (3 points) in each of the five criteria (except for the prevalence) are marked in green.
Indicators with a lower number of points but considered important for the sector are marked in blue.

Table 2.1. Assessment of climate change adaptation indicators for agriculture

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators / vulnerability indicators							
Non-flowing water abstraction for agricultural purposes	1	3	3	3	3	3	16
Irrigated area of vine production	1	3	1	3	3	3	14
Soil health index at farm level	1	1	3	2	2	2	11
Area of land at risk of drought	2	3	3	3	3	3	17
Agricultural land area	1	1	3	3	3	3	14
Risk of liver fluke (Fasciola hepatica) in cattle and sheep	1	1	3	2	3	3	13
Growing area under glass or plastic structures	1	1	3	1	3	1	10
Area of soils at risk of flooding in km^2	1	3	3	3	2	3	15
Changes in wheat and spring barley yields (due to warmer springs); Changes in potato yields; Changes in winter barley yields (due to wetter winters) / Crop yields	2	3	3	3	3	3	17
Number of outbreaks of potato blight	1	2	3	3	2	2	13
Changes in the national agricultural crop mix and diversity index	1	3	3	3	3	3	16
Proportion of agricultural land (utilised agricultural land) within high nature value agricultural systems	1	2	3	1	3	2	12
Arable land at significant risk of flooding	1	3	3	3	2	2	14
Index of farmland bird abundance (Farmland Bird Index)	1	1	3	2	2	2	11
Index of butterflies on agricultural land	1	1	3	2	2	2	11
Index of bats on agricultural land	1	1	3	2	2	2	11
Overall productivity factor	1	1	3	2	3	2	12
Changes in phenology (development phases) of crop plants	1	3	3	2	2	2	13
Maize varieties by maturity group	1	3	3	2	2	2	13
Quality of products collected	1	1	2	1	2	2	9
Hail damage in agriculture	1	3	3	3	3	2	15
Pest invasion	2	3	3	3	3	3	17
Organic matter content of soils	1	1	3	2	3	3	13
Stormwater sensitive areas	1	3	3	2	2	2	13

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Losses in agriculture due to animal and plant pathogens (development of pathogens due to improved living conditions)	1	3	3	3	3	2	15
Seed diversity	1	2	3	1	2	2	11
Vulnerability and resilience of agricultural, horticultural and forestry land to climate change	1	3	3	1	1	1	10
Introduction of new crops and varieties, e.g. spring wheat, expansion of winter wheat, oilseed rape, faba bean into new or currently unproductive areas	1	3	3	3	2	3	15
Occurrence of aphids	1	3	3	3	2	2	14
Increased population migration due to agricultural disruption	1	3	2	2	1	1	10
Residents in flood-prone areas	1	3	3	3	3	2	15
Residents in drought-prone areas	1	3	3	3	3	2	15
Residents of coastal risk areas (due to storms and cyclones)	1	3	2	3	3	2	14
Residents of food insecure areas	1	2	1	2	2	1	9
Change in soil structure and soil nutrient retention capacity due to climate change and increased precipitation (indicators: soil organic matter, soil carbon stock, winter vegetation cover, drainage of arable and horticultural areas, nitrogen and phosphorus emissions to water, change in nutrient balance on arable land)	1	2	3	2	2	2	12
Proportion of protected habitats in agricultural areas	2	2	3	2	3	3	15
Area under agri-environmental schemes	2	2	3	1	3	3	14
Organic land and organic farms	1	2	3	2	3	2	13
Adaptation action indicators							
Agricultural production methods which reduce erosion risk (proportion of arable land cultivated with reduced/zero tillage; with soil cover maintained)	1	2	3	1	2	2	11
Abstraction of water for irrigation	4	3	3	3	3	3	19
Use of climate-adapted crops	2	3	3	2	2	2	14
Area of insured agricultural land	1	3	3	3	3	3	16
Adaptation of management processes	1	2	3	1	1	1	9
Adaptation of the spectrum of varieties	1	3	3	2	2	2	13
Use of plant protection products	1	1	3	2	2	2	11

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Inputs for agriculture and forestry (inputs include seeds, fertilisers, pesticides, machinery)	1	1	3	1	3	2	11
Changes in farming practices	1	1	3	1	1	2	9
Area under targeted agri-environmental schemes / / Proportion of farmland (Utilised Agricultural Area) under High Nature Value farming systems	2	2	3	1	3	2	13
Citizens' willingness to insure crops	1	2	3	2	3	2	13

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.2. Assessment of climate change adaptation indicators for energy efficiency

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Response indicators							
Use of national funds for energy efficiency improvements	1	1	3	2	3	2	12
Energy-efficient communities / regions	1	1	3	1	2	1	9

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.3. Assessment of climate change adaptation indicators for energy infrastructure

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators							
Number of households in fuel poverty	1	1	3	2	3	3	13
Electricity supply disruption due to flooding	1	3	3	3	3	3	16
Electricity supply disruption (number and timing) caused by severe weather events	4	3	3	3	3	3	19
Number of main (or auxiliary) power stations in areas at flood drought risk	1	3	3	3	3	3	16
Customers reliant on electricity substations in areas at flood risk	1	3	3	3	3	3	16
Electricity consumption during hot weather	1	3	3	3	3	2	15
Overhead power lines in forests	1	2	3	3	3	3	15
–Resilience indicators							
Diversification of electricity generation	2	3	3	2	3	3	16
Potential and actual wind energy production	1	3	3	3	3	2	15
Flood resilience of power substations with permanent safeguards	1	3	3	2	2	2	13
Diversification of final energy consumption for heating and cooling	1	3	3	2	2	2	13
Electricity storage options	1	3	3	3	3	3	16
Water use efficiency in thermal power plants	1	1	3	1	2	2	10
Adaptation action indicators							
Primary energy from renewable and local sources	1	3	3	3	3	3	16
Electricity production by thermal power plants as a function of ambient temperature	1	3	3	2	3	2	14
Investment in improving the reliability of the electricity network	1	1	3	3	3	3	14

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.4. Assessment of climate change adaptation indicators for construction, spatial planning and housing

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators / vulnerability indicators							
Share of paved areas in the permanent settlement area	1	3	3	3	2	2	14
Proportion of buildings damaged by climate change	1	3	3	2	2	1	12
Dampness & condensation in housing stock	1	2	3	2	1	1	10
Proportion of dwellings below housing quality standard (including energy efficiency)	1	1	3	1	2	2	10
Property at risk of flooding	2	3	3	3	3	3	17
Settlement and transport areas at risk of flooding	1	2	3	2	2	2	12
Residential areas in flood risk areas	1	3	3	3	3	3	16
Proportion of residential and non-residential buildings in each energy efficiency class	1	2	3	3	2	2	13
Area and average intensity of urban heat islands	1	3	3	2	2	2	13
–Resilience indicators							
Number of properties protected from coastal erosion	1	2	2	3	2	2	12
Proportion of green areas in the urban environment	2	3	3	3	3	3	17
Areas reserved for nature and landscape conservation	1	2	3	2	2	2	12
Areas reserved for groundwater protection and drinking water abstraction	1	3	3	2	2	2	13
Areas reserved for flood protection purposes	1	3	3	3	2	2	14
Areas reserved for special climate functions	1	3	3	2	2	1	12
Adaptation action indicators							
Net change in urban green space and blue zones	2	3	3	3	2	2	15
Number/area of green roofs installed in urban areas	1	3	3	3	3	2	15
Surface area of permeable paving applied to properties	2	3	3	3	2	2	15
Weather-related business insurance claims	2	3	3	3	3	2	16
New housing supply	1	1	3	1	2	2	10
Affordable housing supply	1	1	3	1	2	1	9
Integrating climate change adaptation into the legal framework conditions	1	3	3	3	2	2	14
Consideration of gravitational natural hazards in land use planning regulations	1	2	2	2	2	2	11
Inclusion of climate change adaptation criteria in building support programmes	1	3	3	3	2	2	14
Construction and renovation of public buildings including aspects relevant to adaptation	1	3	3	3	3	3	16
Loss ratio and loss-cost ratio for comprehensive homeowners' life insurance	1	2	3	2	3	2	13

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Proportion of residential buildings covered by extended insurance against natural hazards	1	3	3	3	3	3	16
People displaced due to climatic events	1	3	2	3	3	2	14
Average compensation per claim for extraordinary (weather) risks	1	3	3	3	3	3	16
Number of municipalities that have developed greening plans	1	3	3	2	3	2	14
Number of projects for infrastructure, residential and non-residential premises taking into account changes in meteorological conditions as a result of climate change and impact on human health	1	3	3	2	3	2	14
Proportion of newly built facilities equipped with systems to prevent the effects of heat waves	1	3	3	3	2	2	14
Sustainability and green infrastructure planning of settlements, urban areas and spaces, ecosystem services assessment, nature conservation and resilience	1	3	3	2	2	2	13
Number of spatial planning documents taking into account climate change adaptation issues	2	3	3	3	3	2	16
Availability of an up-to-date assessment of the territory's vulnerability (at municipal level) to the effects of climate change, Inclusion of measures to manage climate change risks and hazards in municipal action plans	1	3	3	2	2	2	13
Number of municipal climate change adaptation plans developed	1	3	3	3	3	3	16
Citizens' willingness to insure property	1	2	3	2	2	1	11

Source: Authors work based on [Broniewicz et al., 2021].

Table 1.5. Assessment of climate change adaptation indicators for transport

Indicator	Evaluation criteria						Evaluation
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators - Vulnerability indicators							
Road network at risk of flooding	1	3	3	2	3	2	14
Rail network at risk of flooding	1	3	3	2	3	2	14
Disruption risk to railway services as a result of flooding	1	3	3	1	2	2	12
Failure of communication networks due to power cuts	1	3	3	2	2	2	13

Indicator	Evaluation criteria						Evaluation
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Risk of traffic disruption as a result of flooding	1	3	3	2	2	2	13
Number of road and rail bridges at risk	1	3	3	2	3	2	14
Damage to transport infrastructure due to extreme events	1	3	3	3	2	2	14
Landslide events affecting the road network	1	2	3	2	2	2	12
Navigability of inland waterways	1	2	2	1	2	2	10
Weather-related road accidents	1	2	3	2	2	2	12
Reliability of the transport network (disruptions to the communication network caused by "messy" roads and flooding)	1	2	3	1	1	1	9
Adaptation action indicators							
Rail network benefiting from flood protection	1	3	3	2	2	2	13
Road network benefiting from flood protection	1	3	3	2	2	2	13
Increasing the share of walking, cycling and public transport (excluding taxis)	1	2	3	3	3	2	14
Integration of climate change adaptation into transport planning instruments	1	3	3	2	2	2	13
Pavement repairs on heavily trafficked road sections	1	1	3	2	2	2	11
Investment in improving the reliability of transport infrastructure	2	1	3	1	2	2	11
Increasing the resilience of transport infrastructure to temperature changes	1	3	3	1	2	2	12

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.6. Assessment of climate change adaptation indicators for nature and biodiversity conservation

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Adaptation action indicators							
Proportion of notified habitats and species in 'positive' or improving condition	1	2	3	1	2	2	11
Protected areas at national and international level	3	3	3	3	3	3	16
Farmland bird population	1	2	3	1	3	2	12
Abundance and productivity of breeding seabirds	1	2	3	1	3	2	12
Abundance of wintering water birds	1	2	3	1	3	2	12
Natural Capital Asset Index	1	1	3	1	2	2	10
Abundance/frequency of butterflies: indicator and total species	1	2	3	1	2	2	11
Proportion of notified habitats and species in 'positive' condition	1	1	3	1	2	2	10
Proportion of reported habitats in unfavourable condition	1	1	3	1	2	2	10
Number of reported freshwater habitat features with invasive non-native species	1	3	3	1	2	2	12
Abundance/frequency of Arctic species	1	3	2	2	2	2	12
Extent of key semi-natural habitats: 1) terrestrial, 2) coastal, 3) deep peat	1	3	3	3	2	2	14
Proportion of pine woodland exposed to Dothistroma needle blight (DNB)	1	3	3	3	2	2	14
Forest bird species index	1	2	3	2	3	2	13
Forest butterfly species index	1	2	3	2	3	2	13
Indicator of breeding wetland birds	1	3	3	3	3	3	16
Bird distribution and wintering grounds	1	3	3	2	3	2	14
Status and trends of selected climate-sensitive species and habitat types	1	3	3	2	2	2	13
Changes in the flora on Alpine summits	1	3	1	2	2	2	11
Projects and measures that contribute to improving water ecology	1	2	3	1	2	1	10
Ecological and chemical status of surface waters	1	2	3	3	3	3	15
Phenological changes (development phases) in wild plant species	1	3	3	2	2	2	13
Temperature index in the bird species community	1	2	3	2	2	2	12
Species composition of trees	1	3	3	2	3	3	15

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Viability of forest stands	2	3	3	2	3	3	16
Soil condition	1	2	3	2	3	3	14
Tree species composition in natural forest reserves	1	3	3	2	3	3	15
Threatened spruce stands	1	3	3	3	3	2	15
Increment of timber	1	2	3	2	3	3	14
Damaged wood	1	2	3	2	3	3	14
Wood damage and extent of expansion caused by the wood bark beetle	2	3	3	3	3	3	17
Occurrence of the pine weevil	1	3	3	3	3	3	16
Threats from the oak bark beetle	1	3	3	3	3	3	16
Fire hazard of forest areas	1	3	3	3	3	3	16
Area affected by major forest fires	1	3	3	3	3	3	16
State of the forests	1	2	3	2	3	3	14
Mixed stands	1	2	3	2	3	3	14
Conservation of forest genetic resources	1	3	3	2	3	3	15
Humus resources in forest soils	1	2	3	2	3	3	14
Occurrence of heat-adapted species in inland waters	1	3	3	3	3	3	16
Outbreaks of West Nile fever in equids	1	3	2	2	3	3	14
Endangered wild species	1	2	3	3	3	3	15
Invasive alien species	1	3	3	3	3	3	16
Proportion of ancient woodlands with declining overall suitability for lichen epiphytes	1	2	3	2	2	2	12
Proportion of coniferous forests in medium/high wind risk areas	1	3	3	2	3	3	15
Proportion of Natura 2000 sites where climate change is a pressure factor	1	3	3	3	3	3	16
Dangerous, new and easily spreading animal diseases and pests	1	2	3	2	3	3	14
Losses in forestry due to plant and animal pathogens (development of pathogens due to improved living conditions)	1	3	3	3	2	2	14
Municipalities where the presence or establishment of the mosquito Aedes albopictus has been detected	1	3	2	3	3	2	14
Increase in the proportion of deciduous trees in mixed forests	1	2	3	2	3	3	14
Extent of storm damage and forest owners' efforts to deal with damage	1	3	3	3	2	2	14
Palmer drought severity index	1	3	3	3	3	3	16
Number of moths and occurrence of multi-generational species	1	2	2	2	2	2	11
Number of species for which climate change has been identified as a major threat	1	3	3	3	3	3	16
Distribution of warm-adapted marine species	1	3	3	3	2	2	14
Response indicators (R) - Adaptation action indicators							
Area of local sites or habitats under adaptive management	1	3	3	2	3	2	14

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Proportion of managed ancient and native woodland sites and annual PAWS (Planted Ancient Woodland Sites) restoration area	1	1	3	1	2	2	10
Number of newly identified invasive species	1	3	3	3	3	3	16
Change in the number and range of invasive non-native species established in the country	1	3	3	3	3	3	16
Annual afforestation	1	2	3	2	3	3	14
Landscape resilience index	1	2	3	1	1	1	9
Area of land under landscape protection	1	1	3	2	3	3	13
Area of reclaimed peat bogs	1	3	3	3	3	3	16
Natural regeneration rate in forests	1	2	3	2	3	3	14
Proportion of forest land with sustainable management certification	1	2	3	3	3	3	15
Integrating climate change adaptation into nature and landscape conservation instruments	2	3	3	3	2	2	15
Restoration of natural floodplains	1	3	3	3	3	3	16
Availability of information on adaptation in forestry	1	3	3	2	2	2	13
Area of reconstructed endangered spruce stands	1	2	3	2	3	3	14
Research and monitoring projects on the ecosystems services and values , integrating ecosystem services assessment into decision-making processes	1	2	3	2	3	3	14
Expenditure on measures to prevent the spread of invasive species due to the effects of climate change	1	3	3	3	2	2	14
Number of projects to restore the hydrological regime of wetland forests	1	3	3	3	3	2	15
Projects implemented by owners and managers of commercial forests to conserve and protect elements of biodiversity	1	2	3	2	3	2	13
Expenditure on measures to provide effective forest protection measures against fires and pests, the conservation of small forests, spring areas, small rivers, wetlands, forest meadows and other forest ecosystems important for the conservation of biodiversity	1	3	3	2	3	2	14

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.7. Assessment of climate change adaptation indicators for water management

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Pressure indicators							
Water losses	1	1	3	3	2	2	12
Domestic and non-domestic water usage	3	2	3	3	3	3	17
Water and food contamination (contamination with biotoxins and pathogens	1	2	3	3	3	3	15
Climate change impact indicators / Vulnerability indicators							
Occurrences of low summer flow in rivers	1	3	3	3	3	3	16
Average flow in rivers	1	3	3	3	3	3	16
Status and distribution of climate-sensitive species: abundance of Arcticcharr (Arctic char) in freshwater lakes	1	3	3	3	3	3	16
Number of reported freshwater habitat features with invasive non-native species	1	3	3	2	3	2	14
Number of harmful algal blooms (HABs)	2	3	3	3	3	3	17
Groundwater quantity and quality	1	2	3	2	3	3	14
Retention areas	1	3	3	3	3	3	16
Ecological and chemical status of surface waters	2	2	3	3	3	3	16
State of water resources	1	3	3	3	3	3	16
Number/frequency of floods	2	3	3	3	3	3	17
Flooding outside risk areas	1	3	3	3	3	3	16
Water outflow	1	2	3	2	2	2	12
Storm tide intensity	1	2	2	2	3	3	13
Episodes related to the occurrence/elimination of microcystins in drinking water	1	3	3	3	3	3	16
Outbreaks of water-borne diseases associated with droughts and floods	1	3	3	2	2	2	13
Number of situations of prolonged drought	1	3	3	3	3	3	16
Number of residents in flood risk areas	1	3	3	3	3	3	16
Population at risk within the floodplain	1	3	3	3	3	3	16
Reliability of raw water supply in water utilities, especially in emergency situations	1	3	3	2	2	2	13
Reliability of the waste water disposal system	1	2	3	2	2	2	12
Increased population migration due to flooding	1	3	3	3	2	2	14
Residents of areas with limited access to water	1	3	3	3	3	3	16
Adaptation action indicators							
Projects and measures contributing to water quality improvement	1	1	3	2	3	2	12
Number of freshwater monitoring stations	1	2	3	2	3	3	14
Progress towards the environmental objectives of the river basin management plans	1	2	3	2	2	2	12
Number of local flood strategies	1	3	3	3	3	3	16

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Number of staff assigned to local flood risk management	1	3	3	3	3	2	15
Investment in coastal protection	1	2	3	3	3	2	14
Compensation paid by insurance companies for floods (rain floods, storm floods)	1	3	3	3	3	3	16
Capital expenditure to improve water supply reliability	1	2	3	3	3	3	15
Flood protection measures for all residents in flood-prone areas	1	3	3	3	3	3	16
Level of implementation of flood risk management programmes	1	3	3	2	2	2	13
Improving the management of surface water, groundwater and the Baltic Sea and ensuring good water quality	1	2	3	1	1	1	9
Upgrading surface (rainwater) wastewater management infrastructure and ensuring its development in urban areas to protect urban areas from excess water and prevent the release of pollutants into the environment	1	2	3	2	3	3	14
Reduction of the negative impact of rising water levels and natural and catastrophic hydro-meteorological phenomena on the Baltic Sea coastal zone through natural coastal management measures	1	3	3	1	2	2	12
Implementation of the flood risk management plan	1	3	3	3	2	2	14

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.8. Assessment of climate change adaptation indicators within the economy sector for industry

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Pressure indicators							
Non-fluvial water intake for fish farming	1	2	3	2	3	2	13
Office space supply (local)	1	1	3	1	2	2	10
Availability of industrial sites (local)	1	1	3	1	2	2	10
Water consumption in the manufacturing sector	1	2	3	3	3	3	15
Climate change impact indicators / Vulnerability indicators							
Water treatment plants in flood risk areas	1	3	3	3	3	3	16
Wastewater treatment plants in flood risk areas	1	3	3	3	3	3	16
Proportion of fish stocks managed sustainably	1	2	3	2	2	2	12
Sale of goods and services for climate change adaptation	1	3	2	2	1	1	10

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Patents registered by companies for water-related adaptation measures	1	3	3	2	3	3	15
Energy supply disruption for businesses	1	2	3	3	3	3	15
Reduction in performance caused by high temperatures	1	3	3	1	1	1	10
Economic damage caused by coastal storms	1	3	3	3	2	2	14
Changing latitudinal range of industries in response to changing optimum conditions for species-specific growth, e.g. aquaculture	1	3	3	2	2	2	13
Adaptation action indicators							
Expenditure on co-financing the adaptation of infrastructure to climate change	1	3	3	3	3	2	15
Integration of adaptation aspects into environmental management systems	1	3	3	2	2	2	13
Expenditure and projects related to reducing the impact of catastrophic meteorological events on industry	1	3	3	3	2	2	14
Resignation of fish farming due to unfavourable weather conditions	1	3	3	3	2	2	14

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.9. Assessment of climate change adaptation indicators for the health sector

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Exposure indicators							
Number of days with ozone concentrations: ≥ 100 μg/m^3	1	2	3	2	3	3	14
Number of days with ozone concentrations: ≥ 120 μg/m^3	1	2	3	2	3	3	14
Annual concentration of PM2.5	1	2	3	2	3	3	14
UV radiation	1	2	3	2	3	3	14
Proportion of the population directly or indirectly exposed to risks related to climate change: avalanches, cyclones, storms, forest fires, floods, etc.	1	3	3	3	2	2	14
Population exposed to the effects of a changing climate (taking into account the vulnerability of age groups and the number of hot and cold days)	3	3	3	3	2	2	16
Number of temperature exceedances above warning thresholds (severity)	1	3	3	3	3	3	16
Concentration of potentially allergenic pollen in the air	1	2	3	3	3	3	15
Length of pollen season (including birch, walnut, hay, willow, alder)	3	3	3	3	3	3	18
Concentration of allergenic fungal spores in the atmosphere	2	3	3	3	3	3	17

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators							
Allergic diseases: dermatitis, eye inflammation, skin sensitivity/irritation	2	2	3	2	2	2	13
Diseases caused by blood-sucking insects: malaria, dengue fever, yellow fever, West Nile fever, West Valley fever, tularemia, Chikungunia virus, syndicate virus, Tahyna virus	1	3	2	3	3	3	15
Diseases caused by other insects: visceral and cutaneous leishmaniasis, chandipura virus, Sicilian virus, tularemia, Tuscan virus, Neapolitan virus	1	3	2	3	3	3	15
Tick-borne diseases: Lyme disease, tick-borne encephalitis, ehrlichiosis, Mediterranean spotted fever, Crimean-Congo haemorrhagic fever, tularemia	3	3	3	3	3	3	18
Diseases caused by protozoa: visceral leishmaniasis; schistosomiasis	1	3	3	3	3	3	16
Rodent-borne diseases: leptospirosis, Hanta virus, haemorrhagic fever (with HFRS syndrome), plague, vasculitis and meningitis virus, smallpox virus, Lhasa virus	1	3	3	3	3	3	16
Summer mortality due to high temperatures	1	3	3	3	2	2	14
Winter mortality due to low temperatures	2	3	3	3	3	3	16
Impact of floods on mental health	1	3	3	2	1	2	12
Indigenous cases of malaria	1	3	2	3	3	3	15
Indigenous cases of West Nile virus	1	3	2	3	3	3	15
Mortality due to high ozone concentrations (2 groups: ≥ 100 µg/m^3, ≥ 120 µg/m^3)	1	2	3	2	2	2	12
Mortality due to PM2.5 concentrations ≥ 10 µg/m^3	1	2	3	2	2	2	12
Pathogen carriers	1	1	3	1	2	2	10
Blue algae contamination in bathing waters	1	3	3	3	3	3	16
Emergency room visits for hyperthermia/heatstroke	1	3	3	3	3	3	16
Hospital admission due to effects of hot weather	1	3	3	3	3	3	16
Excess of observed overall mortality over expected mortality	1	1	3	2	3	2	12
Mortality rate from respiratory causes	1	2	3	2	3	3	14
Cardiovascular mortality rate	1	2	3	2	3	3	14
Emergency hospital admissions for chronic obstructive pulmonary disease	1	2	3	2	3	3	14
Emergency hospital admissions for allergic asthma	1	1	3	2	3	3	13
Indigenous dengue cases	1	3	2	3	3	3	15
Indigenous cases of Chikungunya virus disease	1	3	2	3	3	3	15
Cases of Mediterranean rash fever (exothermic)	1	3	2	3	3	3	15

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Fatalities from forest fires, flooding and coastal storms	1	3	3	3	3	3	16
Water-borne epidemics and heat wave caused by climate change (number of food poisoning outbreaks by pathogen, e.g. salmonella, Campylobacter)	1	3	3	2	3	2	14
Number of rescues per year due to natural phenomena	1	3	3	3	3	3	16
Average duration of rescue operations due to natural phenomena and total duration per year	1	3	3	3	3	3	16
Morbidity and mortality from cardiovascular and respiratory diseases, kidney disease, diabetes, mental illness and behavioural disorders	1	2	3	1	3	3	13
Food- and water-borne diseases	1	3	3	2	3	2	14
Heat shock, injury, starvation, exhaustion, death	1	3	3	2	3	2	14
Skin cancer, cataracts of the eye	1	3	3	3	3	3	16
Diseases of the stomach, digestive system, liver disease, kidney disease diabetes, mental and behavioural disorders	1	1	3	2	3	3	13
Diseases caused by parasites: fascioliosis, gardenia. Diseases caused by viruses and bacteria: hepatitis A, E, diarrhoea, cholera, legionellosis, typhoid fever, shigellosis, campylobacteriosis, E. coli rotovirus, salmonellosis, botulism, cryptosporidiosis, yersiniosis	1	2	3	2	3	3	14
Oncological diseases	1	1	3	2	3	2	12
Health disorders caused by insufficient water and deteriorating water quality	1	2	3	2	2	2	12
Changes in public health as a result of forest fires	1	3	3	1	2	2	12
Health disorders related to hunger, malnutrition and important trace element loss	1	3	3	2	2	2	13
Increased mortality due to lack of food, heat, suicide, outbreaks of violence	1	3	3	2	2	2	13
Increased health risks during tourist activity	1	2	2	2	2	2	11
Anxiety and depression over economic losses due to drought	1	3	3	2	1	2	12
Patients with tuberculosis, exhausted by starvation, patients with infectious diseases, patients with chronic diseases, patients with mental or physical disabilities	1	2	3	2	2	2	12
Adaptation action indicators							
% of clinical areas covered by thermal monitoring	1	3	3	3	3	3	16
% of health care providers reporting adaptation to change in annual reports	1	3	3	1	2	2	12

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Number of overheating risk assessments carried out in clinical areas of NHS trust (required when temperature exceeds 26 degrees C)	1	3	3	2	2	2	13
Increasing the length of cycle paths and number of cycle parking facilities	1	2	3	2	3	3	14
Monitoring and early warning systems	2	3	3	3	3	3	17
High temperature warning service	2	3	3	3	3	3	17
Heat warning system activity	1	3	3	2	3	3	15
Pollen information	1	2	3	3	3	3	15
Activity of the coastal warning system	1	3	3	2	3	3	15
Increasing the number of nursing staff in the region	1	1	3	2	3	3	13
Improve public information on climate change and the risks it poses to human health	1	3	3	1	1	2	11
Pollen monitoring and forecasting, ticks, phenological observations and indicators relevant to determining the impact of climate change on human health	1	3	3	2	3	3	15
Prevention of diseases that can arise and spread as a result of climate change	1	3	3	1	1	2	11

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.10. Assessment of climate change adaptation indicators for tourism

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Climate change impact indicators / vulnerability indicators							
Cultural heritage in flood-risk areas	1	2	3	2	3	3	14
Seasonal schedule of accommodation	1	2	3	3	3	3	15
Ecotourism	1	2	3	1	2	2	11
Accommodation in a coastal tourist area	1	1	3	3	2	2	12
Heat stress in climatic spas	1	3	3	2	3	3	15
Accommodation in winter sports centres	1	2	3	3	3	3	15
Preferences for tourist destinations	1	1	3	1	2	1	9
Seasonal concentration of tourist traffic	1	2	3	2	2	2	12
Episodes related to the occurrence/elimination of microcystins and/or cyanobacteria in bath water	1	1	2	2	2	2	10
Response indicators (R) - Adaptation action indicators							
Integration of climate change adaptation into the tourism concept/strategy	1	3	3	2	3	2	14
Mainstreaming climate change adaptation into tourism subsidies	1	3	3	3	3	2	15

Source: Authors work based on [Broniewicz et al., 2021].

Table 2.11. Assessment of climate change adaptation indicators within the risk management and protection sector and risk protection

Indicator	Evaluation criteria						Total points
	Prevalence	Relevance and adequacy	Suitability	Recognizability	Measurability	Reliability	
Status indicators (S) - exposure/impact of climate change							
Hours of operation in case of weather and weather-related damage	1	3	3	2	2	3	14
Active disaster relief workers	1	2	3	2	3	2	13
Response indicators (R) - indicators of adaptive action							
Civil society and local preparedness (local preparedness of people for emergencies - number of people working in regional voluntary civil protection organisations)	2	2	3	2	1	2	12
Volunteering in the field of protection against hazards	2	2	3	3	2	2	14
Training to improve the competencies of those involved in disaster management	1	3	3	2	3	3	15
Civil protection exercises	1	2	3	2	3	2	13
Integration of climate change adaptation into disaster protection legislation	1	3	3	2	2	2	13
Information on natural hazards	1	2	3	3	2	2	13
Information on behaviour in the event of a disaster	1	2	3	3	2	2	13

Source: Authors work based on [Broniewicz et al., 2021].

The results of the qualitative analysis are presented in Table 2.12. For indicators finally selected, its name is given in the last column.

Table 2.12. Proposed indicators for Poland

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Agriculture			
Non-flowing water abstraction for agriculture/ Irrigation water abstraction	YES	EUROSTAT: Share of irrigated agricultural area	Additional indicator
Area of land at risk of drought	YES	EEA: Intensity and area affected by water scarcity in Europe	The indicator is not unique - the indicator **Yields of selected crops per hectare** contains broader information
Changes in wheat and spring barley yields (due to warmer springs); Changes in potato yields; Changes in winter barley yields (due to wetter winters)	YES	EEA: Water-limited yields EEA: Projected change in average water-limited winter wheat yields	***Yields of selected crops per hectare***
Changes in the national agricultural crop mix and diversity index	YES	**European adaptation strategy:** Making better use of genetic diversity and non-harmful plant genetic resources for climate change adaptation, building on the latest scientific research	The indicator is not unique - the indicator **Yields of selected crops per hectare** contains broader information
Pest invasion	NO	NO	-
Area of insured agricultural land	YES	**European adaptation strategy: Using insurance as a risk transfer mechanism to cover financial losses associated with climate risk**	***Area of insured agricultural crops [ha /%]***
Energy efficiency			
Energy intensity of the economy	YES	EU climate package "Fit for 55"	***Energy intensity of the economy [kgoe / euro]***
Energy-efficient communities/ regions	YES	NO	***Household energy consumption per capita [kgoe/person]***
Energy infrastructure			
Number and duration of power outages due to flooding	YES	NO	***System average long and very long interruption duration indicator SAIDI (with***

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Disruption (number and timing) of electricity supply due to severe weather events	YES	NO	***catastrophic interruptions) [min/consumer/year]***
Number of main (or auxiliary) power plants in flood risk areas	NO	NO	-
Number of customers dependent on substations in flood-prone areas	NO	NO	-
Electricity storage options	YES	NO	Indicator partly incorporates the information of the indicator **Share of primary energy from renewable sources** (The greater the storage capacity, the greater the share of renewables)
Diversification of electricity generation	YES	NO	Indicator partially information **Share of primary energy from renewable sources**
Primary energy from renewable and local sources	YES	NO	***Share of primary energy from renewable sources [%]***
Construction, spatial planning and housing			
Number of properties at risk of flooding	YES	NO	***Proportion of buildings and population in areas at risk of flooding***
Residential areas in flood risk areas	YES	NO	
Proportion of green areas in the urban environment	YES	European adaptation strategy: developing green urban spaces	***Proportion of green areas in the urban environment [%]***
Weather-related business insurance claims	YES	**European adaptation strategy: Using insurance as a risk transfer mechanism to cover financial losses associated with climate risk**	Additional indicator The indicator related to compensations was applied to agriculture
Average compensation per claim for extraordinary (weather) risks	YES	**European adaptation strategy: Using insurance as a risk transfer mechanism to cover financial losses associated with climate risk**	
Proportion of residential buildings covered by extended insurance against natural hazards	YES	**European adaptation strategy: Using insurance as a risk transfer mechanism to cover financial losses associated with climate risk**	
Construction and renovation of public buildings including aspects relevant to adaptation	YES	NO	Not selected due to lack of available data

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Number of spatial planning documents taking into account climate change adaptation issues	YES	**European adaptation strategy: Improving climate change adaptation strategies and plans**	Not selected due to lack of available data
Number of municipal climate change adaptation plans developed	YES	**European adaptation strategy: Improving climate change adaptation strategies and plans** **SPA: Existence of adaptation plans for cities with more than 100,000 inhabitants**	Indicator not recommended due to limited data availability (currently - cities with more than 100,000 inhabitants)
Transport			
Road network at risk of flooding	YES	NO	***Transport infrastructure at risk of flooding [%]***
Rail network at risk of flooding	YES	NO	
Number of road and rail bridges at risk	YES	NO	
Damage to transport infrastructure due to extreme events	YES	NO	***Sections of national roads and railways closed due to extreme events [%]***
Increasing the share of walking, cycling and public transport (excluding taxis)	YES	NO	Additional indicator
Integration of climate change adaptation into transport planning instruments	YES	NO	Not selected due to lack of available data and difficulty in producing such data
Nature and biodiversity conservation			
Indicator of breeding wetland birds	YES	NO	Additional indicator
Wood damage and extent of expansion caused by the wood bark beetle	NO	NO	Additional indicator
Occurrence of the pine weevil		NO	
Threats from the oak bark beetle		NO	
Fire hazard of forest areas	YES	EEA: Forest fires in Europe	***Fire hazard of forest areas***
Area affected by major forest fires	YES	EEA: Forest fires in Europe	**The Forest Fire Risk indicator** better captures the intent of adaptation
Occurrence of heat-adapted species in inland waters	YES	NO	***Number of alien species***
Alien invasive species	YES	NO	
Number of newly identified invasive species	YES	NO	

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Change in the number and range of invasive non-native species established in the country	YES	NO	
Proportion of Natura 2000 sites where climate change is a pressure factor	NO	European adaptation strategy: Updating the Natura 2000 and climate change guidelines	-
Extent of protected areas at national and international level	NO	NO	Additional indicator
Palmer drought severity index	NO	EEA: Trend in frequency of meteorological droughts in Europe	-
Number of species for which climate change has been identified as a major threat	NO	NO	-
Area of reclaimed peat bogs	YES	European adaptation strategy: Protection and restoration of wetlands, peatlands, coastal and marine ecosystems	***High fens degraded but capable of natural and stimulated regeneration***
Restoration of natural floodplains	YES	NO	Indicator is not unique - included in the indicator **Area of retention areas**
Water management			
Domestic and industrial water use rate	YES	**SPA: Urban household tap water consumption per capita [m^3/year].** **EUROSTAT:** Water use index EUROSTAT: Freshwater abstraction **European adaptation strategy: Reduction of water consumption**	***Water consumption per capita in households [m^3/year]***
Occurrences of low summer flow in rivers	NO	EEA: Evolution of annual river flows	-
Average flow in rivers	NO	EEA: Evolution of annual river flows EUROSTAT: Freshwater abstraction	
State of water resources	NO	EUROSTAT: Water resources	-
Status and distribution of climate-sensitive species: abundance of Arcticcharr (Arctic char) in freshwater lakes	NO	NO	-
Number of harmful algal blooms (HABs)	NO	NO	-

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Episodes related to the occurrence/elimination of microcystins in drinking water	NO	NO	
Retention areas	YES	European adaptation strategy: green and blue infrastructure development	***Area of retention areas [ha]***
Number/frequency of floods	YES	EEA: Observed regional trends in annual flood discharges in Europe	Indicator not unique - included in indicator **Proportion of buildings and population in flood risk areas**
Flooding outside risk areas	YES		
Number of residents in flood risk areas	YES		Indicator is not unique - included in the indicator **Area of retention areas**
Population at risk within the floodplain	YES		
Number of situations of prolonged drought	NO	EEA: Trend in frequency of meteorological droughts in Europe	-
Residents of areas with limited access to water	YES	EEA: Intensity and area affected by water scarcity in Europe **European adaptation strategy: Stable and secure drinking water supply**	***Population in drought-prone areas***
Number of local flood strategies	YES	**SPA: Existence of flood risk management plans**	Additional indicator
Compensation paid by insurance companies for floods (rain floods, storm floods)	YES	**European adaptation strategy: Using insurance as a risk transfer mechanism to cover financial losses associated with climate risk**	Additional indicator
Flood protection measures for all residents in flood-prone areas	NIE	NO	-
Industrial economy			
Water intensity of the manufacturing sector	YES	EUROSTAT: Water use efficiency in (EUR per m^3), European adaptation strategy: Reducing water use	***Water consumption in industry***
Patents registered by companies for water-related adaptation measures	YES	European adaptation strategy: Research and development on climate change adaptation	The available data covers only a fraction of the projects actually implemented

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
		SPA: **Number of Polish environmental technologies supporting climate change adaptation verified under ETV system**	
Water treatment plants in flood risk areas	NO	NO	-
Wastewater treatment plants in flood risk areas	NO	NO	-
Expenditure on co-financing the adaptation of infrastructure to climate change	YES	NO	Business support programmes for adaptation to climate change
Health			
Population exposed to the effects of a changing climate (taking into account the vulnerability of age groups and the number of hot and cold days)	YES	NO	Indicator is not unique - **hospital admissions due to effects of heat** are included in the indicator
Number of temperature exceedances above warning thresholds (severity)	NO	NO	-
Length of pollen season (including birch, walnut, hay, willow, alder)	NO	NO	-
Concentration of allergenic fungal spores in the atmosphere	NO	NO	-
Tick-borne diseases: Lyme disease, tick-borne encephalitis, ehrlichiosis, Mediterranean spotted fever, Crimean-Congo haemorrhagic fever, tularemia	YES	NO	***Incidence and hospitalisations due to vector-borne diseases resulting from climate change***
Diseases caused by protozoa: visceral leishmaniasis; schistosomiasis	NO	NO	
Rodent-borne diseases: leptospirosis, Hanta virus, haemorrhagic fever (with HFRS syndrome), plague, vasculitis and meningitis virus, smallpox virus, Lhasa virus	YES	NO	Number of cases of melanoma and other skin malignancies

Selected indicators by area	Usefulness in the legislative process	Recommendation EEA[1)], SPA[2)], Eurostat[3)], European Adaptation Strategy[4)]	Proposed name of the indicator
Skin cancer, cataracts of the eye			
Winter mortality due to lower temperatures	YES	NO	Additional indicator
Blue algae contamination in bathing waters	YES	NO	Additional indicator
Emergency room visits for hyperthermia/heatstroke	YES	NO	Additional indicator
Hospital admission due to effects of hot weather	YES	NO	***Hospital admissions due to effects of hot weather***
Fatalities from forest fires, flooding and coastal storms	YES	NO	Additional indicator
Number of rescue operations per year due to natural phenomena	YES	NO	Additional indicator
Average duration of rescue operations due to natural phenomena and total duration per year	NO	NO	-
% of clinical areas covered by thermal monitoring	NO	NO	-
Monitoring and early warning systems	NO	NO	-
High temperature warning service	NO	NO	
Tourism			
Accommodation in winter sports centres	YES	NO	***Accommodation in winter sports centres***
Integration of climate change adaptation into the tourism concept/strategy	YES	NO	Not selected due to lack of available data
Mainstreaming climate change adaptation into tourism subsidies	YES	NO	***Proportion of funding under tourism support programmes where adaptation issues are addressed***

Source: Authors work based on [Broniewicz et al., 2021].