National climate change adaptation planning and strategies

Legal instrument: Regulation on the Governance of the Energy Union and Climate Action

Obligation: National climate change adaptation planning and strategies – GovReg

1. General information

EU Member State / EEA member country

Croatia

The information in this reporting is updated until (date: YYYY-MM-DD format)

2021-02-15

Is this reporting the mandatory reporting under Art. 19 and Part 1 of Annex VIII of the Governance Regulation and Annex 1 of the Implementing Act?

Yes

2. National circumstances, impacts, vulnerabilities, risks and adaptive capacity

2.1. National circumstances relevant to adaptation actions

Biogeophysical characteristics relevant to adaptation actions

Annex I: 1.1a

Croatia belongs to the Central European, Adriatic-Mediterranean and Pannonia-Danube group of countries. Total area of Croatia amounts 87.661 km2. The inland area amounts 56.594 km2, while the area of territorial sea and internal sea waters amounts 31.067 km2. Croatia has four biogeographic areas, Mediterranean, Alpine, Continental and Pannonian which influence its climate.

The Adriatic Sea is the northernmost part of the Mediterranean Sea. The total length of Croatian coast is 6.278 km, out of which 1.800 km belongs to the mainland and 4.200 km to the island coastline. The highest measured depth is 1.233 m. The Croatian islands include almost all islands of the Adriatic eastern coast and its central part making the second Mediterranean archipelago by size. There are 1.244 islands which are geographically distinguished as 79 islands, 525 islets, 640 cliffs (top above sea-level) and reefs (top below sea-level).

The state sea border is 948 km long and extended at outer boundary of territorial sea. The Ecological and Fisheries Protection Zone of 23.870 km2 reaches the epicontinental border between Croatia and Italy.

There are three large geomorphological natural units in Croatia: the Pannonian basin, mountain system of Dinarides and Adriatic basin. Lowland areas of up to 200 m a.s.l. represent 53% of area of Croatia, hillies and sub-mountains from 200 up to 500 m represent 26%, while there is 21% of mountain areas exceeding 500 m. The highest mountaintop in Croatia is Dinara (1.831 m a.s.l.). Carstic area is relief particularity occupying about 54% of Croatia territory. Karstic forms are developed particularly in limestones in mountainous and coastal area of Croatia and as separated form in Sava-Drava area.

The state of water and sea resources in the territory is largely dependent on transboundary impacts due to the global impact of climate change on the dynamics of ocean and sea level change as well as the high share of cross-border and transboundary watercourses in relation to Croatia's total water resources. The deterioration of hydrological conditions due to climate change will increase the frequency and duration of dry periods on the one hand, and the frequency and intensity of flood situations on the other hand.

According to the average water balance, Croatia abounds with water but the interannual distribution of water quantities is not favourable due to the significant spatial and time unequality in water resources distribution. I addition, Croatia has a large share of karst structures and large spatial-temporal heterogeneity of runoffs. The karst areas occupy about half of the territory and have a small capacity of water accumulation for longer dry periods.

All surface and ground waters are part of either Black Sea or Adriatic catchment area with the watershed running along the mountain and alpine area. Large watercourses dominate the Black Sea catchment area. In the Adriatic catchment area, the abundance and the length of surface watercourses are significantly lower. The majority of large watercourses of the Black Sea catchment area is of interstate significance (boundary or cross-border). The river Danube is the largest and richest in water, flowing through the eastern borderland of Croatia, while the rivers of Sava and Drava have the longest courses in Croatia.

There are not many natural lakes in Croatia. The largest natural lakes are Vrana Lake near Pakoštane, Prokljan Lake, Visovac Lake and Vrana Lake on the island of Cres. Croatia also characterises significant areas with wetland, which are included in the Ramsar wetland protection list: Kopački rit in the Drava and Danube cathments, Lonjsko and Mokro polje and Crna Mlaka in the Sava catchment, lower Neretva part in the Adriatic catchment and Vrana Lake near Pakoštane.

In 2016 from the total agriculture area (2.7 mil. ha) intensively used agricultural land was 1.546.019 ha which represents 27,31 % of the total land area of the Republic of Croatia. In the period from 2007 until today, there is a positive trend in the use of agricultural land. In 2016, the biggest share of 56,4 % take category of oranges and gardens and permanent grassland with 38,8 % which also shows an increase in the trend of use since 2007. The number of livestock in 2016 has declined compared with 2008. Total catches in 2016 amounted to 85.028 tonnes, of which 80,37% is blue fish, while remaining are other species of fish, oysters, shellfish and molluscs. Mariculture includes fish farms for white fish, blue fish and shellfish. The total production of freshwater fish in 2016 amounted about 4.099 tonnes, of which about 66% were carp cultivation. In 2016 total of 3.249 tonnes of young fish were raised.

Pursuant to the Forest Management Plan for the period 2016-2025, total forest and forestland area in Croatia amounted 2.759.039 ha in 2016, which as regarding total inland area of Croatia represents forest cover of 49%. Out of total forest area, productive forest land with tree cover amounts 2.492.676 ha (90%) and the rest is productive forestland without tree cover (productive, non-productive and unfertile land). 76% of forests is owned by the state, managed by the company Hrvatske šume Ltd., while the rest is privately owned. The Forest Management Plan determines growing stock of about 418.618.277 m3 while its yearly increment amounts about 10,1 millions of m3. Species' abundance in the total growing stock is as follows: Common

beech 37,2%, Pedunculate oak 11,6%, Sessile oak 9,4%. The most representative conifers are: Silver fir 7,9 %, Spruce 2,3 %, Black alder 2%, Black pine 1,4 %.

Demographic situation relevant to adaptation actions

Annex I: 1.1b

The Croatian territory is administratively divided into 20 counties and the City of Zagreb, as well as 128 cities, 428 municipalities and 6.755 settlements. The spatial distribution of the population is extremely uneven. The north-west is the most populated part of Croatia, where 15% of the total population is situated in 15% of the territory. Eastern Slavonia, Istria, Croatian Littoral and Southern Dalmatia have an above-average and average population. Croatia consist predominately of smaller settlements with an average number of 657 inhabitants per settlement. Larger and more densely populated settlements are characteristic for eastern Croatia, Međimurje and the Split macro-region. Four large cities stand out in Croatia that are at the centre of development for their regions. These cities are Zagreb with 691.724 inhabitants, Split with 175.140 inhabitants, Rijeka with 143.800 inhabitants and Osijek with 90.411 inhabitants, and together they account for a quarter of the Croatian population.

Economic and infrastructural situation relevant to adaptation actions

Annex I: 1.1c

In terms of quality, number and diversity, the fund of cultural monuments in Croatia is extremely important. According to the data from 2018, a total of 6.832 immovable cultural goods and 2.458 movable cultural goods were entered in the Register of Immovable Cultural Monuments. Of the immovable cultural assets, 388 urban and rural cultural and historical units, 5.054 individual cultural assets of architectural heritage, 42 cultural assets are on the list of cultural assets of national importance, and 8 assets on the UNESCO World Heritage List. Protected areas in Croatia cover 14,5 % of the land area, while forests cover 49 % of the territory

The roads are divided into two groups: public and unclassified. According to the Roads Act (OG 84/11, 22/13, 54/13, 148/13 and 92/14), the legal entities that manage public roads are the Hrvatske autoceste d.o.o. and concessionaires, the company Hrvatske ceste d.o.o. and the County Road Administration. The company Hrvatske autoceste d.o.o. and concessionaires manage motorways, the company Hrvatske ceste d.o.o. state roads, and the County Road Administration county and local roads. Local authorities manage unclassified roads. According to the Decision on the Classification of Public Roads (OG 103/18), the total length of public (categorized) roads is 26.722,35 km, of which AC 1.419,52 km, DC 7.175,65 km, WC 9.483,05 km and LC 8.644,13 km. The total construction length of all railways in Croatia is 2.722,54 km, of which 2.468,54 km are single-track and 254 km are double-track. There are seven large seaports

in Croatia. The main port with the highest traffic is Rijeka, which is insufficiently connected to the hinterland. Depending on the importance and position, inland waterways in Croatia are classified as international, interstate and national. The total length of waterways in Croatia is 804,10 km (from I to VIc class). Croatia has eight international airports open to public traffic.

Croatia has been exposed to the negative effects of climate change for a long time resulting in significant economic losses. According to the European Environment Agency (EEA) report, Croatia belongs to a group of three countries, with the highest cumulative share of the damage from extreme weather and climate events in relation to the Gross Domestic Product (GDP). It is estimated that these losses, in the period from 1980 to 2013, amounted about 2,25 billion EUR or an average of 68 million EUR per year. These losses have increased significantly during 2014 and 2015 (to 2,83 billion EUR in 2015). Some economic sectors were significantly affected in that period. According to some estimates, between 2000 and 2007 extreme weather conditions caused damage to the agricultural sector of 173 million EUR, while the drought in 2003 caused damage of between 63 and 96 million EUR to the energy sector.

If necessary, you can upload here an additional document

-

2.2. Climate monitoring and modelling framework

Main activities on climate monitoring, modelling, projections and scenarios

Annex I: 1.2a

Croatian Meteorological and Hydrological Service (DHMZ) performs meteorological and hydrological activities of interest to the Republic of Croatia, which also include activities of importance for climate monitoring and model development:

- continuous monitoring and systematic collection of data on atmospheric and hydrological phenomena, and

- providing reliable and timely data and information on weather, climate, climatic variations and changes, water, sea, soil and air (Law on Meteorological and Hydrological Activity, NN 66/19).

DHMZ conducts operational monitoring of climate and climate change, which is regularly published on the official website, in professional and scientific papers of domestic and international journals, in reports and studies ordered by the f Ministry responsible for environmental protection. In addition, climatological information layers are an integral part of weather warnings (related to rain, heat waves, wind and snow) and depend on the climatic conditions of a particular area.

The key national project whose results will, among other things, be the support of climate change adaptation systems and warning of dangerous weather conditions is the "Modernisation of the National Weather Observation Network in Croatia" (METMONIC).

At DHMZ, the regional climate model RegCM has been used for many years in research and applied climate activities, and the results of simulations of regional climate models available through international initiatives and projects (ENSEMBLES, EURO-CORDEX, CORDEX FPS Convection). Recent activities include:

- development of climate simulations for the area of Europe and Croatia on the 12.5 km × 12.5 km model grid for the needs of development of the "Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with a view to 2070" and

- participation in the development of a regional climate model for the wider Alpine region and Croatia at the 4 km × 4 km model grid (initial results published as a part of the international efforts: Coppola et al. 2020 and Ban et al. 2021).

In these activities, atmospheric reanalysis of ERA-Interim for the current climate and the results of CMIP5 global climate models for the historical climate and projections for the 21st century were applied as boundary conditions for regional climate models. Assumed future GHG concentration scenarios used in the same activities include RCP4.5 and RCP8.5 and to a lesser extent RCP2.6.

Main approaches, methodologies and tools, and associated uncertainties and challenges

Annex I: 1.2b

Monitoring of the climate and climate change are carried out in accordance with national and international professional standards. The basis is the data measured at meteorological stations and the results of climate models. The methods are based on selected statistical and dynamical models that may be a source of uncertainty in the estimates obtained. Therefore, the methods used are regularly evaluated and extended according to new knowledge, and the results are updated.

In the application of regional climate models as a methodology for studying the properties of past, present and future climate, we find three groups of uncertainties and challenges:

1. Systemic errors of regional climate models

Dynamical climate models (regional and global) numerically solve systems of differential equations describing the laws of conservation of mass, energy, and momentum. Additionally, for

processes that are not directly discernible on the numerical model grid, the same models include physical parameterizations that include the effects of unresolved processes on resolved processes. Limitations of the applied algorithms and non-inclusion of processes for which there is a lower degree of understanding lead to deviations of the solution of climate models with respect to the observations, i.e. to systematic errors if we consider longer periods of time. This type of problem is the subject of model development, where by increasing the spatial resolution and more comprehensive physical parameterizations, one can expect progress in the quality of climate models, i.e. reduction of system errors.

2. Sources of uncertainty in climate projections for the 21st century

Greenhouse gas emissions as a result of human activities are the result of overall extraction and use of fossil fuels and changes in surface type and land use. The actual trajectory of annual emissions during the 21st century of the same gases and their concentrations will be the result of different socio-economic processes (changes in population, speed and extent of transition to a low-carbon society, maintaining the climate system's ability to absorb part of the anthropogenic emissions, etc.). A methodological approach taking into account these sources of uncertainty the application of several representative scenarios of greenhouse gas emissions and / or concentrations. Other sources of uncertainty / uncertainty in 21st century climate projections include the sensitivity of numerical solutions of climate models to a given increase in emissions / concentrations, which depends on the internal structure and settings of the model and, especially for closer periods, the dependence on initial conditions in climate model simulations. In practice, in addition to the model development described in the previous point, different research groups perform simulations with regional climate models using several global climate simulations in separate calculations and several scenarios of greenhouse gas concentrations. For example, as part of the development of the simulation database contained in the repozitorij.meteo.hr, one regional climate model (RegCM4) was forced in separate simulations with four global climate models (CMIP5) using two scenarios of greenhouse gas concentrations (RCP4.5 and RCP8). 5) and in versions on two model grid spacing (50 km and 12.5 km). The current topic of systematic research is the inclusion of scenarios of aerosol concentrations and changes in the land use in an ensemble of different regional climate models and the first organized international experiments are performed as part of the so-called, CORDEX FPS projects.

3. Use and availability of regional climate simulation results

Development and application of regional climate model requires in addition to technically and professionally trained climatologists also the availability of appropriate computing capacity (number and speed of processors, archiving system, presence of software environment allowing simulations) and support IT professionals. After performing a set of simulations according to previously defined protocols, it is necessary to ensure the availability of solutions for research and applied activities. The results of DHMZ simulations are thus available in the internal archive

of DHMZ and part in the external databases of ESGF and repozitorij.meteo.hr. In the future, DHMZ projects plan to invest more resources in developing technical and professional solutions to make the results of climate simulations more accessible to as many interested users as possible, without the need for intervention by DHMZ experts in e.g. extraction and visualization of basic simulation results.

If necessary, you can upload here an additional document

-

2.3. Meteorological Observations (1)

Name of the meteorological service

Croatian Meteorological and Hydrological Service

Status of the meteorological service

Established

Web link to the meteorological service

https://meteo.hr/

2.4. Climate projections and services (1)

Description of climate projections and services

Open access data repository of the climate projections has been developed for the development of the National Adaptation Strategy.

Status of the climate projections and services

Established

Web link to the climate projections and services

https://repozitorij.meteo.hr/

2.5. Climate change impact and vulnerability assessment (CCIVA) (1)

Title of the CCIVA assessment (preferably translated into English)

Results of the Climate Modelling on the High Performance Computing Velebit System

CCIVA status

Completed

Year the CCIVA assessment was completed

2017

Link to the CCIVA assessment

https://prilagodba-klimi.hr/baza-znanja/klimatsko-modeliranje/

CCIVA part of National adaptation strategy (NAS)

Yes

Focus of the CCIVA

Impact

2.6. Observed climate hazards

Temperature-related - acute

Temperature-related - acute - Cold wave/frost, Temperature-related - acute - Heat wave, Temperature-related - acute - Wildfire

If other, please explain

-

Wind-related - acute

Wind-related - acute - Storm (including blizzards dust and sandstorms)

If other, please explain

-

Water-related - acute

Water-related - acute - Drought, Water-related - acute - Flood (coastal fluvial pluvial ground water), Water-related - acute - Heavy precipitation (rain hail snow/ice), Water-related - acute - Snow and ice load

If other, please explain

-

Solid mass-related - acute

-

If other, please explain

-

Temperature-related - chronic

Temperature-related - chronic - Changing temperature (air freshwater marine water), Temperature-related - chronic - Temperature variability

If other, please explain

-

Wind-related - chronic

-

If other, please explain

-

Water-related - chronic

Water-related - chronic - Changing precipitation patterns and types (rain hail snow/ice), Water-related - chronic - Precipitation and/or hydrological variability, Water-related - chronic - Saline intrusion, Water-related - chronic - Sea level rise

If other, please explain

Historical and present changes in the Adriatic salinity and acidification are topics of current research activities.

Solid mass-related - chronic

-

If other, please explain

-

Overview of existing pressures

Member States shall report existing environmental, economic and social pressures that are likely to be significantly affected by climate change: e.g. loss of biodiversity, poor harvest, energy poverty, unemployment, migration. Annex I: 1.3a Footnote3

Climate change in Croatia over the period 1961–2010 has been determined by trends in annual and seasonal mean air temperature, mean minimum and mean maximum temperature; and in indices of temperature extremes; then in precipitation amounts and precipitation indices, as well as in dry and wet spells.

Over the past 50 years (1961 – 2010), the air temperature trends (mean, mean minimum and mean maximum) indicate the trend of warming throughout Croatia. Annual air temperature trends are positive and significant, and changes are greater in the continental part of the country than on the coast and in the Dalmatian hinterland. The observed warming is also reflected in all the temperature extremes indexes with the positive trends of warm temperature indices (warm days and nights and duration of warm periods) and negative trends of cold temperature indices (cold days and cold nights and the length of cold periods).

Likewise, over the past 50 years (1961 –2010), annual rainfall shows predominant non-significant trends, which are positive in the eastern lowlands and negative in other parts of Croatia. A statistically significant reduction of rainfall was observed at the meteorological stations in the mountain region of Gorski kotar and in Istria as well as in the southern coastal area.

Weather changes of dry and rainy periods are shown by annual and seasonal trends of their maximum duration. According to the trends, the most significant changes in the dry periods were in the autumn months when a statistically significant negative trend was observed throughout Croatia. In other seasons, the trend of dry periods for both categories is weaker than in the autumn.

Longer and more frequent drought periods, as well as the increasing threat to agricultural crops from heat stress over the last decades, especially in Dalmatia, are a clear signal, primarily to fruit growers, olive growers and winemakers to implement climate change adaptation measures. The drought in the summer months in the period between 1980 and 2014 was the largest single cause of damage caused to Croatian agriculture by climate variability, while in the period from 2013 to 2016 it caused damage of a total of 3 billion HRK, or 43% of direct aid paid to agriculture in the same period.

The current trend in the number of forest fires shows that there were significantly more fires in the dry years in the Mediterranean area.

Croatia has been exposed to the negative effects of climate change for a long time resulting in significant economic losses. According to the European Environment Agency (EEA) report, Croatia belongs to a group of three countries, with the highest cumulative share of the damage from extreme weather and climate events in relation to the Gross Domestic Product (GDP). It is estimated that these losses, in the period from 1980 to 2013, amounted about 2,25 billion EUR or an average of 68 million EUR per year. These losses have increased significantly during 2014 and 2015 (to 2.83 billion EUR in 2015). Some economic sectors were significantly affected in that period. According to some estimates, between 2000 and 2007 extreme weather conditions caused damage to the agricultural sector of 173 million EUR, while the drought in 2003 caused damage of between 63 and 96 million EUR to the energy sector. It is also estimated that in August 2003 the mortality rate was 4% higher due to a heat waves.

2.7. Identification of key future climate hazards

Temperature-related - acute

Temperature-related - acute - Cold wave/frost, Temperature-related - acute - Heat wave, Temperature-related - acute - Wildfire

If other, please explain

-

Wind-related - acute

Wind-related - acute - Storms (including blizzards, dust and sandstorms)

If other, please explain

-

Water-related - acute

Water-related - acute - Drought, Water-related - acute - Heavy precipitation (rain hail snow/ice), Water-related - acute - Flood (coastal fluvial pluvial ground water), Water-related - acute - Heavy precipitation (rain hail snow/ice)

If other, please explain

-

Solid mass-related - acute

-

If other, please explain

-

Temperature-related - chronic

Temperature-related - chronic - Changing temperature (air freshwater marine water), Temperature-related - chronic - Temperature variability

If other, please explain

-

Wind-related - chronic

Wind-related - chronic - Changing wind patterns

If other, please explain

-

Water-related - chronic

Water-related - chronic - Changing precipitation patterns and types (rain hail snow/ice), Water-related - chronic - Precipitation and/or hydrological variability, Water-related - chronic - Saline intrusion, Water-related - chronic - Sea level rise

If other, please explain

Future changes in the Adriatic salinity and acidification is a topic of current research activities.

Solid mass-related - chronic

-

If other, please explain

-

Secondary effects of the selected hazards, such as forest fires, spread of invasive species and tropical diseases, cascading effects, and multiple hazards occurring at the same time

Annex I: Footnote5

Affected Sectors (10)

Title of the sector

Water management

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

high / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

The observed impacts that can lead to a high degree of vulnerability in the sector of hydrology, water and marine resources are:

- reduction of water levels in lakes and other lake-type natural or built-up systems
- salinization of coastal aquifers and aquatic systems
- increased frequency and intensity of flooding in vulnerable areas
- increasing the frequency and intensity of torrents
- increasing the frequency and intensity of rainwater flooding in urban areas
- risk of flooding at the mouths of watercourses due to sea level rise
- reduction of the efficiency of coastal infrastructure

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. Water management is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable

Describe your assessment

The main expected impacts that can lead to a high degree of vulnerability in the sector of hydrology, water and marine resources are:

- reduction of water levels in watercourses and in springs
- reduction of underground water resources and lowering groundwater levels
- reduction of water levels in lakes and other lake-type natural or built-up systems
- salinization of coastal aquifers and aquatic systems
- water temperature rise followed by reduction of reception capability of aquatic receivers
- increased frequency and intensity of flooding in vulnerable areas
- increasing the frequency and intensity of torrents
- increasing the frequency and intensity of rainwater flooding in urban areas
- risk of flooding at the mouths of watercourses due to sea level rise
- reduction of the efficiency of coastal infrastructure

Change of thermohaline features of the Adriatic Sea will increase the degree of vulnerability of the marine environment. The thinning of the Adriatic Sea's thermohaline circulation can significantly affect a variety of abiotic and biotic processes and changes, especially related to sea ventilation and change in oxygen concentration in deeper layers, increasing the acidity of the sea, as well as a series of related biological processes and impacts on marine biodiversity and fishery.

The projected increase in air temperature and stagnation in total precipitation rates will result in increased evapotranspiration, reduction of surface and underground runoff and, consequently, even more pronounced reduction in water resources. In such conditions, synergistic effects of negative impacts are expected due to an increase in anthropogenic pressures, above all expressed in the increased water demand.

Adverse climate change will be particularly jeopardized vulnerable coastal karst aquifers and other aquatic phenomena in coastal area (lakes, watercourses and springs) because of following cumulative effects:

- changes with reduced flows and groundwater levels
- more intensive sea penetration into the karst coastal aquifers and lakes
- spreading of salty seawater along the watercourse basins deeper into the hinterland

The results of climate modelling show that the intensity of short-term severe precipitation will increase in the future, of both rare and frequent possibilities of the phenomenon, creating preconditions for frequent occurrences of floods in flood watercourses, urban areas and river basins.

Particularly negative impacts of climate change are expected at watercourses in the coastal area due to the coinciding and cumulative effect of sea level rise and the occurrence of extreme flows. With the reduction of the mean annual and minimum annual flows and the increase of maximum annual flows, very pronounced changes in water temperatures are expected, which will have a negative effect on aquatic ecosystems, their diversity and reception capacity as well as the possibility of their use for other purposes. In such circumstances it is necessary to preserve good ecological and chemical status of all water bodies and to ensure a reduction of flood risk.

The expected rise in sea levels, but also the impact of future tides, waves and storms will have an impact on coastal infrastructure. The most vulnerable will be urban areas with low coastline (e.g. places on islands such as Cres, Mali and Veli Lošinj, Krk, Rab, Krapanj, Vela Luka and others, but also in coastal Croatia such as Nin, Trogir, Ston etc.). The particular negative impact of sea level rise is expected to be at sandy shores, which will be subject to increased erosion and other morphological change in terms of changing of their geometries, which can lead to their complete disappearance. However, in areas where this is possible, depending on the geomorphological features of the coast, urbanization of the area and so forth, the emergence of new sandy shores is expected. Negative changes are expected for the artificial parts of the coast, where built beaches will lose their functional optimums, and structural damage can occur.

Title of the sector

Agriculture and food

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

The main observed impacts of climate change that cause high vulnerability in the agricultural sector are:

- shortening of the vegetative period of corn with lower yields
- lower yields of all cultures and higher water demand
- more frequent flooding and stagnation of surface water will reduce or completely destroy yields

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The agricultural sector is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

high / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable

Describe your assessment

The main expected impacts of climate change that cause high vulnerability in the agricultural sector are:

- Shortening of the vegetative period of corn with lower yields
- Lower yields of all cultures and higher water demand
- A longer vegetation period will enable the cultivation of some new cultures and cultivars
- More frequent flooding and stagnation of surface water will reduce or completely destroy yields

According to some predictions, agriculture is the sector that will suffer the highest damage from the consequences of climate change. It is expected that, due to climate change, the yield of agricultural crops in Croatia will be reduced by 3 – 8% by 2050. Without increased investments, a satisfactory percentage of surfaces under irrigation and indoor production cannot be achieved, nor can the level of organic matter in the soil be significantly increased, which will result in a reduction in agricultural production compared to the existing situation.

It has been observed that climate change already affects the phenological phases of apple, grapevine, olive and corn, so that the vegetation period begins earlier, lasts less time, and ultimately yield drops. The lack of ground water (drought) and higher air temperatures in the upcoming period will be two key issues in the struggle of agriculture with climate change. At the same time, climate change will also have some positive effects in the agricultural sector, such as enabling the cultivation of some new crops and cultivars in areas where that has not been possible so far.

Title of the sector

Forestry

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

In the forestry sector, there are several major observed impacts that cause high vulnerability:

- Increased incidence of forest fires
- Decreased productivity of some forest ecosystems
- Migration of harmful organisms
- Damage to forest ecosystems due to the frequency of extreme weather events

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The forestry sector is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

In the forestry sector, there are several major expected impacts that cause high vulnerability. This is primarily related to a higher frequency and length of the forest fire season, including fires on the continent. The current trend in the number of forest fires shows that there were significantly more fires in the dry years in the Mediterranean area, while projections show that the risk of forest fires in the future will be higher for the entire country. Furthermore, the phenological phases of trees are expected to move in the sense of earlier start of vegetation and the extension of the vegetation season depending on species and habitats. Due to change in habitat conditions, migration of species and pests, including invasive species, could occur. The productivity of some forest ecosystems, such as oak-tree forests, could be reduced, although it should be emphasized that it depends not only on atmospheric change but also on the ways of management and other impacts. Due to the increased frequency of forest fires and the occurrence of strong winds, icing events that cause damage, floods, pest attacks and the like, higher damages to forest ecosystems are expected, such as a reduction in the value of wood varieties and the loss of generally beneficial forest functions.

Title of the sector

Fisheries and aquaculture

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

The major observed impacts on the marine ecosystem that is already under the influence of numerous anthropogenic factors, in particular overfishing, habitat destruction and pollution:

- Increase in the number of alien species and the influence on domestic species due to rising sea temperatures
- Decrease of primary production
- Weaker growth and higher mortality of shellfish

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

Taking into account climate change projections, it is very likely that key hazards will affect fisheries and aquaculture, which is elaborated in the National Adaptation Strategy.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The sector of fisheries and aquaculture is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

The major expected impacts of climate change in the fisheries sector will be additional pressure on the marine ecosystem that is already under the influence of numerous anthropogenic factors, in particular overfishing, habitat destruction and pollution.

The estimated increase in the Adriatic Sea's temperature by 1.6 to 2.4 °C by 2070 will result in the migration of fish (especially shrimp and hake) to deeper waters and towards the north, a higher number of invasive species and the reduction or disappearance of domestic species and change in choice of breeding species. Reducing of primary production is expected to result in the number of pelagic fish dropping due to changes in water circulation caused by thermohaline causes. Increasing temperatures and reduced fresh water quantities will limit the availability of water for freshwater aquaculture. The positive effects of rising water temperatures will be accelerated growth and shorter breeding cycle of fish. The acidity of the Adriatic Sea is estimated to increase by 0.1 to 0.2 degree of pH, which will prevent shellfish breeding in certain areas.

Future climate change will jeopardize the economic viability of fishing, especially coastal and demersal. In the cultivation of marine organisms, the impact will be twofold: positive for breeding tuna and sea bream, and negative for the cultivation of sea bass and oysters. The fisheries sector will be particularly vulnerable to global trends in supply and price of fish flour and fish oil as a result of climate change.

Title of the sector

Biodiversity

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

Biodiversity is currently largely endangered by unsustainable exploitation of natural resources and pollution. The most important climate impacts in this sector are:

- change in average air temperatures
- reduction and change in spatial distribution of precipitation
- increase of climate extremes
- sea level rise

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. Biodiversity is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

high / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

Biodiversity is currently largely endangered by unsustainable exploitation of natural resources and pollution. The most important climate impacts in this sector are:

- change in average air temperatures
- reduction and change in spatial distribution of precipitation
- increase of climate extremes
- sea level rise

Therefore, at the habitat level the following is expected:

- increase in arid areas
- reduction, change in share and disappearance of some habitats and species
- decline in biodiversity will contribute to appearance and spread of invasive alien species
- drying out of wetland habitats
- submersion of coastal habitats
- salinization of land and freshwater habitats by the sea

The main expected impacts that cause high vulnerability at the species level are:

- abortion of flowering of plant cryophyllofen and stenothemical species with shortening of vegetation and reduction of vigour
- damage to and extinction of populations due to climatic extremities (long-lasting droughts, excessive short time precipitation, stormy winds, excessive sunlight, etc.)
- spread of thermophilic species range (both positive and negative) due to an increase in average air temperature
- reduction of turgor and vigour, drying and extinction of hygrophilic species due to decrease in quantity and change of precipitation schedule
- spread of xerofiline species range (both positive and negative) due to decrease of quantity and change of precipitation schedule
- reducing populations of forest species due to frequent fires caused by increased average air temperature and reduced and unevenly distributed precipitation

- reduction and disappearance of freshwater species of the adriatic basin due to salinization of coastal habitats caused by sea level rise
- sea species spreading to the north and the appearance of thermophilic (tropical) alien invasive marine species due to rising sea temperature

---

Title of the sector

Energy

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

The main observed impacts that cause vulnerability in the energy sector are:

- Increase in the consumption of electricity for cooling purposes (higher number of cooling degree days) due to increased average air temperature
- Damage to power plants and infrastructure due to extreme weather events – ice breaking and floods

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The energy sector is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

The main expected impacts that cause vulnerability in the energy sector are:

- Decrease in the production of electricity in hydropower plants due to reduced precipitation by up to 10% in all seasons except winter and consequentially lowered flow rate, numerous dry periods and increased evapotranspiration
- Increase in the consumption of electricity for cooling purposes (higher number of cooling degree days) due to increased average air temperature
- Reduction of thermal energy production in thermal power plants due to increased average air temperature in the winter months
- Decrease in the production of electric and thermal energy in thermal power plants due to insufficient cooling of the plants due to flow reduction
- Damage to power plants and infrastructure due to extreme weather events – ice breaking and floods

Climate parameters directly affect the energy sector in the form of increased or reduced energy resource needs at certain periods. Climate extremes and natural disasters will significantly disrupt the safe supply of energy. The global rise of temperature in all seasons will increase the cooling energy consumption in the summer and reduce the energy needed for heating in winter. Extreme climate events will negatively affect the production, transmission and distribution of energy. Decreasing of precipitation in the summer period will lead to a reduction in the hydroelectric power plant contribution, while increasing the need for electricity in the summer months. By reducing the amount of precipitation, there will be a problem with the thermal power plant cooling flow system, which will also negatively affect the generation.

Title of the sector

Tourism

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

In the tourism sector, the main observed impacts of climate change are:

- The tourist offer is not tailored to projected climate change (high temperatures, increased solar irradiance, frequency of extreme weather events, etc.)
- High pressure on various infrastructure systems (water supply, drainage, beach infrastructure, horticulture etc.)

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

Taking into account climate change projections, it is very likely that key hazards will affect the tourism sector, which is elaborated in the National Adaptation Strategy.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The tourism sector is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

In the tourism sector, the main expected impacts of climate change are:

- The tourist offer is not tailored to projected climate change (high temperatures, increased solar irradiance, frequency of extreme weather events, etc.)
- Changing attractiveness of the coastal parts areas and inland areas of the Republic of Croatia
- Damage to and/or reduced functionality of various infrastructure systems (water supply, drainage, beach infrastructure, horticulture etc.)
- Deterioration of the status of ecosystems important for tourism and biodiversity due to the indirect and direct effects of climate change

---

Title of the sector

Health

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

-

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

Taking into account climate change projections, it is very likely that key hazards will affect the health sector, which is elaborated in the National Adaptation Strategy.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The health sector is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable

Describe your assessment

The main expected impacts that cause high vulnerability in the health sector due to increased frequency and duration of extreme weather conditions, as well as the impacts of other important climate parameters are:

- Increased mortality of the population
- Change in epidemiology of chronic non-infectious diseases
- Change in epidemiology of acute infectious diseases
- Reduced quality of outdoor and indoor air due to extremely high and low temperatures and precipitation
- More frequent and longer periods of unavailability of safe (health safe and compliant) water for human consumption
- Increased levels of contaminants in the environment
- Impact on epidemiology of diseases related to climatological factors

Vulnerability in the health sector is most likely to be manifested by an increase in the number of people with acute and chronic illnesses, i.e. increased mortality due to extended periods with high air temperatures; increased illness of vector diseases; increase in respiratory disease due to increased allergenic pollen in the air, etc.

Lower drinking water health safety for human consumption can be expected due to lower availability and increased utilization of resources. The impact of climate conditions is important due to indirect impacts on surface waters and water for recreation, especially in the case of improperly organized supply or drainage systems (waste and drainage water). The impact of seawater on health is significant not only because of the rise in sea temperature and, for example, the growth of toxic algal blooms, but also because of the eutrophication processes due to the large amount of organic matter that comes into the marine ecosystem with human activity.

Climate change will have a significant impact on food security, i.e. availability, distribution and consumption of food. The increase of the acute infections of the digestive system incidence may be expected. Increase in the share of chronic disorders such as endocrine diseases and digestive diseases such as cancer and chronic diseases like Crohn's disease, ulcerative colitis, etc. is also expected. The reduced level of food safety due to microbiological or chemical contamination, because of changed macroclimate and microclimate conditions, presents significant vulnerability and future burden on the health system.

Title of the sector

Spatial planning and development

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

Observed impacts are:

- Sea floods caused by rising sea levels
- Floods in settlements due to heavy precipitation
- Urban heat islands in settlements due to increased average temperatures in the summer months

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

Taking into account climate change projections, it is very likely that key hazards will affect spatial planning and development, which is elaborated in the National Adaptation Strategy.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The vulnerability of the sector to climate change impacts include:

- Flooding in settlements due to rise and extreme sea levels as a result of extreme weather conditions and general rise of the mean sea level (high vulnerability)
- Occurrence of heat islands in settlements due to the influence of extreme temperatures, in particular the increase of hot days and days with temperatures above 35 °c (medium vulnerability)
- Flooding in settlements as a consequence of the higher incidence and intensity of extreme weather conditions that characterize large amounts of precipitation in the short term (medium vulnerability)

Risk of potential future impacts

Annex I: 1.3c-iv

High / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

Spatial planning and development partially includes the management of the marine environment. The estimated average sea level rise at the Croatian coast range from 0,32 m to 1,1 m by year 2100. In combination with the effect of intermittent extreme sea levels ranging from 0,84 m to 1,15 m, the expected extreme intermittent sea levels at the end of the century is in the range of 1,4 m to 2,2 m.

Temperature rise is the most probable aspect of climate change, which among other things, is manifested by the growth of a number of days with a temperature higher than 35 °C. The largest increase, from 3 to 5 days by 2040, is expected in most of northern Croatia, in the part of the Northern Littoral and in the part of the Middle Dalmatia, where this increase is locally more than 100% compared to today's climate. In the period 2041-2070, a further increase of the same parameter is expected from 7 to 10 days in the same areas. Such extended periods of extreme temperatures influence the increased development of heat islands in urban environments. The projected change in the total amount of precipitation is different for different regions and different seasons. A slight increase is expected in the number of days with extreme precipitation in the fall and winter in the southern regions, particularly in the central and southern Adriatic. Larger quantities and irregular incidence of heavy precipitation affects the existing and planned infrastructure for collecting and draining of precipitation waters.

Title of the sector

Civil protection and emergency management

Observed impacts of key hazards, including changes in frequency and magnitude

Annex I: 1.3c-i

High / medium / low / mixed impacts for different hazards / not applicable

Describe your assessment

There is an observed increase in hazards caused by climate change, such as forest fires, droughts etc.

Likelihood of the occurrence of key hazards and exposure to them under future climate

Drawing upon the best available climate modelling science, Annex I: 1.3c-ii

High / medium / low / different likelihood of their occurrence and exposure for different key hazards and/or climate scenarios / not applicable

Describe your assessment

There are four biogeographic regions in Croatia that shape climate variability and therefore there is a different likelihood of occurrence of hazards and exposure to them under future climate.

Vulnerability, including adaptive capacity

Adaptive capacity is defined as 'The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences', Annex I: 1.3c-iii

High / medium / low / mixed situation for different key hazards / not applicable

Describe your assessment

The National Adaptation Strategy is based on an analysis of those sectors and cross-sectoral areas that are highly exposed to climate change and vulnerable and are of socio-economic importance for Croatia. The cross-sectoral area of civil protection and emergency management is highly vulnerable and has low adaptive capacity.

Risk of potential future impacts

Annex I: 1.3c-iv

high / medium / low / high / medium / low / different rating for different key hazards and/or under different climate scenarios / not applicable / not applicable

Describe your assessment

The main expected impacts that cause high or medium vulnerability in this sector are:

- Open-type fires due to extended periods of high solar irradiance and extended periods of high air temperatures
- Epidemics and pandemics due to the impact on the manner of transmission of diseases or the features of diseases caused by changing precipitation, humidity and evaporation rates
- Increased scope of community health and socioeconomic burden due to environmental contamination after risks such as flooding or landslides

3. Legal and policy frameworks and institutional arrangements

Legal and policy frameworks and regulations (max. 750 characters)

Annex I: 2.1

The Climate Change and Ozone Layer Protection Act (OG 127/19) is the basic legal act of the Republic of Croatia regulating the issue of adaptation to climate change. It defines the responsibilities, implementing document as well as the relevant sectors most exposed to climate change.

The responsibility for the climate change policy in Croatia falls within the competence of the Ministry of Economy and Sustainable Development. The implementing documents are National Adaptation Strategy, National Adaptation Plan and Programmes for Climate Change Mitigation and Adaptation and the Protection of the Ozone Layer at the local and regional level.

The Ministry of Economy and Sustainable Development is responsible for the development and implementation of the national adaptation documents in coordination with respective sectoral ministries and other state administration bodies in charge of meteorology, environmental protection, agriculture, fisheries, forestry, water management, energy, industry, transport, infrastructure, spatial planning, nature protection, marine resources, tourism and the protection of human health.

The Act also requires the alignment of all other development documents of individual sectors with the guidelines, basic goals, priorities and measures set out in the National Adaptation Strategy.

The Committee for Inter-Sectoral Coordination for Policies and Measures for Mitigation and Adaptation to Climate Change was established in September 2018 by the Croatian Government. Its task is to coordinate policy, monitor and evaluate implementation of policies and measures. It consists of two groups: coordination (minister and assistant ministers) and technical group (representatives from ministries, scientific institutions, academia and other dealing with climate change and adaptation issues). The new technical group has yet to be designated.

The Civil Protection System Act (OG 82/15, 118/18, 31/20 and 20/21) defines the protection and rescue tasks. One of the tasks is keeping the records for all sources of risk, identification of threats and assessment of the effects of all threats in the Croatian territory. The Republic of Croatia, as well as the local and regional authorities, has an obligation to prepare hazard assessments for all threats, including those caused by climate change and develop action plans.

The Water Act (OG 66/19) prescribes the obligation to consider climate change within the process of development of flood risk management plans and river basin management plan.

The Environmental Protection Act (OG 80/13, 153/13, 78/15, 12/18, 118/18) requires that regional and local authorities adopt Environmental Protection Programmes which partly consist of the Programmes for Climate Change Mitigation and Adaptation and the Protection of the Ozone Layer.

The Environmental Protection Act also prescribes the implementation of Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures. The Decree on the Strategic Environmental Impact Assessment of Plans and Programmes (OG 3/17) determines the ways of implementing Strategic Environmental Impact Assessment and prescribes the mandatory content which should, among other things, deal with probably significant impacts (secondary, cumulative, synergistic, short-term, medium-term and long-term, permanent and temporary, positive and negative) on the climate. It should also address the assessment of the impact of climate change in the area of the relevant strategic / planning / program document. This includes an assessment of vulnerability to climate change (analysis of the expected impact, risk and capacity to adapt the region or sector to the effects of climate change). On how to include climate change and biodiversity in SEA and EIA, the European Commission developed Guidelines in 2013, which were translated and distributed to environmental and nature protection experts and are published online.

3.1. National Adaptation Strategy (NAS) (1)

NAS title

Strategy for adaptation to climate change of the Republic of Croatia for the period to 2040 with a view to 2070 (National Adaptation Strategy, NAS)

NAS status

actual NAS – adopted

Year the NAS was adopted

2020

Period covered by the NAS

period to 2040 with a view to 2070

Link to the NAS

https://narodne-novine.nn.hr/clanci/sluzbeni/2020_04_46_921.html

3.2. National Adaptation Plan (NAP) (1)

NAP title

Action Plan for the Implementation of the NAS (National Adaptation Plan - NAP)

NAP status

being developed

Year the NAP was adopted

-

Period covered by the NAP

2021-2025

Link to the NAP

-

3.3. Overview of institutional arrangements and governance at the national level

Climate vulnerability and risk assessment (max. 1000 characters)

Annex I: 2.2a

A comprehensive assessment of climate impacts and vulnerabilities was carried out as part of the National Adaptation Strategy development process in May 2017, using the climate projections until 2040 and 2070. Eight key sectors and two cross-sectoral thematic areas have been selected for vulnerability analysis for which the climate impacts were described in the

framework of the National Adaptation Strategy drafting process: hydrology; water and marine resources; agriculture; forestry; fisheries; biodiversity; energy; tourism; health; spatial planning and coastal areas management; and disaster risk management.

The assessment was coordinated by the Ministry of Economy and Sustainable Development and was carried out by external experts in coordination with the relevant state administration bodies, institutes, scientists, local authorities and civil sector through workshops, meetings and public hearings.

The development of the Disaster Risk Assessment was coordinated by the Ministry of Interior and prepared by the Main Working Group of the Croatian Disaster Risk Reduction Platform, which consists of coordinators for priority risks and representatives of the following state bodies:

- State Geodetic Administration
- Meteorological and Hydrological Service
- Croatian Bureau of Statistics
- Hrvatske vode
- Ministry of Spatial Planning, Construction and State Property
- Ministry of Culture and Media
- Ministry of the Sea, Transport and Infrastructure
- Ministry of Maritime Affairs, Transport and Infrastructure
- Ministry of Agriculture
- Ministry of Interior
- Ministry of Economy and Sustainable Development
- Ministry of Health
- Seismological Service of the Republic of Croatia

Planning, implementation, monitoring, evaluation and revision of adaptation policy (max. 3000 characters)

Aspects to consider include decision making, planning and coordination related to adaptation strategies, policies, plans and goals, addressing cross-cutting issues, adjusting adaptation priorities and activities, implementing adaptation actions, including facilitating action to avert, minimise and address the adverse effect of climate change. Annex I: 2.2b

The National Adaptation Strategy will be implemented with National Adaptation Plans of a standard duration of five years. Bearing this in mind, the first National Adaptation Plan contains a priority set of measures and activities, with more details than in the National Adaptation Strategy. Along with a description of each measure and activity, the National Adaptation Plan will indicate the implementation bodies and partners and will contain the time-frame, costs and indicators.

Integration of climate change impacts and resilience into environmental assessment procedures (max. 750 characters)

Annex I: 2.2c

The Regulation on the Strategic Environmental Assessment of the Plan and Program (OG 3/17) prescribes the mandatory content, which should, among other things deal with probably significant impacts (secondary, cumulative, synergistic, short-term, medium-term and long-term, permanent and temporary, positive and negative) on the climate. In addition to the above, the strategic study should also address another aspect of climate change, i.e. it should also address the assessment of the impact of climate change in the area of the relevant strategic/planning/program document. This includes an assessment of vulnerability to climate change (analysis of the expected impact, risk and capacity to adapt a region or sector to the effects of climate change). In accordance with the Regulation on Environmental Impact Assessment (OG 61/14, 3/17), which prescribes the content of environmental protection studies in the process of assessing the need for environmental impact assessment of the project, the impact on climate change and adaptation to climate change needs to be taken into account.

In Croatia, there is the practice to include climate change and biodiversity in SEA and EIA process and Guidelines developed by the European Commission were translated and distributed to different experts. The guidelines were also published on the website of the Ministry of Economy and Sustainable Development and the Central Platform for Information and Education on Adaptation to Climate Change in Croatia.

The climate change projections as well as the climate change impact and vulnerability assessment for Croatia produced during the project for the development of the National Adaptation Strategy represent an important source and is the basic document for the preparation of strategic studies and environmental studies in SEA and EIA procedures.

Collection, ownership and re-use of relevant data and access to it (max. 750 characters)

Relevant data: such as climate-related disaster loss data or risk data. Annex I: 2.2d

An open access data repository of the climate projections has been established in 2017 within the development of the National Adaptation Strategy. The data are managed by the Croatian Meteorological and Hydrological Service and can be used by anybody free of charge. The link to the source is provided under section ‘Climate projections and services’.

The revised Disaster Risk Assessment for the Republic of Croatia was published in 2019 and can be found at the website of the Directorate of Civil Protection of the Ministry of the Interior.

Integration of climate change impacts and adaptation planning into disaster risk management frameworks and vice versa (max. 750 characters)

Including Article 6(1) of Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism (OJ L 347 I, 20.12.2013, p. 924). Annex I: 2.2e

There is mutual cooperation and understanding between the ministry responsible for climate change adaptation policy and the ministry responsible for risk management policy. Both policies need to function in a coordination and supportive way. A positive example of a multidisciplinary approach was the development of the Disaster Risk Assessment for the Republic of Croatia.

The Disaster risk management strategy under development will include the impacts and challenges of adaptation to climate change. Challenges and impacts are presented through a description of development needs and potentials by groups of threats, while measures and activities to achieve resilience are presented through strategic objectives, key areas of intervention and risk management action plans.

Since climate change can increase the likelihood of a catastrophe and increase its intensity, the National Adaptation Strategy developed a chapter on the disaster risk management. The main expected impacts causing high or medium vulnerability in this sector are explained under the 'Affected Sector - Civil protection and emergency management'.

3.4. Overview of institutional arrangements and governance at the sub-national level (where "sub-national" refers to local and regional)

Legal requirements and strategic documents

Annex I: 2.3a

According to the Environmental Protection Act and the Climate Change and Ozone Layer Protection Act, local and regional authorities have to develop Programmes for Climate Change Mitigation and Adaptation and the Protection of the Ozone Layer, which are a part of their Environmental Protection Programmes.

The programmes are adopted by the representative bodies of the counties, the City of Zagreb and large cities. Before the adoption, the ministry responsible for environmental protection has to give its consent to the programmes based on previously obtained opinions of ministries and other state bodies on issues within their competence.

Every four year, the local and regional authorities prepare a report on the state of the environment related to the implementation of the programmes, and submit it to the ministry responsible for environmental protection.

According to the Civil Protection System Act, the local and regional authorities have to prepare hazard assessments for all threats including those caused by climate change and develop action plans.

Networks or other collaborations on adaptation across national authorities

Annex I: 2.3b

The Committee for Inter-Sectoral Coordination for Policies and Measures for Mitigation and Adaptation to Climate Change was established in September 2018 by the Croatian Government. Its task is to coordinate policy, monitor and evaluate implementation of policies and measures. It consists of two groups: coordination (minister and assistant ministers) and technical group (representatives from ministries, scientific institutions, academia and other dealing with climate change and adaptation issues).

Good practice examples of networks or other collaborations on adaptation across local and regional authorities

Annex I: 2.3c

Within the HORIZON 2020 project 'Grow green - Green Cities for Climate and Water Resilience, Sustainable Economic Growth, Healthy Citizens and Environments' the city of Zadar is leading a national networks of seven cities. Partners of the project are planning following activities:
- Peer-to-peer internet exchange between GrowGreen cities and partner cities preparing or already implementing Nature Based Solutions Strategies in the fight against climate change
- Targeted support and education of cities for the development and implementation of their own city strategies
- Various activities organized as part of the GrowGreen Cities training programme, such as (online) presentations, webinars, workshops and trainings
- Exploring opportunities for joint collaborative projects on the development and implementation of nature-based solutions
- Partner cities will be invited to regular online conference calls with GrowGreen partners and experts to exchange ideas, learn together, ask questions and better understand common challenges and opportunities for nature-based solutions.

4. Adaptation strategies, policies, plans and goals

Adaptation priorities (max. 750 characters)

Annex I: 3.1

Priority 1. Ensuring sustainable regional and urban development

Adaptation to climate change, prevention and risk management is set as the backbone of future regional and urban development. Disaster prevention and management, as well as adaptation to climate change, is a response to local/regional issues that local/regional administrations need to deal with in order to reduce the potential disaster impact in their area. Natural disasters and climate change impacts can have a significant impact on the socioeconomic development and competitiveness of the individual Croatian regions as well as the entire country and have far-reaching cross-border implications. Investments in prevention and adaptation contribute to the preservation of existing assets and bring a high economic return, where cost of action is far lower than the cost of inaction. Therefore, it is important in the approach to solving and implementation of adaptation measures to identify local/regional measures that will best respond to the vulnerability of a given area. Cities and urban areas are particularly exposed to the influence of climate change (heat waves, extreme precipitation, floods). In this sense, adaptation to climate change and prevention and risk management become a priority when cohesion policy supports urban development projects. Cities and urban areas, especially in coastal areas along rivers and the sea, show vulnerabilities that are usually larger than in the surrounding areas (*e.g.* to floods, to effects of urban heat islands). Because of concentration of population and economic activities in cities, special attention is paid to investments in climate-resistant urban infrastructure and activities aimed at strengthening local level resilience to climate change.

Priority 2. Ensuring preconditions for the economic development of rural areas, coastal areas and islands

Adaptation of rural areas, coastal areas and islands to key climate challenges becomes a prerequisite for the survival of the economy and further economic development of these areas. The lack of moisture in the soil makes it difficult for the development and ripening of agricultural cultures, decreasing their yield, as well as cattle productivity. High air temperatures hinder or completely inhibit the development of agricultural crops and increase evapotranspiration. Long dry periods can completely destroy the harvest of agricultural crops. Existing research points to frequent lack of water in Croatian agricultural soils, and climate models suggest that this problem will become even more pronounced in the future. Spring frosts and thunder damage agricultural cultures and often destroy their crops, especially in fruit growing, vineyards and

vegetable growing. Many agricultural areas have poor soil permeability. With abundant rainfall on such soils, water saturation and surface water stagnation quickly endanger soil fertility and agricultural crops. Damages from sea level rise on the narrow coastline and low coasts of the Croatian Adriatic will be reduced by applying appropriate measures to plan new and remediate existing vulnerable parts of settlements and infrastructure. In coastal areas and islands preconditions must be met for fisheries and aquaculture based on the results of climate modelling that predicts sea temperature rise, resulting in the migration of cold-water species (shrimp, hake) to colder or deeper sea and in the increase in the number of foreign species and impacts on domestic species. Changes in water circulation due to thermohaline causes decrease primary production with the decrease of the number of pelagic fish, and due to increase of acidity of the sea there is less growth and greater mortality of shellfish.

Priority 3. Ensuring sustainable energy development

On the one hand reduction in the average annual precipitation rate reduces the production of electricity in hydropower plants and on the other hand poses a serious problem in ensuring efficient cooling of thermal power plants and thermal power plants – thermal plants (CTS – centralised / district heating systems). Due to the rise in outside temperature, there is also a reduction in the energy needs of buildings, which is the problem for the sustainability and profitability of existing centralised heating systems, if they are not technically prepared to extend services in terms of providing not only centralised heating services but also centralised cooling service of buildings. However, challenges in the energy sector need to be approached with extreme attention in order to ensure sustainable energy, both in terms of electricity production and heat, as well as their distribution and transmission. Also, ever more frequent damages to the power system and its facilities due to extreme weather events (ice and flooding) represent a major financial burden for all energy sector stakeholders, ending with citizens as end-consumers of heat and electricity who ultimately pay the final price of heat and electricity.

Priority 4. Strengthening of the management capacities through a networked monitoring and early warning system

Adapting to climate changes and preventing and managing risk is a horizontal theme, which means that a solid and efficient administration needs to be established to ensure the quality of investment. Responsibilities of the ministries, especially for aspects of cohesion policy, need to be clear and need to include regional and local authorities in the implementation. Namely, weak implementation and administrative capacities at the local and regional levels are the main obstacles to the successful implementation of the measures. Therefore, it is necessary to plan investment in training and capacity-building and adaptation-based expertise, especially for those local units that are most vulnerable to climate change.

Priority 5. Ensuring continuity of research activities

The main obstacle to successful adaptation to climate change is the lack of knowledge to plan adaptation measures in all sectors. Key support for tackling climate change vulnerability concerns the building of a knowledge base and data-monitoring and data-processing capacity, information exchange mechanisms and local and sector-specific action plans for adapting to climate change, risk prevention and management plans at national, regional and local level. The development of the necessary ICT tools (geographic information systems - GIS, detection and monitoring systems, early warning system, risk mapping and assessment) is a necessity and is crucial to their development.

Challenges, gaps and barriers to adaptation

Including those institutional, governance-related and other barriers that restrict the adaptive capacity as identified in the vulnerability assessment. Annex I: 3.2

The National Adaptation Strategy hat identified key measures, which are based on the identified challenges and barriers, such as shortcomings in technology transfer, vulnerability identification and implementation of adaptation measures, capacities and competences of stakeholders.

Therefore, the National Adaptation Strategy apostrophes following measures with high priority:

- KM-01 Strengthening human and technical capacities for implementing research and applied activities in the area of climate modelling, analysis, and interpretation of observed and expected climatic changes
- OM-01 Increase of knowledge and capacity for impact monitoring, risk assessment and adaptation.

Summaries of national strategies, policies, plans and efforts, with a focus on goals and objectives, foreseen actions, budget and timeline

Including nature-based solutions and actions leading to mitigation co-benefits and other relevant co-benefits. The summaries shall cover also efforts to build resilience and avert, minimise and address the adverse consequences of climate change, and include an explanation how gender perspectives have been taken into account. Annex I: 3.3

Adaptation measures from the National Adaptation Strategy by sector:

1. Water management

- HM-01 Implementation of non-structural measures for protection against the harmful effects of water in case of occurrence of extreme hydrological conditions whose increase in intensity and frequency of occurrence is conditioned by climate change

- HM-02 Strengthening the capacity to build, reconstruct and upgrade the system for protection against harmful effects of water and related multi-purpose hydro-technical systems (structural measures) and lowland natural floodplains flooded in a controlled fashion
- HM-03 Strengthening research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water system in current and future climatic conditions
- HM-04 Strengthening the management capacities of responsible institutions to act on the occurrence of extreme hydrological conditions
- HM-05 Strengthening the capacities for effects of the sea on the coastal water-communal infrastructure and coastal water resources in conditions of sea level rise caused by climate change (non-structural measures)
- HM-06 Strengthening urban areas' resilience to anthropogenic pressures conditioned by climate change
- HM-07 Strengthening the capacity for exploration and sustainable management of groundwater
- HM-08 Strengthening the resilience of coastal water utility infrastructure and coastal water resources (structural measures)
- HM-09 Capacity building for the protection of aquatic ecosystems
- HM-10 Inventory of water sources outside the public water supply

2. Agriculture

- P-01 Implementation of an experimental-research climate change adaptation programme in agriculture
- P-02 Increasing the water absorption capacity of agricultural soil
- P-03 Application of conservation soil treatment
- P-04 Breeding of species and cultivars of agricultural crops and breeds of domestic animals that are more resilient to climate change
- P-05 Integration of climate change risks into the development of irrigation systems
- P-06 Application of anti-erosion measures
- P-07 Reconstruction and construction of drainage systems
- P-08 Insurance of agricultural production from production losses caused by adverse climatic conditions

3. Forestry

- ŠU-01 Incorporation of adaptation measures into forestry legislation and management plans or other instruments
- ŠU-02 Research on vulnerability and resilience of forests to climate change
- ŠU-03 Capacity building for the monitoring of forest ecosystems
- ŠU-04 Capacity building for fire protection
- ŠU-05 Implementation of the green infrastructure concept
- ŠU-06 Prediction (forecast) of change in the distribution of harmful organisms

- ŠU-07 Afforestation
- ŠU-08 Awareness raising on climate change impacts and adaptation in the forestry sector
- ŠU-09 Awareness raising of private forest owners on sustainable forest management
- ŠU-10 Risk assessment and development of tools for the reduction of risk of natural disasters in agricultural and forest sector
- ŠU-11 Analysis of adaptation measures for large game
- ŠU-12 Analysis of most vulnerable forest areas and communities and development of adaptation measures

4. Fisheries and aquaculture

- RR-01 Development of new markets and products
- RR-02 Capacity building for climate change impact and vulnerability analysis
- RR-03 Strengthening the resilience of natural resources through adaptive fisheries management
- RR-04 Increasing the involvement of fishermen in the tourism sector
- RR-05 Strengthening capacities in the sector of aquaculture by the increase of breeding of organisms at lower trophic levels and new forms of breeding
- RR-06 Strengthening capacity in the sector of aquaculture through breeding in recirculating aquaculture systems
- RR-07 Strengthening aquaculture capacity by breeding new species of fish
- RR-08 Popularization of new fish species for human consumption
- RR-09 Strengthening aquaculture capacities by selective breeding
- RR-10 Strengthening aquaculture capacities by adapting the quantity and quality of food to changed climate conditions

5. Biodiversity

- B-01 Improvement of knowledge and creation of databases for present and future vulnerability assessment of ecosystems, habitats and species, protected areas and Natura 2000 sites
- B-02 Establishment of a climate monitoring and early warning system for protected areas and Natura 2000 sites and monitoring of ecosystems, habitats and species
- B-03 Development and implementation of measure for building resilience of vulnerable ecosystems, habitats and species
- B-04 Integrated management of freshwater, marine and land resources for the conservation and revitalization of natural ecosystems and biodiversity
- B-05 Integrating knowledge about the effects of climate change into a system of nature protection
- B-06 Preservation of traditional agriculture practices in natural ecosystems

- B-07 Improving sustainable management and infrastructure in natural ecosystems
- B-08 Strengthening the human and financial capacities of the nature protection system

- B-09 Knowledge transfer on the importance of ecosystems, habitats, species, protected areas and Natura 2000 sites as well as the importance of ecosystem services for climate change adaptation

6. Energy

- E-01 Strengthening the resilience of production facilities through the storage of electrical energy
- E-02 Strengthening the capacities and ensuring of an incentivizing legal framework to increase the capacity of renewable energy and distributed sources
- E-03 Strengthening the resilience of existing capacities for electricity and heat production
- E-04 Capacity building for monitoring and fast response to negative climate impact on the electrical energy system
- E-05 Strengthening the resilience of the electrical energy system
- E-06 Strengthening the resilience of the distribution network
- E-07 Strengthening the resilience of the transmission network

7. Tourism

- T-01 Integration of climate change into the tourism development strategy
- T-02 Raising awareness of relevant stakeholders on climate change impacts, risks and adaptation options
- T-03 Strengthening the competencies of high school and university students
- T-04 Strengthening the resilience of tourism infrastructure to different weather extremes
- T-05 Strengthening the resilience of local communities in the tourism sector

8. Health

- ZD-01 Establishment of a system for calculating health-economic indicators for conditions related to climate change
- ZD-02 Development of a climate change impact monitoring system in the healthcare sector
- ZD-03 Establishment of a human biomonitoring framework for tracking environmental factors related to climate change
- ZD-04 Implementation of climate change impact and risk assessments in the healthcare sector
- ZD-05 Connecting and upgrading the monitoring systems of environmental indicators related to climate change
- ZD-06 Increasing the number of secure places for extreme weather events
- ZD-07 Strengthening the monitoring system of species that cause allergies
- ZD-08 Raising awareness of the public and key stakeholders within healthcare system
- ZD-09 Integration of climate change subject into the national school curriculum

9. Spatial planning and development

- PP-01 Improvement of knowledge and creation of databases for monitoring and evaluation
- PP-02 Capacity building in the spatial planning system
- PP-03 Integration of adaptation measures into the spatial planning system
- PP-04 Raising awareness of the public and decision-makers at all levels
- PP-05 Preparation of programmes and renovation projects

10. Risk management

- UR-01 Expansion of the Croatian Platform for Disaster Risk Reduction to include climate-change-related indicators for the development of an early warning system
- UR-02 Multi-sectoral risk assessment for various threat/risk scenarios associated with climate change
- UR-03 Capacity building for risk prevention and response during disasters and major accidents related to climate change
- UR-04 Development of a unified inter-sectoral database of risks, measures, damages and losses
- UR-05 Expanding capacities and models for coverage of risk related to climate change and catastrophic damages

11. General measures

- KM-01 Strengthening human and technical capacities for implementing research and applied activities in the area of climate modelling, analysis, and interpretation of observed and expected climatic changes
- OM-01 Increase of knowledge and capacity for impact monitoring, risk assessment and adaptation
- RP-01 Development of impact indicators for the National Adaptation Strategy

Additional document on the actions and (programmes of) measures reported

-

Overview of the content of sub-national strategies, policies, plans and efforts

Annex I: 3.4

Counties and large cities have a legal obligation to draft planning documents with priority measures for mitigation, adaptation and protection of ozone layer relevant for their area of governance. They are obliged to submit report on the measures taken every two years to the Ministry responsible for national reporting. More specifically, they are required to develop Programmes for Climate Change Mitigation and Adaptation and the Protection of the Ozone

Layer as a part of the Environmental Protection Programmes, which includes following information:

- conditions and measures
- entities that are obliged to implement the measures
- monitoring
- type of intervention in case of environmental pollution,
- deadlines for the implementation,
- sources of financing for the implementation of the identified measures and assessment of the required funds.

Overview of efforts to integrate climate change adaptation into sectoral policies, plans and programs, including disaster risk management strategies and action plans

Annex I: 3.5

The National Adaptation Strategy has been developed in synergy with the Sustainable Development Strategy of the Republic of Croatia and with all relevant sectoral strategies that have been adopted or were in the process of adoption in that period. These strategies address, to a lesser or greater extent, climate change issues, and some of them propose appropriate measures (for example: the Strategy for Maritime Development and Integral Maritime Policy of the Republic of Croatia for the period 2014-2020, the Transport Development Strategy of the Republic of Croatia, the Spatial Development Strategy of the Republic of Croatia, the Draft Management Strategy for the Marine Environment and Coastal Region of the Republic of Croatia). The National Adaptation Strategy tried to avoid measures mentioned in other strategies that contribute to adaptation. For example, it does not propose measures for the marine environment and its ecosystem, as this is already covered by the Draft Management Strategy for the Marine Environment and Coastal Region of the Republic of Croatia.

As the National Adaptation Strategy has a cross-sectoral character, the Climate Change and Ozone Layer Protection Act prescribes alignment of all development strategies with the National Adaptation Strategy to ensure compliance with existing adaptation measures.

In accordance with the Regulation on Environmental Impact Assessment (OG 61/14, 3/17), environmental studies need to include following chapters:
- Projections of climate change in the wider area of the project
- Climate change with the information on the impact of the intervention on climate change and on the impact of climate change on the project.

If significant negative impacts are identified, measures to mitigate and adapt to climate change should be envisaged.

The Disaster Risk Assessment for the Republic of Croatia adopted in 2015 was revised and the updated version was published in 2019. Three questions were addressed within the risk assessment:
1) How does climate change affect risks?
2) What is the expected timeframe for the effects of climate change?
3) What are the reference documents supporting the conclusion?

Eleven risks have been processed (earthquake, flood, plant diseases, animal diseases, soil salinization, drought, industrial accidents, open space fires, extreme temperatures, snow and ice, and epidemics and pandemics), nine of which are related to climate change. Climate change was treated as a driver for events (such as drought, extreme temperatures, extreme precipitations, soil salinization and floods) and was, therefore, an important factor in the risk analysis, as it affects either the intensity or frequency of the event. In addition to the analysis of threats, the analysis of vulnerability of society to disasters is included.

For the development of the Disaster Risk Assessment, the risks were identified and divided into groups. Each group of risks was delegated to a coordinator, a ministry or other state body. For the overall coordination, the Croatian Disaster Risk Reduction Platform has been established, and its main working group is participating in the development of the National Disaster Risk Reduction Strategy. The Directorate of Civil Protection of the Ministry of the Interior coordinates its work.

Local and regional authorities have established the Disaster Risk Reduction Platform of Croatian Counties and Cities. Given the small number of active members, the Platform has yet to develop its full potential in the field of risk management.

Overview of measures in adaptation policy at the national level and good practice examples from the sub-national levels to engage with stakeholders particularly vulnerable to climate change impacts

Annex I: 3.6a

The Ministry of Economy and Sustainable Development has a Plan for awareness raising on resilience and adaptation to climate change at national and local levels. The implementation of the plan started through the development of the website https://prilagodba-klimi.hr/ - the central platform for information and education on adaptation to climate change in Croatia. The website provides information on the implementation of adaptation in Croatia, gives information about climate change impacts in Croatia, vulnerable sectors and planned measures, good

practices relevant to Croatia as well as an overview or the legislation and guidelines for stakeholders involved in climate change adaptation.

Overview of measures in adaptation policy at the national level and good practice examples from the sub-national levels to engage with the private sector

Member States shall provide an overview of available information on private sector plans, priorities, actions and programmes, public/private partnerships, and other relevant private adaptation initiatives and/or projects. Annex I: 3.6b

The International Institute for Climate Action (IICA) has been established. It is an association of experts in the field of Climate Change and Policy. The purpose of the institute is to assist the business community in the fight against climate change by reducing CO2 emissions, introducing the Low Carbon Strategy, the Adaptation Strategy and the European Green Plan into their business plans and processes.

5. Monitoring, reporting and evaluation of adaptation actions and processes

Monitoring, reporting and evaluation (MRE) methodology related to reducing climate impacts, vulnerabilities, risks, and increasing adaptive capacity

Member States shall report on approaches, systems used, transparency and indicators. Annex I: 4.1a

According to the Climate Change and Ozone Layer Protection Act, reports on implementation of adaptation measures are to be submitted to the European Commission in line with the EU Regulation No. 2018/1999. For this purpose central, regional and national authorities as well as other public authorities competent for climate adaptation issues (related to meteorology, environmental protection, agriculture, fishery, forestry, water management, energy, protection of human health etc.) have an obligation to submit reports to the ministry responsible for environmental protection on their activities related to adaptation to climate change.

The National Adaptation Strategy proposes impact indicators for different sectors. Some of these indicators are already monitored or partially monitored, but most of them are not systematically monitored and the methodology will have to be developed. The methodology will be developed through the National Adaptation Plan measure 'Development of impact indicators of the implementation of the adaptation strategy for vulnerable sectors and society'.

MRE methodology related to the implementation of adaptation actions

Member States shall report on approaches, systems used, transparency and indicators. Annex I: 4.1b

Indicators for the monitoring of the implementation of measures and activities of the National Adaptation Strategy will provide answers to the following questions:

- Are the measures and activities being implemented?
- Are there any improvements possible to the climate change adaptation measures and activities?
- Which of the measures are not achieving the expected effects?

State of play of the implementation of measures planned under 'Strategies and Plans', including an overview of the subnational level and the disbursement of funding to increase climate resilience

Annex I: 4.2

The first National Adaptation Plan is being developed and will include the implementation bodies and partners of the measures, timeframe, costs and indicators. However, many adaptation measures are already being implemented through sectoral action plans and activities under local and regional jurisdiction, but are not yet systematically being addressed or monitored as such. With the in 2019 adopted Climate Change and Ozone Layer Protection Act all new sectoral development documents as well as new local and regional environmental protection programmes will be aligned with the National Adaptation Strategy.

State of play of the implementation of measures planned under 'Strategies and Plans': spending earmarked for climate adaptation including in disaster risk management

Annex I: 4.2a

New sectoral strategies and plans are under development.

To the extent possible, state of play of the implementation of measures planned under 'Strategies and Plans': the share of spending used to support climate adaptation in each sector

Share of spending used to support climate adaptation as the additional investment that makes a project (that would have been realised anyway) climate resilient. Annex I: 4.2b

Activities for adaptation to climate change are defined and financed within the framework of the Operational Programme Competitiveness and Cohesion for the EU financial period 2014 – 2020 under the thematic objective 5: 'Promoting climate change adaptation, risk prevention and management'. The funds are used in accordance with the objectives and priorities identified within the framework of the National Adaptation Strategy as well as the framework and preconditions for the adaptation activities determined in accordance with the 6th and 7th National Communications to the UNFCCC. In addition, the Operational programme (under the same thematic objective) provides funding of activities related to the disaster risk management in accordance with the Disaster Risk Assessment for the Republic of Croatia.

In addition to that, certain activities relevant for adaptation to climate change are financed within the framework of the Rural Development Programme for the EU financial period 2014 - 2020 under the following measures:

- M08 - Investments in forest area development and improvement of the viability of forests
- M10 - Agri-environment-climate
- M11 - Organic farming

The funds from Croatia's emission trading have been partially used for the financing of climate change adaptation activities:

- Applied research and development related to climate change adaptation
- Co-financing of the national component within accepted EU projects (e.g. LIFE, Horizon 2020 etc.)
- Co-financing of adaptation priority measures in vulnerable sectors

The funds were allocated by the Ministry of Economy and Sustainable Development through the Plan for the Use of Financial Resources from the Sale of Emission Units by Auction in the Republic of Croatia by 2020 (OG 19/2018, 88/2019) and managed by the Environmental Protection and Energy Efficiency Fund.

Progress towards reducing climate impacts, vulnerabilities and risks

Based on the MRE methodology reported above. Annex I: 4.3a

MRE methodology will be developed with the implementation of the National Adaptation Plan.

Progress towards increasing adaptive capacity

Based on the MRE methodology reported above. Annex I: 4.3b

MRE methodology will be developed with the implementation of the National Adaptation Plan.

Progress towards meeting adaptation priorities

Based on the MRE methodology reported above. Annex I: 4.3c

MRE methodology will be developed with the implementation of the National Adaptation Plan.

Progress towards addressing barriers to adaptation

Based on the MRE methodology reported above. Annex I: 4.3d

MRE methodology will be developed with the implementation of the National Adaptation Plan.

Steps taken to review and update vulnerability and risk assessments

Annex I: 4.4a

The vulnerability and risk assessments for the National Adaptation Strategy has not yet been reviewed and updated.

Steps taken to review and update national adaptation policies, strategies, plans, and measures

Annex I: 4.4b

The National Adaptation Strategy is adopted in 2020 and will be evaluated and updated every five years if needed. The first evaluation and possible revision of the National Adaptation Strategy will be at the earliest after the end of the implementation period of the first National Adaptation Plan. Revision of the NAS will depend on the information that will be collected by the implementation monitoring system as well as the climate change monitoring system in general.

Overview of good practice with regard to steps taken to review and update subnational adaptation plans, policies, strategies and measures

Annex I: 4.5

Subnational adaptation plans, policies, strategies and measures have not yet been reviewed and updated.

6. Cooperation, good practices, synergies, experience and lessons learned in the field of adaptation

Synergies of adaptation actions with other international frameworks and/or conventions

In particular the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction, Annex I: 5.2

Transboundary cooperation in terms of climate adaptation is present in the context of international river commissions for Sava and Danube Rivers, especially on floods (ISRBC and ICPDR).

The Water and Climate Adaptation Plan for the Sava River Basin was developed by the International Sava River Basin Commission (ISRBC) in 2015, as a guidance document for adaptation measures in navigation, hydropower, agriculture, flood protection, economic evaluation of climate impacts and is covering five countries (Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro). Establishment of a joint Flood Forecasting and Warning System in the Sava River Basin and the preparation of the Flood Risk Management Plan in the Sava River Basin are components of the project Improvement of Joint Actions in Flood Management in the Sava River Basin. The Outline of the Climate Adaptation Strategy was prepared in January 2018 for ISRBC as a step towards the full Sava adaptation strategy to climate change.

Croatia also takes part in the implementation of the two macro-regional strategies (EU Strategy for the Adriatic and Ionian Region, EUSAIR; and EU Strategy for the Danube Region, EUSDR). It is participating in regional cooperation projects to address various climate-related challenges shared in the region, through research, knowledge transfer, capacity building and awareness activities, such as DriDanube – Drought Risk in the Danube Region project.

Cooperation with Union Member States, international cooperation, and with regional and international organisations to share information and to strengthen science, institutions and adaptation knowledge

Excluding information on support to developing countries referred to in Part 2 of Annex VIII of Regulation (EU) 2018/1999. Annex I: 5.3a

Relevant scientific institutes participate in numerous EU projects financed by the HORIZON 2020, Programme LIFE, INTERREG etc.

The Ministry responsible for climate action has created the 'Central Platform for Information and Education on Adaptation to Climate Change in Croatia' with the intention to give an overview on all projects related to adaptation in Croatia.

For example, the Institute for Oceanography and Fisheries carries out the monitoring of the marine environment and atmospheric-oceanographic modelling, including ecological modelling, and contributes to the gathering of knowledge on climate change impacts on marine ecosystems through cooperation at the national and international level. The institute participates in several transboundary projects such as RESPONSe, Chenge We Care, ECOSS and AdriaClim funded by the Interreg Italy-Croatia Cooperation Programme that are dedicated to supporting the development of regional and local climate change adaptation plans based on modern meteorological and oceanographic information obtained from the newly implemented Adriatic Sea Observation and Modelling System. The projects will gather new knowledge about the connection of the atmosphere-sea-biodiversity system and contribute to the development of science-based adaptation measures.

Another example are activates of the Faculty of Agriculture of the University of Zagreb in several European and international networks which contribute to adaptation:

1. ICA Regional Network for Central and South Eastern Europe (CASEE) is a network of Central and South Eastern European Higher Education Institutions relating to the Life Science disciplines (agriculture, food, biotechnology, natural resources, rural development and the environment). The objectives of network are to support the implementation of the EU Strategy for the Danube region, strengthen research, education and University Development in this region and develop joint research, educational and other projects.

2. OENOVITI International Network is an international network in oenology and viticulture. The goals of the network are to establish common standards of education and practice in oenology and viticulture through innovative approach based on mobility and exchange of experiences.

3. Balkan Environmental Association (B.NE.A) is an international non-governmental scientific organization with more than 4.000 members tasked with preserving the environment and culture of Balkan countries. Its aim is identify problems in environmental protection and develop cooperation and exchange of information on national, regional and international levels.

4. Visegrad University Association (VUA) was established within a strategic project 'Sustainability in Agrisector of V4 Countries and Cooperating Regions' that Slovak University of Agriculture is coordinating with the support of the International Visegrad Fund. The main aim of the association is to link partner universities in order to provide quality education and scientific environment and to promote development of closer cooperation among the Visegrad group as

well as cooperating regions respecting the neighbouring countries policy of the International Visegrad Fund in the field related to all aspects of sustainability.

Cooperation with Union Member States, international cooperation, and with regional and international organisations to enhance adaptation action at the sub-national, national, macro-regional and international level

Including the area, scale and types of cooperation. Excluding information on support to developing countries referred to in Part 2 of Annex VIII of Regulation (EU) 2018/1999. Annex I: 5.3b

At regional and local level, adaptation is addressed through participation in European projects and initiatives, such as the Covenant of Mayors for Climate and Energy, in which 20 Croatian towns and municipalities are signatories with adaptation commitments (Buzet, Čakovec, Karlovac, Kastav, Koprivnica, Križevci, Labin, Ludbreg, Novigrad, Pazin, Poreč, Prelog, Pula, Rijeka, Rovinj, Sveta Nedjelja, Varaždin, Velika Gorica, Zadar and Zagreb).

The Interreg project ADRIADAPT is building a resilience information platform for Adriatic cities and towns to improve the climate change monitoring and planning of adaptation measures tackling specific effects, in the cooperation area.

7. Any other information related to climate change impacts and adaptation

7.1. Key contact details of national coordinator and organisation (1)

Organisation

Annex I: 6.1

Ministry of Economy and Sustainable Development

Department within the organisation

Service for General Climate Protection Policy

Role of the organisation

Coordination of adaptation policies and reporting

Contact person

-

Role of the contact person

-

Email address

prilagodba@mingor.hr

Website

https://mingor.gov.hr/

7.2. Adaptation portals and platforms (1)

Name

Name of the climate, hazards, vulnerability, impact or adaptation portal or platform

Central Platform for Information and Education on Adaptation to Climate Change in Croatia

Status

Established

Focus of the portal or platform

Climate change adaptation (measures and solutions), Climate change hazards; impact and/or vulnerability

Weblink

https://prilagodba-klimi.hr/

Any other relevant information

Annex I: 6.4

Croatian institutions that maintain the observation systems in the climate segments of atmosphere, sea, land and biodiversity are:

1. Croatian Meteorological and Hydrological Service
2. Institute for Medical Research
3. Public Health Institute
4. Institute for Oceanography and Fisheries
5. Croatian Hydrographic Institute - sea level monitoring along the eastern Adriatic coast
6. "Ruđer Bošković" Institute
7. Faculty of Science, University of Zagreb
8. Croatian Forest Research Institute
9. Croatian Geological Survey
10. Hrvatske vode - monitoring of water quantity and quality

Apart from the listed institutions, numerous institutions and sectors of economy run their own systematic or sporadic observations.

Additional document

-