AdriaClim

Climate change information, monitoring and management tools for adaptation strategies in Adriatic coastal areas

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Chapter 1 - Introduction

According to the definition of the European Environment Agency, “adaptation means anticipating the adverse effects of climate change and taking appropriate measures to prevent or minimize the damage they may cause or exploit the opportunities they may present”. Since climate change manifest its effects in different ways depending on the environmental, social and economic peculiarities of the territories, it is essential to plan adaptation on a regional scale.

The Regional Plan for Adaptation to Climate Change (Piano Regionale di Adattamento ai Cambiamenti Climatici - PRACC) is one of the actions identified in the Regional Sustainable Development Strategy (SRSvS) and was developed through the AdriaClim research project, funded by the Cross-border Cooperation Program of the European Union Interreg Italy-Croatia , and by the agreements between the Ministry of the Environment and Energy Security - MASE and the Marche Region relating to the collaboration aimed at implementing the Regional Strategies for Sustainable Development.

The PRACC is a mainstreaming plan that provides the tools for adaptation to climate change to be included in policies, strategies and plans/programmes in an integrated way, according to a horizontal process, between the structures of the Marche Region, and vertically, between subordinate entities.

The method adopted for the definition of the PRACC is characterized by the following elements:

• An operational technical guide hinged on the VAA and FRC sectors with the function of coordinating the transversal working group and defining the PRACC;

• Scientific approach developed with the contribution of the ATI established by the CIMA Foundation (agent), Eurac Research and the Marche Polytechnic University and by the partners of the AdriaClim project (CMCC Foundation, CNR-ISMAR, ARPA Emilia-Romagna, Emilia-Romagna Region);

• Participation process that involved the main stakeholders and citizens of the Marches externally and various structures internally within the Region.

The Governance

The definition of the PRACC represented a collective process, made possible thanks to the identification of a multi-sector governance capable of combining all the dimensions involved in climate change. The PRACC, being the implementation of the Regional Strategy for Sustainable Development, is governed by a «control room», made up of the top managers of the regional departments. The control room makes use of an intermediate level formed by the contacts

identified by the Department Directors who follow the implementation of the policies relating to sustainable development and who collaborate in the definition of the PRACC.

Chapter 2 - Structure of the Plan

The regional climate change adaptation plan of the Marche Region is organized into a main text and a series of in-depth appendices.

Chapter 2 presents a synthetic picture with respect to the climatic context of the Region. The methodological insights on methods and models and the detailed description of the individual climate indicators are reported in Appendix A.

Chapter 3 presents a summary description of the main factors and resources (territorial, environmental, social, economic, etc.) which may be affected by the ongoing climate change. The description of the indicators used for the analysis of factors and resources is given in Appendix B.

Chapter 4 summarizes the vulnerabilities to climate change of some factors and resources considered and identifies the critical elements and key risks. The complete results of the analysis are reported in Appendix C, while Appendix D describes the adaptation capacity already present in the Marche Region.

Chapter 5 identifies the objectives and lines of action of the plan, summarized in Appendix E, which also contains a first proposal of the process indicators of the plan.

Chapter 6 reports the main elements of the integrated PRAC-SEA monitoring, which will be developed in the "Monitoring Programme".

Appendix F contains the Environmental Report (Appendix F.1) relating to the Strategic Environmental Assessment (SEA) procedure, the non-technical summary with the main contents of the Environmental Report (Appendix F.2) and the impact assessment screening (Appendix F.3).

Chapter 3 - The climate change adaptation stategy

Adaptation objectives

The main objective of the PRAAC is to put in place measures and actions aimed at strengthening regional adaptive capacity. As highlighted in the previous chapters, climate change acts in a cross-cutting manner on various environmental, social and economic aspects. Therefore, the Plan will

necessarily have to act in a cross-cutting and cross-sectoral manner. Accordingly, the overall goal is articulated through the following objectives: definire una governance regionale per l'adattamento, esplicitando le esigenze di coordinamento tra i diversi livelli di governo del territorio e i diversi settori di intervento;

• Improve and systematize the knowledge base on climate change, both in terms of climate data and scenarios and in terms of vulnerability, so as to provide an effective framework for responses;

• Integrate climate change adaptation into sectoral policies, at regional and local levels.

These general objectives are then articulated into specific objectives that are derived from the analyses of climate change vulnerability and risks for the Marche region.The objectives are implemented through lines of action, which contain measures.The objectives and lines of action of the Plan, are summarized in Adaptation section of the technical appendix, which also identifies the correlation with the actions of the Regional Sustainable Development Strategy.

Lines of action

The Plan's actions have been divided into two categories, according to the type of goals to which they contribute to:

1. Cross-cutting adaptation actions.

2. Adaptation actions for specific vulnerabilities

The cross-cutting adaptation actions are actions that by their very nature affect multiple adaptation sectors. Cross-cutting actions refer directly to the sustainability vectors identified in the Regional Sustainable Development Strategy.

Adaptation actions for specific vulnerabilities, on the other hand, refer to individual issues (environmental resources, economic or social factors, etc.) and contribute to the achievement of specific adaptation goals.

The lines of action are divided into measures, which can be cross-cutting or refer to specific vulnerabilities. Measures are divided into two types, which refer to the ways and means of implementation: the Plan's own measures and sectoral measures.

The Plan's own measures are steering and monitoring actions closely related to the issue of climate change. In some cases, the Plan's own measures are cross-cutting in nature; in other cases, they may refer to a specific vulnerability, but one that is addressed with tools that do not belong to a specific sector.

Sectoral measures are those that act within the planning, regulatory, management or normative instruments of the sector under investigation.

Cross-cutting measures

Climate change is by its very nature a cross-cutting phenomenon; therefore, adaptation policies require a cross-cutting approach alongside a more specific and sectoral one. The definition of cross-cutting adaptation measures follows the logic of "sustainability vectors" in the Strategia Regionale di Sviluppo Sostenibile. Sustainability vectors are cross-cutting areas of action indicated by the National Sustainable Development Strategy, to be considered as key levers to initiate, guide, manage and monitor the integration of sustainability into policies, plans and projects, in line with the transformative process triggered internationally by the 2030 Agenda.

Within this Plan, adaptation actions have been identified for the following vectors:

Capacity building: It is the phrase, which has entered common speech, meaning the improvement of the public administration performance. It is a continuous process of improvement within the organization that can be enhanced or accelerated by external inputs and is capable of fostering capacity building through the use of existing capabilities. Capacity building actions for climate change adaptation focus on process governance.

Common knowlege: in general, it relates to improving the state of knowledge. In particular, it refers to the areas where more efforts are needed to complete the information framework, functional to the formulation and evaluation of development policies. For climate change adaptation, common knowledge actions mainly concern the systematization of data and information, the creation of networks and modes of exchange, and the strengthening of synergies, so as to create a common framework that effectively supports decision-making.

Education, information, communication: it represents one of the key dimensions for the effective achievement of a "culture of sustainability," to be promoted at all levels (business, civil society, institutions, research) and in all educational venues, formal and nonformal, from a life-long learning perspective. The goal is to trigger the transformation of the current development model, as well as the dissemination of knowledge, skills, lifestyles and virtuous models of sustainable production and consumption. Adaptation actions for this vector refer in particular to strengthening awareness of the current dynamics, risks and behaviors.

Subsidiarity participation and partnerships: directed at fostering the creation and dissemination of effective and continuous initiatives and pathways for the involvement of all stakeholders at different stages of the decision-making processes. To this end, it is necessary to develop mechanisms for integration at the institutional level, as well as participation and active involvement of the civil society. It is also essential to ensure the development of public-private partnerships in the different sectors that guarantee the adoption of sustainability, quality and innovation criteria.

Specific measures

Measures of adaptation for specific sectors have been identified on the basis of risk analysis in collaboration with offices responsible for sectoral policies. The main specific topic are :

- qualitative protection of water resources
- sustainable use of water resources
- **desertification and land degradation**
- terrestrial ecosystems
- coastal and marine ecosystems
- coastal systems
- risks from climate change
- urban sector
- agriculture
- fisheries and aquaculture
- tourism

Chapter 4 - Official documents

The PRACC was officially adopted with regional act n. 322 del 13/03/2023. The complete documentation used for public consultation during Strategic Environmental Assessment (SEA) procedure is available in the official website of Marche Region:

https://www.norme.marche.it/attiweb/infodoc.aspx?ID=0_25611111

The SEA procedure was concluded with official opinion from Regional Competent Authority n. 151 of 27/06/2023.

Annexes

1. Synthesis of PRACC (english)
2. SEA opinion (italian)

OUTPUT

Climate change adaptation Marche Region

REGIONE MARCHE

Interreg Italy - Croatia AdriaClim
European Regional Development Fund

EUROPEAN UNION

Content

Context

1 Context

According to the definition of the European Environment Agency, "adaptation means anticipating the adverse effects of climate change and taking appropriate measures to prevent or minimize the damage it may cause or take advantage of opportunities that may arise." Since the effects of climate change manifest themselves in different ways depending on the environmental, social and economic peculiarities of the territory, it is essential to develop adaptation plans on a regional scale.

Marche Region's vision in the context of climate change

The Marche Region has identified the need to address climate change adaptation within the scope of its sustainable development policies, which pursue the goal of improving the economic, social and environmental well-being of its citizens by 2030. The Regional Sustainable Development Strategy (SRSvS), adopted in December 2021, acknowledged the global climate change and local impacts affecting the regional territory. Exposure to impacts related to rising temperatures, changing precipitation, changes in mean sea level, and the increased frequency and intensity of extreme events (such as heat waves, flash floods, droughts, and wildfires) increases the vulnerability of the Marche region; these phenomena interact with factors that characterize the region, exacerbating its vulnerabilites and making climate change adaptation action increasingly central and urgent.
The Regional Sustainable Development Strategy has therefore identified a specific course of action that commits the region to the definition of the Regional Climate Change Adaptation Plan (PRACC).

Institutional capacities (present and future)

The overall objective of the Regional Climate Change Adaptation Plan is to put in place concrete measures and actions aimed at strengthening regional adaptive capacity.
The PRACC is based on a scientific approach curated by expert researchers from CIMA Foundation, Eurac Research, 'Università Politecnica delle Marche, and AdriaClim–Euro-Mediterranean Center on Climate Change (CMCC) project partners, National Research Council-Institute of Marine Sciences (CNR-ISMAR), Emilia-Romagna Regional Agency for Environmental Protection (ARPA), and Emilia-Romagna Region. The working group defined the climate context within the regional territory, considering historical trends, forecasts and expected future scenarios, identifying how natural resources and economic or social factors will evolve in the changing climate and what vulnerabilities and risks the region will face.
At the end of the analysis of the regional context, objectives, courses of action and specific measures to ensure adaptation were defined. On the one hand, the measures identified are cross-cutting in nature to ensure unambiguous direction and strengthen the implementation of sectoral measures referring to individual issues (environmental resources, economic or social factors, etc.); on the other hand, they provide specific, clear and concrete directions on what needs to be done.

Climate change adaptation strategy

The overall objective of the Regional Climate Change Adaptation Plan is to put in place concrete measures and actions aimed at strengthening regional adaptive capacity.

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At the end of the regional context analysis objectives, courses of action and specific measures to ensure adaptation were defined. On the one hand, the measures identified are cross-cutting in nature to ensure an unambiguous direction and strengthen the implementation of sectoral measures referring to individual issues (environmental resources, economic or social factors, etc.); on the other hand, they provide specific, clear and concrete directions on what needs to be done.

Climate change in the Marche region: present and future

2 Climate change in the Marche region: present and future

The current climate framework for the Marche Region and the climate variations over recent decades were compiled based on the EOBS climate dataset for Europe. EOBS provides daily temperature and precipitation observations from 1950 to the present with a spatial resolution of about 11 km. In contrast, the future climate scenario was explored based on simulations for the 30-year period 2039-2068 with a 4-km spatial resolution climate model. To assess future changes, the projections for the middle of the century were compared with model simulations on the thirty-year period 1978-2008 taken as the "historical" reference. The projections were supplemented with additional simulations developed as part of the AdriaClim project. Further discussion of the data and model simulations can be found in the section **Climate analysis** in the Technical Appendix.

Mean temperature

Historically, the Marche region has a Mediterranean-type climate in the coastal and mid-hill belt regions with average temperatures around 20-25 °C in the summer and 5-10 °C in winter. Temperatures decrease in the innermost belt where the Umbro-Marchigiano Apennines are concentrated, particularly at the Sibillini Mountains.

Since the middle of the last century there has been an increase in average annual temperatures of about +0.4 °C every decade. Seasonally, the most pronounced temperature increases are in the spring and especially in summer with about + 3 °C over the past 60 years. The mid-century climate scenario reports an additional regional average warming of +1.8 °C above the historical average (1979-2008). This increase is particularly pronounced in winter and summer and in the interior areas of the region.

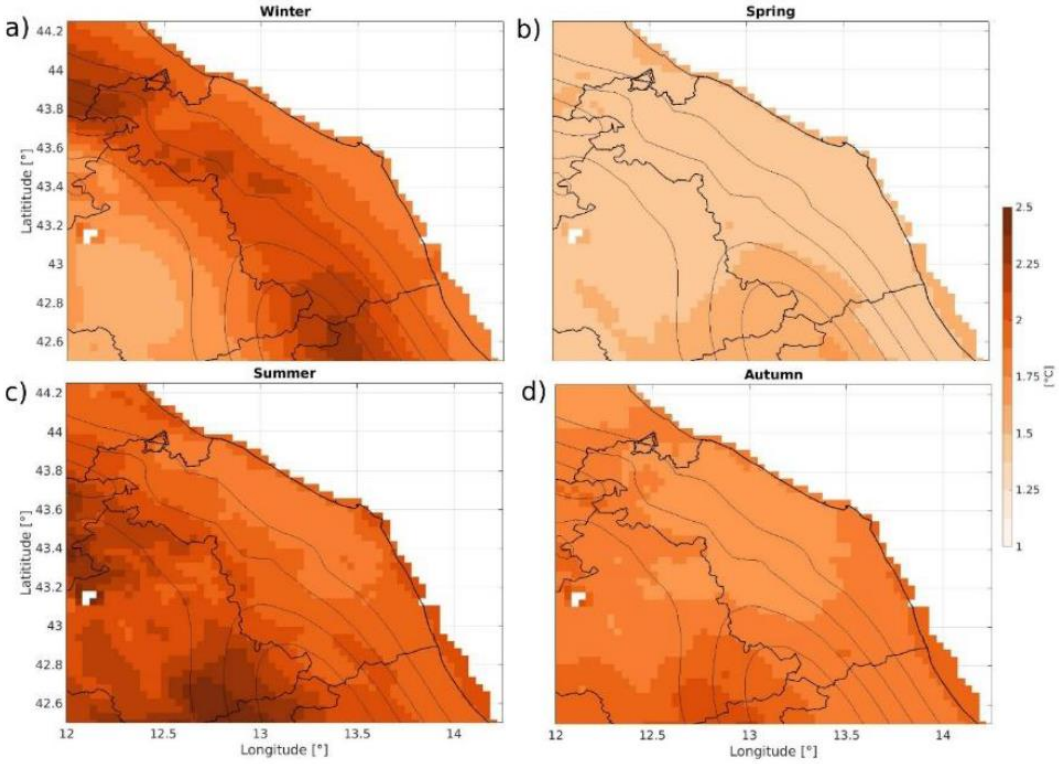

Figure 2.1: Changes in seasonal mean temperature for the future 30-year period 2039-2068 compared to the "historical" reference period 1979-2008. Processing: Fondazione CIMA on WRF simulations (see appendix for more details).

Precipitation

The mean distribution of annual precipitation over the region (mean values over the period 1981-2010) follows the orographic gradient going from about 500 mm per year near the coast, to over 1,000 mm in the Apennine belt, with mean local values exceeding 1,200 mm. It is important to consider that the availability of climate observations at higher elevations is limited leading to a potential underestimation of precipitation values for mountainous areas reconstructed from the EOBS dataset. Seasonally, on the regional level, the lowest precipitation occurs in the summer months, particularly in July, while the highest precipitation occurs in late fall and winter, particularly in November and December.

The average annual precipitation from the middle of the last century to the present hasn't significantly changed, but a general trend toward a decrease in precipitation does emerge, particularly in the summer.

Projections for 2050 (period 2039-2068) show a modest decline in annual precipitation of about 10-12% from the historical average. The most pronounced change occurs in the summer season with an average decline in seasonal total precipitation of about 38% from the historical baseline values. The scenario also shows a reduction in precipitation in the winter and fall, while wetter conditions are reported only for

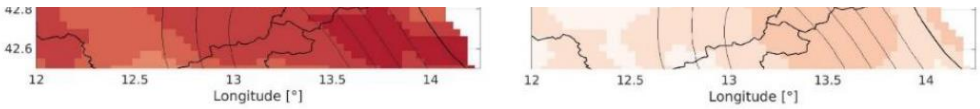

Figure 2.2: Relative changes in seasonal precipitation over the future 30-year period 2038-2069 compared with the "historical" reference period 1979-2008. Processing: Fondazione CIMA on WRF simulations (see appendix for more details).

Climactic extremes

Ongoing climate change doesn't just affect the climate variables' mean value (annual and seasonal), but also their statistical distributions and extreme values. This entails, for example, changes in the frequency and intensity of the most intense weather events.

With respect to temperature extremes, intense hot conditions have become more frequent over the past few decades; this trend is expected to continue in the decades to come. Notably, days affected by heat waves (defined as periods of at least six consecutive days in which the maximum temperature exceeds the 90th percentile, Warm Spell Duration Index - WSDI indicator) at the regional level have increased over the past 60 years from a few days to about 15 days in a year. This increase has particularly accelerated in recent decades. The maximum WSDI indicator values were recorded in 2003 and 2007, when, on average, over the entire region, persistent hot conditions occurred for more than 30 days in a year. Similarly, there are increases in the frequency of summer days (i.e., days when the maximum temperature exceeds 25 °C, indicator Summer Days - SU25) and tropical nights (days when the temperature remains above 20 °C, indicator Tropical Nights - TR). Over the past 60 years, tropical nights have increased on a regional scale from about 5 to 30 nights in a year. The climate scenario considered confirms a general increase for all indicators by mid-century. For the SU25 indicator, an increase of more than 20 days is projected over the period 2039-2068, reaching a total of more than 40 days of exceedance per year, compared with about 18 days per year in the historical period. This result suggests that the annual frequency of days with particularly high temperatures could more than double for the region in the coming decades. In the future, the annual incidence of tropical nights in coastal areas could also double that of the historical period and reach 50 nights a year in certain areas.

Regarding rainfall while no obvious changes in trends emerge over the last 60 years on the basis of observational data, modeled projections to 2050 show a general increase in the region in both the intensity and frequency of heavy precipitation events in the spring compared to the historical 30-year period and a reduction of events in the summer. For the other seasons, the signal is less definite. The average annual intensity of daily precipitation and the annual maximum daily precipitation exhibit higher increases in the northern part of the region, while the change in the annual frequency of extremely rainy days (precipitation above the 95th percentile) is more pronounced along the entire coastal strip. On the other hand, over the past 60 years, the duration of dry periods (defined as the persistence of days without precipitation, indicator Consecutive Dry Days - CDD) exhibits an increasing trend at the regional level (not statistically significant). Modeled projections for 2050 confirm this trend and report, again on a regional scale, a 37 percent increase (compared to the average value for the historical reference period) in the CDD indicator. Water deficit indicators are discussed in more detail in the following section.

The distribution of the future variation over the regional territory based on WRF and AdriaClim projections for 2050 for mean and extreme temperature and precipitation indicators allowed us to identify the climatically critical zones shown in Figure 2.3 and Figure 2.4, respectively.

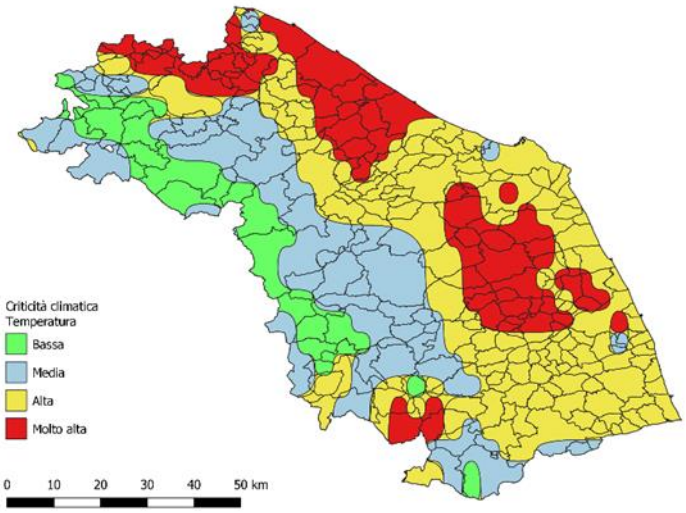

Figure 2.3: Temperature-related climate criticalities for the projections for 2050 (source: AdriaClim).

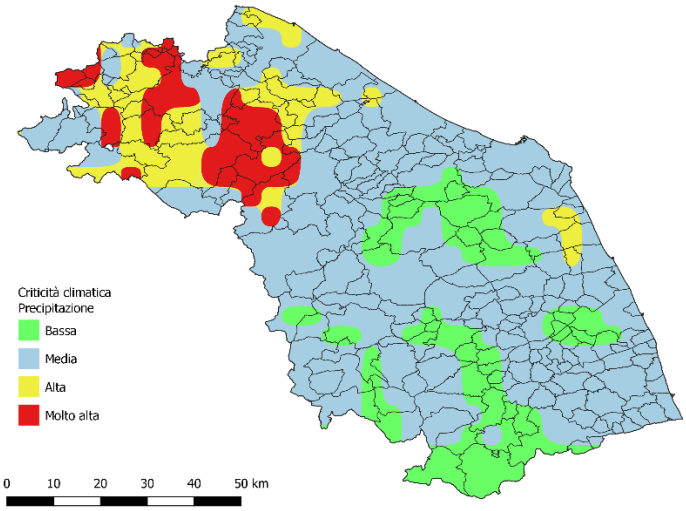

Figura 2.4: Precipitation-related climate criticalities for the projections for 2050 (source: AdriaClim).

Hydrological scenario

Hydrological simulations for 2050 (projections 2039-2068 relative to the historical period 1979-2008) considered several variables such as snow cover (as mass content and as snow days on the ground), average annual discharge into the river network and average monthly and maximum annual discharge (for a set of river sections), evapotranspiration and soil moisture. The increase in temperature and concurrent reduction in precipitation expected from climate projections are reflected in a marked reduction in snowfall at all elevations (-85% on average at elevations of 100-300 m above sea level and -30% at elevations above 1. 000 m, the percentage reduction in nival water equivalent), in a reduction in the season with snow on the ground (up to -20% days in the Sibillini area), in a decline in summer flows (-40% on average over the main streams), winter flows (-10% on average over the main streams) and annual flows (-4% on average over the main streams), and in a reduction in evapotranspiration and average soil moisture (about -10% for both variables on an annual scale). All these results imply a generalized reduction in annual minima over much of the Marche region. Despite this general evolution toward a drier climate, an increase in annual flow maxima is also observed for most sections in the coastal area, the result of a generalized increase in spring and especially fall flow rates in coastal areas. Although drought is determined by a combination of factors, including ecological and geo-pedological ones, an analysis of the main climatic drivers can provide an initial indication of the possible scenarios of drought-related problems. Based on the indicators described in the previous sections, the scenarios for 2050 show more severe criticalities in the coastal area and southern inland areas in terms of dry periods, while the frequency of intense heat conditions generally shows higher increases along the coastal and lower hill ranges. By combining the hydrological assessments with the analysis of the indicators of intense heat and dry periods it was possible to identify the areas of drought-related climatic criticality (Figures 2.5), which show higher criticality for the coastal, northern mid-hills, and central hilly areas, with a hot-spot in the southern high-hills/mountainous area.

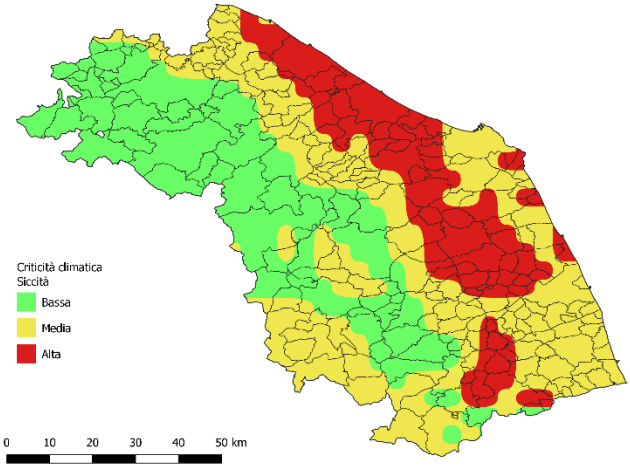

Figura 2.5: Drought-related climate criticalities for the projections for 2050 (source: AdriaClim).

Sea level

Storminess describes the average marine climate off the coast and the probability of occurrence of extreme waves, and is an important variable affecting coastal dynamics. It is therefore necessary to estimate its evolution over the years as a result of ongoing climate change. The maximum wave heights in the future period 2041-2070 according to the RCP 8.5 scenario, reach values of 2.9 m for the 90th percentile and 7.75 for an extreme event with an average return interval of 100 years (Tr=100 years). There is an average increase of the significant wave height of about 4.5 cm for the 90th percentile and about 50 cm for extreme values. The apparent small magnitude of these values should not be misleading: a change of a few tens of centimeters over the mean sea level can translate into the loss of tens of meters of beach.

Increased storminess has repercussions over other factors, such as extreme sea level rise. This, in turn, is determined by other elements such as mean sea level rise, astronomical tide, storm surge (the elevation of the sea surface as a result of changes in atmospheric pressure and winds during storms), and the so-called wave run-up (the rise of waves on the beach face). Using an expedited method based on the use of a simple analytical formula for the run-up and the sum of the maximum values of all the above components, a very conservative maximum sea surface level value is obtained. In fact, this expeditious method does not adequately take into account dissipative phenomena sustained by the waves (e.g., landsliding). For the current scenario, the calculated mean superelevation is 1.35 m and 3.38 m for 90th percentile and Tr=100 years, respectively. For the future scenario, on the other hand, the superelevation averaged 1.76 m for 90th percentile and 3.97 m for Tr=100 years. These sea level values, which determine the maximum coastal inundation that can be hypothesized, are significantly reduced when using a more accurate calculation method based on detailed numerical modeling of coastal circulation. In this case, the significant run-up reduction results in coastal penetrations is being reduced by more than 50 %.

Impacts, vulnerabilities and risks. Nature

3 Impacts, vulnerabilities and risks. Nature

3.1.1 Surface water and groundwater

Surface water and groundwater are critical resources for terrestrial ecosystems, both for the survival of animal and plant species and for the maintenance of natural processes. Surface waters, such as rivers, lakes and wetlands, are essential habitats for many organisms; they provide shelter, food and water. In addition, these waters contribute to the water balance of the territory, helping to regulate air and soil temperatures and mitigate the effects of heat waves. Groundwater, on the other hand, is a valuable source of water for plants and animals living in drier areas and provides drinking water to humans as well.

The Marche region is characterized by the presence of 16 main river basins, within which 185 main river water bodies and 7 lake water bodies (all artificial reservoirs), 49 groundwater bodies and 103 springs have been identified. The rivers, which start from the Apennine chain and flow towards the Adriatic Sea, are predominantly short and have a torrential regime.

In the Marche region, during the 2018-20 monitoring period, 39 percent of river water bodies comply with the European Water Directive and achieve the classification of good ecological status. Thirty-six percent are in the sufficient ecological status, 23 percent in the scarce status, and 2 percent in the poor status. The ecological status of rivers generally worsens toward the coastal belt, where the effect of anthropization increases; rivers with sufficient or poor ecological status can also be found in the hill belt. Most of the water bodies that reach the "good" quality objective are located in the Apennine and foothill areas, where anthropization is contained and river ecosystems are able to maintain conditions that are closer to those of naturalness. Seventy-four percent of groundwater bodies have a good chemical status, while 22 percent show a poor classification. The situation has remained almost stable over the entire period analyzed (2013-2020). Of the 49 groundwater bodies, 24 are judged to be at risk, and 14% of the 73 monitored springs show a decreasing trend in discharge. Deep and shallow aquifers in inland areas are relatively less prone to water shortage than aquifers in the coastal zone. Aquifers in the coastal zone are particularly exposed to salt intrusion, which can degrade their quality.

Climate change impacts

The complex natural system that determines water availability is of fundamental importance and is already heavily impacted by climate change. All major water systems-rivers and streams, lakes, reservoirs, and groundwater-will be subject to possible adverse impacts in the near future, potentially with serious consequences for the immediately dependent systems, e.g., ecosystems, agriculture, fisheries, and tourism.

Some of the major effects of climate change on the surface water and groundwater system depend on the change in the rainfall regime, which may result in extreme flood events with short and more intense rainfall, or lean events, affecting freshwater availability and resulting in hydrological scarcity and increased soil erosion (see also section **Soil** and impacts connected to the management of **Water resources**).

Water scarcity. Drought is a natural and temporary meteorological condition which entails a significant reduction in precipitation relative to the average climatic conditions at a given location of interest. However, rising temperatures and progressive rainfall scarcity may increase the frequency and duration of hydrological drought episodes. Since the early 1990s, in fact, the frequency of hydrological emergencies is about one every five years (much higher than in the previous period), the trend in cumulative precipitation is negative, and the number of drought years in each five-year cycle exceeds the number of rainy years. Forecasts for the coming years indicate that the drought condition may assume a structural character in the future. This phenomenon may be exacerbated by the increase in evapotranspiration resulting from rising air temperatures. Thus, hydrologic drought is associated with the effects of periods with precipitation deficits on soil and subsurface water supply and has frequency and severity defined on a river basin or watershed scale. Other land-use factors may contribute to hydrologic drought, such as deforestation, construction of dams for hydropower, or irrigation water use for agriculture.

Decline in ecological runoff. European Directive 2000/60/EC introduced the concept of ecological runoff **(*deflusso ecologico*-DE), defined as the volume of water that is needed for the aquatic ecosystem to continue to thrive and provide necessary services.** The Ecological runoff concept stipulates that in each section of a natural watercourse, the flow passing through should have natural characteristics, maintaining minimum values needed by the river to ensure good ecological characteristics. The DE takes over from the **minimum vital runoff concept (*deflusso minimo vitale*-DMV)** observed up to now, i.e., the residual flow capable of allowing, in the long term, the preservation of the natural structure of the watercourse and ensuring a balanced use of the water resource, safeguarding the requirements of satisfying the different necessities in terms of water quality and quantity. As hydrological drought episodes increase with increasing frequency, **the ecological runoff might no longer be guaranteed**, thus contributing to the degradation of water quality and the state of the ecosystems.

Alteration of the physical and chemical parameters of the ground and surface waters. Rising water temperatures and water scarcity due to changes in rainfall patterns are climate change effects that could also act on the quality of the ground and surface waters by altering both their **physical** (such as temperature, pH, turbidity, and thermal stratification) and **chemical parameters** (e.g., nutrient concentration, organic matter, dissolved oxygen, heavy metals) with cascading consequences on biological and ecological characteristics (e.g., phytoplankton concentration, community composition and structure).

Rising global temperatures could be a factor responsible for **decreasing oxygen in water**, through the processes of microbial stimulation and mineralization of organic matter that decreases the solubility of oxygen in water and reinforces thermal stratification, a dynamic that prevents different layers of water from mixing together. Higher temperatures can generally promote the **growth of toxic algae** and an **increase in pathogenic microbes**. In addition, warmer temperatures can affect the thermal stratification of water, which can affect the concentration of nutrients in different areas of the water.

Even in an environment characterized by frequent episodes of water scarcity, there may also be an increase in the frequency of extreme precipitation events, with the risk of flooding, particularly in urban areas, exacerbated by inadequate stormwater collection and disposal systems. This can lead to a subsequent increase in **biological contamination** and can alter the physical and chemical parameters of the ground and surface waters.

Increased demand for drinking water could lead to the overexploitation of groundwater, causing the groundwater table level to be lowered. This may lead to increased concentration of chemicals in fresh water, degrading water purity, and increased eutrophication. Increased episodes of extreme

precipitation, which could promote the runoff of chemicals and nutrients from agricultural soils to waters, could also lead to increased eutrophication. Eutrophication is a process caused by enrichment in nutrients, particularly nitrogen and/or phosphorus compounds, resulting in an increase in primary production and algal biomass with consequent alteration of benthic communities and, in general, a decrease in water quality. Eutrophication is usually caused by the imput of nitrogen and phosphorus but can be exacerbated by certain climate change impacts.
Sea level rise may also contribute to salinization of coastal groundwater, with negative impacts on water availability and ecosystem status.
Several vulnerability factors may further amplify the described impacts on water quality, e.g**., increased anthropogenic pressure**, **increased surface runoff** (associated with increasing surface sealing due to anthropization), **poor or insufficient sewage infrastructure**, particularly in coastal areas, **insufficient control of industrial contamination, and insufficient control of nitrate and ammonia usage in agriculture.**

Key Risk

Water quality degradation. The risk of water resource quality degradation refers to a progressive degradation of parameters related to the chemical and physical characteristics of water available for the sustenance of natural ecosystems and for the needs of the socioeconomic system. The consequences associated with this risk can be severe, particularly because of the sensitivity of ecosystems to water quality. The most significant vulnerabilities will be found at the level of the ecological status of lakes and rivers and the chemical status of groundwater, the latter possibly also affected by salinization episodes. (see also key risks: **Risk of salinization of coastal aquifers** and **Loss of littoral and marine biodiversity**

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**medium**	The magnitudes of the possible consequences are significant considering the criticalities of the water resource and the dependence of many natural and socioeconomic sectors on the quality of this resource.
Reliability level (low, medium, high)	**medium**	Impacts considered causative for risk and vulnerability elements are multiple and partially documented.
Possible conflict level (low, medium, high)	**medium**	There is broad agreement on the values and objectives related to the necessity to mitigate this risk. However, it is evident that there are possible conflicts related to the need to preserve the ecological system in heavily man-made areas with industrial and tourism activities.

3.1.2 Soil

Soil performs essential ecosystem maintenance functions (carbon storage, regulation of water flows, ecosystem sustenance, climate regulation, etc.). The soil is also critical for the agricultural sector, as healthy soils support increased yields and improved food security, and for water resources, as soil plays a key role in filtering water and regulating water flows. Soil degradation, i.e., the reduction or loss of soil productive capacity (loss of organic matter, loss of productivity, erosion, salinization), and soil consumption, i.e., the loss of soil due to urbanization of natural, semi-natural or agricultural land, are the most impactful phenomena on this resource. Soil consumption can result in the loss of fertile soil and biodiversity, leading to decreased agricultural productivity, increased water pollution, and the release of carbon dioxide into the atmosphere. Soil degradation can lead to nutrient depletion and decreased water-holding capacity, all of which can have serious implications for food security, water quality, and climate change. Soil is regarded as a nonrenewable resource given the extremely long formation times.

Soil degradation. According to the *Terzo Rapporto sullo Stato dell'Ambiente in Regione Marche* (year 2009) in which data from *the Centro Operativo Servizio Suoli dell'Agenzia regionale per i servizi nel settore agroalimentare delle Marche (ASSAM)* from the 2002-2005 surveys (published in May 2005, the most recent surveys available for the Marche Region) are taken into consideration, 60% of the Marche region's territory is classified as poor in terms of organic matter content, a figure much higher than the national average (24.3%) and the European average (11.4%). Agricultural areas are particularly poor in organic matter: land classified as poor is 80 %. This finding confirms that agricultural management is of paramount importance in regulating the organic matter content of soils. The projection for 2080 of the cumulative change in organic matter in soils shows that almost all of Marche (99.7 % of the territory analyzed) tends to have a negative balance, with a significant potential for loss of organic matter.
Analyses by the *Centro Operativo Servizio Suoli dell'ASSAM* from 2002-2005 (published in May 2005) highlight that 52 percent of agricultural soils in the Marche region are subject to erosion between 5 and 20 tons per hectare per year and about 45 percent of soils in the region are above the erosion threshold of 1 ton per hectare per year (still lower than the national average of about 72 percent). According to data from the Joint Research Center (JRC Ispra), soil erosion projections for agricultural soils for 2050 (RCP 4.5 scenario) compared to current erosion (Panagos et al. 2015) show the particularly delicate position of the Marche region, which could experience much higher erosion than most of Italy, with an average of 4.92 tons per hectare per year.
Soil degradation is also followed by the possible risk of desertification, a phenomenon that occurs when the organic matter in the soil is less than 1 percent. Based on CNR studies reported by the water resources observatory of the Associazione Nazionale Consorzi di Gestione e Tutela del Territorio e Acque Irrigue (ANBI), 30-50 percent of the regional territory is potentially exposed to the risk of desertification.

Soil sonsumption
The Marche region has high soil consumption especially in coastal areas and near water bodies. In 2020, the percentage of soil consumed within 150 meters of water bodies in the Marche region reaches 14.1%, double the national average of 7.2%, with a very high consumption density of 16.79 (m^2/ha) compared to

the national average of 1.39 (m²/ha). The coastal strip of the Marche region also appears to have very high levels of land consumption: 46.1% within 300 meters from the coast, compared to the national average (for coastal regions) of 22.8%; 29.9% from 300 to 1000 meters from the coast, compared to the national average of 18.9%; and finally 12% from 1 to 10 kilometers from the coast, compared to the national average of 8.7%. Similar data are also recorded for consumption density.

Climate change impacts

Soil interactions with climate change are twofold: while soil contributes to carbon storage (and thus has a mitigating effect on climate change), ongoing climate change can affect soil dynamics and exacerbate degradation, desiccation, or erosion. Rising temperatures can also contribute to the decomposition and mineralization of organic matter in the soil, reducing organic carbon (OC) content, thus leading to reduced organic carbon storage capacity. Soil degradation, the reduction or loss of soil productive capacity, and soil consumption, the loss of soil due to urbanization of agricultural, natural or semi-natural land, appear to be the most impactful phenomena on the soil resource. Land degradation and land consumption can both increase the vulnerability of soil to climate change; land degradation is in turn exacerbated by climate change.

Soil degradation

Changes in Soil Organic Carbon (SOC) and Soil Organic Matter (SOM) content are of particular importance in the context of climate change, but also in the context of food production, biodiversity, and generally reflect the qualitative status of the soil.

In the context of climate change, increasing temperature, increasing drought, and increasing frequency and intensity of precipitation extremes will impact soil quality and accelerate degradation. Increased temperature and increased drought lead to decreased soil moisture, both directly and indirectly through biogeochemical mechanisms. Decreased soil moisture leads to a slowdown in the production of carbon content and organic matter, the decline of which results in the loss of soil water retention, which then in turn impairs water uptake. Increases in the frequency and intensity of precipitation extremes erode the soil in general, particularly the upper layer of soil containing carbon and organic matter content. Organic matter in soils (Soil Organic Matter - SOM) is essentially derived from the decomposition of animal and plant residues. SOM exerts a key role in maintaining soil functions and fertility and in determining resistance to erosion. A reduction in organic matter indicates a deterioration in soil quality and an increased risk of desertification.

Soil consuption

Soil consumption is of particular importance because its most extreme form, **total sealing**, results in the total loss of the soil resource. Sealing results in an increased risk of flooding, contributes to climate change, threatens biodiversity, and causes the loss of fertile agricultural land and natural and semi-natural areas. Finally, it contributes, along with urban sprawl and the progressive and systematic destruction of the landscape, especially in rural areas, to the loss of the capacity to regulate natural cycles and mitigate local thermal effects (Commissione Europea 2021; 2012). The Marche region has **high soil consumption, especially in coastal areas and near water bodies**.

Soil erosion, a natural phenomenon that is greatly accelerated by human activities but also by changes in the amount and intensity of rainfall, also leads to **the loss of the soil resource**. In agricultural areas, soil

erosion is one of the greatest threats to soil functioning and leads to loss of arable land and reduced productivity. Soil loss exceeding 1 ton per hectare per year can already be considered irreversible over long time spans, a threshold exceeded by 45% of soils in the region.

Key risk

Loss of biodiversity and ecosystem services. Loss of biodiversity refers to both the loss of soil microbial biodiversity, but also to the loss of biological and ecosystem-level biodiversity. Loss of soil ecosystem services means loss of ecosystem maintenance services (e.g., carbon storage or regulation of water flows) and cultural services.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**medium**	This risk is directly linked to intensifying episodes of water scarcity, changing precipitation cycles, and rising temperatures, which are themselves impacts with high probability of occurrance. The sector has a high adaptive capacity but the trend for this risk is intensifying in the future.
Reliability level (low, medium, high)	**high**	Impacts considered causative for risk and vulnerability elements are multiple and partially documented.
Possible conflict level (low, medium, high)	**low**	There is broad agreement on the values and objectives related to the necessity to mitigate this risk. The presence of possible conflicts, particularly those related to the needs of the socioeconomic sectors involved cannot be ruled out.

3.1.3 Flora and fauna

Ecosystems play an important role in climate regulation, making a major contribution to climate change mitigation and adaptation. In particular, they produce a diverse range of services upon which our well-being depends: from carbon storage to flood control, from coastal and slope stabilization to the provision of clean air and water, food, medicine, and genetic resources. At the same time, however, climate change affects ecosystem dynamics. The latter can lead to a wide range of positive and negative impacts on biodiversity at the genetic, species, and ecosystem levels, including shifts in the distribution of species and ecosystems, changes in species abundance, changes in species phenology (i.e., the distribution of developmental stages of plants and insects, which adjust their temperature according to that of the environment), and an increased risk of extinction for some species. Thus, climate change will also affect the ability of ecosystems to provide ecosystem services. Moreover, climate change usually does not act on ecosystems in isolation, but together with other stressors, such as human land use and management. Conserving and restoring ecosystems, such as by restoring wetlands and natural hydrological conditions in river basins, is not only beneficial to biodiversity per se, but also helpful in reducing the impacts of climate change on society (e.g., flooding).

The Marche region hosts a high variety of ecosystems: in fact, the regional territory contains about 40 percent of the habitats reported in Italy. As of January 1, 2021, parks and nature reserves on the regional territory covered a total area of about 89,470.72 hectares, or 9.59% of the Marche region's territory. Sixty percent of the total area of Marche's habitats falls within protected natural areas. Protected areas remain the most effective tool for habitat conservation.

Some habitats belong to the Natura 2000 Network, the main European Union policy instument for the conservation of biodiversity. It is an ecological network spread throughout the Union, established under the Habitats Directive 92/43/EEC to ensure the long-term maintenance of threatened or rare natural habitats and species of flora and fauna at the Community level. The areas that make up the Natura 2000 Network are not rigidly protected reserves where human activities are excluded; in fact, nature protection must also consider regional economic, social and cultural needs in a logic of sustainable development. Included in the Natura 2000 Network of the Marche region are 3,388 hectares of coastal and sub-coastal environments, 875 hectares of wetlands, 31,922 hectares of forests, heaths and scrublands, 29,264 hectares of natural or semi-natural grasslands and meadows, as well as 7,158 hectares of rocky habitats and caves.

13.5 % of habitats in the Marche region have a favorable conservation status (2018 figure), which is higher than the national average (which stands at 8.3 %), but has seen a considerable decline in recent years (in 2012 the percentage of habitats with favorable conservation status in the Marche region was 28.3 %).

With regard to wildlife species of value and community interest (*faunistiche di valore e di interesse comunitario*), there are numerous species in the Marche region identified in the two directives (Habitats and Birds-Habitat e Uccelli), including the Marsican brown bear (*orso bruno marsicano*), Apennine chamois (*camoscio appenninico*), golden eagle (*aquila reale*), Red-billed chough (*gracchio corallino*), Orsini's viper (*vipera dell'Orsini*), Elaphe quatuorlineata (*cervone*), crested newt (*tritone crestato*), spectacled salamander (*salamandrina dagli occhiali*), macrostigma trout (*trota macrostigma*), and the European bullhead (*scazzone*).

A bioindicator that is particularly sensitive to climate change is 'the honey bee (*Apis mellifera*). In addition to being among the world's most important pollinators and critical to the maintenance of biodiversity, bees are also particularly sensitive to climate change. There is a wealth of data indicating how environmental and climatic changes affect the development and survival of species. First, changing temperatures will lead to major changes in floristics, regarding both species composition and flowering periods, which is why bees may have difficulty finding a source of food. In addition, climate change will lead to changes in the areas suitable for bees, which will tend to abandon areas where the climate is more extreme or otherwise unsuited for their survival. Looking at the data on the evolution of regional beekeeping over time, from 2016 to the present, on average, the number of hives has increased, as have the number of swarms. However, the average honey production per hive has tended to decrease in recent years, mainly due to climate change. For example, frosts in early April 2021 compromised acacia flowering in the valley floor; low temperatures, continuous wind, and lack of rain virtually wiped out acacia production. In 2022, on the other hand, production was reduced due to delayed flowering and a sudden rise in temperatures. Also in 2022, a severe summer drought brought forward the end of the summer wildflower production season.

Climate change impact

Climatic factors represent the basic conditions for the dynamics of natural and semi-natural ecosystems. In a climate change context, a response by the ecosystems is to be expected, which may vary depending on the starting conditions and the biotopes present.

The IPCC's Fourth Assessment Report claims that Mediterranean terrestrial ecosystems are highly vulnerable to desertification and predicts an expansion of adjacent arid and semi-arid systems in the face of climate scenarios of reduced rainfall (especially in the summer period) and rising temperatures above predicted global-scale values.

Many valuable and community-interest wildlife species found in the Marche region are potentially vulnerable to the effects of climate change, either due to **changes in predator-prey dynamics triggered by range change** (e.g., in the case of the Orsini viper and golden eagle) or from the intensification of extreme events (as in the case of the macrostigma trout), or finally due to the degradation of optimal environmental conditions for the reference habitats (which is the case, for example, for the spectacled salamander and the native crayfish) and competition with aggressive alien species that are more tolerant to climate change, such as the Louisiana red crayfish.

Changes in temperature and rainfall patterns particularly affect the dynamics of some species. Amphibians, due to their ethology, are the class with the highest number of species at risk of extinction precisely because of climate change.

Terrestrial ecosystems are subject to various threats, despite the fact that forested area has now been expanding for several decades, a reflection, however, of choices made in other economic sectors and not the result of deliberate forestry and environmental protection policies. The growing forested area is in fact increasingly subject to abandonment and thus degradation, such as forest fires. These, for example, because of the burning by-products, can contribute to the **contamination of aquatic ecosystems**. In addition, extreme adverse hydrological events can lead to total or partial loss of habitat.

Changes in temperature and precipitation **can alter the distribution and productivity of various plant species**, resulting in changes in the composition and structure of forests, grasslands, and other ecosystems, as well as cause changes in wildlife populations and migration patterns.

In general, the presence of transportation infrastructure (e.g., roads, railroads, bicycle paths) or the proximity to urban areas can promote conflicts between human activities and wildlife (e.g., traffic accidents - roadkill). The increase in urban population and tourist numbers may lead to more frequent encounters between people and wildlife and consequent conflicts. Finally, the insufficient presence of protected areas and ecological corridors to connect different wildlife habitats may exacerbate these conflicts.

Key Risk

Loss of biodiversity and ecosystem services. Biodiversity loss refers to both the loss of soil microbial biodiversity and the loss of biological and ecosystem-level biodiversity. Specifically, biodiversity loss is defined as the decline in the number, genetic variability, and diversity of biological species and communities in a given area. Reduction in the provision of ecosystem services means the loss of benefits provided by ecosystems that ensure the survival and well-being of human populations. Ecosystem services are divided into regulatory (climate, water, biodiversity, etc.), provisioning (of food, water or other raw materials), supporting (soil formation and nutrients) and cultural (educational aesthetic values, artistic etc.) services.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**high**	The systems directly exposed to this risk (terrestrial, lake and river ecosystems, coastal areas, wetlands) are of extreme importance, not only because of their intrinsic value, but also because of the services and benefits they provide. The magnitudes of the consequences are significant considering their irreversibility and the potential cascading effect on other systems (e.g., agriculture, tourism).
Reliability level (low, medium, high)	**medium**	The connection between climate change and the impacts considered causative for risk are complex and subject to high variability not only from species to species, but also across ecosystems. The elements of vulnerability are multiple, often well documented and monitored (e.g., the extent of protected areas).
Possible conflict level (low, medium, high)	**medium**	There is broad agreement on the values and objectives related to the necessity to mitigate this risk. However, it is evident that there are possible conflicts related to different land uses (agriculture, energy, tourism, and water use).

3.1.4 Costal areas

Coastal areas are of strategic importance as they host a high percentage of citizens, constitute a relevant source of raw materials and a key link for transportation and commercial activities, and count among the most interesting natural habitats. Coastal zones constitute an extremely important element for the Marche region, with strong interdependence between the most relevant sectors: water resources, ecosystems, tourism, transportation, fisheries and fish farming. However, coastal areas are particularly vulnerable because of the strong anthropogenic pressure induced by the high population density and seasonal tourism. These factors result in significant land consumption, unsustainable exploitation of resources (e.g., water) and ecosystems, and progressive stress on infrastructure (e.g., sewage system), which is already inadequate in certain places for the changing environmental conditions. Additional pressure elements (external drivers) are determined, for example, by the change in the distribution of the settled population (e.g., progressive shift from inland areas to the coast) and tourism (which is very seasonal and concentrated in coastal areas, and doesn't involve diversified activities), increase in the cost of fuels (e.g., for fishing boats) induced by economic regression and conflicts, and change in people's habits (including consumers and tourists) as a result of the pandemic.

Climate change impact

Major climate change-induced hazards include rising temperatures, intensifying heat waves, increases in the intensity and frequency of extreme precipitation events, rising mean sea level and the associated increase in the frequency and duration of coastal flooding events. These hazards will have impacts on the coastal zone as a whole: marine ecosystems, coastal aquifers, and the emerged beach are further discussed.

Marine ecosystems

Climate change poses a threat to the conservation of marine ecosystems, as it amplifies the effects of other factors that affect the balance of marine and coastal systems. The resilience of marine ecosystems, especially in a highly anthropized context such as the Adriatic basin, is found to be drastically reduced as a result of climate change-induced alteration of chemical and physical parameters.

In recent decades, the global average ocean temperature has been rising, and climate scenarios predict that this trend will continue in the future. For the coast of the Marche region, data from the RCP8.5 scenario for surface temperature (i.e., referred to 50 cm below the water surface), show a temperature increase for 2070 of up to 2.29 °C in the spring period, which is equivalent to an increase of about 17 percent of the current temperature. This change alters the status of the water body and may result in adverse effects on native species. In fact, the increase in seawater temperature may lead to a decrease in dissolved oxygen and can facilitate eutrophication processes.

An indicator used to monitor the quality of marine ecosystems is chlorophyll and particularly chlorophyll "a," which is the most common type and is used, in the oceans, as an indicator for the amount of phytoplankton. This is an effective indicator for the productivity of the system and gives an indication of

the level of eutrophication of the waters, that is, the proliferation of microalgae. Chlorophyll "a" is also a key component of trophic indices (assessment of primary production) such as TRIX, used to assess the ecological status of the water body. Comparison of the 2020 and 2070 data under RCP 8.5 scenario show a general decrease in chlorophyll. The sharpest decreases are observed in the summer period and reach values of -1.25 µg/l, or about 78 % of the present value, while localized increases occur in the spring and fall periods (the sharpest increase is 1.14 µg/l, or about 84% of the current value). Although it is related to eutrophication in the system, it is not the only parameter that determines it. In fact, eutrophication is a complex phenomenon, mainly promoted by the abundance of nutrients (nitrogen and phosphorus) from river discharges.

Salinity is, among the characteristics of the marine environment, one that most affects the life of organisms. Climate change affects salinity values: in particular, in semi-closed seas (such as the Adriatic), rising temperatures, increased evaporation and reduced inputs (reduced rainfall) lead to increased salinity values. Low salinity values are usually observed near river mouths, where dilution of fresh water with salty sea water causes a lowering of this parameter. When river inputs decrease, for example due to reduced rainfall (summer period), salinity levels are higher. When comparing surface salinity in the future scenario and in the current scenario, it becomes apparent that the maximum increase is observed in the summer period with values of up to 2.5 psu, or 7 % of the current value, while the most pronounced decrease is observed in the spring with values of -1.2 psu.

There could also be an increase in algal blooms, which can alter the functioning of ecosystems causing direct effects (algal toxins) and indirect effects (dead zones, in which hypoxia is established and biogeochemical cycles are altered by the sudden growth and exploitation of nutrients from the microalga) and impacting the quality of the environment and its socioeconomic use. The coastal strip of the Marche region is affected by blooms of the toxic microalga Ostreopsis cf. ovata in the late summer period, particularly in the Ancona area, with one event per year lasting until the first weeks of October, strongly correlating with surface water layer temperatures and hydrodynamic conditions favorable for bloom development. The trend of rising sea surface temperature and the increasing eutrophication of the Adriatic marine ecosystem affected by the Po River (Tsikoti and Genitsaris, 2021; Randone, 2016) represent processes that can promote the intensification of algal bloom phenomena. Projections in the coming decades, albeit on a large scale, suggest how the establishment and continuation of favorable environmental conditions may support algal bloom phenomena that could arise early or persist longer than the trend observed in recent years, as well as become more intense, with increased proliferation.

The increase in non-native marine species can also be impacting on marine ecosystems. Hydrographic conditions promoted by climate change are promoting an expansion of thermophilic alien species, that is, those that can withstand very high temperatures, toward the central and eastern Mediterranean basin, including the Adriatic Sea (Occhipinti-Ambrogi and Galil 2010). Phenomena such as "meridionalization" (the presence of warm-water species in northern regions) and "tropicalization" (the expansion of non-native tropical species) are intensifying, and longitudinal gradients in the rate of warming of water temperatures can be expected, which may lead to a change in primary production.

Coastal aquifers

When the aquifer is overexploited, salt water can invade groundwater because groundwater levels decrease relative to sea level, allowing salt water to flow into freshwater aquifers. Saline intrusion also affects major rivers or canals. Groundwater salinization is not uniform at the local scale; it depends on a combination of factors for each site, including the hydrogeological context, local rates of groundwater extraction, and hydrological regimes.
The entire coastal zone is considered highly vulnerable up to 1 km from the coastline. This vulnerability extends up to 3 km from the coast in the coastal plains of Senigallia, Porto Recanati, Porto San Giorgio, and Falconara Marittima given the permeable nature of the sediments (sandy-gravel) and the low topographic elevation. A medium vulnerability characterizes the main floodplains, while inland sedimentary deposits show a much lower vulnerability.
Overexploitation of aquifers partially due to there not being a plan to encourage alternative water supply for less valuable uses, is responsible for the salinization of coastal aquifers (see also section **Water resources**).

Also worth mentioning is the risk of interactions between the sewer system and the seawater; increasingly frequent heavy rainfall events can lead to an increased load of urban wastewater on the local sewer systems, which is then discharged into the sea. Sewer systems and treatment plants near the coast are also at risk of damage from extreme storm surges. Interactions between the sewage system and seawater increase the risk of bacterial contamination, with potentially serious impacts on the swimmability of affected stretches of coastline.

Backshore
Over longer periods of time the loss of the beach is related to sea level rise, but for shorter and variable periods it is related to inundation by storm surges also related to the increased frequency and intesity of extreme events. Both wave and underflow erosion cause marine erosion. Marine erosion results in morphological changes due to the displacement of materials and sediments in a longitudinal or transverse direction to the coast. Marine erosion is accelerated during storm surge events and intense winds. Marine inundation itself can also have serious repercussions, mainly it can cause flooding, a phenomenon particularly evident in areas where the coast is already subject to coastal erosion.
Sea level rise and increased intensity and frequency of storm surges will cause the loss of part of the emerged beach, where many structures are located.
Some settlements have already been threatened by sea flooding (especially Marina di Monte Marciano following a few episodes of south-east winds-scirocco; despite periodic beach nourishment with sediment from the Esino River, episodes of severe damage due to storm surges occur annually). In addition, some sections of strategic transportation infrastructure are also at risk.
The vulnerability of the Marche's coasts to inundation and marine erosion is related to the high level of urbanization concentrated along the coast and the overexploitation of the coast for tourism activities.
The coastal areas of the Marche region are subject to high anthropogenic pressure. In particular, most tourism and recreation activities are located on the coast, compared with the under-exploitation of inland areas.

Key risks
Risk of salinization of coastal aquifers. Aquifer salinizationis the process by which the concentration of salts and minerals in groundwater increases as a result of the disruption of the natural balance between

freshwater aquifers and seawater, deteriorating its quality parameters. This risk results in the reduction of freshwater groundwater supplies and a decrease in the biodiversity of near-shore vegetation.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**high**	The phenomenon is strongly influenced by hydrological drought episodes that are already a reality in the region and are likely to increase in the future, even in the short term, also considering the anthropogenic pressure in coastal areas. Salinization results in an irreversible decrease in the availability of the water resource.
Reliability level (low, medium, high)	**high**	The phenomenon of salinization and its correlation with climate change are widely recognized and documented.
Possible conflict level (low, medium, high)	**low**	The agreement level on the need to activate adaptation actions is considered high, thus with a low potential level of conflict.

Risk of progressive loss of the backshore and damage or destruction of structures on it and next to it. The rise in mean sea level and increase in the intensity and frequency of storm surges will cause the loss of portions of the emerged beach, where many structures and infrastructure are located, including transportation infrastructure. In particular, roads and railways are susceptible to structural damage caused by sea flooding, which will be more intense in the future due to the rise in mean sea level and the intensification of extreme events.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**high**	The areas closest to the sea, including beaches, neighboring structures, and transportation infrastructure, are of great importance to the tourism sector and are heavily anthropized. Progressive beach loss is highly probable and mitigation actions for this phenomenon are complex.
Reliability level (low, medium, high)	**high**	The scientific community is in agreement about the phenomena related to the rise in mean sea level and the frequency of intense meteomarine events. Analytical models of flooding are available.
Possible conflict level (low, medium, high)	**high**	The potential for conflict is believed to be high. Actions to adapt to this risk are complex and invasive, with side effects, and require the exposed elements to undergo transition and transformation.

Loss of littoral and marine biodiversity and ecosystem services. The loss of biodiversity and its impact on ecosystem services related to littoral and marine ecosystems can have negative consequences on many of the socioecological and socioeconomic domains related to coastal areas.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**medium**	Coastal zone ecosystems are fragile systems threatened by strong anthropogenic pressure, and could be impacted by adaptation actions related to other risks (e.g., risk of beach loss). Currently, this risk can be assessed as "medium" overall, but may be subject to reassessment in the near future.
Reliability level (low, medium, high)	**medium**	Scientific indications and experimental evidence concur in pointing to factors related to this risk, but more in-depth studies should be conducted to better understand the link to climate change and more accurately quantify its consequences.
Possible conflict level (low, medium, high)	**medium**	The level of agreement on the value of the resources to be protected is high, but the risk of conflict remains medium due to the existence of incompatibilities between the actions needed to safeguard ecosystems and those needed to adapt to other key risks related to coastal areas.

3.1.5 Natural Hazards

3.1.5.1 Fires

The development of fires is influenced by climate change; the variation in the rainfall regime and the increasing temperatures will have increasing effects on fire characteristics (seasonality, extension, cyclicity, etc.).

The Marche region appears to have reduced rates for both the number of fires and the area covered by fire; the triggers for forest fires are unintentional 41% of the time, voluntary for 34%, undefined for 22% and natural for 3%.

The number of forest fires per year has a periodic pattern with above-average values (peaks) fluctuating on average between four and five years. Extremely critical conditions for the high number of fires were found in the years 1992, 1993, 1994 with a peak of as many as 304 events in 1993. In addition to this record three-year period, significantly critical conditions occurred every four to five years, with the number of fires around 80 to 100 per year. From 2013 onward, the number of annual events gradually declined to absolute lows in 2014 and 2016 (4 and 3 events per year, respectively) before increasing again to 84 in the year 2021.

The average fire-affected area in the 30-year period 1991-2021 is 7.27 hectares, with periodic fluctuations and more marked criticality every four to five years. The year 1993 was critical, but the absolute maximum value is recorded in 2007 and is related to a single disastrous fire that occurred in the province of Ascoli Piceno. In general, the average extension per fire, in absolute terms, is rather low and, with the exception of the completely anomalous character of the year 2007, the average extension can be considered one of the smallest in Italy. Regarding the type of burned area, the average stands at 69% wooded area and 31% unwooded area, although a strong fluctuation has been detected over the last 30 years. This variability is mainly attributable to seasonal conditions of greater or lesser aridity, which have a direct effect on both the speed of flame spread and the lengthening of time for firefighting operations.

From the point of view of seasonality, in the Marche region there are two distinctly different periods in which forest fires occur more frequently: one of lower intensity in late winter-early spring and one, which comprises the greatest number of annual events, related to the summer months between July and September, with a maximum value in August.

The aforementioned variability over the course of the year depends essentially on the seasonal pattern of rainfall and in particular on the frequency (rather than the intensity) of rainfall; the scarcity of rainfall in the late winter and summer months greatly affects the number of episodes.

The triggering causes of forest fires in the Marches are as follows:

unintentional causes (of a culpable nature due to negligence, carelessness, inexperience) are those most frequent with a value of 41% of the total; voluntary causes (of a malicious, intentional nature), with a value of 34%; causes defined as "unclassifiable" (doubtful, undefined) due to the lack of certainty as to the reason for the initiation with a value of 22% of the events; natural causes (exclusively from lightning) with a value of 3%, in line with the data reported in the literature.

Unintentional causes result from negligent behavior in the conduct of a variety of activities near and/or within forested territories. These are, for example, destruction by fire of crop residues in fields at an unsafe distance from wooded areas; clearing of herbaceous and/or shrubby plants deemed "pests" in

areas adjacent to hedgerows and thickets; pruning of plants that recklessly escaped the control of the operators, who were responsible for not having taken all the necessary preventive measures beforehand. Different from the previous, and less frequent, are the culpable causes of fires related to the use of fire as part of gardening and/or domestic activities, for example, the burning of crop residues resulting from cleanup at homes or the farmyard, or the careless use of braziers and outdoor hearths.
Other events originate from road infrastructure, often in connection with extreme aridity and temperature conditions, insufficient maintenance of vegetation on escarpments, and/or careless behavior by travelers.
Finally, accidentally triggered events are recorded, e.g., from cigarette butts thrown from motor vehicles along roadsides, fireworks, or recreational (camping-barbecue) fires.
A key index used for the purpose of assessing fire danger in a harmonized manner in Europe is the fire weather index, calculated using the Canadian Forest Service Fire Weather Index (FWI) rating system, which takes into account temperature, relative humidity, wind speed, precipitation, drought conditions, fuel availability, vegetation characteristics, and topography.

Climate change impact
In light of the projected change in FWI compared to the values from 1981-2010 and based on the RCP 8.5 scenario, depending on the various times of the year (winter period, spring period, summer period, fall period), the territory of the Marche region will experience an increase in the fire risk index especially during the months from March to August, while during the rest of the year the increase will be lower.

3.1.5.2 Geological, hydrogeological and hydraulic instability

The various types of instabilities considered, namely geological, hydrogeological and hydraulic, are significantly affected by climate change. In particular, the three categories are sensitive to climatic conditions, which add to the strong anthropogenic pressures to which they are usually subjected. Specifically, variation in the rainfall regime, which results in extreme rainfall or drought events, and increasing temperatures, which affect slope stability, have the capacity to increase the level of risk related to instability.
The Marche region has a total of 17.3 % of its territory in P4 (very high), P3 (high), P2 (medium), and P1 (moderate) landslide hazard areas, compared to a national average of 20 %; if only P4 and P3 areas are considered, the share of terriroty is 7.9 % (equivalent to 738.5 km2) compared to a national average of 8.7 % and to the regions of Central Italy of 10.1 %. The Marche provinces with the highest percentage of very high or high hazard areas are Ancona (9 %) and Pesaro and Urbino (8.7 %).
Hydraulic hazard areas are identified on the basis of three scenarios defined by the Floods Directive. Regarding the floodable areas, ISPRA presents data of the hydraulic hazard areas produced by the District Basin Authorities (*Autorità di Bacino Distrettuali*) on the three scenarios defined by the implementation of the Floods Directive. The Marche region has respectively 0.1 % of its territory in floodable areas relative to high probability flood events, 2.7 % in medium probability areas, and 4 % in low probability areas. The national averages are 5.4%, 10%, and 14%, respectively.

3.1.5.3 Heat waves

Heat waves are defined as periods of at least 6 consecutive days in which the temperature exceeds the 90th percentile in relation to the 30-year period 1981-2010 (i.e., values are in the highest 10% of measurements, indicator WSDI - Warm Spell Duration Index), and in the case of the Marche region they are highest in the southern part of the coastal area and inland along the regional border. Long-term trends report the highest values in the northern end and southern coastal portion of the region, where the periods of the year affected by heat waves have increased by about 4-5 days per decade. At the regional average level, since 1961 the number of days affected by heat waves in a year has increased from a few days to an average of 15 in recent decades, a statistically significant increase. In particular, at the regional scale a more accelerated increase is observed since the end of the last century. The maximum values of the indicator were recorded in 2003 and 2007 when persistent heat conditions occurred for more than 30 days in a year.

3.1.5.4 Avalanches

In mountainous areas, the general increase in temperatures related to climate change leads to a rapid melting of the snowpack and a general alteration in the balance of the snowpack itself, significantly increasing avalanche risk. In order to pursue interventions and investigations at the regional planning level on the issue, the Marche Region has constructed an integrated mapping product: the Probable Avalanche Localization Map (CLPV). The use of the CLPV is optimal in supporting the Civil Protection functional centers in defining alert zones and assessing levels of criticality and territorial contexts that require safety interventions, as well as in supporting the definition of risk scenarios within the Civil Protection Plans, from a forecasting perspective. From a prevention perspective, on the other hand, CLPV can make a positive contribution to the development of urban planning tools or specific sector plans aimed at governing land use. In order to make the information contained in the CLPV homogeneous snd easily consulted by interested parties, a webgis has been created and is currently being improved, which the user can access without having to install any software or have special GIS knowledge.

3.1.5.5 Costal erosion

The sea level rise expected in the coming years will cause the loss of part of the beach, thus exacerbating the already ongoing phenomenon of coastal erosion. The decrease in beach extent, in addition to causing a loss from an environmental and ecosystem point of view, will also have repercussions on the socioeconomic side, considering that many facilities, especially tourist facilities, are located on the coast.

Climate change impact

The results for the future scenario show that the loss of most of the sandy beaches for the 90th percentile scenario and an inland advancement of the sea level up to a few hundred meters for the Tr=100 year scenario. It should be noted that, given the expedited procedure used, the inundable area estimated by

computational methods more closely adhering to the physical mechanisms may deviate significantly from these estimates. In fact, detailed analyses carried out for two test sites (Pesaro and Senigallia), returned less extensive flood-prone areas.

Impacts, vulnerabilities and risks. Society

4 Impacts, vulnerabilities and risks.

4.1.1 Water resources

Water resources in the Marche region are essential for civil uses, the agricultural sector, the manufacturing sector, the energy sector, and for natural purposes, such as ensuring the ecological runoff. Because of this plurality of uses and the possible impact of climate change on the hydrological cycle, water resources management emerges as an area of particular relevance within the adaptation process.

An analysis of water concessions (which authorize withdrawals) shows that the sectors most affected by dissipative uses (i.e., those in which the water withdrawn is used and not released into the water body) are, in order, agriculture (67%), drinking water (24%) and industrial use (5%). In particular, the agricultural sector shows a high number of concessions with, on average, a relatively low flow rate. The volume of water used for irrigation purposes ranges between 47 and 63 million cubic meters per year for the 2016-2020 period, with an average of 57.3 million.

At the *Ambito Territoriale Ottimale* level, that is, the territory over which public utilities are organized, the annual per capita consumption of water resources for civilian uses, calculated as volumes of water injected into the network per population served, registers values between 63.5 and 85.9 cubic meters per capita for the 2016-2021 period.

The main data regarding the management of water resources emerge from ISTAT's Census of water for civil use (*Censimento delle acque per uso civile*) (ISTAT 2017). The efficiency of drinking water distribution networks (ratio of water delivered to users for authorized uses to water injected into the network) is 65.9 percent (ISTAT), which is significantly higher than the Italian average (52 percent) and the Central-Northern average (58.6 percent). According to a 2018 update, the Marche region's water network disperses about 34 percent of the water withdrawn from the environment and fed into the irrigation network, a statistic that is superior to the average performance in Central Italy (49%) and nationally (42%). However, there are differences between provinces within the region with respect to water distribution network losses, ranging from 40% in the Macerata province and 25% in the Fermo province.

In terms of population served by purification, however, the regional performance is lower than the national performance. According to ISTAT data, in 2015 the urban equivalent population served by purification as a percentage of the number of inhabitants was 48.5 %, a figure among the lowest in Italy and significantly lower than the national value, which reaches 59.6 %. As of May 2020, 39 municipalities in the Marche region were still affected by infringement procedures regarding the compliance of wastewater collection and treatment systems with the European directive, for a total of about 700,000 citizens (Banca d'Italia 2021).

Water resources and agriculture

The largest water draws are in agriculture and have a major impact on the water balance. According to data from the 2014-2022 Marche Region Rural Development Program (*Programma di sviluppo rurale*) (RDP), irrigated areas are not widespread and have tended to shrink since 2007, at a faster rate (-34%) than the national average change (-9.7%). The volume of water used for irrigation purposes is about 42 million cubic meters. Analysis of the irrigation methods and sources of supply used reveals the need to implement water-saving and efficient techniques in the use of the water resource. The most used irrigation systems are the least efficient ones (RDP 2014-2020 data), namely sprinkling or sprinkler (75 % of irrigated areas) followed by lateral run-off and infiltration (12%) and microirrigation (9%).
Also, according to data collected by the RDP, it appears that the primary source of supply used by agricultural companies in the Marche is underground (40.4%, compared with a national figure at 25.5%), a condition that is not in line with the logic of rational use of the resource aimed at its protection and conservation. Regione Marche predicts that with the modernization and/or replacement of traditional irrigation systems through the development of new techniques, significant savings in agricultural-related uses can be guaranteed and pressures on river ecosystems reduced. The use of crops with reduced water requirements is also reported as a possible measure to reduce water consumption.

Climate change impact

Water resources are significantly affected by climate change. In particular, the surface water system (rivers and lakes) is sensitive to climatic conditions, as well as being subject to strong anthropogenic pressures. Some of the main effects of climate change on the water system depend on changes in the rainfall regime, which can result in extreme flood events, or lean events. In addition, rising temperatures affect ecosystems related to water systems, with possible effects on both biodiversity and ecosystem services. The risk to the sector is exacerbated by a combination of susceptibility of individual systems to climatic and environmental stimuli and structural vulnerabilities of the resource managagement.
The progressive trend toward decreased precipitation, especially at certain times of the year such as the summer period, can generate significant impacts on the quantitative availability of the resource. The scarcity of precipitation and the decrease in snow cover may lead to more frequent hydrological droughts. This phenomenon may be exacerbated by the increase in evapotranspiration resulting from the increase in air temperature. Thus, hydrologic drought is associated with the effects of periods with precipitation deficits on soil and subsurface water supply and has a frequency and severity defined on a river basin or watershed scale.

Other land use factors such as deforestation, construction of dams for hydropower, or irrigation water use for agriculture can contribute to hydrological drought, leading to water scarcity and potentially causing conflicts between different sectors. **Water scarcity** is defined as a situation in which the demand for water exceeds the availability of the resource. Severe water scarcity adversely affects most of the basic functions of social and socioeconomic systems and can threaten their very survival. An increase in frequency and severity of water shortage episodes associated with emergency conditions at the local level could have possible cascading effects on natural systems (ecosystems) and economic sectors (agriculture and tourism).

Finally, the shortage of fresh water can promote **salt wedge upwelling**. Prolonged exposure to marine intrusion results in significant biological changes in freshwater bodies of water. The phenomenon of saline wedge upwelling is observed at the mouth of rivers, near the bottom of the riverbed, which is occupied

by seawater, which tends to penetrate into the mouth to a greater extent the smaller the incoming freshwater flow from upstream and the higher the tidal level. The tidal ranges specific to the Italian seas (with particular reference to the Adriatic Sea) are rather modest, but the penetration of the saline wedge is strongly influenced/favored by the incoming freshwater flow rates, which, due to the increasingly prolonged lean periods, is strongly decreasing, especially during the summer months. The phenomenon has assumed increasingly worrying proportions in recent decades with progressive saline intrusion along the waterways. The reasons for the worsening of the phenomenon can be sought in subsidence (a phenomenon of soil lowering that can have natural causes, related to geological processes, and artificial or anthropogenic causes, e.g., methane extraction), sea level change, incision of some stretches of the river due to sand and gravel withdrawals, and finally in the substantial water withdrawals for industrial, civil and irrigation uses upstream, which have considerably reduced the lean water flows. The increase in the salinity content of soils in coastal areas, caused by saline intrusion, causes major problems in the area that have important repercussions on several fields, including agriculture, the environment and the availability of drinking water.

Finally, there may be **problems with groundwater recharge**. Changes in rainfall and its regime, coupled with the rise of the saline wedge in coastal areas, and increasing soil sealing may result in decreased infiltration of water into the subsoil resulting in reduced groundwater recharge and thus reduced water availability.

In addition to weather and climate phenomena, the water resources sector is also susceptible to anthropogenic pressure from progressive or temporary population growth or concentration (e.g., related to tourism), and industrial activities. Impactful anthropogenic pressures include **increased water demand for agriculture, increased water demand for drinking water withdrawals, and increased water demand for hydropower generation.**

Increasing water demand for agriculture. Irrigated areas in the Marche region are relatively limited and have been shrinking significantly since 2007. The possible spread of intensive high-revenue, but particularly water-consuming crops, such as horticulture, fruit and floriculture (RDP 2014-2020) combined with rising temperatures and evapotranspiration levels, could lead to a significant increase in water demand in the future, particularly in the southern coastal strip. Moreover, the primary source of supply used by farms in the Marche is underground (40.4 %, compared with a national figure at 25.5 %), a condition that is not in line with the logic of rational use of the resource aimed at its protection and conservation.

Increased water demand for drinking water withdrawals. The current drinking water withdrawal for accounts for 8-10% of the total water use in Marche region. In the Marche region, water withdrawals for potable use correspond to 172.6 million cubic meters, lower than both the national average figure (461) and that of the Central regions (476). There has been a decrease in withdrawals in the Marche region compared to previous surveys, starting with a 2005 datum of about 200 million cubic meters; while for the national and Central Italy datum, withdrawals have continued to increase until 2015 (ISTAT). About two-thirds of the water withdrawn to sustain hydropotable consumption in the Marche region comes from springs, while the remaining third is divided between wells and reservoirs. It is necessary to note

how the population of coastal areas is likely to increase compared to inland areas, partly as a result of the progressive depopulation of mountainous areas. Coastal areas are also subject to strong anthropogenic pressure in the summer season due to strong tourist flows, which may increase as the tourist season becomes longer as a result of the increase in average temperature.
In the Marche region, currently 84 % of drinking water comes from springs or wells and is of good quality. Water scarcity could increase in the future the use of surface water (e.g., from artificial reservoirs), which is generally of lower quality than deep water, thus leading to a possible degradation of the quality of the resource and a possible increase in the potabilization and purification processes.

Increased water demand for hydropower generation. Hydropower generation in the Marche region is relatively small (0.4 TWh as of 2020) and accounting for 16% of locally produced energy. It is possible that in the future, as a result of the transformation of the energy sector and the increasing demand for energy at the local level, this renewable energy production sector will also be increased. While from the water point of view, electricity production does not result in a loss of the water resource, the large amount of water inflow into the plant connected to production require careful regulation and planning.

These anthropogenic pressures require better management of the water resource, both from a supply and from a demand perspective. On the demand side, some of the sectors currently use water resources in inefficient ways. Numerous industrial sectors of relevance to the Marche region tend to be particularly water-hungry, and when all necessary measures are not taken to ensure sustainable use of the water resource (by decreasing withdrawals, particularly from groundwater, and increasing internal recycling) it can lead to a local water crisis situations. In the agricultural sector, the infrastructure network for water adduction and distribution consists of obsolete systems that lead to water losses, even if the surface of irrigated land is limited.

In general, **insufficient water storage is also observed**. The prospect of a gradual reduction in rainfall accompanied by the intensification of violent and confined rainfall is a major concern for the failure to store flood volumes in basins not equipped with reservoirs with high regulation capacity. Most artificial reservoirs also came into existence for needs related to hydropower production and irrigation, and are therefore not prepared and managed for multi-purpose use. Also noteworthy is the absence of a system of water supply infrastructure capable of ensuring modulation in the storage of water volumes beyond the current year of management in relation to the climatic framework and thus accumulating during the hydrological year a certain amount of resource with which to offset possible deficits in the following year. A lack of up-to-date information on aquifer capacity is also problematic. Groundwater storage is an ideal solution where recharge mechanisms are preserved and aquifers are protected from unsustainable withdrawals and chemical contamination. However, information about actual aquifer storage capacities is limited. This may affect long-term planning.

It is also **necessary to anticipate and manage water emergencies**. The failure to adopt hydrological crisis precursors that would enable the initiation of counteractions well in advance complicates emergency management. In addition, particularly at the district level, there is a lack of a stable information circuit between the various stakeholders that would allow data and information to be acquired in a timeframe appropriate to that of the emergency and for signaling, under ordinary conditions, low levels of efficiency.

The lack of an emergency prevention plan developed for possible crisis scenarios, which could also include elements of functional integration between water systems serving different uses (e.g., "exchanging" water and energy through the compensation system), is also found.
Finally, the maintenance of rivers and reservoirs also affects the management of water resources.
Insufficient maintenance of rivers (selective cleaning in the riverbed, restoration of natural river expansion areas, preservation of natural wooded belts) results in a decrease in the efficiency in distributing the water resource in accordance with the natural water cycle, and can greatly increase hydraulic risk, especially considering that the frequency and intensity of localized extreme precipitation phenomena are expected to increase. Insufficient management of artificial reservoirs results in the progressive silting up of reservoirs. It is estimated that about 9 million cubic meters of sediment could be recovered in the Marche region for water storage.

Key risk

Increase in water shortage episodes. Water scarcity is defined as a situation where the demand for water exceeds the availability of the resource. Severe water scarcity negatively affects most of the basic functions of social and socio-economic systems, and can threaten their very survival. The risk refers to an increase in frequency and severity of water scarcity episodes associated with emergency conditions at the local level, with possible cascading effects on natural systems (ecosystems) and economic sectors (agriculture and tourism).

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**high**	The magnitude of the consequences is significant considering the critical nature of the water resource and the dependence of many natural and socio-economic sectors on the availability of this resource. The probability of risk materializing is also considered high for severe episodes of water scarcity that have already been observed in 2022 and in previous years and that are related to weather and climatic conditions and exposure and vulnerability factors that are assumed to persist and worsen in the future. The systems directly exposed to this risk (rivers, reservoirs and lakes, and groundwater systems) are of utmost importance.
Reliability level (low, medium, high)	**high**	The climatic reference framework indicates an increase in unfavorable conditions for water resources, particularly in terms of rising temperatures and progressive rainfall scarcity, particularly in the summer season. Impacts considered causative for risk and elements of vulnerability are multiple and partially documented.
Possible conflict level (low, medium, high)	**medium**	There is broad agreement on the values and objectives related to the necessity to mitigate this risk. However, it is evident that there are possible conflicts related to the

different types of water withdrawls (agriculture, industry, energy, drinking water).

4.1.2 Agricolture and food production

At the economic level, the primary sector in the Marche region is of relative importance, in line with the European average and slightly lower than the national average. The value added (ISTAT data) of agriculture at basic prices per hectare of utilized agricultural area (UAA) is about 1,160 euros, a value lower than the Italian average (2,100) and that of Central Italy (2,100). According to ISTAT data, the value added (to the 2010 prices) of the agricultural sector in the Marche region contracted significantly (-14%) in 2020 compared to the previous year, and over the past 10 years, despite some significant inter-annual fluctuations, it has decreased at an annual average of -0.8%. The figure is in line with the performance of the central Italian regions (while lagging behind the figure for the north-central regions, which is still negative, -0.2 percent). In the primary sector, 64,000 people were employed in 2020 (20 % of whom were employed on an occasional basis).

According to the 2021 agricultural census data, the regional agricultural system consists of 33,800 farms, with a total of 456,365 hectares of utilized agricultural area (UAA). Compared with the previous census (2010), there is a 24.7 % decrease in the number of farms (there were 45,000), which translates into a decrease of about 3.3% in the utilized agricultural area (it was about 472,000 hectares in 2010). The contractions in the number of farms and cultivated area are broadly in line with the national trend of -30.1 % of farms and -2.5 % in utilized agricultural area, respectively. The relative weight of farms and agricultural area in the Marche region to the Italian total remained almost unchanged.

The agricultural area is mainly devoted to rotational crops, while both permanent crops and pastures account for a significantly lower share than the Italian average. More than half of the farms in the Marche region are cultivated with arable crops, with a pronounced role of cereals, and oriented toward extensive farming systems. Durum wheat and corn are the cereal crops that occupy a larger portion of the total arable land area, with 151,016 ha (99,960 ha of durum wheat and 3,669 ha of corn). This is followed by the forage crop rotation, defined as herbaceous arable crops intended for animal feed in rotation with other crops, and occupying the same area for less than five years (ISTAT), with 117,836 ha. Although of lesser importance, crops of industrial plants (44,162 ha) and legumes (21,756 ha) are also important for the agricultural sector. As far as other crops are concerned, in the Marche region we find a fairly significant share of farms growing fruit plants, with a relative share of 4%/5% of the various pome fruits (apple, pear,...) and stone fruits (peach, apricot, cherry,...) compared to the national total. Important in terms of both the number of farms and the agricultural area is the relative weight of truffle farms on the national total, which accounts for 27.5 percent of the agricultural area used nationwide. Wine and olive farms account for 3.5% and 3% of the national total, respectively. el territorio regionale, la specie animale allevata di cui vengono registrati più capi è quella degli avicoli, seguono i lagomorfi, gli ovicaprini, i suini, e infine i bovini-bufalini. Le altre tipologie di allevamento risultano essere residuali nella regione.

When analyzing the livestock sector, it is also important to keep in mind that about 8 % of the regional agricultural area is covered by pastures.

The regional forest area is 33.1 percent of the regional area (2015), which is slightly lower than the Italian average (36.4 %). There is little forestry activity, especially due to the lack of planning and the absence of forest management, as the forested area is mainly private. Forestry production is mainly oriented toward firewood (97 percent), and there is no integration between the forestry sector and the furniture and furnishings supply chain.

Organic agriculture

In the Marche region, the percentage of utilized agricultural area planted with organic crops has increased over the past decade, from 11.2 % in 2010 to 25.5 % in 2021. The sector represents a niche of excellence in the regional primary sector. In fact, the region boasts an incidence in terms of area devoted to organic farming of more than 22 % of the total, which places it fourth in Italy with a higher value than the national average (16%) and the EU average (8%). The share of organic farms, which is 10% of the regional farms, is also higher than in other Italian regions where it averages just over 6% of the total (Cassa Depositi e Prestiti 2021). While agricultural employees in the region are 2 percent of those employed nationwide, they represent 5% of those employed in the organic sector with an increase of 30% between 2018 and 2019. In addition to small niches of excellence in the wine and oil sectors, organic farming in the region is mainly based on cereal and fodder crop production.

Soil and agriculture

Soil and agriculture are inevitably connected sectors: agriculture depends on soil but also in turn plays a key role with respect to soil, biodiversity, and ecosystem protection. Intensive practices, often characterized using high concentrations of chemicals, contribute to the reduction of animal and plant biological diversity, with dramatic impacts on entire ecosystems. In contrast, sustainable agricultural production with low-impact practices, such as precision farming, integrated and organic farming, capable of respecting natural resources such as the soil can positively influence animal and plant biodiversity. In addition, over-intensive agriculture can also promote soil degradation and loss resulting in landslides, especially during extreme weather events, while sustainable and low-impact practices can ensure water and slope regulation contributing favorably to the prevention of the risk of catastrophic events such as floods. Agricultural soil is an immense resource not only in terms of production, but also in terms of drainage and water regulation.

Soil water erosion is a natural phenomenon that can be greatly accelerated by human activities and changes in the amount and intensity of rainfall. In agricultural areas, soil erosion is a major threat to soil functioning and leads to loss of arable land and reduced productivity. Recent scientific studies have shown that water erosion may increase, resulting in greater soil loss from agricultural fields, even though the average annual amount of precipitation is expected to decrease in the future. Soil loss exceeding 1 tonne per hectare per year can already be considered irreversible over long time spans. Soil erosion analyses conducted in 2012 (Borrelli et al. 2017) also showed that for the Marche region values were much higher than 1 tonne per hectare per year with more than 87 percent of the territory having values above 5 tonne

per hectare per year. A study by the European Soil Data Centre (ESDAC) examined soil loss due to water erosion to 2050, taking into account the different IPCC climate scenarios as well as future agriculture and land use dynamics. This scenario shows that the erosion rate for the Marche region remains at high values, especially in the mid and high-hill areas (see also Water Resources section).

Climate change impact

The agricultural sector, by its nature closely linked to and dependent upon changes in temperature and precipitation, is strongly affected by the alterations caused by climate change, also in terms of economic performance. At the same time, this sector is an important contributor to emissions that are considered to be at the root of climate change: in 2012, agriculture contributed 10 percent of greenhouse gas emissions from the territory of the European Union (EEA, 2021). The agricultural sector will be impacted by climate change directly and indirectly.

Directly there will be a **reduction in yields and quality of some crops and a decrease in product quality (including nutritionally).** More than half of the farms in the Marche region are engaged in arable farming, with cereal crops playing a prominent role, and are oriented toward extensive farming systems. According to the Piano Nazionale di Adattamento al Cambiamento Climatico (PNACC), cereal, oilseed, and legume crops, being generally determinate-cycle species, have a length of growing period driven substantially by temperature and day length (Porter and Gawith 1999; Tubiello, Soussana, and Howden 2007; Moriondo, Giannakopoulos, and Bindi 2011). An increase in temperature on the order of 1.5°C, may result in decreased productivity of major cereal and grain crops due to the increased respiration and phenological developmental speed, and to the consequent reduction in the vegetative cycle length of species (Olesen and Bindi 2002; Saadi et al. 2015). In particular, in the Marche region, maize may be more affected by the impacts of climate change than wheat and rice, while slight yield increases are possible for durum wheat (one of the main crops in the region) mainly due to the effect of increased CO_2 concentration, suggesting the possibility of expansion of durum wheat cultivation in new areas. Increased temperature and drought will impact product quality, including nutritionally. Several studies have shown that high temperature penalizes the quality of agricultural products, for example, high temperature stress can decrease the concentration of vitamin C, starch, sugars, and many antioxidants, especially anthocyanins and volatile aroma compounds in fruit. Severe water stress decreases the quality of fruits and vegetables. Higher temperature associated with water stress can also lead to decreased quality of fruits and vegetables in terms of vitamins, antioxidants, and minerals (Shivashankara et al. 2013)

The agricultural sector will also be impacted indirectly, through **decreased soil moisture and evapotranspiration and soil degradation**. (See also section **Soil**). The low prevalence of irrigation systems and the use of inefficient irrigation practices are an important element of system vulnerability that could hamper the sector's adaptation strategies in the face of drought periods that are expected to be increasingly frequent and intense. Poor availability of supply points and reliance on groundwater represent additional elements of complexity for sustainable use of the resource within the agricultural sector. Irrigated areas are not widespread (only 3.6 % compared to a national average of 18.7 % and compared to the average for the Central Italian regions of 7.6 %). 75% of irrigated areas use sprinkler or overhead irrigation, while run-off and lateral irrigation characterize 12%. Therefore, the Piano di Sviluppo Rurale (PSR) highlights the need to implement water-saving and efficient techniques in the use of water resources in the agricultural sector.

As for the livestock sector and its many interconnections with the issue of climate change, the relationship with water resource consumption is highlighted. Globally, estimates report that livestock farming, especially intensive livestock farming with extensive use of feed, is responsible for the consumption of about 8% of total water resources: 7% is used just for irrigating fields with crops destined to become feed or fodder for livestock. Looking at estimates reporting the liters of water required to produce one kilogram of protein for human consumption (considering all stages of livestock farming from fodder production to marketing, including intermediate steps), it is evident that beef cattle farming represents the most impactful on the water resource (211. 026 l/kg), followed by pig farming (88,841 l/kg), sheep and goat farming (average of 58,581.5 l/kg) and poultry farming, especially chickens (21,913 l/kg). As for animal by-products, milk production appears to be more impactful in this respect (31,842 l/kg) than egg production (13,622 l/kg) ((Hoekstra and Chapagain 2006).

Climate change will also negatively impact animal production and reproduction. As the *Piano Nazionale di Adattamento ai Cambiamenti Climatici (PNACC)* reports, the direct effects of climate change on the livestock sector are those that high temperatures have on animal physiology and behavior. For each animal species there is an environmental temperature range, referred to as the thermal comfort zone. Outside this range, the animal is forced to activate a series of physiological and behavioral mechanisms designed to maintain a constant body temperature. Long exposures of animals to heat result in decreased ingestion levels and reduced energy metabolism. In general, heat has a depressing effect on the animal's metabolism with negative consequences on production and reproduction (Nardone et al. 2010). If the critical conditions persist, the animal may experience worsening health conditions up to and including death. Heat stress in the summer season is often associated with the heat wave phenomenon. It was found that in dairy cattle, the risk of mortality during heat waves was significantly higher than on a normal summer day. In addition, this risk was higher in longer waves and in those occurring early in the summer than in those occurring late in the season (Vitali et al. 2014). Associations between heat stress and the occurrence of diseases (infectious, metabolic, etc.) are also well known. Several studies testify to an increased incidence of clinical mastitis or increased somatic cells in milk (indicative of subclinical mastitis) during summer periods (Cook et al. 2007; Bertocchi et al. 2014).The higher incidence of mastitis during the summer period may be associated with the depressive effect that hot weather has on the animal's ability to defend itself (Lacetera 2019) and the greater number of environmental pathogens and vectors (flies) to which animals are exposed during the summer period (Harmon 1994).

The general vulnerabilities of the agricultural sector in the Marche region are numerous.
The 2014-2020 RDP conducted a SWOT analysis of the Marche's primary sector, identifying the sector's strengths and weaknesses. First and foremost, the issue of training of the agricultural entrepreneurs emerges, since most farm managers do not have specific professional training (60 % have an elementary or middle school license, 6.3 % have a diploma in agricultural science, and 1.4 % have a degree in agricultural science, values slightly lower than the national average). Despite the presence of qualified research actors promoting training programs for local entrepreneurs, however, the need for greater integration between businesses and research and development services has emerged. This need also emerges because of the low propensity of regional businesses toward research and development activities and because of their lower rate of innovation compared to the national average. The 2021

Census of Agriculture shows that the number of innovating firms, those that made at least one investment aimed at innovating production technique or management in the three-year period 2018-2020 were 10.4 % of the regional total, compared to a national average at 11%.

Another element of fragility in the primary sector is the low use of information and communication technologies (ICT). In 2021, only 15% of Marche's farms were computerized. This figure is in line with the national average (16%) and with other central Italian regions, but lags significantly behind northern farms (which have values between 30 and 59%). Information technology is an important element in training employees in the sector, triggering innovation processes but also spreading knowledge about climate risks. The degree of seniority of business leaders, an element that generally hinders the diffusion of innovative processes, experimentation with new technologies and the spread of knowledge, can also be considered an element of vulnerability. Information with respect to the challenges of climate change for the primary sector and regarding opportunities for possible adaptation solutions is generally more difficult if employees in the sector have a high average age and little training.

The 2014-2020 PSR also showed that as of 2015, farms were declining, particularly those with fewer than five hectares. The economic size of farms in the Marche is quite small, and only 16% of farms can produce a satisfactory annual income for one person working full-time (25,000 euros).

Finally, a gradual decrease in agricultural land, especially in the Apennine area, could lead to higher soil erosion and habitat reduction. At the regional level, there is a trend toward the gradual abandonment of pastures leading to land transformation and abandonment of mountain areas with an increase in wooded area (compared to the 1970s, the PSR indicates a 60% increase). In other rural areas, on the other hand, the decrease in agricultural area is associated with the increase in urban areas or other economic activities, or to the Apennine municipalities that occupy 31 percent of the territory but where only 7 percent of the population resides.
The regional primary sector possesses some elements of fragility with respect to climate drivers that characterize current trends and expected scenarios. Overall, the decrease in agricultural areas due to the abandonment of farming, especially in the Apennine area, could be further exacerbated by the decrease in precipitation and the increase in average and extreme temperatures. These phenomena could worsen the abandonment trends in inland areas, further weakening local socioeconomic systems.

Key Risk

Risk of a strong decline in the productive capacity of the agriculture and livestock sector. This risk refers to a general degradation of the productive capacity of the sector that includes agriculture and livestock, and describes a systemic impact, which may thus progressively undermine the sector's ability to be competitive domestically and in foreign markets, to ensure a satisfactory livelihood for its workers in terms of wages and working conditions, and at the same time meet the sustainability constraints imposed by environmental and socioeconomic conditions in the coming decades. Rising temperatures in combination with increasing CO_2 and decreasing water availability will impact various cultures differently, and will go on to change the ranges of some crops. Generally speaking, climate change will have a negative impact on agricultural and livestock productivity, although for some crops increased C02 will mitigate rising temperatures more than for others (e.g., durum wheat), and for other crops increased

temperatures will provide opportunities for range expansion in previously unsuitable areas (e.g., vineyards).
The systemic nature of this risk, coupled with the considerable resilience of a historic sector for the region, may make it difficult to initiate transformative adaptation actions, in favor of smaller-scale, temporary actions that, however, tend not to solve the structural problem.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**medium**	This risk is directly related to the intensification of water scarcity episodes, from changes in the rainfall cycle and increase in temperatures, which are themselves impacts with high probability of realization. The sector has a high adaptive capacity but the trend for this risk is intensifying in the future.
Reliability level (low, medium, high)	**medium**	Impacts considered causative for risk and elements of vulnerability are partially documented, but further study would be appropriate, especially on the possible damage at the production and socioeconomic levels and on the sector's ability to respond in a structural and transformative way to the challenges imposed by climate change and other drivers (rural depopulation, aging population, changing tourism patterns).
Possible conflict level (low, medium, high)	**low**	There is broad agreement on the values and objectives related to the necessity to mitigate this risk. However, the potential emergence of resistance and conflict in the face of pressures induced by changes in the food market and consumer habits, decarbonization, etc., is evident.

4.1.3 Marine fisheries and aquaculture

The fishing activity is particularly significant to the regional economy. Fishing contributes 18% to regional revenues (Integrated Coastal Management Plan), so this sector plays a significant role in the regional economy, and the quantities of fish harvested are also a significant share at the national level, albeit declining over the past decade. Aquaculture also plays an important role, especially shellfish farming (which accounts for 38 percent of marine fisheries revenues). In the Marche region, the share of shellfish in the total catch stands at 44.4% (30% of the total catch is clams), the most significant regional-level share in Italy (ISTAT data, 2019).

According to ISTAT data, the quantities of fish harvested, and the productivity of the fishing sector as a whole are declining. In the early 2000s they were among the highest in Italy, while in 2016 the value of fishing per annual work unit is 31,700 euros (reference year 2010), which is lower than both the national average figure (38,000euros) and that of central Italy (37,500 euros). According to ISTAT data in 2019 in the Marche region, the sector harvested 12.7% of the national catch, ranking third after Sicily and Veneto in terms of quantities fished, but over the past ten years in the Marche region the quantities harvested have decreased by 12%. In terms of revenues, the fish sector's production generated 81 million euros, with a relative weight of 9.1% of the national total.

Fish and shellfish species exploited by commercial fisheries are subject to analytical assessments (stock assessments) and are considered for the determination of indices of ecological status. In 2019, 87.5 percent of stocks of commercial interest considered in the Adriatic assessment were found to be overfished, exceeding biologically safe fishing limits. In particular, the overfished situation concerns species such as hake (Merluccius merluccius), Norway lobster (N. norvegicus), anchovies (E. encrasicolus), sardines (S. pilchardus) and cuttlefish (S. officinalis). Among cephalopods, there are positive data for squid (I. coindetii). The annual quantities of fish landed in the Region are declining: in 2008 the catch was 30,810 tons, and in 2018 it was 21,432 tons. The number of active boats and the fishing capacity of boats are also declining; the reduction concerns the trawl fleet, which was reduced by 24 percent between 2010 and 2017.

Impatti dei cambiamenti climatici

The fishing industry is affected by climate change which causes and amplifies changes in the state of marine ecosystems. The strain of fishing adds to these impacts on the marine ecosystem and affects their responsiveness, undermining the services they provide to our society.

One of the main impacts relates to pathogenic microorganisms and alien species, which are becoming more numerous due to rising water temperatures. The increased spread of pathogenic microorganisms in response to rising surface water temperatures (Zgouridou et al. 2022) will also impact aquaculture facilities. Indeed, marine pathogens, enhanced by global warming, can impact the immune systems of bivalve molluscs and weaken their tolerance to temperature extremes.

Phenomena such as "meridionalization" (presence of warm-water species in northern regions) and "tropicalization" (expansion of non-native tropical species) are also intensifying and change in the rate of warming of water temperatures have negative impacts on the optimal habitats for small fish living in the open sea (small pelagics), which may also affect the ethology of the species, and species that stay in the

vicinity of the seafloor. At the same time, temperature and climate regimes may also directly impact the metabolism and physiology of native pelagic species. The increase in gelatinous organisms and particularly the ongoing invasion of the sea nut (*Mnemiopsis leydi*) could contribute to the decline of small pelagics through processes of trophic competition and predation on larvae and eggs. As pelagic species are particularly sensitive to climatic regimes and changes in productivity, it is expected that the purse seine fishery may be particularly affected by these changes.

Increasingly frequent abnormal weather events will cause abrupt disruptions in some water parameters and the mortality of bottom-dwelling species. Aquaculture facilities will also be impacted by extemal events, both through **damage to facility structures** and **increased vulnerability of bivalve shells** due to a combination of factors including water acidification and warming.

The likely worsening of the overall chemical status and increasing eutrophication processes, combined with the numerous impacts that negatively affect ecosystem integrity (such as fishing, alien species inputs, mining activities, hypoxia and anoxia, ocean acidification, and global warming) suggest the lickely possibility that the quality of the marine-coastal ecosystems in the Marche region will incur deterioration. These stresses will not act in a single manner but in a synergistic context, placing great pressure on ecosystem functioning (Bindoff et al. 2019).

For years the fishing sector has suffered from various critical exogenous factors. One particular, concrete threat to the local sector is the large amount of foreign catch on the market (fresh and frozen). The economic crisis has also greatly reduced households' spendable income, resulting in a decrease of fish consumption. The processes of environmental degradation of local marine ecosystems seem to be further accelerated by ongoing and expected climate change, which contributes the loss of marine biodiversity and coastal erosion. Indeed, the Regional Strategy for Sustainable Development of the Marche makes it a priority to act on fishing. The action is located within the Strategic Choice B "Climate Change" and is called "Sustainable management of marine resources and coastal territory." The measure calls for coastal and crossborder dialogues with fisheries and the fish processing industry in order to ensure compliance with precise limits, seasonality and special characteristics. It also calls for the preservation of natural resources (species and habitats), highlighting how the alteration of native animal and plant communities has repercussions on the equilibrium of ecosystems.
The three Fisheries Local Action Groups (FLAGs) into which the coast of the Marche is divided have conducted an analysis within their Local Development Strategies, identifying the strengths, weaknesses, threats and opportunities of the industry.
The FLAG North Marche has identified as weaknesses: the constant reduction in the number of enterprises in the fishing industry; the difficulty for small businesses to invest in innovation and diversification; the lack of synergy between the fishing and the tourism sectors (there are currently no fishing tourism activities in the area); the need for shared management strategies for fishing activities due to the reduction of fish stocks; the local catch, especially blue fish, is poorly valued and scarcely consumed; the sector still has a significant negative impact on the environment, with antiquated means; there is a deficiency in the port services for fishing enterprises. Strengths include how small-scale fishing enterprises, which account for about 50 % of the fleet here, ensure fishing that tends to be more

sustainable for the marine ecosystem. The investments made in improving means, services and safety in ports and vessels has improved the small and medium-sized fishing enterprises from the point of view of the condition of those working in the sector.The sector then presents significant opportunities for development, especially with regard to the activation of new services for the diversification of traditional fishing and processing activities, including through an increased focus on micro fish fisheries that may have a significant capacity for commercial enhancement in both local and international markets.

The FLAG Marche Centro has identified as weaknesses: the presence of micro-enterprises, with a gradual aging of the workforce, poor prospects for generational turnover and a rather low rate of schooling. Then emerges the combination of strong competition from foreign markets with a domestic difficulty to innovate and invest in equipment and vessels. Amongst the various threats the effects of climate change, "which predominantly impacts the quality and availability of fish stocks in the Middle Adriatic" are identified as the most important. It is also pointed out that climate change also affects the loss of marine biodiversity, as well as the increased risk of coastal erosion. Strengths include the important cultural heritage linked to fishing traditions and seafood cuisine in the Marche region, an element to be enhanced in terms of tourism, fish tourism and ichthyic tourism, promoting fishing through income diversification. The area's substantial fishing fleet can represent a potential to be exploited for these activities.
FLAG Marche Sud first highlights among the fragile elements of the sector the lack of cohesion among the sector's actors and the fragmented nature of the initiatives promoted to enhance it. A lack of capacity for innovation is then also observed in this area, at the technological level but also regarding the promotion of alternative activities to fishing (e.g., fishing tourism) that would complement the scarce added value generated by the local fish product (clams, mussels, blue fish). Strengths include the quality of local seafood products and the growing appreciation of seasonal products. In addition, in this territorial context it is highlighted how the area's port areas are effectively connected with urban centers and other areas of the territory. The presence of sites of community interest is also emphasized (San Benedetto del Tronto, near the Sentina Nature Reserve and in Grottammare near the San Nicola rock and a third proposed area located in the area in front of the Pedaso lighthouse). These areas of high naturalistic value can promote the repopulation of the local fish stock and represent target areas for the tourism sector. Threats to the future of the sector include the difficulties of generational transition and the progressive reduction of the fish stock, related to increasing environmental pollution and degradation of the coastal ecosystem and desertification of the seabed.

Key risk

Risk of significant economic losses to the fisheries and aquaculture sector. Damage to aquaculture facility structures, increased vulnerability of bivalve shells leading to lower farm productivity, degradation of native species, and introduction of alien species.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**high**	The fisheries and aquaculture sector is highly exposed to the effects of climate change, effects further amplified by external drivers related to regional and global economic dynamics and specific elements of vulnerability.

Reliability level (low, medium, high)	**medium**	Scientific indications and observed evidence seem to confirm the preliminary considerations made on the causal factors of this risk. The real impact on socio-economic sectors related to fisheries and aquaculture, however, is not sufficiently defined, and more in-depth investigations would be needed.
Possible conflict level (low, medium, high)	**low**	The level of possible conflict related to this risk is considered to be low. This indicates the possibility of focusing adaptation efforts on finding effective solutions, including technical solutions. However, this does not exclude the need for partial transformation of the sector.

4.1.4 Energy

The energy sector is essential to powering our daily activities, contributes significantly to economic development, plays an increasingly important role in the transition to cleaner and more sustainable sources of energy, and is critical to maintaining good health and well-being, as energy is needed to heat and cool homes, provide clean water, and support health systems. Since the management of energy, and in particular electricity, is important to keep most socioeconomic systems running, it is delegated to national utilities. However, it is important for all regions to ensure an adequate level of self-generation to decrease transportation and distribution costs, increase resilience to natural events, and to contribute to the compensation and regulation mechanisms that will be increasingly important in the future to successfully integrate renewable sources characterized by a higher level of volatility.

In the Marche region, energy consumption exceeds production: over the period 1973-2020, the region had to import energy every year. In 2020, the region used about 7,019 GWh, including about 541 GWh of losses and about 6,478 GWh of consumption. Of these 7,019 GWh, 68.6% came from sources outside the Marche region, which therefore exhibits a high energy dependence on the national system. Energy production in the Marche region derives almost entirely from renewable sources, and in particular from photovoltaic, followed by hydroelectric and the renewable share of thermoelectric, while wind power accounts only for a small share of the entire renewable production. The long-term trend in renewable energy production shows an increase in energy produced, particularly for photovoltaics, related to the implementation of renewable incentive policies. However, this trend stopped when the public support measures ended. Over the past decade, there has been a reduction in electricity production that cannot be associated with plant decommissioning but rather can be attributed to a change in water availability associated with changes in rainfall regimes. Total electricity consumption in the Marche region has been declining slightly since 2007, due to a decrease in the energy consumption of the two sectors that use the most electricity: industry (43%) and services (30%).

Climate change impacts

The energy sector is affected by and influences climate change. On the one hand, energy production and consumption are contributors to the emission of climate-altering gases and thus to climate change; on the other hand, climate change may lead to increased consumption as well as changes in production, especially of renewable energy. Climate change and in particular rising temperatures and heat waves will most likely have an impact on the production system and even more so on demand, as the need for space cooling will increase during the summer season. The increased use of cooling systems could overload the power grid and cause episodes of power outages.

In addition, it is necessary to consider that in the coming decades, progressive decarbonization and electrification of transportation and heating systems will further increase the pressure on the electric infrastructure. With regard to production, extreme events (such as storm surges and flooding events) can cause physical damage to electric power plants and infrastructure.

Depending on the specific characteristics of power production and transportation facilities, different impacts are expected.

Hydropower plants

The increase in the intensity and frequency of extreme precipitation events and a reduction in cumulative precipitation could lead not merely to greater difficulties in the operation of hydropower plants but also to a reduction in hydropower production greater than what could be expected on the basis of reduced precipitation alone, especially if some reservoirs were to be closed due to the absence of economic conditions for their exploitation. These difficulties would especially affect run-of-river plants, with increased downtime due to reduced river flows, especially during summer periods. For storage plants, the availability of adequate storage volumes could play a key role in the reliability of the power system as a whole, not only in relation to the variability of water availability but also to discontinuous trends in electricity demand. Discontinuity that is due to the increasing presence of numerous renewable energy sources with intermittent characteristics.

Thermoelectric plants

Generally, the production capacity of thermoelectric power plants could be adversely affected by certain phenomena associated with climate change, such as flooding, reductions in the availability of cooling water and an increase in its temperature, and, finally, an increase in the frequency and intensity of heat waves. Increased temperature and temperature extremes could cause a reduction in the efficiency of thermal power plants. The efficiency of a thermoelectric plant in transforming fuels into electricity depends on the temperature differential between the machine and the external environment. The greater the heat differential, the greater the conversion efficiency and vice versa. As air temperatures increase, the heat differential between the machine and the environment decreases, thus reducing the net power output. The increase in temperature of cooling water, whether of marine or river origin, required for cooling thermoelectric plants, impacts the efficiency of the plant itself. Power plants would need a greater amount of water to ensure their operability. If this increased demand could not be met, the alternative would be to operate at reduced capacity or to shut down the generating plant. During prolonged periods of drought, the water level of water bodies may be inadequate for cooling needs, consequently requiring the shutdown of production activities in order to avoid overheating events. These climate changes may, therefore, especially affect fossil fuel power plants cooled with river water. Finally, the possibility that these kinds of phenomena (droughts and heat waves) may also occur simultaneously should not be overlooked.

Physical damage to the power generation infrastructure

Physical damage to the power generation infrastructure caused mainly by sea and river flooding due to increased frequency and intensity of extreme events and a rise in sea level could cause a reduction in plant production capacity or even a cessation of operations. There were 343 thermoelectric self-producers in 2021, mostly small power plants, while as of December 2022, the large thermoelectric plants in the Marche region were not operating. If the seawater-cooled combined IGCC plant in Falconara Marittima or the river water-cooled thermoelectric power plant in Jesi (AN) were to come into operation, these plants could be impacted in various ways. Both plants would be affected by the heating of cooling water, the Jesi (AN) thermoelectric power plant would be affected by the decrease in river water, and the Falconara combined plant would be affected by the increase in storm surges.

Power grid

The main factors that cause inefficiencies of the power grid are typically: floods, landslides, tornadoes and other extreme phenomena that may result in the collapse of supports or other structural failures; contact with power lines by foreign bodies on assets (plants, trees, branches, tarpaulins, etc.) carried by strong winds; formation of ice sleeves on the lines due to the so-called wet-snow phenomenon, which, by generating high overloads, weigh down the lines and cause short circuits or structural failures; increase in pollutant deposits related to long dry periods (e.g., saline pollution) that causes an increase in the probability of surface discharge. Over the past few years, the power grid infrastructure has been mainly affected by intense snowfall and with an intensification of strong wind gusts as well. Some grid criticalities are already present in the load area between the Villanova, Candia, Villavalle and Pietrafitta ultra-high voltage stations. Large portions of lines in the provinces of Pesaro and Urbino and Ancona have exceeded the voltage for which the line is designed 21.7-65.9% of the frequency (data July 2019-June 2020). Moreover, the entire 132 kV Adriatic system is fed by just four transformer stations (Fano, Candia, Rosara and Villanova) making grid operation in this portion of the territory particularly critical during the summer season. For these reasons, the development interventions already in place are necessary.

Key risk

Risk of increased incidents of power outages. Power outages may occur when power demand exceeds the generation capacity of the infrastructure, either temporarily or structurally, or may be due to damage, failure, or malfunction of power distribution systems. In particular, increases in the intensity and frequency of extreme events can threaten the physical infrastructure of the power grid. The increase in heat waves, and consequently the increased use of cooling systems has the potential to overload the power grid and cause episodes of power outages. In addition, outages can be caused by power failure due to a reduction in power generation. This can be linked to rising temperatures, making heat wave periods particularly critical.

Indicator	Qualitative evaluation	Description
Risk severeness (low, medium, high)	**medium**	The magnitudes of the consequences are significant considering the dependence of socioeconomic sectors (e.g., industry, transportation, domestic use) on the energy resource. However, the impact is reversible, as electricity can be restored to the affected areas. The Marche region is also included within the national energy system and is characterized by a differentiation of production sources, decreasing the probability of the occurrence of these episodes. This risk could increase in the future as a result of overlapping negative effects (increased temperatures, extreme events) and the exacerbation of vulnerable conditions in the area.
Reliability level (low, medium, high)	**medium**	The impacts of climate change related to extreme events are recognized both scientifically and by grid operators. In

		contrast, the effects on plant productivity and demand change need further in-depth studies and empirical data.
Possible conflict level (low, medium, high)	**low**	The level of possible conflict related to this risk is considered to be low. However, it is necessary to emphasize that the management of most of the electric generation and transmission infrastructure is a national responsibility.

4.1.5 Turism

Tourism is considered a highly climate-sensitive industry and is strongly influenced by environmental and socioeconomic changes related to climate change. In the case of beach and mountain tourism, climate change can affect flows and peak periods due to events such as heat waves or lack of snow. In addition, tourism activities themselves can have a significant impact on elements that may concur, along with climate change, to generate or increase risks to human health or the land as a whole. Beach tourism activities (e.g., infrastructure) if promoted without considering the possible natural hazards and expected effects of climate change may, for example, contribute to an increase in assets and people exposed to storm surges or flooding, while also reducing the overall response and adaptive capacity of the territory.

As regional data show, the predominant form of tourism is coastal/balneal tourism, for which it is necessary to consider and analyze the implications related to rising mean sea levels and on which non-negligible elements depend, such as loss of portions of beach, possible destruction of beach infrastructure, alteration of biodiversity, increase in the need for coastal protection, and changes in landscape aesthetics.

Winter snow tourism, though accounting for a residual portion of the total tourist arrivals in the region, has also suffered significant effects in recent decades related to climate change, and in particular rising temperatures and the absence of snowfall.

In the region, tourism is a sector that can be enhanced more and has some critical issues, indicated in the *Piano Regionale Del Turismo* (2021-2023), which particularly emphasizes poor seasonal adjustment. In fact, looking at the data on arrivals in accommodation facilities, the lack of seasonal adjustment of tourism can be seen, as the numbers referring to the summer months show more than double values compared to other months. For the period 2019-2021, the summer share is on average 57 percent of total arrivals, while the winter share is 10 percent.

Regarding the location of tourist flows in the regional territory, in 2021 32.3% of arrivals were concentrated in the province of Ancona, followed by Pesaro Urbino with 26.5%, Ascoli Piceno with 15.7%, Macerata with 15.1% and Fermo with 10.4%. At the municipal level, the Regional Tourism Observatory (*Osservatorio Regionale del Turismo*), which systematizes data on tourist arrivals, reports that the top ten municipalities by number of arrivals in 2021 are all on the coast, confirming the predominant role of seaside tourism. The flow of tourism concentrated on the coast in the summer months may affect the localized increase in resource use, particularly water resources. It should be mentioned that according to the findings of climate analysis and expected impacts of climate change, we are witnessing a gradual decrease in cumulative precipitation, particularly in the summer months, and an increase in the extent of drought periods, creating conflicts between different uses of the resource (e.g. drinking use for the resident population and the tourism sector and irrigation uses for the agricultural sector).

However, in addition to beach tourism, according to the *Piano Regionale Triennale di Promozione Turistica* 2016-2018, the Marche region ranks first in Italy in terms of incidence of employment related to culture and creativity and second in terms of added value of the same sector. The province of Pesaro and Urbino is second in the ranking of the top ten Italian provinces for both wealth and employment produced by the cultural production system. These peculiarities, if properly exploited, could contribute to effective seasonal adjustment.

4.1.6 Urban settlements

The urbanization and infrastructure phenomena affecting the regional territory have profound effects on land use and consumption. When analyzing soil consumption, it is necessary to keep in mind the distinction between permanent consumption (permanent artificial cover) and reversible consumption (reversible artificial cover); total sealing, which is its most extreme form, is the main cause of soil degradation in Europe. In fact, sealing leads to a high risk of flooding, contributes to climate change, threatens biodiversity, causes the loss of fertile agricultural land and natural and semi-natural areas, and finally contributes, together with urban sprawl and the progressive and systematic destruction of the landscape, especially rural, to the loss of the capacity to regulate natural cycles and mitigate local thermal effects (Commissione Europea 2021).

According to the National Land Consumption Report , published by the National Networked System for Environmental Protection (SNPA 2022). in collaboration with Regional and Provincial Agencies and ISPRA, in 2021, the Marche region recorded a total land consumption of 64,751 ha, or 6.94 % of the entire regional area. Specifically, it is the province of Ancona that records the highest percentage figures (9.02% of the land consumed in 2021), while in terms of the change in the amount of land consumed from 2020 to 2021, the province of Macerata records the highest figure, with a net increase of 63.80 hectares consumed (SNPA 2022). At the municipal level, however, San Benedetto del Tronto has the highest percentage of consumed soil, with 37.20 percent, corresponding to 946.94 ha.

On a per capita level, in 2021, Marche recorded a soil consumption of 432.88 m2/inhab, higher than the national average of 362.70 m2/inhab.

From the point of view of the impact of land consumption on ecosystems, at the regional level, only 0.8 percent of the consumed soil is located within areas of high ecological value: this index, defines, in fact, the natural value of a biotope from the environmental point of view and highlights areas where there are peculiar aspects of naturalness of the territory. As for the other ecological value classes, the percentages recorded are as follows: 1.3% for high ecological value, 1.9% for medium value, 3% for low value, and 4% for very low value.

However, land consumption can have non-negligible effects on biodiversity and ecosystem services even in areas adjacent to built-up areas, due to ecological degradation that extends beyond the directly affected area. In order to define the effects in these areas, ISPRA develops a guideline estimate of the potential impact of land consumption, considering an influence criterion based on distance,

4.1.7 Health

The regional figure that refers to the generic mortality rate per 1,000 inhabitants has worsened in the period between 2011 and 2021, from 10.6 to 13.3 per 1,000 inhabitants; however, within it, mortality rates by single disease have had variations that do not always reflect the general average. Some of these rates, referring to diseases most directly related to climate trends and climate change, have followed the trend in general mortality, such as the mortality rate related to diseases of the circulatory system, which rose from 41.22 in 2004 to 40.54 in 2019 (the latest year available) or the mortality rate for ischemic heart disease, which rose from 15.62 to 12.98. In contrast, the mortality rate from chronic obstructive pulmonary disease increased from 3.49 to 4.15.

Climate change poses a threat to population health. In particular, the One health approach recognizes that the health of humans, domestic and wild animals, plants, and the environment in general (including ecosystems) are closely linked and interdependent, and therefore it is necessary to adopt "integral" forms of surveillance that, in addition to human health, include livestock, wildlife, and habitats at risk. Some of the major effects of climate change on health depend on an imbalance in ecosystems with increased intensity of health risks related to disasters, extreme events, reduced water availability, food security, and changes in the occurrence and spread of diseases of infectious origin (pathogen vectors, contaminated water and food). A holistic approach, such as that suggested by One health, urges us to understand the connections and interdependence among various living systems in order to act in an integrated way that benefits humans, animals and the planet.

The association with the issue of human health is an important aspect of the major impacts already observed or expected of climate change. Indeed, climate change can alter patterns of environmental exposure to numerous physical, chemical, and biological risk agents (Bais et al. 2014; Pyšek et al. 2020). To these all the other phenomena recorded in recent decades, such as the increased frequency, duration and intensity of heat waves in the summer season should be added. In addition, increased frequency and intensity of extreme weather events and increased weather variability may expose people to new risks or risks that are already present but with a higher probability. In addition, there is a link between climate change and stratospheric ozone dynamics, the level of which influences the overall amount of UVB (Ultraviolet B:280 to 315 nanometers) radiation reaching the ground: exposure to air pollutants such as ozone, volatile organic compounds, and particulate matter is very sensitive to environmental microclimatic conditions and can be modulated by solar radiation, especially with regard to so-called photochemical pollutants (ozone, aldehydes, PAH derivatives, etc.). Again, the overall effect of climate change can be characterized by a wide local variability, resulting in net increases or decreases in exposure to individual classes of tropospheric pollutants or individual substances.

The effects of climate change on population health are not evenly distributed across the territory: these consequences are more severe in areas with higher population density and will mainly affect the most fragile segments of the population, i.e., those with lower incomes, lonely elderly people, immigrants and people with poor housing conditions, and the chronically ill (chronic obstructive pulmonary disease, asthma, cardiovascular disease, etc.).

The percentage incidence of people with at least one chronic disease ranged from a low of 36.8 to a high of 42.6 during 2009-2021. The chronic diseases linked to factors related to climate change that

were analyzed are hypertension, which records the highest rate, followed by allergic diseases, chronic bronchitis, and diseases of the heart.

Regarding hospitalization in the regional territory, a distinction can be made between the two main types: acute or long-term care/rehabilitation. During the period under consideration (2004-2020), the rate has decreased significantly, while the share of the two types of hospitalization out of the total remains mostly unchanged. Acute hospitalization accounts for an average of 95% of all hospitalizations in the region each year.

The regional data referring to the generic mortality rate per 1,000 inhabitants has worsened in the period between 2011 and 2021, from 10.6 to 13.3 per 1,000 inhabitants; however, within this figure, mortality rates by single disease have had variations that do not always reflect the general average. Some of these rates, related to diseases most directly linked to climate trends and climate change, have followed the trend in general mortality, such as the mortality rate related to diseases of the circulatory system.

The climate change adaptation strategy

5 The climate change adaptation stategy

Adaptation objectives

The main objective of the l Piano regionale di adattamento al cambiamento climatico (PRAAC) is to put in place measures and actions aimed at strengthening regional adaptive capacity. As highlighted in the previous chapters, climate change acts in a cross-cutting manner on various environmental, social and economic aspects. Therefore, the Plan will necessarily have to act in a cross-cutting and cross-sectoral manner. Accordingly, the overall goal is articulated through the following objectives: definire una *governance* regionale per l'adattamento, esplicitando le esigenze di coordinamento tra i diversi livelli di governo del territorio e i diversi settori di intervento;

- Improve and systematize the knowledge base on climate change, both in terms of climate data and scenarios and in terms of vulnerability, so as to provide an effective framework for responses;
- Integrate climate change adaptation into sectoral policies, at regional and local levels.

These general objectives are then articulated into specific objectives that are derived from the analyses of climate change vulnerability and risks for the Marche region.The objectives are implemented through lines of action, which contain measures.The objectives and lines of action of the Plan, are summarized in **Adaptation** section of the technical appendix, which also identifies the correlation with the actions of the Regional Sustainable Development Strategy.

Lines of action

The Plan's actions have been divided into two categories, according to the type of goals to which they contribute to:

1. Cross-cutting adaptation actions.
2. Adaptation actions for specific vulnerabilities

The cross-cutting adaptation actions are actions that by their very nature affect multiple adaptation sectors. Cross-cutting actions refer directly to the sustainability vectors identified in the Regional Sustainable Development Strategy.
Adaptation actions for specific vulnerabilities, on the other hand, refer to individual issues (environmental resources, economic or social factors, etc.) and contribute to the achievement of specific adaptation goals. The lines of action are divided into measures, which can be cross-cutting or refer to specific vulnerabilities. Measures are divided into two types, which refer to the ways and means of implementation: the Plan's own measures and sectoral measures.
The Plan's own measures are steering and monitoring actions closely related to the issue of climate change. In some cases, the Plan's own measures are cross-cutting in nature; in other cases, they may refer to a specific vulnerability, but one that is addressed with tools that do not belong to a specific sector.

Sectoral measures are those that act within the planning, regulatory, management or normative instruments of the sector under investigation.

5.1.1 Cross-cutting measures

Climate change is by its very nature a cross-cutting phenomenon; therefore, adaptation policies require a cross-cutting approach alongside a more specific and sectoral one. The definition of cross-cutting adaptation measures follows the logic of "sustainability vectors" in the *Strategia Regionale di Sviluppo Sostenibile*. Sustainability vectors are cross-cutting areas of action indicated by the National Sustainable Development Strategy, to be considered as key levers to initiate, guide, manage and monitor the integration of sustainability into policies, plans and projects, in line with the transformative process triggered internationally by the 2030 Agenda.
Within this Plan, adaptation actions have been identified for the following vectors:

Capacity building: It is the phrase, which has entered common speech, meaning the improvement of the public administration performance. It is a continuous process of improvement within the organization that can be enhanced or accelerated by external inputs and is capable of fostering capacity building through the use of existing capabilities. Capacity building actions for climate change adaptation focus on process governance.

Common knowlege: in general, it relates to improving the state of knowledge. In particular, it refers to the areas where more efforts are needed to complete the information framework, functional to the formulation and evaluation of development policies. For climate change adaptation, common knowledge actions mainly concern the systematization of data and information, the creation of networks and modes of exchange, and the strengthening of synergies, so as to create a common framework that effectively supports decision-making.

Education, information, communication: it represents one of the key dimensions for the effective achievement of a "culture of sustainability," to be promoted at all levels (business, civil society, institutions, research) and in all educational venues, formal and nonformal, from a life-long learning perspective. The goal is to trigger the transformation of the current development model, as well as the dissemination of knowledge, skills, lifestyles and virtuous models of sustainable production and consumption. Adaptation actions for this vector refer in particular to strengthening awareness of the current dynamics, risks and behaviors.

Subsidiarity participation and partnerships: directed at fostering the creation and dissemination of effective and continuous initiatives and pathways for the involvement of all stakeholders at different stages of the decision-making processes. To this end, it is necessary to develop mechanisms for integration at the institutional level, as well as participation and active involvement of the civil society. It is also essential to ensure the development of public-private partnerships in the different sectors that guarantee the adoption of sustainability, quality and innovation criteria.

5.1.1.1 Capacity building measures and actionse

Capacity building measures are mainly concerned with two aspects: policy coherence and governance.
Policy coherence aims at ensuring the integration and coherence of climate change adaptation both in the vertical dimension (i.e., international, national, and local levels) and in the horizontal dimension, involving sectors and resources pertaining to regional policies. Promoting policy coherence means working for the simplification and enhancement of the coordination mechanisms.
Governance is therefore also particularly important in relation to policy coherence. Governance for the Climate Change Adaptation Plan coincides with that of the Regional Sustainable Development Strategy, under the direction of the *Cabina di regia*, appointed by Secretary general's decree No. 27/2022. The *Cabina di regia* identifies the **contact persons of the working group** of the regional structures that follow the implementation and monitoring of climate change adaptation policies, and these liaise with those in charge of the plan in order to ensure the coordination of cross-cutting policies. The constitution of the working group, in terms of composition and activities, will be determined by a subsequent act of the regional secretary.
In relation to governance and in view of the cross-cutting nature of climate change, it is also important to proceed in order to ensure the **completion of the mapping of regional structures** that can act on certain factors and resources to be considered in the adaptation strategies.

Sustainability vector	Action lines	Actionable measures
Capacity building	Creating a governance for adaptation	Creation of the working group for the governance of the Plan.
		Completing the mapping of the regional structures that can act on certain factors and resources

5.1.1.2 Common knowledge measures and actions

Knowledge of medium- and long-term climate scenarios is essential for guiding adaptation policies and establishing priorities. Generating climate scenarios to a level of detail appropriate to that of regional planning needs both observed data (direct measurements and satellite data) and forecasting models.
The Marche Region has networks for monitoring climatic variables, which belonging to different regional offices (*Direzione Protezione Civile e Sicurezza del territorio, Direzione Agricoltura e Sviluppo rurale*) and the *Agenzia Regionale per la Protezione Ambientale*. There are also other entities within the regional territory that collect and process climatological data. These are supplemented by the expertise of universities and research centers.
Currently, there is a lack of coordination for the systematization of available information and knowledge. Therefore, it is necessary to create a **Permanent Table/Observatory** with the involvement of all stakeholders (research centers, universities, provinces, ARPAM), coordinated by the Region with the aim of promoting the synergy of all available expertise. Specifically, the function of the Permanent Table/Observatory is to:

- Check the state of available knowledge (in terms of monitoring networks and models);

- Identify climate knowledge needs and priorities;
- Provide guidance on the development of homogeneous climate frameworks and scenarios for the regional territory;
- Provide guidance on adaptation priorities based on climate scenarios.

The composition and mode of operation will be determined by a subsequent act of the Regional Council (*Giunta Regionale*).

The information currently present is to be made available to enable guidance for planning, but also for the choices of private individuals. As part of the Interreg Italy-Croatia AdriaClim project, a **geoportal** for sharing climate data has been developed. The Marche Region, a partner in the project, can use the geoportal for sharing a set of climate indicators. Implementing the geoportal with up-to-date data and information and making it available to the public is a necessary adaptation action.

In parallel, it is important to consolidate the knowledge base by strengthening the monitoring of climate change-related variables. For both the creation of knowledge frameworks and the development of models, it is essential to have observed time series, for which it is necessary to provide **monitoring networks for data collection with constant funding.** While for some variables this is relatively straightforward (e.g., meteorological data collected through monitoring stations), for others it becomes necessary to provide special measurement campaigns (e.g., soil moisture). To support monitoring networks, it is useful to develop innovative tools and methods for collecting and sharing data and to use this data to build a hydrometeorological forecast modeling systems. It is also necessary to develop tools and methods for the use and processing of climate data, including through appropriate modeling, in order to produce climate services (analyses, assessments, and long-term projections calibrated to specific needs).

Sustainability vector	Action lines	Actionable measures
Common knowledge	Systematizing common knowledge	Permanent table/Regional climate observatory.
		Geoportal with AdriaClim climate data
	Strengthening knowledge	Introduce and strengthen monitoring networks for data collection and time series creation, develop innovative tools and methods for monitoring phenomena and collecting and sharing data by ensuring ongoing funding
		Develop tools and methods for data analysis and processing, forecasting and hydrometeorological modeling systems, and general climate services

5.1.1.3 Education, information, communication measures and actions

Education on climate change issues is a key aspect of adaptation, this is implemented through actions that aim to inform and communicate the issue. These actions must address different targets, targeting both the adult population and the education of younger groups.

Therefore, possible measures to strengthen education for a "Culture of Sustainability" can be of various kinds. One of the most important is certainly that which refers to **Education for Global Citizenship (ECG)** and especially to related local strategies as tools for creating widespread awareness about dynamics of interdependence on a global and local scale with particular attention to certain issues, including that of climate change. These strategies ensure the activation of specific educational pathways aimed at the population, especially the most vulnerable groups. The regional law on ECG (R.L. 23/2020) is an important starting point for the use of this tool across the board in adaptation strategies. Within the framework of this Plan, **training and information projects** aimed particularly at youth and students will be activated, with a focus on the Plan's actions directly aimed at the population.

Of particular importance is education with respect to risk situations arising from climate change. In this regard, the Civil Protection and Territorial Safety Directorate of the Marche Region has already activated **paths in schools** for education on specific issues related to risk. It is important that this activity be continued and strengthened.

Another fundamental aspect is the education of the citizenry on the correct behaviors to adopt in relation to emergency or potentially dangerous situations. To this end, it is necessary to activate targeted **education and training** courses, including exercises, so as to strengthen knowledge for **self-protection from risks**.

One of the main vulnerabilities that emerged from the Plan's analyses concerns the availability of the water resource. Along with measures aimed at adapting citizens' habits to possible climate scenarios, it is also important to activate campaigns **to raise awareness of the responsible use of the water resource**.

In addition, in order to make information on planning choices accessible, effective and direct methods need to be identified, such as the **creation of a page on the institutional website** dedicated to climate change adaptation.

Sustainability vector	Lines of action	Actionable measures
Education, information, communication	Strengthen education on climate change adaptation issues	Leveraging Global Citizenship Education (ECG) in adaptation: activation of training/information projects
		Strengthen civil defense education actions in schools
		Improve and enhance citizen self-protection through exercises, training and education
	Inform and raise awareness of specific vulnerabilities among the public	Activate campaigns to raise awareness of the responsible use of the water resource

	Identify effective methods for communicating the Plan's choices	Create a page on the institutional website dedicated to climate change adaptation

5.1.1.4 Measures of subsidiarity participation and partnerships

As mentioned, climate change adaptation is a cross-cutting process that needs to be implemented by involving and collaborating with different levels of society. For this reason, it is important that in the implementation of the Plan, not only institutional bodies but also civil society should be involved. In this regard, the **Regional Forum for Sustainable Development** stands as a basis for discussion and collaboration and aims to foster concrete, continuous and consistent participation in the entire process.
At the local level, adaptation policies are implemented by some municipalities through PAESCs (Sustainable Energy and Climate Action Plans) developed within the "Covenant of Mayors." Although **PAESCs** are primarily aimed at climate-altering gas emissions, in recent years they often include sections on adaptation. It is essential that the choices made by individual administrations be **networked** to form a knowledge and comparison base that is also useful to local governments that have not yet embarked on planning.
Exchange of experience, collaboration and creation of shared tools with other administrations are also crucial for the regional administration, which for this purpose promotes **participation in European projects** on specific aspects to develop tools and methods for adaptation.

Sustainability vector	Lines of action	Actionable measures
Subsidiarity participation and partnerships	Creating synergies with local entities	Use the Regional Forum for Sustainable Development as a discussion tool for the implementation of the Plan
		Provide tools for the networking of PAESCs
	Creating partnerships	Participate in European projects on climate change adaptation

5.1.2 Specific measures

5.1.2.1 Measures and actions for the qualitative protection of water resources

Vulnerability and risk analysis shows that ongoing climate change may lead to degradation of water resource quality. This risk is associated with several factors.
Increased episodes of heavy rainfall resulting in sudden and violent river flooding events may result in increased episodes of flooding of the catchment network resulting in urban flooding. In addition, such episodes but also just extreme rainfall events can result in regurgitation of the sewer network or drainage

ditches and drains. Therefore, it becomes essential to intervene on the sewer network with maintenance or adjustment operations in urban areas prone to flash flooding in order to prevent such episodes. Adaptation of the sewer network is also to be considered in order to limit episodes of **sewer backflow**.
Reduced water availability in natural and semi-natural water bodies implies reduced dilution and deterioration of quality status. For this reason, it is necessary to minimize pressures understood as pollutant inputs. In this sense, it is essential to encourage **agricultural practices** that optimize the use of fertilizers and minimize the use of pesticides, including by taking advantage of technology. For possible anthropogenic sources of pollution, it is necessary to activate or strengthen **protocols for control and monitoring** of industrial and agricultural processes related to contamination.
The quality of surface water bodies also depends on the flows that flow in them. In the case of withdrawals subject to a concession, legislation has introduced the concept of **ecological runoff** (DE), which is an evolution of the concept of minimum vital runoff (DMV): with it we move from guaranteeing a minimum instantaneous flow rate to guaranteeing a hydrological regime to achieve the environmental objectives set out in the EU Water Framework Directive No. 2000/60/EC. The calculation of ecological runoff considers both the hydrological and environmental components of the water body. However, ongoing climate change may exacerbate the torrential character of some water bodies, leading to critical situations from an ecological point of view, possibly compromising environmental quality objectives. It is therefore important that forecasting procedures and protocols for optimizing Ecological Runoff be established, also in relation to climate change, avoiding as much as possible emergency flow management of water bodies.

5.1.2.2 Measures and actions for sustainable use of water resources

One of the most direct effects of ongoing climate change for future scenarios will be a reduction in the availability of water resources. It is therefore necessary that uses of the resource be optimized and wastage reduced.
Upstream of it all is the need to complete and keep up-to-date the definition of hydrological and water budgets and Water Balance Planning. The water balance makes it possible to assess the balance or otherwise between the availability of resources that can be found or activated in a reference area and the needs for different uses in compliance with the objectives and criteria established by law. Through **Water Balance Planning**, which will be a pillar of the Water Protection Plan, measures to be taken to counteract any imbalances are identified, including the review of current uses. In accordance with Directive 2000/60/EC, Ministerial Decree July 28, 2004, Legislative Decree No. 152 of April 3, 2006, water balance must be verified at the basin scale, for sub-basins connected to surface water bodies and for groundwater bodies, at least at the detailed scale identified by the basin planning.
For the Marche Region, the Environment and Water Resources Directorate is preparing water budgets. Currently, an initial draft of the Water Budget Planning has been prepared, which contains analyses of the availability of the resource as runoff and infiltration and an indication of the activities that need to be carried out to complete the Budget Planning; these activities are being progressively developed. **Water budgets** are the fundamental tool for managing uses and resolving conflicts. It is therefore essential to put in place tools that allow them to be updated periodically, including in accordance with climate change scenarios, and to strengthen **early-warning** activities to address water scarcity situations.
For the purpose of drafting water budgets, monitoring of uses thus becomes a fundamental tool not only for knowledge but also for management of water resources.
The Marche Region has developed, within the Regional Agriculture Information System (SIAR), a section dedicated to the monitoring of water resource uses (SIAR-DAP) within which derivation and capitation

concessions for each type of use are stored and managed. At present, the quantities of water granted are entered into the system. However, it is planned, as indicated in national regulations and the Water Protection Plan, to enter data on actual withdrawals. Strengthening the monitoring of uses, by ensuring a flow of information of the actual quantities withdrawn, allows for more efficient planning of uses.
With regard to the use of water for agriculture, following the approval of the Decree of the Ministry of Agricultural Food and Forestry Policies of July 31, 2015 on the "Approval of the guidelines for the regulation by the Regions of the methods of quantification of water volumes for irrigation use," the Marche Region approved DGR 590/2017 *DM MIPAAF July 31, 2015 - Approval of: "Regional criteria and methods of quantification of water volumes for irrigation use.*" Based on the above guidance, the Reclamation Consortium reports the irrigation volumes used by entering the information into the SIGRIAN system and the Region validates the data. With regard to self-supply withdrawals, the Region enters the measured or estimated data reported by users for SIAR-DAP into SIGRIAN after verifying the appropriateness of the format. The Regional Council Resolution indicates the withdrawal limits above which the installation of meters is mandatory. It is important to strengthen the activity of collecting, soliciting and entering withdrawal data, as well as to continue and strengthen **control** activities **on withdrawals and releases of minimum vital runoff-ecological runoff**.
In parallel, a system for collecting and storing quantitative data on returns not related to a withdrawal concession (discharge cadastre) will have to be implemented.
Fundamental is the detection and organization of data on stream and spring flow rates, as well as piezometric data, to **assess with some continuity the state of water resources.** In the Marche Region, the detection of stream flow data is followed by the Regional Functional Center at some stations of the MIR Network, whose main purpose is to alert for emergency situations. Therefore, the detection and acquisition of flow data for the purpose of water balance planning and drought situation management should be improved. At present, some measured flow data (from springs and streams) flow into the Environment and Water Resources Directorate, stored in a special database and also used for the purpose of assessing water severity conditions in the regional territory. However, this activity needs to be strengthened. With regard to piezometric data, there is currently no measurement network for continuous surveying. Some information is collected manually by ARPAM at their groundwater monitoring network, while others are received by the Environment and Water Resources Directorate to assess the status of the resource at some catchments; one piezometer is included in the Functional Center's MIR Network. Activities are underway in order to be able to intercept national and district funds (e.g., Development and Cohesion Funds, PNRR) for the implementation of a continuous monitoring network of piezometric data and spring flow rates.
In relation to the reduction in water availability that is already underway, and is likely to be exacerbated by climate change, there is a need to plan for measures to manage potential conflicts. Thus, planning of uses becomes essential, which cannot be done without comprehensive knowledge of the situation (water budgets). Net of planning, water use is currently regulated through specific concessions and the evaluation of their compatibility through the criteria provided to the granting offices in implementation of the derivation directives of the District Basin Authorities. An assessment of the water allocations to be assigned to the various use compartments and within each use compartment, in relation to the importance of the withdrawals and the efficiency of use; with the consequent review of the concessions in place, will have to be contained in the **Water Budget Planning.** Such an assessment may make it possible to equip oneself with tools to objectively identify **priority indicators in the issuance of**

concessions, also according to the economic performance of activities, according to rational needs, and more generally according to the public interest.
Regarding the hydropotable use that falls under the Optimal Territorial Area Authorities (AATOs), it is necessary for the **scope planning of** the 5 AATOs to be coordinated and to consider ongoing climate change.
Within the framework of Water Budget Planning, the possibility of a **gradual reduction in the quantities granted**, in relation to the reduction in the availability of the water resource, may be considered for the most water-demanding and least efficient compartments. In addition, it is important to strengthen the above-mentioned monitoring activities in order to be able to limit withdrawals with appropriate measures in case of drought and the control activities on the release of the minimum vital runoff - ecological runoff (DMV-DE) below which, except for possible exemptions for the drinking and irrigation compartments, withdrawals are not possible.
In parallel, it is necessary for all uses of the water resource to be optimized in order to reduce inefficiencies and minimize waste.
Regarding agricultural use, it is important and can no longer be waived to supplement the regional management system with **farm support services to improve irrigation efficiency** (how much and how to irrigate in relation to seasonal meteorology). There is a need to measure more detailed, field-scale variables (field water capacity, soil moisture content, crop water requirements, etc.) that will allow the amount of water needed by crops to be determined and avoid excesses or states of water stress that can compromise production. These measurements generate additional information to the experience of the farmer who will be able to operate with increasing objectivity in his choices, with greater precision and with better assurance of balance between production needs and irrigation volumes used.
In addition, **more efficient irrigation systems** need to be introduced, taking action on collective irrigation systems to reduce losses, increase efficiency and develop wastewater reuse for agricultural use. Funding is provided in the Rural Development Program (RDP) for some of these activities.
For hydropotable uses, waste reduction is mainly concerned with **improving the efficiency of transport and distribution networks**. For these activities, the Marche region has provided support within the Operational Program of the European Regional Development Fund (ERDF 2021-2027) for the installation and renewal of consumption metering and network leakage detection systems, districting and active leakage control, replacement of network sections and implementation of network automation systems.
With regard to drinking water uses, it will be important to **interconnect aqueduct systems** by linking them to different sources of supply (groundwater, surface water) - existing and new - in order to increase the resilience of the systems. It is also necessary to provide for **multiple-use utilization of existing reservoirs** by establishing protocols for prioritizing the use of different uses in relation to the volumes invaded, to improve the availability of the water resource at existing reservoirs with the **recovery of reservoir capacity** and with management that reduces sediment accumulation, increase surface water storage capacity at reservoirs and groundwater recharge of alluvial aquifers (artificial groundwater supply systems), evaluate the use of water to be treated (denitrificators, desalinators) under drought conditions.

5.1.2.3 Measures and actions to counter desertification and land degradation

Soil is a basic resource for life on the planet and can also be preserved and improved through climate change adaptation measures. The starting point is a sound knowledge base of its inherent characteristics and the processes that led to its formation. The factors that determine the formation and development

of soils can vary from place to place and are the term of comparison for identifying the correct management methods. Given the sudden changes in environmental conditions and land management methods over time, it is necessary to **strengthen the monitoring** of changes to soils in relation to the management methods actually adopted. In particular, a monitoring system will have to be developed for representative sites that can measure changes over time in soil viability and functionality (soil hydrology, carbon cycle, nitrogen cycle, etc.) and changes over time in land use and management. For adaptation purposes, it will also be important to have monitoring data to be able to identify future scenarios differentiated by regional soil unit through the production of **risk maps**. Examples include the soil water erosion risk map and the desertification risk map. Such geographic outputs have direct utility in identifying a hierarchy of hazards, thus guiding in the selection of intervention priorities. Their real function, however, lies in highlighting the determinants of undesirable phenomena, offering information on the best solutions to be adopted. The use of computational models also offers the possibility of incorporating theoretical forecast data and evaluating the margins for improvement from the results obtained. Such descriptive maps of changing phenomena should, therefore, be periodically updated on the basis of monitoring data, on the basis of verification of the results obtained, and in view of new climate change scenarios.

5.1.2.4 Measures and actions for adaptation of terrestrial ecosystems

To protect the terrestrial ecosystems of the Marche region from the effects of climate change and in particular from the most common risks to the Mediterranean area, such as desertification and the expansion of adjacent arid and semi-arid systems, it is important to strengthen knowledge of the issue and integrate protection actions into sectoral planning and land transformation.

Regarding the most vulnerable species, it is first necessary to activate **monitoring on species and/or biomes** sensitive to climate change. In this way, the impacts of climate change (changes in predator-prey dynamics, intensification of extreme events, degradation of environmental conditions of habitats, competition with invasive alien species, etc.) and, consequently, the adaptive capacity of the species can be assessed.

A general strengthening of the cognitive framework on terrestrial ecosystems plays a fundamental role especially in relation to the protection of areas of special naturalistic and ecological interest. It is important to provide, in the context of the **management of Natura 2000 Sites and protected natural areas in** the Marche region, specific **studies or monitoring in** order to produce a comprehensive assessment of the impacts of climate change on the ecosystems themselves, as well as to implement the interventions for the maintenance and restoration of species and habitats related to Natura 2000 sites envisaged by the **Marche** 2021-2027 **PAF** (Prioritized Action Framework) referred to in DGR No. 1361/2021.

With regard to sectoral and spatial planning, it is important to encourage the creation and maintenance of **ecological corridors**, while also taking into account possible changes in ranges in response to the effects of climate change. Ecological corridors are connecting strips of various shapes and sizes, capable of connecting areas of high naturalness together. For this reason, they represent a central element for ecological networks and enable species mobility and genetic interchange, a phenomenon that is indispensable to the maintenance of biodiversity (ISPRA).

Precisely in relation to ecological networks, it is necessary to implement Regional Law No. 2 of February 5, 2013 *Norms on the ecological network of Marche and landscape protection*." With this law, the Region

aims to protect biodiversity through the strengthening of ecological connections and eco-system services, reducing the fragmentation of natural and semi-natural habitats and the environmental matrix, increase the quality of the territory and enhance the landscape, through the establishment of the **Ecological Network of Marche (EMN).** The rationale for the EMN is to find implementation at the local level. Specifically, Article 5, *Relationship of the EMN with the instruments of territorial and urban planning,* of the Regional Law stipulates that the Network is to be implemented in the **instruments of** territorial and urban planning adopted after the law comes into force. At present, however, the application of the EMN at the local scale is still lacking and should therefore be strengthened. Another strength of the EMN is that it has identified (and mapped) connectivity elements. Incorporating the maintenance and strengthening of these elements into spatial transformations, such as those induced by the construction of works and infrastructure, thus becomes a key tool for ensuring the resilience of ecological systems. To this end, **guidelines** should be developed for environmental assessments aimed at ensuring the maintenance of ecological corridors in the implementation of infrastructure projects.

5.1.2.5 Measures and actions for adaptation of marine and coastal ecosystems.

In order to increase the resilience of the marine and coastal ecosystems of the Marche region, located in a context with strong anthropogenic pressure, it is important, as for terrestrial ecosystems, to strengthen the cognitive framework in consideration of ongoing climate change. Again, it is necessary to provide for **periodic monitoring** of the most vulnerable resources and species and/or biomes sensitive to climate change, with particular attention to the deterioration of aquatic ecosystem conditions, in order to assess impacts and adaptive capacities.

To ensure the protection and conservation of marine and coastal ecosystems, it is important to foster a **stable and structured involvement** of agencies and organizations involved in ecosystem protection in sectoral planning and land transformation contexts.

5.1.2.6 Measures and actions for coastal systems

Vulnerability and risk analysis shows that ongoing climate change will have multiple effects on coastal systems. It is therefore necessary for sector planning to keep these effects in mind by providing guidance for the design of interventions.

Sea level rise and the increase in extreme weather phenomena expected in the coming years will cause the loss of part of the emerged beach, thus aggravating the already ongoing phenomenon of coastal erosion. Therefore, it becomes essential to intervene in the **adaptation of existing coastal defense works**, considering sea level rise scenarios, to restore their functionality. It is also important that climate change scenarios are also considered in the design of **new works**. For the Marche Region, the Environment and Water Resources Directorate is responsible for managing funding for such interventions. In the design of which it is necessary to provide guidance that considers sea level rise scenarios.

The Implementation of the European Directive 2007/60/EC on the management of flood risks, implemented by Legislative Decree No. 49 of Feb. 23, 2010, requires a different treatment of the risk to which the territory-including the coastal territory-is subjected. This implementation requires **the perimeter of areas subject to marine flooding to address** the phenomena of sea level rise, and the consequent retreat of the coastline, that threaten infrastructure and buildings. It assumes importance to accurately estimate inundation perimeters, either at the level of the entire coastline or for specific

stretches considered critical, in order to better calibrate mitigation and adaptation actions to this type of impact.
Despite the implementation of the previous measures, it is necessary to implement a sound **cost-benefit analysis to** identify the structures/infrastructures on which to intervene as a priority with a setback measure in order to reduce the risks to people and the repercussions on the socio-economic side.

5.1.2.7 Measures and actions to counter risks from climate change

The risks associated with climate change are varied in nature. However, the main ones are related to the intensification of extreme events and in particular floods. EU legislation (Floods Directive 2007/60/EC) provides a specific planning tool for the management of this type of risk, the district flood risk management plans. Article 14.4 of the aforementioned EU directive requires that district plans take into account the impact of climate change.
In the Flood Risk Management Plan for the Central Apennine River Basin District (PGRAAC), second update, it was represented how current trends and possible future changes in the flood regime require keeping a high focus on their effects. Particular attention was paid to those types of floods triggered by intense and concentrated events (flash flood, pluvial flood), which are certainly more sensitive to the effects of climate change and which in mountain basins can also give rise to particularly critical debris flow phenomena.
Variation in hydrological regimes results in variation in the return times of flood events. Therefore, as suggested in the PGRAAC itself, it becomes necessary to **revise the way return times are calculated**, including considering current climate change scenarios.
Increased intense precipitation events lead to increased risks from flood events. Therefore, the management of the surface hydrographic network becomes of primary importance. In particular, it is necessary to act with an integrated perspective in ordinary and extraordinary management events, which are already provided for by specific regulations. It is therefore necessary to **plan** at the basin or sub-basin level **maintenance interventions**, aimed at reducing vulnerability.
Preventing the risks associated with the river network also means intervening in order to reduce the elements exposed to risk. This implies intervening with specific **actions of redevelopment, preservation and expansion of river areas**, through urban planning tools, river redevelopment and in particular through the use of river contracts.
With the intensification of extreme events and the potential intensification of risk in certain areas, the appropriateness of relocation will need to be examined. One tool for assessing the appropriateness of relocation, which is useful in identifying the cost-effectiveness of risk reduction actions, is the **cost-benefit analysis** for facilities and infrastructure located in high and very high risk areas. The cost-benefit analysis makes it possible to evaluate the costs of each of the alternatives and define the sustainability of the action.
Another type of risk influenced by climate change, and in particular the change in rainfall pattern and rising temperatures, is the development of forest fires. In order to increase its prevention, **sustainable forest management** should be strengthened or introduced. In addition, considering the high number of forest fires related to voluntary causes, it is important to strengthen **prevention, monitoring and investigation efforts** to prevent fires caused voluntarily and intentionally.
One aspect of strong relevance to reducing hazard-related vulnerabilities concerns the awareness of the exposed population. In this regard, adaptation actions should be aimed at **improving the warning communication system** and preparing administrators and personnel for emergency management.

When a flood event cannot be avoided, it is necessary to properly manage the emergency. In this regard, it is crucial to increase the **preparedness** of administrators and staff for **emergency management.**

5.1.2.8 Measures and actions for urban sector adaptation

Analysis of vulnerabilities and risks shows that ongoing climate change can affect the urban sector. The construction of infrastructure in urbanized areas and the current pattern of urban development, resulting in land consumption, can have non-negligible effects on ecosystem services and adaptive capacity to climate change.

In order to reduce this pressure and maintain the residual adaptive capacity of territories, it is necessary to limit land consumption.

In the Marche region, the coastal area, which has very high land consumption, is particularly vulnerable. In particular, the Integrated Coastal Zone Management Plan (ICZM Plan) regulates the use of the areas of the maritime domain to ensure a proper balance between the preservation of the environmental and landscape aspects of the coastline and the development of the tourist and recreational activities that take place there. The ICZM Plan also identifies the perimeter of areas subject to marine flooding. Finally, the ICZM Plan identifies the technical implementation standards of **land use limitation measures** that should be strengthened for adaptation to climate change.

The Marche Region has already embarked on a path to update land-use regulations. Although the current regional legislation provides for a **limitation of land consumption**, it needs to be updated in order to direct municipalities to revise their land-use plans in favor of the goals of limiting land consumption and prioritizing reuse of the built environment. In parallel, the region is in the process of modernizing the regional technical map as the basis for creating a **regional telematics platform for monitoring land consumption** and representing building and urban transformations.

With regard to urban planning tools, **guidelines** should be **introduced** so that measures **to reduce the risk** associated with climate change are considered by evaluating forecast scenarios for extreme events.

5.1.2.9 Measures and actions for agricultural adaptation

The implementation of agricultural policies is heavily influenced by European regulations. During successive programming periods, environmental aspects, including those of adaptation to climate change, have become an integral part of agricultural policies. With the new Common Agricultural Policy (CAP) Programming 2022 2027, the "cross-compliance" rules that have been in place since 2005 have been strengthened and additional agri-environmental commitments have been introduced, the so-called "ecoschemes" that farmers will have to undertake in order to benefit from EU funds supporting the CAP. The new "enhanced cross-compliance" is compulsory for all agricultural enterprises, the "ecoschemes" that adopt a voluntary approach were organized by the Ministry of Agriculture, Food Sovereignty and Forestry with the contribution of all Italian regions to allow access to as many farmers as possible. In order to improve the positive role for the environment of agriculture and in particular agricultural management (the concept of management is not a synonym for cultivation, it goes beyond the crop cycle and aims at maintaining land productivity in a long-term logic) and increase the effectiveness of commitments made through the CAP, it is necessary to trace the production process that the farmer chooses to adopt with objective feedback. Tracking becomes particularly important in relation to adaptation to climate change: for example, in the use of the water resource, it is important to provide farmers with supporting tools for

determining how much water to use in relation to crop needs, soil, morphological and climatic characteristics.

It is important to have tools to more accurately determine resource availability and act accordingly in issuing "concessions." The rational management of water resources in agriculture starts from the proper conduct of irrigation technique that aims to achieve the best balance between water used, crop needs, and less energy use. Going up in the territorial organization this action in agriculture involves all public administrations that have responsibilities in the management of public water, artificial reservoirs, distribution networks and self-supply systems. In this regard, at the impetus of EU regulations, much has been done in recent years, both in terms of investment and regulatory systems at the different levels of intervention (national, regional, irrigation districts, etc.). In the short term, more attention will have to be paid to the implementation of actions already planned within the timeframe. In particular, it will be necessary to incentivize **crops that are more resilient to climate change** from the overall perspective of sustainable agricultural management.

The most recent meteorological events characterized by increasing rainfall intensity draw a future scenario characterized by higher runoff velocities, which, even with sufficient resilience of natural and man-made infrastructure, will result in lower uptake and thus lower water availability at the watershed scale. It is therefore necessary to incentivize **cropping systems that prevent** soil **erosion** and **ways of managing soils that improve their hydrological capacity**.

Fundamental is the role of agriculture in stormwater regulation. For the application of sustainable techniques in agriculture, it is strategic to have an accurate and periodically updatable knowledge framework. In particular, knowledge of meteorological variables is now essential for the proper and effective management of major crops. In a context of ongoing climate change, it becomes essential to have short-term (daily or weekly) and long-term (semiannual or quarterly) weather forecasting tools that combined with other information (soil hydrology, soil biology, and plant water requirements, etc.) will allow crop choices to be conducted more correctly and effectively. Such information will be particularly important in the rational management of irrigation techniques that rely on the correct watering rate and time of operation, typical for each crop and irrigation district. How much and when to irrigate is made explicit in the so-called "**irrigation advice**" and today, thanks to modern technologies, can be made available to all farmers easily and at low cost. In the near future these services should be extended to as many users as possible and organized within the framework of a regional monitoring and assistance system capable of aggregating and evaluating the activities carried out and the results achieved.

5.1.2.10 Measures and actions for the adaptation of marine fisheries and aquaculture

Ongoing climate change is interfering with the normal ecological dynamics of fish populations. These issues are compounded by overfishing in marine fisheries, which greatly limits the adaptive capacity of populations. Reducing overfishing of fish stocks therefore becomes a key objective for regional adaptation policies. There is already a firm regulatory framework at the European level for the protection of fish stocks (e.g., EU Regulations No. 1005/2008 and No. 1224/2009), the implementation of which has not yet shown effective reduction of impacts.

The Marche Region has already embarked on a path to support the marine fishing sector through investments financed with public resources (European Maritime Affairs and Fisheries Fund). In parallel, it is identifying solutions for a **transition to sustainable fishing models,** including through the conversion of fishing systems**.** In particular, with the Interreg Italy-Croatia project DORY - Actions for Capitalization of

the Adriatic Marine Environment and Ecosystem-Based Management," of which the Marche Region is the lead partner, the issue of fish stock exploitation has been addressed in a transnational manner. Indications for a sustainable fishing model emerged from the project that now need to be implemented.
The marine fisheries sector will not have to be downsized. Rather, while overfishing is reduced, action will have to be taken to address the economic impact of more complex operating conditions in the sector. In particular, actions that aim to **supplement** fishing **income** with other activities, such as through funding for the development of complementary activities related to tourism, become essential. Another measure to address the economic impact is the **enhancement of the catch**, including through the use of **economic marketing tools** to improve profitability and the promotion of sustainable approaches to fishing and aquaculture. This can also be achieved through communication and business management support for the promotion of new species in the market and with better integration of the sector with those of tourism and transport.
Actions aimed at knowledge are essential for adaptation to climate change. In this regard, it is also important to develop a **dynamic and systematic monitoring** system **of the possible suffering of the sector,** to identify necessary adaptation and transformation actions, and **of aquaculture and mussel farming practices,** to verify their effects.
Illegal fishing **activities** are one of the factors contributing to decreasing the resilience of fish stocks to climate change. Countering this phenomenon, including through intensified monitoring of activities and the introduction of information systems, becomes an important adaptation action.
Finally, studies and in-depth investigations aimed at **improving knowledge** on the marine species of fish interest most sensitive to climate change are essential to adequately calibrate all atre measures.

5.1.2.11 Measures and actions for tourism adaptation

With reference to the vulnerabilities related to the anthropogenic pressure of seasonal tourism in the coastal strip of the Marche region, it is necessary to activate as soon as possible specific interventions useful for decreasing this pressure on coastal areas in the summer season, encouraging **deseasonalization, diversification and relocation of** tourist flows.
In this regard, the **integration of tourism and mobility** is one of the useful tools in order to increase the attractiveness of inland areas, which are often little known and difficult to access. Among the various measures that can be activated, for example, the creation of new bicycle routes could increase tourist interest in these areas, while also responding to the need for diversification and relocation of flows.
In connection with the fragility of the winter tourism sector related to rising temperatures and decreasing snowfall, specific means of **strengthening and diversifying tourism offerings in mountainous areas** should be envisaged in order to compensate for the decline in tourist flow related to ongoing and expected future climatic variations. When planning new infrastructure, this need for diversification should be taken into account and facilities for alternative tourist attractions should be provided.

5.1.2.12 Measures and actions for the adaptation of the energy sector

In relation to ongoing climate change, the priority risk for the power sector is the increase in power outage episodes. This risk is generated by some possible effects of climate change such as reduced water availability for cooling power generation plants and hydropower, increased energy demand in summer due to temperature increases and increased frequency of heat waves, and finally increased damage to energy production and transportation infrastructure due to increased frequency and intensity of extreme events.

The lines of action to be followed refer to both the orientation of energy demand and the adaptation to climate change scenarios of the renewable energy production and distribution system.
For the first aspect, adaptation solutions refer to the reduction of energy demand for air conditioning, particularly through energy efficiency in buildings. On this aspect, the region has already activated lines of intervention through Regional Development Programming instruments. For example, Action 2.1.2 of ROP ERDF 2021-2027 allocates resources to promoting eco-efficiency and reducing primary energy consumption.
To adapt the renewable energy production and distribution system to climate change scenarios, it is necessary to act both on the resilience of infrastructure and on the potential reduction of energy production from renewable sources. On the latter aspect, possible actionable measures concern, for example, storage systems that can compensate for the intermittent nature of renewable source production. Particular attention should also be paid to hydroelectric plants, for which a reduction in production is possible as a result of reduced water availability. Therefore, it may be appropriate to de-incentivize run-of-river plants, which are more vulnerable to the effects of climate change.
Relocation of energy production is a measure that can actively contribute to the resilience of energy infrastructure: the ERDF ROP 2021-2027 supports renewable sources, especially photovoltaics, with Action 2.2.1. Finally, it is necessary to activate measures for securing energy infrastructure, especially in areas most sensitive to climate change (such as coastal area subject to storm surges, areas subject to landslides, etc.).

5.1.3 Implementation, monitoring and updating

Implementation

The Regional Climate Change Adaptation Plan is a mainstreaming plan that provides the tools for climate change adaptation to be included in policies, strategies, and plans/programs in an integrated way, according to a horizontal process, among the structures of the Marche Region, and a vertical process, among the subordinate entities.
This means that adaptation goals and related actions will be pursued primarily by sectoral and cross-sectoral plans at different levels of government, and not directly by the Plan. During the development of the Plan, planning and programming tools that will be able to integrate adaptation actions within the regional context were mapped and identified, depending on their implementation status, and taking into account the adaptation elements already in place.

Table 1: Main plans and programs identified that will be able to implement adaptation actions.

Regional plans, programs and instruments
PGIZC Integrated Coastal Zone Management Plan (D.a.[1]. no. 140 of 6/12/2019)
PTA Water Protection Plan (d.a. n.145 of 26/01/2010, several updates, including NTA in 2019)
PEAR Regional Environmental Energy Plan (d.a. no. 42 of 20/12/2016) (in the process of being updated)
PRA Waterworks Regulatory Plan (d.g.r. no. 238 of 10/03/2014)
PFV Faunistic Venatorial Plan (d.g.r. 1619 of 17/122019)

PFR Regional Forest Plan (Resolution No. 114 of 2/26/2009)
PQUAP Five-year Program for Protected Areas (2021-2025) (Resolution No. 17 of 4/8/2021)
Regional Plan for the planning of forecasting and prevention activities and active fight against forest fires (d.g.r. no. 792 of 10/07/2017 and d.g.r. 823 of 29/06/2020)
REM Ecological Network of Marche (d.g.r. no. 1634 of 7/12/2011)
Priority Action Framework (DGR No. 1361 of 15/11/2021)
Regional Complement for Rural Development 2023 -2027 of the CAP National Strategic Plan (Decision C(2022) No. 8645 of 02/12/2022)
ERDF Program 2021-2027 EC Decision C(2022) 8702
Basin Plans
Hydrogeological Structure Plans (PAI) prepared by the former Basin Authorities under Law No. 183/1989: a. Hydrogeological Arrangement Plan (PAI) of the Tiber River (D.P.C.M. Nov. 10, 2006, G.U. No. 33, Feb. 9, 2007 - "First Update" approved by DPCM April 10, 2013, G.U. Aug. 12, 2013)); b. PAI of the Tronto River - (D.c.r. No. 81 of Jan. 29, 2008, B.U.R.M. No. 16 of 14/02/2008 -) c. PAI Marecchia and Conca rivers (DPCM February 25, 2020 - OJ No. 261, October 21, 2020 - DCIP No. 2, 18/11/2019); d. PAI of the basins of regional importance (D.C.R. No. 116 of 21/1/2004 - Update 2016 approved by D.P.C.M. 14/3/2022)
PGRA - Flood Risk Management Plan: • Of the Central Apennine River Basin District (Cycle II) (DPCM of December 1, 2022) • Po River District (DPCM No. 5 of December 20, 2021)
District management plan: • Central Apennine District (adopted by the Permanent Institutional Conference of District Basin Authorities on 12/20/2021) • Po River District (adopted by the Permanent Institutional Conference of District Basin Authorities on 12/22/2021)
Additional regional instruments, the relationship of which to adaptation will be verified during implementation and/or, in the case of very old plans and programs, upon review/update of these instruments:
Air quality remediation and maintenance plan (DACR No. 143 of January 12, 2010)
Regional Transportation Plan Regional infrastructure, freight and logistics plan (Resolution No. 51 of July 3, 2012) *(under revision)*
Plan for the Development and Diffusion of Electric Mobility
PRGR Regional Waste Management Plan (d.g.r.n. 34 of 2/2/2015) *(under revision)*
Land use plan (PIT) (d.c.r. no. 284, Feb. 8, 2000)
PPAR Environmental Landscape Plan (DACR No. 197 of November 3, 1989)
FSC 2021-2027

FEAMP 2021-2027
Marche Land Reclamation Consortium _ PGB General Land Reclamation Plan (CDA Resolution 445 of 2 12 2019)
Types of local and supra-local oians, programs, and instruments that *may play a role in implementing adaptation goals*
PTCP Provincial territorial coordination plans
Parks Plans
Management plans for Natura 2000 Network areas.
Municipal general regulatory plans (and other urban planning instruments)
PUMS Urban Plans for Sustainable Mobility.
PRP Port Master Plans
Beach plans
River contracts

Monitoring

The PRACC has a time horizon of 6 years (2023 - 2029), but has longer-term goals defined consistently with climate scenarios to 2050 as its goal: with the Plan, therefore, a path of adaptation begins that will be developed over a longer time frame and therefore must be characterized by a flexible approach in implementation so as to respond nimbly to changes in the context and scenarios that may occur over time.

The tool through which to implement this approach is monitoring. Monitoring therefore forms an integral and indispensable part of the Plan implementation process and is closely integrated with the Strategic Environmental Assessment (SEA) process.

In particular, monitoring assumes a key role in periodically updating knowledge with respect to trends in climate indicators and indicators that record their impacts and describe regional vulnerabilities. It also makes it possible to follow the implementation process of the Plan and its effects, to verify its contribution to the sustainability objectives of the Regional Sustainable Development Strategy (SRSvS), to highlight any critical implementation issues, and to provide useful elements for redirecting adaptation objectives and, more specifically, lines of action and measures, in relation to the changing context. Finally, monitoring can suggest criteria, mitigation, and compensation to reduce any unanticipated negative effects or enhance positive and synergistic effects.

The Plan is accompanied by an "Integrated Plan SEA Monitoring Program," where the methodology adopted is described and in particular are made explicit:

- the objectives of Plan-SA monitoring;
- The governance of monitoring: roles and responsibilities, operational arrangements for carrying out activities and information flow, and the role of internal and external participation in Regione Marche;
- The Monitoring Report: content and periodicity;
- the indicators selected for monitoring: context indicators, context contribution indicators, process indicators;
- The ways of reorienting the Plan;
- the necessary resources.

A central point of the monitoring system is the construction of the indicator system. This is closely linked to the content of the planning and SEA process, so that monitoring is, in fact, an update of it. The **indicator system is** based on three types:

Context indicators, selected from the indicators used for climate scenario definition and context analysis;

indicators of contribution to the environmental context, for recording the overall effects of different types of action on the Sustainability Goals of SRSvS;

process indicators, closely linked to the Plan's action lines. These monitor the implementation of the Program as well as the application and effectiveness of sustainability criteria, and in some cases allow the calculation of contribution indicators.

To contribute to SRSvS monitoring, the selection of context and contribution indicators takes into account the set of indicators adopted by SRSvS, with particular reference to Appendix 5, where the contribution indicators mandatorily required in SEA monitoring are identified for a list of specific plans.
As the PRACC is implemented through other regional and local plans and programs, the populating of indicators, particularly process and contribution indicators, may take place within the monitoring systems of the other planning and programming tools already mentioned.
In order to be able to monitor the PRACC implementation process and the degree to which its objectives are being achieved, by aggregating the contributions derived from the various plans involved, appropriate coordination arrangements will have to be established among the monitoring systems of all plans and programs involved in the implementation, including sharing the way indicators are calculated, defining the modalities and periodicity of data reporting.

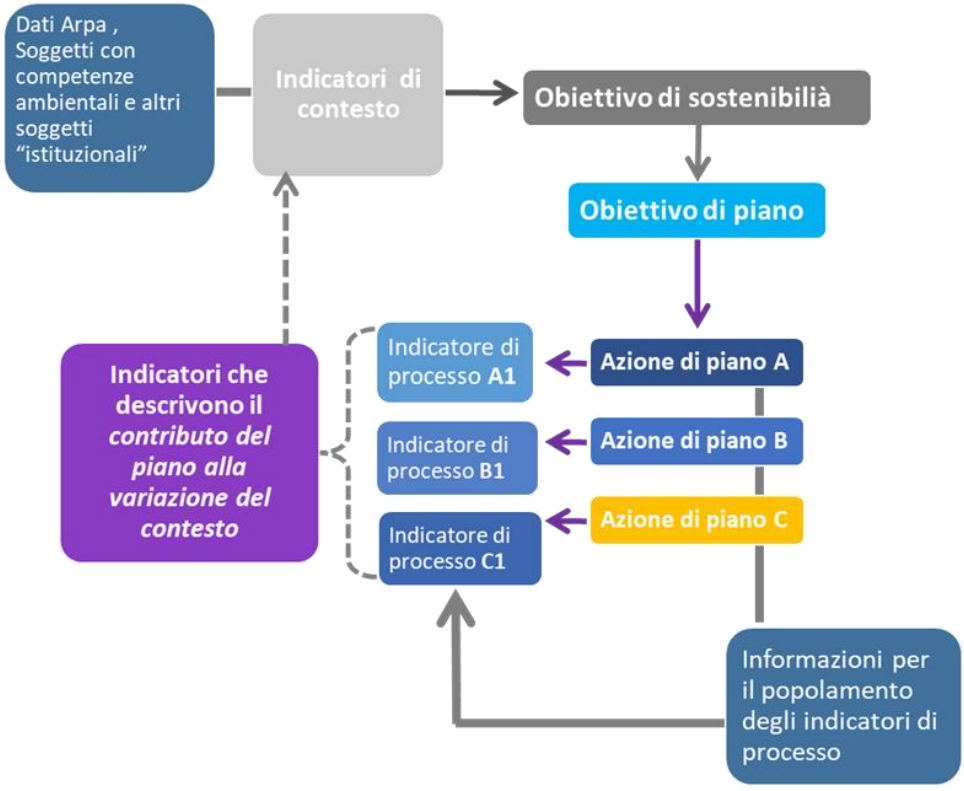

Figure 1: Passing information in the monitoring proces

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7 Tecnical appendix

The methodology

The assessments described in this paper start from the analysis of the climate framework and have included an examination of the factors and resources of the Marche Region for some of the main sectors, highlighting their peculiar characteristics and the critical issues present, and highlighting possible elements of vulnerability to the effects of ongoing and expected climate change. Natural resources and related socioeconomic sectors are analyzed separately. However, it is essential to consider the complexities of the relationships between natural resources and human activities and their mutual influence: natural elements influence socioeconomic activities and at the same time human activities determine a pressure on the territory (e.g., agricultural activity on soil quality, transport system on air quality). In the case of the Marche Region, this complexity emerges particularly in coastal areas. The different methodologies and approaches used for climate analysis and assessment of factors and resources are briefly described below. Where possible, standard or widely accepted approaches in the scientific community have been used.

Climate analysis

The analysis of the past, present, and future climate framework of the Marche Region is based on data, information, and models from various sources.

The current and past climate framework was analyzed based on the European EOBS dataset (Haylock et al. 2008). EOBS is the reference climate dataset for Europe containing spatialized time series of several climate variables, including temperature and precipitation, obtained by interpolation of daily observations collected from ground stations of European meteorological networks (https://www.ecad.eu/). The dataset continuously covers the period 1950-2020 and has a spatial resolution of 0.1° x 0.1° (about 11 km).

The future climate scenario, on the other hand, was developed using model simulations with a spatial resolution of 4 km and developed for a future 30-year period centered on the mid-century (2039-2068). The projected climate changes were evaluated against the model simulations for the historical 30-year period 1979-2008. To assess future climate change based on the evolution of atmospheric greenhouse gas concentrations, the climate model adopts the most onerous emission scenario (RCP 8.5) in which no climate protection measures are taken and greenhouse gas emissions increase continuously, i.e., leading to a radiative forcing of 8.5 W/m² in 2100 compared with the pre-industrial period. Under this scenario, an average global temperature increase of about +4.3 °C is estimated for the period 2081-2100 compared to pre-industrial levels (1950-1900). Although other emission scenarios are also available (https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html), the choice of the RCP 8.5 scenario allows for the most pessimistic climate scenario in which climate variations and their impacts are most evident. However, it is important to remember that in the short and medium term the differences between the emission scenarios and the associated global temperature evolution are still small, while the

divergences are more evident during the second half of the century, when the effects of different emission mitigation policies become decisive.

Concurrently, as part of the Interreg Italy-Croatia AdriaClim project, in which the Marche Region is participating, additional climate simulations have been produced. In particular, the Adriaclim modeling system is based on a subregional downscaling of different models and two subregional models developed within the project, one for wave motion and the other for biochemical aspects.

Vulnerabilities and risks

The analysis of impacts, vulnerabilities and risks is based on the concepts described by the United Nations **Office for Disaster Risk Reduction (**UNDRR, 2022) on climate change-related risk, and follows the approach proposed by IPCC (Intergovernmental Panel on Climate Change) AR5 and AR6 (IPCC 2022), which is an important reference standard in the field of climate risks. The methodologies used and briefly set out below are also consistent with the standard guidance ISO 31000 - Risk management - Principles and guidelines (ISO/IEC 2018), ISO 31010 - Risk management - Risk assessment techniques. (ISO/IEC 2019) and ISO 14091 - Adaptation to climate change - Guidelines on vulnerability, impacts and risk assessment. (ISO/IEC 2020). The assessments included in the document are based on the review of documents and reports related to the Marche Region, and the evidence proposed in the National Plan for Adaptation to Climate Change (PNACC - Ministry of Environment 2018).
The analysis methodology is also based on the tool of **impact chains**, a tool for conceptualizing climate risk and its components that has been successfully used in various operational contexts of risk analysis and management. The impact chains methodology is explained in detail in the dedicated document (UNDRR 2022; Zebisch et al. 2022)..
An impact represents a consequence (negative/adverse or neutral) that can be considered a hazard and potentially a **key risk**. Impacts can be directly linked to a hazard (e.g., intensification of landslide events can be considered an impact directly related to the occurrence of extreme precipitation events) or represent an indirect consequence (e.g., intensification of electricity blackouts or degradation of agricultural production can be considered indirect consequences of phenomena associated with climate change). Several impacts can thus be linked together in a chain that describes a cascading effect.

Key Risks. The analysis of risk, and in particular of particularly relevant risks called "**key risks**," is carried out by critically evaluating all available information, both quantitative (observed data) and qualitative (scientific publications, institutional reports, and observations and comments of consulted experts). However, this analysis is always partially subjective and based on potentially incomplete or outdated information. In order to facilitate a critical assessment of the outcome of the risk analysis, an ordinal scale (low, medium, high) is therefore proposed for each key risk according to the three independent indicators described below.
Risk severity: quantifies the risk by weighing both the possible consequences on exposed systems and its probability of materialization in the medium-term future.
Reliability level: indicates how much the risk severity assessment is subject to uncertainty. For example, a high level of reliability (regardless of high or low risk level) indicates that the severity assessment is based on consistent and up-to-date information and is therefore reliable. A low level of reliability, on the

other hand, indicates that the available information is insufficient, inadequate, or even conflicting, and therefore less reliable.

Possible Level of Conflict: This indicator is especially useful in assessing adaptation actions and describes the expected level of agreement on baseline values and adaptation goals by those most involved. A low level of conflict indicates substantial agreement on necessary adaptation actions that can then be addressed in a technical/economic and operational context. A high level of conflict, on the other hand, may imply the need for strong mediation at the social, political, and economic levels.

The analysis was carried out for the main factors and resources that may be affected by climate change. It should be noted that all factors and resources are, however, strongly interconnected with interdependent relationships, represented in the following figure.

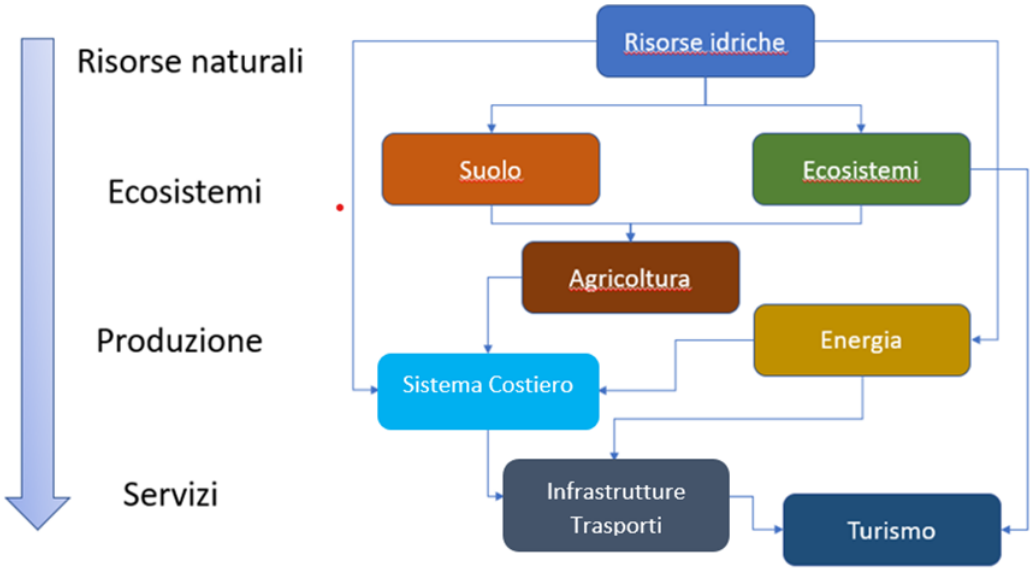

Figure 1 Interdependence and hierarchy of different factors and resources. The order of factors and resources, from top to bottom, indicates the change in perspective from natural processes and systems to the tertiary sector (source: Eurac Research).

Adaptation

Scientific research regarding adaptive capacity has developed rapidly since the IPCC recognized adaptive capacity as a crucial component of vulnerability in 2001. The analysis of adaptive capacity has also included a consultation focus implemented through questionnaires with departments directly concerned with sectoral policies. This survey was carried out using as a basis for reasoning the measures proposed in the PNACC (-June 2018 version) and allowed to tie the analysis of risks and vulnerabilities to the lines of action that could potentially be activated, accompanying planning in the definition of specific measures for the Marche Region. An initial general information regarding the adaptive capacity of Regione Marche was carried out by the European Commission's ESPON (European Spatial Planning Observation Network) program and PNACC. The methodology used in the project is similar and consists of using a set of indicators to assess five basic dimensions of adaptive capacity: "social," "technological," "infrastructural,"

"institutional," and "economic." In the PNACC work, however, the scope of analysis is narrowed to the national context, and the comparison is made between Italian provinces and regions. The adaptive capacity index proposed by PNACC is based on the 2013 version of the methodology applied by ESPON.

Options/fitting measures (summary table)

For the action lines identified in the Plan, the categorization chosen for the measures in the National Climate Change Adaptation Plan (NCCP) has been borrowed here**Error! Bookmark not defined.** which are distinguished into:

Type A (soft) actions	They include policy, legal, social, management, and financial measures that can change behavior and lifestyles, helping to improve adaptive capacity and raise awareness of climate change issues. By their nature, these measures can only have positive and indirect impacts on all intercepted components.
Type B actions (not soft)	*Green,* while having a materiality and structural intervention component, are based on "nature-based" solutions and employ the multiple services provided by natural ecosystems to enhance resilience and adaptive capacity. These types of actions generally have positive and more direct environmental impacts than the former.
	Grey also have a materiality and structural intervention component related to the improvement and adaptation to climate change of facilities and infrastructure (actions on facilities, materials and technologies or defense systems, networks, storage and transmission). These interventions have potential negative impacts on natural ecosystems, and must be proposed by regional/local sectoral planning and activated only downstream of a specific environmental assessment, through instruments such as EIA, SEA and VINCA, deputized, among other things, to identify specific mitigation measures for any negative impacts that may be found.

From these considerations, in the following table, for each line of action the type of measure was identified and the contribution-no (indifferent or irrelevant), positive or negative-was assessed on each environmental component, always keeping in mind the particularly critical elements detected by the SWOT analysis. The following legend was used for the qualitative assessment of impact:

+++ = high positive impact
++ = average positive impact
+ = low positive impact
0 = indifferent/not relevant
+/- = uncertain impact
- = low negative impact
- = average negative impact
- - - = high negative impact

Table F.2.3: Type of measure and assessed contribution on each environmental component for each action line.

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
Ensure the qualitative protection of the water resource	Efficiency and adaptation of disposal and sewage infrastructure	Maintenance and upgrading of sewerage system in urban areas prone to flash flood episodes	Waters	AA.SS	B (grey)	0	+++	+	0	0	+++	0	+
		Interventions to limit episodes of urban flooding from sewage backflow	Waters	AA.SS	B (grey)	0	+++	+	0	0	+++	0	+
	Reduction of pressures on the water system	Encourage agricultural practices that optimize fertilizer use and minimize pesticide use in agriculture	Agriculture	AA.SS	B (green)	0	+++	++	++	+	++	0	0
		Activate or strengthen control and monitoring protocols for industrial and agricultural processes related to contamination	Waters	AA.SS	A	0	+	+	+	0	+++	0	0
		Establish forecasting procedures and protocols for optimizing ecological runoff, including in relation to climate change, avoiding as much as possible emergency flow management of water bodies	Waters	AA.SS	A	0	+++	++	+/-	+/-	++	0	0
Strengthening sustainable use of the water resource	Completing and strengthening water resources knowledge	Complete/update water balances and enhance early-warning activities.	Waters	AA.SS	A	0	+++	+	0	0	++	0	0
		Strengthen/improve monitoring, measurement and data collection on quantities taken and quantities discharged	Waters	AA.SS	A	0	+++	+	0	0	++	0	0
		Strengthen/improve monitoring of available water resources	Waters	AA.SS									
		Strengthen/improve control/measurement of DMV/DE releases.	Waters	AA.SS	A	0	++	+	+/-	+/-	++	0	0
	Managing conflicts in the use of water resources	Water budget planning	Waters	AA.SS	A	0	+++	+/-	++	+/-	+++	+/-	0
		Coordinate updates to scope plans by explicitly considering climate risk	Waters	AA.SS									
		Priority indicators in the granting of concessions	Waters	AA.SS									

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
		Review of current uses also in relation to future water availability	Waters	AA.SS									
		Establish protocols to regulate use priorities in the case of multiple-use artificial reservoirs	Waters	AA.SS									
	Water use efficiency	Enhance cognitive and data collection activities to define the amounts of water needed by the farmer for efficient use of water resources and develop forecasting systems	Waters	AA.SS	A	0	++	+	+	0	+	0	0
		Improve the efficiency of distribution networks for irrigation and drinking water use	Waters	AA.SS	B (grey)	0	+++	0	0	0	+++	0	0
		Introduce more efficient irrigation techniques, particularly in drought-prone areas	Waters	AA.SS	B (green)	0	+++	++	+	+	++	0	0
		Interconnections of aqueduct systems and sources	Waters	AA.SS	B (grey)	0	+++	0	0	0	+++	0	0
		Increase surface water storage capacity in reservoirs and artificial recharge of groundwater aquifers	Waters	AA.SS	B (grey)	0	+++	+/-	0	+/-	+/-	0	0
Ensure the protection of the soil resource and its adaptive capacity	Monitoring and strengthening knowledge about the qualitative status of soils and their management	Establish a network of soil monitoring and land management (land)	Soil	AA.SS	A	0	+	+++	++	+++	+++	0	0
		Produce maps on soil status and hazard factors (soil quality map, water erosion risk map, desertification risk map, soil consumption map, etc.).	Soil	AA.SS									

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
Strengthen the knowledge framework on terrestrial ecosystems in relation to ongoing climate change	Provide for periodic monitoring of the most vulnerable resources	Activate monitoring on species and/or biomes sensitive to climate change in order to assess impacts and adaptive capacity	Terrestrial ecosystems	AA.SS	A	0	0	+	+++	+	++	0	0
		Provide, in the context of management of Natura 2000 Sites and protected natural areas, monitoring or studies to assess the impacts of climate change on ecosystems	Terrestrial ecosystems	AA.SS									
Integrating ecosystem protection into sectoral planning and land transformation actions	Encourage the creation and maintenance of ecological corridors while also considering possible changes in ranges in response to climate change	Implementing R.L. 2/2013 for the integration of the Regional Ecological Network (REM) into planning tools	Terrestrial ecosystems	AA.SS	A	0	0	+++	+++	+++	++	0	0
		Guidelines for considering the maintenance of ecological corridors in environmental assessments of infrastructure projects	Terrestrial ecosystems	AA.SS									
Restoring ecosystems	Marche PAF Implementation 2021-2027	Activate interventions to maintain and restore habitats and species in Natura 2000 sites Marche	Terrestrial ecosystems	AA.SS	B (green)	0	0	++	+++	++	++	0	0
Strengthen the knowledge framework on marine and coastal ecosystems in view of ongoing climate change	Provide for periodic monitoring of the most vulnerable resources	Activate monitoring on species and/or biomes sensitive to climate change in order to assess impacts and adaptive capacity	Marine ecosystems	AA.SS	A	0	+	0	+++	+	++	0	0

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
Integrating ecosystem protection into sectoral planning and land transformation actions	Integrating marine and coastal ecosystem conservation into sectoral policies	Promote methods for the stable involvement of agencies and organizations involved in ecosystem protection in sectoral choices	Marine ecosystems	AA.SS	A	0	+	0	+++	+	++	0	0
Strengthen the region's tourist attractiveness outside the coastal areas and in all seasons (deseasonalization of tourist flows)	Deseasonalization and relocation of tourist flows	Increase the attractiveness of inland areas including through the integration of mobility and tourism (bicycle routes)	Tourism	AA.SS	B (green)	+/-	+	++	+/-	+/-	+++	0	+
		Interventions to decrease anthropogenic pressure on coastal areas in the summer season (deseasonalization, diversification and relocation)	Tourism	AA.SS	A	+/-	+/-	++	+/-	+/-	+/-	+/-	+/-
		Interventions to strengthen and diversify winter tourism offerings in mountain areas, to compensate for declines in tourist flows related to reduced snowfall	Tourism	AA.SS									
Protecting coastal areas from climate risks	Strengthen and improve systems to protect against storm surges and extreme events	Adapt existing coastal protection works and design new works considering sea level rise scenarios	Coasts	P	B (grey)	0	+/-	+/-	+/-	+/-	+/-	0	+/-
		Accurate estimation of inundation perimeters, either at the level of the entire coastline or for specific stretches considered critical, in order to better calibrate mitigation and adaptation actions to this type of impact.	Coasts	P	A	0	0	++	0	+	+++	0	0

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
		Define structures/infrastructure for which cost/benefit analysis suggests a setback of settlements from the shoreline	Coasts	P	B (grey)	+/-	+/-	+/-	+/-	+/-	+++	+/-	+/-
Reduce overfishing of fish stocks.	Reduce fishing pressure	Integrate marine fisheries and local tourism, or other sea-based activities on an equally local scale	Fishing	AA.SS	A	0	0	0	+++	+	++	0	0
		Implement a sustainable fishing model especially for overfished species	Fishing	AA.SS									
	Coping with the economic impact of the most difficult operating conditions	Catch enhancement, improved business profitability, and promotion of sustainable approaches to fisheries and aquaculture - introduction of new species to the market with business management and marketing tools and improved integration with tourism and transport sectors	Fishing	AA.SS	A	0	0	0	++	0	++	0	+/-
		Provide for dynamic and systematic monitoring of possible industry distress, to identify adaptation and transformation interventions, and of aquaculture/mussel farming practices, to verify their effects	Fishing	AA.SS	A	0	0	0	+	0	+	0	0
	Ensure strict compliance with fishing regulations, eliminating all forms of illegal activities	Prevention of IUU fishing (Illegal, Unauthorized, Unmonitored) - information and monitoring systems	Fishing	AA.SS	A	0	0	0	++	0	+++	0	0

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
	Improving knowledge about fish stocks to target fishing activities	Improve knowledge of marine species of fish interest most sensitive to climate change	Fishing	AA.SS	A	0	0	0	+++	0	+	0	0
Prevent potentially dangerous situations and activate climate change-induced risk reduction measures	Preventing/reducing hydraulic/hydrogeological risk.	Revision of the way return times are calculated as a function of climate change	Risks	AA.SS	A	0	0	+++	0	0	+++	0	0
		Integrated maintenance management of surface water bodies including artificial reservoirs in order to manage and compensate for flood events	Risks	AA.SS	B (green)	0	+++	++	+/-	+/-	+++	+/-	0
		Strengthen actions for redevelopment, preservation and expansion of river areas including through the tool of river contracts	Risks	AA.SS	B (green)	0	+++	++	++	++	++	0	0
		Promote cost-benefit analysis for facilities/infrastructure in high-risk and very high-risk areas in order to verify the convenience of relocation	Risks	AA.SS	B (grey)	+/-	+/-	+/-	+/-	+/-	+++	+/-	+/-
	Preventing forest fire risk	Strengthening sustainable forest management	Risks	AA.SS	B (green)	+	+	+++	++	++	+++	+/-	0
		Strengthen prevention, control, and investigative efforts to prevent deliberately and intentionally caused fires	Risks	AA.SS	A	+	+	++	++	++	+++	0	0
	Increase awareness in relation to risks	Improvement of alert communication system	Risks	AA.SS	A	0	0	0	0	0	+++	0	0
		Increase the preparedness of administrators and staff for emergency management	Risks	AA.SS	A	0	0	0	0	0	+++	0	0
Reduce pressure in	Limit land consumption, with	Strengthening the measures provided in the PGIZC for limiting	Urban planning	AA.SS	A	0	0	+++	+	+++	+++	0	0

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
terms of land consumption in order to maintain the residual adaptive capacity of territories	special attention to areas adjacent to the coastline	land consumption in the coastal area											
		Providing for a regional telematics platform for monitoring land consumption and representation of building and urban transformation	Urban planning	AA.SS									
		Strengthening regulations for reducing land consumption including through urban regeneration	Urban planning	AA.SS									
	Increasing the resilience of urban settlements to climate change	Introduce urban planning guidelines aimed at reducing and not increasing climate change risks	Urban planning	AA.SS	A	+	+	+++	+	+++	+++	+/-	+/-
Making agriculture resilient to climate change	Adapting cultivation techniques to ongoing climate change	Create tools to support crop choices according to climate trends, including those related to water availability (irrigation advice)	Agriculture	P	A	0	++	++	+/-	+/-	+++	0	0
		Incentivizing crops more resilient to the effects of climate change	Agriculture	AA.SS	B (green)	0	++	++	+/-	+/-	+++	0	0
Making agriculture a tool for adaptation to climate change	Preventing uneven soil erosion through agricultural practices	Incentivize cropping systems that prevent soil erosion	Agriculture	AA.SS	B (green)	0	+	+++	+	+++	+++	0	0
		Encouraging ways of managing soils that improve their hydrological capacity (absorb and retain water)	Agriculture	AA.SS									
Adapt the renewable energy production and	Take action to prevent or mitigate the reduction of renewable energy	Compensate for the intermittent nature of renewable generation (e.g., storage systems)	Energy	AA.SS	B (grey)	+++	+	+/-	0	0	++	+++	++
		For hydropower, de-incentivize run-of-river plants, as these are	Energy	AA.SS	A	0	+/-	0	0	+	0	+/-	0

Adaptation goal	Lines of action	Actionable measures	Sector	P = plan measures / AA.SS = of other instruments	Type of action	AIR	WATER	SOIL	BIOD	PAES&B	SAL&RISC	ENERGY	MOB&TR
distribution system to climate change scenarios	production related to climate change	the most vulnerable to the effects of climate change											
	Increasing the resilience of energy infrastructure to climate change	Interventions to increase the security of energy infrastructure (relocations, underground lines, etc.).	Energy	AA.SS	B (grey)	+/-	0	+/-	+/-	+/-	+++	+++	++
		Incentives for decentralization of the generation system (electricity generation by consumers to reduce grid vulnerability)	Energy	AA.SS									
Reduce energy demand during peak periods	Increasing energy efficiency in heating and cooling systems	Implementation of interventions on the existing building stock to reduce air conditioning requirements, both for the winter and summer seasons	Energy	AA.SS	B (grey)	+++	+	0	0	+/-	+	+++	0

Table F.2.3: Type of measure and assessed contribution on each environmental component for each action line

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[1] With reference to the "PNACC Sector Action Database" (Annex IV

REGIONE MARCHE
Giunta regionale

DECRETO DEL DIRIGENTE DEL SETTORE VALUTAZIONI E AUTORIZZAZIONI AMBIENTALI
n. 151 del 27 giugno 2023

Oggetto: Procedura di Valutazione Ambientale Strategica (VAS) del Piano Regionale di Adattamento al Cambiamento Climatico, Regione Marche 2023-2029: parere motivato di VAS ai sensi del D.lgs. 152/2006, art. 15 e Valutazione di Incidenza ai sensi del DPR 357/1997, art. 5.

VISTO il documento istruttorio e ritenuto, per le motivazioni nello stesso indicate, di adottare il presente decreto;

VISTO l'articolo 15 della legge regionale n. 18 del 30 luglio 2021 "Disposizioni di organizzazione e di ordinamento del personale della Giunta regionale";

DECRETA

DI DARE ATTO che nell'ambito delle consultazioni pubbliche di VAS del Piano Regionale di Adattamento al Cambiamento Climatico (PRACC) sono pervenute le osservazioni e i contributi riportati nell'allegato A al presente decreto;

DI ESPRIMERE parere motivato positivo nell'ambito della procedura di Valutazione Ambientale Strategica del PRACC, con le seguenti prescrizioni:
- dovranno essere recepite le osservazioni, in conformtià a quanto indicato nelle controdeduzioni di cui all'allegato A al presente decreto;
- dovranno essere integrate le misure previste nel PRACC, in linea con gli orientamenti emersi in fase di VAS e riportati documento istruttorio del presente decreto;
- dovranno essere indicate le modalità attuative delle misure previste, in linea con gli orientamenti emersi in fase di VAS;
- preliminarmente alla pubblicazione della dichiarazione di sintesi dovrà essere trasmesso all'Autorità competente VAS, per l'approvazione, il Programma di Monitoraggio integrato, redatto sulla base delle indicazioni del Rapporto Ambientale e del presente documento istruttorio. Il monitoraggio di VAS è integrato al monitoraggio del Piano.

DI DISPORRE che ai sensi dell'art. 17 del D.Lgs. 152/2006 siano adempiuti gli obblighi circa l'informazione sulla decisione a cura dell'Autorità Procedente.

DI ACQUISIRE, ai sensi della D.G.R. 1661/2020**,** il parere per lo screening di valutazione di incidenza (livello I) espresso dagli Enti Gestori del Siti Natura 2000, come riportato nell'allegato B del presente decreto;

DI INTEGRARE, ai sensi dell'art. 10 comma 3 del D.Lgs. 152/2006, il presente parere motivato, con il parere positivo per la Valutazione di Incidenza di cui all'art. 5 del D.P.R. 357/1997 per il Piano Regionale di Adattamento al Cambiamento Climatico Marche 2023-2029, ferma restando l'applicazione della valutazione di incidenza ai singoli progetti, ove pertinente;

DI TRASMETTERE gli esiti del presente procedimento all'Autorità Procedente, Settore Fonti energetiche, rifiuti, cave e miniere della Regione Marche, nonché agli Enti gestori dei Siti Natura 2000;

DI PUBBLICARE per estratto il presente decreto sul Bollettino Ufficiale della Regione Marche e per intero sul sito web istituzionale della Regione Marche: https://www.regione.marche.it/Regione-Utile/Ambiente/Controlli-e-Autorizzazioni/Valutazioni-Ambientali-Strategiche-VAS#2278_VAS-regionali-in-corso

Attesta, inoltre, che dal presente decreto non deriva né può derivare un impegno di spesa a carico della Regione.

Si attesta l'avvenuta verifica dell'inesistenza di situazioni anche potenziali di conflitto di interesse ai sensi dell'art. 6bis della L. 241/1990 e s.m.i.

Il dirigente
Roberto Ciccioli

DOCUMENTO ISTRUTTORIO

Normativa di riferimento

- **D.G.R. 6 dicembre 2021 n. 1523** – "Articoli 4, 11 comma 2, lettera b) e c), 13 e 14 della L.R. n 18/2021. Istituzione delle Direzioni e dei Settori della Giunta regionale";
- **D.G.R. 30 dicembre 2021 n. 1677** – "Articoli 4 comma 3 lettera c), 11 comma 2 lettera g) e 41, commi 1 e 2, L.R. n 18/2021. Conferimento degli incarichi di direzione dei Settori".
- **Direttiva 2001/42/CE del 27/06/2001** "Concernente la valutazione degli effetti di determinati piani e programmi sull'ambiente"
- **Decreto legislativo 3 aprile 2006, n. 152** "Norme in materia ambientale"
- **Legge regionale 12 giugno 2007, n. 6** "Modifiche e integrazioni alle Leggi regionali 14 aprile 2004, n. 7, 5 agosto 1992, n. 3, 28 ottobre 1999, n. 28, 23 febbraio 2005, n. 16 e 17 maggio 1999, n. 10 – Disposizioni in materia ambientale e rete natura 2000
- **Deliberazione di Giunta Regionale n. 1647 del 23/12/2019** - "Approvazione linee guida regionali per la Valutazione Ambientale Strategica e revoca della D.G.R. 1813/2010" - B.U.R. Marche n. 4 del 03/01/2020
- **Decreto PF VAA n. 13 del 17/01/2020** - "Indicazioni tecniche, requisiti di qualità e moduli per la Valutazione Ambientale Strategica"
- **Decreto del Presidente della Repubblica 8 settembre 1997, n. 357** "Regolamento recante attuazione della direttiva 92/43/CEE relativa alla conservazione degli habitat naturali e seminaturali, nonché della flora e della fauna selvatiche"
- **D.G.R. del 30 dicembre 2020, n. 1661** – "Adozione delle Linee guida regionali per la Valutazione di incidenza quale recepimento delle Linee guida nazionali. Revoca della DGR n. 220/2010, modificata dalla DGR n. 23/2015, così come rettificata dalla DGR n. 57/2015.
- **D.G.R. 13 dicembre 2021, n. 25** – Strategia Regionale per lo Sviluppo Sostenibile.

Motivazione

Iter amministrativo

Con deliberazione n. 322/2023 è stato adottata da parte dell'Assemblea legislativa regionale, ai sensi dell'azione B.5.1 della Strategia Regionale di Sviluppo Sostenibile, la proposta di "Piano regionale di adattamento al cambiamento climatico" 2023-2029.

Con nota ID. 29035860 del 16/03/2023 il Settore Fonti energetiche, rifiuti, cave e miniere, in qualità di Autorità procedente, ha trasmesso al Settore Valutazioni e Autorizzazioni Ambientali, Autorità competente VAS, la proposta di PRACC 2023-2029 chiedendo l'avvio del procedimento di VAS.

Con nota prot. n. 0311111 del 17/03/2023 il Settore Valutazioni e Autorizzazioni Ambientali ha avviato le consultazioni pubbliche del procedimento di Valutazione Ambientale Strategica (VAS) di cui all'art. 14 del D.lgs. 152/2006; le consultazioni si sono svolte dal 17/03/2023 al 01/05/2023.

Con la medesima nota, il Settore Valutazioni e Autorizzazioni Ambientali ha chiesto altresì agli Enti gestori dei Siti Natura 2000 di esprimere il proprio parere in merito alla valutazione di incidenza di livello I per il piano in oggetto. In particolare è stato chiesto di trasmettere il parere coordinato ai sensi del paragrafo 5.4 delle linee guida regionali di cui alla DGR 1661/2020.

Al fine di facilitare la partecipazione nell'ambito della consultazione di VAS, è stato organizzato un workshop in data 21 marzo 2023, in cui è stata presentata la proposta di piano e il Rapporto Ambientale. A seguito della conclusione delle consultazioni pubbliche sono pervenute osservazioni dai seguenti soggetti.

- Dipartimento di Prevenzione - UOC ISP Ambiente e Salute (prot. reg. n. 0347811|27/03/2023)
- Comune di San Benedetto del Tronto (prot. reg. n. 0421372|12/04/2023)
- Legambiente (prot. reg. n. 0473873|26/04/2023)
- Comitato TAG Costa-Mare (prot. reg. n. 0474411|26/04/2023)
- Alice de Simone (0479721|26/04/2023)
- Monica Laneri (0483951|27/04/2023)
- AIP2 Marche (0479835|27/04/2023)
- Anna Zauli (0493778|28/04/2023)
- Sandro Ciccarelli (0495021|28/04/2023)
- Stefano Chelli - Marco Cervellini (prot. reg. n. 0489794|28/04/2023)
- Ass. La Lupus in fabula (prot. reg. n. 0499108|02/05/2023)
- Ass. Italia Nostra (prot. reg. n. 499209|02/05/2023)
- Forum Salviamo il Paesaggio (prot. reg. n. 0499214|02/05/2023)
- Parco Naturale Regionale del Conero (prot. reg. n. 503385|02/05/2023)
- Parco Ggran Sasso Laga (prot. reg. n. 0504177|02/05/2023)
- Riserva Naturale Torricchio (prot. reg. n. 0504562|02/05/2023)
- Giacomo Boccalini (prot. reg. n. 499113|02/05/2023)
- Walter Doro (prot. reg. n. 499117|02/05/2023)
- Rita Novelli (prot. reg. n. 499167|02/05/2023)
- Filippo Grimaldi (prot. reg. n. 499172|02/05/2023)
- Alessandra Marangoni (prot. reg. n. 499183|02/05/2023)
- IAM-em-Erich (prot. reg. n. 499183|02/05/2023)
- Corbanese Gastone (prot. reg. n. 499234|02/05/2023)
- Loredana Vanin (prot. reg. n. 499239|02/05/2023)
- Tiziana Sperli (prot. reg. n. 499309|02/05/2023)
- Paola Peron (prot. reg. n. 499375|02/05/2023)
- Piven' Viktoria (prot. reg. n. 499961|02/05/2023)
- Edison S.p.a. (prot. reg. n. 505460|02/05/2023)
- Regione Umbria (prot. reg. n. 050453|02/05/2023)
- ATO3 (prot. reg. n. 500355|02/05/2023)
- ARPAM (prot. reg. n. 0503408|02/05/2023)
- Parco Gran Sasso Laga (prot. reg. n. 0504177|02/05/2023)

- Riserva Naturale Torricchio (prot. reg. n. 0504562|02/05/2023)
- Alessia Lenzi (prot. reg. n. 499204|03/05/2023)
- Provincia di Macerata (prot. reg. n. 0509044|03/05/2023)
- Parco Nazionale dei Monti Sibillini (prot. reg. n. 0566466|16/05/2023)

Si precisa che il contributo del Parco Nazionale dei Monti Sibillini è pervenuto correttamente entro i termini di consultazione (ID 29423990 del 26/04/2023) e che per mero errore materiale è stato acquisito al protocollo regionale solo successivamente.

Istruttoria tecnica

INQUADRAMENTO DEL PROGRAMMA E DELL'AMBITO TERRITORIALE DI RIFERIMENTO

Il Piano regionale di adattamento al cambiamento climatico della Regione Marche (PRACC) è organizzato in un testo principale ed in una serie di appendici di approfondimento. Il Piano presenta il quadro climatico nel contesto regionale (capitolo 2) e la relazione tra questo e tutti i fattori e le risorse del territorio regionale che ne subiscono gli effetti (capitolo 3), Vengono poi presentate le vulnerabilità e i rischi (capitolo 4) e vengono individuati gli Obiettivi e linee di Azione del piano, (capitolo 5 Appendice E, in cui è riportata anche una prima proposta degli indicatori di processo del Piano). Il Capitolo 6 riporta gli elementi principali del monitoraggio integrato PRACC-VAS, che saranno sviluppati nel "Programma di Monitoraggio". I documenti relativi alla VAS e alla valutazione di incidenza sono riportato nell'Appendice F.

Le azioni di piano sono state suddivise in due categorie, in relazione alla tipologia di obiettivi cui contribuiscono:

1. Azioni di Adattamento Trasversali
2. Azioni di Adattamento per Specifiche Vulnerabilità.

Le Azioni di Adattamento Trasversali riguardano i quattro dei vettori di sostenibilità della Strategia Regionale di Sviluppo Sostenibile, come riportato nella tabella successiva.

Vettore	**Linea Azione**
Vettore capacity building	Creare una governance per l'adattamento
Vettore conoscenza comune	Mettere a sistema le conoscenze comuni
	Rafforzare le conoscenze
Vettore educazione comunicazione	Individuare metodi efficaci per comunicare le scelte di piano
	Informare e sensibilizzare la cittadinanza su specifiche vulnerabilità
	Rafforzare l'educazione sui temi di adattamento ai cambiamenti climatici
Vettore sussidiarietà partecipazione	Creare partenariati
	Creare sinergie con gli Enti Locali

Le Azioni di Adattamento per Specifiche Vulnerabilità sono classificate a seconda del fattore o della risorsa cui si riferiscono.

Fattore/risorsa	**Obiettivo**	**Linea Azione**
Acque	Garantire tutela qualitativa della risorsa idrica	Efficientamento e adeguamento delle infrastrutture di smaltimento e depurazione
		Riduzione delle pressioni a carico del sistema idrico

	Rafforzare uso sostenibile della risorsa idrica	Completare e rafforzare le conoscenze in materia di risorse idriche
		Efficientamento dell'uso delle risorse idriche
		Gestione dei conflitti nell'uso delle risorse idriche
Agricoltura	Rendere l'agricoltura resiliente ai cambiamenti climatici	Adeguare le tecniche di coltivazione ai cambiamenti climatici
	Rendere l'agricoltura uno strumento di adattamento	Prevenire l'erosione del suolo irregolare attraverso le pratiche agricole
Coste	Proteggere le aree costiere dai rischi climatici	Aumentare la resilienza dei sistemi costieri
		Rafforzare e migliorare i sistemi di protezione da mareggiate e eventi estremi
Ecosistemi marini	Integrare tutela ecosistemi nella pianificazione settoriale e nelle azioni di trasformazione territoriale	Integrare la conservazione degli ecosistemi marini e costieri nelle politiche settoriali
	Rafforzare quadro conoscitivo sugli ecosistemi marini e costieri con cambiamenti climatici	Prevedere monitoraggi periodici sulle risorse più vulnerabili
Ecosistemi terrestri	Integrare tutela ecosistemi nella pianificazione settoriale e trasformazione territoriale	Favorire corridoi ecologici considerando modifiche degli areali per cambiamento climatico
	Rafforzare il quadro conoscitivo ecosistemi terrestri con cambiamenti climatici	Prevedere monitoraggi periodici sulle risorse più vulnerabili
	Ripristino ecosistemi	Attuazione PAF Marche 2021-2027
Energia	Adeguare produzione e distribuzione di energia rinnovabile agli scenari	Aumentare la resilienza delle infrastrutture energetiche
		Intervenire per prevenire o mitigare la riduzione di produzione di energia rinnovabile per cambiamenti climatici
	Ridurre la domanda di energia nei periodi di picco	Aumentare l'efficienza energetica nei sistemi di riscaldamento e raffreddamento
Pesca	Ridurre il sovrasfruttamento degli stock ittici	Assicurare uno stretto rispetto della normativa di pesca, eliminando attività illegali
		Fronteggiare l'impatto economico delle più difficili condizioni operative
		Migliorare le conoscenze sugli stock ittici per indirizzare le attività di pesca
		Ridurre la pressione di pesca
Rischi	Prevenire potenziale pericolo e attivare misure di riduzione del rischio dai cambiamenti climatici	Aumentare la consapevolezza in relazione ai rischi
		Prevenire il rischio incendi boschivi
		Prevenire/ridurre il rischio idraulico/idrogeologico
Suolo	Garantire tutela del suolo e capacità di adattamento	Monitoraggio e rafforzamento delle conoscenze su stato qualitativo dei suoli e gestione
Turismo	Rafforzare l'attrattività turistica fuori dalle zone costiere e destagionalizzazione	Destagionalizzazione e delocalizzazione dei flussi turistici
Urbanistica	Ridurre consumo di suolo e mantenere capacità di adattamento	Aumentare la resilienza degli insediamenti urbanistici
		Limitazione del consumo di suolo con attenzione alle aree adiacenti alla costa

Le linee di azione si articolano in misure, che possono essere trasversali o riferite a specifiche vulnerabilità. Le misure sono distinte in due tipologie, che fanno riferimento alle modalità e agli strumenti di attuazione: le misure proprie del piano e le misure settoriali.

Le misure proprie del piano sono azioni di indirizzo e di monitoraggio strettamente correlate al tema dei cambiamenti climatici. In alcuni casi, le azioni proprie del piano hanno una natura trasversale, in altri casi possono riferirsi ad una vulnerabilità specifica, che però viene affrontata con strumenti che non appartengono ad un settore specifico.

Le misure settoriali sono quelle che agiscono all'interno degli strumenti pianificatori, regolamentari, gestionali o normativi del settore indagato.

PRINCIPALI INTERFERENZE CON L'AMBIENTE

Per la specifica finalità del piano, le interferenze con l'ambiente delle linee di azione sono per la maggior parte positive. Gli effetti ambientali positivi derivanti dall'attuazione delle azioni/misure sono correlati alla loro potenzialità di ridurre gli impatti negativi dei cambiamenti climatici limitando la vulnerabilità del territorio e incrementando la sua resilienza. Il Piano, oltre ad avere un taglio conoscitivo (con una prima costruzione di quadri e scenari climatici), ha un forte il carattere strategico, in quanto individua gli strumenti di pianificazione e programmazione che potranno adottare misure di adattamento all'interno del contesto regionale.

Va specificato, altresì, che le "misure proprie del piano" sono azioni immateriali (monitoraggi, indirizzi e linee guida) che non comportano effetti diretti sull'ambiente. Le misure settoriali, invece, agiscono all'interno di altri strumenti (settoriali appunto) di pianificazione o programmazione. A tal fine, per la redazione del PRACC, è stato seguito un approccio di co-progettazione partecipata delle linee di azione con i Settori regionali interessati. Gli indirizzi che ne derivano perciò non presentano effetti diretti, che, se presenti, potranno essere valutati nell'ambito pianificazione settoriale.

Relativamente alle azioni per le specifiche vulnerabilità, il rapporto ambientale riporta la valutazione qualitativa dei potenziali effetti di ciascuna misura. L'analisi è attuata attraverso la definizione della tipologia di misura (soft, non soft-green, non soft-grey) e il contributo su ogni componente ambientale.

Non sono presenti impatti negativi ma, per alcune misure, viene valutato un impatto incerto per una o più componenti ambientali.

Di seguito si riporta una sintesi degli esiti delle valutazioni presentate nel Rapporto Ambientale e dell'istruttoria interna effettuata a livello di componente ambientale.

- Aria

Nel rapporto ambientale viene indicato che le azioni che prevedono interventi infrastrutturali potrebbero comportare un potenziale effetto negativo per le emissioni, ad esempio per le seguenti linee di azione:

- interventi volti a aumentare la sicurezza delle infrastrutture energetiche (es. Interramenti)
- arretramento degli insediamenti dalla linea di riva
- delocalizzazione delle infrastrutture
- integrazione fra mobilità e turismo (realizzazione piste ciclabili)

L'eventuale impatto sula qualità dell'aria è da intendersi riferito principalmente alle fasi di cantiere degli interventi. A tal fine si precisa che tale tipologia di impatti, oltre a dover essere puntualmente valutata in fase progettuale, può essere generalmente mitigata o annullata dalle "buone pratiche di cantiere", correntemente in uso per la realizzazione di interventi strutturali e infrastrutturali.

Per la specifica azione di "integrazione fra mobilità e turismo", nell'attuazione della misura si attendono effetti positivi sulla qualità dell'aria, in relazione allo stimolo all'utilizzo della mobilità dolce.

Per quanto riguarda la "destagionalizzazione e delocalizzazione dei flussi turistici", per la quale il RA aveva individuato possibili effetti negativi derivanti dell'aumento di mobilità e consumi nelle aree interne, si rileva che l'azione non è volta ad un incremento dei flussi turistici, bensì ad una loro diversa distribuzione, con un auspicabile potenziale miglioramento della qualità dell'aria nelle aree maggiormente congestionate.

Si ritiene, pertanto, che non possano derivare dalle misure previste effetti ambientali negativi significativi.

- Acqua

Le azioni del Piano agiscono in maniera positiva sulla risorsa idrica, andando ad interessare sia gli aspetti quantitativi (con azioni di efficientamento e risparmio) sia qualitativi. Il RA individua potenziali effetti sulla disponibilità di risorsa idrica e di aggravio del sistema di depurazione delle acque reflue nelle aree interne, in particolari periodi turistici in combinazione con i fenomeni di siccità, a causa della "Destagionalizzazione e delocalizzazione dei flussi turistici" per aumento della popolazione temporaneamente residente. Si rileva, tuttavia, che tale misura è propriamente finalizzata ad alleggerire la pressione nei periodi di maggiore criticità idrica (estate) e nei sistemi con il maggiore carico turistico (sistemi costieri).

Non si rilevano effetti negativi significativi del Piano sulla matrice acqua.

- Suolo

In generale le azioni di Piano producono effetti positivi sulla matrice suolo, sia in termini di qualità sia in termini di consumo. Per la qualità, con le azioni di monitoraggio e rafforzamento delle conoscenze dei suoli e della loro si potrà andare a colmare una lacuna conoscitiva sull'acquisizione e monitoraggio di dati sul suolo, individuato come criticità di adattamento. In aggiunta alle misure di settore, anche buona parte delle altre misure previste hanno effetti potenzialmente positivi sul suolo.

La limitazione del consumo di suolo, con particolare attenzione alle aree adiacenti alla costa e le azioni volte ad aumentare la resilienza degli insediamenti urbanistici ai cambiamenti climatici avranno effetti positivi sulla vulnerabilità degli insediamenti in particolare sul settore costiero e una generale riduzione della pressione antropica su quel comparto. L'arretramento degli insediamenti/adeguamento opere di protezione spiaggia o la realizzazione di nuove infrastrutture legate alla necessaria delocalizzazione di quelle esistenti, potrebbe comportare consumo di suolo. A tale proposito si fa presente che azione del piano non è la "delocalizzazione" ma analisi costi benefici per valutare la convenienza della delocalizzazione. Eventuali interventi di delocalizzazione dovranno necessariamente prevedere misure atte al contenimento dell'uso del suolo, in linea con le altre misure del Piano.

Non si rilevano effetti negativi significativi del Piano sul suolo.

- Ecosistemi terrestri e marini

Le azioni previste nel Piano hanno, sostanzialmente, effetti positivi su ecosistemi e risorse naturali. Il PRACC ha messo in evidenza alcune carenze conoscitive e le azioni sono concentrate prevalentemente sui monitoraggi. Le possibili interferenze con i sistemi naturali derivanti dalla realizzazione di progetti fisici (ad esempio piste ciclabili) potrà essere adeguatamente valutata e mitigata a livello di singolo progetto.

Inoltre, nel RA sono identificate potenziali interferenze derivare dalle misure di "Adeguamento delle opere di protezione costiera esistenti e progettazione delle nuove opere" su habitat e specie marine e marino-costiere, in particolare per alterazione dell'habitat con creazione di substrato duro (artificiale), alterazioni delle comunità biologiche autoctone e reclutamento di specie non indigene; eventuale risospensione dei sedimenti con possibili effetti sulla qualità delle acque ed ecosistemi a seguito di movimentazione dei fondali marini. A tal proposito si rileva che il Piano non prevede ex novo l'introduzione di opere di protezione, attività già prevista dagli attuali strumenti pianificatori, ma parla di "adeguamento" in funzione dei cambiamenti climatici. Resta ferma l'esigenza, in fase di realizzazione dei singoli progetti, di prevedere modalità realizzative tali da minimizzare i possibili impatti.

Relativamente al possibile impatto segnalato nel rapporto ambientale derivante dall'introduzione di specie aliene nell'ambito di interventi di ingegneria naturalistica o nell'introduzione di colture "aliene" resilienti ai cambiamenti climatici in ambito agricolo, questo dovrà essere previsto ed evitato attraverso appositi indirizzi per le fasi attuative.

- Paesaggio e beni culturali

In linea generale, non introducendo in maniera diretta trasformazioni territoriali, il PRACC non interferisce con la componente paesaggio.

Eventuali interferenze sul paesaggio legate direttamente o indirettamente all'alterazione/modificazione materiale, visiva e percettiva del contesto paesaggistico e alle trasformazioni di uso del suolo possono essere legati in particolare ad alcune misure quali "Arretramento degli insediamenti e adeguamento opere di protezione spiaggia" o alle trasformazioni dei corpi idrici, per la gestione degli invasi nell'ambito delle azioni di "Gestione dei conflitti nell'uso delle risorse idriche". Tali aspetti dovranno essere tenuti in considerazione e puntualmente valutati nelle fasi di realizzazione degli interventi.

Non sono state previste misure specifiche per la tutela dei beni culturali soggetti ai danni causati da eventi estremi sempre più frequenti, aumento della concentrazione della CO2 nell'aria, incremento dei cicli di cristallizzazione. Sarebbe opportuno che le misure di adattamento tenessero conto anche di tali aspetti

- Salute

La maggior parte delle linee di azione e/o misure previste dal PRACC hanno potenziali effetti positivi sulla salute umana e sulla protezione della popolazione dai rischi, proprio per la natura del Piano stesso che promuove l'adattamento dei territori e della popolazione ai cambiamenti climatici in atto. Tuttavia, non risultano presenti misure specifiche dirette per l'adattamento in termini di salute umana. Tali aspetti andrebbero approfonditi in fase di adeguamento del Piano. Ad esempio, non sono state previste misure specifiche sulla raccolta dati e il monitoraggio di indicatori di salute e benessere della popolazione.

MISURE PER IL MONITORAGGIO

Il PRACC è un Piano a forte valenza ambientale e la sua attuazione avviene anche e in maniera significativa attraverso gli strumenti di pianificazione di settore a valenza ambientale. Pertanto, il sistema di monitoraggio di Piano e il sistema di monitoraggio VAS sono in parte coincidenti: è opportuno quindi che gli indicatori di VAS e gli indicatori di piano siano ragionati congiuntamente. L'integrazione del sistema di monitoraggio ambientale, ovvero della VAS, insieme a quello del PRACC, è funzionale alla costruzione di un sistema unico che consenta di osservare al contempo il grado di attuazione del Piano, la sua efficacia rispetto ad obiettivi ed azioni e i suoi effetti ambientali.

Il monitoraggio di VAS è lo strumento attraverso cui è possibile misurare la sostenibilità del Programma. Il monitoraggio VAS è peraltro individuato anche come strumento della Strategia Regionale di Sviluppo Sostenibile approvata con Deliberazione dell'Assemblea legislativa delle Marche n. 25/2021.

Gli indicatori del sistema di monitoraggio VAS permettono di rappresentare le relazioni tra fenomeni che ne caratterizzano gli andamenti e le politiche esercitate. Per monitorare gli effetti ambientali previsti e individuarne eventualmente ulteriori, è previsto l'utilizzo di tre categorie di indicatori:

- Indicatori di contesto
- Indicatori di processo
- Indicatori di contributo

Gli indicatori di contesto sono quelli finalizzati a descrivere lo stato e l'andamento delle risorse interessate dall'attuazione del Piano. L'individuazione degli indicatori di contesto per il monitoraggio si basa:

- sull'analisi di contesto effettuata nell'ambito del PRACC (analisi fattori e risorse, appendice B);
- sugli indicatori della SRSvS particolarmente pertinenti agli obiettivi di sostenibilità individuati.

Inoltre, vista la natura e lo scopo del piano, particolare rilevanza avranno anche gli indicatori di contesto relativi al quadro climatico riportati nell'appendice A del PRACC.

La SRSvS è la prima tra le fonti di dati da tenere in considerazione al duplice scopo di uniformare il monitoraggio del Piano di Adattamento e relativa VAS agli altri strumenti di pianificazione regionale e di contribuire viceversa attivamente al monitoraggio della SRSvS, con le modalità sopra precisate.

Nel Programma di monitoraggio dovranno pertanto essere considerati indicatori tra quelli utilizzati per il monitoraggio della Strategia Regionale di Sviluppo Sostenibile, che interagisce con il processo di attuazione e che rappresenta uno strumento di verifica dell'attuazione e del raggiungimento degli obiettivi prefissati, capace di fornire elementi utili all'eventuale riorientamento delle politiche.

Gli indicatori di contributo (o di performance ambientale) misurano il contributo (o impatto) del Programma al raggiungimento degli obiettivi ambientali. Indicatori di processo e di contributo possono far parte degli indicatori di Programma come indicatori di output e di risultato.

La SRSvS (in Appendice 5) definisce un insieme di indicatori di contributo al contesto per la VAS, e rispetto ad alcuni P/P ne indica l'obbligatorietà in fase di monitoraggio.

Sebbene il PRACC non rientri, attualmente, in questo insieme di P/P, il Rapporto Ambientale ha selezionato gli indicatori di contributo della VAS utili al monitoraggio del contesto della SRSvS.

Gli indicatori di processo sono quelli strettamente legati alle azioni di programma in quanto misurano la sua attuazione e risultano utili alla comprensione delle performance ambientali degli interventi realizzati. Un indicatore generale sull'attuazione del piano darà conto del numero di azioni attivate sul totale delle azioni previste. Per le azioni che prevedono incentivi o la realizzazione di interventi (inclusa la messa in opera di reti di monitoraggio o l'attuazione di studi o ricerche), vengono individuati anche specifici indicatori per quantificare il livello di attuazione. Una prima individuazione degli indicatori di processo è riportata nell'Appendice E del PRACC.

Per il PRACC è prevista la realizzazione di un Programma di Monitoraggio Integrato (PMI) che coniughi le esigenze della VAS con quelle di monitoraggio proprie del programma. I contenuti minimi del PMI dovranno prevedere:

- gli indicatori di contesto individuati sulla base dell'appendice A (indicatori climatici) e dell'appendice B (fattori e risorse) nonché degli indicatori di contesto della SRSvS;
- gli indicatori di contributo, in cui andranno individuati anche gli indicatori più appropriati tra quelli minimi obbligatori di VAS dell'Appendice 5 della SRSvS;
- gli indicatori di processo, individuati sulla base dell'Appendice E del PRACC.

Vista la natura e la struttura del PRACC, che trova attuazione attraverso strumenti settoriali, è inoltre importante che l'attuazione del PRACC venga anche monitorata in termini di coerenza con gli strumenti di pianificazione vigenti.

Il PMI dovrà inoltre indicare le responsabilità per il monitoraggio, e la periodicità per la raccolta e l'elaborazione delle informazioni e la trasmissione dei report all'autorità competente di VAS.

OSSERVAZIONI PERVENUTE

Durante la fase di osservazioni pubbliche sono pervenute osservazioni da parte di 36 distinti soggetti come riportato nell'iter amministrativo del presente decreto. I documenti pervenuti sono stati esaminate

congiuntamente da Autorità procedente e Autorità competente e sono state identificate n. 65 osservazioni specifiche, che sono sintetizzate nell'Allegato B, che riporta anche le controdeduzioni.

La maggior parte delle osservazioni non ha interessato i documenti di VAS (rapporto ambientale) ma riguardava linee di azione e misure.

VALUTAZIONE DI INCIDENZA

Le Linee guida per la valutazione di incidenza di cui alla D.G.R. 1661/2020, al paragrafo 5.8 stabiliscono che sulla base delle previsioni dell'art. 10 comma 3 del D.Lgs. 152/2006, coordinate con l'art. 24, comma 3, lettera b) della L.R. n. 6/2007, la valutazione dell'Autorità competente per la VAS dà atto in modo distinto degli esiti della Valutazione di incidenza da parte della competente Autorità, rispetto ai livelli a cui è stata condotta, incluso il Livello I, relativo allo screening. Al medesimo paragrafo, le linee guida specificano che "alla luce degli orientamenti della Corte di Giustizia europea, l'esito dello screening di incidenza condotto in fase di verifica di assoggettabilità a VAS diventa discriminante per determinare la necessità di sottoporre il piano a VAS"

Pertanto, contestualmente all'avvio del procedimento di VAS, è stato chiesto agli Enti gestori dei siti Natura 2000 di esprimersi in merito alla valutazione di incidenza.

Con nota acquisita a prot. n. 0399579 del 05/04/2023 l'Unione Montana del Catria e Nerone esprime una valutazione di incidenza positiva, demandando l'analisi, qualora necessaria, delle eventuali incidenze sui Siti Natura 2000 ai singoli interventi in merito.

Il Parco Interregionale Sasso Simone e Simoncello, con nota acquisita al prot. reg. n. 0441006 del 17/04/2023 ha espresso parere positivo precisando che qualora gli interventi attuativi del Piano siano localizzati in ambiti interessati dai Siti della Rete Natura 2000 o comunque siano potenzialmente interferenti con i Siti Natura 2000, saranno sottoposti alla procedura di valutazione di incidenza al fine di escludere eventuali incidenze negative.

Con nota acquisita al prot. n. 449473 del 18/04/2023 l'Unione Montana Tronto e Valfluvione ha inviato il proprio parere positivo per lo screening di incidenza, precisando che in sede di progettazione degli interventi da realizzarsi, dovrà essere prodotto puntuale studio di incidenza specifico che attesti la conformità dell'intervento in relazione alle esigenze ecologiche dei tipi di habitat naturali e delle specie presenti, nel rispetto delle misure di conservazione previste e di quelle contenute nei Piani di gestione adottati.

La Provincia di Pesaro e Urbino, in qualità di Ente Gestore della Riserva Naturale Statale "Gola del Furlo", con nota acquisita al prot. reg. n. 0443070 del 17/04/2023, ritenendo che il Piano Regionale di Adattamento ai Cambiamenti Climatici non sia in grado di produrre effetti negativi che possano ritenersi significativi nei confronti di specie ed habitat di interesse comunitario, esprime una valutazione di incidenza positiva.

Sempre la Provincia di Pesaro Urbino, come Ente gestore dei Siti Natura 2000 di propria competenza, diversi da quelli ricadenti della Riserva del Furlo, con nota acquisita al prot. reg. n. 0485944 del 27/04/2023 esprime il proprio parere positivo per lo screening di incidenza specifico, precisando che qualora gli interventi attuativi del Piano siano localizzati in ambiti interessati dai Siti della Rete Natura 2000 o comunque siano potenzialmente interferenti con i Siti Natura 2000, tali interventi saranno sottoposti alla procedura di valutazione di incidenza, al fine di escludere eventuali incidenze negative e di individuare le opportune misure di mitigazione, ove necessario.

Con nota acquisita a prot. n. 0421372 del 12/04/2023 il Comune di San Benedetto del Tronto, in qualità di ente gestore della Riserva Naturale della Sentina, ha trasmesso una valutazione di incidenza positiva.

L'Unione Montana Montefeltro, con nota acquisita al prot. reg. n. 0456072 del 19/04/2023 esprime parere con esito positivo, specificando che eventuali interventi attuativi del Piano siano localizzati nel sito Rete Natura 2000 di propria competenza, saranno sottoposti alla procedura di valutazione di incidenza al fine di escludere eventuali incidenze negative e di individuare le opportune misure di mitigazione, ove necessario.

Il Parco nazionale dei Monti Sibillini, con nota ID 29423990 del 26/04/2023, acquisita al prot. reg. n. 0566466 del 16/05/2023, esprime una valutazione di incidenza positiva. Nella stessa nota, il Parco ha presentato ulteriori osservazioni che sono state esaminate nell'istruttoria di VAS.

Con nota acquisita a prot. n. 0474679 del 26/04/2023 l'Unione Montana Potenza Esino Musone ha trasmesso una valutazione di incidenza positiva esprimendosi anche per la Riserva naturale del monte San Vicino e del monte Canfaito.

L'Unione Montana dei Monti Azzurri, con nota acquisita al protocollo regionale n. 0477489 del 26/04/2023 ha espresso parere positivo.

L'Unione Montana dei Sibillini, con nota acquisita al protocollo regionale n. 0500161 del 28/04/2023 ha espresso parere positivo rimandando alle opportune procedure di valutazione di incidenza, da adottarsi nella fase attuativa dei singoli interventi che saranno realizzati sul territorio.

L'Unione Montana Marca di Camerino, con nota acquisita al prot. regionale n. 0500949 del 02/05/2023, ha espresso il proprio parere positivo ricordando la facoltà di esprimere i pareri di Valutazione d'Incidenza per tutte le eventuali azioni e/o interventi che si intendono effettuare.

Con nota prot. reg. n. 0503385 del 02/05/2023, il Parco del Conero ha espresso parere positivo per lo screening di incidenza. Nella stessa nota, il Parco ha presentato ulteriori osservazioni che sono state esaminate nell'istruttoria di VAS.

Con nota prot. reg. n. 0504177 del 02/05/2023 il Parco Nazionale del Gran Sasso e Monti della Laga, per i siti di propria competenza, ha trasmesso parere positivo, presentando alcune osservazioni che sono state esaminate nell'istruttoria di VAS.

Con nota acquisita al protocollo reg. n. 0504562 del 02/05/2023, l'Università di Camerino, in qualità di Ente gestore della Riserva Naturale Montagna di Torricchio, ha rilasciato il parere positivo di propria competenza per la valutazione di incidenza.

Con nota prot. reg. n. 0509044 del 03/05/2023 la Provincia di Macerata, come Ente gestore dei Siti Natura 2000 di propria competenza, ha trasmesso parere positivo precisando che *nell'attuale fase di programmazione non è possibile definire le azioni strutturali che si svilupperanno dal Piano di adattamento al cambiamento climatico, pertanto non è possibile prevedere incidenze dirette, indirette, e/o cumulative, anche potenziali delle stesse, sull'integrità del sito "Selva dell'Abbadia di Fiastra" e sulle specie di interesse comunitario presenti in esso*. Con nota acquisita al proit. Reg. n. n. 0702875 del 12/06/2023, la Fondazione Giustiniani Bandini, in qualità di Gestore della Riserva Naturale dell'Abadia di Fiastra, ha comunicato di non avere osservazioni in merito alla procedura in oggetto.

La Provincia di Ancona, con nota acquisita al prot. regionale n. 0535085 del 09/05/2023, ha trasmesso il parere positivo per la valutazione di incidenza dei siti di propria competenza, ovvero "Fiume Esino in località Ripabianca" e "Selva di Castelfidardo". Per il SIC/ZPS "Fiume Esino in località Ripabianca" il parere della provincia ha acquisito anche il parere dell'ente Gestore della Riserva Di Ripabianca, co-gestore del sito.

Con nota acquisita al prot. reg. n. 523320 del 05/05/2023 la Provincia di Ascoli Piceno, ha espresso parere positivo per lo screening di valutazione di incidenza, precisando che gli eventuali impatti saranno valutati in riferimento ai singoli interventi che dovessero interessare direttamente od indirettamente i siti Natura 2000.

L'Unione Montana dell'Esino Frasassi, con nota acquisita al prot. regionale n. 0590775 del 22/05/2023 si è espressa per i siti ricadenti nel proprio territorio ed in qualità di Ente Gestore della Parco Regionale Gola della Rossa e Frasassi. L'Unione ha espresso parere positivo in riferimento alla Valutazione di Incidenza-Livello I Screening, specificando che nell'attuale fase di programmazione, in assenza di informazioni relative alle linee di azione e alla loro localizzazione non è possibile definire le azioni strutturali che si svilupperanno dal piano, pertanto non è possibile prevedere incidenze dirette, indirette, e/o cumulative, anche potenziali delle stesse su specie o sugli habitat di interesse comunitario presenti nei siti di nostra competenza. Qualora dovessero discendere dal Piano , seppure in via indiretta, la realizzazione di interventi di tipo strutturale / infrastrutturale, per tali interventi dovrà essere garantita, la verifica delle interferenze con i Siti Natura 2000 pertanto dovranno essere assoggettati alle procedure di Valutazione d'Incidenza Ambientale in conformità con l'allegato G del DPR 357/97 e con le Linee guida per la Valutazione di Incidenza (VINCA) di cui alla DGR 1661 del 30 dicembre 2020.

L'Unione Montana Alta Valle del Metauro, con nota acquisita al prot. reg. n. 0660031 del 01/06/2023 ha espresso una valutazione di incidenza positiva, demandando l'analisi, qualora necessaria, delle eventuali incidenze sui siti Natura 2000 ai singoli interventi in merito.

Il Parco Regionale del San Bartolo con nota acquisita al prot. reg. n. 0714670 del 13/06/2023 ha espresso il proprio parere positivo per lo screening di valutazione di incidenza.

Sulla base dei pareri pervenuti è quindi possibile affermare che il parere complessivo di valutazione di incidenza, compreso nel parere di VAS, sia positivo.

Esito dell'istruttoria

Tutto ciò premesso si propone:

DECRETA

DI DARE ATTO che nell'ambito delle consultazioni pubbliche di VAS del Piano Regionale di Adattamento al Cambiamento Climatico (PRACC) sono pervenute le osservazioni e i contributi riportati nell'allegato A al presente decreto;

DI ESPRIMERE parere motivato positivo nell'ambito della procedura di Valutazione Ambientale Strategica del PRACC, con le seguenti prescrizioni:

- dovranno essere recepite le osservazioni, in conformtià a quanto indicato nelle controdeduzioni di cui all'allegato A al presente decreto;
- dovranno essere integrate le misure previste nel PRACC, in linea con gli orientamenti emersi in fase di VAS e riportati documento istruttorio del presente decreto;
- dovranno essere indicate le modalità attuative delle misure previste, in linea con gli orientamenti emersi in fase di VAS;
- preliminarmente alla pubblicazione della dichiarazione di sintesi dovrà essere trasmesso all'Autorità competente VAS, per l'approvazione, il Programma di Monitoraggio integrato, redatto sulla base delle indicazioni del Rapporto Ambientale e del presente documento istruttorio. Il monitoraggio di VAS è integrato al monitoraggio del Piano.

DI DISPORRE che ai sensi dell'art. 17 del D.Lgs. 152/2006 siano adempiuti gli obblighi circa l'informazione sulla decisione a cura dell'Autorità Procedente.

DI ACQUISIRE, ai sensi della D.G.R. 1661/2020**,** il parere per lo screening di valutazione di incidenza (livello I) espresso dagli Enti Gestori del Siti Natura 2000, come riportato nell'allegato B del presente decreto;

DI INTEGRARE, ai sensi dell'art. 10 comma 3 del D.Lgs. 152/2006, il presente parere motivato, con il parere positivo per la Valutazione di Incidenza di cui all'art. 5 del D.P.R. 357/1997 per il Piano Regionale di Adattamento al Cambiamento Climatico Marche 2023-2029, ferma restando l'applicazione della valutazione di incidenza ai singoli progetti, ove pertinente.

Il responsabile del procedimento
(*Roberto Ciccioli*)

Documento informatico firmato digitalmente

ALLEGATO A
Osservazioni pervenute

n.	*Sintesi Osservazione*	*Proposta da*	*Piano / VAS*	*Controdeduzione*	*Modalità di recepimento*
1	Le misure ed azioni di educazione, informazione, comunicazione potrebbero beneficiare fortemente dell'apporto dei Centri di Educazione Ambientale inseriti nella rete INFEA.	- Comune di San Benedetto del Tronto (0421372|12/04/2023) - Ass. La Lupus in fabula (0499108|02/05/2023) - Ass-Italia Nostra (499209|02/05/2023) - Forum Salviamo il Paesaggio (0499214|02/05/2023) - Parco Conero (503385|02/05/2023)	P	Il sostegno agli INFEA può essere inserito come misura del piano	Modifica della sezione 5.2.1 – Misure di educazione del PRACC
2	Per la messa in rete PAESC" (misure di sussidiarietà, partecipazione e partenariati), si può prevedere l'organizzazione di un tavolo tecnico istituzionale.	- Comune di San Benedetto del Tronto (0421372|12/04/2023)	P	Verrà inclusa una misura per l'attivazione di un gruppo di sussidiarietà verso il basso per la messa in rete dei PAESC	Modifica della sezione 5.2.1 – Misure di sussidiarietà del PRACC
3	Le misure ed azioni per l'adattamento degli ecosistemi terrestri e marini non contemplano la necessità di ampliare la superficie protetta sia a terra che a mare. Inserire come obiettivo di adattamento il raggiungimento del 30% di superficie protetta a terra e a mare, sia attraverso interventi attivi di competenza regionale (Rete Natura 2000, aree protette regionali), sia attraverso la facilitazione di processi finalizzati all'istituzione di aree protette di competenza nazionale (parchi nazionali e/o aree marine protette).	- Comune di San Benedetto del Tronto (0421372|12/04/2023) - Legambiente (0473873|26/04/2023) - Comitato TAG Costa-Mare (0474411|26/04/2023) - Stefano Chelli - Marco Cervellini (0489794|28/04/2023) - Ass. La Lupus in fabula (0499108|02/05/2023) - Ass-Italia Nostra (499209|02/05/2023) - Forum Salviamo il Paesaggio (0499214|02/05/2023) - Parco Conero (503385|02/05/2023) - Parco Ggran Sasso Laga (0504177|02/05/2023) - Riserva Naturale Torricchio (0504562|02/05/2023)	P/V	Le aree protette sono considerate nel Rapporto Ambientale come punto di forza per l'adattamento. Sebbene l'istituzione di aree protette possa avere come conseguenza indiretta anche quella di migliorare l'adattamento ai CC, le azioni di PRACC si concentrano su misure dirette di adattamento. Tuttavia verrà inserita una linea d'azione sulla tutela dei sistemi naturali e una relativa misura atta a verificare, negli specifici strumenti di settore, la	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri – e Misure e azioni per l'adattamento degli ecosistemi marini e costieri

		- Parco Sibillini (0566466|16/05/2023)		possibilità di estendere la superficie protetta	
4	Tra le azioni di adattamento del settore urbanistico inserire le tecniche di micro-forestazione urbana, come strumento da promuovere tra gli strumenti regionali e comunali	- Comune di San Benedetto del Tronto (0421372|12/04/2023) - Ass. La Lupus in fabula (0499108|02/05/2023) - Ass-Italia Nostra (499209|02/05/2023) - Forum Salviamo il Paesaggio (0499214|02/05/2023) - Parco Conero (503385|02/05/2023)	P	La specifica della microforestazione urbana, può essere inserita negli indirizzi della pianificazione urbanistica per la riduzione dei rischi connessi ai cambiamenti climatici	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento del settore urbanistico - Indicazioni specifiche nelle Norme Tecniche Attuative
5	Per l'adattamento delle aree urbane diviene essenziale prevedere Linee Specifiche di azione dedicate a: - potenziamento del verde urbano, ed in particolare riforestazione di tutte le aree disponibili nelle zone più centrali delle città, per mitigare le c.d. isole di calore: - sistematica sostituzione di tutte le singole alberature rimosse per cause naturali (morte, malattia) - rinaturalizzazione di aree oggi prive di alberi e arbusti (piazze, ma arche parcheggi) - creazione di boschi urbani a ridosso delle aree centrali	- Legambiente (0473873|26/04/2023)	P	La specifica degli aspetti indicati può essere inserita negli indirizzi della pianificazione urbanistica per la riduzione dei rischi connessi ai cambiamenti climatici	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento del settore urbanistico - Indicazioni specifiche nelle Norme Tecniche Attuative
6	Non viene trattato l'obbiettivo B.3 Migliorare la qualità dell'aria	- Legambiente (0473873|26/04/2023)	P/V	La qualità dell'aria è stata considerata nel Rapporto Ambientale per l'analisi del contesto e la valutazione degli effetti. Sebbene ci siano connessione tra cambiamenti climatici e qualità dell'aria, non sono state individuate azioni possibili di competenza della Regione, ulteriori a quelle già in	Nessuna modifica necessaria

				atto per la qualità dell'aria, associate ai cambiamenti climatici, da includere nel Piano.	
7	Nell'obiettivo di adattamento "Rafforzare un uso sostenibile della risorsa idrica", appare assai debole e quasi residuale la misura "Miglioramento dell'efficienza delle reti di distribuzione per uso irriguo e idropotabile", mentre non è ben comprensibile l'obbiettivo della misura "Interconnessioni dei sistemi acquedottistici e delle fonti"	- Legambiente (0473873|26/04/2023)	P	L'applicazione delle misure verrà dettagliata ulteriormente nel Piano. Il miglioramento dell'efficienza delle reti di distribuzione per uso irriguo e idropotabile risulta una misura fondamentale per il piano. Il Piano non prevede l'aumento della captazione di sorgenti, ma anzi è teso ad ottimizzare gli usi esistenti.	Modifica della sezione 5.2.2 - Misure e azioni per un uso sostenibile della risorsa idrica - Indicazioni specifiche nelle Norme Tecniche Attuative
8	Mancano azioni specifiche a tutela della fauna selvatica, delle specie animali, ed in particolare della classe degli anfibi, che è la più a rischio per l'aumento delle temperature, la diminuzione delle precipitazioni e il conseguente deterioramento degli habitat	- Legambiente (0473873|26/04/2023)	P	Nella misura di attivazione di mantenimento e ripristino di habitat e specie nei Siti Natura 2000 verrà fatto specifico riferimento agli habitat umidi e agli anfibi che risultano particolarmente vulnerabili ai cambiamenti climatici.	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri -
9	Non sono previste misure per la protezione del mare. Si chiede di aumentare la superficie protetta ricorrendo, almeno nella fase iniziale all'effettiva e veloce istituzione delle Aree Marine Protette della Costa del Conero e della Costa del Piceno.	- Legambiente (0473873|26/04/2023)	P	Per quanto si concordi sulla funzione delle aree protette per la tutela degli ecosistemi, l'istituzione di aree marine protette non è di diretta competenza della Regione ma del MASE. Tuttavia verrà inserita, nella linea d'azione "Integrare la conservazione degli ecosistemi marini e costieri nelle politiche	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi marini e costieri

				settoriali", una misura atta a verificare, negli specifici strumenti di settore, la possibilità di estendere la superficie protetta. Si veda anche osservazione n. 3	
10	Sono previste numerose misure a tutela dei terreni agricoli, compresi sia nel Settore Acque che di Prevenzione del rischio idrogeologico. Non ci sono Linee di Azione per incentivare la gestione dei terreni agricoli vincolati dal P.A.I. (zone R1, R2, R3, R4) con piani di riforestazione adeguatamente finanziati in relazione al rischio idrogeologico (più è alto il rischio e la pericolosità più è alto il mancato reddito agricolo).	- Legambiente (0473873|26/04/2023)	P	L'osservazione sarà integrata nella linea di azione "Prevenire e mitigare il rischio idraulico e idrogeologico".	Modifica della sezione 5.2.2 - Misure e azioni per contrastare i rischi derivanti dai cambiamenti climatici
11	Non sembra prevista alcuna azione che favorisca l'agricoltura biologica, che certamente favorirebbe il raggiungimento di alcune azioni previste dal Piano	- Legambiente (0473873|26/04/2023)	P	Il PRACC prevede diverse misure orientate ad indirizzare la sostenibilità delle pratiche agricole in relazione alle vulnerabilità dei cambiamenti climatici, anche in relazione all'uso di concimi e di pesticidi, indipendentemente dal disciplinare biologico.	Nessuna modifica necessaria
12	E' prevista la sola misura "Rafforzare la gestione sostenibile delle foreste" su boschi e foreste, tra le azioni di prevenzione degli incendi boschivi, che sembra non essere proporzionata alla estensione delle superfici boscate in rapporto al totale del territorio. Si ritiene indispensabile citare la Strategia Europea per le Foreste per il 2030.	- Legambiente (0473873|26/04/2023)	P	Le misure sulle foreste verranno rafforzate all'interno della sezione ecosistemi.	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri

13	La linea di azione “Destagionalizzazione e delocalizzazione dei flussi turistici” prevede una misura per la diversificazione dell’offerta turistica invernale delle aree montane, per compensare cali di flusso turistico collegati alla riduzione delle precipitazioni nevose. Sarebbe opportuno, data la presenza di tale misura, di indirizzarne gli obiettivi verso un’offerta turistica meno energivora e più resistente al cambiamento climatico, sostenendo apertamente una forma di turismo idonea alle 4 stagioni (legata al turismo dolce).	- Legambiente (0473873|26/04/2023)	P	La descrizione della misura verrà approfondita in linea con quanto proposto	Modifica della sezione 5.2.2 - Misure e azioni per l’adattamento del Turismo - Indicazioni specifiche nelle Norme Tecniche Attuative
14	Citare opportunamente la Strategia Europea per la Biodiversità 2030 ed integrare i suoi obiettivi all’interno della strategia del Piano regionale, come contributo fondamentale per l’adattamento degli ecosistemi terrestri e marini ai cambiamenti climatici.	- Comitato TAG Costa-Mare (0474411|26/04/2023)	P/V	La Strategia Europea per la Biodiversità 2030 è considerata nel rapporto Ambientale di VAS. I principi in essa contenuti, pertinenti i CC, sono comunque inclusi nel PRACC.	Nessuna modifica necessaria
15	Indicare come “Elementi di fragilità” la superficie protetta sia terrestre che marina, riportando le percentuali attualmente protette, inferiori a quelle previste dal-la strategia Biodiversità 2030, sia a terra che a mare.	- Comitato TAG Costa-Mare (0474411|26/04/2023)	P	L’estensione delle aree protette verrà inclusa tra gli elementi di fragilità sia degli ecosistemi marini che degli ecosistemi terrestri	Modifica della Sezione 3.5 Ecosistemi terrestri e della sezione 3.6 Ecosistemi marini
16	Applicazione dell’indice di rischio climatico per la biodiversità in Mare come indice di stato e risposta, in base alla sensibilità della singola specie alle variazioni del clima, alla prevista esposizione futura al cambiamento climatico, al potenziale di adattamento della specie al surriscaldamento globale. L’indice è costruito sulla base di due tipi di scenari: quello ad alte emissioni e quello ad alta mitigazione.	- Comitato TAG Costa-Mare (0474411|26/04/2023)	P	L’indice di rischio citato Boyce, et al., 2022) è già stato applicato a livello globale. Tale indice, o altri indici valutati pertinenti, potranno essere utilizzati, se opportuno, per le valutazioni di adattamento nell’ambito della misura già prevista per la linea d’azione “Prevedere monitoraggi periodici sulle risorse più vulnerabili”	Indicazioni specifiche nelle Norme Tecniche Attuative relative alla alla Sezione 3.6 Ecosistemi marini

17	Integrazione nelle 5.2.1. Azioni di adattamento trasversali: Continuazione del progetto INTEREG GECO2 (Green Economy and CO2, https://www.italy-croatia.eu/web/geco2), del quale le Marche sono state partner, che ha avuto come obiettivo quello di rafforzare a potenziale capacità del settore agricolo della regione adriatica di ridurre le emissioni di carbonio nell'atmosfera attraverso una migliore gestione dei suoli e dei residui delle colture e a creare reddito attraverso la creazione di mercati volontari del carbonio.	- Comitato TAG Costa-Mare (0474411|26/04/2023)	P	Il progetto in esame riguarda azioni di mitigazione. Tra le azioni di adattamento trasversale c'è comunque il sostegno alla partecipazione a progetti europei sull'adattamento ai CC	Nessuna modifica necessaria
18	Integrazione nelle 5.2.2. Azioni di adattamento per specifiche vulnerabilità: a) Azioni integrate con le politiche agricole sull'incremento di carbonio nei suoli e l'incremento di pratiche per la riduzione dell'erosione e la raccolta d'acqua (sistemi di raccolta diffusi, fosse livellari, fasce tamponi boscate, sistemi di ingegneria naturalistica diffusi con specie produttive in modo da integrare il reddito dell'agricoltore). b) Uso di animali di allevamento in modo integrato con l'agroselvicoltura per integrare la zootecnia nel territorio ed utilizzare il pascolo per il controllo delle specie invasive, la creazione e manutenzione di fasce tagliafuoco, il mantenimento dei prati stabili e dei pascoli. c) La creazione di sistemi resilienti nelle aree costiere permette di rispondere ai cambiamenti climatici riducendo i rischi per l'economia e la società (ricostruzione delle dune, il ripristino della vegetazione stabilizzante, la ricostruzione delle barre sommerse, l'introduzione di sistemi di fitodepurazione costiera tali da ricreare le	- Comitato TAG Costa-Mare (0474411|26/04/2023)	P	a) Indicazioni relative alle pratiche agricole sono già fornite e verranno ulteriormente dettagliate nei documenti attuativi b) Verrà aggiunta una specifica linea d'azione nella sezione "Misure e azioni per contrastare la desertificazione e il degrado del territorio" c) Tali aspetti verranno specificati nell'ambito della misura di promozione di rinaturalizzazione dell'area costiera	a) Integrazione della sezione 5.2.2 Misure e azioni per l'adattamento dell'agricoltura Indicazioni specifiche nelle Norme Tecniche Attuative b) Integrazione della sezione 5.2.2 Misure e azioni per contrastare la desertificazione e il degrado del territorio c) Modifica sezione 5.2.2 Misure e azioni per i sistemi costieri

	aree umide salmastre e ridurre la risalita del cuneo salino.)				
19	Il Piano regionale di adattamento al cambiamento climatico risulta essere carente rispetto agli obiettivi e alle conseguenti azioni per la conservazione degli ecosistemi terrestri e marini e della relativa biodiversità.	- Stefano Chelli - Marco Cervellini (0489794|28/04/2023)	P	Le misure di adattamento per gli ecosistemi verranno rafforzate nel piano, anche in linea con altre osservazioni pervenute	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri e Misure e azioni per l'adattamento degli ecosistemi marino-costieri
20	Sui cambiamenti climatici, oltre al forzante antropico e alla manipolazione climatica indotta dalle attività di geoingegneria incidono fattori esclusivamente naturali: in primis cause astronomiche e planetarie (orbite della Terra, del Sole e degli altri pianeti del sistema solare). Alla luce della documentazione trasmessa, sia analitica che tecnico-scientifica, si auspica che codesti uffici in qualità di Proponenti del PRACC tengano in debita considerazione TUTTI i fattori naturali e antropici che influenzano le condizioni climatiche della Regione Marche e dell'Italia intera.	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023) - Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023) - Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023) - Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)	P/V	Il quadro conoscitivo del Piano si concentra sull'analisi e la valutazione degli effetti, analizzando le osservazioni attuali e utilizzando per le proiezioni modelli specifici e downscaling locali. Non vengono esaminate le cause dei fenomeni e delle tendenze analizzate. Inoltre, la mitigazione dei cambiamenti climatici non è oggetto di questo Piano.	Nessuna modifica necessaria

21	L'osservazione pone il tema della geoingegneria intesa come manipolazione artificiosa di alcune variabili climatiche. È necessario monitorare le attività di geoingegneria che vengono svolte in Italia e in Europa, al fine di verificare quali alterazioni climatiche/meteorologiche effettivamente hanno determinato e determinano nel territorio regionale, in particolare identificare quelle alterazioni che sono state e sono devastanti per le Marche (bombe d'acqua, alluvioni, siccità, degrado dei suoli agricoli, ecc.).	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023) - Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023) - Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023) - Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)	P	La geoingegneria è un tema molto controverso e ancora molto dibattuto di cui non si conoscono le implicazioni reali. La modellistica attuale non permette di inserire forzanti legate alla geoingegnerie; tali aspetti sono tuttora oggetto di dibattito scientifico. Scopo del piano è quello di evidenziare lo stato attuale (misurato) e le probabili tendenze, che servono come guida per l'identificazione delle misure di adattamento.	Nessuna modifica necessaria
22	L'osservazione chiede di approfondire le interferenze tra il clima e la tecnologia high frequency active auroral research program (che può determinare significative manipolazioni meteorologiche, sino a vere e proprie devastanti alluvioni)	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023) - Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023)	P	Si prende atto delle informazioni ricevute; non si ravvisa nessuna competenza diretta del PRACC con la quale si possa intervenire	Nessuna modifica necessaria

		- Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023) - Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)			
23	E' necessario riconoscere con precisione le cause del cambiamento climatico in atto, discriminando i forzanti esclusivamente naturali (che non possono essere ignorati perché ci sono stati sempre e sempre ci saranno, imputabili alle leggi dell'astrofisica e dell'astronomia), dai forzanti antropici e "artificiosi" come sono le tecniche di geoingegneria atmosferica	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023) - Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023) - Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023)	P	Il quadro conoscitivo del Piano si concentra sull'analisi e la valutazione degli effetti, con lo scopo di identificare misure di adattamento. Non vengono esaminate le cause dei fenomeni e delle tendenze analizzate. Si fa altresì presente che i forzanti astronomici inducono cicli di variabilità climatica con scale temporali al di fuori dalla dimensione di analisi del PRACC.	Nessuna modifica necessaria

		- Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)			
24	Integrare nelle analisi chimiche delle acque superficiali e sotterranee, il contenuto in metalli pesanti e elementi non previsti attualmente dalla normativa (Ba, Sr, Li, solfati e ioduri)	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023) - Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023) - Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023) - Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)	P	La tutela qualitativa delle acque, incluse quelle destinate al consumo umano, è di competenza del Piano di Tutela delle Acque sulla base di disposizioni comunitarie e nazionali	Nessuna modifica necessaria
25	Nel PRACC non è riportato alcun grafico di variazione nel tempo della temperatura del Mar Adriatico, né si fa alcun riferimento ai dati di misura della temperatura e della salinità dei mari e degli oceani che sono stati raccolti negli ultimi anni	- Alice de Simone (0479721|26/04/2023) - Monica Laneri (0483951|27/04/2023) - Anna Zauli (0493778|28/04/2023) - Sandro Ciccarelli (0495021|28/04/2023) - Giacomo Boccalini (499113|02/05/2023)	P	I dati relativi alla temperatura del mare sono inseriti nella sezione 3.6 del piano (Ecosistemi marini) e nell'appendice B	Nessuna modifica necessaria

		- Walter Doro (499117|02/05/2023) - Rita Novelli (499167|02/05/2023) - Filippo Grimaldi (499172|02/05/2023) - Alessandra Marangoni (499183|02/05/2023) - IAM-em-Erich (499183|02/05/2023) - Corbanese Gastone (499234|02/05/2023) - Loredana Vanin (499239|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Tiziana Sperli (499309|02/05/2023) - Paola Peron (499375|02/05/2023) - Paola Peron (499375|02/05/2023) - Piven' Viktoria (499961|02/05/2023) - Alessia Lenzi (499204|03/05/2023)			
26	Mappare e diffondere la conoscenza delle esperienze di partecipazione sul tema dell'adattamento ai cambiamenti climatici attraverso una call periodica e la creazione di una sezione dedicata sul Portale Nazionale sull'adattamento ai cambiamenti climatici dell'ISPRA	- AIP2 Marche (0479835|27/04/2023)	P	La mappatura delle esperienze di partecipazione verrà inserita come azione. La Regione non ha invece competenze nella modifica del Portale Nazionale di Ispra	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati
27	Promuovere nei territori analisi e valutazioni partecipate per comprendere i valori di vulnerabilità socio-territoriali al fine di recuperare o rivedere la natura, la consistenza e la rilevanza dei processi sociali, istituzionali, culturali, economici,.. per finalità di prevenzione e per migliorare le risposte in caso di evento disastroso	- AIP2 Marche (0479835|27/04/2023)	P	La proposta verrà integrata nell'ambito del Forum per lo Sviluppo Sostenibile	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati – Indicazioni specifiche nelle Norme Tecniche Attuative
28	Favorire a livello comunale la formazione di infrastrutture relazionali socio-culturali secondo una dinamica di networking (non solo associazioni specifiche di protezione civile) riconosciute dalle amministrazioni locali che in chiave di sussidiarietà orizzontale possono esprimere quei comportamenti	- AIP2 Marche (0479835|27/04/2023)	P	La proposta verrà integrata nell'ambito delle misure di sussidiarietà, nella linea di azione Creare sinergie con gli enti locali	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati

	pro-sociali che in genere si manifestano nelle fasi successive agli eventi disastrosi e che possono concorrere alla eventuale ricomposizione e ricostruzione del tessuto comunitario impattato				
29	Promuovere la diffusione degli strumenti di governance partecipata già esistenti e utilizzati sui territori, quali ad esempio i Contratti di Fiume (e analoghi "Contratti di Costa" o "Contratti di laguna"), o gli Osservatori del paesaggio (https://territorio.regione.emilia-romagna.it/osservatorio-qualita-paesaggio) come strumenti utili a creare una rete attiva e un presidio organizzato dal basso che vede coinvolti enti, istituzioni pubbliche, private e comunità locale. Questi strumenti contribuiscono alla preservazione, al monitoraggio del paesaggio e delle risorse ambientali e possono contribuire a definire strategie, politiche e azioni all'interno di piani di governo del territorio.	- AIP2 Marche (0479835|27/04/2023)	P	Lo strumento dei contratti di fiume è già incluso nelle azioni per contrastare i rischi dei cambiamenti climatici. Verrà inserita una più generica azione trasversale.	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati
30	Promuovere la creazione di Presidi della Partecipazione, costituiti da cittadini, singoli od organizzati, quali luoghi deputati alla promozione e alla realizzazione dei processi partecipativi al livello delle comunità locali d'intesa con le amministrazioni locali.	- AIP2 Marche (0479835|27/04/2023)	P	La creazione di presidi verrà inserita come misura, nella linea di azione Creare sinergie con gli enti locali	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati
31	Promuovere il coinvolgimento permanente della comunità scolastica e in particolare degli studenti superiori e universitari su sfide/problemi concreti, tutorati da esperti di processo e di contenuto, per progettare soluzioni possibili.	- AIP2 Marche (0479835|27/04/2023)	P	La proposta verrà integrata nell'ambito del Forum per lo Sviluppo Sostenibile	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati
32	Riportare la metodologia di lavoro con gli adulti alla scala e alla portata delle bambine, dei bambini e delle Istituzioni scolastiche, di ogni ordine e grado, presenti sul territorio, in modo da creare per il futuro	- AIP2 Marche (0479835|27/04/2023)	P	Verrà aggiunta una misura con il coinvolgimento dei CEA	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati

	comunità più consapevoli, responsabili e pronte a impegnarsi in prima persona.				
33	Coordinare le procedure di partecipazione con quelle previste dalla normativa sui Piani di Protezione Civile.	- AIP2 Marche (0479835|27/04/2023)	P	Il coordinamento verrà inserito come misura, nella linea di azione Creare sinergie con gli enti locali. Le osservazioni 28, 30 e 33 verranno sviluppate in una misura con una logica integrata	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati
34	Pianificare in anticipo l'offerta di supporto, non solo materiale ma anche psicologico, e di rielaborazione collettiva di eventi estremi;	- AIP2 Marche (0479835|27/04/2023)	P	Nell'adeguamento del piano a seguito degli esiti VAS verrà introdotta una linea d'zione per aumentare la resilienza ai cambiamenti climatici con azioni specifiche volte in particolare a individuare azioni specifiche all'interno del Piano Regionale della Prevenzione collegate al tema clima e salute. Gli aspetti segnalati potranno essere affrontati all'interno di tale misura	Modifica della sezione 5.2.2, introduzione di una sezione "Misure e azioni di adattamento per la salute umana"
35	Affrontare la rielaborazione dei conflitti su temi ambientali e sociali in modo collaborativo, e come stimolo per affrontare temi caldi e prevenire o mitigare le vulnerabilità.	- AIP2 Marche (0479835|27/04/2023)	P	Si tratta di una modalità della gestione dei processi partecipativi in materia dei cambiamenti climatici, e verrà considerato nell'ambito dell'attuazione delle misure di partecipazione	Nessuna modifica necessaria
36	Anche se un Piano non può contenere misure specifiche occorre che orienti in modo inequivocabile i successivi strumenti pianificatori, regolamentari, gestionali e normativi prodotti dalla Regione.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Il piano verrà dotato di Norme Tecniche Attuative	Elaborazione delle Norme Tecniche Attuative

37	È necessaria una vasta opera di restauro forestale, che porti in nostri boschi ad uno stadio evolutivo e strutturale superiore, in modo da combattere con risultati tangibili e veloci il dissesto idrogeologico, riattivare la formazione dei suoli, sequestrare enormi quantità di carbonio dall'atmosfera, fissandolo nel legno e nel suolo. Lo stato depresso dei boschi è un serio problema per l'affermarsi delle attività legate al turismo e le attività forestali in essere contribuiscono fattivamente alla destrutturazione della rete sentieristica.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Verrà inserita una misura relativa agli ecosistemi forestali	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri
38	Oggi occorre invece definire al più presto obiettivi concreti di adattamento per gli ambienti urbani, alcuni dei quali possono essere raggiunti soltanto mediante la costruzione di una vasta e capillare infrastruttura verde, costituita non solo da parchi, giardini, alberate, ecc. ma anche dalle cosiddette NBS – Nature Based Solutions (rain gardens, pocket gardens, tetti verdi, ecc.). Si ritiene pertanto necessario inserire nel PRACC, le seguenti azioni, valide per i comuni con più di 15.000 abitanti: 1. stabilire che i piani del verde non debbano essere un'appendice degli strumenti urbanistici, bensì l'elemento centrale della pianificazione delle città; 2. predisporre, a brevissima scadenza, uno Schema di piano del verde, così come è già stato fatto con lo Schema di regolamento del verde urbano (DGR 603/2015), che i comuni debbono approvare a breve termine; 3. stabilire che il suddetto Schema di piano del verde debba contenere norme finalizzate al miglioramento della dotazione di verde esistente (per tutelare e incrementare la fornitura di Servizi Ecosistemici) e soprattutto norme finalizzate al concreto contrasto al	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Verrà inserita una misura relativa al verde urbano e dettagliata nelle Norme Tecniche Attuative	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento del settore urbanistico - Indicazioni specifiche nelle Norme Tecniche Attuative

	consumo di suolo mediante la realizzazione di aree verdi, sia ovunque vi siano superfici ancora disponibili, sia mediante la depavimentazione di superfici asfaltate / cementificate; 4. stabilire forme di premialità per i comuni che adottano i piani del verde secondo il suddetto Schema				
39	Per quanto riguarda la descrizione dello scenario relativo alla disponibilità di risorse idriche (§ 3.2) mentre sono state analizzate le condizioni dei corpi idrici non è stata effettuata una stima, seppure sommaria, dei fabbisogni idrici pregressi, che andrebbero peraltro distinti per categorie di consumo (civile, agricolo, industriale),rispetto ai quali valutare le criticità future(§ 4.2.1)e programmare le relative misure di adattamento e resilienza	- Ass. La Lupus in fabula (0499108|02/05/2023) - Ass-Italia Nostra (499209|02/05/2023) - Forum Salviamo il Paesaggio (0499214|02/05/2023)	P	Nel piano è riportata la stima degli usi pregressi (sezione 3 e appendice B). La programmazione degli usi in funzione dei cambiamenti climatici è oggetto di misure specifiche, basate sull'elaborazione di bilanci idrici	Nessuna modifica necessaria
40	Per quanto riguarda il consumo di suolo, è sia necessario, almeno nella fascia costiera, passare da normative che prevedono una progressiva "limitazione" del consumo di suolo ad una vera e proprio "arresto", anche attraverso politiche e strumenti incentivanti la rigenerazione urbana ed il riuso degli edifici dismessi. Si propone di approvare una legge regionale che disciplini e limiti l'uso del suolo da parte dei Comuni.	- Ass. La Lupus in fabula (0499108|02/05/2023) - Ass-Italia Nostra (499209|02/05/2023) - Forum Salviamo il Paesaggio (0499214|02/05/2023)	P	La Regione, in armonia con le politiche e gli indirizzi europei e statali, sta recependo gli obiettivi del contenimento del consumo di suolo a fini paesaggistici e di riduzione del rischio e degrado del suolo, nella redigenda Proposta di Legge "Norme della pianificazione per il governo del territorio" in corso di approvazione. Tali aspetti verranno dettagliati nelle specifiche attuative	Indicazioni specifiche nelle Norme Tecniche attuative della Sezione 5.2.2. – Misure e azioni per l'adattamento del settore urbanistico
41	Incentivare solo forme di turismo sostenibile, esplicitando dei criteri specifici e verificabili per valutare l'effettiva sostenibilità. Anche a livello turistico dovremmo modificare i consumi di energia e	- Ass. La Lupus in fabula 0499108|02/05/2023	P	Verrà aggiunta una misura specifica per l'incentivo di forme di turismo sostenibile	Modifica della Sezione 5.2.2. – Misure e azioni per l'adattamento del turismo

	di acqua: si pensi ad esempio al consumo di acqua a livello di stabilimenti balneari e al processo di innevamento artificiale che produce danni anche a livello della qualità del suolo.				
42	Evitare nuove concessioni e finanziamenti per infrastrutture turistiche sul litorale che non potranno avere un futuro per l'innalzamento del livello del mare e per l'aumento dei fenomeni meteo estremi in quantità e intensità.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Per quanto riguarda il pericolo di "erosione del litorale" le concessioni sono comunque già regolate dal codice della navigazione. In caso di erosione, la concessione si estingue. Le infrastrutture turistiche, almeno quelle sul demanio marittimo, sono "per legge amovibili", cioè "smontabili e delocalizzabili". Per le infrastruttire su terreno regolato dal PRG, le NTA del Piano GIZC pongono già delle limitazioni. Inoltre tale aspetto potrà essere affrontato nell'ambito dell'analisi costi benefici che si rende necessari a per tutte le nuove infrastrutture in area costiera.	Integrazione della 5.2.2. – Sezione Misure e azione per i sistemi costieri
43	Evitare finanziamenti per infrastrutture turistiche legate allo sci da discesa che non possono avere una prospettiva, neanche economica, data l'altezza delle montagne marchigiane, l'aumento delle temperatura e la diminuzione delle precipitazioni nevose. Vietare anche gli impianti temporanei di pattinaggio su ghiaccio per i grandi consumi di acqua e corrente elettrica.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Nell'ambito dell'azione di Destagionalizzazione e delocalizzazione dei flussi turistici saranno introdotti studi di fattibilità economica-ambientale per i finanziamenti di tale tipologia di infrastruttura turistica	Integrazione della 5.2.2. – Sezione Misure e azioni per l'adattamento del turismo

44	La formazione va fatta soprattutto a Sindaci, assessori e consiglieri. Pertanto aggiungere questa formazione.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Nel vettore di sostenibilità "educazione, informazione, formazione" verrà aggiunta una misura riferita agli amministratori	Integrazione della 5.2.1 – Sezione Misure e azioni di educazione, informazione, comunicazione
45	Energia: dare obiettivi per Comune con incentivi e sanzioni. Ogni Comune deve approvare le aree idonee per installazioni di eolico e fotovoltaico. In difetto la Regione commissari i Comuni per questa funzione.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	Gli obiettivi in materia di produzione di energia sono dettati da specifica normativa e tarati a livello Regionale. I criteri per le aree idonee vengono sanciti a livello nazionale e la loro applicazione è di competenza regionale. Tali aspetti riguardano la mitigazione ai cambiamenti climatici piuttosto che l'adattamento	Nessuna modifica necessaria
46	I PAESC vanno attuati. Alcuni Comuni hanno approvato i PAESC ma poi non hanno approvato i piani di mitigazione a adattamento. Dopo l'approvazione di di questo Piano di adattamento climatico Marche si dia tempo massimo 6 mesi ai Comuni con più di 10 mila abitanti di approvare i piani di mitigazione e adattamento. In difetto la Regione commissari i Comuni per questa funzione.	- Ass. La Lupus in fabula (0499108|02/05/2023)	P	I PAESC sono strumenti volontari di competenza diretta dei Comuni su cui l'Amministrazione Regionale non ha potere coercitivo. Le azioni previste dal PRACC sono volte a incentivarne l'attuazione attraverso forme di coordinamento e sostegno.	Nessuna modifica necessaria
47	Sul tema "Acqua" condividiamo gran parte degli obiettivi indicati nel PRAC ma temiamo che non vengano recepiti nelle politiche di settore perché vengono perseguiti in modi un po' troppo generici che non vincolano i decisori a politiche coerenti con gli obiettivi enunciati.	- Ass. La Lupus in fabula (0499108|02/05/2023	P	Le misure previste verranno ulteriormente dettagliate dei documenti attuativi del Piano	Indicazioni specifiche nelle Norme Tecniche Attuative relative alle Misure di Adattamento per gli usi della risorsa idrica
48	Per il settore dell'energia si sottolinea l'importanza di mantenere in efficienza le infrastrutture per garantire	- Edison S.p.a. (505460|02/05/2023)	P	L'efficienza delle infrastrutture in relazione ai cambiamenti	Nessuna modifica necessaria

	alla regione di soddisfare i propri fabbisogni energetici, sia con una produzione interna, sia con quote di import che rappresentano una significativa dipendenza energetica dal sistema nazionale.			climatici è già presa in considerazione nelle misure attualmente incluse nel PRACC, in termini di sicurezza rispetto agli eventi estremi e di variazioni nella produzione in relazione ai cambiamenti climatici. Tali misure potranno essere ulteriormente dettagliate	
49	L'indicazione riportata nel Piano di "de-incentivare" la produzione idroelettrica a causa della riduzione della disponibilità idrica non appare una soluzione che mette in sicurezza il sistema energetico regionale. Anzi, potrebbe aumentare la necessità di aumentare l'importazione di energia dall'esterno.	- Edison S.p.a. (505460|02/05/2023)	P	Nelle misure attivabili, non si parla di de-incentivazione ma viene individuata una valutazione periodica delle potenzialità e della sostenibilità economica e ambientale della produzione di energia idroelettrica da acqua fluente. Tale tipo di approccio risulta cautelativo anche nei confronti dei produttori di energia, oltre che permettere una più corretta pianificazione della effettiva disponibilità energetica.	Nessuna modifica necessaria
50	Una proposta per assicurare una indipendenza energetica potrebbe essere quella di sviluppare le cosiddette Comunità energetiche che consentono di produrre energia e conseguentemente auto consumarla, riducendo il rischio associato al prelievo di energia dalla rete.	- Edison S.p.a. (505460|02/05/2023)	P	Le Comunità energetiche verranno esplicitamente inserite nella misura "Incentivi per la decentralizzazione del sistema di produzione (generazione elettrica da parte dei consumatori, al fine di ridurre la vulnerabilità della rete)"	Integrazione Sezione 5.2.2. Linea di azione Aumentare la resilienza delle infrastrutture energetiche ai cambiamenti climatici

51	Ciò che accomuna le due regioni Umbria e Marche in prossimità del confine delle aree interne e montuose, è l'aumentare di fenomeni estremi legati al cambiamento climatico come il rischio idraulico e idrogeologico, che si somma ad altre criticità già presenti come ad esempio il rischio sismico che caratterizza entrambi i territori regionali. Quindi agire sul contrasto ai cambiamenti climatici con azioni comuni alle due regioni potrebbe anche aumentarne in qualche misura l'adattamento e la resilienza generale. Tale aspetto risulta particolarmente rilevante per quanto riguarda l'aggiornamento e coordinamento dei PPAR e l'implementazione delle Reti Ecologiche	- Regione Umbria (050453|02/05/2023)	P	Verrà introdotta una misura per rafforzare la collaborazione e il coordinamento per le azioni e le pianificazioni specifiche relative a problematiche connesse ai cambiamenti climatici in aree omogenee condivise da Regioni Confinanti	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati – Linea di azione "creare partenariati"
52	Il tema della riqualificazione fluviale, della preservazione e ampliamento degli ambiti fluviali potrebbe accomunare le due regioni nell'implementazione dei contratti di Fiume.	- Regione Umbria (050453|02/05/2023)	P	Nella misura relativa ai contratti di fiume già presente nel PRACC, verrà esplicitata l'opportunità di attivare percorsi congiunti su bacini condivisi	Integrazione Sezione 5.2.2 Misure e azioni per contrastare i rischi dai cambiamenti climatici – Linea di azione prevenire/ridurre il rischio idraulico/idrogeologico
53	Per affrontare i rischi comuni alle due regioni in tali aree, si potrebbe affinare anche il sistema di allertamento e di gestione delle emergenze di natura sismica, idraulica e idrogeologica e degli incendi boschivi che potrebbe trarre vantaggio da un'azione combinata comune.	- Regione Umbria (050453|02/05/2023)	P	Tale approccio viene incluso nella misura per rafforzare la collaborazione e il coordinamento tra Regioni Confinanti (si veda osservazione 51)	Modifica Sezione 5.2.1. Misure di sussidiarietà, partecipazione e partenariati – Linea di azione "creare partenariati"
53	Qualora le previsioni di Piano dovessero interessare siti Natura 2000 umbri o in qualche modo dovessero andare ad incidere su specie ed habitat per i quali tali siti sono stati individuati, si renderà necessario attivare la procedura di Valutazione di Incidenza Ambientale	- Regione Umbria (050453|02/05/2023)	V	Nell'attuazione del Piano, in caso di interferenze, verranno applicate le opportune procedure valutative, come previsto dalla specifica normativa	Nessuna modifica necessaria

54	Considerato l'uso concorrente delle risorse idriche per uso agricolo e idropotabile, si suggerisce di promuovere il riutilizzo di acque reflue depurate in ambito agricolo, anche attraverso politiche e agevolazioni che lo rendono di più facile attuazione e più conveniente economicamente	- ATO3 (500355|02/05/2023)	P	Verrà inclusa una misura specifica per la promozione dell'utilizzo di acque depurate in agricoltura.	Integrazione sezione 5.2.2. Misure e azioni per un uso sostenibile della risorsa idrica – Linea di Azione gestione dei conflitti nell'uso delle risorse idriche
55	Avviare un percorso condiviso per individuare, sulla base di un adeguato quadro conoscitivo complessivo, di informazioni aggiornate e dati di monitoraggio indispensabili per effettuare valutazioni e previsioni – le esigenze effettive e operare scelte strategiche, al fine di predisporre una pianificazione coordinata tra i diversi settori	- ATO3 (500355|02/05/2023)	P	La proposta si inserisce nella misura già prevista di Pianificazione di Bilancio idrico, che verrà ulteriormente dettagliata nelle modalità di attuazione. Sono inoltre previste misure specifiche per il rafforzamento del quadro conoscitivo in materia di disponibilità della risorsa idrica	Indicazioni specifiche nelle Norme Tecniche Attuative nella Linea di Azione Completare e Rafforzare le conoscenze in materia di risorse idriche - Misura Completare e aggiornare i bilanci idrici)
56	Tra gli indicatori di contesto non si considera l'efficienza negli usi diversi da quello idropotabile e in particolare per gli usi irrigui, che sono prevalenti	- ATO3 (500355|02/05/2023)	M	L'indicatore proposto verrà inserito nel sistema di monitoraggio del Piano	Integrazione nel sistema di monitoraggio
57	In merito alla periodica reportistica prevista dal Piano di Monitoraggio, l'utilità della costruzione di uno o più indici aggregati derivanti dalla combinazione di più indicatori che possano sintetizzare l'andamento nel tempo del "rischio chiave". Ciò in riferimento agli ambiti individuati nel piano: risorse idriche, biodiversità, agricoltura e suolo, energia e fascia costiera. Tali indici aggregati risulterebbero utili soprattutto nella comunicazione dei risultati in quanto fornirebbero un quadro immediato dell'evoluzione dello stato dell'ambiente in relazione ai mutamenti dovuti anche ai cambiamenti climatici in relazione ai singoli ambiti.	- ARPAM (0503408|02/05/2023)	M	Si concorda sulla proposta	Integrazione nel sistema di monitoraggio

58	Valutare le sinergie con il Piano Nazione di Adattamento ai Cambiamenti Climatici (PNACC)	- ARPAM (0503408|02/05/2023)	M	Tale aspetto verrà introdotto nell'ambito del monitoraggio del PRACC	Integrazione nel sistema di monitoraggio
59	Si richiede che vengano rivalutati nel Piano, a partire dal quadro conoscitivo e normativo, fino alla definizione di specifici obiettivi, azioni di monitoraggio e misure concrete, i seguenti aspetti: specie floristiche di Interesse Conservazionistico; specie aliene invasive; gestione forestale sostenibile	- Parco Gran Sasso Laga (0504177|02/05/2023)	P	La gestione forestale sostenibile verrà sviluppata all'interno delle misure relative agli ecosistemi (si vedano anche oss. nn. 12 e 37). Verrà introdotta una misura sulle specie aliene. Le misure relative al monitoraggio sono già incluse nel piano	Modifica della sezione 5.2.2 - Misure e azioni per l'adattamento degli ecosistemi terrestri e Misure e azioni per l'adattamento degli ecosistemi marini
60	Si ritiene necessario approfondire gli aspetti connessi al consumo di suolo e in particolare: • tendere all'annullamento del consumo di suolo; • effettuare un censimento finalizzato all'individuazione delle principali aree impermeabilizzate; • verificare dove sia possibile togliere le impermeabilizzazioni e ripristinare la permeabilità del suolo procedendo all'impianto di essenze vegetali autoctone idonee;	- Parco Gran Sasso Laga (0504177|02/05/2023)	P	Per il censimento del consumo di suolo, nella linea di azione relativa alla limitazione del consumo di suolo è presente nel PRACC una misura che prevede una piattaforma telematica regionale per il monitoraggio del consumo di suolo e la rappresentazione delle trasformazioni edilizie e urbanistiche. Per il consumo di suolo nella redigenda legge urbanistica (si veda oss. 40) saranno incentivate opere di rinaturalizzazione, recupero, deimpermeabilizzazione in grado di assicurare i servizi ecosistemici forniti dai suoli naturali. I criteri, gli indirizzi e le modalità tecniche per contenere il consumo di suolo a livello regionale, provinciale e	Indicazioni specifiche nelle Norme Tecniche Attuative relative alla sezione 5.2.2 - Misure e azione per l'adattamento del settore urbanistico

				comunale saranno stabiliti nel PTR (Piano Territoriale Regionale), nel PTCP (Piano Territoriale di Coordinamento Provinciale) e nel PUG unico (Piano Urbanistico Generale unico). La PdL prevede anche attività di monitoraggio delle azioni di contenimento del consumo di suolo e un sistema di interscambio dei dati informativi sullo stato del territorio.	
61	Si richiede che vengano rivalutati nel Piano, gli aspetti relativi alla coerenza con il Piano del Parco e i Piani di gestione dei Siti Natura 2000 compresi nel settore marchigiano del Parco	- Parco Gran Sasso Laga (0504177|02/05/2023)	V	A livello di Rapporto Ambientale è stata valutata la coerenza con la Strategia Nazionale per la Biodiversità. Non sono state individuate incoerenze o impatti negativi con gli aspetti relativi agli obiettivi di conservazione dei sistemi naturali e della biodiversità. L'attivazione di singoli interventi sarà soggetta alle vigenti norme atte a garantire la coerenza con la pianificazione del Parco e con la conservazione della rete Natura 2000. In fase di monitoraggio del PRACC è prevista la verifica della coerenza tra l'attuazione la pianificazione settoriale	Nessuna modifica necessaria

62	Nel capitolo relativo ad “obiettivi e linee di adattamento” - Misure e azioni per contrastare i rischi derivanti dai cambiamenti climatici è citata la necessità di “Rafforzare la gestione sostenibile delle foreste”, ma questa enunciazione è del tutto generica se non si riferisce a documenti concreti. Si suggerisce ad esempio di far riferimento alla Strategia Europea per le foreste 2030 in cui i principi che dovrebbero guidare la gestione sostenibile sono ben enunciati. Ad esempio tale gestione sostenibile deve tener conto della necessità di incrementare la capacità di stoccaggio di anidride carbonica da parte delle foreste e di un utilizzo principalmente finalizzato alla produzione di materiale legnoso con elevato valore aggiunto ed elevata durabilità. Occorre però prendere atto che lo stato delle conoscenze sulle foreste regionali è scarso e non aggiornato. Per poter quindi effettuare una seria gestione sostenibile delle foreste (come specificato dal Piano regionale), si ritiene utile inserire una azione finalizzata ad aggiornare l’Inventario Forestale Regionale	- Riserva Naturale Torricchio (0504562|02/05/2023)	P	Le azioni sulle foreste verranno rafforzate nella linea di azione relativa agli ecosistemi terrestri. Per quanto riguarda il quadro conoscitivo, sono già presenti misure di monitoraggio per i biomi sensibili ai cambiamenti climatici	Modifica della sezione 5.2.2 - Misure e azioni per l’adattamento degli ecosistemi terrestri
63	La pianificazione di bilancio idrico è individuata come principale strumento per la gestione degli usi e per contrastare eventuali disequilibri. Si fa anche riferimento all'efficientamento della rete di distribuzione e all'incremento della capacità di stoccaggio di acque superficiali attraverso la realizzazione di invasi artificiali: Si ritiene che il monitoraggio delle risorse idriche disponibili, attività inclusa nella linea di azione volta a rafforzare e completare le conoscenze, debba includere anche programmi di prospezione e ricerca volti a individuare nuove fonti di approvvigionamento alternative a quelle già utilizzate, le quali penalizzano,	- Parco Sibillini (0566466|16/05/2023)	P	Il PRACC mira a ridurre le esigenze di approvvigionamento idrico per i diversi usi. La riduzione delle captazioni è fondamentale in particolare in ambiente montano dove sono presenti habitat peculiari legati alla presenza di sorgenti e corsi d’acqua.	Nessuna modifica necessaria

	attraverso captazioni soprattutto in ambiente montano, gli ecosistemi più vulnerabili ai cambiamenti climatici. Si ricorda, a tal proposito, che sono già significative le criticità riscontrabili in diversi habitat fluviali ed ecosistemi sorgentizi presenti nell'area protetta, imputabili all'eccessiva presenza di captazioni e usi non sostenibili della risorsa idrica.				
63	Sul tema della prevenzione dei rischi associati al reticolo idrografico sono proposte "specifiche azioni di riqualificazione, preservazione e ampliamento degli ambiti fluviali, attraverso gli strumenti urbanistici, di riqualificazione fluviale, e in particolare attraverso l'utilizzo di Contratti di fiume."Questo tema è strettamente correlato anche alla tutela qualitativa delle risorse idriche e alla tutela e potenziamento dei corridoi ecologici. Si ritiene che le azioni proposte siano efficaci soprattutto in una prospettiva di pianificazione di medio-lungo termine, tuttavia si ravvisa anche la necessità di sottoporre a verifica e valutazione ambientale i singoli interventi attuati in alveo, sulle sponde e nelle aree golenali che spesso sono progettati senza tener conto dei servizi ecosistemi (SE) di regolazione che gli ecosistemi fluviali-ripariali già potrebbero naturalmente fornire anche per contrastare il rischio idrogeologico. Il taglio non selettivo e oculato della vegetazione ripariale potrebbe, ad esempio, rappresentare una significativa minaccia alla diffusione e penetrazione di specie aliene, con ripercussione sulla capacità di adattamento di tali ecosistemi ai cambiamenti climatici e con graduale perdita di efficacia dei SE forniti.	- Parco Sibillini (0566466|16/05/2023)	P	L'applicazione della VIA è disciplinata da specifica normativa che individua le tipologie progettuali da assoggettare. Nel caso di VIA o di screening, vengono valutati anche i servizi ecosistemici	Nessuna modifica necessaria

64	In relazione alla fragilità del settore turistico invernale legata all'aumento delle temperature e alla diminuzione di precipitazioni nevose, viene evidenziata per le aree montane la necessità di adottare strumenti volti al "rafforzamento e la diversificazione delle offerte turistiche nelle aree montane". Si condivide pienamente tale indirizzo e si auspica una sua concreta, fattiva e urgente attuazione anche attraverso una rigorosa e costante verifica di coerenza tra PRACC e atti di programmazione delle opere pubbliche della Regione Marche e/o altri atti di programmazione settoriale. Il potenziamento della capacità turistica delle aree interne attraverso la diversificazione dell'offerta deve valutare attentamente anche l'impatto che potrebbero altre forme alternative di fruizione che, richiedendo anch'esse la realizzazione di infrastrutture sportive-turistico- ricreative, potrebbero compromettere gli obiettivi di adattamento ai cambiamenti climatici di ecosistemi vulnerabili come quelli montani.	- Parco Sibillini (0566466|16/05/2023)	P/M	Nel monitoraggio integrato VAS- Piano sarà prevista una verifica di coerenza tra l'attuazione del PRACC e gli strumenti pianificatori esistenti	Da includere nel Programma Integrato di Monitoraggio
65	Nel Piano l'Ape da miele (Apis mellifera) quale bioindicatore particolarmente sensibile ai cambiamenti climatici descrivendo quali sono i fattori di rischio che influenzano lo sviluppo e la sopravvivenza della specie. Considerato che il nesso tra biodiversità vegetale e impollinazione è strettissimo e che l'ape è solo l'esponente di punta del complesso degli insetti impollinatori, si invita a valutare se l'apicoltura per le sue peculiarità possa essere oggetto di una specifica attenzione con l'inserimento di linee d'azione e misure specifiche quali Prevenire l'eccessiva concentrazione di arnie al fine di evitare il "sovra pascolamento" (con geo-	- Provincia di Macerata (0509044|03/05/2023)	P	In fase di adeguamento del piano a seguito degli esiti VAS sarà valutata la fattibilità di inserire misure specifiche per il settore dell'apicoltura	Eventuale modifica della sezione 5.2.2 - Misure e azioni per l'adattamento dell'agricoltura

	referenzazione degli apiari definendo dei criteri per selezionare apiari troppo vicini tra loro.), indirizzare le pratiche agricole nel raggio di 3 km dall'apiario, ecc				

ALLEGATO B

Elenco dei Pareri di Valutazione di Incidenza di livello I (screening) rilasciati dagli enti gestori

Ente Gestore	Protocollo regionale acquisizione parere	Esito
Provincia di Pesaro e Urbino	n. 0485944 del 27/04/2023	Positivo
Provincia di Ascoli Piceno	n. 0523320 del 05/05/2023	Positivo
Provincia di Ancona	n. 0535085 del 09/05/2023	Positivo
Provincia di Macerata	n. 0509044 del 03/05/2023	Positivo
Unione Montana del Montefeltro	n. 0456072 del 19/04/2023	Positivo
Unione Montana Alta Valle del Metauro	n. 0660031 del 01/06/2023	Positivo
Unione Montana del Catria e Nerone	n. 0399579 del 05/04/2023	Positivo
Unione Montana Esino-Frasassi	n. 0590775 del 22/05/2023	Positivo
Unione Montana Potenza Esino Musone	n. 0474679 del 26/04/2023	Positivo
Unione Montana Marca di Camerino	n. 0500949 del 02/05/2023	Positivo
Unione Montana dei Monti Azzurri	n. 0477489 del 26/04/2023	Positivo
Unione montana dei Sibillini	n. 0500161 del 28/04/2023	Positivo
Unione Montana del Tronto e Valfluvione	n. 0449473 del 18/04/2023	Positivo
Parco Nazionale dei Monti Sibillini	n. 0566466 del 16/05/2023	Positivo
Parco Nazionale del Gran Sasso e Monti della Laga	n. 0504177 del 02/05/2023	Positivo
Parco Naturale Regionale del Conero	n. 0503385 del 02/05/2023	Positivo
Parco Naturale Regionale del Monte San Bartolo	n. 0714670 del 13/06/2023	Positivo
Parco Naturale Regionale del Sasso Simone e Simoncello	n. 0590775 del 22/05/2023	Positivo
Parco Naturale Regionale Gola della Rossa e di Frasassi	n. 0590775 del 22/05/2023	Positivo
Riserva Naturale Statale Abbadia di Fiastra	n. 0702875 del 12/06/2023	Positivo
Riserva Naturale Statale Montagna di Toricchio	n. 0504562 del 02/05/2023	Positivo
Riserva Naturale Statale Gola del Furlo	n. 0443070 del 17/04/2023	Positivo
Riserva Naturale Regionale Ripa Bianca di Jesi	n. 0535085 del 09/05/2023	Positivo
Riserva Naturale Regionale Sentina	n. 0421372 del 12/04/202	Positivo
Riserva Naturale Monte San Vicino e del Monte Canfaito	n. 0474679 del 26/04/2023	Positivo