

## The STRATEGY

### ON ADAPTATION TO CLIMATE CHANGE AND MEASURES TO MITIGATE ITS NEGATIVE EFFECTS FOR ZAKARPATSKA OBLAST

2024



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## INTRODUCTION

Among the regions of Ukraine, Zakarpatska Oblast is characterized by unique natural conditions, which determine the peculiarities of climate change manifestations on its territory and the need to identify appropriate adaptation measures. The geographical connection of Zakarpattia with the eastern countries of the European Union justifies the expediency of taking into account the experience of neighbouring countries, particularly the Slovak Republic, when assessing the expected climate change in the region and developing adaptation measures.

The Strategy was developed within the framework of the Slovak-Ukrainian Project "Climate Change Adaptation Strategy and Mitigation Steps for Slovak-Ukrainian Crossborder Region" (CLIMADAM), GGC01008, which is being implemented based on the Partnership Agreement between the Kosice Regional Development Support Agency (Slovakia) and the Department of Urban Planning and Architecture of the Zakarpatska Oblast State Administration. The final version of the Agreement was signed on 02/03/2021 in Uzhhorod and on 02/18/2021 in Kosice.

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The effects of climate change have spatially expressed differences due to the landscape, infrastructure and social characteristics of the territory. In regard of this, the Strategy is based on a spatial approach: the analysis of the degree of vulnerability of the territory to climate change and the development of adaptation measures was carried out in the context of territorial communities as the basic territorial unit for making management decisions. The effectiveness of planning and implementing regional adaptation to climate change can only be ensured by consolidating the efforts of regional public authorities and local governments in close cooperation with the national level government, as well as by involving a wide range of stakeholders, primarily businesses and NGOs.

## 1. International and national background of the Strategy development

At the end of the 20th century, the international community officially recognized climate change as a global problem with both social and economic consequences, and its solution requires concerted efforts from all countries. The relevant position was enshrined in the United Nations Framework Convention on Climate Change<sup>1</sup>, adopted in 1992 at the UN Conference in Rio de Janeiro. The Convention was ratified by Ukraine in 1996<sup>2</sup>. The Convention laid the foundations for addressing the problem, focusing mainly on reducing the anthropogenic impact on climate change, particularly by reducing greenhouse gas emissions by all countries of the world.

In 2015, the Paris Agreement to the United Nations Framework Convention on Climate Change<sup>3</sup> was adopted, which, realizing the irreversibility of climate change, already pays considerable attention to climate change mitigation and adaptation. In 2016, the Agreement was also ratified by Ukraine<sup>4</sup>.

In furtherance of global agreements, the European Union also pays attention in its strategic planning to reducing the anthropogenic impact of climate change, mitigating its effects and adapting to them. In particular, in 2021, as a follow-up to the achievements of the previous strategy, the European Commission adopted a new EU Climate Change Adaptation Strategy<sup>5</sup>, which defines how the European Union can adapt to the inevitable effects of climate change and become climate resilient by 2050. The EU Strategy sets four goals - to make climate change adaptation smarter, more systematic and faster, and to enhance international action on climate change adaptation.

The Strategy envisages the application of the latest advances in science and digital technologies for adaptation needs, taking into account the interrelationships between climate change and the state of ecosystems and ecosystem services, and emphasizes the fundamental importance of maintaining a data system on climate-related risks and losses as a key to making informed decisions. To support climate change adaptation processes, the EU has created a European adaptation knowledge platform, Climate-ADAPT<sup>6</sup>, aimed at collecting, systematizing and disseminating climate change adaptation solutions.

Since climate change will have an impact on all levels of society and in all sectors of the economy, the Strategy envisages the integration of climate change resilience measures into a wide range of sectoral policies and strategic documents. At the same time, it is about involving

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<sup>1</sup> United Nations Framework Convention on Climate Change. Official text:

[https://unfccc.int/files/essential\\_background/background\\_publications\\_htmlpdf/application/pdf/conveng.pdf](https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf)

<sup>2</sup> The Law of Ukraine «On Ratification of the United Nations Framework Convention on Climate Change».

Official text: <https://zakon.rada.gov.ua/laws/show/435/96-%D0%B2%D1%80#Text>

<sup>3</sup> Paris Agreement. Official text: [https://treaties.un.org/doc/Treaties/2016/02/20160215%2006-03%20PM/Ch\\_XXVII-7-d.pdf](https://treaties.un.org/doc/Treaties/2016/02/20160215%2006-03%20PM/Ch_XXVII-7-d.pdf)

<sup>4</sup> The Law of Ukraine «On Ratification of the Paris Agreement». Official text:

<https://zakon.rada.gov.ua/laws/show/1469-19#n2>

<sup>5</sup> EU Strategy on Adaptation to Climate Change. Official text: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0082>

<sup>6</sup> Climate-ADAPT: <https://climate-adapt.eea.europa.eu>

national, regional and local authorities, businesses and individuals in the adaptation process, as different solutions need to be implemented at different levels and by different parties.

The Strategy emphasizes the need to accelerate adaptation processes, as climate change is currently developing faster than humanity has time to implement adaptation measures. Considering that infrastructure is being built for a long time, investments in infrastructure must be resilient to the expected future effects of climate change. The Strategy also stipulates that ensuring a stable availability of fresh water is a fundamental basis for climate resilience.

In turn, Ukraine is also gradually developing a regulatory and planning framework for climate change adaptation. In particular, one of the goals of the Strategy of the State Environmental Policy of Ukraine for the period up to 2030, approved by the Law of Ukraine in 2019<sup>7</sup>, is to ensure the integration of environmental policy into the decision-making process for the socio-economic development of Ukraine. Among the tasks to achieve this goal is climate change prevention and adaptation. The description of the expected results of the strategy's implementation stipulates that the territorial expansion of cities and other settlements will be possible only if recreational, environmental, healthcare areas and facilities, landscapes, forests, parks, squares, and individual green spaces are preserved, created and restored, and their development will be more in line with the requirements of climate change adaptation.

In addition, at the national level, Ukraine has the Concept of Implementation of the State Policy in the Field of Climate Change for the Period up to 2030<sup>8</sup>, one of the three key areas of which is climate change adaptation, building resilience and reducing risks associated with climate change. As part of the implementation of the relevant area, the Concept provides for the development and implementation of a mechanism for the formation of adaptation policy on the principle of local (regional) to national level, with priority attention to the actions of those communities and sectors of the economy that are most vulnerable to the impacts of climate change; creation of a nationwide system for managing risks caused by changes in the frequency and intensity of extreme weather events and natural disasters in Ukraine, as well as migration of people due to climate factors; implementation cross-border climate change adaptation projects with neighbouring partner countries.

To implement the provisions of the Concept, in 2021, the Cabinet of Ministers of Ukraine approved the Strategy for Environmental Security and Adaptation to Climate Change for the period up to 2030<sup>9</sup>, which provides for reducing the risks and scale of natural disasters arising from climate change; using climate information in economic sectors obtained through a modern system of collecting key climate data, coordinating scientific research in the field of climate change; ensuring sustainable forest management and enhancing the ability of forest ecosystems to adapt to climate change, strengthening the resilience of forest ecosystems to pests and new

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<sup>7</sup> The Law of Ukraine «On the Key Principles (Strategy) of the State Environmental Policy of Ukraine for the Period till 2030». Official text: <https://zakon.rada.gov.ua/laws/show/2697-19#Text>

<sup>8</sup> The CMU Decree of 7 December 2016, № 932-p «On Approving the Concept of State Climate Change Policy Implementation until 2030». Official text: <https://zakon.rada.gov.ua/laws/show/932-2016-%D1%80#n8>

<sup>9</sup> The CMU Decree of 20 October 2021 № 1363-p «On Approving the Strategy for environmental safety and adaptation to climate change for the period up to 2030». Official text: <https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text>

climatic conditions, implementing fire prevention and rapid response measures; enhancing the adaptive capacity and resilience of social, economic and environmental systems to climate change; inclusion of environmental safety and climate change adaptation measures in national and regional strategies and river basin management plans; raising awareness of representatives of central and local government authorities and local self-government bodies authorised to make decisions in the field of environment on climate change mitigation and adaptation; analysing the impact of climate change on cultural heritage sites and tourist attractions, planning and implementing appropriate measures to preserve these sites.

Climate change, being global in nature, primarily affects the specific conditions and resources of the territory at the local level, causing the development of hazardous processes in the environment and the occurrence of emergencies with specific consequences in the respective territory. That is why, along with international and national climate change adaptation measures designed to provide a legal, institutional, methodological and information framework, measures should be developed and implemented at the local (regional) level, taking into account the specifics of the relevant territory, such as natural, social and economic.

Climate change has systemic direct and indirect impacts on the environment, economy, public health, energy security, heritage preservation, water and food supply, and emergencies. Ensuring resilience to such changes requires both organizational and infrastructural measures that should be implemented at the local (regional) level.

In addition, the effects of climate change are transboundary, which makes it important to cooperate across borders in this area, develop joint solutions, and develop adaptation strategies coordinated for neighbouring territories.

The issue of climate change and adaptation to it has already been implemented to some extent at the level of Zakarpatska Oblast in strategic planning. For example, the Regional Development Strategy of Zakarpatska Oblast for 2021-2027<sup>10</sup> identifies climatic conditions as a strength that provides favourable conditions for the population's livelihoods, tourism and agriculture, while at the same time, the threats include the increasing impact of global climate change trends on natural and urban ecosystems and the unpredictable acceleration of global climate change processes. The regional strategy sets out the tasks of ensuring sustainable energy development in all sectors of energy consumption and its preventive adaptation to global climate change, the formation of environmentally oriented multifunctional forestry close to nature and protection of forests from the impact of climate change, development and improvement of systems and means of protecting territories from natural and human-made disasters and global climate change.

The Strategy for Adaptation to Climate Change and Measures to Mitigate its Negative Effects for Zakarpatska Oblast takes into account the global principles enshrined in international agreements and strategies, national goals and objectives set by the state authorities in strategic planning documents, the experience of the Slovak Republic and the provisions of the Adaptation Strategy to Climate Change in the Košice Region, the provisions of the current

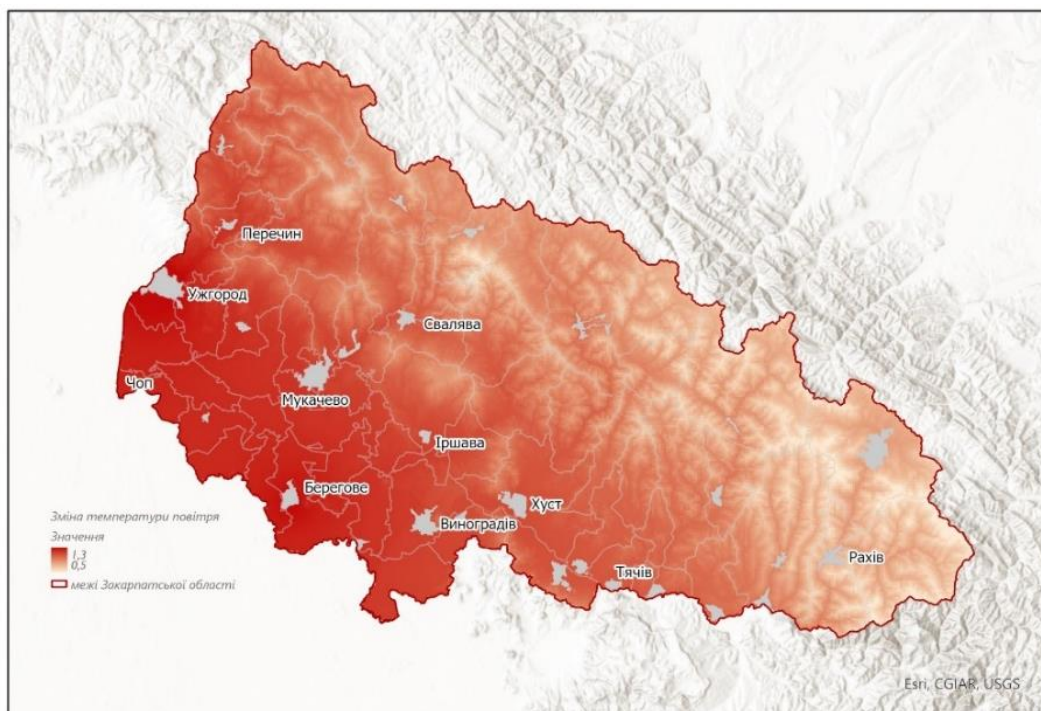
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<sup>10</sup> The Regional Development Strategy of Zakarpattia Oblast for 2021-2027. Official text:  
<https://carpathia.gov.ua/storage/app/sites/21/Economics/201001-1840p.pdf>

Regional Development Strategy of Zakarpatska Oblast, as well as the results of climate change forecasting in Zakarpatska Oblast until 2050.

## 2. Expected climate change in Zakarpatska Oblast

Forecasting climate change in Zakarpatska Oblast includes an assessment of potential climate change in the period 2021-2050 relative to the baseline period 1991-2020 based on the calculation of climate indices. The thermal regime of Zakarpatska Oblast depends on the geographical location (latitude), which determines the amount of solar radiation, as well as on the nature of the underlying surface and the peculiarities of atmospheric circulation, which is influenced by the Carpathian mountain range. Due to sharp elevation changes, there is a variation in the distribution of forecasted air temperature values. The expected change in the average air temperature in the period 1991-2020 - 2021-2050 ranges from 0.5°C in the foothill and mountainous areas to 1.5°C in the lowlands (Figure 1).



**Figure 1. Expected change of average air temperature by 2050.**

The number of frosty days is expected to decrease by 11 days on the plains and by 17 days in the mountainous areas. This is again explained by different types of relief, as the Zakarpattia lowland is protected from the cold north and northeast winds, while in the highlands, depending on the exposure of the slopes, the direction and protection of the mountain valleys, the number of frosty days will decrease faster due to the increase in temperature gradients (Figure 2).

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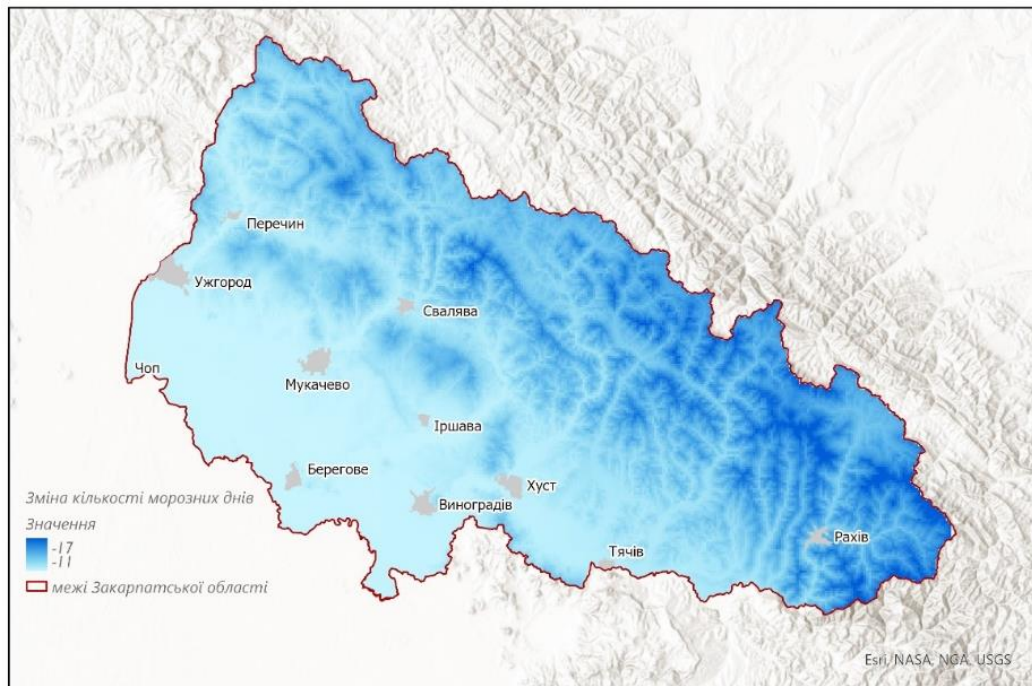
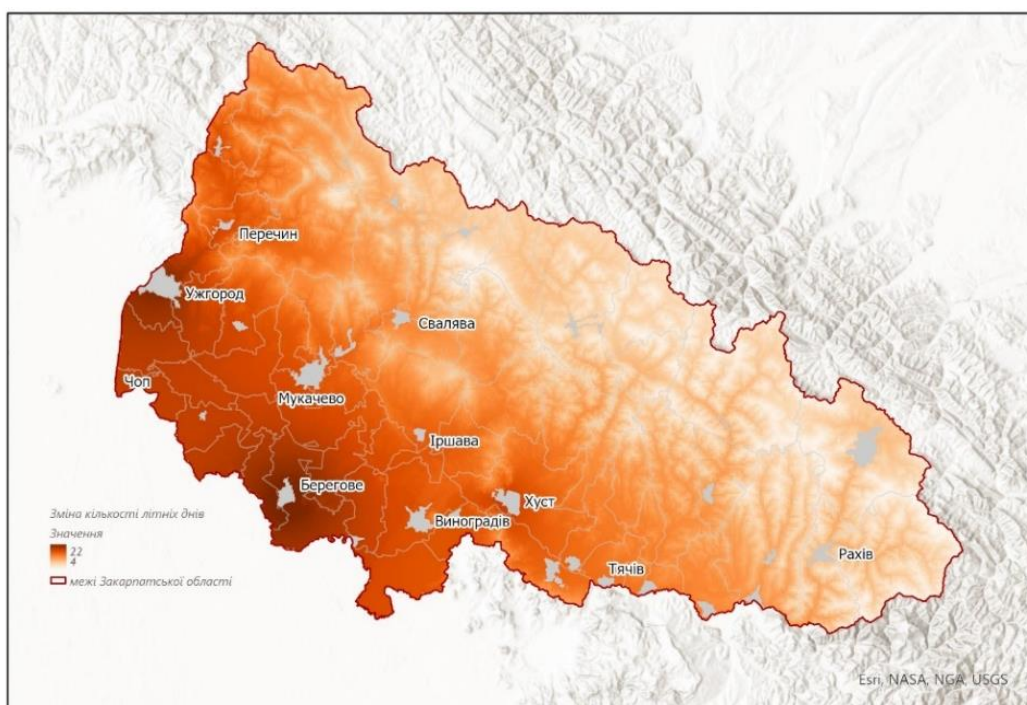


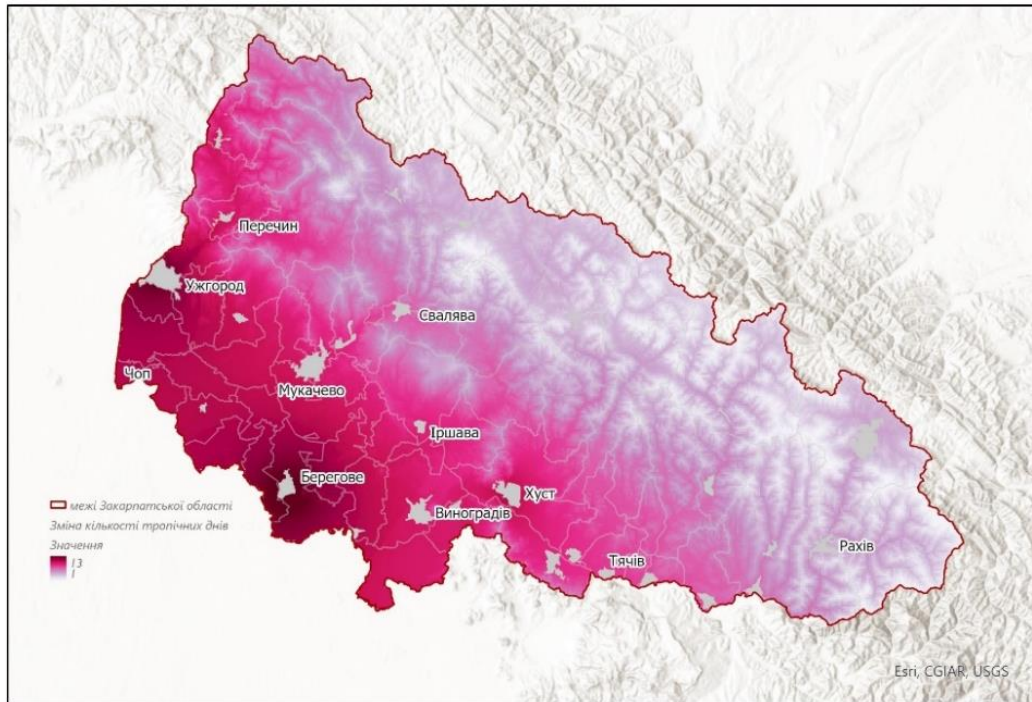
Figure 2. Expected change in the average number of frosty days by 2050.

The average annual number of summer days will increase by at least 4 days in the mountainous area, and by at most 18-20 days in the plain area. In the vicinity of the lowest stations of Uzhhorod and Berehove, the number of summer days will increase by 22 per year (Figure 3). Temperatures above 30°C (tropical days) in Zakarpattia are observed mainly on the plains and will increase by 13 days per year. The change in the average annual number of days with a temperature above 30°C in the high-mountainous part of the Carpathians will be noted with less intensity, and in some places will remain unchanged (Figure 4).



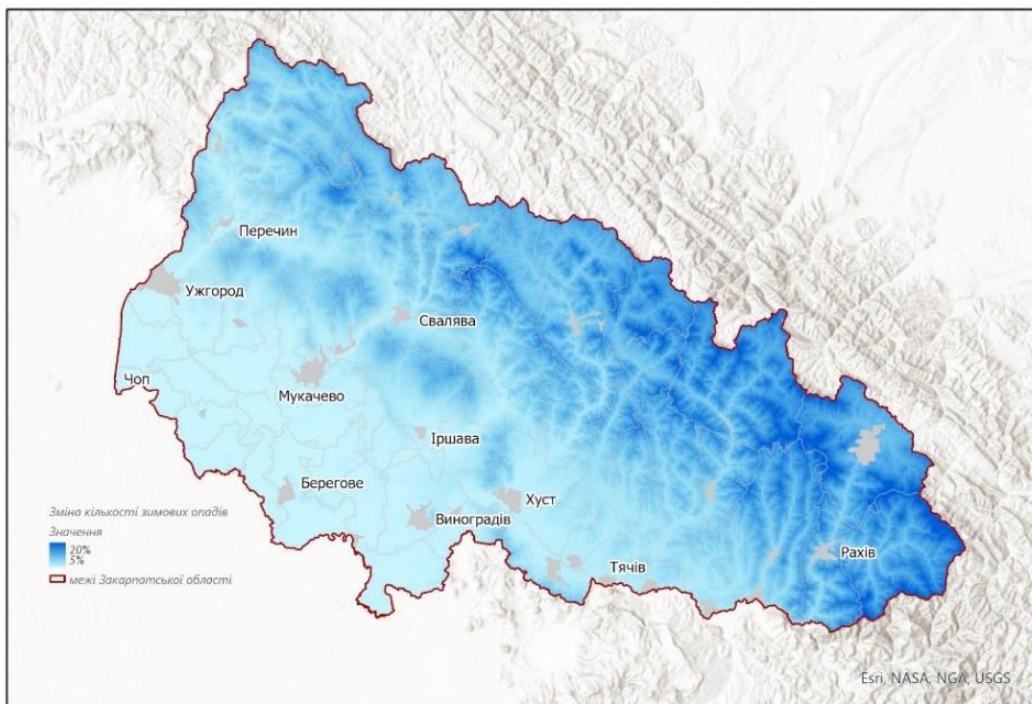


**Figure 3. Expected change in the average annual number of summer days by 2050.**

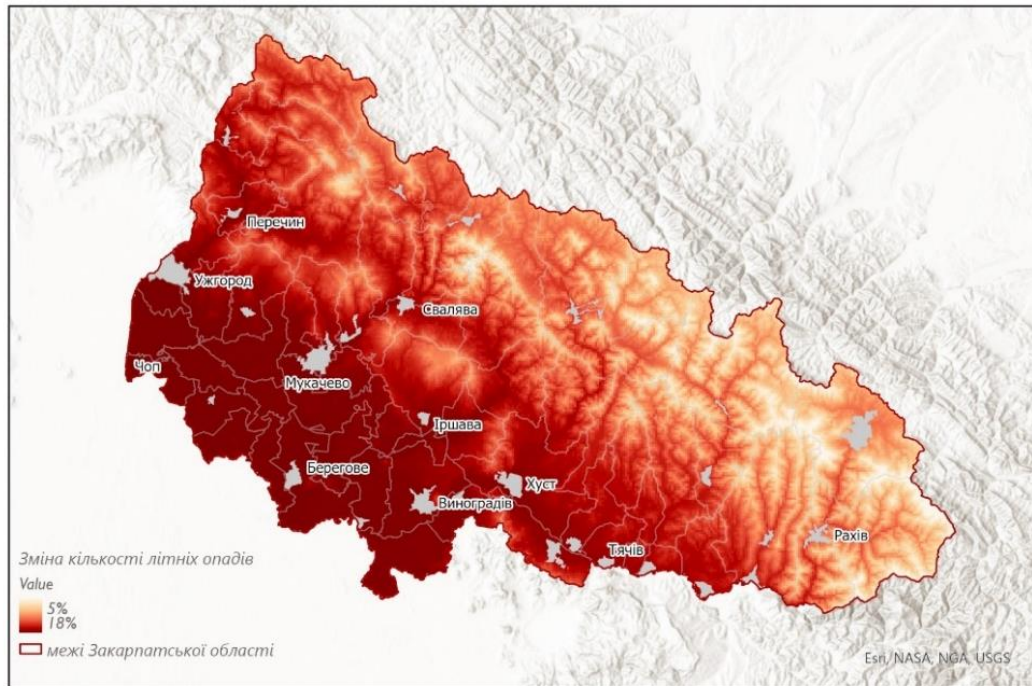


**Figure 4. Expected change in the average annual number of tropical days by 2050.**

In the winter months, there will be an increase in the average amount of precipitation by at least 5% in the plain area and up to 20% part of Zakarpatska Oblast (Figure 5). In the summer months, there will be a slight increase in precipitation in the mountainous area - by 5%, and in the plain area the increase will be up to 18% (Figure 6).

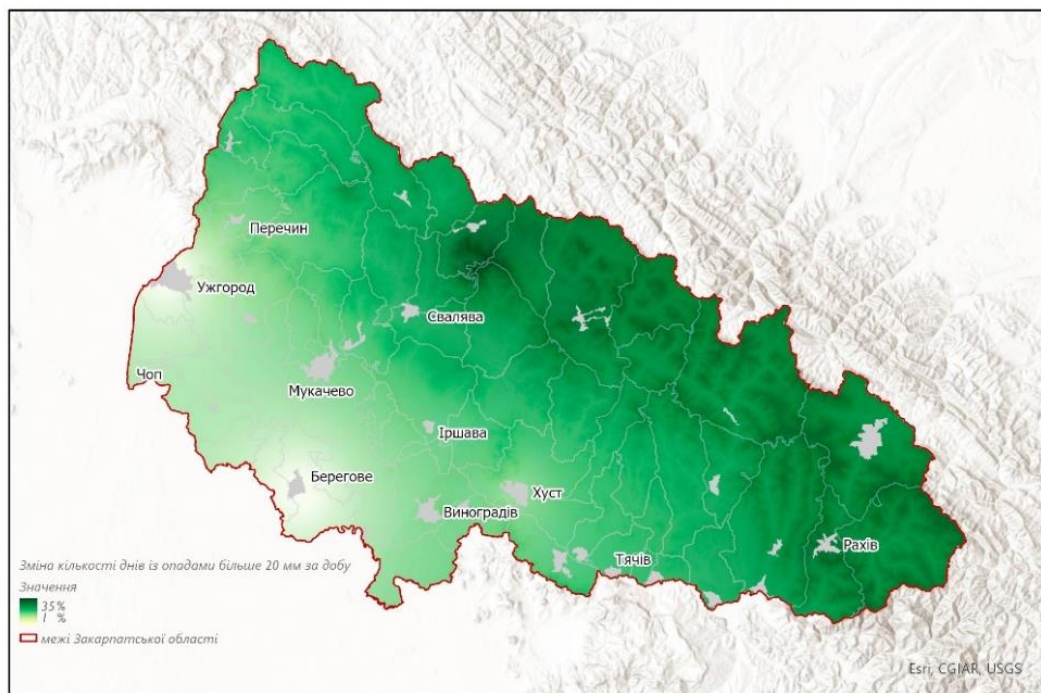


**Figure 5. Expected change in average winter precipitation by 2050.**



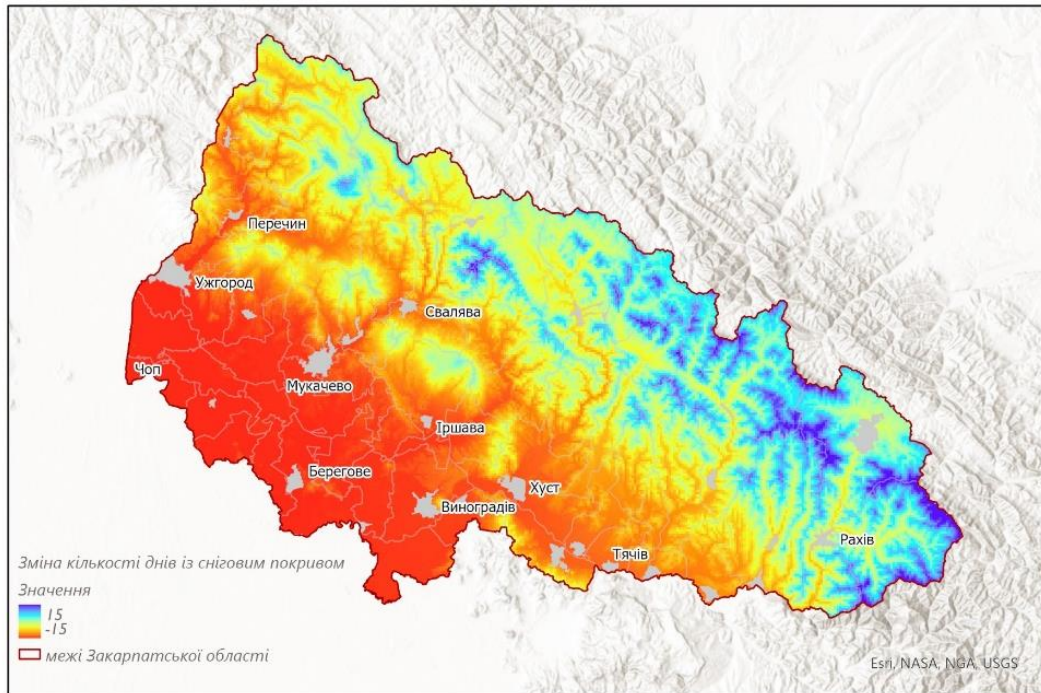
**Figure 6. Expected change in average summer precipitation by 2050.**

The biggest change in the average number of days with more than 20 mm of precipitation per day will be observed in the most mountainous part of Zakarpatska Oblast, where the number of such days will increase by 35% per year. In the flat area, the number of days will change insignificantly - by 1-2% per year. These processes will lead to the strengthening of flood and landslide processes in the mountainous part of the region (Figure 7).



**Figure 7. Expected change in the average number of days with precipitation above 20 mm by 2050.**

According to forecasts, the number of days with snow cover in the mountains will increase, while in the lowlands it will decrease, leading to floods in the mountains and increased droughts in the lowlands (Figure 8).



**Figure 8. Expected change in the average number of days with snow cover by 2050.**

Maximum evaporation will be observed within the Zakarpattia lowlands (Uzhhorod, Berehove). Changes in potential evaporation in Zakarpatska Oblast will range from 5% in mountainous areas to 15% increase in flat areas (Figure 9). The arid-climatic indicator of humidification will increase over most of the region (Figure 10).

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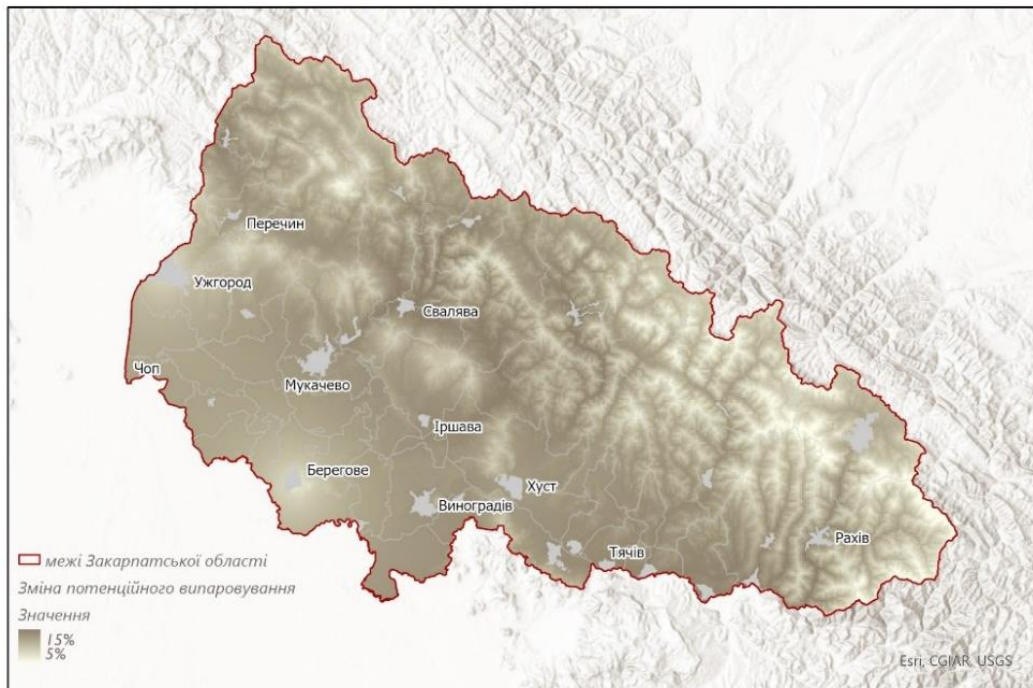


Figure 9. Expected change in potential evaporation by 2050.

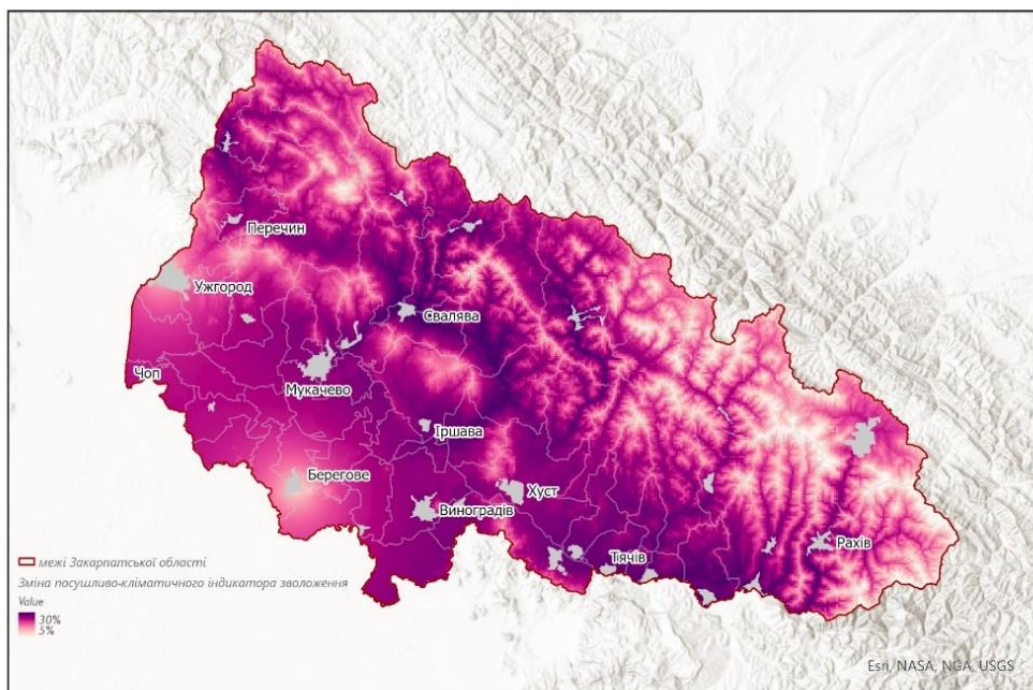


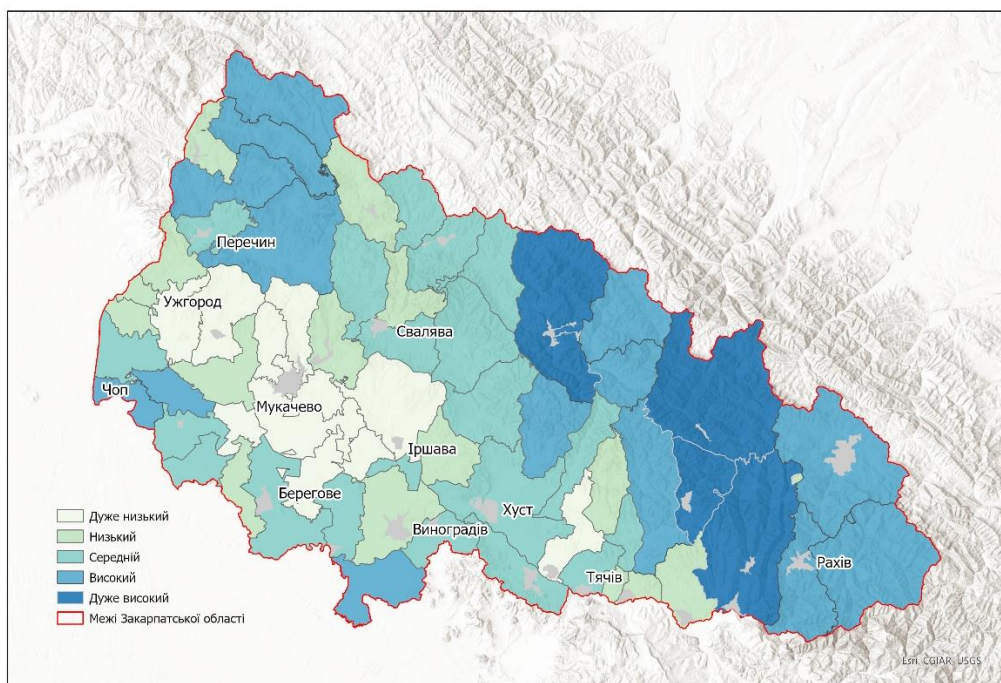
Figure 10. Expected change in the arid-climatic moisture indicator by 2050.

The analysis of the results shows that wide variations in landscape conditions in Zakarpatska Oblast cause significant differences in climate change. Therefore, the development of adaptation measures should take into account differences in landscape conditions, as well as the current state of natural and infrastructural resilience to climate change.

### 3. Expected impact of climate change on the state and development of the region

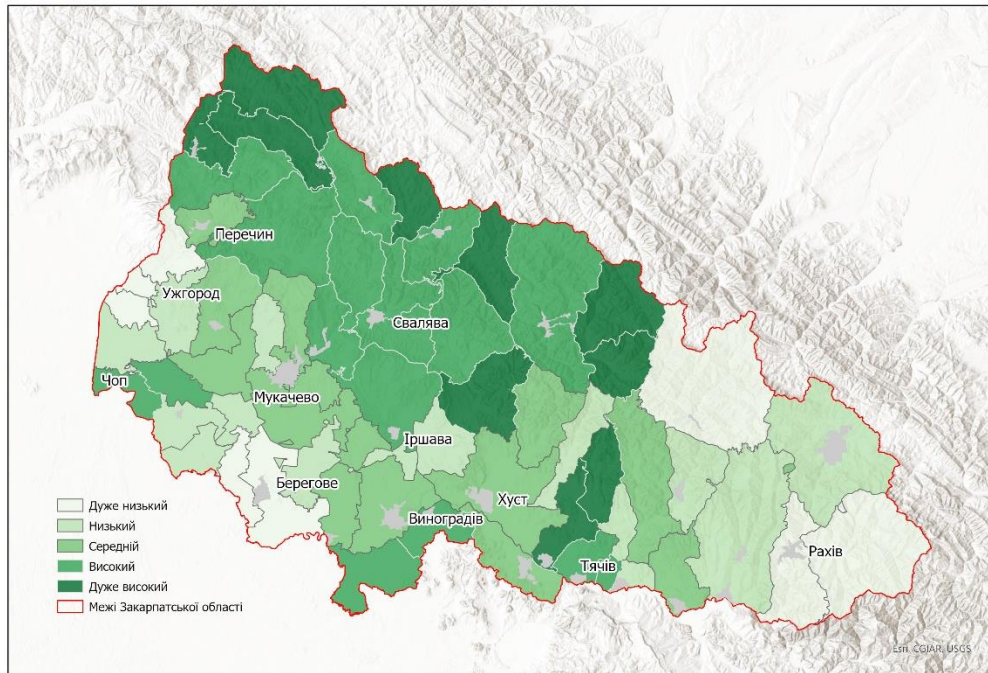
Climate change is manifested in changes in the entire range of climate indicators, which in turn has a direct and indirect impact on the physical conditions of the territory, the state of the environment, as well as on the population, economy and infrastructure.

The direct impact is manifested particularly in the *physical impact* on the territory through such negative phenomena as flooding of settlements and infrastructure, development of landslide processes, which will increase to a lesser or greater extent depending on the relative change in precipitation. Within the Zakarpatska Oblast, the highest physical impact is mostly experienced by territorial communities in mountainous areas with significant elevation differences in the respective territory. Mizhhirskaa, Ust-Chornianska, Velykobychkivska and Dubovetska territorial communities are characterized by the highest rates.



**Figure 11. Physical impact of projected climate change**

Changes in air temperature, humidity and precipitation depending on the degree of the protected area, the proportion of built-up and green areas, the species composition of forest plantations that determine their sensitivity to fires, the structure and characteristics of the soil cover that determine the sensitivity of soils to droughts and erosion, cause the *environmental impact* of climate change. Among the territorial communities of Zakarpattia, the highest environmental impact is expected both in the highlands - in Ust-Chornianska, Rakhivska, Bohdanska, and in the lowlands – in Berehivska, Velykobyhanska, Onokivska, Uzhhorodska, and Kholmkiwska territorial communities.



**Figure 12. Environmental impact of projected climate change**

Climate change also affects the health and safety of the population of the respective territory. In particular, an increase in the number of hot days (with temperatures above 30<sup>o</sup> C) leads to an increase in morbidity and mortality. A prolonged period of abnormal heat exacerbates health problems in people with chronic diseases, primarily cardiovascular, respiratory and cerebrovascular diseases, as well as diseases related to diabetes. Increased precipitation, especially on days with intense precipitation, increases the risk of flooding by flood waters, including populated areas, putting the population at risk. The degree of *social impact* of climate change is higher for territorial communities with a higher population density, in particular, the urban communities – Uzhhorodska and Mukachivska – are characterized by the highest level.

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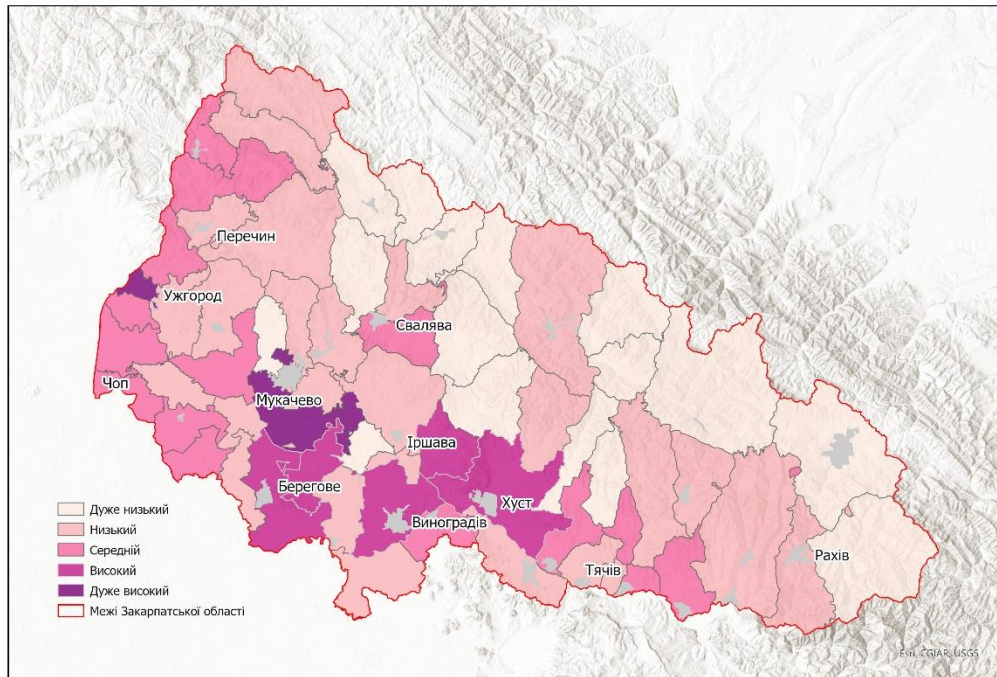


Figure 13. Social impact of projected climate change

Changes in climate indicators, such as rising temperatures and changes in precipitation, as well as an increase in the number of days with extreme weather events, have an impact on economic activity. The impact on forestry, tourism, and energy has a particular importance for Zakarpatska Oblast. The most severe *economic impact* is experienced by territorial communities both in the lowlands and in the highlands – Uzhhorodska, Kholmkiwska, Berehivska, Mukachivska, Khustska, Bohdanska and Yasinianska.

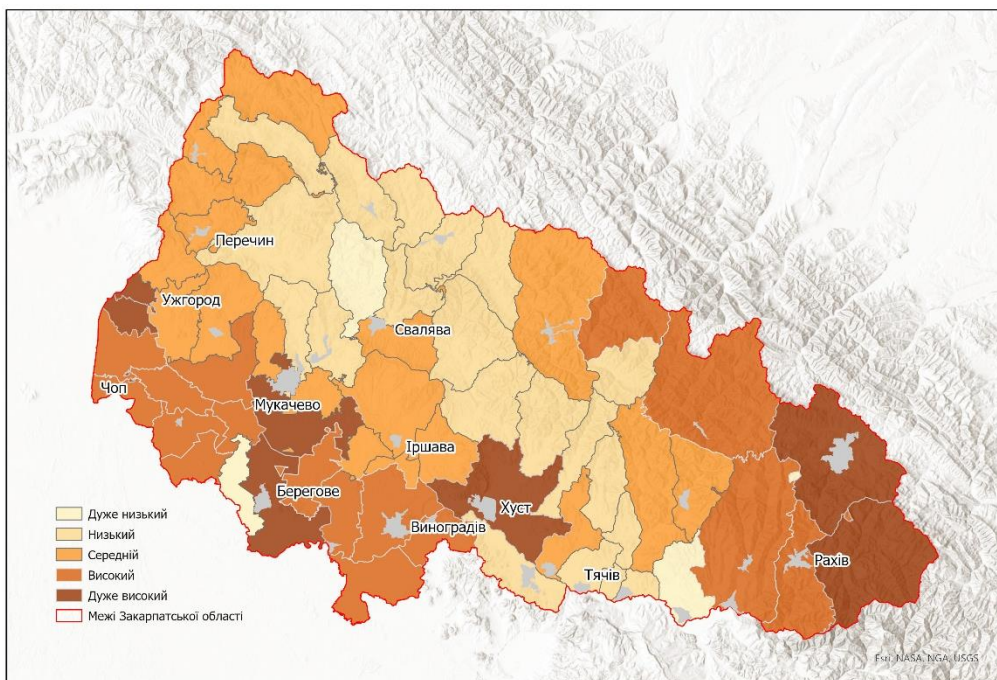
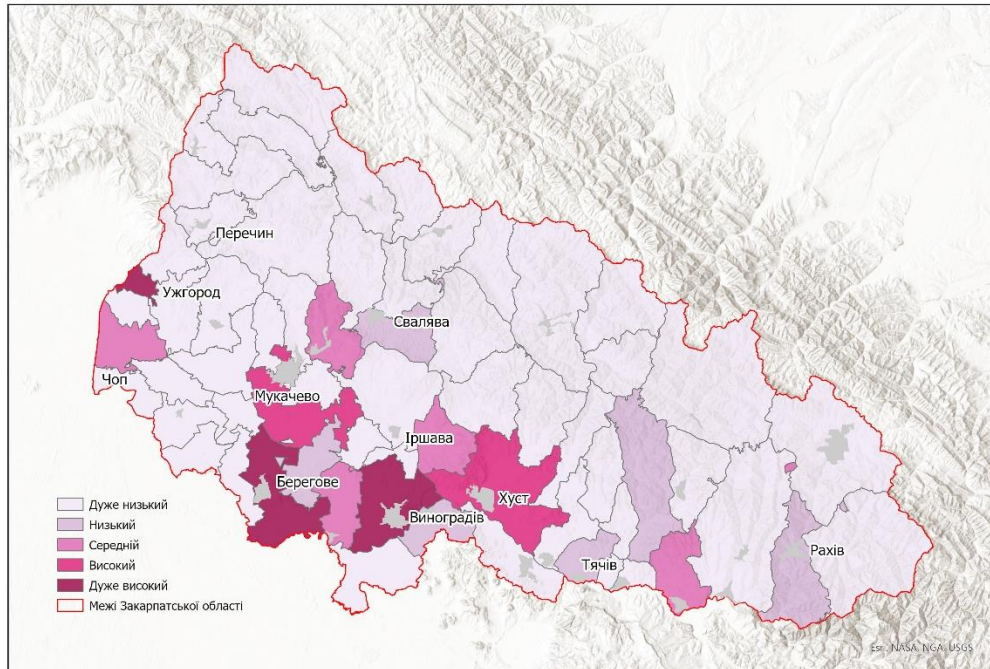


Figure 14. Economic impact of projected climate change

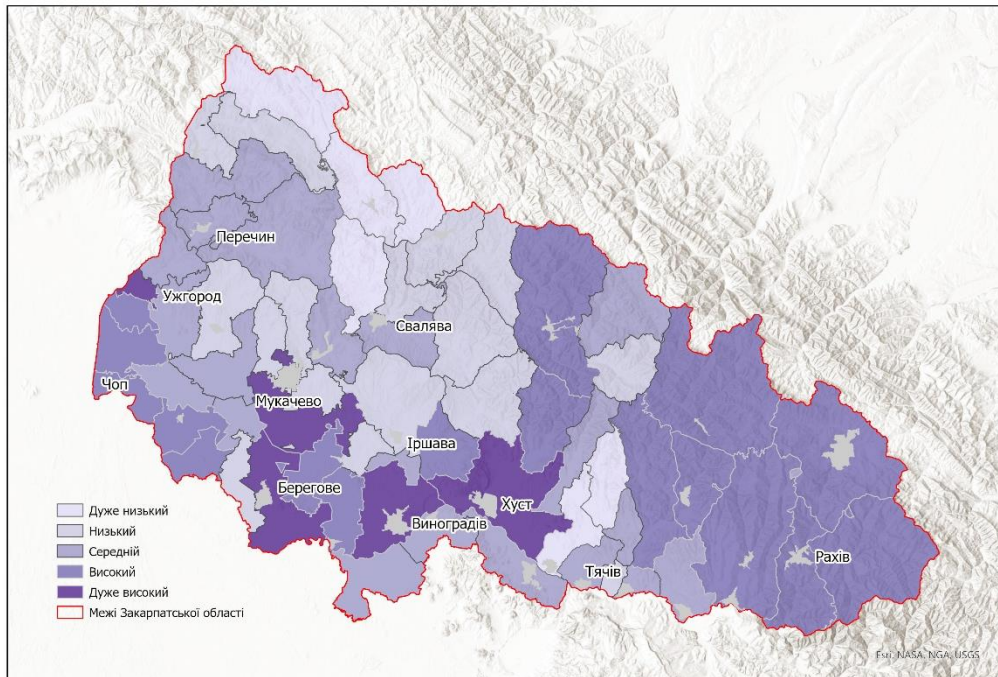
Climate change will also increase the risk to the preservation of cultural heritage by increasing the occurrence of environmental emergencies. The degree of *cultural impact* is determined by both the changes in the intensity of environmental emergencies and the concentration of cultural heritage sites in the area. The highest cultural impact is expected in Berehivska, Vynohradivska, and Uzhhorodska territorial communities.



**Figure 15. Cultural impact of projected climate change**

Thus, it is obvious that climate change affects both different components of the territory and all territorial communities in the region, but for each community the impact has its own special character and requires an individual approach to mitigate the effects of climate change.



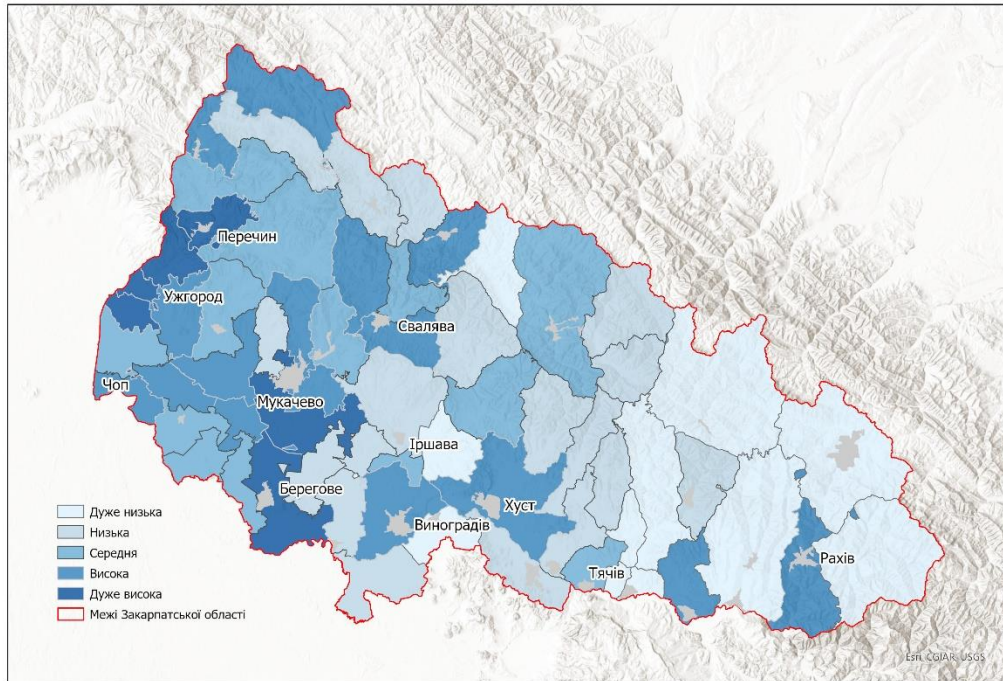


**Figure 16. Cumulative impact of projected climate change**

The value of the expected *cumulative impact* of projected climate change, obtained by summarizing individual types of climate change impacts, is highest in urban communities – Berehivska, Vynohradivska, Mukachivska, Uzhhorodska, and Khustska. Also, the territorial communities of the highlands in the east of Zakarpatska Oblast have a relatively high cumulative impact – Bohdanska, Velykobychkivska, Dubivska, Rakhivska, and Ust-Chornianska territorial communities.

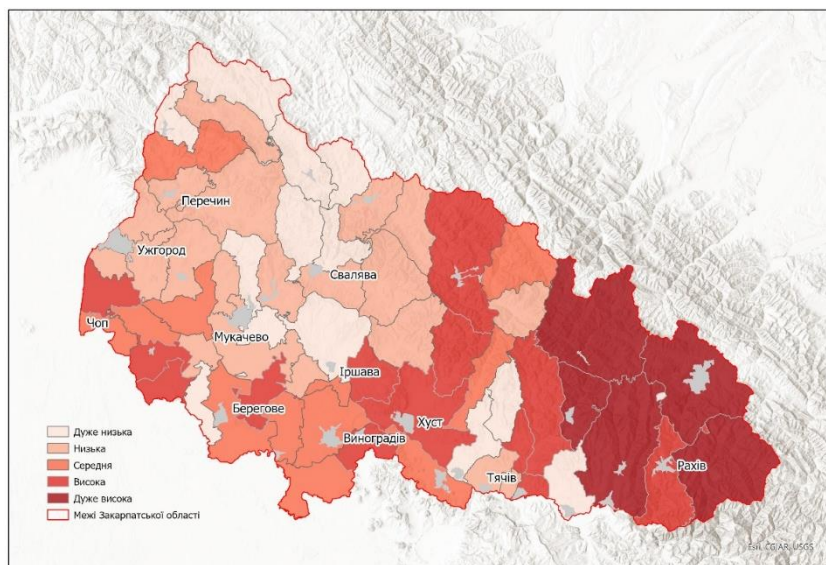
#### **4. Spatial structure of vulnerability to climate change**

The consequences of climate change impacts on a particular territory can be mitigated by the *adaptive capacity* of the territory, which is formed by the infrastructure, social, and organizational conditions of the territory. The highest adaptive capacity is specific to the urban territorial communities – Berehivska, Mukachivska, Perechynska, and Uzhhorodska, as well as the closest to Uzhhorod – Kholmkiivska and Onokivska rural territorial communities. The territorial communities with the lowest adaptive capacity are concentrated mainly in the highlands in eastern Zakarpattia - Bohdanska, Yasinyanska, Velykobychkivska, Ust-Chornianska, as well as close to them the foothill communities – Vilzovetska, Neresnytska, Solotvynska, Teresvyanska.



**Figure 17. Adaptive capacity of the territory to the projected climate change**

Taking into account the expected impacts of climate change and the adaptive capacity of territorial communities, the degree of *vulnerability* to climate change of the territorial communities of Zakarpatska Oblast was determined. According to the results of the vulnerability calculation, spatial patterns can be noted across the region – the territorial communities of the highlands in the east of the region are characterized by the highest vulnerability, while the western part of the mountainous territorial communities is less vulnerable to climate change, and the territorial communities of the Zakarpattia lowlands are characterized mostly by the average values of vulnerability.



**Figure 18. Vulnerability of the territory to climate change**

Territorial communities with the highest level of vulnerability to climate change require the most attention and support to increase their adaptive capacity. At the same time, communities with medium and low levels of vulnerability should not be neglected, as the adaptive capacity of the region depends on the combined capacity of all territorial communities, and disasters, including those caused by climate change, are usually not limited to the location of their occurrence, but spread to adjacent and relatively remote areas regardless of administrative boundaries and state borders.

***The territorial communities with the high level of vulnerability*** are mountainous, farthest from the regional centre with difficult transport accessibility, characterized by higher absolute altitudes than the rest of the region, difficult engineering and geological conditions, the development of hazardous natural processes, and the predominance of forestry and tourism in the economic complex. For these communities, the most urgent is the implementation of measures on:

- protecting the territory from the development of hazardous natural processes such as landslides, erosion, mudflows, and avalanches;
- improving transport accessibility;
- optimization of forestry;
- diversification of the tourism industry;
- providing the population with water supply.

***Territorial communities with the medium level of vulnerability*** are mainly concentrated in the Zakarpattia lowlands and are characterized by a high risk of flooding by flood and freshet waters, large areas of agricultural land, higher population density, and most communities have relatively high levels of adaptive capacity. In order to reduce vulnerability to climate change in these communities, it is most urgent to implement measures on:

- protecting the territory from flooding and revitalizing river floodplains;
- optimization of agriculture and the structure of agricultural land;
- adaptation of urban spaces to climate change;
- protecting the population from high temperatures.

***Territorial communities with the low level of vulnerability*** are located in the western half of the mountainous and foothill territory of Zakarpattia. Most of them are characterized by a low level of cumulative impact and, at the same time, relatively high levels of adaptive capacity. In order to further reduce the vulnerability of these communities to climate change, the most urgent is to implement measures on:

- protecting the territory from the development of hazardous natural processes, primarily erosion and landslides;
- optimization of forestry;
- diversification of the tourism industry.

## **5. Strategic goals of climate change adaptation, tasks and measures aimed at achieving them**

**The main aim** of the Strategy is to ensure an effective adaptation of the territory of Zakarpatska Oblast to climate change, reducing its negative impact on the population, infrastructure, economy and environment of the region.

The goal should be achieved through the achievement of strategic objectives by implementing tasks and measures corresponding to each objective, which are either of regional significance or focused on certain types of territorial communities, depending on the degree of their vulnerability to climate change.

**Strategic goal 1:** Strengthening organizational and information support to climate change adaptation.

**Task 1.1:** Establishing a coordinated management system for adaptation to climate change.

Actions:

1.1.1. Establishing a coordination and advisory body of the regional council on climate change adaptation.

1.1.2. Developing and approving a procedure for coordinating the activities of local governments on climate change adaptation.

1.1.3. Considering climate change impacts and adaptation tasks in state planning documents at the regional and local levels.

**Task 1.2:** Information provision of climate change adaptation measures.

Actions:

1.2.1. Analysing and defining the list of data required to monitor climate change in Zakarpatska Oblast, assess its impacts and adaptive capacity of the territory, respond promptly to emergencies, plan adaptation measures and effectiveness of adaptation measures monitoring.

1.2.2. Organizing the collection, processing and storage of data on climate change and adaptation to it, taking into account the available state, municipal and private sources of the necessary data.

1.2.3. Forming a single window of open access to data on climate change and adaptation to it in Zakarpatska Oblast (in the form of a separate geoportal or a subsection of an existing regional geoportal).

**Task 1.3:** Implementation of innovative solutions for adaptation to climate change.

Actions:

1.3.1. Supporting regular scientific research in the field of climate change adaptation in Zakarpatska Oblast, including the implementation of international experience in this field in the region.

1.3.2. Organizing a cross-border cooperation with neighbouring countries in the field of climate change adaptation.

1.3.3. Organizing regular advanced training for officials of regional state authorities and local governments in the field of climate change and adaptation.

***Implementation indicators:***

Indicator 1.1. Number of meetings of the coordination and advisory body of the regional council on climate change adaptation.

Indicator 1.2. A procedure for coordinating the activities of local governments on climate change adaptation is in place.

Indicator 1.3: Number of relevant open-access datasets on climate change and adaptation to it at the territory of Zakarpatska Oblast.

Indicator 1.4: Number of scientific-research projects in the field of climate change adaptation in Zakarpatska Oblast.

Indicator 1.5. Number of transboundary projects/activities dedicated to climate change and adaptation.

Indicator 1.6: Share of officials of regional state authorities and local self-government bodies who have undergone advanced training in climate change and adaptation.

**Strategic goal 2:** Preservation of the sustainable state of natural landscapes.

***Task 2.1:*** Protecting the biodiversity of the region.

Actions:

2.1.1. Establishing the boundaries of the territories and objects of the nature reserve fund and other environmental protection areas.

2.1.2. Create open information resources on the location, zoning, and regimes of protected areas.

2.1.3. Eliminating invasive species in the region and preventing their uncontrolled spread.

***Task 2.2:*** Ensuring the spatial connectivity of natural landscapes of Zakarpatska Oblast.

Actions:

2.2.1. Developing an up-to-date regional scheme of the ecological network of Zakarpatska Oblast, taking into account the function purpose of the territory as defined by local urban planning documents and the structure of lands by designated purpose.

2.2.2. Constructing green infrastructure elements to form spatial connections between natural and semi-natural landscapes.

***Implementation indicators:***

Indicator 2.1: Share of protected areas in Zakarpatska Oblast for which boundaries are established in accordance with the law (%).

Indicator 2.2: Share of protected areas in Zakarpatska Oblast with information on their location, zoning and regimes available in open information sources (%).

Indicator 2.3: Area of territories cleared of invasive species (ha).

Indicator 2.4. Effective mechanisms are in place to prevent the uncontrolled spread of invasive species in Zakarpatska Oblast.

Indicator 2.5: The up-to-date regional scheme of the ecological network of Zakarpatska Oblast is approved.

Indicator 2.6. Number of green infrastructure elements.

**Strategic goal 3:** Prevention of negative consequences of extreme processes in the environment.

**Task 3.1:** Water retention in the landscape taking into account the ecosystem approach.

Actions:

3.1.1. Expanding the area of territories with the implementation of forest reclamation measures.

3.1.2. Constructing reservoirs to capture and redistribute surface runoff, including on rivers.

3.1.3. Implementing solutions for the accumulation of rainwater in settlements and its further use for technical purposes.

3.1.4. Conserving and restoring wetlands.

3.1.5. Reconstructing meliorative networks using water recycling mechanisms to accumulate drainage water and use it in dry periods.

**Task 3.2:** Revitalization of riverbeds and floodplains in the region.

Actions:

3.2.1. Restoring of natural vegetation cover within river floodplains.

3.2.2. Creating public green spaces along rivers in settlements.

3.2.3. Implementing landscape and engineering solutions for coastal protection.

**Task 3.3:** Development of infrastructure for engineering protection of the territory in areas where ecosystem solutions are not effective or cannot be implemented.

Actions:

3.3.1. Maintaining the existing engineering protection facilities and constructing new ones, primarily flood, landslide, avalanche and mudflow protection facilities.

3.3.2. Arranging drainage for surface runoff on forest roads in mountainous and foothill areas.

3.3.3. Implementing innovative fire protection solutions in natural landscapes.

**Implementation indicators:**

Indicator 3.1. The area of territories with the implementation of forest melioration measures (ha).

Indicator 3.2: Useful volume of reservoirs for catching and redistributing surface runoff (cubic meters).

Indicator 3.3. Volume of rainwater that can be collected and reused in settlements (cubic meters).

Indicator 3.4: Area of wetlands in the region (ha).

Indicator 3.5. Area of territories where river channels and floodplains have been revitalized (ha).

Indicator 3.6. Length of river banks for which bank protection measures have been implemented (km).

Indicator 3.7. Area of territories protected from hazardous natural processes by engineering structures (ha).

Indicator 3.8. Length of forest roads equipped with surface runoff drainage (km).

Indicator 3.9. Area of natural landscapes where innovative fire protection solutions have been implemented (ha).

**Strategic goal 4.** Reducing the vulnerability of the population to climate change.

**Task 4.1:** Operational protection of the population against emergency situations.

Actions:

4.1.1. Establishing a system for promptly informing the public about hazardous phenomena using modern means of communication.

4.1.2. Developing a network of civil defence units to ensure rapid response to emergencies.

4.1.3. Developing a network of healthcare facilities to ensure prompt accessibility and timely first aid.

4.1.4. Maintaining the proper quality of highways connecting territorial communities with each other and with the regional centre, including protection from the impact of hazardous natural processes.

4.1.5. Developing the road network so that each territorial community has an alternative way to connect with the regional centre.

**Task 4.2:** Building the population's capacity to adapt.

Action:

4.2.1. Regularly informing citizens through the media and web resources about climate change issues and expected impacts in Zakarpatska Oblast.

4.2.2. Distributing of informational materials and holding informational events for residents on how to act in the face of potential natural and man-made disasters.

4.2.3. Conducting information events on climate change and adaptation to it, targeting pupils and students, as well as teachers.

4.2.4. Disseminating the best practices of climate change adaptation among households, agricultural and industrial activities.

**Implementation indicators:**

Indicator 4.1. Regular prompt citizens informing about hazardous phenomena by modern means of communication is introduced.

Indicator 4.2: Average and maximum service radii of existing civil protection units (km).

Indicator 4.3: Average and maximum service radii of existing healthcare facilities (km).

Indicator 4.4: Length of roads in need of repair, reconstruction, or engineering protection from natural hazards (km).

Indicator 4.5: Number of territorial communities with only one road connecting them to the regional centre.

Indicator 4.6. A number of mass media information notices on climate change issues and expected impacts in Zakarpatska Oblast.

Indicator 4.7. A number of information events on actions in the face of potential natural and man-made disasters.

Indicator 4.8. A number of information events for young people on climate change and adaptation.

Indicator 4.9. A number of best practices of climate change adaptation described and disseminated among the population.

Indicator 4.10. A number of participants in information activities (persons).

**Strategic goal 5:** Support of a favourable environment in settlements.

**Task 5.1:** Planning of settlement territories resistant to climate change.

Actions:

5.1.1. Considering tasks of climate change adaptation in project decisions of master plans of settlements and detailed plans of territories within settlements.

5.1.2. Forming a balanced structure of functional zoning of settlement areas with a combination of not large functional zones of residential, public and green spaces, convenient for walking between them.

5.1.3. Planning the development of settlements to ensure comfortable air circulation in built-up areas.

5.1.4. Developing planning solutions to relocate buildings from river floodplains and revitalize the relevant floodplain areas.

**Task 5.2:** Reduction of the share of artificial coverings in the area of populated areas.

Actions:

5.2.1. Increasing the area of green spaces in settlements.

5.2.2. Landscaping of streets and public spaces using woody vegetation with dense crowns.

5.2.3. Constructing of green roofs and vertical landscaping.

5.2.4. Clearing and arranging existing water bodies in settlements and creating new ones.

5.2.5. Constructing of artificial water bodies in settlements – ponds, rain gardens, fountains, etc.

5.2.6. Applying of water-permeable coverings on areas with artificial cover.

**Task 5.3:** Adaptation of buildings to climate change.

Actions:



5.3.1. Designing and constructing new buildings using the latest energy sustainability solutions.

5.3.2. Reconstructig of public buildings with insulation, air conditioning or regulated ventilation systems, and external shading elements.

5.3.3. Promoting the use of the latest energy sustainability solutions in the construction or reconstruction of privately owned buildings.

5.3.4. Establishing networks of drinking fountains in settlements.

**Task 5.4:** Ensuring sustainable water supply and sewage disposal.

Actions:

5.4.1. Constructing of centralized water supply networks in settlements located in areas with limited groundwater resources.

5.4.2. Providing settlements with a network of centralized and local treatment facilities to treat the entire volume of wastewater.

5.4.3. Developing mechanisms to stimulate citizens to connect to water supply and sewage networks.

**Implementation indicators:**

Indicator 5.1: Share of settlements provided with urban planning documentation, the design solutions of which take into account the tasks of climate change adaptation (%).

Indicator 5.2: Share of green spaces in the total area of settlements (%).

Indicator 5.3: Share of buildings and structures with green roofs or vertical gardening (%).

Indicator 5.4: Share of the area of water bodies in the total area of settlements (%).

Indicator 5.5. Share of the area of settlements with water-permeable coverings (%).

Indicator 5.6: Area of buildings with effective thermal insulation (square meters).

Indicator 5.7: Area and share of low-energy and passive public buildings (square meters, %)

Indicator 5.8: Share of low-energy and passive residential buildings in the total housing stock (%).

Indicator 5.9: Share of settlements with networks of drinking fountains (%).

Indicator 5.10: Share of settlements with access to centralized water supply (%).

Indicator 5.11: Share of households connected to centralized water supply (%).

Indicator 5.12: Share of settlements with access to centralized sewerage with wastewater treatment (%).

Indicator 5.13: Share of households connected to centralized wastewater disposal (%).

Indicator 5.14: Share of treated wastewater (%).

**Strategic goal 6:** Building a climate-resilient economic complex.

**Task 6.1:** Diversification of the economic complex of the region.

Actions:

6.1.1. Developing investment proposals to attract climate-resilient businesses to Zakarpattia's territorial communities.

6.1.2. Creating infrastructure conditions to attract investors.

6.1.3. Developing spatial/urban planning documentation considering investment proposals to create conditions for a quick business start-ups.

**Task 6.2:** Ensuring sustainable forestry.

Actions:

6.2.1. Increasing the area of forests.

6.2.2. Optimizing the age and species composition of forests.

6.2.3. Preventing forests degradation.

6.2.4. Promoting the formation of communal forests.

**Task 6.3:** Protecting agriculture from the negative impacts of climate change.

Actions:

6.3.1. Diversification of agro-landscape structures (stimulating the formation of a variegated structure of agricultural land with an alternation of relatively small plots of arable land with different crops and other types of agricultural land).

6.3.2. Monitoring the crop rotations completion in agriculture.

6.3.3. Contour farming on agricultural lands with a slope of more than 10%.

6.3.4. Increasing the area of linear forests (forest belts) on agricultural lands.

6.3.5. Applying the latest agromelioration solutions.

6.3.6. Expanding the area for growing more heat-loving and drought-resistant crops.

**Task 6.4:** Supporting and increasing the competitiveness of tourism.

Actions:

6.4.1. Diversification of tourism services.

6.4.2. Introducing tourism products that are relevant all year round.

6.4.3. Supporting the development of ecological and educational tourism.

6.4.4. Identify, develop and promote regional and local products/brands that have the potential for tourism development.

**Task 6.5:** Ensuring the sustainability of the energy system in the region.

Actions:

6.5.1. Stimulating the introduction of energy-efficient and resource-saving technologies.

6.5.2. Increasing the capacity of electricity generation from renewable sources.

6.5.3. Placing solar panels on the roofs and facades of existing residential buildings.

6.5.4. Assessing the potential of the region's watercourses for the installation of small hydropower plants with an assessment of its negative and positive impact on the environment and local energy.

6.5.5. Creating a system of local storage of electricity generated from renewable energy sources and a system of electricity exchange aimed at critical situations.

**Task 6.6:** Introducing the mechanisms to stimulate the implementation by local businesses the climate change adaptation measures.

Actions:

- 6.6.1. Development of "green" and "climate" loans to provide financial and economic support for agricultural and non-agricultural businesses in view of climate change.
- 6.6.2. Introducing agricultural insurance to protect agricultural producers from losses due to adverse weather conditions.

***Implementation indicators:***

Indicator 6.1: Number of new businesses that started operating in the region.

Indicator 6.2: Area of forests (ha).

Indicator 6.3: Area of communal forests (ha).

Indicator 6.4. Share of forests certified under the FSC scheme in the total area of forests in the region (%).

Indicator 6.5: Share of agricultural land with contour farming (%).

Indicator 6.6: Share of agricultural land under crop rotation (%).

Indicator 6.7: Share of agricultural land with the latest agromelioration solutions implemented (%).

Indicator 6.8: Area of linear forests (ha).

Indicator 6.10: Number of tourist complexes that offer tourist and recreational services year-round.

Indicator 6.11: Number of popularized regional and local tourist-attractive products/brands.

Indicator 6.12. Installed capacity of new renewable energy sources (kW).

Indicator 6.13: Number of "green" or "climate" loans granted.

Indicator 6.14: Number of agricultural insurance contracts concluded.

**6. The procedure for ensuring the Strategy implementation, monitoring, evaluation the implementation results and reporting**

The key to the successful implementation of the Strategy is the coordinated involvement of all relevant parties, including structural units of the Zakarpatska Oblast State Administration in accordance with their respective mandates, local governments as key actors at the local level, scientific and educational institutions to implement innovative solutions and raise general awareness on the climate change issues, NGOs representing the interests of different segments of the region's population, and local businesses as directly involved in the implementation of the Strategy.

Funding for the implementation of the Strategy may be provided from the regional budget, local budgets, state subventions, international technical and/or financial assistance, and other sources not prohibited by law.

Organizational support and monitoring of the Strategy implementation, as well as coordination of the activities of the parties involved, is carried out by the Department of Urban Planning and Architecture of the Zakarpatska Oblast State Administration.

The Strategy implementation is monitored annually. To this end, all parties involved in the implementation of the Strategy by February 1 of the year following the reporting year shall submit to the Urban Planning and Architecture Department information on the status of the implementation of measures in accordance with their powers, as well as proposals for further measures to fulfil the objectives of the Strategy.

The Department of Urban Planning and Architecture analyses and summarizes the information submitted by the parties involved in the implementation of the Strategy on the status of implementation of the Strategy and proposals for further measures and, based on the results, prepares an annual report on the status of implementation of the Strategy, which is submitted annually by March 1 to the Zakarpatska Oblast Council and published on the official website of the Zakarpatska Oblast State Administration. Experts, civil society organizations, and scientific institutions may be involved in the preparation of the annual report on the implementation of the Strategy.

Based on the results of the regional council's review of the annual report on the status of the Strategy implementation, further measures to implement the Strategy are determined and the relevant expenditure items are included in the regional budget for the year following the reporting year.

Once every 5 years, the Urban Planning and Architecture Department ensures analyse of the dynamics of climate change in the territory of Zakarpatska Oblast and its compliance with the forecast of expected changes set out in the Strategy. The results of the analysis may serve as a basis for amending the Strategy.

## ANNEX

### **Indicators of climate change impact, adaptive capacity of the territory and vulnerability to climate change in terms of territorial communities of Zakarpatska Oblast**

The degree of vulnerability of the territory of Zakarpatska Oblast was determined on the basis of the methodology of the Adaptation Strategy to Climate Change in the Košice Region elaborated in the framework of the Project “Climate Change Adaptation Strategy and Mitigation Steps for Slovak-Ukrainian Crossborder Region” (CLIMADAM), and adapted to the conditions of the territory of Zakarpatska Oblast, taking into account the availability of input data.

According to the proposed methodology, the assessment of the territory's vulnerability to climate change is based on a comparison of climate change impact indicators with indicators of the territory's adaptive capacity.

In turn, the impact of climate change is determined on the basis of indicators of the territory's sensitivity to climate change correlated with climate indicators (see Table 1), namely:

- change in the average annual air temperature;
- change in the average annual number of frosty days;
- change in the average annual number of summer days (with the maximum daily temperature above 25 degrees Celsius);
- change in the average annual number of tropical days (with a maximum daily temperature above 30 degrees Celsius);
- relative change in the average amount of precipitation in the winter months;
- relative change in the average amount of precipitation in the summer months;
- change in the average number of days with precipitation above 20 mm per day;
- change in the average number of days with snow cover per year;
- relative change in annual potential evaporation;
- change in the arid-climatic moisture indicator.

***The cumulative impact of climate change*** consists of physical, environmental, social, economic, and cultural impacts, which are calculated by comparing the indicators of the territory's sensitivity to climate change with climate indicators (see Section 2 of the Strategy).

The physical impact of climate change takes into account the following sensitivity indicators:

- settlements sensitivity to floods;
- roads and railways sensitivity to floods;
- roads and railways sensitivity to flash floods;
- settlements sensitivity to landslides;

- roads and railways sensitivity to landslides.

The environmental impact of climate change takes into account the following sensitivity indicators:

- forests sensitivity to fires;
- protected areas degree;
- soils sensitivity to erosion;
- content of organic carbon in the soil;
- soils sensitivity to drought;
- green areas degree;
- built-up areas degree.

The social impact of climate change takes into account the following sensitivity indicators:

- population sensitivity to summer heatwaves;
- population sensitivity to summer floods.

The economic impact of climate change takes into account the following sensitivity indicators:

- forests sensitivity to drought;
- summer tourism sensitivity to summer temperatures;
- energy demand sensitivity to heatwaves;
- energy demand sensitivity to frost.

The cultural impact of climate change takes into account the sensitivity of immovable cultural heritage objects to floods.

The combination of the five types of impacts provides an indicator of the cumulative impact of climate change on the territory.

***The adaptive capacity of the territory*** was determined based on the following indicators:

- specific weight of expenditures on development measures in local budgets;
- the percentage of financed expenditures on development measures in local budgets;
- capacity (surplus) of local budgets;
- share of the population with higher education;
- number of places in tourist facilities;
- a population sensitive to summer heat;
- connection to the public water supply (share of connected households);
- connection to a sewerage network with treatment facilities (share of connected households);
- high-speed Internet access (the share of built-up areas with high-speed Internet connections);
- civic participation (voter activity in local government elections);
- provision of services to the population (accessibility of social infrastructure facilities);
- age dependency (the ratio of the elderly population to the working-age population);
- transport accessibility (distance to the regional centre).

The result of comparing the indicators of the cumulative impact of climate change and the adaptive capacity of the territory is the degree of ***vulnerability of the territory to climate change*** (see Section 4 of the Strategy).

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Table 1.

**Climate indicators of climate change by the territorial communities of Zakarpatska Oblast**

Territorial community (TC)	Change in average annual air temperature	Change in the number of frosty days	Change in the number of summer days	Change in the number of tropical days	Change in the amount of winter precipitation	Change in the amount of summer precipitation	Change in the number of days with more than 20 mm of precipitation per day	Change in the number of days with snow cover	Change in potential total evaporation, mm	Change of arid climate indicator of humidification
Baranynska village TC	0,80	0,08	0,77	0,77	0,07	0,93	0,07	0,07	0,07	0,07
Bativska town TC	0,79	0,01	0,79	0,79	0,00	1,00	0,00	0,00	0,00	0,00
Bedevlianska village TC	0,51	0,20	0,46	0,46	0,20	0,81	0,20	0,20	0,20	0,20
Berehivska city TC	0,83	0,02	0,94	0,94	0,01	1,00	0,01	0,01	0,01	0,01
Bilkiwska village TC	0,55	0,20	0,52	0,52	0,20	0,81	0,20	0,20	0,20	0,20
Bohdanska village TC	0,00	0,99	0,02	0,02	1,01	-0,01	1,00	1,00	1,00	1,00
Bushtynska town TC	0,53	0,20	0,49	0,49	0,19	0,81	0,19	0,19	0,19	0,19
Velykobereznianska town TC	0,52	0,28	0,53	0,54	0,31	0,69	0,31	0,31	0,31	0,31
Velykoberezka village TC	0,77	0,03	0,81	0,81	0,03	0,98	0,02	0,03	0,03	0,03
Velykobyihanska village TC	0,84	0,01	0,94	0,94	0,00	1,00	0,00	0,00	0,00	0,00
Velykobychkivska town TC	0,17	0,69	0,16	0,16	0,69	0,31	0,69	0,69	0,69	0,69
Velykodobronska village TC	0,80	0,01	0,78	0,78	0,00	1,00	0,00	0,00	0,00	0,00
Velykoluchkivska village TC	0,76	0,03	0,73	0,73	0,02	0,99	0,02	0,02	0,02	0,02
Verhniokoropetska village TC	0,68	0,07	0,64	0,64	0,06	0,94	0,06	0,06	0,06	0,06
Vylotska town TC	0,75	0,03	0,77	0,77	0,02	0,99	0,02	0,02	0,02	0,02
Vynohradivska city TC	0,67	0,06	0,67	0,67	0,05	0,95	0,05	0,05	0,05	0,05
Vyshkivska town TC	0,54	0,21	0,54	0,55	0,20	0,80	0,20	0,20	0,20	0,20

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Territorial community (TC)	Change in average annual air temperature	Change in the number of frosty days	Change in the number of summer days	Change in the number of tropical days	Change in the amount of winter precipitation	Change in the amount of summer precipitation	Change in the number of days with more than 20 mm of precipitation per day	Change in the number of days with snow cover	Change in potential total evaporation, mm	Change of arid climate indicator of humidification
Vilkhovetska village TC	0,46	0,28	0,41	0,41	0,28	0,72	0,28	0,28	0,28	0,28
Volovetska town TC	0,19	0,63	0,05	0,05	0,70	0,30	0,70	0,70	0,70	0,70
Horinchivska village TC	0,40	0,43	0,29	0,29	0,45	0,55	0,45	0,45	0,45	0,45
Horondivska village TC	0,78	0,01	0,78	0,78	0,01	1,00	0,01	0,01	0,01	0,01
Dovzhanska village TC	0,44	0,36	0,32	0,32	0,38	0,63	0,37	0,37	0,38	0,37
Drahivska village TC	0,36	0,50	0,28	0,28	0,51	0,49	0,51	0,51	0,51	0,51
Dubivska town TC	0,25	0,62	0,20	0,20	0,63	0,37	0,63	0,63	0,63	0,63
Dubrynytsko-Malobereznianska village TC	0,51	0,32	0,49	0,49	0,34	0,66	0,34	0,34	0,34	0,34
Zhdenievsk town TC	0,30	0,56	0,18	0,18	0,59	0,41	0,59	0,59	0,59	0,59
Zarichanska village TC	0,67	0,06	0,64	0,64	0,05	0,96	0,05	0,05	0,05	0,05
Ivanovetska village TC	0,66	0,13	0,60	0,60	0,13	0,88	0,12	0,13	0,13	0,05
Irshavska city TC	0,50	0,31	0,43	0,43	0,32	0,68	0,32	0,32	0,32	0,32
Kamianska village TC	0,69	0,06	0,66	0,66	0,06	0,95	0,06	0,06	0,06	0,06
Keretskivska village TC	0,34	0,50	0,19	0,20	0,54	0,46	0,54	0,54	0,54	0,54
Kolochavska village TC	0,18	0,78	0,06	0,07	0,83	0,17	0,83	0,83	0,83	0,83
Kolchynska town TC	0,53	0,30	0,45	0,45	0,31	0,69	0,31	0,31	0,31	0,31
Korolivska town TC	0,61	0,11	0,64	0,64	0,10	0,90	0,10	0,10	0,10	0,10
Kosonska village TC	0,79	0,01	0,82	0,82	0,00	1,00	0,00	0,00	0,00	0,00
Kostrynska village TC	0,39	0,48	0,34	0,34	0,51	0,49	0,51	0,51	0,51	0,51



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Territorial community (TC)	Change in average annual air temperature	Change in the number of frosty days	Change in the number of summer days	Change in the number of tropical days	Change in the amount of winter precipitation	Change in the amount of summer precipitation	Change in the number of days with more than 20 mm of precipitation per day	Change in the number of days with snow cover	Change in potential total evaporation, mm	Change of arid climate indicator of humidification
Mizhhirska town TC	0,27	0,64	0,08	0,08	0,70	0,30	0,69	0,69	0,70	0,69
Mukachivska city TC	0,73	0,03	0,71	0,71	0,03	0,98	0,03	0,03	0,03	0,03
Nelipynska village TC	0,35	0,44	0,21	0,22	0,47	0,53	0,47	0,47	0,47	0,47
Neresnytska village TC	0,32	0,53	0,25	0,25	0,54	0,46	0,54	0,54	0,54	0,54
Nyzhniovoritska village TC	0,29	0,50	0,14	0,14	0,53	0,48	0,52	0,52	0,52	0,52
Onokivska village TC	0,73	0,21	0,70	0,70	0,20	0,81	0,19	0,19	0,20	0,19
Perechynska city TC	0,64	0,18	0,60	0,60	0,19	0,82	0,18	0,19	0,19	0,19
Pyiterfolvivska village TC	0,69	0,03	0,69	0,69	0,03	0,98	0,02	0,03	0,03	0,03
Pylypetska village TC	0,26	0,63	0,08	0,09	0,71	0,29	0,71	0,71	0,71	0,71
Polianska village TC	0,42	0,36	0,31	0,31	0,38	0,62	0,38	0,38	0,38	0,38
Rahivska city TC	0,08	0,77	0,12	0,12	0,76	0,24	0,75	0,75	0,76	0,75
Svaliavska city TC	0,45	0,32	0,33	0,33	0,34	0,66	0,34	0,34	0,34	0,34
Serednianska town TC	0,67	0,18	0,62	0,62	0,17	0,83	0,17	0,17	0,17	0,17
Synevyrska village TC	0,13	0,87	0,00	0,00	0,95	0,05	0,94	0,94	0,95	0,94
Solotvynska town TC	0,42	0,30	0,37	0,38	0,30	0,70	0,30	0,30	0,30	0,30
Stavnska village TC	0,38	0,51	0,31	0,31	0,54	0,46	0,54	0,54	0,54	0,54
Siurtivska village TC	0,85	0,01	0,83	0,83	0,00	1,01	0,00	0,00	0,00	0,00
Teresvianska town TC	0,49	0,21	0,44	0,44	0,21	0,80	0,21	0,21	0,21	0,21
Turieremetivska village TC	0,47	0,38	0,39	0,39	0,40	0,61	0,39	0,39	0,40	0,39
Tiachivska city TC	0,54	0,16	0,50	0,50	0,16	0,85	0,16	0,16	0,16	0,16
Uglianska village TC	0,39	0,44	0,32	0,32	0,44	0,56	0,44	0,44	0,44	0,44

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<b>Territorial community (TC)</b>	<b>Change in average annual air temperature</b>	<b>Change in the number of frosty days</b>	<b>Change in the number of summer days</b>	<b>Change in the number of tropical days</b>	<b>Change in the amount of winter precipitation</b>	<b>Change in the amount of summer precipitation</b>	<b>Change in the number of days with more than 20 mm of precipitation per day</b>	<b>Change in the number of days with snow cover</b>	<b>Change in potential total evaporation, mm</b>	<b>Change of arid climate indicator of humidification</b>
Uzhhorodska city TC	1,00	0,03	1,00	1,00	0,01	1,00	0,01	0,01	0,01	0,01
Ust-Chornianska town TC	0,07	0,93	0,02	0,02	0,99	0,01	0,98	0,98	0,98	0,98
Holmkivska village TC	0,92	0,01	0,91	0,91	0,00	1,00	0,00	0,00	0,00	0,00
Khustska city TC	0,56	0,17	0,58	0,58	0,16	0,84	0,16	0,16	0,16	0,16
Chynadiivska town TC	0,49	0,33	0,41	0,41	0,34	0,66	0,34	0,34	0,34	0,34
Chopska city TC	0,80	0,01	0,79	0,79	0,00	1,00	0,00	0,00	0,00	0,00
Yasinianska town TC	0,05	0,91	0,04	0,05	0,95	0,05	0,94	0,94	0,94	0,94

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Table 2.

**Indicators of physical sensitivity and climate change impact by the territorial communities of Zakarpatska Oblast**

Territorial community (TC)	Settlements sensitivity to floods	Sensitivity of Highways and railways to floods	Highways and railways sensitivity to flash floods	Highways and railways sensitivity to landslides	Settlements sensitivity to landslides	Physical impact
Baranynska village TC	0,11	0,14	0,02	0,02	0,01	<b>0,29</b>
Bativska town TC	0,74	0,77	0,00	0,00	0,00	<b>1,51</b>
Bedevlianska village TC	0,21	0,35	0,00	0,27	0,05	<b>0,88</b>
Berehivska city TC	0,58	0,61	0,01	0,00	0,00	<b>1,19</b>
Bilkivska village TC	0,06	0,24	0,06	0,15	0,06	<b>0,57</b>
Bohdanska village TC	0,00	0,00	0,02	1,65	0,61	<b>2,28</b>
Bushtynska town TC	0,08	0,09	0,06	0,00	0,07	<b>0,30</b>
Velykobereznianska town TC	0,06	0,12	0,00	0,33	0,06	<b>0,58</b>
Velykoberezka village TC	0,11	0,21	0,02	0,00	0,00	<b>0,33</b>
Velykobyihanska village TC	0,36	0,35	0,00	0,00	0,00	<b>0,71</b>
Velykobychkivska town TC	0,05	0,10	0,16	1,39	1,69	<b>3,39</b>
Velykodobronska village TC	0,84	0,98	0,00	0,00	0,00	<b>1,82</b>
Velykoluchkivska village TC	0,37	0,31	0,01	0,00	0,00	<b>0,69</b>
Verhniokoropetska village TC	0,00	0,00	0,01	0,00	0,00	<b>0,01</b>
Vylotska town TC	0,46	0,63	0,02	0,00	0,00	<b>1,11</b>
Vynohradivska city TC	0,19	0,25	0,02	0,09	0,00	<b>0,56</b>
Vyshkivska town TC	0,26	0,90	0,11	0,09	0,09	<b>1,46</b>
Vilkhovetska village TC	0,05	0,00	0,10	0,71	0,12	<b>0,99</b>
Volovetska town TC	0,00	0,00	0,04	1,14	0,26	<b>1,44</b>

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Territorial community (TC)	Settlements sensitivity to floods	Sensitivity of Highways and railways to floods	Highways and railways sensitivity to flash floods	Highways and railways sensitivity to landslides	Settlements sensitivity to landslides	Physical impact
Horinchivska village TC	0,21	0,53	0,01	1,20	0,40	<b>2,35</b>
Horondivska village TC	0,05	0,11	0,00	0,00	0,00	<b>0,17</b>
Dovzhanska village TC	0,00	0,00	0,03	1,00	0,22	<b>1,25</b>
Drahivska village TC	0,00	0,00	0,03	0,70	0,35	<b>1,08</b>
Dubivska town TC	0,05	0,46	0,03	1,47	0,96	<b>2,99</b>
Dubrynytsko-Malobereznianska village TC	0,11	0,21	0,00	1,08	0,43	<b>1,82</b>
Zhdeniivska town TC	0,00	0,00	0,00	0,50	0,16	<b>0,66</b>
Zarichanska village TC	0,47	0,37	0,02	0,10	0,00	<b>0,98</b>
Ivanovetska village TC	0,05	0,06	0,04	0,00	0,03	<b>0,18</b>
Irshavska city TC	0,00	0,01	0,03	0,15	0,06	<b>0,25</b>
Kamianska village TC	0,11	0,00	0,03	0,00	0,00	<b>0,14</b>
Keretskivska village TC	0,00	0,00	0,01	1,21	0,22	<b>1,44</b>
Kolochavska village TC	0,00	0,00	0,42	0,87	0,43	<b>1,73</b>
Kolchynska town TC	0,06	0,11	0,00	0,23	0,03	<b>0,44</b>
Korolivska town TC	0,38	0,57	0,05	0,00	0,00	<b>0,99</b>
Kosonska village TC	0,49	0,61	0,00	0,00	0,00	<b>1,10</b>
Kostrynska village TC	0,00	0,00	0,01	1,51	0,24	<b>1,77</b>
Mizhhirska town TC	0,06	0,18	0,20	1,44	1,14	<b>3,03</b>
Mukachivska city TC	0,12	0,21	0,01	0,00	0,00	<b>0,34</b>
Nelipynska village TC	0,00	0,00	0,01	0,47	0,09	<b>0,57</b>
Neresnytska village TC	0,08	0,31	0,01	1,10	0,59	<b>2,09</b>
Nyzhniovoritska village TC	0,00	0,00	0,00	1,23	0,24	<b>1,47</b>
Onokivska village TC	0,28	0,26	0,00	0,04	0,03	<b>0,61</b>

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Territorial community (TC)	Settlements sensitivity to floods	Sensitivity of Highways and railways to floods	Highways and railways sensitivity to flash floods	Highways and railways sensitivity to landslides	Settlements sensitivity to landslides	Physical impact
Perechynska city TC	0,20	0,20	0,00	0,55	0,06	<b>1,01</b>
Pyiterfolvivska village TC	0,76	0,95	0,00	0,00	0,00	<b>1,71</b>
Pylypetska village TC	0,00	0,00	0,42	0,97	0,16	<b>1,54</b>
Polianska village TC	0,01	0,14	0,00	0,72	0,27	<b>1,14</b>
Rahivska city TC	0,31	0,50	0,10	0,64	0,53	<b>2,08</b>
Svaliavska city TC	0,02	0,07	0,00	0,75	0,11	<b>0,96</b>
Serednianska town TC	0,00	0,00	0,04	0,22	0,11	<b>0,36</b>
Synevyrska village TC	0,00	0,00	0,24	1,30	0,42	<b>1,97</b>
Solotvynska town TC	0,06	0,06	0,03	0,25	0,21	<b>0,62</b>
Stavnenska village TC	0,00	0,00	0,03	1,15	0,43	<b>1,60</b>
Siurtivska village TC	0,48	0,75	0,00	0,00	0,00	<b>1,23</b>
Teresvianska town TC	0,27	0,47	0,01	0,00	0,03	<b>0,77</b>
Turieremetivska village TC	0,00	0,00	0,00	0,93	0,65	<b>1,58</b>
Tiachivska city TC	0,23	0,47	0,01	0,41	0,10	<b>1,22</b>
Uglianska village TC	0,00	0,00	0,00	0,51	0,14	<b>0,65</b>
Uzhhorodska city TC	0,34	0,29	0,00	0,00	0,00	<b>0,64</b>
Ust-Chornianska town TC	0,00	0,00	0,12	1,24	1,50	<b>2,86</b>
Holmkivska village TC	0,34	0,43	0,00	0,00	0,00	<b>0,77</b>
Khustska city TC	0,15	0,42	0,05	0,24	0,28	<b>1,14</b>
Chynadiivska town TC	0,07	0,12	0,01	0,43	0,14	<b>0,76</b>
Chopska city TC	1,01	1,01	0,00	0,00	0,00	<b>2,01</b>
Yasinianska town TC	0,00	0,00	0,15	0,99	0,93	<b>2,08</b>

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Table 3.

**Indicators of environmental sensitivity and climate change impact by the territorial communities of Zakarpatska Oblast**

<b>Territorial community (TC)</b>	<b>Forests sensitivity to fires</b>	<b>Protected areas degree</b>	<b>Soils sensitivity to erosion</b>	<b>Content of organic carbon in the soil</b>	<b>Soils sensitivity to drought</b>	<b>Green areas degree</b>	<b>Build-up areas degree</b>	<b>Environmental impact</b>
Baranynska village TC	0,38	0,87	0,20	0,63	0,02	0,42	0,67	<b>3,17</b>
Bativska town TC	0,12	0,79	0,01	0,62	0,00	0,78	0,71	<b>3,02</b>
Bedevlianska village TC	0,33	0,69	0,55	0,45	0,10	0,20	0,33	<b>2,66</b>
Berehivska city TC	0,33	0,84	0,08	0,67	0,00	0,83	0,80	<b>3,54</b>
Bilkivska village TC	0,35	0,75	0,73	0,36	0,11	0,30	0,40	<b>3,00</b>
Bohdanska village TC	0,95	0,68	0,84	0,02	0,78	0,00	0,02	<b>3,30</b>
Bushtynska town TC	0,19	0,70	0,17	0,34	0,12	0,16	0,38	<b>2,05</b>
Velykobereznianska town TC	0,49	0,51	0,24	0,33	0,11	0,05	0,50	<b>2,22</b>
Velykoberezka village TC	0,45	0,77	0,05	0,56	0,01	0,40	0,78	<b>3,01</b>
Velykobyihanska village TC	0,24	0,83	0,01	0,66	0,00	0,85	0,85	<b>3,44</b>
Velykobychkivska town TC	0,73	0,77	0,73	0,09	0,50	0,03	0,16	<b>3,01</b>
Velykodobronska village TC	0,22	0,52	0,01	0,61	0,00	0,60	0,70	<b>2,66</b>
Velykoluchkivska village TC	0,31	0,72	0,05	0,60	0,00	0,60	0,66	<b>2,95</b>
Verhniokoropetska village TC	0,53	0,74	0,24	0,51	0,02	0,26	0,56	<b>2,86</b>
Vylotska town TC	0,27	0,72	0,03	0,59	0,01	0,59	0,68	<b>2,89</b>
Vynohradivska city TC	0,28	0,62	0,45	0,55	0,02	0,46	0,50	<b>2,88</b>
Vyshkivska town TC	0,56	0,73	0,39	0,32	0,14	0,20	0,49	<b>2,84</b>
Vilkhovetska village TC	0,49	0,74	0,84	0,26	0,22	0,13	0,30	<b>2,99</b>
Volovetska town TC	0,53	0,77	0,79	0,08	0,48	0,03	0,05	<b>2,73</b>
Horinchivska village TC	0,65	0,84	0,67	0,16	0,31	0,04	0,27	<b>2,95</b>
Horondivska village TC	0,33	0,78	0,02	0,57	0,00	0,60	0,70	<b>3,01</b>

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Territorial community (TC)	Forests sensitivity to fires	Protected areas degree	Soils sensitivity to erosion	Content of organic carbon in the soil	Soils sensitivity to drought	Green areas degree	Build-up areas degree	Environmental impact
Dovzhanska village TC	0,39	0,72	0,47	0,19	0,24	0,04	0,31	<b>2,36</b>
Drahivska village TC	0,64	0,61	0,87	0,19	0,34	0,11	0,23	<b>3,00</b>
Dubivska town TC	0,58	0,88	0,94	0,11	0,45	0,05	0,18	<b>3,19</b>
Dubrynytsko-Malobereznianska village TC	0,70	0,85	0,22	0,25	0,12	0,02	0,48	<b>2,65</b>
Zhdeniivska town TC	0,67	0,84	0,47	0,11	0,37	0,01	0,18	<b>2,64</b>
Zarichanska village TC	0,16	0,72	0,65	0,54	0,02	0,49	0,44	<b>3,01</b>
Ivanovetska village TC	0,61	0,78	0,24	0,47	0,05	0,30	0,53	<b>2,98</b>
Irshavska city TC	0,53	0,65	0,41	0,30	0,17	0,18	0,37	<b>2,61</b>
Kamianska village TC	0,31	0,74	0,35	0,54	0,02	0,44	0,56	<b>2,97</b>
Keretskivska village TC	0,48	0,83	0,50	0,13	0,36	0,03	0,19	<b>2,52</b>
Kolochavska village TC	0,71	0,00	0,68	0,00	0,70	0,03	0,06	<b>2,19</b>
Kolchynska town TC	0,68	0,84	0,43	0,31	0,16	0,11	0,41	<b>2,92</b>
Korolivska town TC	0,36	0,64	0,24	0,50	0,06	0,41	0,53	<b>2,74</b>
Kosonska village TC	0,14	0,80	0,03	0,64	0,00	0,83	0,75	<b>3,18</b>
Kostrynska village TC	0,62	0,49	0,33	0,11	0,29	0,02	0,34	<b>2,20</b>
Mizhhirska town TC	0,36	0,95	0,65	0,06	0,58	0,02	0,07	<b>2,69</b>
Mukachivska city TC	0,26	0,76	0,18	0,60	0,01	0,56	0,56	<b>2,92</b>
Nelipynska village TC	0,67	0,80	0,56	0,16	0,31	0,01	0,21	<b>2,74</b>
Neresnytska village TC	0,38	0,71	0,90	0,14	0,36	0,07	0,22	<b>2,78</b>
Nyzhniovoritska village TC	0,20	0,80	0,63	0,05	0,24	0,05	0,13	<b>2,10</b>
Onokivska village TC	0,69	0,91	0,39	0,54	0,08	0,11	0,61	<b>3,33</b>
Perechynska city TC	0,56	0,82	0,33	0,40	0,08	0,08	0,54	<b>2,82</b>
Pyiterfolvivska village TC	0,11	0,65	0,06	0,58	0,01	0,65	0,61	<b>2,68</b>
Pylypetska village TC	0,05	0,96	0,40	0,05	0,71	0,03	0,08	<b>2,28</b>
Polianska village TC	0,57	0,78	0,52	0,19	0,22	0,05	0,29	<b>2,60</b>

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<b>Territorial community (TC)</b>	<b>Forests sensitivity to fires</b>	<b>Protected areas degree</b>	<b>Soils sensitivity to erosion</b>	<b>Content of organic carbon in the soil</b>	<b>Soils sensitivity to drought</b>	<b>Green areas degree</b>	<b>Build-up areas degree</b>	<b>Environmental impact</b>
Rahivska city TC	0,88	0,53	1,40	0,07	0,57	0,03	0,11	<b>3,59</b>
Svaliavska city TC	0,38	0,79	0,46	0,27	0,19	0,08	0,29	<b>2,47</b>
Serednianska town TC	0,50	0,84	0,13	0,48	0,06	0,24	0,58	<b>2,83</b>
Synevyska village TC	0,82	0,00	0,61	0,03	0,75	0,01	0,00	<b>2,23</b>
Solotvynska town TC	0,12	0,70	1,12	0,32	0,19	0,17	0,27	<b>2,88</b>
Stavnenska village TC	0,29	0,12	0,30	0,11	0,32	0,01	0,31	<b>1,46</b>
Siurtivska village TC	0,21	0,77	0,00	0,67	0,00	0,76	0,77	<b>3,18</b>
Teresvianska town TC	0,20	0,68	1,15	0,46	0,11	0,23	0,26	<b>3,09</b>
Turieremetivska village TC	0,56	0,80	0,26	0,21	0,22	0,04	0,38	<b>2,47</b>
Tiachivska city TC	0,32	0,70	0,37	0,37	0,09	0,25	0,38	<b>2,48</b>
Uglianska village TC	0,62	0,43	0,55	0,14	0,28	0,06	0,29	<b>2,36</b>
Uzhhorodska city TC	0,00	0,99	1,01	1,01	0,00	0,82	0,00	<b>3,83</b>
Ust-Chornianska town TC	0,80	1,01	0,69	0,01	0,77	0,00	0,02	<b>3,29</b>
Holmkivska village TC	0,23	0,90	0,08	0,80	0,00	0,91	0,58	<b>3,51</b>
Khustska city TC	0,38	0,72	0,65	0,35	0,10	0,23	0,45	<b>2,87</b>
Chynadiivska town TC	0,69	0,59	0,41	0,28	0,18	0,11	0,37	<b>2,64</b>
Chopska city TC	0,09	0,73	0,03	0,63	0,00	0,60	0,66	<b>2,74</b>
Yasinianska town TC	0,69	0,74	0,69	0,09	0,70	0,03	0,04	<b>2,98</b>



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Table 4.

**Indicators of social and economic sensitivity and impact of climate change in the context of territorial communities of  
Zakarpatska Oblast**

Territorial community (TC)	Population sensitivity to summer heatwaves	Population sensitivity to floods	Social influence	Forests sensitivity to drought	Summer tourism sensitivity to summer temperatures	Energy demand sensitivity to heat	Energy demand sensitivity to frost	Economic influence	Cultural influence
Baranynska village TC	0,19	0,02	<b>0,21</b>	0,04	0,56	0,05	0,00	<b>0,65</b>	<b>0,00</b>
Bativska town TC	0,21	0,10	<b>0,31</b>	0,00	0,78	0,06	0,00	<b>0,84</b>	<b>0,00</b>
Bedevlianska village TC	0,16	0,04	<b>0,20</b>	0,00	0,46	0,01	0,00	<b>0,47</b>	<b>0,00</b>
Berehivska city TC	0,25	0,32	<b>0,57</b>	0,00	0,66	0,36	0,01	<b>1,03</b>	<b>0,90</b>
Bilivska village TC	0,33	0,15	<b>0,48</b>	0,09	0,51	0,08	0,03	<b>0,70</b>	<b>0,30</b>
Bohdanska village TC	0,01	0,00	<b>0,01</b>	1,00	0,02	0,00	0,06	<b>1,08</b>	<b>0,00</b>
Bushtynska town TC	0,18	0,07	<b>0,25</b>	0,07	0,45	0,08	0,04	<b>0,65</b>	<b>0,00</b>
Velykobereznianska town TC	0,17	0,08	<b>0,24</b>	0,17	0,52	0,03	0,01	<b>0,73</b>	<b>0,00</b>
Velykoberezka village TC	0,45	0,01	<b>0,46</b>	0,01	0,79	0,02	0,00	<b>0,83</b>	<b>0,10</b>
Velykobyihanska village TC	0,11	0,04	<b>0,16</b>	0,00	0,00	0,04	0,00	<b>0,04</b>	<b>0,00</b>
Velykobychkivska town TC	0,04	0,10	<b>0,14</b>	0,42	0,15	0,03	0,18	<b>0,77</b>	<b>0,00</b>
Velykodobronska village TC	0,08	0,10	<b>0,18</b>	0,00	0,76	0,06	0,00	<b>0,82</b>	<b>0,00</b>
Velykoluchkivska village TC	0,18	0,14	<b>0,33</b>	0,01	0,71	0,11	0,00	<b>0,84</b>	<b>0,00</b>
Verhniokoropetska village TC	0,21	0,00	<b>0,21</b>	0,03	0,62	0,02	0,00	<b>0,66</b>	<b>0,00</b>
Vylotska town TC	0,05	0,11	<b>0,16</b>	0,01	0,76	0,08	0,00	<b>0,85</b>	<b>0,30</b>
Vynohradivska city TC	0,09	0,44	<b>0,53</b>	0,03	0,57	0,34	0,03	<b>0,97</b>	<b>1,00</b>
Vyshkivska town TC	0,07	0,13	<b>0,20</b>	0,10	0,30	0,06	0,02	<b>0,48</b>	<b>0,00</b>

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Territorial community (TC)	Population sensitivity to summer heatwaves	Population sensitivity to floods	Social influence	Forests sensitivity to drought	Summer tourism sensitivity to summer temperatures	Energy demand sensitivity to heat	Energy demand sensitivity to frost	Economic influence	Cultural influence
Vilkhovetska village TC	0,21	0,05	<b>0,26</b>	0,07	0,41	0,03	0,02	<b>0,52</b>	<b>0,00</b>
Volovetska town TC	0,02	0,00	<b>0,02</b>	0,46	0,04	0,00	0,04	<b>0,54</b>	<b>0,00</b>
Horinchivska village TC	0,07	0,09	<b>0,16</b>	0,25	0,28	0,02	0,04	<b>0,59</b>	<b>0,00</b>
Horondivska village TC	0,15	0,03	<b>0,17</b>	0,00	0,78	0,04	0,00	<b>0,83</b>	<b>0,00</b>
Dovzhanska village TC	0,09	0,00	<b>0,09</b>	0,22	0,30	0,03	0,05	<b>0,60</b>	<b>0,00</b>
Drahivska village TC	0,07	0,00	<b>0,07</b>	0,25	0,27	0,02	0,05	<b>0,59</b>	<b>0,00</b>
Dubivska town TC	0,05	0,17	<b>0,22</b>	0,34	0,19	0,02	0,10	<b>0,66</b>	<b>0,00</b>
Dubrynytsko-Malobereznianska village TC	0,21	0,04	<b>0,24</b>	0,21	0,49	0,01	0,00	<b>0,71</b>	<b>0,00</b>
Zhdeniivska town TC	0,07	0,00	<b>0,07</b>	0,34	0,16	0,00	0,00	<b>0,50</b>	<b>0,00</b>
Zarichanska village TC	0,13	0,07	<b>0,20</b>	0,01	0,64	0,03	0,00	<b>0,68</b>	<b>0,00</b>
Ivanovetska village TC	0,07	0,03	<b>0,10</b>	0,05	0,59	0,03	0,00	<b>0,68</b>	<b>0,00</b>
Irshavska city TC	0,12	0,01	<b>0,13</b>	0,18	0,33	0,10	0,11	<b>0,71</b>	<b>0,00</b>
Kamianska village TC	0,03	0,01	<b>0,04</b>	0,02	0,65	0,03	0,00	<b>0,71</b>	<b>0,00</b>
Keretskiivska village TC	0,01	0,00	<b>0,01</b>	0,31	0,19	0,01	0,07	<b>0,58</b>	<b>0,00</b>
Kolochavska village TC	0,00	0,00	<b>0,00</b>	0,48	0,06	0,00	0,03	<b>0,58</b>	<b>0,00</b>
Kolchynska town TC	0,11	0,04	<b>0,14</b>	0,17	0,40	0,02	0,01	<b>0,60</b>	<b>0,00</b>
Korolivska town TC	0,20	0,15	<b>0,35</b>	0,05	0,63	0,12	0,02	<b>0,81</b>	<b>0,10</b>
Kosonska village TC	0,21	0,07	<b>0,27</b>	0,00	0,78	0,04	0,00	<b>0,82</b>	<b>0,00</b>
Kostrynska village TC	0,14	0,00	<b>0,14</b>	0,35	0,24	0,00	0,00	<b>0,59</b>	<b>0,00</b>

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Territorial community (TC)	Population sensitivity to summer heatwaves	Population sensitivity to floods	Social influence	Forests sensitivity to drought	Summer tourism sensitivity to summer temperatures	Energy demand sensitivity to heat	Energy demand sensitivity to frost	Economic influence	Cultural influence
Mizhhirska town TC	0,02	0,10	<b>0,12</b>	0,54	0,06	0,01	0,15	<b>0,76</b>	<b>0,00</b>
Mukachivska city TC	0,04	0,81	<b>0,85</b>	0,01	0,45	0,63	0,03	<b>1,12</b>	<b>0,60</b>
Nelipynska village TC	0,16	0,00	<b>0,16</b>	0,26	0,21	0,00	0,01	<b>0,48</b>	<b>0,00</b>
Neresnytska village TC	0,04	0,12	<b>0,15</b>	0,29	0,25	0,04	0,15	<b>0,73</b>	<b>0,10</b>
Nyzhniovoritska village TC	0,03	0,00	<b>0,03</b>	0,25	0,14	0,00	0,03	<b>0,42</b>	<b>0,00</b>
Onokivska village TC	0,25	0,05	<b>0,30</b>	0,11	0,62	0,02	0,00	<b>0,75</b>	<b>0,00</b>
Perechynska city TC	0,05	0,10	<b>0,15</b>	0,10	0,52	0,04	0,01	<b>0,68</b>	<b>0,00</b>
Pyiterfolvivska village TC	0,00	0,17	<b>0,17</b>	0,01	0,68	0,10	0,00	<b>0,80</b>	<b>0,00</b>
Pylypetska village TC	0,09	0,00	<b>0,09</b>	0,38	0,05	0,00	0,02	<b>0,46</b>	<b>0,00</b>
Polianska village TC	0,03	0,02	<b>0,05</b>	0,20	0,01	0,02	0,04	<b>0,27</b>	<b>0,00</b>
Rahivska city TC	0,00	0,19	<b>0,19</b>	0,54	0,10	0,02	0,15	<b>0,81</b>	<b>0,10</b>
Svaliavska city TC	0,09	0,16	<b>0,24</b>	0,19	0,32	0,05	0,09	<b>0,65</b>	<b>0,10</b>
Serednianska town TC	0,20	0,00	<b>0,20</b>	0,08	0,57	0,06	0,02	<b>0,73</b>	<b>0,00</b>
Synevyrska village TC	0,00	0,00	<b>0,00</b>	0,92	0,00	0,00	0,02	<b>0,94</b>	<b>0,00</b>
Solotvynska town TC	0,07	0,16	<b>0,24</b>	0,15	0,02	0,08	0,10	<b>0,34</b>	<b>0,20</b>
Stavnenska village TC	0,16	0,00	<b>0,16</b>	0,37	0,28	0,01	0,01	<b>0,67</b>	<b>0,00</b>
Siurtivska village TC	0,19	0,08	<b>0,26</b>	0,00	0,83	0,05	0,00	<b>0,88</b>	<b>0,30</b>
Teresvianska town TC	0,17	0,14	<b>0,32</b>	0,08	0,44	0,04	0,03	<b>0,59</b>	<b>0,00</b>
Turieremetivska village TC	0,15	0,00	<b>0,15</b>	0,22	0,31	0,03	0,05	<b>0,61</b>	<b>0,00</b>
Tiachivska city TC	0,07	0,13	<b>0,20</b>	0,05	0,45	0,06	0,02	<b>0,59</b>	<b>0,10</b>

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Territorial community (TC)	Population sensitivity to summer heatwaves	Population sensitivity to floods	Social influence	Forests sensitivity to drought	Summer tourism sensitivity to summer temperatures	Energy demand sensitivity to heat	Energy demand sensitivity to frost	Economic influence	Cultural influence
Uglianska village TC	0,06	0,00	<b>0,06</b>	0,23	0,31	0,02	0,03	<b>0,59</b>	<b>0,00</b>
Uzhhorodska city TC	0,08	1,01	<b>1,08</b>	0,00	0,42	1,00	0,03	<b>1,45</b>	<b>0,80</b>
Ust-Chornianska town TC	0,00	0,00	<b>0,00</b>	0,91	0,02	0,00	0,02	<b>0,94</b>	<b>0,00</b>
Holmkivska village TC	0,27	0,11	<b>0,38</b>	0,00	0,90	0,09	0,00	<b>0,99</b>	<b>0,00</b>
Khustska city TC	0,08	0,51	<b>0,58</b>	0,07	0,44	0,40	0,12	<b>1,02</b>	<b>0,60</b>
Chynadiivska town TC	0,11	0,08	<b>0,19</b>	0,19	0,24	0,03	0,04	<b>0,49</b>	<b>0,30</b>
Chopska city TC	0,21	0,13	<b>0,34</b>	0,00	0,75	0,08	0,00	<b>0,84</b>	<b>0,00</b>
Yasinianska town TC	0,02	0,00	<b>0,02</b>	0,93	0,01	0,00	0,14	<b>1,08</b>	<b>0,00</b>

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Table 5.

**Indicators of adaptive capacity of the territory in the context of territorial communities of Zakarpatska Oblast**

<b>Territorial community (TC)</b>	<b>Specific weight of expenditures on development measures in local budgets</b>	<b>Percentage of financed costs for development measures in local budgets</b>	<b>Capacity (surplus) of local budgets</b>	<b>Share of the population with higher education</b>	<b>The number of places in tourist facilities</b>	<b>Population sensitive to summer heat</b>	<b>Connection to the public water supply</b>	<b>Connection to the sewage network with treatment facilities</b>	<b>High-speed Internet access</b>	<b>Public participation</b>	<b>Providing of services to the population</b>	<b>Age dependency</b>	<b>Transport accessibility</b>	<b>Adaptive capacity</b>
Baranynska village TC	0,93	0,05	0,77	0,65	0,72	0,25	0,59	0,92	0,00	0,16	0,50	0,16	0,04	<b>3,29</b>
Bativska town TC	0,88	0,31	0,44	0,61	0,98	0,27	0,84	0,91	0,00	0,67	0,81	0,17	0,18	<b>3,82</b>
Bedevlianska village TC	1,00	1,00	0,65	0,61	0,99	0,34	1,00	1,00	0,30	0,84	0,87	0,22	0,74	<b>5,06</b>
Berehivska city TC	0,89	0,45	0,55	0,45	0,71	0,26	0,48	0,49	0,08	0,34	0,87	0,17	0,32	<b>2,82</b>
Bilkivska village TC	0,99	0,79	0,64	0,61	0,99	0,64	1,00	1,00	0,15	1,00	0,79	0,50	0,43	<b>5,19</b>
Bohdanska village TC	0,95	0,37	0,74	0,61	0,98	0,30	1,00	1,00	0,00	0,54	0,90	0,19	1,00	<b>5,08</b>
Bushtynska town TC	0,84	0,55	0,54	0,61	0,92	0,36	1,00	1,00	0,10	0,72	0,93	0,24	0,66	<b>4,77</b>
Velykobereznianska town TC	0,73	0,14	0,55	0,59	0,98	0,32	0,70	0,74	0,00	0,51	0,67	0,21	0,20	<b>3,50</b>
Velykoberezka village TC	0,90	0,22	0,40	0,57	0,98	0,55	1,00	1,00	0,00	0,87	0,78	0,41	0,33	<b>4,58</b>
Velykobyihanska village TC	0,89	0,85	0,32	0,61	0,00	0,12	1,00	1,00	0,20	0,51	0,77	0,07	0,28	<b>3,79</b>
Velykobyichkivska town TC	0,94	0,39	0,71	0,61	0,91	0,26	0,96	0,98	0,10	0,99	0,90	0,16	0,89	<b>5,30</b>
Velykodobronska village TC	0,96	0,26	0,41	0,61	0,97	0,10	1,00	1,00	0,15	0,26	0,93	0,06	0,14	<b>3,49</b>
Velykoluchkivska village TC	0,93	0,39	0,00	0,61	0,98	0,25	1,00	1,00	0,00	0,54	0,81	0,16	0,18	<b>3,49</b>
Verhniokoropetska village TC	0,73	0,02	0,44	0,26	0,96	0,33	1,00	1,00	0,20	0,00	0,29	0,21	0,26	<b>3,17</b>
Vylotska town TC	0,96	0,39	0,67	0,61	0,98	0,07	1,00	1,00	0,15	0,54	0,79	0,04	0,42	<b>4,28</b>
Vynohradivska city TC	0,78	0,29	0,58	0,45	0,85	0,13	0,67	0,85	0,00	0,54	0,95	0,08	0,46	<b>3,63</b>
Vyshkivska town TC	0,77	0,71	0,59	0,78	0,55	0,12	0,92	0,97	0,24	0,42	0,91	0,07	0,64	<b>4,40</b>

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Territorial community (TC)	Specific weight of expenditures on development measures in local budgets	Percentage of financed costs for development measures in local budgets	Capacity (surplus) of local budgets	Share of the population with higher education	The number of places in tourist facilities	Population sensitive to summer heat	Connection to the public water supply	Connection to the sewage network with treatment facilities	High-speed Internet access	Public participation	Providing of services to the population	Age dependency	Transport accessibility	Adaptive capacity
Vilkhovetska village TC	0,90	0,46	0,67	0,78	1,00	0,50	1,00	1,00	0,17	0,70	0,89	0,36	0,74	<b>5,25</b>
Volovetska town TC	0,86	0,12	0,59	0,68	0,69	0,40	0,34	0,80	0,10	0,34	0,65	0,27	0,40	<b>3,44</b>
Horinchivska village TC	0,87	0,11	0,60	0,61	0,98	0,25	0,99	0,99	0,15	0,34	0,79	0,16	0,56	<b>4,25</b>
Horondivska village TC	0,92	0,45	0,02	0,61	0,99	0,19	1,00	1,00	0,00	0,55	0,94	0,11	0,21	<b>3,50</b>
Dovzhanska village TC	0,92	0,54	0,57	0,50	0,94	0,29	1,00	1,00	0,02	0,13	0,96	0,18	0,48	<b>3,87</b>
Drahivska village TC	0,66	0,78	0,49	0,61	0,98	0,26	1,00	1,00	0,15	0,54	0,89	0,17	0,62	<b>4,43</b>
Dubivska town TC	0,67	0,12	0,53	0,66	0,98	0,24	0,93	1,00	0,00	0,33	0,98	0,15	0,77	<b>4,37</b>
Dubrynytsko-Malobereznianska village TC	0,94	0,80	0,55	0,61	1,00	0,42	1,00	1,00	0,28	0,34	0,48	0,29	0,15	<b>3,95</b>
Zhdeniivska town TC	0,76	0,04	0,84	0,78	0,87	0,37	0,98	0,98	0,40	0,46	0,00	0,25	0,33	<b>4,61</b>
Zarichanska village TC	0,84	0,81	0,49	0,75	0,99	0,21	1,00	1,00	0,05	0,30	0,86	0,13	0,39	<b>4,05</b>
Ivanovetska village TC	0,96	0,29	0,79	0,86	0,99	0,12	0,95	1,00	0,00	0,43	0,53	0,07	0,19	<b>4,28</b>
Irshavska city TC	0,93	0,55	0,52	0,71	0,77	0,27	0,81	0,82	0,00	0,80	0,75	0,17	0,39	<b>4,22</b>
Kamianska village TC	0,68	0,30	0,76	0,66	0,99	0,05	1,00	1,00	0,00	0,80	0,61	0,03	0,37	<b>4,62</b>
Keretskivska village TC	0,87	0,27	0,64	0,79	0,98	0,05	0,83	1,00	0,10	0,72	0,97	0,03	0,43	<b>4,44</b>
Kolochavska village TC	0,95	0,00	0,94	0,82	0,98	0,07	1,00	1,00	1,00	0,28	0,72	0,04	0,67	<b>4,74</b>
Kolchynska town TC	0,37	0,09	0,18	0,75	0,88	0,23	0,49	0,90	0,00	0,59	0,60	0,15	0,23	<b>3,29</b>
Korolivska town TC	1,00	0,75	1,00	0,93	0,98	0,32	0,68	0,97	0,72	0,80	0,89	0,21	0,49	<b>5,08</b>
Kosonska village TC	0,86	0,04	0,00	0,85	0,95	0,25	1,00	1,00	0,00	0,87	0,74	0,16	0,26	<b>4,14</b>

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<b>Territorial community (TC)</b>	<b>Specific weight of expenditures on development measures in local budgets</b>	<b>Percentage of financed costs for development measures in local budgets</b>	<b>Capacity (surplus) of local budgets</b>	<b>Share of the population with higher education</b>	<b>The number of places in tourist facilities</b>	<b>Population sensitive to summer heat</b>	<b>Connection to the public water supply</b>	<b>Connection to the sewage network with treatment facilities</b>	<b>High-speed Internet access</b>	<b>Public participation</b>	<b>Providing of services to the population</b>	<b>Age dependency</b>	<b>Transport accessibility</b>	<b>Adaptive capacity</b>
Kostrynska village TC	0,98	0,01	0,68	0,61	0,70	0,40	1,00	1,00	0,00	0,54	0,31	0,27	0,25	<b>4,35</b>
Mizhhirska town TC	0,94	0,50	0,94	0,64	0,84	0,24	0,73	0,73	0,03	0,43	0,63	0,15	0,55	<b>4,16</b>
Mukachivska city TC	0,00	0,11	0,48	0,45	0,64	0,06	0,18	0,31	0,06	0,80	0,99	0,03	0,23	<b>2,49</b>
Nelipynska village TC	0,92	0,33	0,56	0,61	0,99	0,72	0,62	1,00	0,00	0,38	0,80	0,59	0,33	<b>4,09</b>
Neresnytska village TC	0,97	0,45	0,39	0,78	0,98	0,14	1,00	1,00	0,63	0,84	0,93	0,09	0,74	<b>4,83</b>
Nyzhniovoritska village TC	0,85	0,05	0,59	0,80	0,97	0,21	1,00	1,00	0,43	0,43	0,39	0,13	0,37	<b>4,32</b>
Onokivska village TC	0,85	0,84	0,43	0,00	0,89	0,36	0,84	0,88	0,15	0,26	0,70	0,24	0,03	<b>2,68</b>
Perechynska city TC	0,35	0,32	0,49	0,45	0,87	0,08	0,72	0,72	0,00	0,39	0,80	0,05	0,11	<b>2,93</b>
Pyiterfolvivska village TC	0,99	0,55	0,29	0,86	0,98	0,00	1,00	1,00	0,00	0,64	0,67	0,00	0,47	<b>4,26</b>
Pylypetska village TC	0,56	0,43	0,62	0,61	0,65	1,00	1,00	1,00	0,10	0,54	0,24	1,00	0,47	<b>5,24</b>
Polianska village TC	0,97	0,57	0,69	0,33	0,02	0,10	0,64	0,64	0,40	0,41	0,64	0,06	0,30	<b>3,06</b>
Rahivska city TC	0,84	0,35	0,53	0,45	0,83	0,00	0,70	0,70	0,00	0,27	0,99	0,00	0,94	<b>3,61</b>
Svaliavska city TC	0,90	0,58	0,68	0,45	0,96	0,27	0,58	0,87	0,00	0,52	0,83	0,17	0,32	<b>3,58</b>
Serednianska town TC	0,42	0,08	0,78	0,61	0,92	0,33	0,83	1,00	0,00	0,54	0,57	0,22	0,11	<b>4,10</b>
Synevyrska village TC	0,70	0,08	0,42	0,80	0,93	0,18	1,00	1,00	0,00	0,51	0,89	0,11	0,60	<b>4,44</b>
Solotvynska town TC	0,64	0,08	0,63	0,61	0,04	0,20	0,16	0,49	0,00	0,54	0,97	0,12	0,84	<b>3,39</b>
Stavnenska village TC	0,91	0,50	0,58	0,20	0,91	0,51	1,00	1,00	0,00	0,14	0,32	0,36	0,31	<b>3,59</b>
Siurtivska village TC	0,95	0,07	0,44	0,61	1,00	0,23	0,94	1,00	0,15	0,61	0,59	0,14	0,08	<b>3,82</b>

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Territorial community (TC)	Specific weight of expenditures on development measures in local budgets	Percentage of financed costs for development measures in local budgets	Capacity (surplus) of local budgets	Share of the population with higher education	The number of places in tourist facilities	Population sensitive to summer heat	Connection to the public water supply	Connection to the sewage network with treatment facilities	High-speed Internet access	Public participation	Providing of services to the population	Age dependency	Transport accessibility	Adaptive capacity
Teresvianska town TC	0,64	0,20	0,63	0,61	0,99	0,39	1,00	1,00	0,00	0,74	1,00	0,27	0,76	<b>5,00</b>
Turieremetivska village TC	0,99	0,93	0,54	0,62	0,78	0,37	1,00	1,00	0,15	0,32	0,64	0,25	0,15	<b>3,89</b>
Tiachivska city TC	0,41	0,27	0,47	0,45	0,91	0,13	0,70	0,67	0,48	0,95	0,91	0,08	0,71	<b>4,03</b>
Uglianska village TC	0,97	0,67	0,50	0,72	0,98	0,19	1,00	1,00	0,20	0,59	0,82	0,12	0,68	<b>4,61</b>
Uzhhorodska city TC	0,55	0,23	0,54	0,45	0,42	0,08	0,00	0,00	0,08	0,84	0,99	0,04	0,00	<b>1,88</b>
Ust-Chornianska town TC	0,97	0,51	0,89	0,83	0,93	0,24	1,00	1,00	0,80	0,51	0,63	0,15	0,77	<b>5,15</b>
Holmkivska village TC	0,54	0,60	0,58	0,22	0,99	0,30	0,14	0,82	0,15	0,51	0,90	0,19	0,04	<b>2,50</b>
Khustska city TC	0,69	0,27	0,66	0,20	0,76	0,13	0,70	0,69	0,08	0,82	0,95	0,08	0,54	<b>3,68</b>
Chynadiivska town TC	0,95	0,76	0,59	1,00	0,58	0,27	0,90	0,87	0,14	0,26	0,65	0,17	0,25	<b>4,05</b>
Chopska city TC	0,44	0,70	0,36	0,45	0,95	0,26	0,69	0,72	0,08	0,54	0,85	0,17	0,13	<b>3,06</b>
Yasinianska town TC	0,85	0,19	0,74	0,79	0,20	0,41	1,00	1,00	0,20	0,87	0,98	0,28	0,96	<b>5,64</b>



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Table 6.

**Vulnerability of the territory to climate change in the context of territorial communities of Zakarpatska Oblast**

Territorial community (TC)	Physical impact	Environmental impact	Social impact	Economic impact	Cultural impact	Cumulative impact	Adaptive capacity	Vulnerability
Baranynska village TC	0,29	3,17	0,21	0,65	0,00	1,43	3,29	<b>0,08</b>
Bativska town TC	1,51	3,02	0,31	0,84	0,00	1,95	3,82	<b>0,23</b>
Bedevlianska village TC	0,88	2,66	0,20	0,47	0,00	1,25	5,06	<b>0,10</b>
Berehivska city TC	1,19	3,54	0,57	1,03	0,90	3,36	2,82	<b>0,17</b>
Bilkivska village TC	0,57	3,00	0,48	0,70	0,30	2,02	5,19	<b>0,29</b>
Bohdanska village TC	2,28	3,30	0,01	1,08	0,00	2,19	5,08	<b>0,47</b>
Bushtynska town TC	0,30	2,05	0,25	0,65	0,00	0,99	4,77	<b>0,00</b>
Velykobereznianska town TC	0,58	2,22	0,24	0,73	0,00	1,20	3,50	<b>0,04</b>
Velykoberezka village TC	0,33	3,01	0,46	0,83	0,10	1,83	4,58	<b>0,24</b>
Velykobyihanska village TC	0,71	3,44	0,16	0,04	0,00	1,19	3,79	<b>0,05</b>
Velykobychkivska town TC	3,39	3,01	0,14	0,77	0,00	2,30	5,30	<b>0,54</b>
Velykodobronska village TC	1,82	2,66	0,18	0,82	0,00	1,75	3,49	<b>0,15</b>
Velykoluchkivska village TC	0,69	2,95	0,33	0,84	0,00	1,69	3,49	<b>0,14</b>
Verhniokoropetska village TC	0,01	2,86	0,21	0,66	0,00	1,22	3,17	<b>0,04</b>
Vylotska town TC	1,11	2,89	0,16	0,85	0,30	1,95	4,28	<b>0,19</b>
Vynohradivska city TC	0,56	2,88	0,53	0,97	1,00	2,90	3,63	<b>0,19</b>
Vyshkivska town TC	1,46	2,84	0,20	0,48	0,00	1,51	4,40	<b>0,16</b>
Vilkhovetska village TC	0,99	2,99	0,26	0,52	0,00	1,51	5,25	<b>0,21</b>
Volovetska town TC	1,44	2,73	0,02	0,54	0,00	1,33	3,44	<b>0,06</b>
Horinchivska village TC	2,35	2,95	0,16	0,59	0,00	1,86	4,25	<b>0,25</b>
Horondivska village TC	0,17	3,01	0,17	0,83	0,00	1,41	3,50	<b>0,08</b>
Dovzhanska village TC	1,25	2,36	0,09	0,60	0,00	1,22	3,87	<b>0,06</b>
Drahivska village TC	1,08	3,00	0,07	0,59	0,00	1,42	4,43	<b>0,13</b>
Dubivska town TC	2,99	3,19	0,22	0,66	0,00	2,25	4,37	<b>0,38</b>
Dubrynytsko-Malobereznianska village TC	1,82	2,65	0,24	0,71	0,00	1,73	3,95	<b>0,19</b>

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Territorial community (TC)	Physical impact	Environmental impact	Social impact	Economic impact	Cultural impact	Cumulative impact	Adaptive capacity	Vulnerability
Zhdeniivska town TC	0,66	2,64	0,07	0,50	0,00	1,08	4,61	<b>0,03</b>
Zarichanska village TC	0,98	3,01	0,20	0,68	0,00	1,58	4,05	<b>0,16</b>
Ivanovetska village TC	0,18	2,98	0,10	0,68	0,00	1,24	4,28	<b>0,07</b>
Irshavska city TC	0,25	2,61	0,13	0,71	0,00	1,14	4,22	<b>0,04</b>
Kamianska village TC	0,14	2,97	0,04	0,71	0,00	1,18	4,62	<b>0,06</b>
Keretskivska village TC	1,44	2,52	0,01	0,58	0,00	1,26	4,44	<b>0,08</b>
Kolochavska village TC	1,73	2,19	0,00	0,58	0,00	1,20	4,74	<b>0,07</b>
Kolchynska town TC	0,44	2,92	0,14	0,60	0,00	1,27	3,29	<b>0,05</b>
Korolivska town TC	0,99	2,74	0,35	0,81	0,10	1,79	5,08	<b>0,27</b>
Kosonska village TC	1,10	3,18	0,27	0,82	0,00	1,85	4,14	<b>0,24</b>
Kostrynska village TC	1,77	2,20	0,14	0,59	0,00	1,34	4,35	<b>0,11</b>
Mizhhirska town TC	3,03	2,69	0,12	0,76	0,00	2,02	4,16	<b>0,29</b>
Mukachivska city TC	0,34	2,92	0,85	1,12	0,60	2,86	2,49	<b>0,09</b>
Nelipynska village TC	0,57	2,74	0,16	0,48	0,00	1,15	4,09	<b>0,04</b>
Neresnytska village TC	2,09	2,78	0,15	0,73	0,10	1,90	4,83	<b>0,29</b>
Nyzhniovoritska village TC	1,47	2,10	0,03	0,42	0,00	1,00	4,32	<b>0,00</b>
Onokivska village TC	0,61	3,33	0,30	0,75	0,00	1,75	2,68	<b>0,07</b>
Perechynska city TC	1,01	2,82	0,15	0,68	0,00	1,45	2,93	<b>0,06</b>
Pyiterfolvivska village TC	1,71	2,68	0,17	0,80	0,00	1,70	4,26	<b>0,21</b>
Pylypetska village TC	1,54	2,28	0,09	0,46	0,00	1,17	5,24	<b>0,07</b>
Polianska village TC	1,14	2,60	0,05	0,27	0,00	1,02	3,06	<b>0,00</b>
Rahivska city TC	2,08	3,59	0,19	0,81	0,10	2,33	3,61	<b>0,26</b>
Svaliavska city TC	0,96	2,47	0,24	0,65	0,10	1,46	3,58	<b>0,08</b>
Serednianska town TC	0,36	2,83	0,20	0,73	0,00	1,35	4,10	<b>0,10</b>
Synevyrska village TC	1,97	2,23	0,00	0,94	0,00	1,53	4,44	<b>0,17</b>
Solotvynska town TC	0,62	2,88	0,24	0,34	0,20	1,41	3,39	<b>0,04</b>
Stavvenska village TC	1,60	1,46	0,16	0,67	0,00	1,06	3,59	<b>0,01</b>
Siurtivska village TC	1,23	3,18	0,26	0,88	0,30	2,22	3,82	<b>0,22</b>

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Territorial community (TC)	Physical impact	Environmental impact	Social impact	Economic impact	Cultural impact	Cumulative impact	Adaptive capacity	Vulnerability
Teresvianska town TC	0,77	3,09	0,32	0,59	0,00	1,59	5,00	<b>0,23</b>
Turieremetivska village TC	1,58	2,47	0,15	0,61	0,00	1,42	3,89	<b>0,11</b>
Tiachivska city TC	1,22	2,48	0,20	0,59	0,10	1,45	4,03	<b>0,09</b>
Uglianska village TC	0,65	2,36	0,06	0,59	0,00	1,01	4,61	<b>0,01</b>
Uzhhorodska city TC	0,64	3,83	1,08	1,45	0,80	3,98	1,88	<b>0,00</b>
Ust-Chornianska town TC	2,86	3,29	0,00	0,94	0,00	2,26	5,15	<b>0,50</b>
Holmkivska village TC	0,77	3,51	0,38	0,99	0,00	2,12	2,50	<b>0,09</b>
Khustska city TC	1,14	2,87	0,58	1,02	0,60	2,76	3,68	<b>0,26</b>
Chynadiivska town TC	0,76	2,64	0,19	0,49	0,30	1,51	4,05	<b>0,06</b>
Chopska city TC	2,01	2,74	0,34	0,84	0,00	2,01	3,06	<b>0,15</b>
Yasinianska town TC	2,08	2,98	0,02	1,08	0,00	2,00	5,64	<b>0,46</b>