Green B-LEAF | Interreg Euro-MED | Co-funded by the European Union

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# INTEGRATED CLIMATE DATA AND VULNERABILITY MAPPING GUIDE

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## Abbrevations

**API**: Application Processing Interface.

**ARPA**: American Rescue Plan Act.

**CECI**: Citizen Involvement in Circular Economy Initiatives.

**CELAC**: Community of Latin American and Caribbean States.

**CEP**: Citizen Engagement Programme.

**CORINE**: Coordination of Information on the Environment (Land Cover datasets).

**CRS**: Coordinate Reference System.

**CRVA**: Climate Risk and Vulnerability Assessment (toolkit).

**DEMOTEC**: Engaging Citizens in Decision Making.

**DRR**: Disaster Risk Reduction.

**EEA**: European Environment Agency.

**e-ID**: Electronic Identification.

**EMPATIA**: Enabling Multichannel Participation Through ICT Adaptations.

**EmPaci**: Empowering Participatory Budgeting in the Baltic Region.

**EWS**: Early Warning Systems.

**FOSS**: Free and Open Source.

**GaYA**: Government and Youth in the Alps.

**GBT**: Green Budget Tagging.

**GIS**: Geographic Information Systems.

**GPB**: Green Participatory Budgeting.

**GPKG**: GeoPackage.

**Green B-LEAF**: Green Participatory Budgeting for Local Environmental Action and Sustainable Future.

**HCMR**: Hellenic Center for Marine Research.

**ICT**: Information and Communication Technology.

**IPCC**: Intergovernmental Panel on Climate Change.

**MC-YOU**: Minecrafting Resilient Cities: Innovative YOUth-led Policy process for sustainable

Europe.

**MoU**: Memorandum of Understanding.

**NBS**: Nature-Based Solutions.

**NEB**: New European Bauhaus.

**NEBA**: Supporting the integration of New European Bauhaus values and principles in the regional planning process.

**NUTS**: Nomenclature of Territorial Units for Statistics (statistical units).

**OSM**: OpenStreetMap.

**PB**: Participatory Budgeting.

**PESTLE**: Political, Economical, Social, Technological, Legal, Environmental (analysis).

**PET**: Physiological Equivalent Temperature.

**PoC**: Proof of Concept.

**SHP**: Shapefile.

**SPM**: Summary for Policymakers.

**SWOT**: Strength, Weakness, Opportunities, Threats (analysis).

**TOMORROW**: Cities of Tomorrow.

**UGA**: Urban Governance Atlas.

**UHI**: Urban Heat Island.

**WFS**: Web Feature Service.

**WP1**: Work Package 1.

# Executive summary

Based on the insights from previous tasks (Joint Methodology for climate data mapping and vulnerability assessment, Data collection and review of existing best practices and databases and Community workshops), Center for Climate Change, Promo Idea, Municipality of Strumica and Municipality of Faro coordinated the development of the final document: “Integrated Climate Data and Vulnerability Mapping Guide". This deliverable consolidates the findings from data reviews, community workshops, and vulnerability assessments, providing synthesized guidelines for subsequent project phases. The Guide features climate and vulnerability maps that will form a joint database with the most common climate-related threats, including data from each community. A special section of the Guide will contain data of the best identified practices in the field of PB and GPB collected in the process of data collection and review of existing best practices.

This is a comprehensive guide combining data from climate mapping, best practice review, and community-driven vulnerability assessment. It will provide a synthesized overview of best practices, and outcomes from previous projects that can be adapted and applied within the Green B-LEAF project.

# 1. Introduction

## 1.1 Project Context and the Green B-LEAF Mission

The Green B-LEAF (Green Participatory Budgeting for Local Environmental Action and sustainable Future) project is a transnational initiative co-funded by the European Union through the Interreg Euro-MED Programme. The project is driven by a critical mission: promoting climate change adaptation, disaster risk prevention, and enhanced resilience within rural Mediterranean communities. By integrating ecosystem-based approaches with innovative governance models, Green B-LEAF aims to equip local public authorities and residents with the necessary tools to navigate the "green transition" effectively.

Rural communities across the Mediterranean region face a suite of shared, escalating challenges. Extreme climatic events, such as intense heatwaves, heavy rainfall, flash flooding, and coastal erosion, are becoming more frequent and severe. These threats are often compounded by historical urban development patterns, including urban sprawl and soil sealing, which reduce the natural capacity of these territories to absorb climate shocks. The Integrated Climate Data and Vulnerability Mapping Guide (the “Guide”) is established as the technical foundation to address these vulnerabilities.

## 1.2 Purpose and Scope of the Guide

The Integrated Climate Data and Vulnerability Mapping Guide serves as a comprehensive methodological and technical cornerstone for the Green B-LEAF project. Its core purpose is to provide a synthesized overview of best practices and localized climate data that can be adapted and scaled across diverse rural contexts. This guide is not merely a technical report; it is a strategic tool designed to bridge the gap between high-level scientific data and hyper-local community needs.

Specifically, the guide:

- Consolidates findings from extensive reviews of existing climate databases, previous projects, and successful regional practices.
- Integrates community-driven vulnerability assessments derived from direct stakeholder and citizen engagement.
- Provides a joint database of climate-related threats, featuring specialized climate and vulnerability maps for each participating community.

## 1.3 A New Approach: Data-Driven and Community-Led

What sets the Green B-LEAF approach apart is its commitment to community ownership of climate adaptation. Traditional adaptation strategies often fail because they are

perceived as top-down mandates that lack local relevance. This guide addresses this by combining rigid scientific data mapping with participatory workshops, ensuring that the identified vulnerabilities reflect the lived experiences of the residents.

Furthermore, the methodology is explicitly aligned with the New European Bauhaus (NEB) principles. By emphasizing sustainability, inclusiveness, and aesthetics, the guide ensures that climate resilience measures contribute to the overall quality of life and cultural identity of rural areas. This holistic framework allows local authorities to move beyond technical solutions toward "real-life" adaptation strategies.

## 1.4 Implementation and Strategic Integration

The outputs of this guide provide the essential "groundwork" for the subsequent phases of the project. The vulnerability maps and threat databases contained herein will directly inform the development of the Green B-LEAF Participatory Budgeting Methodology and the Green Budget Tagging (GBT) toolkit. By identifying precisely where a community is most at risk, local authorities can use these mappings to prioritize data-driven budgeting decisions, ensuring that public funds are allocated to green projects that will have the greatest impact on local resilience.

Ultimately, this guide serves as the first step in establishing a Transnational Network of Rural Communities, fostering a culture of knowledge exchange and collaborative action to face the shared climate crisis of the Mediterranean region.

Climate change is increasing the frequency and intensity of extreme weather events such as floods, heatwaves, and droughts. Understanding where risks are highest and which populations or systems are most vulnerable is essential for effective planning.

Guide's Objectives:

- Provide a standardized methodology.
- Support spatial planning and policymaking.
- Enable prioritization of adaptation measures.

Guide's Target Users:

- Local governments
- Urban planners
- Environmental agencies
- NGOs and development partners

# 2. Conceptual Framework

## 2.1 The IPCC Foundation: Risk, Vulnerability, and Adaptation

The conceptual foundation of this Guide is rooted in the global standards established by the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report. This framework is aligned with the IPCC's assessment of impacts, adaptation, and vulnerability, which examines the interplay between ecosystems, biodiversity, and human communities. We utilize the IPCC's framing of "Point of Departure" concepts to ensure that our local mapping is scientifically rigorous. Specifically, this guide adopts the IPCC's multi-dimensional view of risk, which considers the vulnerabilities and capacities of both the natural world and human societies to adapt to a changing climate. For Mediterranean rural communities, this means looking beyond simple weather data to assess the risks to terrestrial and freshwater ecosystems, as well as the unique threats faced by coastal settlements and the global water cycle.

## 2.2 The Green B-LEAF Nexus: Data-Driven Participation

The core innovation of the Green B-LEAF framework is the integration of high-level climate science with hyper-local participatory governance. While traditional models often separate technical data from social reality, our framework operates on the "Nexus" principle:

- Scientific Mapping: Utilizing existing climate databases and regional fact sheets to identify macro-trends such as heatwaves and flash flooding.
- Community-Led Insights: Supplementing scientific data with community-driven vulnerability assessments. This ensures that the mapping reflects the "real-life" experiences of residents who navigate these territories daily.

This approach transforms the community from passive recipients of climate data into proactive participants in leading their own green transformation.

## 2.3 Integrating New European Bauhaus (NEB) Principles

A defining element of this conceptual framework is its explicit alignment with the New European Bauhaus (NEB). Rather than viewing climate adaptation as a purely technical or engineering challenge, our framework incorporates three core NEB values:

1. Sustainability: Promoting nature-based solutions and ecosystem-based approaches to disaster risk prevention.
2. Inclusiveness: Empowering marginalized and underrepresented groups to have an equal voice in identifying local vulnerabilities.

3. Aesthetics: Integrating design thinking to ensure that green infrastructure and climate interventions create beautiful and inspiring public spaces.

Following this approach, the Guide ensures that climate resilience measures also contribute to the social cohesion and cultural identity of Mediterranean rural areas.

## 2.4 Financial Resilience through Green Budget Tagging (GBT)

The final pillar of our framework is the link between mapping and money. The data generated through this guide provides the evidence base for Green Budget Tagging (GBT). This concept involves identifying and categorizing municipal budgetary allocations that contribute to environmental and climate objectives.

By conceptually linking vulnerability maps to the Green B-LEAF Participatory Budgeting Methodology, we enable local authorities to move from "planning" to "action". This ensures that public funds are not just spent but are strategically invested in projects that directly mitigate the specific climate threats identified in the mapping phase. This integrated model provides a scalable, transnational framework for rural communities to achieve a sustainable and resilient future.

# 3. Methodological Approach

The methodological approach for the Integrated Climate Risk and Vulnerability Mapping Guide follows a rigorous, five-step process designed to bridge the gap between high-level scientific assessments and the lived realities of Mediterranean rural communities. This framework ensures that our data-driven planning is both scientifically sound and community-owned.

## Step 1: Scoping

The initial phase involves defining the geographic and thematic boundaries of the assessment. For this guide, the geographic area is focused on rural Mediterranean territories represented by our consortium, the municipalities in Italy, Portugal, Croatia, Bulgaria, Greece, Spain, Slovenia, and North Macedonia. Key sectors targeted include agriculture, tourism, and local infrastructure, which are disproportionately impacted by climate shifts. The primary objective of this step is to establish the criteria and tools needed to foster data-driven budgeting decisions that align with the specific needs of these communities.

## Step 2: Hazard Analysis

In this step, we identify and analyze the relevant climatic hazards threatening the Mediterranean region. Drawing from historical data and projected climate models, we focus on identifying threats such as severe heatwaves, heavy rainfall, flash flooding, droughts, and coastal erosion. This analysis utilizes a joint methodology to collect and review existing data from regional fact sheets, previous Interreg projects, and global databases to avoid duplication and build upon proven findings.

## Step 3: Exposure Analysis

Exposure analysis involves mapping the population and physical assets located in hazard-prone areas. This step assesses the potential impacts on human settlements, terrestrial and freshwater ecosystems, and key infrastructure. By utilizing specialized climate maps, we pinpoint exactly which residential zones or agricultural lands are situated in high-risk areas, such as floodplains or zones prone to soil sealing.

## Step 4: Vulnerability Assessment

The vulnerability assessment moves beyond physical exposure to analyze the sensitivity and adaptive capacity of the community. This is a participatory phase where we select indicators based on both technical data and community workshops involving at least 20

stakeholders per community. We assess how well local systems—both natural and social—can adjust to climate shocks without losing their fundamental functions. This includes evaluating the capacity of local authorities to implement Nature-Based Solutions (NBS) and disaster risk prevention strategies.

## Step 5: Risk Calculation

The final step involves the synthesis of hazard, exposure, and vulnerability layers to calculate integrated risk levels. These layers are combined to form a joint database of climate-related threats, resulting in the final Integrated Climate Data and Vulnerability Mapping Guide. This integrated risk map serves as the evidentiary base for the Green Budget Tagging (GBT) toolkit, enabling municipalities to prioritize financial resources for projects that directly mitigate the most critical risks identified in the mapping process.

# 4. Climate Hazard Identification

The identification of climate hazards is the fundamental starting point for assessing risk and building resilience within the Green B-LEAF framework. This chapter defines the primary threats facing Mediterranean rural communities and outlines the data-driven approach used to monitor them. Rural Mediterranean territories are increasingly experiencing the adverse effects of climate change, characterized by extreme climatic events that are becoming more frequent and intense.

## 4.1 Definitions of Common Hazards

The following hazards represent the most significant threats to the safety, economy, and ecosystems of the project's partner municipalities:

- Floods: Defined as the temporary overflowing of water onto land that is normally dry. In the Mediterranean context, these often manifest as flash floods triggered by heavy, concentrated rainfall, which can be exacerbated by soil sealing and inadequate urban drainage.
- Heatwaves: Prolonged periods of abnormally hot weather. These events are becoming more severe in the region, leading to "heat island" effects in settled areas and posing significant risks to public health and the agricultural sector.
- Droughts: Extended periods of deficient rainfall that result in water shortages. Droughts in this region directly threaten freshwater ecosystems and the viability of rural livelihoods such as farming and sustainable tourism.
- Landslides: The movement of a mass of rock, debris, or earth down a slope. While often triggered by heavy rainfall or flooding, the risk of landslides is increased by urban sprawl and the loss of natural vegetation cover.

## 4.2 Hazard Profiles for Partner Municipalities

The Green B-LEAF project brings together a diverse group of municipalities, each facing localized manifestations of these broader climate hazards:

- Vodnjan (Croatia): Faces a critical combination of heat islands, droughts, and flash floods, which threaten the town's historic urban center and agricultural stability.
- Sandanski (Bulgaria): Primarily deals with severe heatwaves that significantly impact the local tourist season and public health.
- Faro (Portugal): Vulnerable to a variety of urban and coastal-related climate challenges, requiring focused mapping of coastal erosion and flood risks.
- Strumica (North Macedonia): Identified as a region requiring robust disaster risk

prevention due to shifting precipitation patterns and environmental vulnerabilities.

- Quart de Poblet (Spain): Situated in the Valencia metropolitan area, this municipality prioritizes mapping for Mediterranean climate scenarios including flash flooding and prolonged dry spells.
- Pilea-Hortiatis (Greece): Experiences challenges in balancing urban growth with environmental sustainability, focusing on hazards that threaten its diverse urban-suburban-rural landscape.
- Beltinci (Slovenia): Located in the flat Prekmurje area, this municipality focuses on green investments to mitigate hazards affecting its local agricultural and natural ecosystems.
- Campobasso (Italy): As part of the Molise region, it addresses general Mediterranean rural vulnerabilities, specifically those related to soil sealing and extreme weather events.

## 4.3 Data Sources for Hazard Mapping

To ensure the accuracy of the Integrated Climate Data and Vulnerability Mapping Guide, we utilize a multi-layered data collection strategy:

1. Meteorological Data: Historical and real-time records from local weather stations are used to analyze trends in temperature and precipitation to identify the frequency of heatwaves and heavy rain.
2. Satellite Data: Remote sensing technology provides critical information on land use, soil sealing, and vegetation health, allowing us to map exposure and exposure zones with high precision.
3. Climate Models: We utilize projected climate models to anticipate future hazards, ensuring that the Green Budget Tagging (GBT) and participatory budgeting decisions made today are resilient to long-term climate shifts.

By consolidating these data points into a joint database of climate-related threats, the guide provides a localized evidentiary base for every partner community.

# 5. Exposure Analysis

## 5.1 Defining Exposure in the Green B-LEAF Context

Exposure analysis is the critical second pillar of our risk assessment methodology. While Chapter 4 identified the "shocks" (hazards), Exposure Analysis identifies the "elements at risk" the people, assets, and ecosystems that are physically located in areas prone to these hazards. Within the Green B-LEAF project, this analysis is essential for creating data-driven decision-making frameworks that allow rural Mediterranean communities to prioritize investments where they are most needed.

## 5.2 Key Elements at Risk

To ensure a holistic view of community resilience, our exposure analysis focuses on four primary categories:

- Population Density: We map the spatial distribution of residents, with a specific focus on vulnerable and marginalized groups who may be disproportionately affected by climate shocks. By identifying high-density residential zones in hazard-prone areas—such as floodplains or urban "heat islands"—local authorities can better plan emergency responses and long-term adaptation.
- Critical Infrastructure: This includes the physical "backbone" of our municipalities, such as water cycles, energy grids, transport networks, and public buildings. For partners like Strumica, this involves assessing the exposure of new electric transport infrastructure to extreme weather. Protecting these assets is vital for maintaining municipal services during and after a climate event.
- Economic Zones: For rural Mediterranean territories, economic stability is often tied to the land. We analyze the exposure of agricultural lands, forestry, and tourism hubs. For example, in Sandanski, we map how severe heatwaves overlap with key tourist districts, while in Vodnjan, we examine the exposure of agricultural assets to prolonged droughts.
- Natural Ecosystems: Our approach recognizes that nature is both an asset and a defense. We map terrestrial and freshwater ecosystems, as well as biodiversity hotspots, to understand how climate change threatens the "ecosystem services" (like natural water filtration or cooling) that rural communities rely on.

## 5.3 Spatial Mapping and GIS Tools

The core technical engine of this chapter is the use of Geographic Information Systems (GIS). GIS tools allow us to move beyond static lists of assets and into dynamic spatial distribution mapping.

By utilizing specialized climate maps and satellite data, we create visual overlays where hazard layers (e.g., a flood zone) are superimposed onto exposure layers (e.g., a residential district or a critical bridge). This "joint database" of spatial data provides the evidentiary base required for Green Budget Tagging (GBT). It enables local public authorities to see exactly where their territory is "exposed," ensuring that the Green Participatory Budgeting process is grounded in geographic reality rather than just perception.

## 5.4 Integration with Community Input

While GIS provides the technical "where", our methodology integrates these maps with community workshops. Citizens and local stakeholders help validate these exposure maps by identifying "real-life" assets that may not be captured by satellite data alone, such as cultural heritage sites or local informal gathering spaces. This ensures that the exposure analysis remains inclusive and community-driven, in line with the New European Bauhaus principles.

# 6. Vulnerability Assessment

## 6.1 Defining Vulnerability in Rural Mediterranean Contexts

In the framework of the Green B-LEAF project, vulnerability is defined as the degree to which a system—whether an ecosystem or a human community—is susceptible to, and unable to cope with, the adverse effects of climate change. Following the IPCC Sixth Assessment Report standards, our vulnerability assessment focuses on the interplay between the sensitivity of a community and its ability to adapt. For the Mediterranean region, this means identifying how specific social, economic, and environmental factors amplify the risks posed by heatwaves, floods, and droughts.

## 6.2 Social Indicators: Assessing Community Sensitivity

The social dimension of vulnerability focuses on the characteristics of the population that influence their ability to respond to climate shocks.

- Age Distribution: We prioritize mapping the distribution of the elderly and children, as these groups are often more physically sensitive to extreme events like heatwaves.
- Health Conditions: This indicator assesses the prevalence of climate-sensitive health issues and the overall wellbeing of the community, drawing from global assessments of health risks related to changing climate structures.
- Education Levels: Literacy and education levels are critical for determining a community's capacity to access, process, and act upon climate risk information and adaptation strategies.

## 6.3 Economic Indicators: Livelihoods and Financial Resilience

Economic vulnerability is closely tied to the stability of local livelihoods and the diversity of income sources.

- Income Levels: Lower income levels often correlate with higher vulnerability, as these households may lack the financial resources to implement private adaptation measures, such as home cooling or flood defenses.
- Employment: In rural Mediterranean territories, many residents depend on climate-sensitive sectors like agriculture and tourism. We assess how shifts in the climate—such as prolonged droughts in Vodnjan or severe heatwaves in Sandanski—threaten local employment and economic stability.

## 6.4 Environmental Indicators: Ecosystem Health

Environmental vulnerability examines the current state of the natural world and its ability to continue providing essential "ecosystem services".

- Land Degradation: Decades of urban sprawl and soil sealing have reduced the natural capacity of the land to absorb water and regulate temperature. This indicator maps areas of high degradation that are susceptible to landslides or flash floods.
- Water Availability: Given the Mediterranean's increasing risk of drought, we monitor the current status of the global water cycle at a local level to ensure the sustainability of freshwater ecosystems and human water supply.

## 6.5 Adaptive Capacity: The Power to Respond

Adaptive capacity refers to the ability of systems, institutions, and individuals to adjust to potential damage or take advantage of opportunities.

- Access to Services: We map the proximity and quality of critical services, including healthcare, emergency response, and social welfare, which are vital for maintaining community functions during climate events.
- Institutional Strength: This is a core focus of the Green B-LEAF project. It assesses the capacity of local public authorities to implement data-driven planning and manage green budgeting. Strengthening institutional capacity through tools like the Green Budget Tagging (GBT) toolkit ensures that municipalities have the governance structures needed to move from identifying risks to funding real-life adaptation projects.

## 6.6 Participatory Validation

To ensure these indicators reflect "real-life" conditions, each partner municipality facilitates community workshops involving at least 20 local stakeholders and citizens. This inclusive approach, aligned with New European Bauhaus principles, allows residents to provide direct feedback on which social and economic factors they perceive as the greatest barriers to their community's resilience.

# 7. Indicators and Index Development

To translate complex climate data into a format that is accessible for local public authorities and the general public, the Green B-LEAF project utilizes a structured process for developing a composite Climate Risk and Vulnerability Index. This index serves as the mathematical engine for the Integrated Climate Data and Vulnerability Mapping Guide, transforming raw environmental and social data into a prioritized roadmap for green investment.

## 7.1 Step 1: Indicator Selection

The first step involves identifying specific, measurable indicators that reflect the unique vulnerabilities of rural Mediterranean communities. Based on the Joint Methodology developed by the project partners, indicators are selected across three primary pillars:

- Hazard Indicators: Frequency and intensity of heatwaves, heavy rainfall, and droughts.
- Exposure Indicators: Population density in flood-prone areas and the location of critical infrastructure [Sources for Chapter 5].
- Vulnerability Indicators: Social factors (age, health), economic factors (income, employment), and environmental factors (soil sealing, water availability) [Sources for Chapter 6].

The selection process is supported by the Center for Climate Change (CCC) and Promo Idea, ensuring that the indicators are both scientifically rigorous and relevant to the "real-life" challenges of partners like Sandanski (heatwaves) or Vodnjan (flash floods).

## 7.2 Step 2: Data Normalization (0–1 Scale)

Because indicators are measured in different units—such as degrees Celsius for temperature or percentages for unemployment—they cannot be compared directly. To solve this, we apply Data Normalization. Every raw data point is converted into a standardized 0–1 scale, where 0 represents the lowest risk/vulnerability and 1 represents the highest. This normalization process ensures that environmental degradation and economic instability can be viewed through a single, cohesive lens, allowing local authorities to see which factors are most significantly driving risk in their specific territory.

## 7.3 Step 3: Weighting (Equal or Expert-Based)

Not all indicators impact a community's resilience equally. In this step, we assign a "weight" to each indicator to reflect its relative importance.

- Equal Weighting: In some scenarios, all indicators are treated equally important to maintain simplicity and transparency for the Participatory Budgeting process.
- Expert-Based Weighting: Utilizing the expertise of partners like the Municipality of Faro and CCC, we can assign higher weights to specific critical threats, such as coastal erosion in maritime areas or drought in agricultural zones.

This step is often validated through community workshops, ensuring that the weightings align with the lived priorities of at least 20 local stakeholders per community.

## 7.4 Step 4: Aggregation into Composite Index

The final step is the Aggregation of all normalized and weighted layers into a single Composite Climate Risk Index. By combining the hazard, exposure, and vulnerability scores, we produce the final maps contained in the Integrated Climate Data and Vulnerability Mapping Guide.

This composite index is a vital tool for the Green B-LEAF Participatory Budgeting Methodology. It provides the "data-driven" evidence required for Green Budget Tagging (GBT), enabling municipalities to move beyond top-down budgeting and instead fund the specific green projects that the index identifies as having the greatest impact on local resilience.

# 8. Spatial Analysis and GIS Mapping

The technical core of the Integrated Climate Data and Vulnerability Mapping Guide lies in the transformation of raw environmental and socio-economic data into actionable visual intelligence. By utilizing Geographic Information Systems (GIS), we bridge the gap between high-level IPCC climate assessments and the hyper-local needs of Mediterranean rural communities. This chapter details the spatial processes used to create the evidentiary base for the Green B-LEAF Participatory Budgeting Methodology.

## 8.1 Technical GIS Processing

To ensure the maps are both scientifically accurate and practically useful for local public authorities, our methodology employs two primary modes of data processing:

- Raster/Vector Processing: We integrate raster data (continuous surfaces such as temperature gradients from climate models or elevation data for flood modeling) with vector data (discrete points and polygons representing critical infrastructure, population centers, and administrative boundaries). This allows us to precisely calculate the intersection of climate hazards with human and natural assets.
- Overlay Analysis: This is the critical step where different layers of information—hazards, exposure, and vulnerability—are stacked. By performing an overlay analysis, we can identify geographic "hotspots" where high climatic pressure (e.g., extreme heat) coincides with high sensitivity (e.g., elderly populations or degraded ecosystems).

## 8.2 Map Classification and Standardization

To facilitate data-driven decision-making, all spatial outputs are categorized using a standardized map classification system. Following the normalization process (0–1 scale) established in Chapter 7, the GIS outputs are classified into low, medium, and high-risk zones. This visual classification is essential for the Green Budget Tagging (GBT) toolkit, as it allows municipal planners to see at a glance where green investments must be prioritized to have the maximum impact on local resilience.

## 8.3 Key Mapping Outputs

The spatial analysis phase produces three distinct categories of maps, which together form a joint database of climate-related threats for the Mediterranean region:

1. Hazard Maps: These maps visualize the spatial extent and intensity of specific climatic threats, such as flash flood zones, heat stress areas, and drought-prone regions. They draw on regional fact sheets and previous Interreg initiatives to ensure they reflect the most current Mediterranean climate scenarios.
2. Vulnerability Maps: Moving beyond the physical environment, these maps illustrate the social, economic, and environmental susceptibility of the community. They highlight areas with limited adaptive capacity, such as regions with high soil sealing or neighborhoods with high concentrations of marginalized groups.
3. Risk Maps: The final and most critical output, the Risk Map, is the synthesis of the hazard and vulnerability layers. These maps provide the ultimate roadmap for Green Participatory Budgeting, enabling residents and local governments to propose and fund green projects—such as nature-based solutions—directly in the areas identified as being at the highest integrated risk.

## 8.4 Alignment with NEB Principles

In line with New European Bauhaus (NEB) principles, these mapping outputs are designed to be inclusive, sustainable, and aesthetically engaging. By making complex climate risk data visually accessible to the general public, we ensure that citizens are not just observers of the mapping process but active participants in interpreting the results and leading the green transformation of their own living areas.

# 9. Validation and Verification

The final phase of the mapping process ensures that the technical data synthesized in previous chapters aligns with the "real-life" conditions of Mediterranean rural communities. Validation and verification are essential to transform the Integrated Climate Data and Vulnerability Mapping Guide from a theoretical document into a reliable tool for data-driven decision-making. This phase utilizes a combination of practical testing, participatory feedback, and historical analysis.

## 9.1 Field Validation through Pilot Implementation

Field validation is primarily achieved through the piloting and validation phase (Activity 2.3), where the community-specific models are tested in real-world municipal contexts.

- Feasibility Testing: Participating municipalities, including Faro, Quart de Poblet, and Vodnjan, integrate these mapping outputs into their actual budgeting processes to demonstrate practical feasibility and effectiveness.
- Performance Assessment: A structured data collection and analysis process is led by the Center for Climate Change (CCC) to assess the performance of the mapping models and identify areas where the digital layers may need refinement to better reflect ground-level reality.

## 9.2 Stakeholder Workshops and Community Input

The Green B-LEAF methodology places a high premium on inclusive, community-driven validation. This ensures that the scientific maps are not just top-down assessments but are validated by those who live in the affected areas.

- Participatory Feedback: Each partner municipality organizes workshops involving at least 20 local stakeholders and citizens. These participants review the preliminary climate and vulnerability maps, providing direct input on whether the identified "hotspots" match their lived experiences.
- Refining Vulnerability: These workshops are critical for validating the social and economic indicators of vulnerability, ensuring that the mapping captures the unique challenges of marginalized groups and local economic dependencies that automated data might overlook.

## 9.3 Comparison with Past Events and Existing Data

To ensure technical accuracy, the new mapping outputs are verified against historical climate records and observed impacts.

- Baseline Review: Task 1.2 involves a thorough review of existing data from previous reports, regional fact sheets, and databases to ensure the current mapping builds upon proven effective approaches.
- Consistency Checks: By comparing our generated maps with the observed climate change impacts documented in the IPCC Sixth Assessment Report and previous Interreg initiatives, we can verify the reliability of our hazard projections.
- Historical Calibration: This comparison allows the consortium to calibrate the mapping guide, ensuring that the identified threats—such as the frequency of flash floods or heatwaves—are consistent with the territory's historical climate structure.

## 9.4 Final Synthesis and Quality Assurance

The results of these validation steps are consolidated into the final Integrated Climate Data and Vulnerability Mapping Guide. This iterative process, overseen by a Quality Assurance framework, ensures that the final maps provide a "Rural Municipality-friendly" evidentiary base that is both scientifically robust and community-vetted. This verified data then serves as the foundation for the Green B-LEAF Participatory Budgeting Methodology, ensuring that every Euro spent on climate resilience is directed toward verified needs.

# 10. Communication of Results

The final phase of the mapping process focuses on translating technical data into accessible formats that drive action. Effective communication is the bridge between scientific assessment and the "real-life" climate adaptation strategies required for Mediterranean rural communities. By utilizing a multi-channel approach, the Green B-LEAF project ensures that climate risk information is transparent, inclusive, and actionable for both decision-makers and the general public.

## 10.1 Maps and Dashboards: Visualizing Localized Risk

The most immediate visual outputs of this Guide are the specialized climate and vulnerability maps, which are consolidated into a joint database of climate-related threats. These maps serve as the visual evidentiary base for Green Participatory Budgeting, allowing residents to clearly see where their territory is most at risk.

- Visual Summaries: Following the model of the IPCC's Global to Regional Atlas, the project provides visual summaries and case studies that illustrate climate change impacts and risks at the community level.
- Interactive Dashboards: To enhance transparency, the project explores the integration of data visualization and analysis platforms—similar to those used in the OpenBudgets.eu initiative—to track and analyze climate-related expenditures.
- Digital Platforms: All mapping results and tools are hosted on the Green B-LEAF Capacity-Building Platform, a digital hub that provides stakeholders with interactive implementation guides and implementation roadmaps in multiple languages.

## 10.2 Reports: Comprehensive Documentation for Transparency

Comprehensive reporting ensures that the data-driven planning process is documented for long-term municipal use and transnational knowledge exchange.

- Integrated Mapping Guide: This document serves as the primary technical report, synthesizing findings from data reviews, community workshops, and localized vulnerability assessments to provide a consolidated overview of best practices.
- Thematic Community Reports: Project partners contribute high-quality inputs and case studies to thematic community reports for the Interreg Euro-MED "Green Living Areas" mission. These reports highlight the project's unique methodologies and practical achievements, amplifying the results to a broader Mediterranean network.
- Fact Sheets: Drawing inspiration from IPCC standards, the project utilizes fact sheets to provide snapshots of key findings distilled from the comprehensive mapping reports, making them easier for non-technical stakeholders to digest.

## 10.3 Policy Briefs: Actionable Insights for Decision-Makers

Policy briefs serve as high-level summaries designed to inform strategic planning and resource allocation within local public authorities.

- Rural Municipality-friendly Policy Tool: A cornerstone of the Green B-LEAF Toolkit is the policy tool, which provides step-by-step instructions, templates, and resources specifically tailored to the governance needs of rural municipalities.
- Summary for Policymakers (SPM): Modeled after the IPCC's Summary for Policymakers, these briefs provide concise, high-level summaries of key findings to gain government approval and facilitate alignment with broader strategies like the European Green Deal.
- Green Budget Tagging (GBT) Briefs: These instruments allow local authorities to present clear financial data on how budgetary allocations contribute to environmental and climate objectives, ensuring that financial resources are strategically aligned with the community's identified climate resilience goals.

By utilizing these tools, the project ensures that the results of the vulnerability mapping have a long-lasting effect on the territory, fostering a sense of ownership among community members and providing a robust framework for continuous adaptation.

# 11. Integration into Planning

The ultimate value of the Integrated Climate Risk and Vulnerability Mapping Guide lies in

its transition from a technical document to a functional pillar of local governance. By providing hyper-local climate data, the Guide enables rural Mediterranean authorities to move beyond reactive measures toward proactive, data-driven planning. This chapter outlines how the mapping outputs are integrated into three core planning domains to foster climate-resilient development.

## 11.1 Urban and Rural Spatial Planning

Historical urban development in the Mediterranean—marked by urban sprawl and soil sealing—has significantly amplified climate vulnerabilities. This Guide provides the evidentiary base to reform spatial planning by:

- Managing Infrastructure Risk: Utilizing maps to identify where key infrastructure and settlements are exposed to sea-level rise or flooding, as assessed in global and regional Mediterranean frameworks.
- Implementing Nature-Based Solutions (NBS): Identifying optimal locations for green corridors and permeable surfaces to restore ecosystem services and mitigate the "heat island" effect.
- Applying New European Bauhaus (NEB) Principles: Ensuring that spatial planning is not only functional but also sustainable, inclusive, and aesthetic. By integrating community input from workshops, planners can ensure that new green spaces reflect the cultural identity and "real-life" needs of the residents.

## 11.2 Disaster Risk Reduction (DRR)

The Green B-LEAF project is explicitly aligned with the Interreg Euro-MED objective of promoting disaster risk prevention and resilience. The Integrated Mapping Guide facilitates DRR by:

- Hazard Targeting: Providing precise visualizations of high-risk zones for flash floods, landslides, and severe heatwaves.
- Resource Prioritization: Enabling local authorities to use Green Budget Tagging (GBT) to allocate funds specifically toward emergency response infrastructure and disaster prevention measures in the most vulnerable areas.
- Community Preparedness: Using maps as communication tools to increase public awareness and engagement, ensuring that residents in high-exposure zones are informed and involved in resilience planning.

## 11.3 Climate Adaptation Strategies

Rather than relying on top-down mandates, this Guide supports bottom-up climate adaptation where ownership resides within the community. The integration into broader

adaptation strategies occurs through:

- Green Participatory Budgeting (GPB): The risk and vulnerability layers directly inform the GPB methodology, allowing citizens to propose and vote on adaptation projects—such as water conservation systems or reforestation—that address the specific threats identified in their territory.
- Sectoral Adaptation: Providing data to protect climate-sensitive sectors like agriculture, forestry, and tourism, which are vital for rural livelihoods.
- Policy Alignment: Serving as a "Rural Municipality-friendly" tool that helps local governments align their local actions with wider strategies, including the European Green Deal and the Territorial Agenda 2030.

By embedding these mapping results into the daily operations of municipal departments, the Green B-LEAF project ensures that sustainability and resilience become permanent features of the Mediterranean's institutional framework.

# 12. Tools and Resources

To achieve the objective of equipping rural communities with hyper-local climate data

and fostering data-driven decision-making, the Green B-LEAF project utilizes a suite of specialized technical tools. These resources allow for the consolidation of findings from data reviews, community workshops, and vulnerability assessments into a functional, user-friendly format for local authorities.

## 12.1 Geographic Information Systems (GIS): QGIS and ArcGIS

The production of specialized hazard, vulnerability, and risk maps relies on advanced GIS software such as QGIS or ArcGIS. These tools are essential for the technical processes outlined in this Guide, including:

- Spatial Data Integration: Combining raster layers (climate models) and vector layers (infrastructure and population data) to identify precise geographic intersections of risk.
- Overlay Analysis: Stacking various data layers to visualize "hotspots" where climatic hazards overlap with high social or environmental sensitivity.
- Map Classification: Standardizing risk levels into visual categories (low to high) to guide the Green Budget Tagging (GBT) and participatory budgeting processes.

## 12.2 Climate Data Portals and Databases

The methodology for climate data mapping is built upon a thorough review of existing databases and climate data portals to avoid duplication and build on proven approaches. Key resources include:

- Regional and Global Fact Sheets: Utilizing snapshots of key findings distilled from the IPCC Sixth Assessment Report and regional Mediterranean datasets.
- Global to Regional Atlas: Leveraging visual summaries and case studies on climate impacts and risks to calibrate local models.
- Joint Database of Climate-Related Threats: A consolidated repository created by the project that features data on the most common Mediterranean threats, including heatwaves, floods, and droughts, tailored for each partner community.

## 12.3 Statistical and Analytical Software

To transform raw indicators into the Composite Climate Risk Index, statistical tools are used for:

- Data Normalization and Aggregation: Converting diverse indicators (e.g., income levels, temperature gradients) into a standardized 0–1 scale for comparative analysis.
- Risk Calculation: Performing structured analysis and detailed evaluation of the performance and community acceptance of different climate models.

- Green Budget Tagging (GBT) Tool: A specialized instrument designed for rural municipalities to track and analyze budgetary allocations in relation to their environmental impact, ensuring financial resources align with climate resilience goals.

### 12.4 Collaborative and Capacity-Building Platforms

Beyond technical mapping, the project utilizes digital platforms to ensure the transferability of results:

- Green B-LEAF Capacity-Building Platform: A comprehensive digital hub consolidating training materials, community engagement tools, and implementation guides in multiple languages.
- Open Government and Visualization Tools: Drawing on synergies with platforms like OpenBudgets.eu, the project emphasizes the use of data visualization to enhance financial transparency and citizen engagement in the green transition.
- Basecamp: Used for internal project management and the seamless exchange of technical documents and draft deliverables between transnational partners.

# 13. Annexes

## ANNEX I Vulnerability Assessment of Partner Municipalities – The Findings

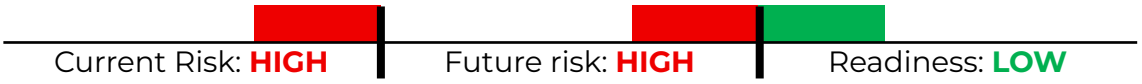
### Risk Profile – Municipality of Beltinci

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are

**Ecosystems**

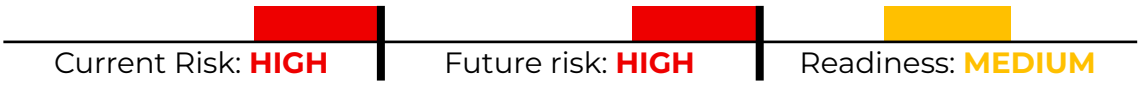
- **Species distribution shifts**

  Owner: Co-owned




- **Ecosystems/society risk due to invasive species**

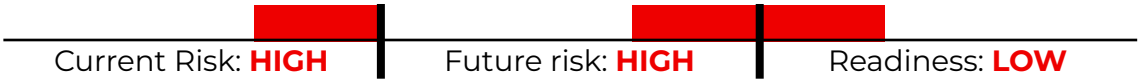
  Owner: Co-owned




These two sub-categories reflect strong ecological pressure.

- **Soil health**

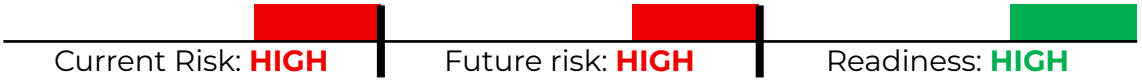
  Owner: Co-owned




The assessment shows that erosion and fertility decline likely under heavier extremes.

- **Wetlands/aquatic ecosystems**

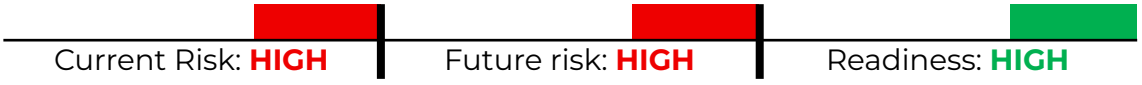
  Owner: Co-Owned




**Food**

- **Crop production**

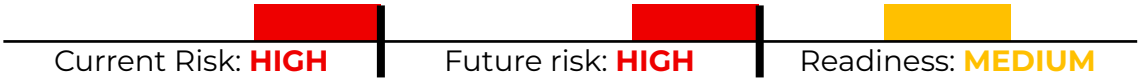
  Owner: Co-Owned




The assessment shows strong exposure, but programs exist (training, early warning, irrigation improvements).

- **Food prices**

  Owner: National




The assessment shows that inflationary spikes are linked to climate extremes; social protection is needed.

- **Livestock**

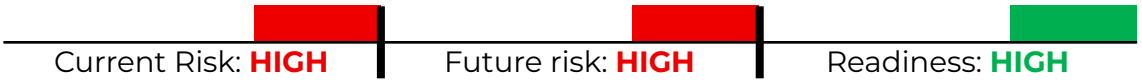
  Owner: Co-Owned


The assessment shows active veterinary/early-warning capacity helps.

**Health**

- **Heat stress – general population** is **High–High** with **Low readiness**:

  Owner: Co-Owned




The assessment shows cooling centers & neighborhood shade are priority.

- **Outdoor workers**

  Owner: National


The assessment shows legal protections, there are protocols recorded.

- **Wellbeing in non-adapted buildings**: **High current**, **Medium future**, **High readiness**

  Owner: Co-Owned


The assessment shows high readiness that should keep retrofit programs going.

**Infrastructure**

- **Damage to buildings**

Owner: Co-Owned


The assessment shows that this subsector requires steady investment.

- **Land-based transport**

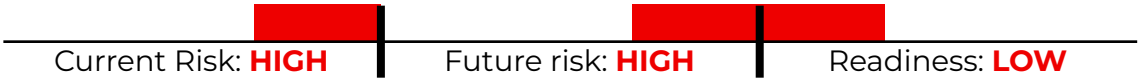
  Owner: Co-Owned


The assessment shows that this subsector requires steady investment.

**Economy & Finance**

- **Public finances**

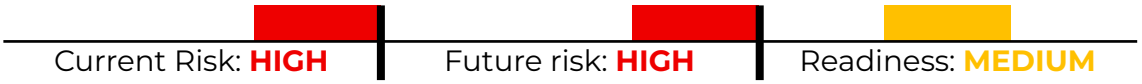
  Owner: Co-Owned




The assessment shows fiscal stress from emergencies & repairs, but very limited buffers.

- **Property & insurance markets**

  Owner: National




The assessment shows risk to households/businesses, and therefore incentives for resilience are needed.

- **Water scarcity impacts**

  Owner: Co-Owned


- **Supply chains**: **Medium–Medium–Low** →

  Owner: National

| Current Risk: **MEDIUM** | Future risk: **MEDIUM** | Readiness: **LOW** |
|---|---|---|

The assessment shows logistics sensitivity and limited redundancy.

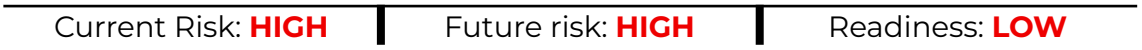
## Risk Profile – Municipality of Vodnjan-Dignano

The municipality has high current risk in nearly all ecosystem categories, except soil health (Low). Future risks remain High in most categories.
Adaptive capacity ranges from Low to very Low.

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

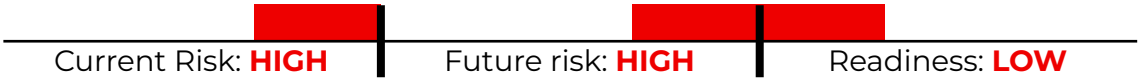
**Ecosystem and Environmental Risks**

- **Coastal ecosystems**




The assessment shows risks in the future which impose weak mitigation.

- **Marine ecosystems**




There is a present risk of acidification and pollution and a weak governance relation to this issue.

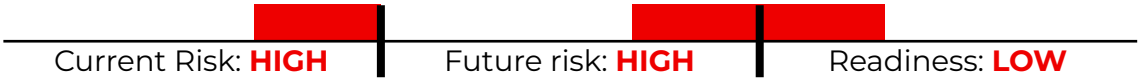
- **Biodiversity/carbon sinks**


There is a high current risk of forest loss and carbon stock depletion due to wildfires, droughts, and warming. While future severity for carbon sinks is projected to decrease, current adaptive capacity remains low.

- **Species distribution shifts**


There is a present climate-driven shifts of species in relation to changing climate conditions. There is poor planning in order to decrease this risk, although there are present strategies.

- **Invasive species**



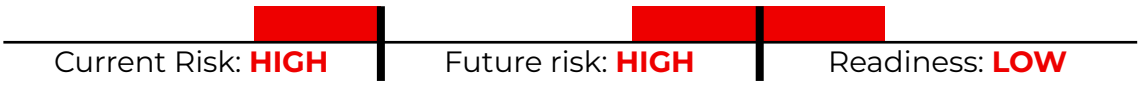

The local climate is becoming increasingly suitable for non-native and invasive species,

but there is limited prevention.

- **Soil health**


Risks to soil health are rated as medium, driven by long-term changes in precipitation and increasing extreme weather events.

- **Aquatic/wetlands**

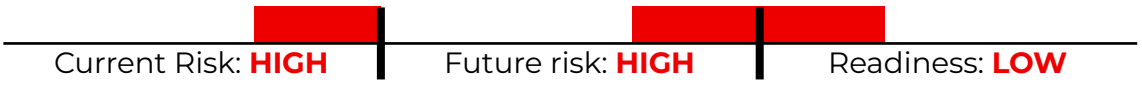



The assessment shows increased fragility due to pollution, drying of the wetland, but low monitoring over these potential risks.

**Food and Agricultural Risks**

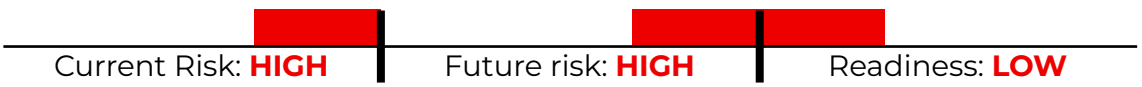
The agricultural sector is under severe stress from extreme weather and biological threats. The municipality of Vodnjan-Dignano experiences high risk in food security, crop production, and livestock production. Fisheries are non-available because the municipality does not have a marine dependent economic sector. The adaptive capacity to these risks is on a low level, because most of the adaptive actions are not taken or partially implemented.

- **Crop production**




The municipality faces lower crop production due to frequent drought periods, limited water for irrigation, and annual late frosts. There is low readiness because there is partial farmers training and partial adoption of alternative crops.

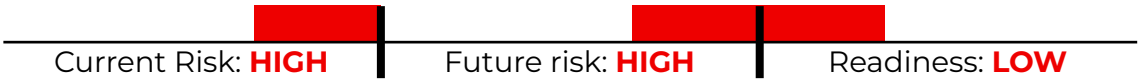
- **Food security (prices)**




Recent climate extremes have led to increased input costs for water, fertilizer, and fuel, contributing to higher food prices and impacting socially vulnerable groups. The readiness is categorized as low because there are only partial measures like availability of

public regional plan for buffering and presence of public canteens.

- **Livestock production**

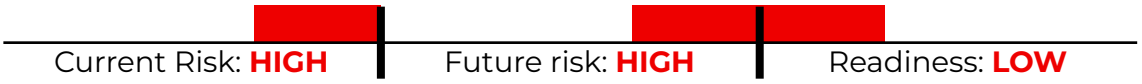



Heatwaves have reduced forage availability and livestock productivity (e.g., milk yield). Furthermore, there is a documented spread of pests and diseases affecting production. There is only partial financial assistance to help farmers which proves the low readiness level.

**Health Risks**

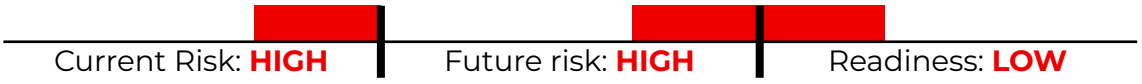
Health is the most critical risk cluster for the Municipality of Vodnjan-Dignano. All health-related risks are assessed as high.

- **Heat stress – population**



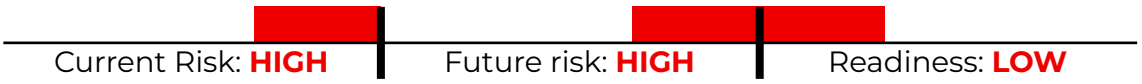

There is a clear trend of more frequent consecutive hot days and rising nighttime temperatures. This poses a high risk to the general population and especially to outdoor workers who report symptoms of fatigue and heat stress.

- **Built environment exposed to wildfires**



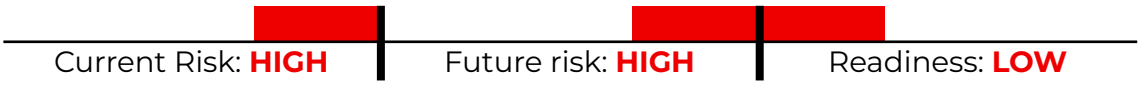

Most of the risks related to vulnerability due to wildfires are assessed as high, but there are a small number of adaptive measures to decrease the risk level in the future. Although there is partial adoption of early warning mechanisms, fire-resistant building codes and shelters for vulnerable groups, the overall readiness is assessed as low.

- **Poorly adapted buildings**



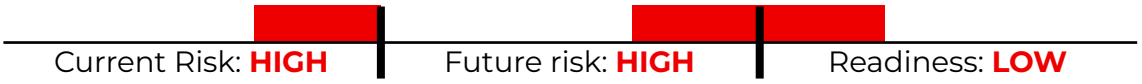

A high percentage of the population lives in buildings constructed without climate-resilience standards, leading to poor wellbeing during extreme temperature events.

- **Heat stress – outdoor workers**



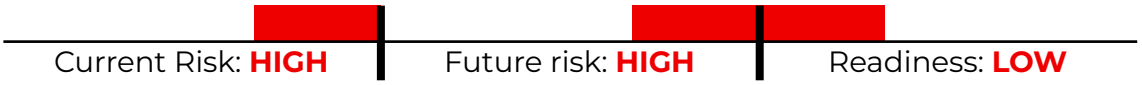

There are not sufficient adaptive measures to the heat stress risk in the municipality.

- **Pathogens in coastal waters**



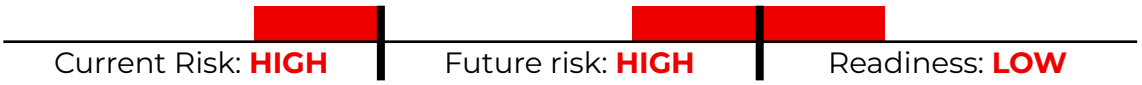

The assessment shows that the risks related to pathogens in coastal areas are present but the adaptive measures are mostly partial.

- **Health systems & infrastructure**




The risk is high across all subareas of the category, but only the local action plan and public campaigns are partially responded as an adaptive measure.

- **Infectious diseases**



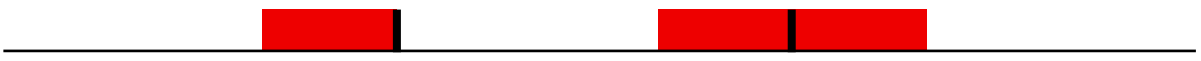

The municipality has seen an increase in climate-sensitive disease outbreaks, such as the West Nile virus. Risks are exacerbated by standing water areas and poor drainage.

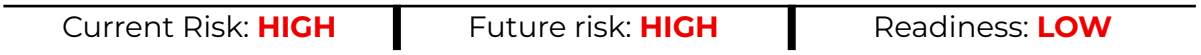
**Infrastructure risks**

- **Pluvial (rainfall-related), flash, and coastal flooding**


Pluvial (rainfall-related), flash, and coastal flooding are all high-severity risks. Sea levels are rising measurably, threatening coastal homes and energy facilities.

- **Structural and Energy Risks**






Extreme heat and droughts are causing deterioration of the energy grid and roads. The municipal drainage system is currently considered inadequate for heavy precipitation.

- **Transport**


While marine transport is at a medium risk level, land-based transport faces high risks from floods and landslides.

**Economy and Finance Risks**

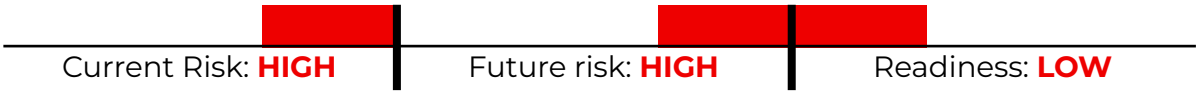
- **Public and Private Finance**


Climate disasters are impacting public finances, yet there is no dedicated contingency fund or long-term financial strategy for climate change impacts.

- **Tourism**


The municipality's summer tourism is at high risk due to heatwaves, wildfires, and coastal erosion, which have already led to revenue losses and cancellations.

- **Supply Chains and Property**




Supply routes for raw materials are exposed to climate hazards. The property market is also at high risk because many buildings are old, poorly constructed, and lack affordable insurance options for high-risk zones.

**Overall Adaptive Capacity**

Across all sectors, the municipality's readiness is primarily rated as low. Key gaps include:

- Missing Management Plans: Many essential plans for coastal zones, flood risks, and wildfire prevention are not in place or not updated.
- Resource Deficits: There is a lack of specialized training for staff, limited early

warning systems (specifically for heat and frosts), and no mandatory climate risk disclosure for businesses.

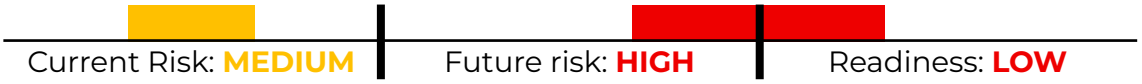
- Infrastructure Gaps: Sewage treatment and irrigation systems require modernization to handle changing climate conditions.

## Risk Profile – Municipality of Faro

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

**Ecosystems**

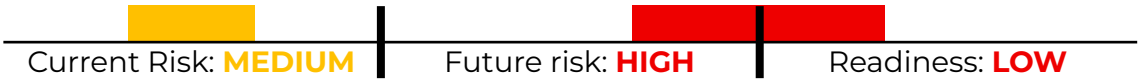
Overall cluster estimate




Highest-concern items:

- **Coastal ecosystems**

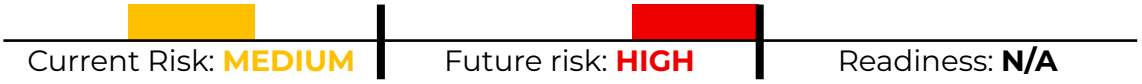
  **Ownership: National**




Municipality of Faro shows multiple pressures: biodiversity loss, coastal erosion, changes in sea structure, eutrophication, aquifer drought/pollution

- **Marine ecosystems**

  **Ownership: EU**




Faro is exposed to heatwaves, ocean acidification, marine pollution, overfishing, and eutrophication.

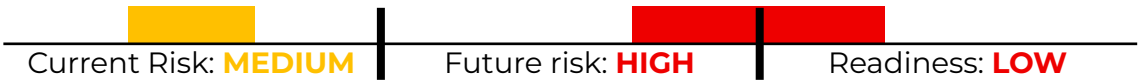
- **Biodiversity / Carbon Sinks due to Wildfires**

  **Ownership: Local**


Forest loss from drought and warming, wildfire presence, increases in fire frequency/intensity. There are preventive measures and restoration, so risk does not escalate but remains substantial

- **Species distribution shifts**

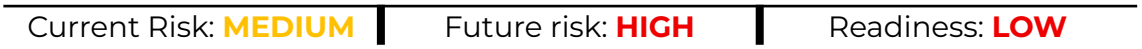
  **Ownership: National**




Climate conditions are changing; native species are shifting range; invasive species are expanding; multiple ecosystem barriers exist.

- **Invasive species**

  **Ownership: National**




Climate changes favor non-native species; disturbances like fires and floods help invasions; ecosystems are already degraded. Monitoring exists but public awareness and readiness are weak.

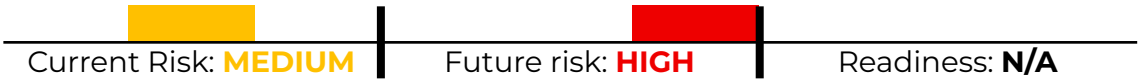
- **Soil Health**

  **Ownership: EU**


Extreme events affect soils, erosion is present, degradation is visible, and agricultural productivity is already harmed. However, soil health is not as critical as other risks now, but poor readiness causes future deterioration.

- **Aquatic & wetland ecosystems**

  **Ownership: National**




Wetlands face droughts, temperature changes, pollution, shrinking habitats, biodiversity declines, and ecosystem fragility. Monitoring exists only partially; degradation is already visible.

## Food

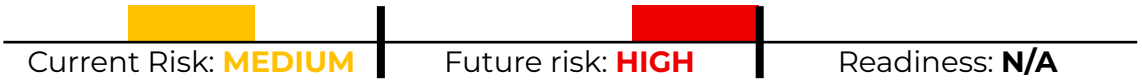
- **Crop Production**

  **Ownership: National**


Some hazards exist (drought, heavy rainfall), but Municipality of Faro is not heavily reliant on local crop production.

- **Fisheries & Aquaculture**

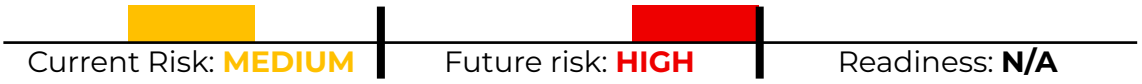
  **Ownership: EU**




Municipality of Faro's coast experiences extreme marine weather, algal blooms, invasive marine species, coastal erosion, and storm surges. Adaptation capacity is weak (few warnings, little diversification), so future risk rises to "High".

- **Food Prices & Food Security**

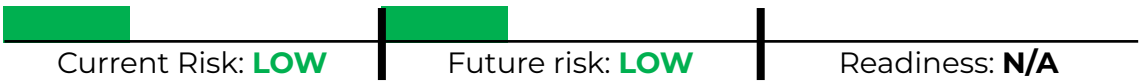
  **Ownership: National**




Local extreme events affect prices; global disruptions affect import-dependent markets; vulnerable groups are impacted. Municipality lacks buffers (no food-price emergency plans).

- **Livestock Production**

  **Ownership: EU**

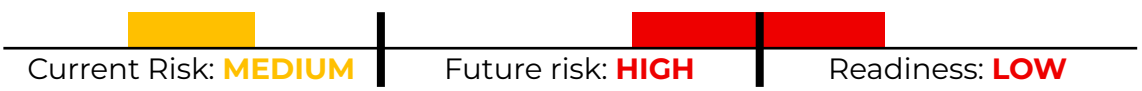



Although Municipality of Faro faces heatwaves and water stress, local livestock is not a major sector. Low readiness persists, but the sector is small enough to keep future risk low.

## Health

- **Heat Stress – General Population**

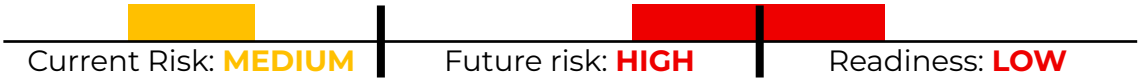
  **Ownership: Local**




Heatwaves increasing; no action plans; no early warning; no cooling centers; high urban heat island exposure. This is one of the most critical rising risks.

- **Wildfire Impacts on Population & Built Environment**

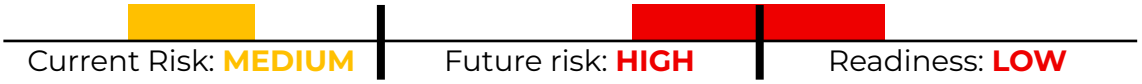
  **Ownership: National**




Wildfire frequency rising; insufficient community preparedness; limited EWS; evacuation plans missing; shelters absent. Future climate increases wildfire danger.

- **Wellbeing Impacts from Non-Adapted Buildings**

  **Ownership: Local**




Buildings lack insulation; many built before adaptive standards; high energy poverty; no retrofitting support. Consequently, risk escalates.

- **Heat Stress – Outdoor Workers**

  **Ownership: National**


Exposure exists but data is not available for many conditions.
Work shifts occur during hottest hours; no surveillance or worker protection.

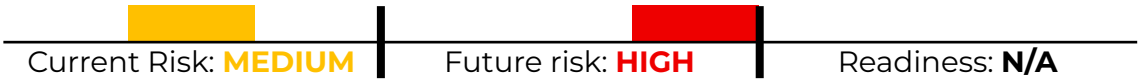
- **Pathogens in Coastal Waters**

  **Ownership: EU**


Algal blooms, eutrophication, sewage overflow risk, tourism exposure low but rising hazard due to warming seas.

- **Health Systems & Infrastructure**

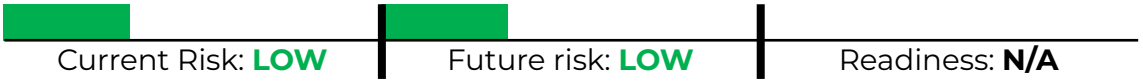
  **Ownership: National**




Health systems overwhelmed during extremes; poor emergency communication; no climate-adapted emergency plans. Demand increases with climate change.

- **Infectious Diseases**

  **Ownership: National**

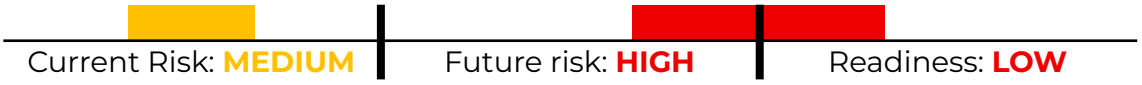



Most climate-sensitive disease indicators are not available, limited evidence of outbreaks. Some risk factors (informal settlements, waste mismanagement) exist but not enough to raise risk.

**Infrastructure**

- **Pluvial & Fluvial Flooding**

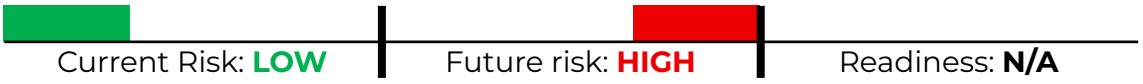
  **Ownership: Local**




Heavy rainfall increasing; drainage capacity insufficient; risk maps not available; many critical areas flood-prone.

- **Coastal Flooding**

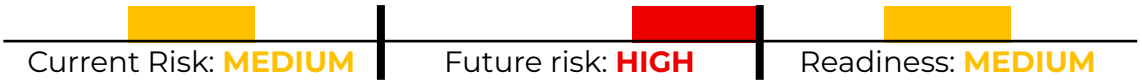
  **Ownership: National**




Although current damage is limited, Municipality of Faro is exposed to sea-level rise, storm surges, coastal erosion; adaptation is inadequate.
This produces a strong risk escalation.

- **Damage to Infrastructure & Buildings**

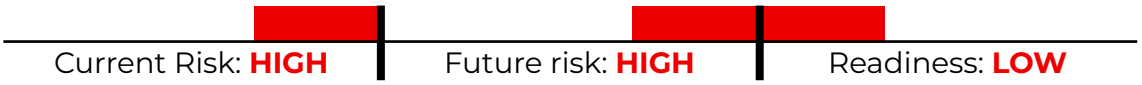
**Ownership: Local**




Storms, fires, heat and drought already cause damage; no resilience standards in building codes; assets located in high-risk zones. Future climate increases frequency & severity.

- **Energy Disruption due to Heat & Drought**

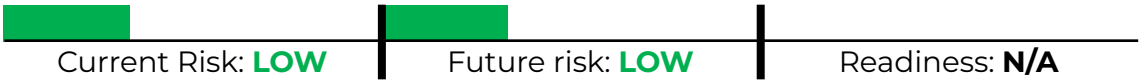
  **Ownership: National**




This is one of the most severe existing risks. Heatwaves strain electricity grids; water shortages reduce cooling; extreme temperatures impair operations. No adaptation measures are in place.

- **Energy Disruption due to Flooding**

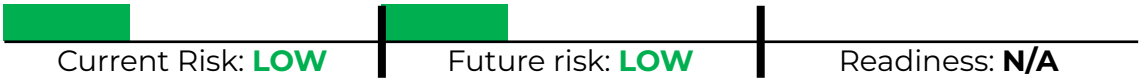
  **Ownership: National**




Flood risk exists but infrastructure seems less exposed.

- **Marine Transport**

  **Ownership: National**




Despite coastal hazards disruptions are not common.

- **Land Transport**

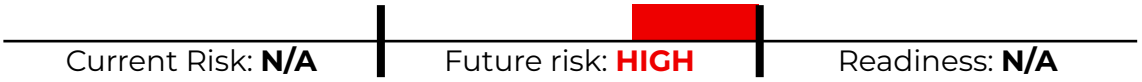
  **Ownership: National**


Flooding and soil erosion increasing; no resilience standards; no EWS.

**Economy and Finance**

- **Public Finances**

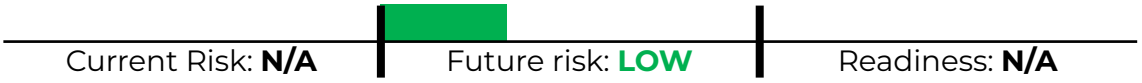
  **Ownership: National**




Municipality faces increasing climate-related costs; lacks adaptation budgets; disaster spending growing. This creates a future financial shock risk.

- **Property & Insurance Markets**

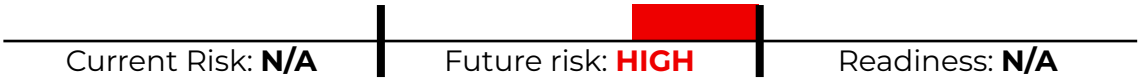
  **Ownership: Co-owned**




Although buildings are vulnerable, the system doesn't show current severe financial instability.

- **Water Scarcity Impact on Population/Economy**

  **Ownership: EU**




Diminishing water supply; infrastructure leakage; agriculture highly water-dependent; limited water-saving investments.

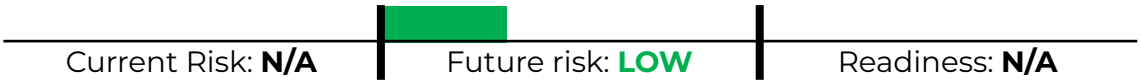
- **Supply Chains**

  **Ownership: National**


Industrial areas located in climate-sensitive zones; little adaptive planning; moderate exposure.

- **Financial Markets**

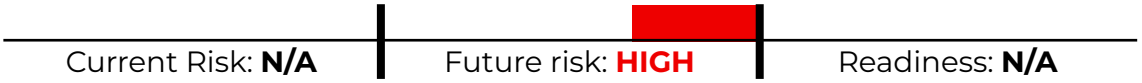
**Ownership: EU**




Although exposed to some high-risk sectors, institutional capacity is limited but impacts remain low in current modelling.

- **Winter/Summer Tourism**

  **Ownership: National**




Coastal tourism is affected by heatwaves, wildfires, erosion, sea-level rise; tourist-dependent economy vulnerable.

## Risk Profile – Municipality of Quart de Poblet

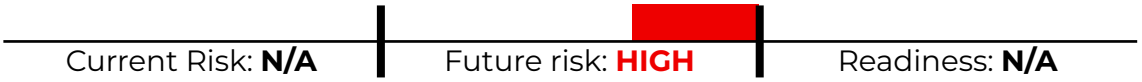
Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

**Ecosystems**

**Highest-priority items (by future severity & gaps):**

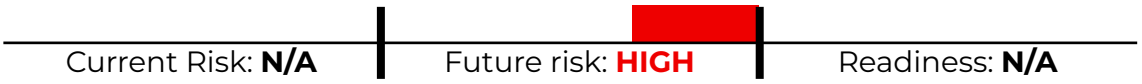
- **Soil health** assessment shows risk of erosion/quality decline without mitigation capacity.

  **Ownership: Local**




- **Aquatic & wetland ecosystems** assessment shows loss of buffering functions (flood absorption, water quality) likely.

  **Ownership: Local**




- **Invasive species (ecosystems/society)** comparatively better capacity, but still watchlist.

  **Ownership: Local**


- **Biodiversity/carbon sinks and species shifts**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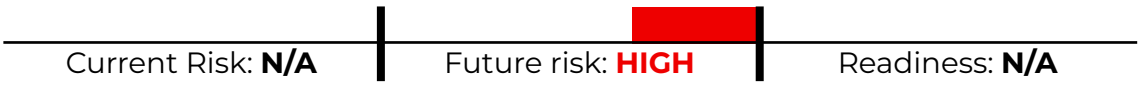
**Food (Agriculture, Prices, Livestock)**

**Key risks:**

- **Livestock production**

  **Owner: National**




  This assessment shows that municipality has heat/disease/water stresses with no documented capacity.

- **Crop production**

  **Owner: Local**

This assessment shows that drought/heavy rain/pest episodes indicate rising vulnerability.

- **Food security (prices)**

  **Owner: National**


This assessment shows that there is a present affordability pressure for vulnerable households, with no buffers recorded.

**Capacity signal:** This cluster stands out as a policy and program gap.

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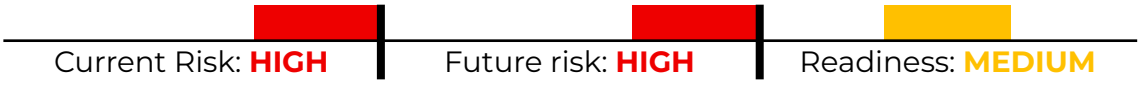
**Health**

**Top items:**

- **Heat stress — outdoor workers**

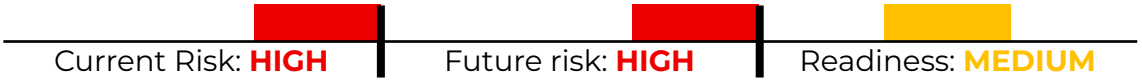
  **Owner: National**




This assessment shows one of the best-documented capacities (work protocols), but still high risk.

- **Heat stress — general population**

  **Owner: Local**




The assessment shows urgent need for cooling centers, shading, alerts.

- **Population/built environment due to wildfires**


The assessment shows that evacuation/readiness measures are not recorded.

- **Health systems & infrastructure**


- **Infectious diseases**


The assessment shows that for Health systems & infrastructure and Infectious diseases have no readiness data.

Pathogens in coastal waters is assessed have **low future risk** but needs surveillance.

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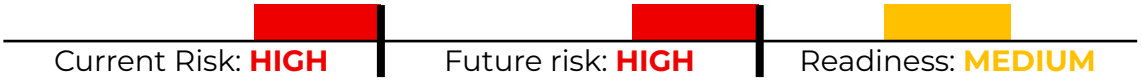
**Infrastructure**

**Highest pressures:**

- **Pluvial & fluvial flooding**

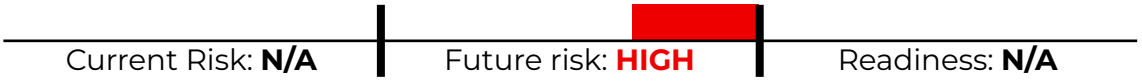
  **Owner: National**




The assessment shows immediate and growing risk; some capacity exists (still insufficient).

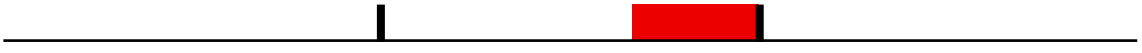
- **Coastal flooding**

  **Owner: National**




The assessment reflects basin-level exposure, but the capacity is not recorded locally.

- **Energy disruption due to flooding Owner: EU**



Current Risk: **N/A** | Future risk: **HIGH** | Readiness: **N/A**

The assessment shows critical-service continuity at risk.

- **Mitigating factor: Damage to infrastructure & buildings**

  **Owner: Local**


The assessment shows that this is one area with relatively strong documented capacity.

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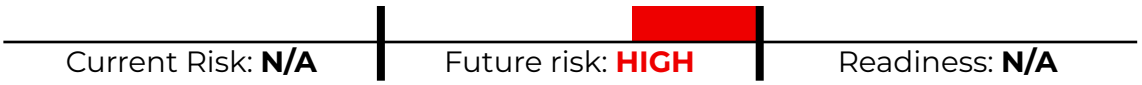
**Economy & Finance**

**Key exposures:**

- **Public finances**

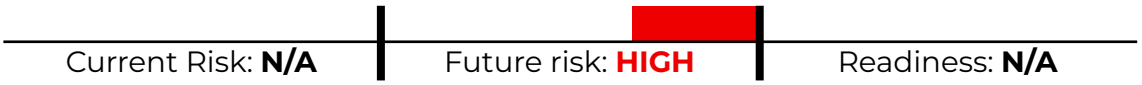
  **Owner: EU**




The assessment shows fiscal shocks likely as climate incidents mount; no buffers recorded.

- **Water scarcity (population/economy)** ,

  **Owner: National**




The assessment shows structural risk for local economy and households.

- **Property & insurance markets**

  **Owner: National**


The assessment shows exposure exists, but the incentives/retrofits are underdeveloped.

This cluster's **future risk is estimated as avg = 2.33 (near High)** with **Readiness assessment of avg = 0.17** which implies on **acute preparedness gap**.

**This municipal risk profile shows that:**

- **Highest future pressures** are: Infrastructure, Economy & Finance, and Health (especially heat).

  **Readiness lags** most in Food, Ecosystems, and key Economy/Finance items.

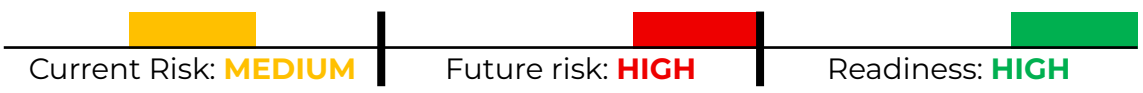
- **Immediate priorities** (by category):
  - **Health**: heat-health plan (cooling centers, shading, alerts);
  - **Infrastructure**: drainage upgrades; flood mapping; energy continuity plans;
  - **Economy & Finance**: climate stress-tests; contingency funds;
  - **Food**: agrometeorological alerts, resilient varieties, farmer support; food-price safety nets;
  - **Ecosystems**: soil/river-corridor restoration, wetland buffers, invasive-species monitoring.

## Risk Profile – Municipality of Pilea-Hortiatis

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

**Ecosystems**

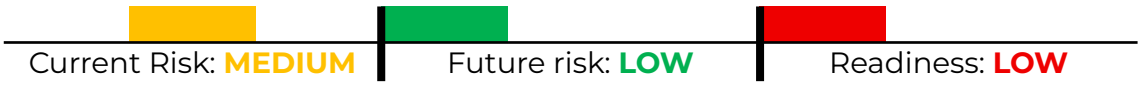
- **Biodiversity & carbon sinks due to wildfires**




Increasing wildfire frequency and intensity threatens forests that include fire-sensitive species. Although prevention and restoration measures exist, mapping of carbon sinks

and long-term resilience planning are incomplete, leading to an elevated future risk.

- **Coastal & marine ecosystems**




Pilea-Hortiatis is indirectly affected by coastal pressures. Impacts exist (pollution proximity, climate stress), but the municipality's inland/mixed character and some adaptation actions keep future risk lower.

- **Species distribution shifts & invasive species**

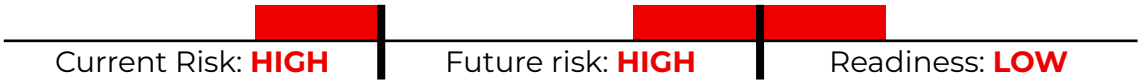

Climate-driven pressures exist, but current exposure is limited and risks are managed largely at national level

- **Soil health**


Some erosion and extreme-weather pressure exist, but visible degradation is limited.

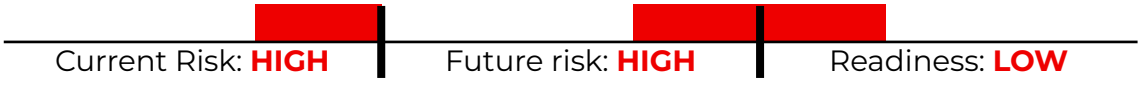
**Food**

- **Crop production**




Droughts, heavy rainfall, pest pressure, and water-stress already affect agriculture. While there is some access to advisory services and resilient varieties, irrigation modernization and policy support remain insufficient.

- **Livestock production**

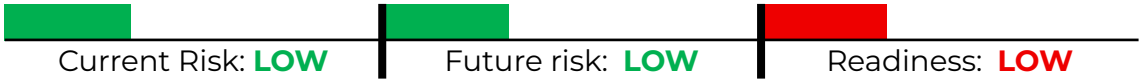


Heatwaves, forage stress, disease vectors, and productivity losses are present. Partial insurance and early-warning access exist, but overall vulnerability remains high.

- **Food security & prices**


The municipality is exposed to food-price volatility due to climate extremes and market shocks. Social support mechanisms exist, lowering future risk slightly.

- **Fisheries & aquaculture**



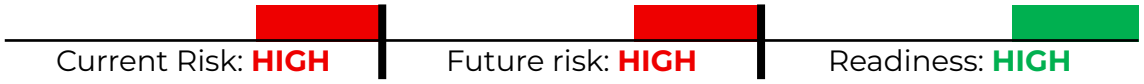

The primary reported impact is that rising temperatures are affecting the thermal regime of local rivers, lakes, and wetlands. However, there are no widespread signs of wetland drying, declining biodiversity, or fish kills.

**Health Risks**

- **Heat stress – general population**


Although heat-health action plans, early warning systems, cooling centers, and trained responders are in place, heatwaves are increasing and energy poverty remains a concern, keeping overall risk high.

- **Population & built environment due to wildfires**




Wildfire exposure is significant. While evacuation planning, drills, and EWS exist, critical infrastructure and transport routes remain exposed.

**Heat stress — outdoor workers**


A high percentage of outdoor workers are exposed to daily maximum temperatures that exceed safe thresholds during peak work hours. Protective measures are robust.

Occupational safety regulations enforce safe work-rest cycles, and workers are provided with cooling gear, shaded rest areas, drinking water, and flexible shifts. There are also active inspection mechanisms to enforce these protocols.

- **Health systems & infrastructure**


Climate-related emergencies increasingly strain health services during peaks (e.g. heatwaves). Capacity exists, but demand growth drives future risk higher.

- **Pathogens in coastal waters**


Rising sea temperatures and longer warm seasons increase pathogen persistence, requiring continued monitoring.

- **Infectious diseases**


Vector-borne and climate-sensitive diseases are not yet widespread but are expected to increase with warming conditions.

- **Wellbeing due to non-adapted buildings**


Rising energy costs during more frequent extreme weather events are severely affecting household budgets, leading to energy poverty. The municipality's building stock is relatively resilient; there is not a high proportion of non-renovated pre-1980s residential or public buildings. Furthermore, there is comprehensive financial support such as grants, loans, and subsidies—available for low-income households to improve housing adaptation and energy retrofitting.

**Infrastructure Risks**

- **Damage to infrastructure & buildings**


Extreme weather events have already caused damage to infrastructure and buildings.

Existing measures, including resilience standards, green infrastructure, and post-disaster response planning, indicate a high level of readiness and an established approach to infrastructure risk management. However, future risks remain due to increasing climate pressures and the need for further scaling and integration of these measures .

- **Pluvial & fluvial flooding**


Flooding is currently controlled through drainage, green infrastructure, and EWS, but climate projections show increasing rainfall intensity.

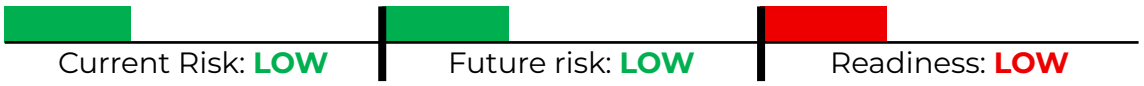
- **Energy disruption due to heat & drought**


Grid exposure to heat stress exists, though monitoring and resilient materials investments help moderate risk.

- **Land-based transport**


Exposure to weather extremes exists, but redundancy and contingency planning reduce escalation.

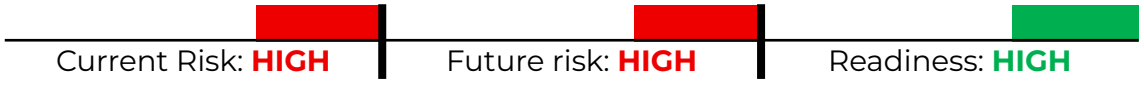
- **Marine transport & coastal flooding**




Marine transport operations have not been disrupted by climate events, and there are no recorded increases in storm surges or wave heights at local port locations. Aside from operational early warning systems for storms and high tides, readiness is minimal. Climate risks are not integrated into port master plans, ports have not been retrofitted with elevation or backup systems, and there is no flexibility in routing or scheduling to adapt to potential future disruptions.

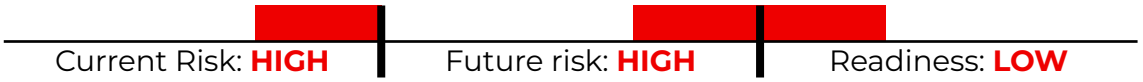
**Economy & Finance Risks**

- **Public finances**



Climate-related emergencies increase municipal spending, despite the existence of contingency funds and insurance mechanisms.

- **Tourism (winter/summer)**




Reduced snowfall, climate variability, and ecosystem degradation affect tourism viability, particularly seasonal activities.

- **Water scarcity – population & economy**


Declining water availability and increased demand drive future risk, despite investments in efficiency.

- **Supply chains & financial markets**


Generally resilient, with diversification and coordination measures in place. Local businesses are partially investing in diversified or circular supply chains to reduce dependence on vulnerable imports. There is active coordination among industry, logistics providers, and authorities to respond to disruptions, and infrastructure upgrades

- **Property and insurance markets**


Climate risks are successfully integrated into building codes, land use planning, and permitting processes. Insurance providers offer climate-risk-sensitive products. However, risk assessments only partially guide property investments, affordable insurance is only partially available.

- **Financial markets**


The local financial system is not heavily exposed to high-risk sectors or real estate markets vulnerable to sea-level rise or wildfires. Financial regulators are only partially conducting climate stress tests, and financial institutions are only partially building internal capacity to

manage physical and transition climate risks.

**MOST IMPORTANT FINDINGS**

Pilea-Hortiatis demonstrates strong resilience in managing infrastructure and public health, but faces certain structural challenges to its local economy (agriculture and tourism) and its natural ecosystems.

**Critical Action Areas** (High Risk + Low Readiness) These sectors require immediate intervention, as they face high current and future risks coupled with a low capacity to adapt:

**Agriculture:** Both crop and livestock production are highly vulnerable to climate shifts, and the municipality currently lacks the readiness to manage these co-owned risks.

**Tourism:** Winter and summer tourism face critical threats from shortened seasons and degraded natural attractions. The municipality has low readiness to help this vital sector diversify or adapt.

These risks are often shared across multiple governance levels (e.g. national agricultural policies, regional tourism strategies, and environmental regulation), which limits the municipality's direct control and constrains its capacity to respond independently.

**The Dominant Threat**: Wildfires represent the most pervasive hazard across the municipality, though preparedness is remarkably strong.

**Health & Infrastructure:** Wildfires pose a high current and future risk to the population and built environment. Uniquely, this is categorized as a strictly locally-owned responsibility, and the municipality demonstrates high readiness with early warning systems and evacuation plans.

**Ecosystem Escalation**: The impact of wildfires on biodiversity and carbon sinks is the only ecosystem risk projected to escalate from a medium current risk to a high future risk, though readiness here is also high.

**Systemic Weakness: Natural Ecosystems** The municipality exhibits a widespread lack of adaptive capacity regarding its natural environment. There is low readiness across almost all ecosystem risks, including:

- Coastal and marine ecosystems.
- Threats from invasive species and shifts in species distribution.
- Soil health, aquatic, and wetland ecosystems.

This is partly explained by the fact that many ecosystem-related risks fall under national-level responsibility, limiting the municipality's direct capacity to intervene.

**Municipal Strengths** (High Risk + High Readiness) Pilea-Hortiatis is well-prepared to

handle several major threats. For the following areas, the municipality faces high immediate risks, but maintains high readiness, leading to more optimistic future projections:

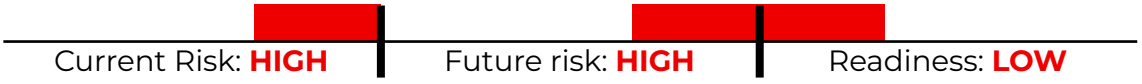
- **Public Finances:** Despite high risks of climate-related financial shocks, local authorities have strong contingency planning and access to climate risk insurance.
- **Public Health:** Heat stress for the general population and pathogens in coastal waters currently pose high risks, but robust early warning systems and action plans are projected to reduce these to medium risks in the future.
- **Infrastructure:** Current high risks of damage to infrastructure and buildings are mitigated by proactive climate-resilient building codes and green infrastructure use.

## Risk Profile – Municipality of Strumica

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

**A. Heat stress – general population**

- **Owner: National**




**Why this is critical:**

Strumica is already experiencing stronger heatwaves and has **insufficient preparedness**—no cooling centers, limited shading, and vulnerable populations exposed.

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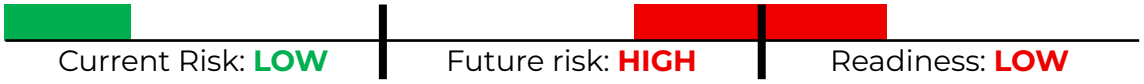
**B. Food security due to higher food prices**

- **Owner: National**




**Why this matters:**

Even if current exposure is modest, **future risk jumps sharply**. Rising input costs and climate-driven pressure on agriculture can reduce affordability, especially for vulnerable groups.

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**C. Population/built environment due to wildfires**

- **Co-Owned responsibility (Local + National)**


**Interpretation:**
Wildfires are an active and **recurrent threat** around Strumica. Although readiness is better than in other areas, evacuation systems and fire-resistant planning need strengthening.

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**D. Biodiversity/carbon sinks lost to wildfires**

- **Co-Owned**


**Meaning:**
Ecosystems are exposed, and readiness is insufficient for prevention, monitoring, and restoration.

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**E. Crop Production**

- **Local responsibility**

Current Risk: **MEDIUM** | Future risk: **MEDIUM** | Readiness: **LOW**

**Why this matters:**

Agriculture is a cornerstone of the Strumica economy. Drought, heavy rainfall, pest risks, and limited adaptive capacity (no early warnings, limited training, low adoption of resilient varieties) increase vulnerability.

---

**F. Water scarcity (population & economy)**

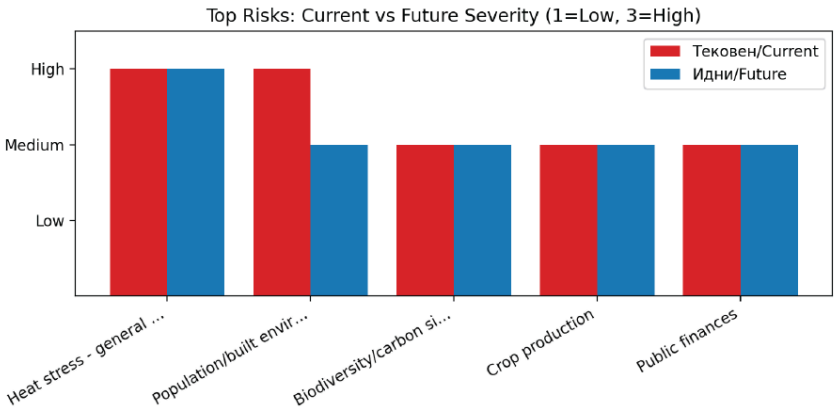
- **Local**

Current Risk: **MEDIUM** | Future risk: **MEDIUM** | Readiness: **LOW**

**Key concern:**

Multiple indicators from the questionnaires confirm **reduced water availability**, **leaks**, **reliance on single water sources**, and **insufficient regional coordination.**

**Top risks (current vs future)**




**WHAT MUNICIPALITY OF STRUMICA MUST PRIORITIZE**

**3. The Municipality's Critical Risk Gaps**

**A. Heat stress (general population) - highest overall risk gap**

Gap = Future risk (3) – Readiness (1) = +2

This is the single most urgent climate vulnerability.

Actions missing: cooling centers, heat-island reduction, effective warning systems, cooling for public buildings.

---

**B. Food security due to higher food prices — severe future risk**

Gap = **3 – 1 = +2**

The municipality lacks:

- early-warning/monitoring systems
- food support programs
- support for local producers
- urban/community farming initiatives

This will hit low-income families hardest.

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**C. Water scarcity — persistent, structural vulnerability**

Gap = 2 – 1 = +1

Missing readiness areas include:

- leakage reduction
- smart irrigation
- backup water sources
- regional cooperation
- water-saving programs

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**D. Wildfire impacts — high present exposure**

Although readiness is medium, wildfire risk is deeply embedded in both natural and built-environment systems.

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**E. Crop production and ecosystems — readiness too low**

Both have Medium future risk but only Low readiness.

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**4. Three Most Important Messages**

**Strumica faces an escalating public-health threat from extreme heat.**

The combination of High current + High future + Low readiness makes this the municipality's top climate emergency.

**Food and water security will deteriorate without immediate adaptive measures.**

Future High food-price risk and Medium water-scarcity risk are major social-stability concerns.

**Agriculture and fire-sensitive ecosystems require urgent investment.**

Crop production and natural systems form the backbone of Strumica's economy—but adaptability is currently too low for rising climate stress.

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**5. Top Recommended Actions (Next 12–24 Months)**

**A. Heat Risk (highest priority)**

- Establish cooling centers in public buildings
- Expand green spaces & shading
- Introduce heat early-warning SMS system
- Improve ventilation/insulation in schools and elderly facilities
- Workplace heat-protection enforcement

**B. Food & Water Security**

- Community gardens & local producer support
- Food-price monitoring unit
- Emergency food support mechanism
- Repair municipal water leaks
- Expand water-efficient irrigation

**C. Wildfire Management**

- Firebreak maintenance & mapping
- Early-warning alarms (sirens/SMS)
- Community wildfire drills
- Protect settlements in the wildland-urban interface

**D. Agriculture Support**

- Promote climate-resilient varieties
- Introduce local agrometeorological services
- Provide training & insurance access

**E. Ecosystem Resilience**

- Reforestation after fires
- Biodiversity monitoring
- Map carbon-sink zones
- Update land-use plans to incorporate climate refugia

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**6. Summary**

Strumica's biggest climate threats are extreme heat, rising food insecurity, wildfire exposure, and increasing pressure on water and agricultural systems—while readiness remains too low to match future risks.

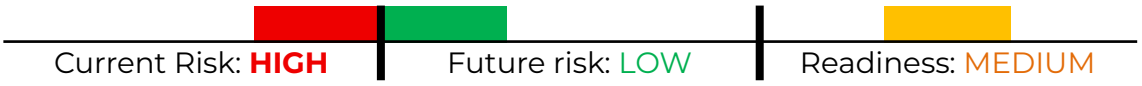
## Risk Profile – Municipality of Sandanski

Across all five clusters (Ecosystems, Food, Health, Infrastructure, Economy & Finance), the most significant risks—based on current and future severity—are:

**A. Public Finances (Economy & Finance Cluster)**


This suggests strong exposure to climate-related fiscal shocks, such as emergency spending, recovery costs, and disrupted revenue streams. Although readiness is high, the financial system remains highly sensitive to risk escalation.

**B. Wildfire Impacts on People & Buildings (Health Cluster)**



Even though future risk is estimated lower, **current exposure is already high**, especially where buildings, settlements, or tourist zones intersect with forests. Local-level actions matter most here.

**C. Biodiversity & Carbon Sinks Lost to Wildfires (Ecosystems Cluster)**


Ecosystems are already impacted, but the municipality has **strong adaptive capacity** (reforestation, fuel-management, restoration plans). Maintaining these programs is critical.

**D. Food Security Due to Higher Food Prices (Food Cluster)**

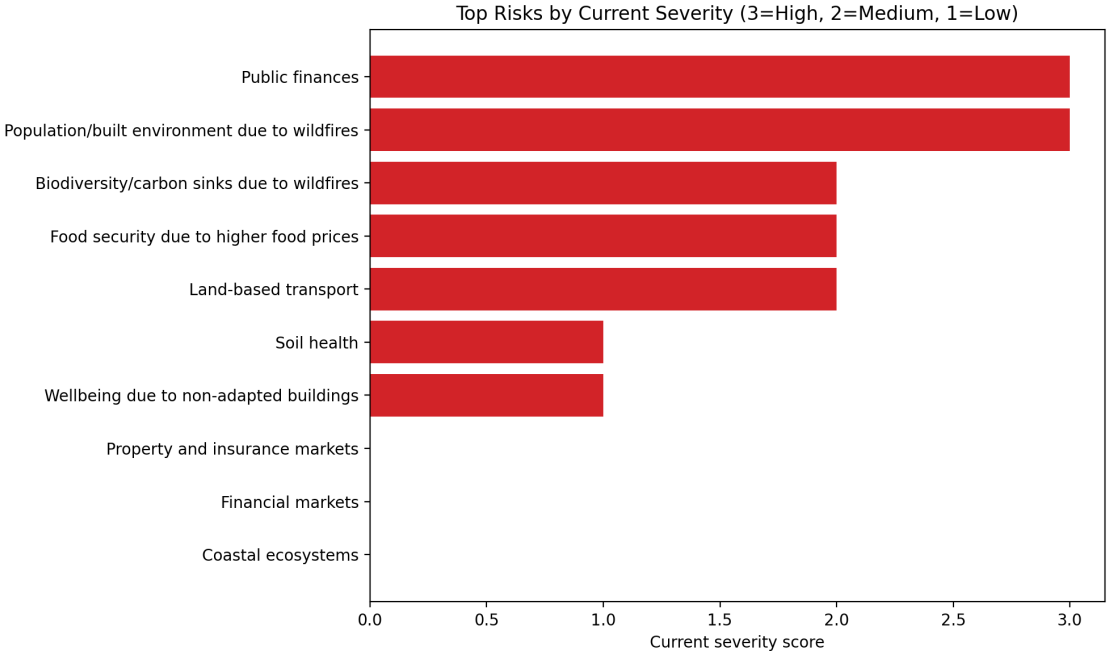

- **Responsibility: Co-Owned (Local + National)**

This is one of the **largest readiness gaps**. Vulnerable groups, market dependencies, and rising input costs create food affordability problems, an issue that will likely intensify.

**E. Property & Insurance Markets + Financial Markets (Economy & Finance)**

Both risks have:


This indicates **unpreparedness** for climate-related market volatility, insurance premiums, or investment impacts. These gaps should be addressed urgently.




## WHAT MATTERS MOST FOR ACTION

### Critical Messages for Decision-Makers

### A. The municipality's biggest exposure is economic.

Public finances, property markets, and financial systems face medium to high risks, with two of these having no readiness capacity identified.

**Why this matters:**
Economic fragility directly affects the municipality's ability to absorb shocks, invest in adaptation, and protect vulnerable households.

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### B. Wildfire-related impacts remain the most acute physical hazard.

- High risk to population and built environment
- Medium risk to ecosystems
- Local responsibility is high—meaning local governance plays a central role

**Why this matters:**
Even if future projections show decreasing wildfire risk, the present burden remains high, especially near settlements, forests, and tourism zones.

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### C. Food security is a growing social risk with insufficient readiness.

Medium risk but Low readiness means residents, especially low-income groups—are vulnerable to food price spikes.

**Why this matters:**

Food insecurity is a major driver of social inequality and political instability.

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**D. Infrastructure risks are currently manageable but need modernization.**

- Land-based transport: Medium current risk, Low future risk, Low readiness
- Most other infrastructure risks: Low overall

**Why this matters:**

Maintaining roads, drainage, and energy systems in a changing climate avoids larger costs later.

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**5. Top Five Priority Actions (Based on Gaps + Risk Severity)**

**1. Strengthen preparedness for food price shocks**

Examples: *local vouchers, food banks, local producer support, monitoring systems*.

**2. Introduce climate-related stress tests for municipal budgets**

Since public finances are highly exposed, budgeting frameworks should simulate droughts, wildfires, and tourism shocks.

**3. Build readiness capacity in the insurance & financial markets sector**

Municipality should coordinate with national regulators to develop local risk mapping, awareness campaigns, and incentives for resilient construction.

**4. Maintain and professionalize wildfire response systems**

- Improve evacuation planning
- Continue fuel-management programs
- Protect buildings in forest-adjacent areas

**5. Improve transport infrastructure heat-resilience**

Especially for roads vulnerable to extreme heat and freeze–thaw cycles.

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**6. Stakeholder Coordination Needs**

Based on responsibility distribution:

- **National level** owns *most* risks → requires stronger vertical coordination.
- **Local level** must continue leading wildfire and health-related risk management.
- **Co-Owned (Local + National)** issues (e.g., food prices) require shared strategies.
- **EU-related risks** (e.g., fisheries, supply chains) depend on broader policy frameworks.

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**7. Final Takeaway**

Sandanski Municipality biggest immediate threats are wildfire impacts and food price vulnerability, while the most strategic long-term risks lie in economic and financial exposure—where readiness is currently weakest.

# ANNEX II Community Workshops – The Findings

## Municipality of Campobasso - Community Workshop – The Findings

The community workshop held in March 2026 by GAL Molise explored the intersection of participatory budgeting and environmental action. Conducted in a hybrid format, the session aimed to engage local stakeholders in identifying climate risks and prioritizing green infrastructure investments. Central to the discussion was the presentation of a Climate Risk and Vulnerability Assessment toolkit, designed to help municipalities make evidence-based decisions regarding resource allocation. The Municipality of Campobasso served as a primary case study, illustrating how direct citizen involvement can successfully foster sustainable development and community transparency. Ultimately, the report concludes that such collaborative governance tools are essential for strengthening local resilience and addressing urgent ecological challenges in the region.

**Analysis of the Findings from the GAL Molise Community Workshop**

**Workshop Overview and Strategic Context**

The community workshop, held on March 16, 2026, served as a critical milestone for the Green B-Leaf project within the Molise region. Organized by GAL Molise, the session was conducted in a hybrid format, allowing for a diverse range of participation through both online and in-person attendance. The primary objective was to bridge the gap between theoretical governance tools and local environmental needs, specifically focusing on participatory budgeting (PB) and climate resilience.

The workshop was contextualized within the broader framework of the Green B-Leaf project, with opening remarks providing updates on recent international developments, such as the partnership meeting held in Valencia in February 2026. This positioning helped participants understand that their local inputs were part of a larger, coordinated effort to advance environmental sustainability and green public policies across Europe.

**Participatory Budgeting: A Tool for Civic Engagement and Green Investment**

A significant portion of the workshop's findings centered on the utility of participatory budgeting as a governance mechanism. The source material defines PB as a tool that allows citizens to participate directly in decision-making processes, thereby identifying local needs and setting investment priorities.

The workshop highlighted several key insights regarding PB:

- Institutional Continuity: The experience of the Municipality of Campobasso provided a powerful case study. Represented by Mr. Bartolomeo Terzano, the municipality revealed that PB practices initiated under a previous administration were successfully maintained and expanded by the current one. This suggests that PB can transcend political cycles, providing a stable platform for long-term

community engagement.

- Beyond Financial Scale: Although the financial resources currently allocated to PB in Campobasso remain relatively modest, the findings suggest its value is not solely monetary. Instead, its primary success lies in fostering community engagement and rebuilding the trust-based relationship between citizens and local government institutions.
- Strategic Alignment: PB is increasingly recognized as a strategic instrument for climate action. By involving stakeholders in defining green priorities, municipalities can ensure that public funds are directed toward green infrastructure and adaptation measures that have local support and relevance.

**Technical Empowerment: The CRVA Toolkit**

A core finding of the workshop was the necessity of evidence-based tools to guide political and financial decisions. Cinzia De Letis introduced the Climate Risk and Vulnerability Assessment (CRVA) toolkit, a practical instrument designed to help municipalities integrate climate considerations into their budgeting processes.

The analysis of the toolkit's role revealed its potential to:

1. Structure Decision-Making: It provides a systematic approach to identifying climate hazards and evaluating the adaptive capacity of a territory.
2. Prioritize Interventions: By assessing exposure and vulnerability, the toolkit allows local authorities to allocate resources more effectively to the areas or sectors most at risk.
3. Enhance Transparency: Using structured data to justify budgeting decisions makes the allocation of resources for green actions more transparent and easier to communicate to the public.

**Territorial Challenges and Local Priorities**

The workshop facilitated a "Public Debate" specifically aimed at identifying risks and vulnerabilities unique to the Molise region. Participants were encouraged to reflect on which sectors and population groups are most susceptible to climate-related pressures and which green infrastructures would be most feasible within the local context.

A notable finding was the unique challenge posed by the territorial structure of GAL Molise, which represents multiple municipalities. Unlike other project partners who might focus on a single urban area, GAL Molise had to adapt the workshop format. While this structural constraint prevented hands-on group work or the direct compilation of the CRVA tool during the session, the demonstration of the toolkit was still deemed successful in achieving its objectives. This indicates that even in complex, multi-municipal contexts, awareness-building and capacity-building are achievable through targeted demonstrations and collective dialogue.

**Strategic Conclusions and Future Directions**

The workshop concluded that there is strong stakeholder support for strengthening participatory governance in Molise. The findings underscore that:

- User-friendly tools are essential for enabling municipalities to move from general climate goals to concrete, data-driven investments.
- There is a clear appetite among local representatives, such as those from Campobasso, to expand the use of PB despite existing financial or structural limitations.
- The engagement from participants confirmed that the topics of climate risk assessment and participatory governance are highly relevant to the local population and institutions.

Ultimately, the workshop laid the groundwork for the future application of participatory budgeting supported by climate risk assessment tools. It demonstrated that fostering a shared understanding of local priorities is a prerequisite for making informed, inclusive, and effective decisions regarding the environmental and climate challenges facing the Molise region.

**Conclusion**

The community workshop held by GAL Molise on March 16, 2026, yielded several key conclusions regarding the integration of participatory governance and climate resilience. The primary conclusions from the session include:

- **Effectiveness of Practical Tools:** The workshop effectively demonstrated that concrete and user-friendly tools, such as the Climate Risk and Vulnerability Assessment (CRVA) toolkit, are essential for supporting municipalities. These tools assist local authorities in assessing climate risks, identifying specific vulnerabilities, and prioritizing local needs for strategic resource allocation.
- **Strengthening Participatory Budgeting (PB):** A major conclusion was the potential for these tools to enhance participatory budgeting processes. By utilizing structured, evidence-based approaches, municipalities can make more informed, transparent, and inclusive decisions when addressing environmental and climate challenges.
- **Adaptability to Structural Constraints:** Despite GAL Molise's unique territorial structure—which represents multiple municipalities and prevented the hands-on group sessions used by other partners—the workshop successfully achieved its objectives. The toolkit demonstration proved that it is possible to promote awareness and build capacity even within structural limitations.
- **Value of Civic Engagement:** The experience of the Municipality of Campobasso highlighted that participatory budgeting is a powerful tool for fostering community engagement and strengthening the bond between citizens and local institutions. Stakeholders confirmed that this practice is effective even when financial resources are relatively modest.
- **Stakeholder Validation and Relevance:** The positive feedback from participants and institutional representatives confirmed that climate risk assessment and participatory governance are highly relevant topics for the region. The workshop succeeded in encouraging a shared understanding of local priorities.
- **Foundations for Future Action:** Ultimately, the workshop served to lay the

groundwork for the future application of participatory budgeting practices supported by climate risk assessment tools across the Molise territory.

## Municipality of Pilea - Hortiatis - Community Workshop – The Findings

**Workshop Context and Participation Overview**

The community workshop for the Municipality of Pilea-Hortiatis (PP6), held on February 26, 2026, served as a critical milestone for the Green B-LEAF project. The event brought together 22 participants, comprising 14 women and 8 men, including municipal staff (permanent and contracted), external experts, and local citizens. The primary objective was to introduce the Green Participatory Budgeting (Green PB) model and to gather qualitative data on climate risks, vulnerable populations, and green infrastructure priorities within the municipality. This collaborative environment was designed to foster dialogue and lay the groundwork for community-driven environmental governance.

**Identifying Local Climate Risks and Vulnerabilities**

The workshop revealed a significant consensus regarding the environmental threats facing the region. Wildfires were identified by 100% of participants (22 out of 22) as the most critical climate risk. This unanimous concern is attributed to the municipality's extensive forested zones and the collective memory of recent fire events. Secondary concerns included heatwaves, flooding, and pollution (each cited by approximately 36% of participants), reflecting the pressures of rising temperatures and urban environmental stress.

In terms of vulnerability, the analysis highlighted two primary areas of concern:

- Infrastructure and Transport: Identified by 68% of participants as the most exposed sector, emphasizing the risk climate events pose to mobility and essential services.
- Socially Vulnerable Households: 64% of participants noted that households—specifically the elderly, women, and children—face the greatest climate-related challenges, indicating that impacts are not felt evenly across the population.

Furthermore, there was a striking 91% consensus that climate vulnerability is geographically concentrated in specific "hotspots," likely neighborhoods near forested areas or those with aging infrastructure. This underscores a community demand for spatially targeted adaptation measures.

**Strategic Priorities for Green Infrastructure**

When discussing potential solutions, participants demonstrated a clear preference for nature-based interventions.

- Top Priorities: "River and floodplain restoration" (68%) and "Urban green spaces" (50%) were the most favored infrastructure projects. These choices indicate a community desire for projects that simultaneously mitigate risk and improve local

quality of life.
- Secondary Priorities: Sustainable transport and renewable energy projects were valued but seen as less urgent than immediate protective measures.

Despite the clear vision for these projects, the workshop identified a major bottleneck: **Funding.**
A total of 86% of participants cited "Lack of funding" as the primary barrier to implementing green infrastructure. While public awareness and political support were also mentioned, they were considered minor hurdles compared to the structural challenge of securing financial resources.

**The Prioritization Exercise and Most Voted Measures**
A key component of the workshop was a prioritization exercise where participants scored measures based on Impact, Feasibility, and Community Benefit. Three specific measures emerged with a perfect total score of 15:

1. **Wildfire prevention**
2. **School and public building upgrades**
3. **Green public spaces**

These "Most Voted Measures" reflect a pragmatic community orientation. The focus on wildfires addresses the most immediate threat, while the upgrades to schools and public buildings (which received 59% of the specific vote) link climate resilience with everyday community infrastructure.

**Future Governance and Engagement Models**
The workshop successfully highlighted a strong desire for shared governance. Participants expressed a clear preference for active involvement in municipal budgeting and decision-making for climate projects.
- Engagement Tools: Online platforms and surveys were identified as the most effective and accessible tools for future citizen engagement.
- Youth Focus: There was a noted emphasis on school-based and youth-focused initiatives to cultivate civic responsibility and climate awareness in younger generations.

**Conclusion**
The findings from the Pilea-Hortiatis workshop portray a community that is well-informed about its environmental vulnerabilities and eager to participate in the solution-building process. The 100% consensus on wildfire risk provides a clear mandate for the municipality to prioritize prevention in its 2026 budget. While financial constraints remain the most significant hurdle, the community's support for Green Participatory Budgeting suggests that a collaborative, transparent approach to resource allocation could effectively bridge the gap between municipal planning and citizen needs.

**Critical Climate Risks and Geographic Hotspots**

The most striking conclusion from the workshop is the unanimous consensus on wildfire risk, with 100% of participants (22 out of 22) identifying it as the most critical threat to the municipality. This intense concern is attributed to the area's extensive forested zones and the collective memory of recent fire events. Secondary concerns include heatwaves, flooding, and pollution, each identified by approximately 36% of participants, illustrating the complex intersection of rising temperatures and urban environmental stress.

Furthermore, 91% of participants agreed that climate vulnerability is geographically concentrated. This consensus suggests that specific neighborhoods—likely those adjacent to forests, in flood-prone zones, or with aging infrastructure—face heightened exposure, reinforcing the need for spatially targeted adaptation measures rather than uniform municipal policies.

**Vulnerability of Infrastructure and Social Groups**

In assessing sectoral impacts, the community concluded that critical infrastructure and transport systems face the highest exposure (68%), followed closely by households and socially sensitive groups, such as the elderly, women, and children (64%). This prioritization reflects an understanding that climate impacts are not distributed evenly and that disruptions to essential services disproportionately affect those with reduced adaptive capacity. While water supply and local businesses were recognized as vulnerable, they were considered to be at a more moderate risk level.

**Prioritized Green Infrastructure and Nature-Based Solutions**

Participants expressed a clear preference for nature-based solutions over technical or purely administrative interventions. The top priorities for green infrastructure were:

- River and floodplain restoration (68%).
- Expansion of urban green spaces, including parks, trees, and green roofs (50%).

These choices indicate a community desire for projects that simultaneously reduce climate risks and enhance the daily quality of life. While sustainable mobility and renewable energy were valued, they were perceived as secondary to the immediate, protective needs of wildfire prevention and urban greening.

**Barriers to Implementation**

A significant finding of the workshop is the identification of funding as the primary bottleneck for climate action. 86% of participants cited a "Lack of funding" as the most significant barrier, far surpassing concerns regarding public awareness (23%) or political support (18%). This suggests that while there is strong community and institutional willingness to advance climate initiatives, the municipality faces a structural challenge in securing the necessary financial resources to move from planning to execution.

**Strategic Measures and Future Governance**

The prioritization exercise revealed three measures that achieved a perfect total score of 15 based on impact, feasibility, and community benefit:

1. Wildfire prevention.
2. School and public building upgrades.
3. Green public spaces.

Regarding future governance, the workshop concluded with a strong demand for shared

decision-making. Participants identified online platforms and surveys as the most effective tools for engagement, reflecting a need for accessible and inclusive participation. Additionally, there was a strong emphasis on youth-focused and school-based initiatives to cultivate climate awareness and civic responsibility in the next generation. Overall, the community demonstrated a clear willingness to take an active role in municipal budgeting to ensure that local resilience strategies reflect citizen needs.

## Municipality of Beltinci - Community Workshop – The Findings

The report summarizes a community workshop held in the Municipality of Beltinci to evaluate local climate-related risks and develop practical adaptation strategies. A diverse group of stakeholders identified vulnerabilities across five primary sectors, including ecosystems, food systems, public health, infrastructure, and finance. Participants proposed and ranked various resilience measures, such as implementing nature-based land management, upgrading water supply networks, and promoting climate-smart agriculture. The event emphasized the need for a holistic approach that combines infrastructure modernization with community education to safeguard the region's long-term stability. Ultimately, the document outlines a coordinated roadmap for mitigating the impacts of extreme weather events like floods, droughts, and heatwaves.

**Analysis of Findings from the Beltinci Community Workshop**

**Overview and Methodology**

The community workshop for the Municipality of Beltinci, held on March 30, 2026, served as a critical participatory milestone for Activity 1.1 of the Green B-LEAF project. Facilitated by Kristina Koter and Simona Roudi, the session gathered 15 participants, representing a strategic mix of 11 municipal administrators and 4 representatives from local community associations and NGOs. The workshop's primary objective was to engage these stakeholders in a critical assessment of local conditions, moving from the theoretical identification of climate-related risks to the proposal of actionable, evaluated solutions.

The workshop employed a structured methodology: an initial presentation on Data Mapping and Vulnerability Assessments was followed by interactive group sessions. Participants were divided into five thematic clusters—Ecosystems, Food, Health, Infrastructure, and Economy/Finance—to identify specific vulnerabilities and propose green infrastructure solutions.

**Sectoral Vulnerability Analysis**

**Ecosystems** and Natural Areas Group findings highlighted a tension between human accessibility and environmental conservation. A significant management challenge exists regarding field and forest pathways within protected areas; inadequate maintenance here leads to habitat disturbance and soil degradation. Furthermore, abandoned gravel pits represent a major environmental concern, as extraction sites often lack adequate

restoration, resulting in safety risks and missed ecological reuse opportunities. Finally, poorly maintained riverbeds were identified as a primary driver of increased flooding and erosion risks.

**Food Systems and Agriculture**

The analysis revealed that Beltinci's food sector is hampered by long supply chains, which increase dependency on external markets and reduce transparency. Environmental concerns are also high regarding the quality of food, specifically the excessive use of agricultural chemicals that damage soil health and consumer trust. A lack of coordination among farmers currently results in low levels of local self-sufficiency.

**Public Health and Quality of Life**

Participants identified three primary health risks driven by environmental factors: winter air pollution from residential solid fuel heating, groundwater contamination from agricultural pesticides and fertilizers, and extreme summer temperatures. These heatwaves pose significant risks of dehydration and heat stress, particularly for the municipality's elderly and at-risk populations.

**Infrastructure and Public Utilities**

A critical vulnerability identified is the combined sewage system, which fails to separate wastewater from stormwater. This design leads to system overloads during heavy rainfall, increasing the risk of urban flooding and environmental contamination. Additionally, the aging water supply network and local roads are increasingly susceptible to seasonal stresses and extreme temperatures.

**Economy and Public Finance**

The economic analysis underscored that climate hazards carry direct financial burdens. Floods disrupt productivity and incur high recovery costs, while heatwaves reduce work efficiency and spike public spending due to increased energy consumption for cooling systems.

**Proposed Strategic Solutions**

Nature-Based and Ecosystem-Friendly Management Across the sectors, a central theme emerged: the adoption of nature-based solutions. For ecosystems, this involves planting native (autochthonous) plant species to boost biodiversity and water retention. For water management, participants proposed sustainable regulation of watercourses and the development of water protection embankments to restore natural aquatic dynamics.

**Climate-Smart Agriculture and Local Systems**

To address food vulnerabilities, the workshop proposed Climate-Smart Farming, which includes improved irrigation, frost protection, and adaptable crop varieties. Strengthening local food systems through producer cooperatives and market-oriented procurement by public institutions was identified as a way to enhance economic resilience and reduce transport-related emissions.

**Public Health and Infrastructure Modernization**

Proposed health interventions include financial support for cleaner heating methods and upgrading the water supply network's integrity to prevent chemical contamination. For infrastructure, participants emphasized using cohesion funding for sewage

modernization—specifically the separation of wastewater and stormwater—and the climate-resilient upgrading of local roads.

**Evaluation and Ranking of Measures**

The workshop concluded with a collective evaluation of the proposed solutions based on three criteria: Impact, Feasibility, and Community Benefit, each scored on a scale of 1 to 5.

- **Highest Ranking Measures:**
  - Water Resilience Measures: Including irrigation, rainwater harvesting, and drought protection, received perfect scores (5/5) across all categories due to their immediate necessity for both the economy and ecosystems.
  - Heat Mitigation Actions: Tree planting, urban shading, and cooling devices were highly valued for their direct benefit to vulnerable populations (Total Score: 5/5).
  - Climate-Smart Farming: Essential for stabilizing local production and ensuring food security (Total Score: 5/5).
  - Sewage Modernization: While scoring slightly lower on immediate feasibility (4/5) due to its complexity, it was ranked as having a maximum impact and community benefit (5/5).

**Conclusions**

The findings from the community workshop in the Municipality of Beltinci established that local climate risks are deeply interconnected, impacting multiple sectors and dimensions of quality of life simultaneously. The participants concluded that addressing these vulnerabilities requires a holistic strategy that integrates environmental protection, climate adaptation, and economic resilience.

Key conclusions from the workshop include:

- Adoption of Nature-Based Solutions:
  A central strategic theme was the shift toward nature-based and ecosystem-friendly management. Measures such as planting native plant species and sustainable land management were identified as essential for boosting biodiversity, soil stability, and natural defenses against floods and droughts.
- Climate-Smart Agriculture and Local Systems:
  To ensure food security, the workshop emphasized the transition to Climate-Smart Farming, which includes improved irrigation, frost protection, and adaptable crop varieties. Strengthening local food systems through cooperatives, shorter supply chains, and local institutional procurement was concluded to be a primary way to support the local economy and reduce environmental impacts.
- Prioritization of Water Management:
  Effective water management emerged as a critical priority. Participants proposed the regulation of watercourses and the modernization of infrastructure—specifically separating wastewater and stormwater in the sewage system—to balance water availability and prevent environmental contamination.
- Public Health and Environmental Links:

Strategic health interventions must target air pollution from residential heating and the growing risks of extreme summer heat. Proposed solutions include financial support for cleaner heating methods and the implementation of urban cooling measures like shading and greening to protect vulnerable populations.

- Economic Resilience and Financial Stability:
  From a financial perspective, the workshop concluded that proactive investments in green infrastructure and adaptation measures will minimize long-term damage costs. These actions protect agricultural productivity and public infrastructure, reducing the municipality's need for emergency financial responses.
- Capacity Building and Community Engagement:
  Success in these initiatives depends on continuous awareness-raising, training, and knowledge exchange, particularly within agricultural cooperatives. Participants expressed a significantly increased awareness of these challenges and a strong interest in the next steps of project implementation.

## Municipality of Strumica - Community Workshop – The Findings

**Analysis of Community Workshop Findings: Promo Idea Strumica**

**Workshop Overview and Participant Profile**

The community workshop, held on March 11, 2026, in Strumica, served as a critical platform under the Green B-LEAF project to engage the local population in environmental decision-making. A total of 22 participants attended, characterized by a significant youth presence, with 17 individuals falling within the 16–30 age range. This demographic focus was intentional, aiming to capture the specific perspectives, expectations, and priorities of the younger generation regarding local climate vulnerabilities and the potential of green infrastructure. The session was structured to move from identifying problems to mapping practical solutions and, finally, prioritizing those solutions within the framework of participatory budgeting.

**Identification of Local Climate Vulnerabilities**

Participants were divided into five thematic groups to identify how climate change manifests in their daily lives. Their findings suggest that climate-related issues in Strumica are no longer abstract concepts but visible, everyday pressures.

- **Ecosystems and Public Spaces:** Group 1 highlighted a gradual loss and degradation of green areas. They expressed concern over the "growing pressure" local ecosystems face from heat, drought, and inadequate maintenance, specifically noting the risk of wildfires and the urgent need to protect local biodiversity.
- **Food Security and Agriculture:** Group 2 focused on the vulnerability of local agriculture to high temperatures. This group noted that climate impacts on farming do not just affect producers but lead to broader community issues, such as reduced food availability and rising prices.

- **Public Health and Well-being:** Group 3 identified extreme summer heat as a primary risk. They emphasized that the lack of shade and overheating in public spaces negatively impacts health, particularly for children and the elderly, while also raising concerns about deteriorating air quality.
- **Urban Infrastructure:** Group 4 discussed how existing infrastructure is ill-equipped for heavy rainfall and extreme heat. Key issues included drainage challenges and "overheated public surfaces," leading to a call for more climate-sensitive planning for streets and public spaces.
- **Economic Impact:** Group 5 connected environmental issues to financial consequences. They noted that climate damage and the resulting maintenance requirements create economic pressure for both individual households and the municipality through the need for additional public investment.

**Proposed Green Infrastructure Solutions**

In the second phase of the workshop, participants mapped out "practical and visible" improvements to address these vulnerabilities.

- Nature-Based Urban Solutions:
  Suggestions included introducing moss-based green façade solutions on public buildings in the town center and increasing the planting of local vegetation. These were viewed as both functional and symbolic steps toward a "greener municipality".
- Sustainable Food Practices:
  The focus shifted toward community-based initiatives, such as supporting local and seasonal food and raising awareness about sustainable consumption habits.
- Cooling and Shading:
  To combat heat, participants proposed additional tree planting and wooden shade elements in parks and playgrounds to make public spaces more usable during the summer.
- Greener Mobility:
  Infrastructure solutions centered on reducing car dependency by creating pedestrian-friendly spaces and supporting cycling through better-connected routes and parking.
- Education and Budgeting:
  A significant finding was the need to fund "soft" measures alongside physical infrastructure. This includes budget support for environmental education, awareness-raising, and youth-led initiatives to ensure the green transition is understood and supported by the wider public.

**Prioritization and Strategic Ranking**

A structured prioritization exercise evaluated proposed measures based on their Impact, Feasibility, and Community Benefit (each rated 1–5). The results highlighted a preference for measures that combine social relevance with practical visibility.The highest-ranked measure—budget support for education and youth initiatives (Score: 14)—underscores the participants' belief that a successful green transition requires an informed and engaged

community. Shaded public spaces (Score: 13) followed closely, reflecting the immediate physical need to address urban heat.

**Conclusion:**

**Integration with Participatory Budgeting**

The community workshop held in Strumica led to several key conclusions regarding the local youth's perception of climate change and their role in municipal planning:

- **Recognition of Climate Realities:** The workshop confirmed that young participants clearly recognize the environmental and climate-related pressures affecting their daily lives, such as extreme heat, insufficient shade, and the degradation of green areas. These issues are no longer viewed as abstract concepts but as visible, everyday challenges with growing financial implications for both households and local institutions.
- **Practical View of Green Infrastructure:** From a youth perspective, green infrastructure is understood as a set of practical and visible local improvements rather than just large-scale investments. Participants prioritized measures that directly enhance quality of life and health, such as shaded public spaces, small greening actions around schools, and improved support for cycling and pedestrian mobility.
- **Integration with Participatory Budgeting:** A central outcome was the strong link established between environmental priorities and participatory budgeting. Participants expressed a clear interest in having community needs directly reflected in local budget planning through accessible green measures.
- **Emphasis on "Soft" Measures:** The findings highlight that a green transition should involve more than just physical infrastructure; it must also include budget support for education, awareness-raising, and youth-led initiatives. This approach ensures the transition is supported by better public understanding and active community participation.
- **Prioritized Actions:** The prioritization exercise identified three top-ranking measures based on their impact, feasibility, and community benefit:
    1. Budget support for environmental education and youth initiatives (Score: 14).
    2. More shaded public spaces in parks and schools (Score: 13).
    3. Moss-based or similar green façade solutions on public buildings (Score: 12).
- **Value of Youth Perspective:** Overall, the workshop demonstrated that younger community members provide valuable insights into local vulnerabilities and solutions. Their participation is seen as essential for shaping more inclusive, informed, and effective local decision-making regarding green infrastructure and budgeting.

## Municipality of Faro - Community Workshop – The Findings

**Analysis of Findings: Community Workshop for Climate Adaptation (Estoi, Faro)**

**Overview and Methodology**

The community workshop, held on March 24, 2026, in Estoi (Faro), brought together 25 participants, including representatives from the municipal administration, NGOs, and local institutions. Organized under the Green B-LEAF project, the session aimed to validate the results of the Climate Risk and Vulnerability Assessment (CRVA) and identify green infrastructure solutions through a participatory approach. The methodology integrated technical presentations with two thematic group work sessions and a final prioritization exercise,.

**Key Climate Risks and Geographic Hotspots**

The analysis revealed a strong consensus regarding the most significant climate threats facing the parish of Estoi.

- Primary Threats: Participants identified flooding, wildfires, and heat-related health impacts as the most critical risks,.
- Geographic Vulnerability: Rural and peri-urban areas were identified as vulnerability hotspots due to dispersed settlements, agricultural land use, and limited infrastructure capacity,.
- Specific Hotspots: The Ribeira do Rio Seco was highlighted as a major flood risk area, exacerbated by insufficient maintenance of watercourses and existing infrastructure.

**Sectoral Findings: Vulnerabilities and Proposed Solutions**

The workshop findings were categorized into five thematic sectors, revealing specific fragilities and community-led adaptation strategies.

**Water Management and Scarcity**

Participants noted that the combination of flooding and water scarcity threatens both urban infrastructure and agricultural land.

- Proposed Solutions: Priorities include the cleaning and rehabilitation of the Ribeira do Rio Seco and the restoration of traditional water infrastructure such as fountains, tanks, and reservoirs to improve storage and preserve local heritage,. At a larger scale, nature-based solutions like retention basins and increased vegetation cover were proposed to enhance water infiltration.

**Energy Resilience**

The local energy system is characterized by a dependence on external sources and a lack of efficiency, making essential services—such as schools and health centers—vulnerable to extreme weather events,.

- Proposed Solutions: The group proposed a transition to solar-powered LED public lighting and improving the energy efficiency of public buildings,. A critical measure identified was increasing energy storage capacity to reduce reliance on external

fossil-fuel generators.

**Public Health and Environmental Stressors**

Concerns were raised regarding the accessibility and capacity of health services, specifically restricted pharmacy hours and health center availability,. Environmental factors like air pollution, noise, and heat exposure were identified as significant risks for the elderly and children.

- Proposed Solutions: Suggested interventions include expanding health center hours and home-care services, alongside environmental measures like green buffers (tree planting) and noise barriers,.

**Agriculture and Land Management**

Vulnerability in this sector stems from land abandonment, poor vegetation management, and waste accumulation, which heighten the risk of river overflow and wildfires,.

- Proposed Solutions: The community focused on revitalizing rural areas through community gardens in abandoned orchards and the creation of multifunctional parks,. Training activities and support for landowners were also seen as essential for landscape resilience.

**Infrastructure and Urban Livability**

Current urban spaces suffer from heat accumulation due to a lack of shade and vegetation, leading to the degradation of roads and pavements,.

- Proposed Solutions: The requalification of Rua de Faro was a key proposal, involving tree planting, traffic reorganization, and improved accessibility to enhance thermal comfort. Other measures included the reinforcement of Ponte de Milreu and the transformation of underused spaces like “Campo da Bola” into shaded leisure areas,.

**Prioritization and Strategic Measures**

The prioritization exercise used criteria of impact, feasibility, and community benefit to rank the proposals. Four measures received the maximum score of 15, marking them as immediate priorities for the Participatory Budgeting process,:

1. Energy: Replacement of public lighting with solar energy and LED solutions.
2. Water: Requalification of fountains, tanks, and water lines.
3. Infrastructure: Urban redesign and greening of Rua de Faro.
4. Agriculture: Development of the “Aldeia Core” (community gardens, workshops, and events).

**Transversal Findings and Implementation Barriers**

The workshop conclusions highlighted several systemic themes:

- Social Vulnerability: There is a recurring need to address the fragility of elderly populations and isolated households alongside physical infrastructure upgrades,.
- Implementation Barriers: Lack of funding was consistently identified as the primary obstacle to implementing adaptation measures. Gaps in technical knowledge and institutional coordination were also noted,.
- Governance: Participants expressed a strong preference for participatory

decision-making, viewing the workshop format as the most effective mechanism for citizen engagement.

**Conclusion**

The workshop successfully integrated scientific data with local knowledge to create a context-specific adaptation roadmap for Estoi. The findings emphasize a preference for practical, visible, and implementable solutions that provide immediate community benefits while addressing long-term climate resilience. These outcomes serve as the foundation for translating priorities into concrete proposals within the Green B-LEAF Participatory Budgeting framework.

The following key findings and strategic directions emerged from the session:

**Consensus on Climate Risks and Vulnerabilities**

The workshop validated that local perception is primarily shaped by high-impact, visible events.

- Primary Threats: Participants reached a strong consensus that flooding, wildfires, and heat-related health impacts are the most significant threats to the parish.
- Geographic Hotspots: Rural and peri-urban areas were identified as particularly exposed due to dispersed settlements, agricultural land abandonment, and limited infrastructure capacity.
- Systemic Fragilities: Critical points of vulnerability include water supply networks, drainage systems, and general infrastructure. Additionally, elderly populations and isolated households were highlighted as socially vulnerable groups requiring integrated adaptation strategies.

**Thematic Priorities for Adaptation**

Through sectoral group work, participants proposed a range of solutions focused on green infrastructure and community resilience:

- Water Management: Priorities include the cleaning and rehabilitation of watercourses (specifically Ribeira do Rio Seco) and the restoration of traditional water infrastructure like fountains and tanks to address both flooding and scarcity.
- Energy Resilience: There is a strong push for energy autonomy through solar-powered LED public lighting and improving the efficiency of public buildings, such as schools and health centers.
- Urban Livability: Proposed interventions focus on reducing heat accumulation in urban spaces through tree planting, particularly the requalification of Rua de Faro and the creation of shaded leisure areas like "Campo da Bola".
- Agriculture and Social Wellbeing: Solutions include the revitalization of abandoned orchards through community gardens and extending healthcare services (e.g., weekend hours and home care) to better support the elderly.

**Prioritized Actions (Highest Score: 15)**

Four specific measures were identified as having the highest impact, feasibility, and community benefit:

1. Energy: Replacement of public lighting with solar energy and LED solutions.
2. Water: Requalification of fountains, tanks, and water lines.
3. Infrastructure: Urban redesign and greening of Rua de Faro.
4. Agriculture: Development of the “Aldeia Core” (integrating community gardens, workshops, and events).

**Implementation Barriers and Governance**

- Funding Gaps: The lack of funding was consistently identified as the primary barrier to implementing these adaptation measures.
- Participatory Governance: There is a robust community preference for participatory decision-making. Participants viewed the workshop format as the most effective mechanism for citizen engagement and expressed a clear desire for this approach to continue within the Participatory Budgeting (PB) process.

In conclusion, the workshop provided a solid, evidence-based foundation for the next phases of the Green B-LEAF project, ensuring that future climate interventions are both technically grounded and locally supported

## Municipality of Vodnjan-Dignano-CommunityWorkshop-The Findings

The community workshop for the Green B-LEAF project was held on 8 April 2026 in Vodnjan-Dignano. Originally scheduled for late March, the event was postponed by ten days to ensure the participation of key stakeholders. A total of 11 participants attended, representing municipal administration (6), NGOs (4), and local institutions (1).

Due to the relatively small group size, the workshop methodology was adapted from five separate thematic breakout groups to a single plenary session. This session utilized the Mentimeter interactive platform, allowing all 11 participants to sequentially address five critical Climate Risk and Vulnerability Assessment (CRVA) clusters: Ecosystems, Food/Agriculture, Health, Infrastructure, and Economy/Finance. This approach ensured that every topic received comprehensive group attention while providing quantifiable, anonymous data for analysis.

**Section 1: Current Vulnerabilities and Community Experience**

The findings validate the CRVA’s identification of 30 climate risks, 24 of which are categorized as high severity. The workshop revealed a community already grappling with tangible climate impacts, particularly regarding water management, heat stress, and agricultural stability.

**1.1 Water Scarcity and Quality**

Water emerged as the most critical cross-cutting concern. Participants expressed significant alarm over illegal groundwater extraction, which received a concern score of 8.3/10, and general groundwater quality, which scored 7.1/10. The 2022 drought remains a

vivid benchmark for local vulnerability: 5 respondents reported their gardens drying up, and 4 experienced household water reductions.

### 1.2 Heat Stress Hotspots

Workshop data confirmed that urban heat is a localized threat. Roads without shade were identified as the primary heat stress location by 7 out of 11 respondents. The town centre of Vodnjan was also noted as a hotspot, while rural areas like Galizana and Peroj were not viewed as high-risk zones for heat.

### 1.3 Agricultural Risk

The local economy, heavily dependent on over 300,000 olive trees and 150,000 grapevines, is highly exposed to drought and extreme weather. Participants prioritized irrigation from local sources as the dominant agricultural need, with a score of 8/10.

### 1.4 Infrastructure and Flooding

Despite the absence of permanent watercourses, pluvial (rain-related) flooding is a widespread issue. Six participants reported experiencing road flooding, and five others were aware of similar cases, confirming that current infrastructure is poorly adapted to climate extremes.

## Section 2: Prioritized Green Solutions and Strategic Actions

Participants did not only identify problems but also ranked specific adaptation measures based on their impact, feasibility, and community benefit.

### 2.1 Nature-Based Ecosystem Solutions

The top-ranked measure for ecosystems was the coastal protection of Barbariga and Peroj, receiving a perfect priority score of 10. Other highly favored solutions included:

- Urban tree planting (Score: 8), viewed as a dual-purpose solution for ecosystem health and heat mitigation.
- Restoration of traditional ponds (lokve) (Score: 5), which showed high community awareness due to projects like the Istrian de Dignan farm.

### 2.2 Water Management and Regulations

There is strong community backing for water-sensitive development. A proposal for mandatory rainwater collection on new buildings received a high support score of 8.2/10. For infrastructure, participants prioritized permeable pavements and rain gardens over traditional "grey" infrastructure. One specific proposal involved utilizing rooftop and cistern water in the old town centre to simultaneously mitigate flooding and provide water for urban greening.

### 2.3 Health and Education

For heat stress mitigation, "More trees" was the undisputed top priority (Score: 14). Interestingly, citizen education was ranked second, ahead of built solutions like cooled

public spaces or fountains. This suggests that the community values knowledge-based and nature-based solutions over purely technological fixes.

**Section 3: Financial Governance and Participatory Budgeting**

The workshop highlighted a significant investment gap in climate resilience.

**3.1 Budgetary Inadequacy**

The current EUR 10,000 natural disaster budget reserve was unanimously deemed insufficient. All respondents agreed on the need for dedicated municipal climate adaptation budgets and enhanced county-level coordination for disaster response.

**3.2 Overall City Priorities**

When asked to rank the city's general priorities for future investment, participants placed them in the following order:

1. **Municipal Infrastructure**
2. **Healthcare**
3. **Environmental Protection**
4. **Agriculture**
5. **Energy Efficiency**
6. **Tourism** (ranked last, suggesting a shift toward core resilience over commercial development).

**3.3 Readiness for Participatory Budgeting**

The concept of green participatory budgeting was met with zero opposition. Approximately 73% of participants (8 out of 11) expressed a definite willingness to participate, with half of those preferring an online format.

**Conclusion**

The workshop outcomes provide a evidence base for the Green B-LEAF project's next steps. The community has clearly signaled that water security, urban cooling (through tree planting), and coastal protection must be the cornerstones of the green participatory budget. Furthermore, the findings emphasize that successful climate adaptation in Vodnjan-Dignano will require integrated planning—combining regulatory changes (like mandatory cisterns) with direct investments in green infrastructure and a significant increase in dedicated disaster reserves.

# ANNEX III Best practices in the field of PB and GPB

Among the activities in the Green B-LEAF project, the review of the best practices in partner countries related to participatory budgeting (PB), green PB, green infrastructure and climate resilience enabled the partners to understand the current situation in partner countries and to obtain knowledge about best solutions regarding this kind of budgeting process. In the period of September 2025 to January 2026 project partners gathered a large amount of information about successful examples of PB from previous years.

There are 16 unique examples of participatory budgeting and related practices documented across the provided sources. These are categorized as follows:

**Greece (4 examples)**

- Pilot Participatory Budgeting in the Municipality of Chalandri: A pilot focused on urban regeneration and public space improvements.
- Citizens' Participatory Budgeting Scheme in the Municipality of Ioannina: A recurring practice for small-scale citizen-proposed projects.
- Participatory Budget in the Municipality of Kifissia: A structured process using local assemblies to prioritize neighborhood needs.
- "FOLLOWGREEN" Program (Pilea-Hortiatis): A digital environmental engagement and recycling reward program.

**Bulgaria (3 examples)**

- "Reshava Sofia" / Citizens' Budgets "Ideas for the City": A large-scale, institutionalized PB mechanism for city-wide and district-level projects.
- HALO Foundation Citizen Budget Programme (Haskovo): A program focusing on smaller settlements and nature protection, supported by an NGO.
- Call for Project Proposals for Local Initiatives (Sandanski): A municipal-led pilot for beautifying inter-block spaces and green areas.

**Italy (2 examples)**

- Participatory Budgeting in the Municipality of Campobasso: An annual cycle allowing citizens to vote on projects across various thematic areas.
- Bologna Participatory Budgeting: A sophisticated model that explicitly integrates sustainability and climate neutrality criteria into the co-design process.

**North Macedonia & Western Balkans (7 examples)**

- Budgetary Forum Sessions in Berovo: A two-step forum process used to prioritize riverbed construction and community projects.

- Community Forums in Sveti Nikole: A process used to fund energy-efficiency renovations for local infrastructure like kindergartens.
- EU4Green (Multi-national Western Balkans): A support framework for implementing the Green Agenda and green finance across the region.
- Local Budget Forums in the Municipality of Strumica: A participatory mechanism for selecting priorities like electric public transport and solar installations.
- “Budget for All” (Krushevo): A practice focused on reaching rural residents to create a "citizen-friendly" version of the municipal budget.
- Youth Education on Public and Local Finance Management: A practice focused on building financial literacy among youth as a prerequisite for participation.
- Citizens’ Budget Platform: An online transparency tool designed to simplify budget information for the public, although currently underutilized.

**Differences between processes in a local context**

The sources indicate that while the core concept of participatory budgeting (PB) remains consistent—involving citizens in budget allocation—there are significant differences in **institutionalization, budget scale, methodology, and the level of green integration** across the different countries.

**1. Institutionalization and Scale**

There is a notable divide between large-scale institutionalized programs and smaller pilot initiatives:

- **Bulgaria:** Sofia's "Reshava Sofia" is a highly institutionalized model with a significant budget of 5.3 million BGN (approx. €2.7 million) and a structured two-tier system for city-wide and district-level projects.
- **Italy:** Bologna also shows a high level of institutionalization with a €3 million budget and a sophisticated co-design process involving municipal technicians and neighborhood districts.
- **Greece & North Macedonia:** In contrast, processes in these countries are often described as pilot phases or recurring initiatives with smaller budget envelopes, typically ranging from €15,000 to €200,000.

**2. Methodological Approaches**

The "stages" of participation vary by country:

- **North Macedonia:** The process frequently follows a "Forum Session" model. This typically involves two distinct parts: a first session for idea generation and a second session where prioritized ideas are voted on for the following year's budget. There is also a unique emphasis on financial literacy, with some programs focusing on educating youth about public finance as a prerequisite for PB.

- **Greece:** Greek municipalities often utilize "Neighborhood Assemblies" and structured stages (sometimes up to four) that move from information to representative election, proposal submission, and finally implementation.
- **Italy:** Bologna uses "Laboratori di Quartiere" (neighborhood laboratories) where citizens work alongside facilitators and technicians to "co-design" projects, ensuring technical feasibility before they reach the voting stage.

**3. Integration of Green/Climate Criteria**

The degree to which "Green" criteria are formalized varies significantly:

- **Italy (Bologna):** Sustainability is a foundational criterion for the entire PB cycle. Projects must explicitly align with the city's climate neutrality goals ("Missione Clima") from the earliest phase.
- **Bulgaria & North Macedonia:** In these contexts, green projects (like park renovations or energy efficiency) tend to emerge organically from citizen priorities rather than through mandatory "green" selection criteria.
- **Greece:** While some Greek practices like "FollowGreen" are dedicated entirely to environmental engagement (specifically recycling rewards), other PB practices in the country do not yet have formal mechanisms for climate tagging or green spending tracking.

**4. Lead Institutions and Rural Focus**

- **Bulgaria:** A distinct difference here is the role of NGO facilitators like the HALO Foundation, which acts as an intermediary to bridge administrative gaps in smaller or resource-constrained municipalities.
- **North Macedonia:** There is a specific focus on rural settlements to bridge urban-rural disparities. In Krushevo, consultations were decentralized to reach residents in villages up to 20 km from the municipal center, ensuring that rural needs were captured in the "Citizen Budget".

**5. Tools and Transparency**

- **Bulgaria & Italy:** These countries demonstrate advanced use of digital platforms (like Decidim in Sofia) to manage the entire cycle from submission to voting.
- **North Macedonia:** While digital tools exist (like the national gragjanskibudzet.mk platform), their uptake has been limited, and the focus remains heavily on in-person deliberative sessions.

## Guide for successful for a successful participatory budgeting (PB) process

Based on the diverse municipal practices across Greece, Bulgaria, Italy, and North Macedonia, a complete guide for a successful participatory budgeting (PB) process follows a structured cycle that moves from institutional preparation to public accountability.

**Phase 1: Governance and Preparation**

- Formal Legal Decision: The process must begin with a Municipal Council decision that defines the legal framework, the geographic scope, and a clear budget ceiling (e.g., €150,000 in Chalandri or €3 million in Bologna).
- Formation of a Coordination Body: Establish a dedicated Coordination Committee or joint working group consisting of municipal staff and, in some cases, NGO partners to manage the cycle.
- Defining Thematic Priorities: Determine if the call is open or thematic. For a "Green PB," sustainability criteria should be a foundational requirement for project eligibility from the start.

**Phase 2: Awareness and Civic Education**

- Capacity Building: Before asking for ideas, launch public awareness campaigns to inform citizens about their rights and the PB concept.
- Financial Literacy Training: A critical prerequisite is educating participants (especially youth) on how municipal budgets function, including tax awareness and the limits of fiscal space.
- Targeted Outreach: Use surveys and decentralized consultations in rural settlements to identify specific local needs and bridge urban-rural disparities.

**Phase 3: Idea Generation and Submission**

- Hybrid Submission Channels: Collect proposals through digital platforms (like *Decidim*) complemented by physical neighborhood assemblies or "Laboratories" to ensure accessibility for those with lower digital literacy.
- Open Call for Proposals: Invite residents, NGOs, and informal groups to submit project ideas that address local challenges, such as urban greening or small-scale infrastructure.

**Phase 4: Technical Screening and Co-Design**

- Feasibility Assessment: A municipal commission must vet all proposals against legal, technical, and financial criteria. This includes verifying municipal land ownership to avoid later delays.

- Co-Design Phase: Instead of just rejecting ideas, use facilitators and technicians to work with citizens to refine raw ideas into technically sound and sustainable project proposals.
- Written Feedback: Provide transparent feedback to all proposers, explaining why certain projects were admitted or rejected for the final vote.

**Phase 5: Deliberation and Voting**

- Public Presentation: Publish all eligible proposals on a digital platform for public review.
- Democratic Voting: Conduct a final vote using secure online systems (e-ID) or in-person ballots at community events. Define clear eligibility (e.g., residents aged 16+).
- Selection: The highest-ranked projects are prioritized for the upcoming budget year.

**Phase 6: Implementation and Monitoring**

- Budget Integration: Formally incorporate winning projects into the Annual Technical Program or municipal investment plan.
- Project Execution: Execute projects through standard municipal procurement procedures, typically over a 12–15 month timeline.
- Citizen Monitoring: Allow citizens to track the progress of implementation through dedicated online dashboards or commissions.

**Phase 7: Transparency and Evaluation**

- The "Citizen Budget": Create and publish a simplified, non-technical version of the final municipal budget to show exactly where funds were allocated.
- Post-Implementation Review: Document lessons learned and outcomes to refine the methodology for the next annual cycle.
- Traceability: Maintain a permanent web page that archives past projects and their current status to build long-term trust

## Improvements of the PB process

Based on the previously presented guide synthesized from the project sources, the following elements were frequently missed or faced challenges across various examples. While Bologna comes closest to the full model, it lacks certain advanced technical tracking mechanisms.

**Phase 1: Governance & Institutionalization**

- Missing Formal Institutionalization: Many processes, particularly in Greece (Chalandri) and North Macedonia (Strumica), function as one-off pilots or are not anchored in permanent legal acts, making them dependent on annual administrative commitment.
- Lack of Explicit "Green" Priority: Most examples (Ioannina, Campobasso, Krushevo) do not have mandatory green criteria; instead, environmental projects only emerge "organically" and must compete with other local development needs.

**Phase 2: Awareness & Civic Education**

- Low Initial Awareness: In Sofia and Sandanski, initial public awareness was as low as 10%, requiring massive investment in campaigns before participation could even begin.
- Financial Literacy Gaps: Most practices do not include the foundational education required for citizens to understand municipal budgets. The "Youth Education" practice in Macedonia identifies this as a major barrier, noting that only 15.5% of surveyed youth understood the taxes they pay.
- Information Gaps in Rural Areas: In Krushevo, it was noted that rural residents had zero previous experience with PB, leading to significant information barriers.

**Phase 3: Idea Generation & Submission**

- Digital vs. Physical Gaps: Some processes are heavily weighted toward one channel. For instance, the Macedonian Forum Sessions (Berovo, Sveti Nikole) focus on in-person attendance, which limits participation to very small groups (34–61 people). Conversely, Sofia initially struggled to reach marginalized groups who lack digital access.

**Phase 4: Technical Screening & Co-Design**

- Complexity of Site Ownership: A major technical hurdle missed in early planning for Sofia and Sandanski was the difficulty of verifying municipal ownership of proposed land, which caused significant delays in the feasibility phase.
- Lack of Co-Design Refinement: In Ioannina, the process misses a collaborative refinement stage; instead, municipal services simply review and select proposals, limiting formal citizen decision-making power.

**Phase 5: Deliberation & Voting**

- Underrepresentation of Demographics: Despite open calls, many examples missed the mark on inclusivity. In Krushevo, women accounted for only 16% of consultation participants, and youth engagement was also noted as low across multiple practices.

- Non-Binding Results: In Ioannina, the process is criticized because it does not constitute a "full PB cycle" with a binding citizen vote on final allocations.

**Phase 6: Implementation & Monitoring**

- The "Laborious Process" Delay: Several examples (Chalandri, Sofia) highlight a gap in milestone communication. Citizens often voted, but then faced a "laborious" 12–15 month wait for implementation with limited visibility on progress.
- Maintenance Challenges: Kifissia noted that while projects were built, they lacked a clear plan for long-term maintenance after completion.

**Phase 7: Transparency & Tracking**

- No Green Budget Tagging (GBT): Almost every example, including Bologna and Sofia, lacks a formal, systematic mechanism for measuring environmental impact or tracking green spending through tagged budget lines. Environmental evaluation remains largely qualitative.
- Underutilized Transparency Tools: The Macedonian "Citizens' Budget" platform exists but is essentially a "static transparency instrument" because only dozen out of 82 municipalities used it to publish their budget in a citizen-friendly format.

| Example | Primary Missing Elements |
|---|---|
| **Chalandri (GR)** | Annual repeatability; explicit green criteria. |
| **Ioannina (GR)** | Binding voting; co-design refinement; green criteria. |
| **Sofia (BG)** | Land ownership verification; climate impact scoring. |
| **Bologna (IT)** | Formal Green Budget Tagging (expenditure tracking). |
| **Krushevo (NMK)** | Gender and youth balance; formal climate framework. |
| **Strumica (NMK)** | Legal institutionalization; systematic green prioritization. |

# ANNEX IV Climate and Vulnerability Maps - The most common climate-related threats and data from each community.

## Quart de Poblet (Valencia, Spain)

Area: 19.6 $km^2$

Population: 25035 (2021)

The town of Quart de Poblet (2022) is located on the central coast of the Valencian Community in Spain. Bordering the sea, it is located only 4.9 km from Valencia, the capital city. The Turia river runs through the town from the north and to the west lies the Poyo ravine (Rambla del Poyo). Along with 17 other towns, it forms the “Huerta Sur” “comarque”. Quart de Poblet is a landscape surrounded by fruit crops with urban areas, housing estates, industrial estates and transport infrastructure typical of the metropolitan environments of large cities such as Valencia.

Quart de Poblet is characterized by a flat terrain that makes up simple hydrographic networks, mainly comprising the Turia river and the Rambla del Poyo. A small part of the town belongs to the Turia River National Park. As its next to the Gulf of Valencia, marine intrusion problems are present. These involve high concentrations of salt and highly degraded reservoirs, the result of chemical fertilizers used in agricultural activities, industrial discharge and wastewater infiltration.

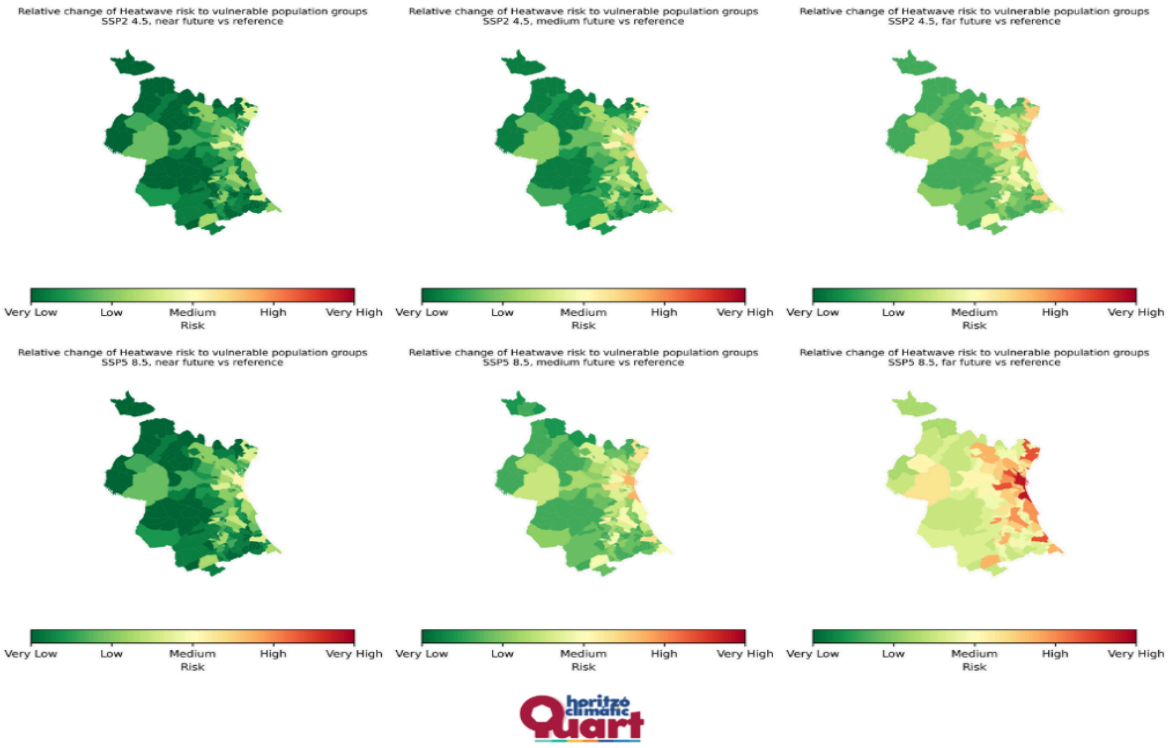
As part of the Valencian region, it experiences a Mediterranean climate, with hot, humid summers and mild winters. The average temperatures reach 18 °C, with August being the warmest (30 °C) and January the coldest (6 °C). High humidity is persistent, peaking between June and October. Winds shift seasonally, blowing from the west during the winter and the east in the summer. Rainfall is concentrated between September and May, October being the wettest month, while summers tend to be dry and clear.

A relevant finding (Fernandez-Garza, Gielen, Pulido-Velazquez, Avila-Velasquez, Rubio-Martin, Macian-Sobbies, 2025) is that from the period of 1979 to 2014, the intensity of heatwaves increased by 3.6 °C, more than double the internationally recognized 1.5 °C threshold, indicating that the Mediterranean region is experiencing a faster warming than the Northern Hemisphere average. Sea temperatures are more higher and humid than in the past, resulting in more intense and frequent heatwaves. Reduced rainfall and water evaporation has led to vegetation loss and increased exposure of bare soil. Beyond physical aspects, climate change has caused serious implications in human health and adaptation. The prolonged duration of heatwaves reduces recovery periods, which increases the risk of chronic heat stress, sleep deprivation and cumulative health damage.

Within this context, two population groups are vulnerable to heatwaves. Children up to 12 years are at high risk due to their physiology and limited ability to regulate body temperatures, with boys generally outnumbering girls, especially in municipalities such as

Quart de Poblet. Older adults aged 60 or above, are also highly vulnerable due to preexisting health conditions and reduced capacity to adapt to heat. In contrast to children, women outnumber men in this age group, a pattern that becomes more pronounced after the age of 75.

Graphic 1: Climate projections on heatwave risks to vulnerable population groups in the community of Valencia, Spain




Source: Quart de Poblet Advances Local Climate Risk Analysis through QCATI Project - Climaax

Forest fires (Corticos, Duarte, 2025), have also become a major environmental concern. These fires have been intensified by land abandonment, meteorological factors and urban expansion. One significant cause of fire intensity is dense vegetation accumulation caused by rural land desertion, acting as fuel for wildfires. Additionally, meteorological factors such as high temperatures and drought conditions add to the exposure of fire.

The region's geographical and hydrological characteristics have made it historically vulnerable to flooding. In 1957, the city of Valencia was hit by torrential rain, known to locals as "gota fria". It accumulated up to 300 liters of water per square meter within hours, destroying critical urban infrastructure and resulting in more that 80 deaths. The "Plan Sur" was a direct response to the tragedy. Conceived by the Spanish Government in collaboration with local authorities, it aimed at redirecting the Turia River from Valencia by detouring it southward. The execution of the plan not only required redesigning the river's course, but also the reorganization of road networks, irrigation systems and connections

between various neighborhoods in the city. The floods in 2024, caused by similar phenomena, had similar consequences in the areas where the modifications were made. The most affected areas included the Ribera Alta, the Huerta Sud and municipalities such as Chiva and Utiel, where rivers and streams overflowed (Polo-Martin, 2025).

The Turia River, which runs through Quart de Poblet, forms a part of the planning scope of Xuquer River Hydrological Plan. According to the plan, the town is classified as a "ASPRF", an Area with Significant Potential Risk of Flooding. Nature-based solutions (NBS) have been favored as ways to build resilience against episodes of flooding. For instance, involving farmers and landowners in floodplain restoration ensures practical, community-driven outcomes. NBS policy frameworks ensure coherence between environmental, urban planning and social-economic goals by aligning NBS initiatives with existing laws. The city of Valencia's dam removal projects demonstrate how local governments can align sustainable water management policies with regional ecological restoration goals (Corticos, Duarte, 2025).

## Faro (Faro, Portugal)

Area: 202.57 $km^2$

Population:

Municipality: 70347 (2024)

Faro is the southernmost city in continental Portugal. Located in the Faro Municipality, it is the capital of the Algarve region. The city is surrounded to the north, east and west by an agricultural countryside and to the south by the Atlantic Ocean, where the wetland Ria Formosa coastal system is located (Berte, Panagopoulos, 2014). One of the most vulnerable areas in Portugal, Ria Formosa is a nature reserve that includes a coastal lagoon that is protected from direct ocean impact via sandy barrier islands and reserves split into bays. Due to its ecological importance, it was established as a natural park, for which a multitude of governmental organizations, national, regional organizations and municipalities are responsible for its management (Domingues, Costas, de Jesus, Ferreira, 2014). Both the city and region of Faro based their economy on tourism, with Ria Formosa playing an important role. In addition to the reserve's use by tourists and residents for leisure, it supports other economic activities such as seafood farms and harbors.

Faro has a moderate Mediterranean climate. Summers are warm and hot and sunny with average daytime temperatures of 35 °C. The annual average temperatures are around 17 °C, with rainfall reaching about 350 mm. The city has identified three main urban threats in basing their climate adaption plans: heatwaves, droughts and flooding. Climate change scenarios prognose that the Mediterranean will be more drier and exposed to heatwaves in the near future. Portuguese climate is characterized by dry and hot summers, with temperatures above 22 °C during the hottest months, while colder months are between 0

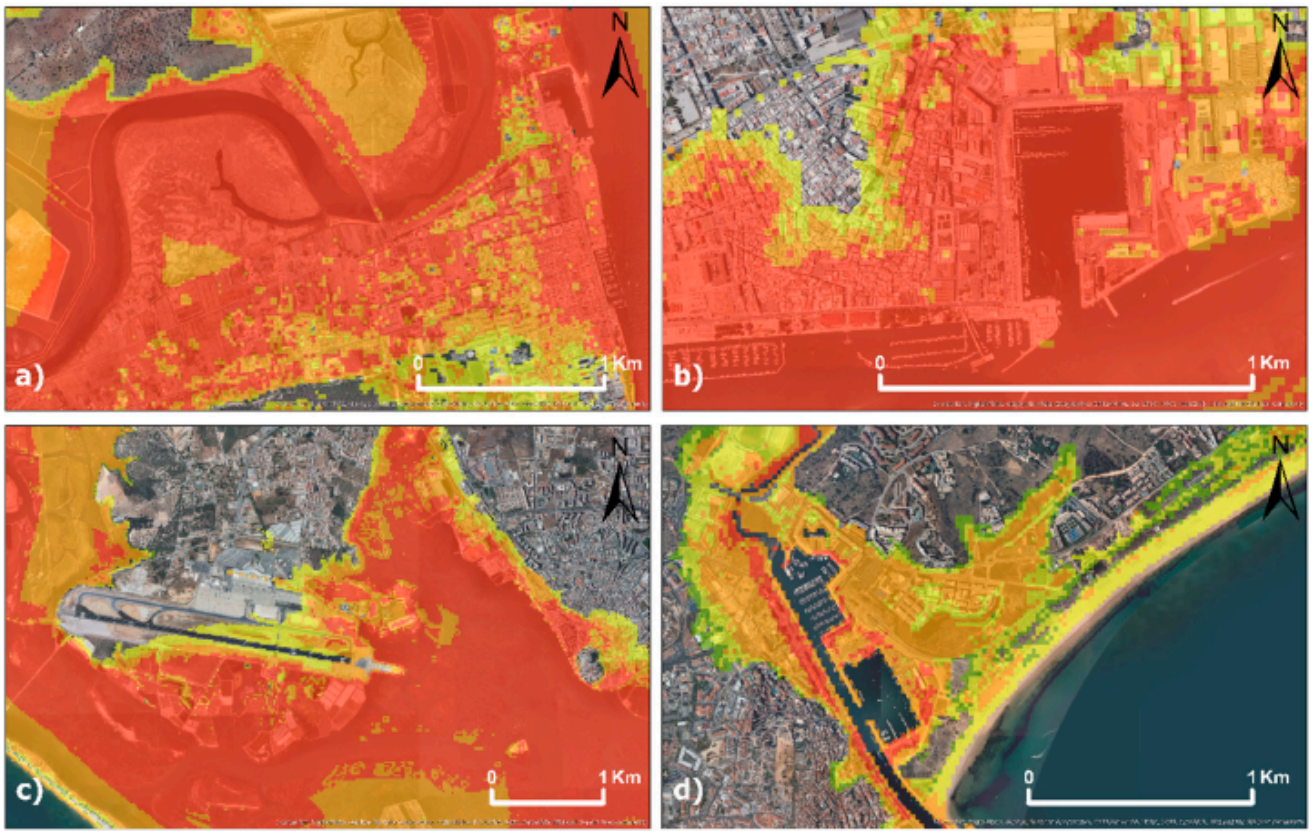
and 18 °C. In Algarve, minimum air temperature are higher than 15 °C, with higher value occurring in the months of July and August. Portugal has a relatively high level of exposure to heatwaves, with great impacts on health, and more generally, to other ecological such as loss of livestock, dried-up crops and loss of forest cover caused by wildlife activity.

Monthly rainfall in Portugal varies depending on the season. Precipitation is higher in the winter and lower in the summer. Rainfalls are stronger in the southern half of the country, particularly in the Algarve region, where Faro is situated. The city was struck by floods in 2008 and 2011, causing economic impacts such as damage to public and private buildings, loss of earnings in industry and trade, road, railway and transportation interruptions and high prices for essential commodities. Seasonal and annual disparity in rainfall has contributed to geographical and temporal mismatch between water availability and demand. The dry climate contributes to a number of water stress situations that complicate resource management and lead to extensive socio-economic and environmental impacts. Due to this, the Portuguese presidency of the European Union Council placed “water scarcity and droughts” as an main priority.

It is estimated that by the year 2100 that an area covering 1146 $km^2$ of the Portugal area will be affected by tide flooding and rising sea levels. Inland waters are projected to be most affected areas, corresponding with areas with high level of exposure. Districts that have large harbors and bays are at severe risk of this phenomenon. The district of Faro has the highest number of areas in the country that are considered vulnerable. These include the cities of Vila Real de Santo Antonio, Olhao, Lagos and Faro, with its airport being classified as extremely sensitive.

Graphic 2: Physical vulnerability projections in the Faro District for 2100:

a) Villa Real de Santo Antonio
b) Olhao
c) Faro Airport
d) Lagos




Source: Rocha, C., Antunes, C., Catita, C. (2020). "Coastal vulnerability assessment due to sea level rise: the case study of the Atlantic Coast of mainland Portugal". Water Journal January 2020 12 (2).

The concept of ecosystem services provide a useful instrument for sustainable planning in the restoration of degraded systems. They can help to mitigate urban temperature by providing shadows to streets, sidewalks and buildings by tree plantation and green walls. Ecoservices can help mitigate water runoff by incentivizing absorbent soils in parking areas, squares, backyards and gardens, while also providing cities with fresh water through obtaining and purifying water storages.

## Pilea-Hortiatis (Thessaloniki, Greece)

Area: 155.63 km$^2$

Population:

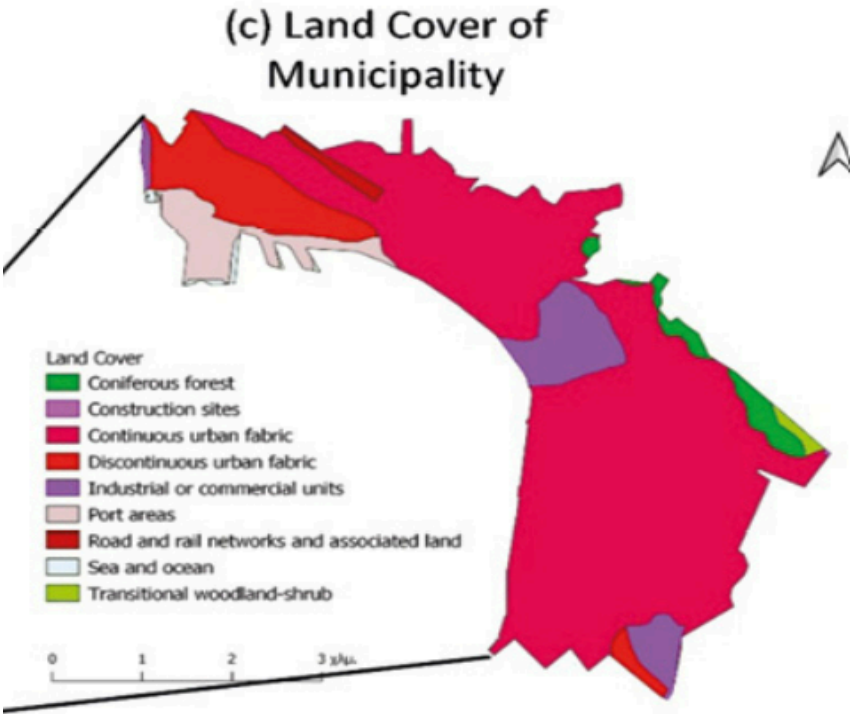
Municipality: 72384 (2021)

Thessaloniki is the second largest city of Greece, with its metropolitan area consisting of the municipalities: Thessaloniki, Kalamaria, Pilea, Panorama, Neapoli- Sykies, Pavlos Melas, Kordelio- Evmosmos, Ampelokipoi-Menemeni, Chalkidona, Thermi, Thermaikos, Delta, Oraiokastro, Langadas and Volvi (Lazaridis, Latinopoulos, 2022). It is a coastal city located in

the Thermaikos Gulf with a Delta of three major rivers (Vardar, Gallikos, Aliakmon) and a gateway for transport and wholesale trade activities. Thessaloniki is a significant industrial center, which features organized industrial sites located in the northwest part of the city and service sectors in the central and southern part. (Thoidou, 2021)

In recent decades, the ever-increasing city activities have led to bigger energy consumption, fossil fuel emissions, and consequently, temperature increases. Additionally, the high building density increased the probability of floods. Other factors to flooding involve urban fabrics covered by impermeable materials. Almost 83% of the area belongs to buildings and artificial surfaces, 73% is continuous urban fabric and 10% discontinuous.

Graphic 3: Land cover of the municipality of Thessaloniki, Greece




Source: Lazaridis, V., Latinopoulos, D. (2022). "Estimating urban vulnerability to flood and heat hazards: A case study in the Municipality of Thessaloniki, Greece". European Spatial Research and Policy. Volume 29, 2022. Number 2

The climate of the area is considered Mediterranean, with the summer period being characterized by high temperatures, mainly in the period from July to August, during which humidity levels and rainfall is low. The average temperatures for July are 27.3 °C, while the maximum can even exceed 40 °C. The increase in global average temperature could affect the region, aggravating the urban heat island (UHI) effect[1] and sea level rise.

[1] An Urban Heat Island (UHI) is an indicator used to measure temperature differences in urban and rural areas. It can be used to quantify both air and land surface temperatures.

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Nov | Oct | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Record high °C (°F) | 18.99 (66.18) | 22.16 (71.89) | 23.21 (73.78) | 29.55 (85.19) | 33.77 (92.79) | 41.15 (106.07) | 42.21 (107.98) | 39.04 (102.27) | 35.88 (96.58) | 31.66 (88.99) | 25.32 (77.58) | 22.16 (71.89) | 42.21 (107.98) |
| Average high °C (°F) | 9.17 (48.51) | 11.84 (53.31) | 15.22 (59.4) | 19.68 (67.42) | 24.84 (76.71) | 29.7 (85.46) | 32.71 (90.88) | 32.83 (91.09) | 28.08 (82.54) | 21.53 (70.75) | 16.55 (61.79) | 11.06 (51.91) | 21.1 (69.98) |
| Daily mean °C (°F) | 6.55 (43.79) | 9.25 (48.65) | 12.43 (54.37) | 16.65 (61.97) | 21.79 (71.22) | 26.79 (80.22) | 29.66 (85.39) | 29.8 (85.64) | 25.21 (77.38) | 19.13 (66.43) | 14.16 (57.49) | 8.52 (47.34) | 18.33 (64.99) |
| Average low °C (°F) | 3.14 (37.65) | 5.36 (41.65) | 7.27 (45.09) | 10.12 (50.22) | 14.71 (58.48) | 19.43 (66.97) | 22.17 (71.91) | 22.98 (73.36) | 19.39 (66.9) | 14.9 (58.82) | 10.88 (51.58) | 5.25 (41.45) | 12.97 (55.35) |
| Record low °C (°F) | -10.55 (13.01) | -4.22 (24.4) | -3.17 (26.29) | 2.11 (35.8) | 6.33 (43.39) | 11.61 (52.9) | 14.77 (58.59) | 15.83 (60.49) | 10.55 (50.99) | 4.22 (39.6) | -1.06 (30.09) | -4.22 (24.4) | -10.55 (13.01) |
| Average precipitation mm (inches) | 24.4 (0.96) | 28.22 (1.11) | 43.04 (1.69) | 34.59 (1.36) | 37.44 (1.47) | 31.35 (1.23) | 24.35 (0.96) | 20.7 (0.81) | 21.88 (0.86) | 24.62 (0.97) | 32.12 (1.26) | 28.04 (1.1) | 29.23 (1.15) |
| Average precipitation days (≥ 1.0 mm) | 4.32 | 6.71 | 7.97 | 5.56 | 7.48 | 7.1 | 5.95 | 4.8 | 4.99 | 4.32 | 5.56 | 5.09 | 5.82 |
| Average relative humidity (%) | 77.41 | 78.81 | 75.35 | 70.19 | 66.56 | 61.12 | 56.79 | 55.31 | 61.44 | 69.65 | 76.73 | 75.24 | 68.71 |
| Mean monthly sunshine hours | 7.52 | 8.53 | 10.41 | 13.05 | 14.49 | 14.93 | 14.98 | 14.52 | 12.12 | 8.87 | 7.75 | 7.65 | 11.24 |

Studies (Christakakis, Aivazidou, Brattich, 2026) showed that UHI intensity in Thessaloniki is higher in the month of July, especially during the night hours. This is due to the slow release of heat that is stored in build-up surfaces such as concrete and asphalts. The dense urban landscapes restrict sky visibility by trapping heat and hindering its evaporation. Urban heat island intensity is amplified during heatwaves, due to meteorological stagnation and urban energy dynamics. Elevated temperatures lead to reduced wind speeds and cloud cover, which limits nocturnal cooling, while increased cooling system usage create artificial heat emissions. In contrast, rural areas such as Pilea Hortiatis cool more rapidly during the summer periods due to higher radiative losses and lower thermal inactivity. In January, reduced solar exposure and lack of vegetation contribute to a “cold island effect”.

As global warning effects for the Mediterranean are projected to be highly intense, scenarios (Parliari, Keppas, Papadogiannaki, Papadoupoulos, Kontos, Melas, 2023) point to an additional month of summer days in Greece for the period of 2030 to 2060. With summer temperature expected to increase above 35 °C, heat-related health risks such as cardiovascular mortality are forecast to grow. Furthermore, urban expansion and extreme weather phenomena escalate the overall climate risks, as the region lacks necessary disaster resistant infrastructure.

Globally, urban disaster management is evolving to address emerging challenges such as climate change, rapid population and technological advancements. Leveraging technology, such as big data, digital tools and early warning systems, can help municipalities like Thessaloniki and Pilea Hortiatis improve early warning systems and disaster response times. Implementing “smart city” technologies and disaster-reducing infrastructures, e.g flood-proof buildings and heatwave resistant urban designs can help optimize disaster management and improve the overall resilience of cities.

## Vodnjan - Dignano (Pula, Istria, Croatia)

Area : 101 $km^2$

Population:

Municipality: 5838 (2021)

Located in the Istrian (Istra) peninsula, it is characterized by a positive UHI index and averagely warmer temperatures than usual. Annual air temperatures range from 13 to 15 °C on average. The annual total of rain precipitation reaches 700 to 900 mm, with a pronounced summer minimum and autumn maximum, which indicates a sub mediterranean climate in the region (Kuhta, Srtoj, Frangen, 2014). The Pula region sits on a wide plateau characterized by low bays that gently flow from the central part of the peninsula to the coastal line. Due to this, the coast is characterized by complex sea wave patterns influenced by prevailing winds. Dominant winds that cause surface waves in the Adriatic Sea are “bora”, “sirroco” and “maestral” (Maric, Peer, Cipak, Kobas, Siljeg, Krvavica, 2024). The “bora” is a cold and dry wind prevalent during the months of December and March, characterized by increased evaporation, sea density and heat loss. The “sirroco” is a warm and humid wind which, during storm conditions, can reach speeds of over 100 km/h. Similarly to the “bora” wind, it is most frequent during the colder months.

The survey results showed that climate change has negatively affected the lives of citizens in Pula and nearby Istrian towns such as Vodnjan and Rovinj. A study conducted by the Meteorological and Hydrological Institute of Croatia showed that there is an increase in average annual, maximum and minimum temperatures in the last few years. Temperature extremes, both heatwaves and hot spells, can worsen chronic conditions and contribute to excess mortality. Prolonged exposure to high temperatures increase the prevalence of acute and chronic illnesses including cardiovascular and respiratory diseases. Warmer temperatures also facilitate the spread of vector-borne diseases (Malaria, West Nile disease) and intensify respiratory conditions due to high pollen concentrations (Boromisa, 2025).

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Nov | Oct | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Record high °C (°F) | 15.0 (59.0) | 15.0 (59.0) | 20.0 (68.0) | 23.0 (73.4) | 27.0 (80.6) | 32.0 (89.6) | 35.0 (95.0) | 35.0 (95.0) | 30.0 (86.0) | 26.0 (78.8) | 21.0 (69.8) | 16.0 (60.8) | 35.0 (95.0) |
| Average high °C (°F) | 9.12 (48.42) | 9.49 (49.08) | 12.32 (54.18) | 15.95 (60.71) | 19.39 (66.9) | 24.43 (75.97) | 27.21 (80.98) | 27.78 (82.0) | 23.24 (73.83) | 18.49 (65.28) | 14.38 (57.88) | 10.74 (51.33) | 17.71 (63.88) |
| Daily mean °C (°F) | 7.96 (46.33) | 8.23 (46.81) | 10.93 (51.67) | 14.42 (57.96) | 17.99 (64.38) | 23.04 (73.47) | 25.74 (78.33) | 26.0 (78.8) | 21.62 (70.92) | 16.98 (62.56) | 13.18 (55.72) | 9.51 (49.12) | 16.3 (61.34) |
| Average low °C (°F) | 6.22 (43.2) | 6.16 (43.09) | 8.66 (47.59) | 11.66 (52.99) | 14.82 (58.68) | 19.37 (66.87) | 22.06 (71.71) | 22.58 (72.64) | 18.97 (66.15) | 14.76 (58.57) | 11.4 (52.52) | 7.73 (45.91) | 13.7 (56.66) |
| Record low °C (°F) | -4.0 (24.8) | -5.0 (23.0) | 0.0 (0) | 4.0 (39.2) | 4.0 (39.2) | 10.0 (50.0) | 16.0 (60.8) | 15.0 (59.0) | 12.0 (53.6) | 7.0 (44.6) | 3.0 (37.4) | -1.0 (30.2) | -5.0 (23.0) |
| Average precipitation mm (inches) | 145.35 (5.72) | 211.4 (8.32) | 142.78 (5.62) | 115.15 (4.53) | 188.15 (7.41) | 150.74 (5.93) | 149.42 (5.88) | 133.25 (5.25) | 269.64 (10.62) | 223.65 (8.81) | 277.53 (10.93) | 177.58 (6.99) | 182.05 (7.17) |
| Average precipitation days (≥ 1.0 mm) | 13.18 | 13.18 | 12.27 | 12.45 | 16.73 | 13.73 | 13.82 | 10.27 | 13.36 | 13.0 | 14.64 | 12.73 | 13.28 |
| Average relative humidity (%) | 73.43 | 72.93 | 71.68 | 70.87 | 71.87 | 69.16 | 65.17 | 63.84 | 67.83 | 72.57 | 75.23 | 73.38 | 70.66 |
| Mean monthly sunshine hours | 6.74 | 7.05 | 10.11 | 12.74 | 13.65 | 14.09 | 14.3 | 13.79 | 12.0 | 7.78 | 7.22 | 6.67 | 10.51 |

Long droughts contribute to fine particle suspension in the air, thus affecting air quality. Sea level rise and extreme weather events can cause damage to transportation infrastructure, affect road viability. The projected average maximum temperatures during the summer can have an negative impact on tourism demand. It is also noted that the region suffers from natural ecosystem modifications, unsustainable use of natural resources and air pollution, particularly in the west and south coast of Istria.

## Beltinci (Pomurje, Slovenia)

Area : 62 km$^2$

Population:

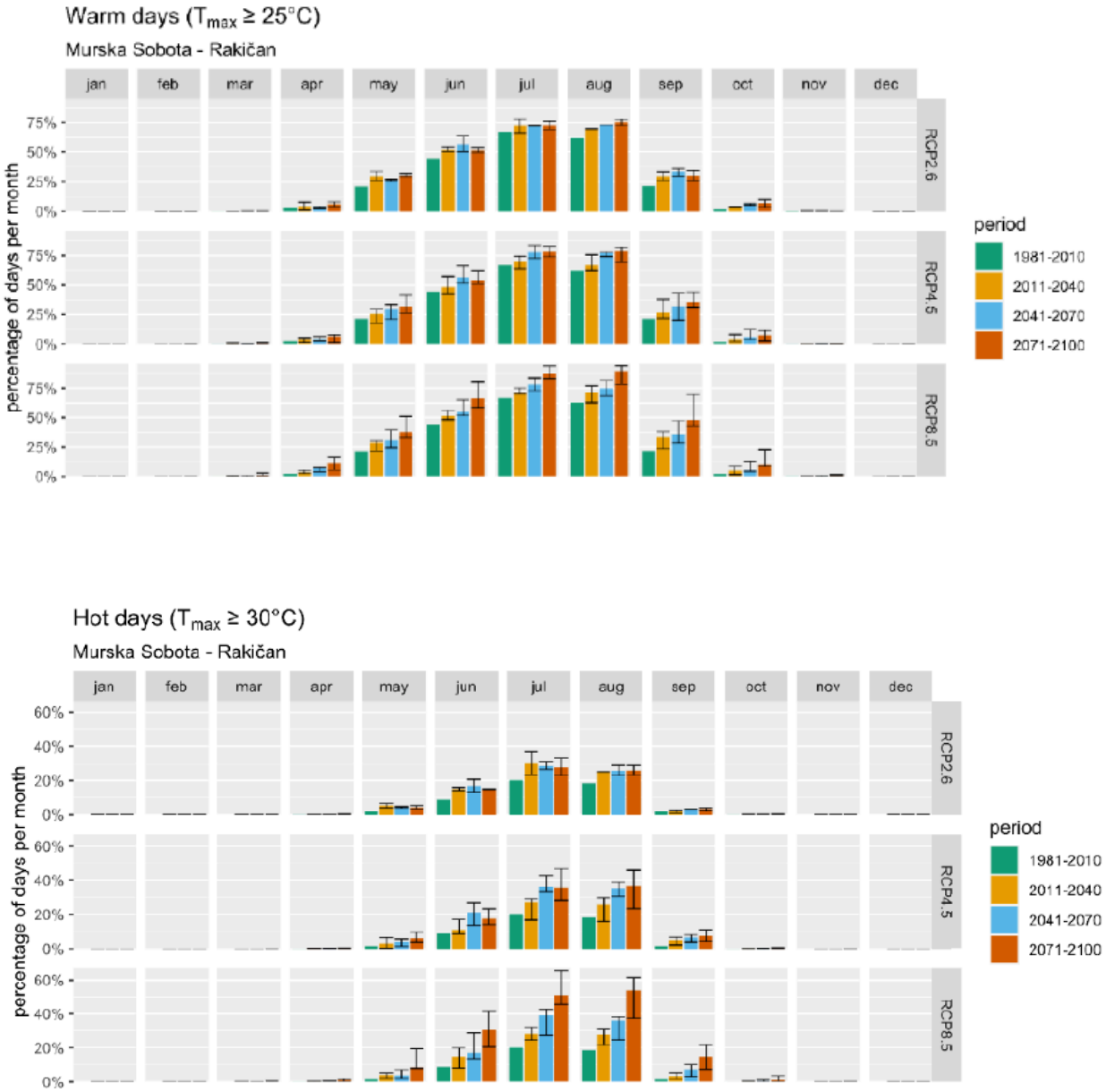
Municipality: 8109 (2024)

Beltinci is characterized by a “Pannonian” continental climate, with annual temperatures ranging from 4.8 to 15.3 °C, with rain precipitation amounting to 801 mm/ m$^2$. Compared to other regions, the Mura or Pomurje region is more drier, meaning frequent and longer dry spells often lead to high evapotranspiration rates (Vrsic, Pulko, Vodovnik-Plevnik, Perko, 2024). Future projections (Turnsek, Cooper, Farrell, Kokot, Spinoler, Znigrasic, Kuk, Pogacar, 2024) predict that the number of days with high temperatures will increase in the warmer months of the year, July and August. This high frequency of hot days could become a serious issue that impacts the tourism sector. Alongside Podravje, Mura is wine-growing region, where some of the most of the world’s important grape varieties for wine production are grown. Tourism activities also put a focus on physical activities such as cycling and walking, with sports events such as marathons being held along the river Mura. Extending the tourist season might benefit Slovenian tourism, however it faces stiff competition from Alpine and Adriatic countries (Turnsek, Rangus, Stuhec, Farrell, Pozvek, Spindler, Kokot, Cooper, Pogacar, Znidarsic, Crepsinek, 2023).

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Nov | Oct | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Record high °C (°F) | 12.0 (53.6) | 20.0 (68.0) | 22.0 (71.6) | 28.0 (82.4) | 28.0 (82.4) | 34.0 (93.2) | 37.0 (98.6) | 39.0 (102.2) | 31.0 (87.8) | 25.0 (77.0) | 21.0 (69.8) | 15.0 (59.0) | 39.0 (102.2) |
| Average high °C (°F) | 3.03 (37.45) | 4.83 (40.69) | 11.05 (51.89) | 16.85 (62.33) | 19.84 (67.71) | 24.58 (76.24) | 27.15 (80.87) | 27.44 (81.39) | 21.64 (70.95) | 15.76 (60.37) | 9.81 (49.66) | 4.68 (40.42) | 15.56 (60.01) |
| Daily mean °C (°F) | 0.69 (33.24) | 2.32 (36.18) | 7.86 (46.15) | 13.37 (56.07) | 16.84 (62.31) | 21.66 (70.99) | 23.82 (74.88) | 23.57 (74.43) | 17.95 (64.31) | 12.22 (54.0) | 6.91 (44.44) | 2.12 (35.82) | 12.44 (54.39) |
| Average low °C (°F) | -2.15 (28.13) | -1.13 (29.97) | 2.84 (37.11) | 6.32 (43.38) | 9.48 (49.06) | 13.37 (56.07) | 15.05 (59.09) | 15.25 (59.45) | 11.42 (52.56) | 7.19 (44.94) | 3.62 (38.52) | -0.6 (30.92) | 6.72 (44.1) |
| Record low °C (°F) | -13.0 (8.6) | -14.0 (6.8) | -15.0 (5.0) | -2.0 (28.4) | 0.0 (0) | 4.0 (39.2) | 7.0 (44.6) | 6.0 (42.8) | 4.0 (39.2) | -2.0 (28.4) | -12.0 (10.4) | -17.0 (1.4) | -17.0 (1.4) |
| Average precipitation mm (inches) | 57.49 (2.26) | 93.35 (3.68) | 58.36 (2.3) | 60.43 (2.38) | 143.41 (5.65) | 118.89 (4.68) | 97.94 (3.86) | 88.45 (3.48) | 100.08 (3.94) | 79.27 (3.12) | 95.15 (3.75) | 56.85 (2.24) | 87.47 (3.44) |
| Average precipitation days (≥ 1.0 mm) | 10.36 | 11.36 | 8.82 | 10.55 | 18.36 | 15.82 | 14.55 | 11.09 | 9.82 | 8.64 | 8.73 | 8.73 | 11.4 |
| Average relative humidity (%) | 83.3 | 80.7 | 71.98 | 68.9 | 75.22 | 74.01 | 69.66 | 67.79 | 72.86 | 78.48 | 82.75 | 82.17 | 75.65 |
| Mean monthly sunshine hours | 6.64 | 6.55 | 9.47 | 12.72 | 13.34 | 13.77 | 14.01 | 13.65 | 11.53 | 7.94 | 7.04 | 6.86 | 10.29 |

As 58% of its territory is covered in forests, Slovenia is affected from climate threats like increased wildfires, increased risks of pests, disease and species redistribution. Projections show a 20 to 40% increase in forest fires by 2100, with the regions most at risk being Obalno-Kraska, Posavska, Podravska and Pomurje (Mura). Climate change can exert a direct influence to ecosy-stem structure and composition, affect vegetation wildlife before and after a fire, therefore diminishing post recovery. Declining ecosystem resilience might worsen fire vulnerability, hampering the regrowth of existing species. Climate change and biodiversity are interconnected. If one worsens, it fuels the downward spiral of the other. The three dominant species of flora in Slovenia, the beech, spruce and silver fur, which account over 70% of the growing stock in the country, have been on a declining trend in the last 20 years. Despite a turnover, the future of these species looks uncertain. An honorable mention regarding wildfires are their effect on human health. Because fires often coincide with heatwaves, air pollution and heat exposure, it can considerably increase impacts on cardiovascular and respiratory health.

Graphic 4: The percentage of warm and hot days in Murska Sobota, Pomurje, Slovenia




Source: Turnšek, M., Cooper, C., Pavlakovič Farrell, B., Kokot, K., Špindler, T., Žnidaršič, Z., Kuk, R., Pogačar, T. (2024). *Tourism Climate Change Adaptation: The Case of Slovenia*. University of Maribor, University Press.

## Sandanski (Bulgaria)

Area: 26,86 $km^2$

Population:

City: 24682 (2021)

Municipality: 36335 (2021)

Sandanski is a town situated in southwestern part of Bulgaria, located in the Pirin Mountain range. It is a very popular tourist destination which offers visitors exceptional and well preserved nature, rivers and favorable conditions for leisure walks, relaxation and healing. The town serves as a gateway to the “Pirin National Park”, which encompasses the whole mountain. The park is characterized by specific “alpine” territories and rich biodiversity. Forests cover around 57.3 % of the park’s area, with 95% of the forests being coniferous and 5% deciduous. Dominant tree species include the spruce, the beech and the pine tree (Glushkova, Zhiyanski, Yaneva, 2023).

Sandanski has a temperate climate. Summers are very hot and dry with occasional thunderstorms, and during heat waves the temperature may exceed 40 °C reaching to 45 °C, the highest recorded temperature in the city. Winters are damp and relatively mild, lasting for about three months from December through February. Springs and falls are generally about two months each. The summer is the longest season in Sandanski, lasting 4 months – from early June to late September. Precipitation is evenly distributed throughout the year except for July and August when droughts often occur.

Sandanski is characterized by a Mediterranean climate, with annual temperatures reaching 25°C during the summer months. Winter temperatures usually remain above freezing point (3.1°C) (Nikolova, Radeva, Todorov, Matev, 2024). Due to a decrease in rain precipitation, droughts are common in the autumn months, which affects the harvesting of cultures such as corn (Popova, Ivanova, Martins, Pereira, Doneva, Alexandrov, Kerhceva, 2014) and sunflowers.

| Climate data for Sandanski (1991–2020), Extremes 1961-2020 [hide] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
| Record high °C (°F) | 18.7 (65.7) | 22.8 (73.0) | 27.8 (82.0) | 32.2 (90.0) | 36.0 (96.8) | 42.0 (107.6) | 44.6 (112.3) | 42.4 (108.3) | 38.9 (102.0) | 33.4 (92.1) | 27.0 (80.6) | 22.9 (73.2) | 44.6 (112.3) |
| Mean daily maximum °C (°F) | 7.7 (45.9) | 11.1 (52.0) | 15.5 (59.9) | 20.3 (68.5) | 25.6 (78.1) | 30.4 (86.7) | 33.3 (91.9) | 33.6 (92.5) | 28.1 (82.6) | 21.4 (70.5) | 14.6 (58.3) | 8.6 (47.5) | 20.9 (69.6) |
| Daily mean °C (°F) | 3.1 (37.6) | 5.5 (41.9) | 9.4 (48.9) | 13.9 (57.0) | 18.9 (66.0) | 23.4 (74.1) | 25.9 (78.6) | 25.9 (78.6) | 20.9 (69.6) | 14.9 (58.8) | 9.2 (48.6) | 4.2 (39.6) | 14.6 (58.3) |
| Mean daily minimum °C (°F) | −0.7 (30.7) | 1.0 (33.8) | 4.2 (39.6) | 8.1 (46.6) | 12.7 (54.9) | 16.7 (62.1) | 18.9 (66.0) | 19.0 (66.2) | 14.7 (58.5) | 10.0 (50.0) | 5.1 (41.2) | 0.7 (33.3) | 9.2 (48.6) |
| Record low °C (°F) | −21.0 (−5.8) | −13.9 (7.0) | −10.4 (13.3) | −6.5 (20.3) | 1.8 (35.2) | 5.9 (42.6) | 10.0 (50.0) | 8.2 (46.8) | 3.0 (37.4) | −2.7 (27.1) | −12.0 (10.4) | −16.2 (2.8) | −21.0 (−5.8) |
| Average precipitation mm (inches) | 39 (1.5) | 34 (1.3) | 44 (1.7) | 43 (1.7) | 45 (1.8) | 47 (1.9) | 34 (1.3) | 30 (1.2) | 37 (1.5) | 51 (2.0) | 46 (1.8) | 55 (2.2) | 504 (19.8) |
| Average precipitation days (≥ 1 mm) | 6 | 6 | 6 | 6 | 7 | 6 | 5 | 3 | 5 | 5 | 6 | 7 | 67 |
| Average relative humidity (%) | 75 | 71 | 66 | 62 | 62 | 59 | 54 | 55 | 59 | 67 | 77 | 78 | 65 |
| Mean monthly sunshine hours | 126 | 146 | 195 | 217 | 268 | 310 | 350 | 334 | 254 | 197 | 134 | 110 | 2,641 |
| Mean daily daylight hours | 9.6 | 10.6 | 12.0 | 13.4 | 14.5 | 15.1 | 14.8 | 13.8 | 12.5 | 11.1 | 9.9 | 9.2 | 12.2 |
| Source: NOAA NCEI[4](Humidity 1961-1990[5])Weather atlas(Daylight hours)[6] | | | | | | | | | | | | | |

| Climate data for Sandanski (1981–2010), Precipitation (2010-2020) [hide] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
| Record high °C (°F) | 18.0 (64.4) | 21.9 (71.4) | 30.0 (86.0) | 31.5 (88.7) | 36.8 (98.2) | 42.0 (107.6) | 44.6 (112.3) | 42.5 (108.5) | 38.7 (101.7) | 34.6 (94.3) | 26.0 (78.8) | 22.9 (73.2) | 44.6 (112.3) |
| Mean daily maximum °C (°F) | 7.0 (44.6) | 10.2 (50.4) | 14.9 (58.8) | 20.5 (68.9) | 26.5 (79.7) | 30.1 (86.2) | 32.9 (91.2) | 32.8 (91.0) | 28.9 (84.0) | 22.3 (72.1) | 15.5 (59.9) | 9.7 (49.5) | 20.9 (69.6) |
| Daily mean °C (°F) | 3.5 (38.3) | 5.6 (42.1) | 9.5 (49.1) | 14.5 (58.1) | 19.5 (67.1) | 24.2 (75.6) | 27.6 (81.7) | 27.3 (81.1) | 21.7 (71.1) | 15.6 (60.1) | 10.5 (50.9) | 4.9 (40.8) | 15.4 (59.7) |
| Mean daily minimum °C (°F) | −0.1 (31.8) | 1.0 (33.8) | 4.5 (40.1) | 9.1 (48.4) | 13.5 (56.3) | 17.1 (62.8) | 19.5 (67.1) | 19.3 (66.7) | 15.3 (59.5) | 10.7 (51.3) | 5.2 (41.4) | 1.7 (35.1) | 9.7 (49.5) |
| Record low °C (°F) | −21.0 (−5.8) | −15.3 (4.5) | −9.4 (15.1) | −4.3 (24.3) | 1.5 (34.7) | 6.7 (44.1) | 8.8 (47.8) | 6.5 (43.7) | 1.0 (33.8) | −2.1 (28.2) | −7.5 (18.5) | −16.9 (1.6) | −21.0 (−5.8) |
| Average precipitation mm (inches) | 43.1 (1.70) | 38.4 (1.51) | 53.7 (2.11) | 40.9 (1.61) | 43.4 (1.71) | 54.9 (2.16) | 29.7 (1.17) | 30.3 (1.19) | 40.4 (1.59) | 54.8 (2.16) | 47.5 (1.87) | 50.3 (1.98) | 527.3 (20.76) |
| Average precipitation days (≥ 1 mm) | 5.3 | 5.3 | 5.2 | 6.2 | 6.9 | 5.6 | 4.5 | 3.5 | 4.2 | 5.3 | 6.3 | 7.8 | 66.1 |
| Average snowy days | 5.1 | 2.4 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 3.2 | 11.9 |
| Mean monthly sunshine hours | 123 | 144 | 211 | 232 | 286 | 311 | 369 | 348 | 256 | 212 | 131 | 100 | 2,723 |
| Percentage possible sunshine | 43 | 49 | 52 | 54 | 60 | 69 | 77 | 78 | 70 | 58 | 45 | 36 | 60 |
| Source: stringmeteo.com[7] | | | | | | | | | | | | | |

## Strumica (North Macedonia)

Area: 124 $m^2$

Population:

City: 33825 (2021)

Municipality: 49995 (2021)

Strumica is the largest city in southeastern North Macedonia and the country's ninth most populous overall, situated near the Novo Selo-Petrich border crossing with Bulgaria. About 54,676 people live in the city and its surrounding region. The city, which is the eponymous seat of the Strumica Municipality, is named after the Strumica River, a tributary of the Struma which runs through it.
Strumica, North Macedonia, experiences a temperate humid climate with a broad temperature range. The region's climate is characterized by Köppen-Geiger classifications of Cfa and Cfb. The winter months, particularly January and February, are cold, with temperatures dropping to -19°C and -17°C respectively. Spring brings gradual warming, with March and April averages of 8°C and 12°C, and maximums peaking at 25°C and 29°C. Summer months, from June to August, are hot, with maximum temperatures consistently hovering around 40°C to 40°C. The onset of autumn in September marks a cooling trend, with temperatures averaging 20°C, before dipping again in November and December. Strumica's climate is vital for its rich agricultural landscape, offering diverse climatic conditions throughout the year.

| Climate data for Strumica (224m) [hide] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
| Mean daily maximum °C (°F) | 7.4 (45.3) | 12.8 (55.0) | 16.5 (61.7) | 21.1 (70.0) | 24.9 (76.8) | 30.5 (86.9) | 33.6 (92.5) | 33.4 (92.1) | 28.7 (83.7) | 22.0 (71.6) | 15.2 (59.4) | 9.7 (49.5) | 21.3 (70.4) |
| Daily mean °C (°F) | 2.5 (36.5) | 6.5 (43.7) | 9.7 (49.5) | 13.6 (56.5) | 17.7 (63.9) | 22.7 (72.9) | 25.2 (77.4) | 25.0 (77.0) | 20.5 (68.9) | 14.5 (58.1) | 9.5 (49.1) | 4.8 (40.6) | 14.4 (57.8) |
| Mean daily minimum °C (°F) | −2.3 (27.9) | 0.2 (32.4) | 2.8 (37.0) | 6.1 (43.0) | 10.5 (50.9) | 14.8 (58.6) | 16.9 (62.4) | 16.5 (61.7) | 12.2 (54.0) | 7.0 (44.6) | 3.8 (38.8) | 0.0 (32.0) | 7.4 (45.3) |
| Average precipitation mm (inches) | 33 (1.3) | 33 (1.3) | 36 (1.4) | 37 (1.5) | 52 (2.0) | 41 (1.6) | 33 (1.3) | 29 (1.1) | 28 (1.1) | 39 (1.5) | 54 (2.1) | 44 (1.7) | 459 (17.9) |
| Source 1: weatheronline.co.uk [9] | | | | | | | | | | | | | |
| Source 2: Climate-Data.org [10] | | | | | | | | | | | | | |

Mean annual temperature and precipitation temporal change for Strumica region are given in Figure 2 for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). For all scenarios increase in future temperature is expected. In the first half of the century there is no significant difference for different scenarios and expected temperature increase is

between 1 and 1,5 °C, on the other hand for the end of the century increase in temperature is 1 °C, 2 °C and 4.5 °C, for low, mid and high scenarios, respectively, clearly indicating that future evolution in temperature is determined by future concentration of GHGs. For precipitation change, again in the first half of the century, results are similar for all scenarios giving annual precipitation change between 0 and -10 %, with some chances that anomaly can be even positive. For the second half precipitation change is clearly negative for high scenario up to -30%, and mid scenario -15%, but for low scenario precipitation change is positive, about +5%.

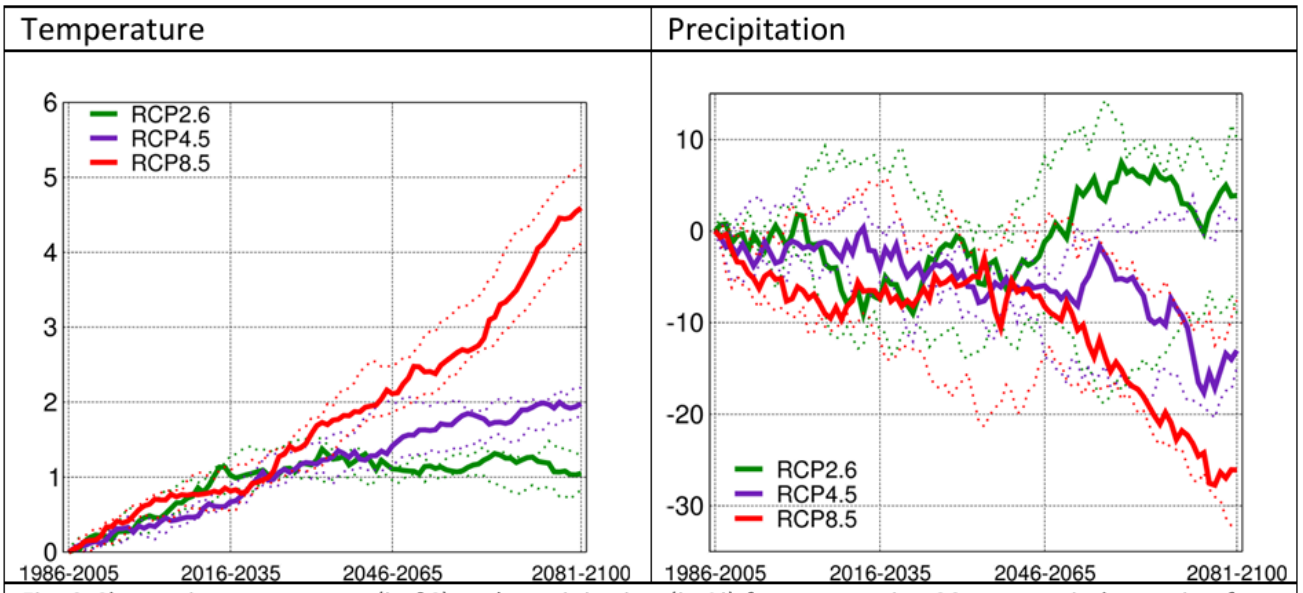



Fig. 2 Change in temperature (in °C) and precipitation (in %) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25$^{th}$ to 75$^{th}$ percentile.

In Figure 3 change in frost and ice days for Strumica region are given for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). For all scenarios decrease in future frost and ice days is expected, which is not surprising since that increase in mean annual temperature is expected. In the first half of the century there is no significant difference for different scenarios and expected decrease in frost days is about -10 days, on the other hand for the end of the century decrease in frost days for high scenario is about -45 days. Expected decrease in ice days is about -3 days for all scenarios for the middle of century, and for the end of the century change is about -6 days for high scenario and -3 days for low and mid scenarios.

Source: Report on climate change projections and changes in climate extremes for STRUMICA REGION (Vladimir Djurdjevic, March 2020 )

Web-link :ebae6eea1e15cb38822e20eb42de1997acf3d47b8068a0b330dd360d5f368e0f.pdf

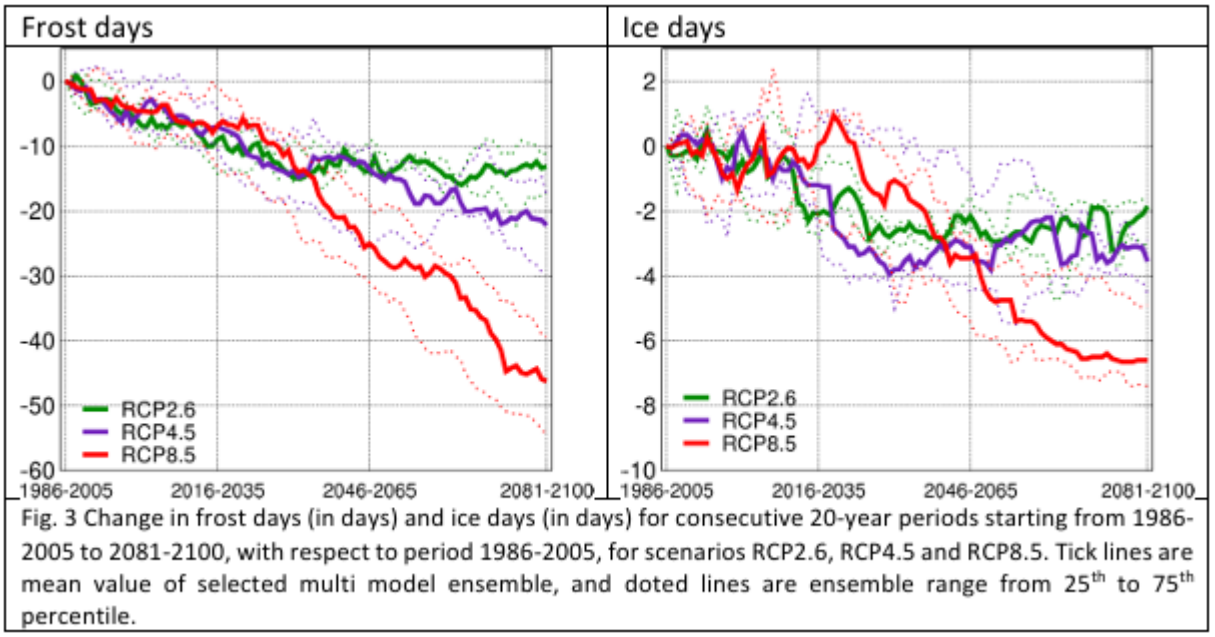



Fig. 3 Change in frost days (in days) and ice days (in days) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25$^{th}$ to 75$^{th}$ percentile.

In Figure 6 change in heat wave duration for Strumica region are given for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). The change is very similar up to period 2046-2065, with increased duration of heat waves od about 1 day. After this period there is significant increase in heat waves duration for high scenario, and for the end of the century increase in duration is between 12 and 15 days, for mid scenario the increase is between 1 and 2 days and for the low scenario change no change is present.

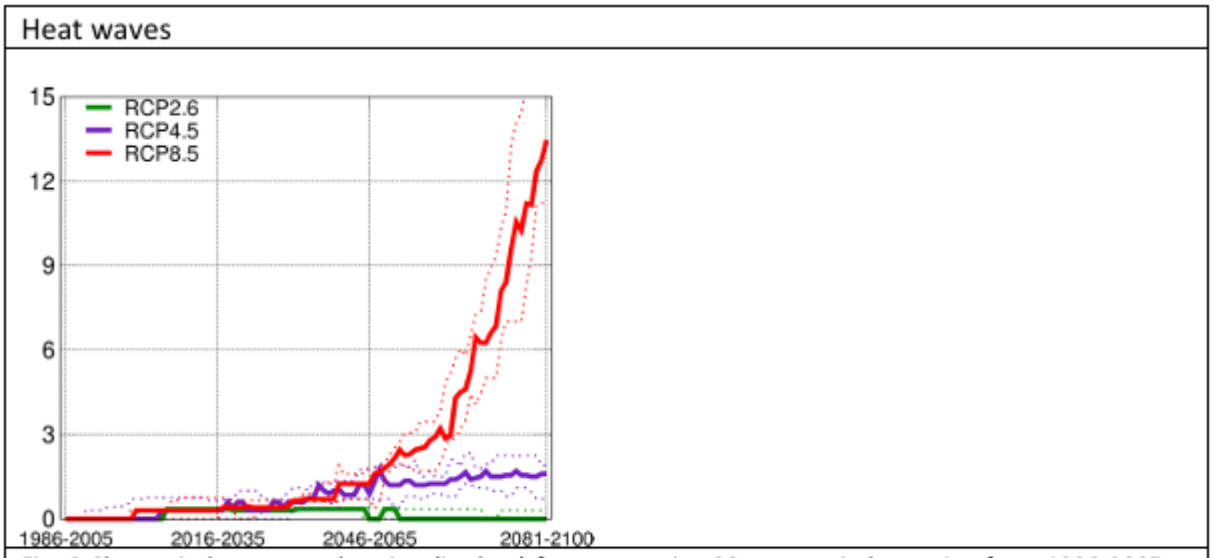



Fig. 6 Change in heat wave duration (in days) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25$^{th}$ to 75$^{th}$ percentile.

In Figure 7, change in number of days with precipitation above 40 mm (RR40) and change in daily maximum precipitation (RX1D) for Strumica region are given for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). It is clear that internal variability dominates in comparison to climate change signal in the future. For number of days with precipitation above 40 mm, overall positive change is present for all scenarios, for majority of future periods. For high scenario, upper limit of ensemble spread above 100%, which means that doubling of these days is potentially possible in the future. Similar conclusion can be applied for maximum daily accumulation, for mid and high scenario ensemble spared is predominantly positive, and for the low scenario, spread is evenly distributed on positive and negative change. Maximum of change in terms of upper limit of ensemble spread is between +10% and +15%, for the end of the century, for mid and high scenario.

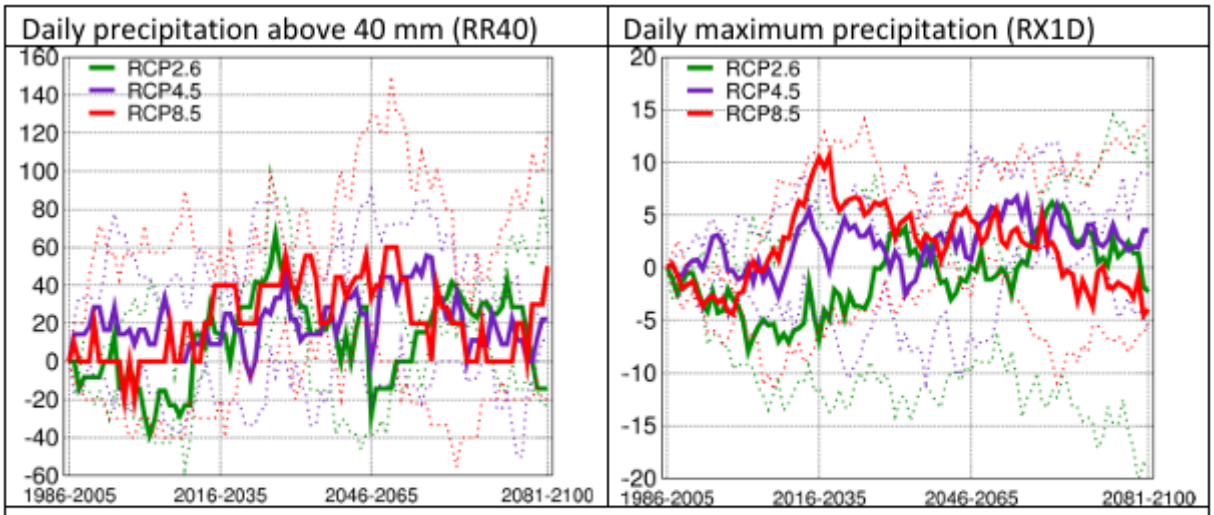



Fig. 7 Change number of days with precipitation above 40 mm (in %) and maximum daily precipitation (in %) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25$^{th}$ to 75$^{th}$ percentile.

In Figure 8 change in consecutive dray days for Strumica region are given for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). For low and mid scenarios, the increase is between 0 and 3 days, for most of the analyzed future period. For mid scenario upper limit of the spread is more pronounced for the end of the century with values above 9 days. For the high scenario significant increase is present for the end of the century with change between 9 and 12 days, indicating higher risk for drought in case of this scenario.

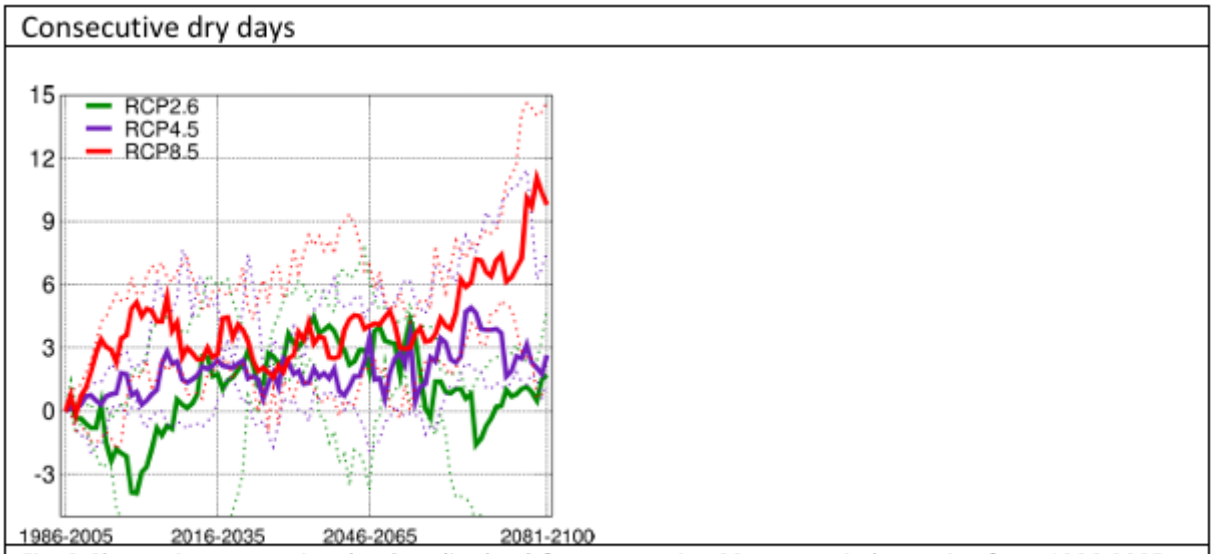



Fig. 8 Change in consecutive dry days (in days) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25th to 75th percentile.

In Figure 9 change in growing season length for Strumica region are given for scenarios RCP2.6 (low), RCP4.5 (mid) and RCP8.5 (high). For all scenarios increase ins growing season length is present. In the middle of the century the expected increase is 20 days, and for the end of the century, for low and mid scenarios, will stay on this level, but for high scenario increase is between 40 and 50 days.

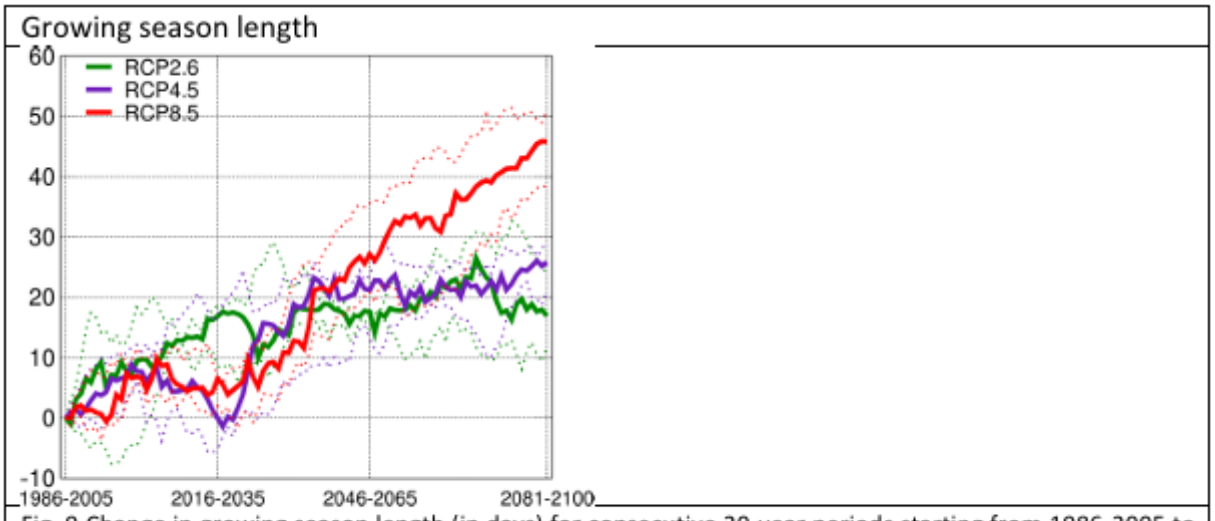



Fig. 9 Change in growing season length (in days) for consecutive 20-year periods starting from 1986-2005 to 2081-2100, with respect to period 1986-2005, for scenarios RCP2.6, RCP4.5 and RCP8.5. Tick lines are mean value of selected multi model ensemble, and doted lines are ensemble range from 25th to 75th percentile.

# ANNEX V Previous projects – The usable outcomes

Some of the objectives of the Green B-LEAF project are similar to the objectives of several other EU projects which gives an opportunity to reuse some of their successful tools, methodologies and expertise.

**EMPATIA** - (Enabling Multichannel Participation Through ICT Adaptations) was a platform designed to improve existing e-government platforms by adding new features, such as data generation and visualization, voting systems and opinion mining (Omar, Weerakkody, Sivarjah, 2018). It was a 2-year project which was piloted in four EU cities - Lisbon (Portugal), Milan (Italy), Ričany (Czech Republic) and Wuppertal (Germany), with the objective of achieving inclusivity, efficiency, transparency, multichannel innovation, integration, feasibility, replication and adaptation in local "participatory budgeting" activities.

The success of the project came down to the modular ICT (Information and communication technology) systems. These ICT systems were available to the public in the form of websites, composed of visualization mechanisms which allowed users to run PB processes online, such as submitting proposals, voting, tracking budget allocations and project impacts. In all four pilots, the ICT websites had up to 3000 users who visited the websites or had registered to the system. By combining online and offline channels, EMPATIA achieved its objective of ensuring inclusivity to all participants, particularly the communities with lower digital literacy.

Each pilot had contributed with a different set of outcomes, unique to each setting. In Ričany, for instance, EMPATIA helped the town conduct it's first "participatory budgeting" process. It demonstrated the necessity of implementing a monitoring cycle to the Municipality of Milan, the development of a multichannel, co-decisional PB system in Wuppertal and a unified participation strategy in Lisbon.

The Green-B-LEAF project will use EMPATIA's tools and methodologies for participatory budgeting to enhance the effectiveness of Green PB initiatives. The insights from EMPATIA's research on civic engagement can inform strategies to increase citizen participation in climate resilience efforts.

**EmPaci- Empowering Participatory Budgeting in the Baltic Region**

The "Empowering Participatory Budgeting in the Baltic Region" project or "EmPaci" was launched to raise awareness and knowledge on the "Participatory Budgeting" concept among local governments and citizens in the region. The regional countries were very diverse in terms of experience regarding participatory budgeting. In some, the concept was well known (Poland), however, for others (Latvia, Lithuania), it was unclear from an organizational point of view. For this reason, events and workshops were organized to fit the awareness level of municipal representatives and citizens.

In Telstai, Lithuania, the "EmPaci" team collaborated with Klaipeda University to organize a

PB implementation event that was attended by the local municipality staff and residents. The region of Vidzeme, Latvia organized a webinar as part of it's "Innovation Week", Bielsko-Biala in Poland established a "consultation point", to reach people who did not use online channels. Butzow, Germany used traditional offline tools like posters and press announcements. At the same time, special cards were delivered to each town household, as a method to reach interested participants.

Special attention within the project was dedicated to the Lahti and Riihimaki Municipalities in Finland, in part to the innovative approach they took to implementing PB practices. Through "Project Guardians" and "PB coaches", the cities diversified stakeholder supporters by engaging them into several co-designing activities. Both initiatives were the basis for the "Train-the-Trainer", an online course that brought all stakeholders together to promote participation and knowledge. Unique to the "EmPaci" project was the "Lackathon", an event which gather citizens and non-profit organizations from the city of Lahti, to work on improving ideas before they can get a final vote.

Green B-LEAF project will use and adapt EmPaci methodologies to enhance PB practices and will utilize training materials and workshops for local authorities.

**OpenBudgets.eu**

"OpenBudgets.eu" is a research project funded by the EU's "Horizon 2020" initiative. It aims to support financial transparency, government efficiency and citizen engagement through the development of an open-source technology platform. Based on the "open data lifecycle" concept, the platform allows users to pre-process, exploit and maintain budget and spending data by creating, selecting, harmonizing, interlinking and exploring datasets. It is divided into five layers: a data storage layer, a data transformation layer, an Application Processing Interface (API) layer, a platform and an application layer.

An interesting component of the "OpenBudgets" platform is its participatory budgeting software. It was developed to enable citizen participation by voting and monitoring budget activities. Citizens can vote on their preferred proposals by being assigned a number that represents the public budgets they can allocate to a preferred project. The monitoring tools help citizens monitor budget transactions, compare budgeted figures versus actual spending numbers and give feedback to the administrators responsible for implementing the proposals. The "OpenBudgets" team provided participants with educational material to help the understand and learn how to use the software to influence budget allocation and monitor budget usage.

The "OpenBudgets" toolbox and solutions were extensively tested in three major European cities: Bonn, Paris and Thessaloniki. The project received very positive feedback on its developed toolset with key components such as visualization, data interaction, KPI analysis, participatory budgeting being appealing to end users. To promote the platform, a video game "The Good, the bad and the Accountant" was developed to explain the inner function of the local administration, land and corruption. By playing, the user received information regarding accounting and budgeting in an entertaining and fun way. Other

promotional activities included the “MEP Expenses campaign”, initiated to highlight expenses made by members of the European Parliament that were not accounted for. Spanish municipalities were involved in a case study regarding participatory budgeting. As budgets differed depending on municipality and region, the core team, in collaboration with the NGO “Civio” developed a budget visualization tool focused on local administrations called “Where do my taxes go”.

The Green B-LEAF project can use the some of the experiences and tools developed in this project, predominantly budget visualization tool and the PB software.

**DEMOTEC- Engaging Citizens in Decision Making**

The “DEMOTEC” Project (2022) was a Horizon 2020 research-oriented project, launched with the purpose of investigate whether and how participatory budgeting practices can improve citizen engagement at a local level and help reconnect citizens with municipality policy-making processes. The project’s consortium was composed of seven partners that included an interdisciplinary team of five academic institutions from the United Kingdom, the Netherlands, Romania, Poland and Cyprus, supported by two independent organizations, “DemSoc” and “EURACTIV”. They conducted PB experiments in seven participant cities, one for each country. Among the selected cities were Ypsonas (Cyprus), Neapoli-Sykies (Greece), Sligo (Ireland), Rotterdam (Netherlands), Walbrzych (Poland), Cluj-Napoja (Romania) and Fife (Scotland).

To design the experiments, the project team divided the process in three phases: priority-setting phase, proposal articulation phase and decision-making phase. At the same time, participants were split into four groups: Cohort A, Cohort B, Cohort C, Cohort D. Cohort A participants were involved in all phases of the experiment, while the other three had a limited contribution. The experimental process involved discussion meeting between focus groups of five to ten members and a project moderator, lasting mostly two hours. Quantitative data was collected by questionnaires, with one being handed out before the main activities and another after. Participants were given limited information about the project to reduce affective responses. A Discourse Quality Index was used to assess the quality of dialogue, utilizing “speech” as a unit of analysis. Participants were given six candidate projects to give an opinion on and vote, after which “coders” identified utterances throughout the activity and categorized them based on characteristics such as duration, foul language, justification and counter-argumentation.

In some cities, the experimental process differed. The restricted conditions in Cyprus posed the need to create a new group, Cohort E, consisting of university students. Unlike the other studies, most of the activities were conducted offline. In Scotland, UK, the authorities of the Fife used the “DEMOTEC” experiments to allocate real funds during the project. In collaboration with the Democratic Society of Fife and the University of Strathclyde, the Fife council ran three-weekend focus groups to review the experiment designs. During the process, participants gave their opinions and ideas on specific area landmarks, such as the Cowdenbeath and Lochore Meadows, with each focus group

selecting their “Top Three” ideas.

The city council of Sligo, Ireland was directly involved in the planning process of their “DEMOTEC” project, making use of the experiments to conduct an actual consultatory participatory budgeting process in the town of Tubbercurry. With the help of the local government, the project team organized workshops to gather input on future town development and community views on participatory budgeting. Participants had the choice between two in-person meetings or an on-line focus group to take part in the experiment.

Green B-LEAF project can use the results from different PB experiments conducted by the DEMOTEC project to use the lessons learned and conclusion for inclusion of citizens and media into PB processes. Green B-LEAF can benefit from DEMOTEC's methods for involving citizens in decision-making processes related to climate resilience and green initiatives. By utilizing DEMOTEC's frameworks for assessing the impact of green technologies in rural settings, Green BLEAF can ensure that these technologies meet community needs. Additionally, collaboration on policy development can integrate citizen input and technology assessments, enhancing sustainable development strategies. This alignment can improve Green B-LEAF's participatory approaches and technology integration, ensuring effective and inclusive climate resilience strategies.

**Decider pour Paris**

Since 2014, participatory budgeting has been a democratic initiative that has allowed the citizens of Paris to vote on projects they would like to see implemented. To encourage wider participation, the city launched the digital platform “Decider pour Paris” (2022). This feature allows participants to submit ideas throughout the year in parallel with the “citizens ideas” (idées citoyennes) box.

To propose an idea, participants first need to create an account on the “Decider pour Paris” website (deciderparis.fr). The proposed ideas must be in accordance with the 4R’s: Recevable (Acceptable), Robuste (Robust), Realisable (Feasible), Rassembleur (Unifying). After the submission, each project is reviewed by the local Parisian government to confirm it meets the main criteria (city jurisdiction, investment expenditure, public interest). To give their initiative any chance of success, participants are invited to workshops, where they present their PB ideas in a brief manner. One of the participants can volunteer to take notes of all validated proposals. If the workshop generates several ideas, then there is a possibility to submit multiple projects

The “Decider pour Paris” platform also allows users to vote on projects that interest or impact them. Participants can vote on two types of projects: city-wide and district projects. They must vote for at least one project, but have the choice to vote for ten projects maximum (five Parisian projects and five district projects). If the patrons have difficulties accessing the website, they can cast their vote physically, by the several “citizen boxes” spread across the municipality. For the proposals to be reviewed by the local government, they must receive more than 1500 votes. If approved, the city of Paris will

support the implementation.

Thanks to participatory budgeting, the City of Paris (2018) conducted several projects to make the city more sustainable. One initiative focused on renovating an amphitheater in the "Jardins des Amandiers" (Almond Gardens) by creating a retractable roof that doesn't damage the garden's vegetation. To help combat energy poverty in working class neighborhoods, Paris approved the idea of producing electricity and hot water through photovoltaic or thermal panels that were installed on housing and building rooftops. The city also experimented with innovative systems, such as photovoltaic sidewalks. Other projects included "cool islands", spots where citizens can refresh themselves and "beautification" activities that involved the painting of murals across the city.

The Green B-LEAF project can draw on Decider Paris' extensive experience in fostering citizen participation and implementing community-driven projects. By adopting similar strategies and tools, the Green B-LEAF project can enhance the engagement of rural communities in the Mediterranean region, ensuring that their voices are heard in the decision-making process for climate resilience initiatives.

**Participatory Budgeting Project (PB CAN)**

The Participatory Budgeting Project (PBP) (2017) is an initiative that empowers people to decide how to spend public money, primarily in the US and Canada. Their goal is to create and support participatory budgeting processes that deepen democracy, build stronger communities and make public budgets more equitable and effective. They were the first organization to bring participatory budgeting practices in the United States when they collaborated with the City of Chicago to help them allocate capital funds. Since then, the practice has been conducted in several cities, supported by key government institutions like the White House.

The city of Vallejo, California was the second municipality to cooperate with the "PBP" organization. They launched a PB pilot with the aim of designing ways the city can use the revenue generated from the newly approved sales tax. Boston launched the "Youth Lead the Change PB" initiative, which attracted more than 4500 youth participants, while New York City developed the "Where we Live NYC" urban housing plan (2020) to study and address residential segregation patterns and how they affect citizens. Participatory Budgeting was used for a second time in Chicago, to overhaul zoning and development decisions in the city's 35$^{th}$ District (2020).

In 2021, The American Congress passed the "American Rescue Plan Act" (ARPA) to support communities affected by the COVID-19 pandemic. The Youth was uniquely impacted by the pandemic and were vastly underrepresented in government decisions made in their behalf. As part of their commitment to transforming democracy through community participation, the project assembled the "Democracy Beyond Elections" campaign (2021). It gathered a diverse coalition of partners, from grassroots organizations to policymakers, to develop an agenda that enables community-led decision making a reality.

To prepare for the upcoming school year, The School District of Central Falls, Rhode Island launched the "VOCES CON PODER" (Voices with Power) initiative (2021), to help decide how to allocate ARPA funds into participatory budgeting practices. Project teams consisting of parents and students reached out to the community to gather ideas for spending priorities. Those ideas were then shaped into proposals that were voted based on their benefits to the school community. In the State of Oregon, five non-profit organizations, in collaboration with the Seeding Justice Foundation and three State Legislators, launched the "Youth Voice Youth Vote PB" campaign (2022). Centered around youth and youth decision making, the project team consisted of 22 youth leaders that designed or executed the PB processes from process rules to outreach. A staff team, composing of five youth consultants and a steering committee studied and researched the needs of the community.

The Green B-LEAF project can utilize PB CAN's resources and case studies to enhance community engagement and ensure that local residents actively participate in decision-making processes related to climate adaptation. This synergy can foster greater community involvement and ownership of green initiatives.

**Cities of Tomorrow (TOMORROW)**

The "Cities of Tomorrow" project, also known as "TOMORROW", was a project funded within the Horizon 2020, with the goal of empowering local authorities to lead a transition towards low-carbon, resilient and more livable cities by developing energy transition roadmaps with citizens and local stakeholders. To facilitate and accelerate energy transitions, the project implemented innovative engagement and government processes, based on the concept of transition management.

The innovative engagement processes developed over the course of the TOMORROW project were based on reviews of existing methodologies and approaches used by some frontrunner European cities: Leuven, Ghent (Belgium) and Nantes (France). Inspired by the processes and activities that the "lighthouse" cities had put into place, TOMORROW supported pilots in six cities: Brest (France), Nis (Serbia), Brasov (Romania), Dublin (Ireland), Mouscron (Belgium) and Valencia (Spain).

The use of analysis tools helped cities like Mouscron, Brasov and Dublin, leading to the creation of transition teams comprised of members from various units and departments within the cities. For the project to bring in radical perspectives and actions into transitional management activities, the process had to be democratically legitimate. This helped TOMORROW convince the authorities in the town of Nis to conduct an energy poverty and consumption analysis in a period of local and national elections. Valencia set up the "Energy Transition Roundtable" to work on the city's "Just and Inclusive Energy Transition strategy", linking activities to existing city structures, policies, programs and initiatives. The project also organized public events in Brest, gathering a diverse group of participants that wanted to share stories on climate issues that might inspire other stakeholders.

Green B-LEAF project can utilize TOMORROW's tools and methodologies to enhance participatory budgeting processes. Green B-LEAF can also Adopting TOMORROW's comprehensive roadmap strategies to ensure integrated and sustainable community planning.

**Government and Youth in the Alps (GaYA)**

The "Government and Youth in the Alps" project (2019), known also as "GaYA" was part of the EU's "Alpine Space Project", aimed at increasing the quality of democracy in the Alpine area by enhancing the capacity of decision and policy makers to involve youth as future leaders in democratic systems. Structured to be realized in a two-year timeframe (2016-2018), it's end goal was to raise awareness and spread knowledge on adopting innovative methods and instruments in decision-making processes among politicians, civil servants and young adults.

Within the project, "Youths" were identified as young adults somewhere around 15 to 25 years old, who took part in such activities as either a member of a youth parliament or a local youth council. A study showed that, out of the whole Alpine region territory, 76% of the municipalities conducted participatory democratic practices aimed at young adults. "Jugend in der Traunsteinregion" was a project initiated in the Traunstein region of Austria, where young people established youth councils based on a group dynamic. "HDJ" was a "kick-off" event held in Heidelberg, Germany where youth administrators and youth representatives shared ideas through the WhatsApp platform. "My Wo Do + 24", held in Wolkendorf, Austria, allowed young people to act as agents of change by getting them involved in the planning of the municipality's spatial use, while "Rendering Trentogiovanni" in Trento, Italy, allowed young people to share their views and opinions and organize them in four main groups: jobs, culture, participation and inclusion.

The topics of the practices varied, from urban policies to environmental initiatives. For example, Energiewende, held in Weying, Germany, was a participatory workshop, held with the purpose of achieving a transition to renewable energy by 2025. "Beko", was a discussion panel featuring citizens and stakeholders from municipalities of the Baden-Wurttemberg region of Germany, held with the intent to develop common energy policy recommendations for the regional government.

Green B-LEAF project can adopt similar participatory models to engage youth in climate resilience initiatives, leveraging insights from the project's capacity-building activities, and fostering transnational cooperation to integrate diverse youth perspectives into the Green PB methodology.

**Citizen Involvement in Circular Economy Initiatives (CECI)**

The "CECI (Citizen Involvement in Circular Economy Implementation)" project (2023) was part of the EU's Interreg Europe Program, starting from 2019 until 2022. The project's goal was to raise awareness on circular economy practices, highlight the importance of citizen engagement, adopt sustainable consumption practices, promoting sustainable services

and encouraging circular thinking. It collaborated with 6 EU countries, with pilots in the region of Paijat-Hame in Finland, the city of Mechelen in Belgium, with the intent of creating and maintaining citizen involvement in circular economy practices.

In Finland, the project team collaborated with the LAB University of Applied Science in Lahti to work on the "Maallemuuttajat 2030" project (the "Urban Rural-Migrants 2030" project, in English). The objective was to find solutions to local issues like high unemployment, rural exodus, disappearing local services, while also creating positive environmental and social issues at the same time. During the summer of 2020, the local libraries in the towns of Asikkala and Hollola opened a sharing service section, where local residents could share tools and materials that can minimize consumption and serve their needs better. While some of the donated items were in good condition, a handyman was responsible for repairing and restoring the products so they can be of use for many years. Residents could select up to 20 items and rent them for two weeks. Among the donated items included a sewing machine, kitchen equipment for baking purposes, a cordless drill and many more.

Circular Economy practices are a top priority of the city of Mechelen (2023) in Belgium. As part of "Flemish Vision 2050", the city plans to reduce material footprint by 30% by combating water scarcity, supporting circular activists and providing directions to local stakeholders by outlining a circular strategy. Inspired by the initiatives in Finland, Mechelen collaborated with "CECI" to launch a local urban lab for citizen engagement in circular economy practices. Under the name "Stroom Projet", the aim was to make the project representative of the diverse population of the city by actively engaging with people who are not concerned with sustainable consumption. From data collected through survey, studies, and interviews with key city figures, they were able to design a physical and digital map of the city's circular initiatives. They looked to examples from other European cities, such as bike sharing service in Ostrava, Czech Republic and a ride sharing service in Lahti, Finland, as ways that they could make circular products and services mainstream. The lessons learned from the "Stoop Projet" allowed the city to implement a wide campaign to integrate circular consumption activities with social and neighborhood work. As of 2026, it's still ongoing.

Green B-LEAF can adopt similar participatory models to engage youth in climate resilience initiatives, leveraging insights from the project's capacity-building activities, and fostering transnational cooperation to integrate diverse youth perspectives into the Green PB methodology.

**Interlace Hub - Restoring Urban Ecosystems**

With the overarching aim of empowering local authorities to restore their urban ecosystems and make their cities more inclusive, resilient and livable, the "Interlace" project (2025) was initiated to develop approaches and tools around urban "nature-based solutions". Central to the process were six committed EU and CELAC (Community of Latin American and Caribbean States) partner cities: Chemnitz (Germany), Portoviejo (Ecuador),

Granollers (Spain), Envigado (Colombia), Krakow (Poland) and San Jose (Costa Rica).

The research team focused on several key questions regarding policy and governance, in particular urban planning and citizen engagement. An agile methodology involving stakeholder discussion and a questionnaire survey was used to structure the development process of three urban planning tools: Archdaily, SketchUp and Unlimited Cities. These tools allowed project partners to make better informed decisions regarding urban planning. Example, Granollers and Envigado conducted micro-scale modeling exercises to improve thermal comfort through NBS. A PET (Physiological Equivalent Temperature) index was used to assess the impact of the thermal environment on the human body, while computer simulations were conducted to model climate and urban design scenarios to measure the effectiveness of NBS. By comparing alternatives and indicators, the final results showed that urban practices, like vegetation can reduce heat stress, however they come with limitations. By combining nature-based solutions with standard urban designs such as buildings and roads, cities can improve thermal comfort and climate resilience at a micro scale.

Community and citizen engagement played a great role in NBS integration. Interlace's "Citizen Engagement Programme" was conceived to increase public awareness of the value of nature in the cities. From the start, young people were identified as a key audience, with programmed workstreams placing emphasis on this engaging this target group specifically. Urban art interventions were devised with local artists to highlight the beauty and importance of wildlife and biodiversity. In Envigado, a CEP called "Guardians of the Ayura" was set up to raise awareness of the importance of the La Ayura creek. This initiative utilizes maps to help children understand their potential impact on the local landscape. "SILAPE KIDS", a citizen science workshop, was organized to highlight public awareness on nature conservation and sustainable use of public resources. Noteworthy was the utilization of the video game "Minecraft" as a tool to help young people discover, learn, plan and design nature-based solutions.

Green B-LEAF project can benefit from INTERLACE's policy instruments and governance strategies for implementing nature-based solutions. This collaboration can support the integration of sustainable practices and green infrastructure into the Green PB methodology, enhancing the overall effectiveness of climate resilience efforts. Their Urban Governance Atlas (UGA) represents an interactive online database of over 250 good practice policy instruments that support nature-based solutions and ecosystem restoration.

**REFLOW**

The "REFLOW" project was a Horizon 2020 research initiative, with the goal of developing circular and regenerative cities through practices that align market and environment needs. At the core of developing, testing and summarizing Circular Economy Strategies in the "REFLOW" project were six pilot cities: Amsterdam (Netherlands), Berlin (Germany), Cluj-Napoja (Romania), Milan (Italy), Paris (France), Velje (Denmark).

The Milan pilot action focused on food by tracking its flow across the city. Three different solutions (2022) were developed with the help of REFLOW OS, an online and offline set of tools that help communities create federal and secure economic networks: PrimaSeconda, a web application that supports the processing of recurring food surpluses and the increase in value within a transformation process, the "Food Market 4.0 Dashboard", an integrated system of hardware and software solutions aiming to prevent food waste, and "BOTTO", an communication system for surplus fruits and vegetables. It allows wholesalers to recover food before it is thrown away, divided between edible and non-edible and redistributed to anyone that wants to take it.

During the Amsterdam pilot action, the project team collaborated with "SwapShop", a chain of secondhand retail stores where customers can bring their own clothes to be swapped with other ones. The project team developed an application based on the "REFLOW OS", to keep track of the items that were sold to customers. A QR code stitched on the items allows users to access a website containing information regarding the article. It also contains "Swapbot", a chatbot that answers user question regarding a particular item of clothing.

In Velje, the team partnered with the supermarket chain "REMA 1000", to minimize their plastic container usage by visualizing a circular value chain loop with the help of "REFLOW OS". Other initiatives included a FabLab where participants could build flowerpots made out of recycled paper. A "Wastewater Heat Radar" was developed in Berlin, which helped indicate heat energy, then linking it to buildings and districts in need of heat energy. The main task of the application was to create awareness, show heat potential and foster a wide range of implementations in Berlin, by accumulating inquires and creating synergies at a district level.

By integrating circular economy principles from REFLOW, Green B-LEAF can ensure community-driven projects are not only resilient but also resource-efficient. Second, REFLOW's digital tools for monitoring and managing resource flows can enhance Green B-LEAF's Green Budget Tagging (GBT) toolkit.

**NEBA - Supporting the integration of New European Bauhaus values and principles in the regional planning process**

The NEBA project brought together regions with unique local backgrounds, to explore the best practices that insure synergies of interregional cooperation in the areas. Through a "State of the Art" analysis, the project combined SWOT (Streingh, Weakness, Opportunities, Threats) and PESTLE (Political, Economical, Social, Technological, Legal, Environmental) analysis methodologies, to access internal capacities and external challenges in NEBA cities, such as Turin (Italy), Galway (Ireland), Geel (Belgium), Elverum (Norway), Stara Zagora (Bulgaria) and Panevezys (Lithuania). Many European cities implemented the NEB project through the help of "Labs" or an "Academy". As a solution, these approaches were highlighted as ways that NEB implementation could be advanced in "SoA" cities.

The “NEBA” Regional Reports showed that all partner members have been pursuing or attempting to implement “New European Bauhaus” policies directly or indirectly into their respective policies. The city of Stara Zagora (2024) has developed a framework to integrate NEB values into the general criteria of Ministry of Regional Development. It conducted renovation projects on Ayazmoto Park and Stantsionna Gradina Park, while creating a brand new recreational and leisure center, Artileyrsky Park. Elverum took concreate action by joining a regional initiative called the “Climate Partnership”. Based on their experience on the DESIRE Project, the UNITO Green Corridor and the NEBathon, the government of Torino (2024) published a manifesto, which serves as guideline to anyone interested in developing NEB initiatives. Panevezys and Galway designed local strategy development plans to establish projects with a focus on environmental sustainability, while Geel (2024), a member of UNESCO’s List of Good Safeguarding Practices, integrated its ancient community-based foster care model in their green planning processes.

Green B-LEAF can use NEBA's interdisciplinary approach to regional planning, involving urban planning, architecture, landscaping, and ecology for its holistic strategy for climate resilience. Green B-LEAF can use integrate NEBAs interdisciplinary frameworks to develop more comprehensive and effective solutions.

**Minecrafting Resilient Cities: Innovative YOUth-led Policy Process for Sustainable Europe ("MC YOU")**

“MC-YOU” (“Minecrafting Resilient Cities: Innovative YOUth-led Policy process for sustainable Europe”), a Horizon 2020 backed project, was established to engage and empower young people to design sustainable and modern European cities through the creative and educational potential of Minecraft, providing an opportunity for policymakers to benefit from the much needed perspective of younger generations.

The project consisted of six project phases in the form of workshops, where partakers learned, identified, discussed, designed and presented their ideas on solving urban issues. At the end of the pilot cycle, an award show was held to present the innovative ideas developed throughout the project with the help of Minecraft, with an audience voting for the best one. The project was piloted concurrently in three European cities: Riga (Latvia), Sandanski (Bulgaria) and Faro (Portugal). Project teams organized “Agoras”, public hearings, to ease discussions on key issues, like resilient city challenges, sustainability, youth participation, urban planning and gamification. They were held in both a physical space and an online space. Pilot results showed that teacher’s involvement, expert feedback, municipal endorsement and school leadership consultations, were pivotal in the project’s success. An interesting case was the Municipality of Faro. It developed a promotional strategy that combined digital outreach via social media channels with physical posters that contained QR codes.

The Green B-LEAF project can benefit from these initiatives by integrating their successful strategies for youth engagement, participatory processes, and sustainable development.

Specifically, the use of interactive tools like Minecraft from "MC YOU" can be adapted to engage communities in climate resilience planning.

# ANNEX VI GIS Software

**GIS** stands for **Geographic Information System**. At its simplest, it is a framework for gathering, managing, and analyzing data rooted in geography.

Think of it as a **"Smart Map."** While a paper map just shows you where things are, GIS software links **Location** (where things are) with **Information** (what things are like).

- **The Layer Cake Concept:** GIS works by stacking layers of information on top of each other. You might have a base layer of a satellite image, a second layer showing property boundaries, and a third layer showing underground water pipes.
- **Data + Location:** In a spreadsheet, you might see "Main Street." In GIS, that "Main Street" entry is physically tied to coordinates on Earth. When you update the spreadsheet, the map changes; when you move a point on the map, the data updates.

**Common Uses for GIS:**

- **Environmental Science:** Mapping deforestation or tracking air quality.
- **Urban Planning:** Deciding where to build a new park based on population density.
- **Disaster Management:** Predicting which houses will flood during a storm.

**QGIS** (formerly known as Quantum GIS) is a specific, professional-grade software application used to create and edit GIS data.

It is **Free and Open Source (FOSS)**. This means anyone can download it, use it for any purpose (including commercial work), and even look at the "source code" to see how it's built.

QGIS is popular because:

- Zero Cost: While commercial competitors (like ArcGIS) can cost thousands of dollars per year, QGIS is completely free.
- Cross-Platform: It runs on Windows, macOS, and Linux.
- Community-Driven: Thousands of volunteers worldwide contribute to its development. If a user needs a specific tool that doesn't exist, they can write a "plugin" and share it with everyone.
- Interoperability: It can open almost any type of map file format in existence, making it the "Swiss Army Knife" of the mapping world.

**Usage of QGIS**

1. Digitize: Trace over satellite imagery to create your own digital maps.
2. Analyze: Find out how many people live within 5km of a specific bus stop.
3. Visualize: Turn boring spreadsheets into heatmaps, 3D terrains, or beautiful printable posters.
4. Process: Convert raw GPS data from a phone or drone into professional maps.

**Conclusion:** If GIS is the *concept* of using digital maps to solve problems, QGIS is the *power tool* you use to do the work.

How familiar are you with handling data—do you usually work with spreadsheets or are you coming at this from a design perspective?

**How to use QGIS**

list of tutorials to help you transition from installation to creating your first professional maps.

**Official QGIS Resources (The "Gold Standard")**

The official documentation is comprehensive and updated for every version.

- **QGIS Training Manual:** This is a complete, step-by-step course. It takes you from "I've never opened GIS" to advanced spatial analysis.
- **A Gentle Introduction to GIS:** If you are new to the *concept* of mapping (layers, vectors, rasters), read this first. It explains the theory without getting bogged down in buttons.
- **QGIS User Guide:** Best used as a reference manual when you need to know exactly what a specific tool or button does.

**Best YouTube Channels (Visual Learning)**

Visual tutorials are often better for learning the user interface and "tricks of the trade."

- **Klas Karlson:** * *Best for:* Creative cartography and "How-To" snippets.
    - *Key Tutorial:* QGIS 3 for Absolute Beginners (A great 15-minute primer).
- **Hans van der Kwast:** * *Best for:* Hydrology and professional environmental analysis.
    - *Key Tutorial:* QGIS for Beginners Playlist.
- **OpenSourceOptions:** * *Best for:* Long-form, detailed courses.
    - *Key Tutorial:* QGIS Full Course for Beginners (3+ hours of structured learning).

**Specialized Web Tutorials (The "Deep Dives")**

- **QGIS Tutorials and Tips (Ujaval Gandhi):** This is widely considered the best

unofficial resource on the web. It offers short, task-oriented tutorials (e.g., "How to georeference a map" or "How to perform a buffer analysis").

- **FreeGISData.rtwilson.com:** Not a tutorial site, but a massive list of where to find free data to practice your mapping skills.

**Quick Start Path Recommendation:**

1. **Watch:** A 15-minute "Beginner Overview" on YouTube to see the workflow.
2. **Follow:** The **QGIS Training Manual (Module 3: Creating a Basic Map)**.
3. **Practice:** Use **QuickMapServices** (the plugin) to bring in a Google Satellite layer and try tracing buildings or roads in your own neighborhood.

# ANNEX VII The Data Repositories

Green B-LEAF project Data Repository:

z_old - Google Drive

Free spatial data (Shapefiles or GeoPackage files) for Europe is straightforward because of the continent's strong open-data initiatives.

The most reliable sources for European geospatial data are shown below:

**1. Top-Tier Continental Portals**

- **Eurostat (GISCO):** This is the gold standard for official European administrative boundaries. You can download NUTS regions (statistical units), countries, and coastal lines in various scales and formats (SHP and GPKG).
- **The European Data Portal:** A massive aggregator that links to national open-data portals across the EU. You can search specifically for "geospatial" and filter by country.
- **Copernicus Land Monitoring Service:** Best for environmental data. It provides the **CORINE Land Cover** datasets, which show how land is used (forests, urban areas, agriculture) across all of Europe.

**2. Infrastructure & Physical Geography**

- **OpenStreetMap (OSM) via Geofabrik:** Geofabrik provides daily updated extracts of OpenStreetMap data. You can download specific files for the whole of Europe or drill down into individual countries.
    - *Note:* These are often provided as .osm.pbf, but QGIS can open these directly, or you can find SHP versions on the same site.
- **Natural Earth:** Great for small-scale maps (1:10m, 1:50m). It provides clean, stylized layers for European borders, roads, railways, and rivers that are perfect for cartography.
- **EuroGeographics (Open Regional Data):** Provides medium-scale authoritative geospatial data, including the "Open Regional Map" which covers administrative boundaries and names.

**3. Specialized Data (Energy & Environment)**

- **European Environment Agency (EEA):** Excellent for vector data regarding protected areas (Natura 2000 sites), water bodies, and climate zones.
- **ENTSO-E Interactive Map:** While primarily an interactive map, they often provide

data exports or links regarding the European high-voltage electricity grid.

**Quick Tips for QGIS Users:**

- Prefer GPKG over SHP: If you have the choice, download the GeoPackage (.gpkg). It is a more modern format that handles larger datasets faster and keeps all your layers in a single file.
- Coordinate Systems: Most European data uses EPSG:3035 (ETRS89 / LAEA Europe) for equal-area mapping. Make sure your QGIS project CRS is set correctly to avoid "stretched" looking maps.
- Direct Access: In QGIS, you can often skip downloading files by using WFS (Web Feature Service) connections provided by these portals, allowing you to stream the vectors directly into your project.

# Conclusions

The Integrated Climate Data and Vulnerability Mapping Guide serves as the definitive technical and methodological cornerstone for the Green B-LEAF project, establishing a robust framework for climate resilience in rural Mediterranean communities. By consolidating scientific data, regional best practices, and community-driven insights, this document provides the "groundwork" necessary to move from high-level climate theory to localized, data-driven budgeting decisions. The primary mission of this initiative is to promote climate change adaptation, disaster risk prevention, and enhanced resilience through an ecosystem-based approach that balances human and environmental needs.

**A Rigorous and Unified Methodology**

The guide establishes a standardized, five-step methodological approach—Scoping, Hazard Analysis, Exposure Analysis, Vulnerability Assessment, and Risk Calculation—to ensure that climate planning is scientifically rigorous and consistent across diverse territories. Rooted in the IPCC Sixth Assessment Report standards, the framework adopts a multi-dimensional view of risk, analyzing the interplay between ecosystems, biodiversity, and human societies. A critical technical achievement of the guide is the development of a Composite Climate Risk and Vulnerability Index, which utilizes data normalization (on a 0–1 scale) and expert weighting to transform complex environmental and social indicators into a prioritized roadmap for investment.

**The Synergy of Data and Participation**

A defining innovation of this guide is the "Green B-LEAF Nexus," which integrates high-level scientific mapping with hyper-local participatory governance. While Geographic Information Systems (GIS) and satellite data provide the technical "where" of climate risk, community workshops involving at least 20 stakeholders per municipality provide the "real-life" validation. This approach ensures that the mapping reflects the lived experiences of residents and aligns with New European Bauhaus (NEB) principles of sustainability, inclusiveness, and aesthetics. By making complex risk data visually accessible through interactive maps and dashboards, the project fosters a culture of community ownership over the green transition.

**Localized Findings and Regional Resilience**

The vulnerability assessments and risk profiles detailed in the annexes highlight the urgent, specific threats facing partner municipalities:

- Heatwaves and Wildfires: Identified as critical threats in Sandanski, Strumica, and Pilea-Hortiatis, where they impact public health, tourism, and ecosystem carbon sinks.
- Flooding and Sea-Level Rise: Major concerns for coastal and riparian areas like Faro, Quart de Poblet, and Vodnjan, requiring urgent drainage upgrades and

nature-based solutions.

- Agricultural and Economic Gaps: Many regions, such as Beltinci and Strumica, face significant readiness gaps in food security and water management, where future risks to crop production and public finances are high but current adaptive capacity remains low.

**Bridging Mapping to Financial Action**

The ultimate value of this guide lies in its integration into local governance through Green Budget Tagging (GBT) and Green Participatory Budgeting (GPB). By identifying geographic "hotspots" of high integrated risk, the guide enables local authorities to prioritize the allocation of public funds toward projects—such as nature-based solutions (NBS) and energy-efficient building upgrades—that will have the greatest impact on resilience. This strategic link ensures that financial resources are not merely spent but are invested in verified community needs, moving municipalities from "planning" to "real-life" adaptation.

**Conclusion and Future Outlook**

The completion of this guide marks the first step in establishing a Transnational Network of Rural Communities dedicated to collaborative climate action. It provides a scalable model for rural Mediterranean territories to navigate the "green transition" effectively. As municipalities begin to implement the Green B-LEAF Toolkit, the synthesis of validated data and inclusive governance will serve as a permanent feature of the region's institutional framework, fostering long-term social cohesion, economic stability, and environmental health. This guide is not just a technical manual; it is a vision for a sustainable future where community voices and scientific evidence work in tandem to face the shared climate crisis.

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