CLIMAAX
climate ready regions

Deliverable Phase 3 – Climate risk management

Climate Risk Analysis for Garmen (CRAG)

Bulgaria, Municipality of Garmen

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Document Information

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Abbreviations and acronyms

Abbreviation / acronym	Description
CMT	Core Municipal Team
CRA	Climate Risk Assessment
CRAG project	Climate Risk Analysis for Garmen project
CRM	Climate Risk Management
CoP	Community of Practice
D1	Deliverable 1
D2	Deliverable 2
DFSCP	Department of Fire Safety and Civil Protection
EET	External Expert Team
EEA	Environment Executive Agency
IFP	Individual Follow-up Plan
MECSP	Municipal Expert Council on Spatial Planning
MIDP	Municipal Integrated Development Plan
MOEW	Ministry of Environment and Water
NAMRB	National Association of Municipalities in the Republic of Bulgaria
NIMH	National Institute for Meteorology and Hydrology
NSI	National Statistical institute
RCP	Representative Concentration Pathways
RIEW	Regional Inspectorate of Environment and Water
SRI	Solar Reflectance Index
WARBD	West Aegean River Basin Directorate

Executive summary

This deliverable presents the results of Phase 3 of the CRAG (Climate Risk Analysis for Garmen) project implemented under the CLIMAAX initiative. Building upon the refined Climate Risk Assessment (CRA) developed during Phase 2, the purpose of this deliverable is to translate climate risk analysis into a practical Climate Risk Management (CRM) framework that supports evidence-based municipal decision-making, long-term adaptation planning and the implementation of resilience measures. While the refined CRA identified and analyzed the priority climate risks facing Garmen Municipality - river floods and heatwaves - this deliverable demonstrates how those findings can be integrated into municipal policies, planning instruments, and investment decisions. The document develops a comprehensive CRM framework tailored to the needs and capacities of Garmen Municipality. It establishes strategic CRM objectives and corresponding indicators, identifies the enabling conditions necessary for effective climate risk management, and proposes a portfolio of priority adaptation measures addressing structural, non-structural, nature-based, governance, and social dimensions of resilience. Particular attention is given to protecting disproportionately affected population groups, strengthening institutional capacity and ensuring that climate adaptation generates wider environmental, social, and economic co-benefits.

An important outcome of Phase 3 is the translation of the refined CRA into concrete policy recommendations. The deliverable reports on the designed updates to the Municipal Climate Change Adaptation Strategy, the initiation of a Municipal Climate Risk Management Plan and identifies opportunities for integrating climate risk considerations into the Municipal Integrated Development Plan, the Municipal Energy Efficiency Program, and municipal spatial-planning practice. The report also proposes practical governance mechanisms, including the introduction of methodological guidance on Solar Reflectance Index (SRI) criteria for building facades and public-space paving materials when public funding is used, reflecting stakeholder recommendations received during the CRAG participatory process. These actions demonstrate how climate risk assessment can be systematically mainstreamed across municipal governance rather than remaining a stand-alone technical exercise. The deliverable further examines the institutional, technical and financial conditions required for successful implementation of Climate Risk Management. It identifies key actors, policy instruments, knowledge gaps, supportive elements and monitoring arrangements necessary for maintaining an adaptive and evidence-based approach to climate resilience. Particular emphasis is placed on strengthening stakeholder engagement, improving municipal information systems, mobilizing national and European funding opportunities and establishing monitoring and evaluation mechanisms that support the continuous updating of climate policies as new knowledge and climate information become available. Phase 3 has also strengthened the institutional capacity of Garmen Municipality, whereby the Municipal administration has gained experience in applying climate evidence to policy development. The project has therefore contributed not only to improving knowledge of local climate risks but also to establishing practical governance mechanisms for their long-term management.

Overall, this deliverable demonstrates that Climate Risk Management should be understood as a continuous governance process rather than a one-time planning exercise. The refined CRA, the updated Climate Change Adaptation Strategy and the future Municipal Climate Risk Management Plan together provide Garmen Municipality with a coherent framework for managing climate risks and strengthening resilience. In this respect, Phase 3 completes the transition from climate risk assessment to climate risk management and provides the Municipality with a durable foundation for evidence-based adaptation planning, policy implementation, and future investment decisions.

1 Introduction

1.1 Main objectives of the project

The third phase of the Climate Risk Assessment (CRA) sought to translate the refined multi-risk assessment into concrete policy instruments and governance processes that strengthen the municipality's long-term resilience to climate change. Building on the scientific evidence and locally validated findings produced in the previous phases, this phase focused on embedding climate risk considerations into municipal strategic planning, risk management, and investment priorities.

The first objective was to integrate the outcomes of the refined CRA into the municipality's Climate Change Adaptation Strategy. Through a systematic review of the existing strategy, the Expert Evaluation Team (EET) has supported the Climate Management Team (CMT) in enhancing both the analytical foundation of the document and its strategic orientation. Particular emphasis has been placed on improving the assessment of climate threats and risks and on strengthening the rationale, prioritization, and design of adaptation objectives, measures, and actions. The updated strategy therefore reflects the most recent evidence on local climate risks while providing a more robust framework for climate adaptation planning and implementation.

The second objective was to operationalize the findings of the CRA by initiating the development of a municipal climate risk management plan. Building upon the updated adaptation strategy, the municipality has used the multi-risk assessment to establish a structured approach to climate risk prevention, preparedness, and resilience. Special attention has been given to addressing the needs of disproportionately affected population groups and ensuring that risk management measures contribute to a socially equitable adaptation process.

A further objective has been to strengthen the municipality's capacity to mobilize financial resources and foster multi-level governance for climate adaptation. The evidence generated through the CRA will serve as a basis for advocating national funding opportunities and attracting investments for priority adaptation measures. At the same time, the municipality will use the assessment to promote enhanced regional cooperation in planning for climate risks and disaster prevention, recognizing that many climate hazards extend beyond administrative boundaries and require coordinated responses.

Finally, Phase 3 has aimed to ensure that the knowledge generated throughout the CRA process is effectively communicated and translated into action. Supported by the EET, the municipality has implemented targeted stakeholder engagement activities to promote the updated strategic documents, build institutional and public ownership of the proposed measures, and facilitate their implementation. In doing so, the phase has established a clear pathway from climate risk assessment to evidence-based decision-making, policy implementation, and long-term climate resilience.

1.2 Project team

The team consists of the CLIMAAX Municipal Team (CMT) - three municipal employees designated by the mayor, and a subcontracted External Expert Team (EET). The two teams work closely in constant communication following the IFP Work Plan. The CMT ensures the EET receives the relevant information/feedback from the municipal administration, that the administration takes full advantage of the project as a learning experience, and monitors that project activities and deliverables provided by the EET are of high quality. The CMT comes from the municipal department

of EU projects and ensures exchange of information and capacity building for their colleagues of other units, e.g. public works and architecture, spatial planning, green systems, environment, civil protection. The EET supports the CMT and delivers commissioned actions and deliverables as per the Work Plan. The EET provides the expert support enabling project implementation.

1.3 Outline of the document's structure

Following the introductory section, whereby the project objectives are presented, the document is organized around the practical application of the refined Climate Risk Assessment to climate risk management at the municipal level. Section 2 presents the local profile, summarizing the priority climate risks identified during Phase 2, the municipality's resilience capacity, the relevant policy and institutional context, the key actors involved in climate risk management, and the lessons learned from previous climate-related events. Building on this foundation, Section 3 constitutes the core of the report by defining the municipality's climate risk management objectives, identifying the enabling conditions for their implementation, proposing adaptation and risk management measures for the prioritized risks, and describing how these measures can be integrated into municipal planning, decision-making, and future investments. Section 4 evaluates the usability of the project results and reflects on the lessons learned throughout the implementation process. The final sections summarize the main conclusions, assess the project progress achieved against the planned outputs and milestones, present the supporting documentation produced during the project, and provide the references used in the preparation of the deliverable.

2 Local profile

2.1 Summary of Key Risk Assessment results

The refined Climate Risk Assessment (CRA) undertaken during Phase 2 identified river floods and urban heatwaves as the two priority climate risks for the Municipality of Garmen. Risk prioritization was carried out using the CLIMAAX Key Risk Assessment Protocol and the dashboard. The elements were rated as a result of team meetings discussing own knowledge, experience, and expertise, as well as inputs based on records of stakeholder feedback provided both in bilateral settings and during multi-stakeholder consultations – both as part of the Phase 2 process and others organized outside the CRAG project that had touched on either of the two risks, where feedback had been recorded. Since stakeholder feedback does hold an element of subjectivity due to risk perception based on personal experience and proximity, the project team weighed-in in respect to the capacity risk, as the administration is most well-positioned in terms of knowledge to assess it and this is the element where third-party feedback was less decisive in attributing a score.

Risk Workflow	Severity		Urgency	Capacity	Risk Priority
	C	F		Resilience/ CRM	
River flooding					Very High
Urban heatwaves					Moderate

Severity	Urgency	Resilience Capacity	Risk Ranking
Critical	Immediate action needed	High	Very high
Substantial	More action needed	Substantial	High
Moderate	Watching brief	Medium	Moderate
Limited	No action needed	Low	Low

Figure 2-1: Risk prioritization of the two selected risks to analyze under the CRAG project.

The assessment concluded that river floods constitute the municipality's highest-priority climate risk ("very high priority") because of their potential to cause severe damage to critical infrastructure, residential areas, businesses, water supply systems, transport infrastructure, and the natural environment. Previous flood events, particularly along the Kanina River, have demonstrated the municipality's significant exposure to this hazard and the high economic and social costs associated with recovery. Local data incorporated during Phase 2 enabled the identification of flood hotspots, vulnerable infrastructure, businesses, and socially significant facilities, providing a much stronger basis for prioritizing future adaptation investments.

Urban heatwaves were attributed a "moderate priority" according to the Key Risk Assessment Evaluation Dashboard. Although their impacts are generally less sudden than flooding, the assessment accounted for the clear increase in the frequency of heatwave events under both current and future climate scenarios. The integration of local demographic and economic data refined the identification of the most vulnerable settlements and population groups, particularly elderly residents, young children, and areas where high population density coincides with concentrations of economic activity. The assessment also highlighted the cascading effects of heatwaves on public health, tourism, agriculture, energy demand, and water resources, making this hazard a growing concern for the municipality's long-term resilience.

The Key Risk Assessment further evaluated the municipality's resilience capacity, understood as its ability to anticipate, cope with, adapt to, and recover from climate-related impacts. While the municipality has already taken important steps by adopting a Climate Change Adaptation Strategy, strengthening institutional knowledge through the CLIMAAX process, and actively engaging stakeholders, significant limitations remain with regard to financial resources, technical capacity, local monitoring data, and implementation of structural adaptation measures. Consequently, the overall resilience capacity for the priority risks is assessed as “medium” for urban heatwaves and “low” for river flooding. Existing institutional commitment and growing awareness provide a solid foundation for strengthening resilience. However, substantial investments in prevention, improved governance, and enhanced coordination across governance levels are required before resilience can be considered substantial. The incorporation of the refined CRA is without doubt a considerable step towards an improved level of resilience.

The participatory approach applied throughout Phase 2 has further strengthened the reliability of the assessment. Municipal experts, regional authorities, representatives of vulnerable groups, local businesses, and residents participated through bilateral consultations, expert meetings, and public consultations. Stakeholder feedback largely validated the workflow outputs and emphasized the need for greater spatial precision to support decision-making, which directly informed the incorporation of additional local datasets into the refined assessment. As a result, the Key Risk Assessment provides a scientifically robust and locally validated evidence base for the climate risk management activities undertaken in Phase 3, including the update of the municipal Climate Change Adaptation Strategy, the initiation of a municipal climate risk management plan, and the prioritization of future adaptation investments.

Table 2-1: Resilience capacity of Garmen municipality in respect to the priority risks of the refined CRA.

Priority climate risk	*Resilience capacity (low, medium, substantial, high)*	*Description of the resilience capacity (such as existing knowledge, planned measures, gaps)*	*Stakeholders, experts and priority groups involved in the key risk assessment & modality of engagement*
River floods	*low*	*The municipality possesses growing institutional knowledge, an adopted Climate Change Adaptation Strategy, experience from previous flood events, and a clear understanding of local flood hotspots as a result of the Climaax methodology framework. Nevertheless, resilience remains constrained by limited financial resources, insufficient structural flood protection, limited local monitoring capacity, and dependence on external funding for large-scale prevention measures.*	*Municipal administration, regional civil protection authorities, River Basin Directorate, forestry authorities, local experts, representatives of affected communities, local businesses (particularly tourism), and residents participated through expert meetings, bilateral consultations, and public consultation.*
Urban heatwaves	*moderate*	*Institutional understanding of heat-related risks has increased considerably through the CRA, while local demographic data enable targeted protection of vulnerable groups. However, adaptation*	*Municipal administration, health and social service representatives, local residents, vulnerable population groups (particularly elderly people), businesses, regional experts,*

		measures remain at an early stage, local monitoring capacity is limited, and additional investments are required in urban cooling, public health preparedness, and protection of vulnerable populations.	*and the wider public engaged through stakeholder consultations and public meetings.*

2.2 Key implementation mechanisms and policy context for CRM

Climate risk management in the Municipality of Garmen is shaped by a combination of municipal strategies and plans, regional water and disaster-risk governance arrangements, national legislation and sectoral policies, EU regulatory requirements, and the investment decisions of public and private actors. These instruments do not yet constitute a single integrated climate risk management system. Nevertheless, taken together, they provide a substantial policy and institutional basis through which the findings of the refined Climate Risk Assessment can be translated into preventive measures, spatial-planning decisions, sectoral actions and investment priorities. The central implementation challenge is therefore not the absence of policy instruments, but the need to improve their coordination, ensure that they use the same climate-risk evidence and move municipal practice from predominantly reactive disaster response towards systematic prevention, preparedness and long-term adaptation.

At the municipal level, the principal policy instrument is the Climate Change Adaptation Strategy of Garmen Municipality for 2024-2030. The Strategy provides the overarching framework for improving local climate resilience and covers the principal sectors affected by climate change, including water resources, agriculture, forestry, biodiversity, public health, tourism, infrastructure and the built environment. The refined CRA adds a more detailed and locally grounded evidence base to this framework. Phase 3 therefore provided the opportunity to update the Strategy.

The Strategy should be implemented in close connection with the Municipal Integrated Development Plan 2021-2027, which is the main instrument for coordinating territorial, economic, social and infrastructure investment in the municipality. The Plan already recognizes the need for climate-risk management in agriculture, including adaptation measures and training for agricultural producers. Its future implementation and revision can be used to mainstream the CRA findings into investment planning, project selection and municipal budgeting. Projects concerning roads, bridges, water supply, public buildings, tourism infrastructure, public spaces and environmental protection should be screened for present and future flood and heat risk before funding and design decisions are made.

Municipal spatial-planning instruments are another essential implementation mechanism. The CRA's flood maps and identified damage hotspots can inform the preparation or amendment of general and detailed spatial plans, zoning decisions and development permits. In areas exposed to river flooding, planning rules can restrict or condition new construction, preserve space for natural water retention, require appropriate elevations and drainage, and avoid locating critical or socially sensitive facilities in areas of high risk. Where development in exposed areas cannot be avoided, permits can require flood-resilient design, safe access and evacuation arrangements, and protection of essential utilities. This approach is consistent with the EU Floods Directive, which explicitly links flood-risk management with spatial planning, land use and nature conservation.

For heatwaves, spatial planning and municipal development control can promote vegetation, shading, permeable surfaces, retention of existing mature trees, cool construction materials and

improved thermal performance of public and private buildings. The CRA identifies Garmen, Ognyanovo, Debren and Dabnitsa as important areas where heat exposure coincides with population or business concentration, with Ognyanovo requiring particular attention because of its combination of vulnerable residents, tourism activity, and businesses. These results can be used to prioritize cooling measures in public spaces, health and social facilities, schools, tourism areas, and locations used by elderly residents.

The municipal disaster-protection plan, including its flood component, remains the main operational instrument for preparedness, warning, emergency response, evacuation and recovery. The refined CRA indicates, however, that the municipality's capacity to manage major river floods with its own resources is low and that activation of regional and national assistance is often necessary. The plan should therefore be reviewed against the new flood-risk information and linked more closely with prevention and adaptation measures. Appropriate mechanisms include updated emergency scenarios, clarified command and communication procedures, identification of vulnerable people and critical facilities, pre-agreed arrangements with regional services, regular exercises, public information protocols, and post-event recovery procedures.

The municipal climate risk management plan which design has been started in Phase 3 can connect these otherwise separate instruments. It can translate the CRA into a prioritized program of structural, nature-based, social, health, governance and communication measures. It can establish responsible municipal units, partner institutions, indicative costs, funding sources, implementation periods, and monitoring indicators. It should also include procedures for periodically updating the risk assessment as new climatic, cadastral, demographic or infrastructure data become available.

River-flood risk cannot be managed exclusively within the administrative boundaries or institutional capacity of Garmen Municipality. The municipality is situated in the West Aegean River Basin District, and flood-risk prevention must therefore be coordinated with the West Aegean River Basin Directorate, the Blagoevgrad Regional Administration, fire safety and civil-protection structures, water operators, road authorities, and neighboring municipalities.

The principal regional policy instrument is the Flood Risk Management Plan for the West Aegean River Basin District 2022-2027, adopted as part of Bulgaria's implementation of the EU Floods Directive. Flood-risk maps and the Plan's program of measures provide a formal basis for coordinating river-basin interventions, early warning, riverbed management, land-use decisions and investments in flood prevention. Garmen is planning to use the refined CRA and its more detailed local and cadastral data to advocate the inclusion or prioritization of relevant measures concerning the Mesta and Kanina river systems in regional programs and future updates of the Flood Risk Management Plan.

Regional implementation should combine structural protection with catchment-scale and nature-based measures. Riverbed correction and protective facilities may be required at the most exposed locations, but these should be complemented by restoration of riparian vegetation, improved forest and soil management, retention of water upstream, protection of floodplains and control of erosion and sediment accumulation. This combination is particularly important because interventions in one section of a river can transfer risk downstream unless they are assessed within the wider river-basin context.

The Water Framework Directive and Bulgaria's river-basin management system also require the protection and improvement of the ecological condition of water bodies. Flood-protection measures should consequently be coordinated with water-quality, ecosystem, and biodiversity objectives and

should avoid unnecessary deterioration of river habitats. At EU level, the Water Framework Directive remains the foundation of water policy, while the developing European water-resilience agenda emphasizes protection and restoration of the water cycle, efficient water use, preparedness, and access to clean water.

The regional disaster-protection system is equally important. Municipal planning must be coordinated with the district-level disaster-protection plan and the territorial structures of the Unified Rescue System. This is particularly relevant for severe floods that exceed local response capacity. Shared risk information can reduce delays during emergencies and strengthen the municipality's practical coping capacity.

At national level, the National Climate Change Adaptation Strategy and Action Plan to 2030 provide the overarching policy framework. The Strategy assesses vulnerability and adaptation needs across agriculture, forestry, biodiversity and ecosystems, water, energy, transport, the urban environment, health and tourism, while treating disaster-risk management as a cross-sectoral issue. These priorities correspond closely to Garmen's territorial profile and provide a policy basis for integrating the municipal CRA into sectoral planning and for requesting national support for locally identified adaptation measures.

The National Disaster Risk Reduction Strategy 2018-2030 establishes a framework for reducing existing risks, preventing the creation of new risks, improving preparedness and response capacity, and applying the principle of rebuilding better after disasters. Together with the Disaster Protection Act, it assigns an important planning and coordination role to municipal authorities. The Act provides for municipal disaster-protection plans developed through municipal disaster-risk reduction councils, creating a statutory mechanism through which the findings of the CRA can influence prevention, preparedness, emergency response and recovery planning.

The national flood-risk and water-management framework is operationalized through the Water Act, the river-basin management plans and the flood-risk management plans. For Garmen, these instruments can enable measures that exceed municipal competence or financial capacity, including larger river-protection works, hydrological monitoring, catchment management and coordinated actions along the Mesta and Kanina rivers. The municipality should formally submit its locally refined risk evidence to the relevant basin and national authorities when plans and programs of measures are prepared or updated.

National spatial planning, construction and infrastructure standards also offer mechanisms for CRA results incorporation. Even where explicit municipal climate-adaptation standards are not yet established, Garmen can require that municipal projects and commissioned designs assess flood exposure, surface drainage, heat stress, thermal performance, water efficiency, and continuity of essential services. Climate-risk screening can become a condition for municipal investment approval and for the preparation of funding applications. This would reduce the risk of investing public resources in infrastructure that may become unsafe, ineffective or costly to maintain under future climatic conditions.

In respect to water and flood management, priority mechanisms include maintenance and restoration of riverbeds; inspection of bridges, culverts and protective infrastructure; improved stormwater drainage; restrictions on development in flood-prone locations; hydrological monitoring; early warning; catchment-scale retention; and protection of drinking-water and wastewater systems. Measures should be coordinated with the relevant Basin Directorate and designed to contribute simultaneously to flood prevention, water quality, and ecosystem resilience.

Agriculture is economically important to Garmen and is exposed to heat, drought, water scarcity, soil erosion, intense rainfall and flood damage. The municipal integrated development plan, Bulgaria's CAP Strategic Plan for 2023–2027, and the EU Common Agricultural Policy provide mechanisms for farmer training, risk-management instruments, water-saving irrigation, improved soil management, diversification, agroforestry and investments that increase resilience. The municipality can support implementation by disseminating information, facilitating partnerships and incorporating agricultural land and irrigation infrastructure into local risk planning.

In respect to forestry, biodiversity, and ecosystems it is important to note that forests cover a major share of Garmen's territory, while part of the municipality lies within the Natura 2000 network. Forest and ecosystem management can reduce erosion, regulate runoff, improve water retention, limit heat exposure and protect tourism and agricultural resources. Relevant measures should be coordinated with forestry authorities, the regional environmental inspectorate and Natura 2000 management mechanisms. Bulgaria's Prioritized Action Framework for Natura 2000 for 2021-2027 provides a strategic basis for planning conservation and ecological-infrastructure measures and for connecting biodiversity protection with available EU funding.

When it comes to public health and social protection, heatwave management requires coordination between the municipality, health services, social-service providers, schools, childcare facilities and community organizations. Implementation mechanisms can include heat-health action protocols, early warning, outreach to elderly and isolated residents, lists of people requiring assistance, access to cooled public spaces, adjusted working and service hours, drinking-water provision and guidance for schools, employers and tourism providers. The CRA's identification of demographic and spatial vulnerability should be used to target these interventions rather than applying them uniformly across the municipality.

Tourism, particularly in Ognyanovo, depends on the quality of natural resources, thermal-water assets, accessibility and visitor safety. Tourism planning and business licensing can encourage emergency preparedness, heat protection, water efficiency and continuity plans. Municipal promotion and investment support should favor tourism projects that provide shaded and vegetated spaces, maintain safe indoor temperatures and avoid increasing exposure in flood-prone areas.

In respect to buildings, transport, and critical infrastructure, new municipal and private investments could be subject to climate-risk screening. Public buildings, roads, bridges, electricity and communication systems, water infrastructure and healthcare or social facilities should be designed or renovated to remain operational during heatwaves and floods. Procurement documents and technical specifications can require climate-resilient materials, adequate drainage, passive cooling, shading, backup power, protection of equipment and safe access during emergencies.

The European Climate Law requires continuous progress in strengthening adaptive capacity, resilience and reduced vulnerability to climate change. The EU Strategy on Adaptation to Climate Change translates this into the objectives of smarter, faster and more systemic adaptation, with better data, accelerated implementation, integration across sectors and strong support for local action and nature-based solutions. These principles closely correspond to the CRAG approach and support the municipality's use of the refined CRA as the evidence base for policy and investment decisions.

EU sectoral legislation reinforces this framework. The Floods Directive requires systematic assessment, mapping and management of flood risks; the Water Framework Directive supports integrated water and ecosystem management; the CAP framework links agricultural support with

environmental and climate objectives; and the Birds and Habitats Directives underpin the protection and management of Natura 2000 areas. Together, these instruments favor integrated measures that reduce climate risk while producing benefits for water, biodiversity, agriculture and local livelihoods.

EU financing is likely to remain essential because many preventive investments exceed the municipality's own budget. Relevant mechanisms include the European Regional Development Fund, the Cohesion Fund and Bulgaria's Environment Program 2021-2027, the CAP Strategic Plan and rural-development instruments, LIFE, Horizon Europe, Interreg and Mission Adaptation opportunities. Municipal project proposals will be stronger when they demonstrate that measures respond to quantified and spatially identified risks, are consistent with national and regional plans, protect vulnerable groups, avoid maladaptation and generate environmental or social co-benefits. Bulgaria's Environment Program already supports measures connected with flood-risk management and Natura 2000 priorities, illustrating how national programs can operationalize EU environmental and resilience objectives.

Private businesses, farmers, tourism operators, property owners, utilities, insurers and financial institutions have an important role in implementing CRM. Businesses can assess their exposure, protect premises and equipment, maintain continuity and evacuation plans, reduce water demand and improve thermal conditions for workers and visitors. Farmers can adopt climate-resilient crops, soil-conservation practices, efficient irrigation and insurance or other risk-sharing instruments. Property owners can improve drainage, shading, insulation and flood resilience, while utilities can climate-proof essential infrastructure. The municipality can encourage such action through planning conditions, procurement criteria, public-private partnerships, technical guidance, awareness campaigns and the dissemination of locally specific risk information. Municipal or externally funded grant schemes can require beneficiary co-financing, maintenance commitments and compliance with resilience standards. Banks and investors can also use the CRA to evaluate physical climate risks and identify viable adaptation investments. Private involvement should, however, complement rather than replace public responsibility. Measures must not transfer risk to neighboring properties or communities, restrict equitable access to essential services, or concentrate protection only in economically valuable locations. Public investment and external funding should prioritize critical infrastructure, vulnerable residents and locations where the social consequences of flooding or heat are greatest.

The successful implementation of CRM in Garmen depends on establishing a clear vertical connection between EU objectives, national strategies, regional river-basin and disaster-protection arrangements, and municipal planning and investment decisions. Horizontally, the municipality must coordinate climate adaptation with spatial planning, water management, agriculture, forestry, biodiversity, public health, social protection, tourism and infrastructure policy. The refined CRA provides the common evidence base needed for this integration. The most important implementation mechanism will be to make climate-risk consideration a routine requirement rather than a separate project activity. Municipal strategies, spatial plans, budgets, procurement procedures, infrastructure designs, funding applications and emergency plans should all demonstrate how they address the priority risks identified by the CRA. In this way, the assessment can become an operational decision-support instrument that guides prevention, attracts funding, strengthens regional coordination and progressively increases Garmen's capacity to cope with, adapt to and transform in response to climate-related harm.

2.3 Key actors and systems for CRM

While the municipality holds the primary legal responsibility for local disaster prevention, preparedness and response, effective climate risk management (CRM) de facto depends on the coordinated action of institutions operating at local, regional, national and European levels, together with the active participation of the local community, economic actors, and civil society. Also, due to the complexity of the impacts of climate-related risks, the implementation of climate adaptation measures requires continuous cooperation across sectors including water management, spatial planning, civil protection, agriculture, forestry, biodiversity conservation, public health, and regional development. The refined Climate Risk Assessment (CRA) has equipped the municipality with a tool to strengthen this multi-level governance approach by providing a common evidence base that can be used by all relevant actors in planning and decision-making.

The Municipality of Garmen is the central actor responsible for coordinating climate risk management locally. Through the Mayor and the municipal administration, the municipality leads the adoption and implementation of the Climate Change Adaptation Strategy, coordinates the integration of climate risks into municipal planning documents, oversees local stakeholder engagement, and is responsible for disaster prevention planning under the Disaster Protection Act. The municipality's principal motivation is to reduce the growing impacts of river floods and heatwaves on residents, infrastructure, local businesses, and municipal services while increasing preparedness and attracting external financial resources for adaptation measures. At the same time, its implementation capacity remains constrained by limited financial resources, insufficient technical expertise, dependence on national and EU funding, and limited availability of local climatic monitoring data. These challenges make cooperation with higher levels of government and external experts particularly important. The CRAG project has played a crucial role for overcoming some of these constraints by providing the methodological framework, guidance, and technical support to produce the refined CRA, but also by significantly strengthening the institutional capacity within the municipality through the transfer of knowledge and analytical approaches that will continue to influence CRM policy making long after completion of the project.

At the regional level, several public authorities play an essential role in implementing CRM. The West Aegean River Basin Directorate (WARBD), operating under the Ministry of Environment and Water, is responsible for river basin management, preparation, and implementation of River Basin Management Plans and Flood Risk Management Plans, water permitting and coordination of flood prevention measures within its territory, which includes the Mesta River catchment. The Directorate therefore represents one of the municipality's most important institutional counterparts for addressing river flood risks and coordinating adaptation measures that extend beyond municipal boundaries. Likewise, the Regional Inspectorate of Environment and Water (RIEW) - Blagoevgrad, the Regional Governor's Administration, regional structures of the General Directorate Fire Safety and Civil Protection, the State Forestry Agency, and the River Basin Council could contribute sectoral expertise, regulatory oversight, emergency preparedness and environmental management that directly influence the municipality's adaptive capacity. Bulgarian water policy explicitly assigns River Basin Directorates responsibility for basin-scale water management and flood-risk planning, while regional environmental authorities support implementation and monitoring of environmental legislation.

National institutions establish the legislative, strategic, and financial framework within which municipal CRM is implemented. The Ministry of Environment and Water (MOEW) develops national climate adaptation policy, coordinates implementation of the National Climate Change Adaptation

Strategy, oversees river basin management and flood-risk planning, and manages major environmental funding programs. Other ministries, including the Ministry of Regional Development and Public Works, Ministry of Agriculture and Food, and Ministry of Interior, provide policy leadership in spatial planning, agricultural adaptation, civil protection and disaster management respectively. Although municipalities are legally responsible for local prevention and adaptation planning, implementation frequently depends on cooperation with these national authorities, particularly when larger infrastructure investments, technical guidance or financial support are required. Official national adaptation policy recognizes municipalities as key actors in implementing adaptation measures across sectors.

Local stakeholders represent another essential component of the CRM system. These include residents, particularly those living in flood-prone areas and other disproportionately affected or vulnerable groups, local businesses in tourism, agriculture, services and retail, educational institutions, healthcare and social services, utility operators, media and non-governmental organizations. Their primary motivation lies in reducing the direct impacts of climate hazards on livelihoods, health, economic activity, and quality of life. At the same time, these stakeholders often face barriers related to limited awareness of long-term climate risks, insufficient technical knowledge, financial constraints, and the absence of formal organizational structures representing vulnerable groups. Nevertheless, they possess valuable local knowledge concerning historical flood events, exposure patterns, and the practical feasibility of adaptation measures, which has made their participation indispensable for evidence-based climate risk management.

Stakeholder engagement formed a central component of the refined CRA and was implemented throughout several analytical stages. During the scoping phase, consultations with municipal experts, representatives of regional authorities and disproportionately affected groups contributed to the validation of the selected priority risks and the identification of locally relevant exposure and vulnerability factors. During the risk exploration and regionalized risk analysis, bilateral meetings with experts and municipal departments supported the selection and integration of local data and knowledge, while public consultation with local residents validated the preliminary findings from Phase 1 and identified the need for greater spatial precision to guide adaptation investments. The feedback received directly influenced the incorporation of cadastral information, infrastructure data - protective infrastructure, riverbed condition, demographic information, and information on locally significant assets into the refined CRA. This participatory approach strengthened local ownership of the CRA while ensuring that the assessment reflects both scientific evidence and practical local experience to serve two central purposes: constitute a firm foundation for policy-making and responding to stakeholder needs and priorities.

Looking beyond the project, the municipality has started to expand this governance network during Phase 3. It has designed and strategized processes to strengthen cooperation with regional authorities responsible for water management and disaster prevention, engage national institutions in support of funding applications and policy coordination, and disseminating the CRA methodology and findings through the National Association of Municipalities in the Republic of Bulgaria. Such continued cooperation will support the transition from climate risk assessment to operational climate risk management while fostering greater institutional coordination, improved preparedness and increased investment in climate adaptation measures. This multi-level governance approach is consistent with both the CLIMAAX framework and the broader objectives of the EU Strategy on Adaptation to Climate Change, which emphasize integrated governance, stakeholder participation and evidence-based decision-making as prerequisites for building resilient communities.

The governance system described above, summarized in Table 2-2, demonstrates that climate risk management in Garmen is inherently a multi-level and cross-sectoral process, with the municipality at its heart. While the municipality remains the principal risk owner and coordinator, effective implementation depends on sustained collaboration among regional and national authorities, scientific experts, economic actors and the local community. The stakeholder engagement undertaken throughout the CRAG project has established the foundations for this cooperation and produced a shared understanding of climate risks that will facilitate the transition from assessment to implementation as mapped out during Phase 3.

Table 2-2 Governance system for CRM in Garmen municipality

Key actors	*Role and responsibility*	*Motivation and needs*	*Opportunities related to their active involvement in CRM*	*Barriers related to their active involvement in CRM*	*Type of engagement*
Municipality of Garmen (Mayor, Municipal Administration, CMT, EET)	Leads local climate adaptation and disaster risk management; updates the Climate Change Adaptation Strategy; integrates CRM into municipal planning; coordinates implementation and stakeholder engagement.	Protect residents, infrastructure, economy and municipal assets; improve preparedness; attract funding for adaptation.	Direct decision-making authority; integration of CRM into planning, budgeting and investment; coordination of local actors.	Limited financial and human resources; limited technical expertise; lack of local climatic monitoring; dependence on external funding.	Led all CRAG phases; participated in scoping, risk exploration, regionalized risk analysis, stakeholder engagement, validation of findings and preparation of Deliverables 1, 2, and 3.
West Aegean River Basin Directorate	River basin management; implementation of River Basin Management Plans and Flood Risk Management Plans; coordination of flood prevention and water management.	Reduce flood risks; improve water management and compliance with national and EU legislation.	Integration of municipal priorities into regional flood management; technical expertise; coordination across municipalities.	Measures often depend on national funding and inter-municipal coordination.	Identified as key partner for implementation.
Regional Directorate "Fire Safety and Civil Protection"	Disaster preparedness, emergency response, early warning and crisis management.	Improve preparedness and reduce disaster impacts.	Joint planning, emergency exercises, information exchange and early warning systems.	Focus traditionally placed on emergency response rather than long-term adaptation.	Identified as key partner for implementation.
Regional Governor's Administration	Coordinates regional disaster management and cooperation among	Strengthen regional resilience and coordinated response.	Facilitate inter-institutional	Limited direct influence over national decisions.	Identified as key partner for implementation.

	municipalities and state institutions.		cooperation and regional planning.		
Regional Inspectorate of Environment and Water (RIEW)	Environmental protection, biodiversity conservation, Natura 2000 implementation and environmental permitting.	Protect ecosystems while supporting sustainable development.	Integration of ecosystem-based adaptation and biodiversity objectives into CRM.	Administrative procedures and limited financial resources.	Identified as key partner for implementation.
Ministry of Environment and Water	National climate adaptation policy; implementation of the National Climate Change Adaptation Strategy; flood and water policy; management of environmental funding programs.	Support implementation of national climate policy and EU obligations.	Funding programs; methodological guidance; policy coordination.	National funding constraints; competing priorities.	Identified as key institution for advocacy and implementation.
Ministry of Interior	National disaster protection policy; civil protection and emergency management.	Improve disaster preparedness and emergency response.	Coordination with regional civil protection structures.	Focus on response rather than preventive adaptation.	Indirect stakeholder through the national disaster management framework. Identified as an important partner for implementation.
Ministry of Agriculture and Food	Agricultural policy, rural development, forestry and CAP implementation.	Increase resilience of agriculture and rural communities.	Funding opportunities for climate-resilient agriculture and forestry.	Fragmented implementation at local level.	Identified as a future partner for adaptation funding and policy coordination.
Local businesses (tourism, agriculture, services, retail)	Implement adaptation measures within their operations; contribute local knowledge on climate impacts.	Protect economic activity, employees and investments.	Investment in resilient infrastructure and business continuity planning.	Limited financial capacity; varying awareness of climate risks.	Participated in stakeholder meetings, particularly during risk exploration and validation of findings.

Residents and disproportionately affected groups	Provide local knowledge; validate risk assessment; participate in adaptation planning; benefit from adaptation measures.	Protect health, livelihoods and property; improve quality of life.	Community participation; local knowledge; increased awareness and ownership.	Limited technical knowledge and organizational capacity; vulnerability due to age, location or socio-economic conditions.	Engaged through bilateral consultations, meetings with vulnerable groups and public consultation during the scoping, risk exploration and validation stages.
Media	Disseminate project results; increase public awareness and support for adaptation.	Inform the public about climate risks and adaptation measures.	Broader public outreach and awareness raising.	Limited technical understanding of climate risk issues.	Used to communicate project progress.
National Association of Municipalities in the Republic of Bulgaria (NAMRB)	Dissemination of good practices; exchange of experience among municipalities.	Strengthen municipal capacity nationwide.	Replication of the CLIMAAX methodology and wider dissemination of project results.	Participation depends on municipal engagement and available resources.	Stakeholder for dissemination of project outcomes and knowledge transfer.

2.4 Lessons learned from past events

Past climate-related events in the Municipality of Garmen have demonstrated that prevention and preparedness would be considerably more effective and less costly than responding to disasters after they occur. River flood events affecting settlements located along the Kanina river system have highlighted the municipality's exposure to extreme hydrological events and the limitations of relying primarily on emergency response mechanisms. Municipal authorities, supported by regional civil protection structures, have managed to respond to emergencies, experience has shown that recovery requires substantial financial and human resources and may have long-lasting social and economic consequences for affected population subgroups. These experiences have reinforced the municipality's commitment to shifting from a predominantly reactive approach towards a preventive climate risk management model grounded in scientific evidence and long-term planning.

Past events have also demonstrated that climate impacts rarely affect all population groups equally. Floods primarily threaten residents, businesses and infrastructure located in exposed areas, while heatwaves disproportionately affect elderly people, young children and other vulnerable members of the community. The CRA process confirmed that climate risk management should therefore place greater emphasis on identifying disproportionately affected population groups and integrating social vulnerability into both emergency planning and long-term adaptation policies. The municipality considers this an essential component of climate justice and intends to further strengthen targeted prevention measures through the updated Climate Change Adaptation Strategy and the future municipal climate risk management plan.

Another important lesson concerns institutional cooperation. Previous flood events have demonstrated that effective disaster management depends on timely coordination between the municipality, regional civil protection services, the West Aegean River Basin Directorate, environmental authorities, emergency responders, and local residents. At the same time, the implementation of the CRAG project has shown that cooperation should not be limited to emergency situations but should become an integral part of prevention, preparedness, and awareness-raising activities. Stakeholder engagement undertaken during the CRAG project confirmed that combining scientific analysis with institutional expertise and local knowledge leads to more robust and operationally relevant climate risk assessments. This collaborative approach has strengthened local ownership of the assessment and created favorable conditions for the incorporation of the CRA into policy making and CRM.

The municipality has further recognized that climate change is increasing both the frequency and intensity of extreme weather events, requiring planning processes that explicitly account for future climate conditions rather than relying solely on historical experience. The refined CRA, developed using the CLIMAAX methodology and incorporating climate projections alongside local information, provides the municipality with the analytical basis needed to anticipate future risks rather than simply react to past events. This represents a significant institutional shift towards proactive climate risk management and supports the integration of adaptation considerations into municipal planning, investment programming, and sectoral policies.

Finally, past events have demonstrated that building institutional capacity is itself an important adaptation measure. Before joining CLIMAAX, the municipality lacked access to an established methodology, specialized expertise, and sufficient resources to develop a comprehensive climate risk assessment. Through the collaborative work for the CRAG project, municipal staff have

strengthened their understanding of climate risk assessment, stakeholder participation, and evidence-based adaptation planning. This knowledge constitutes a lasting benefit of the project and will continue to support the municipality in updating strategic documents, attracting adaptation funding and progressively strengthening local climate resilience well beyond the project's duration.

3 Climate risk management – phase 3

3.1 CRM objectives

The Climate Risk Management (CRM) objectives for Garmen Municipality build directly upon the evidence generated through the refined Climate Risk Assessment (CRA) developed during Phase 2 of the CRAG project. While the Municipality adopted its Climate Change Adaptation Strategy for the period 2024-2030 prior to the production of the refined CRA, the present assessment considerably enhances the analytical basis upon which the Strategy can be implemented and updated. The refined CRA provides an improved understanding of the municipality's climate risks, allowing adaptation priorities and implementation measures to be more accurately targeted. Consequently, the CRM objectives presented below should be understood not as replacing the existing strategic objectives, but as operationalizing and strengthening them through an evidence-based climate risk management approach.

The overarching objective of climate risk management in Garmen Municipality is to progressively reduce climate-related risks to people, infrastructure, ecosystems, and economic activities while strengthening the long-term resilience and adaptive capacity of the municipality under present and future climate conditions. Consistent with the vision of the Municipal Climate Change Adaptation Strategy, climate risk management seeks to reduce the municipality's vulnerability through the gradual implementation of nature-based solutions, technological interventions, institutional measures, and enhanced stakeholder participation, thereby improving environmental quality, public safety, and the wellbeing of local communities.

The refined CRA identified river floods and heatwaves as the municipality's priority climate risks requiring the greatest strategic attention. River floods represent the most immediate physical threat to settlements, transport infrastructure, public services, agricultural land, and economic activities located along the Mesta River and its tributaries. At the same time, the assessment demonstrated that heatwaves are expected to become increasingly significant due to projected climatic changes, posing growing risks to public health, particularly for elderly people, young children and other disproportionately affected population groups. The CRM objectives therefore focus on reducing both current and future climate risks through preventive action, improved preparedness, increased institutional capacity and the systematic integration of climate risk considerations into municipal governance.

A fundamental principle guiding climate risk management in Garmen Municipality is the transition from reactive disaster response towards proactive risk prevention and long-term resilience building. Experience from previous climate-related events, together with the findings of the refined CRA, demonstrates that effective climate adaptation depends on anticipating future risks rather than responding only after disasters occur. Accordingly, the CRM objectives prioritize preventive investments, risk-informed spatial planning, protection of critical infrastructure, improved emergency preparedness, and strengthened institutional coordination across sectors involved in climate adaptation and disaster risk management.

Another cross-cutting objective is to ensure that climate risk management contributes to socially equitable and inclusive development. The refined CRA demonstrated that climate risks are not distributed uniformly across the municipality and that certain population groups experience disproportionately higher levels of vulnerability related to risk hotspots. Climate risk management should therefore systematically incorporate social vulnerability into planning, prioritization, and implementation processes, ensuring that adaptation measures provide particular protection for vulnerable residents while simultaneously strengthening the resilience of the municipality as a whole. This objective is fully consistent with the municipality's long-term commitment to improving living conditions and safeguarding the wellbeing of its communities under changing climatic conditions.

The CRM objectives further recognize that climate resilience cannot be achieved solely through municipal action but requires coordinated governance across local, regional, and national levels. Successful implementation therefore depends on sustained cooperation between municipal departments, regional authorities, national institutions, emergency management authorities, businesses, civil society, and local communities. Building upon the collaborative stakeholder engagement established through the CRAG project, climate risk management will continue to promote evidence-based decision-making, knowledge exchange and public participation as essential enabling conditions for successful adaptation.

Finally, climate risk management is conceived as a dynamic and iterative process of continuous learning and improvement. The refined CRA establishes a robust baseline for understanding climate risks, while the updated Climate Change Adaptation Strategy and the future municipal Climate Risk Management Plan provide the operational framework for implementing adaptation measures, monitoring progress and periodically revising priorities as new information becomes available or the CRA is rerun. In this way, Garmen Municipality seeks not only to reduce present climate risks but also to strengthen its long-term capacity to anticipate, adapt to, and transform in response to future climate change.

Table 2-3 below list the formulated CRM objectives for Garmen municipality and provides and overview of potential assessment indicators.

Table 2-3 Primary CRM objective for Garmen municipality

Primary objectives	*Assessment indicators*
Reduce flood risks to people, infrastructure, economic activities, and ecosystems	Implementation indicators: - Number/length of structural flood protection measures implemented. - Number of nature-based flood management measures implemented. - Number of bridges, culverts and drainage systems rehabilitated or maintained. - Number of settlements with updated flood preparedness and evacuation arrangements. - Number of awareness-raising campaigns and training for vulnerable residents conducted. Outcome indicators: - Reduction in the population exposed to high flood risk. - Reduction in the number of critical facilities located in high flood-risk areas.

	- Reduction in estimated annual flood damages (where data are available).
Reduce the impacts of increasing heatwaves on human health and quality of life	Implementation indicators: - Number of municipal buildings upgraded for thermal resilience. - Number of shaded public spaces and cooling measures established. - Number of heat-health awareness campaigns implemented. - Number of municipal heat-response protocols adopted. Outcome indicators: - Reduction in the number of vulnerable residents exposed to severe heat stress. - Reduction in reported heat-related incidents (where data are available). - Improved accessibility to cooling infrastructure and public services during heatwaves.
Integrate climate risk considerations into municipal policy-making, planning and investment decisions	Implementation indicators: - Percentage of municipal investment projects screened for climate risks. - Number of planning documents updated using CRA findings. - Number of investment proposals using CRA evidence. Outcome indicators: - Increased proportion of municipal investments contributing to climate resilience. - Reduced creation of new climate risks through planning decisions. - Improved climate-proofing of municipal infrastructure investments.
Protect disproportionately affected population groups and strengthen climate justice	Implementation indicators: - Number of targeted adaptation measures implemented for vulnerable groups. - Number of consultations involving disproportionately affected groups. - Number of vulnerable residents included in emergency planning. Outcome indicators: - Reduced social vulnerability to floods and heatwaves. - Increased equitable distribution of adaptation measures. - Improved protection of vulnerable residents during climate-related events.
Improve monitoring, evaluation and continuous learning	Implementation indicators: - Municipal CRM monitoring framework established. - Frequency of monitoring reports. - Frequency of updates of the CRA and Climate Risk Management Plan. Outcome indicators:

	- Improved quality and availability of climate-risk information. - Regular evidence-based revision of CRM priorities. - Progressive increase in municipal resilience capacity over time.

Table 2-4 Additional CRM objective for Garmen municipality

Additional objectives	*Assessment indicators*
Strengthen municipal adaptive capacity and institutional preparedness	Implementation indicators: - Number of municipal staff trained. - Number of municipal departments participating in CRM implementation. - Number of emergency exercises conducted annually. - Number of institutional coordination meetings. Outcome indicators: - Improved municipal capacity to anticipate and manage climate risks. - Improved institutional coordination during climate-related emergencies. - Increased implementation capacity for adaptation projects.
Promote ecosystem-based adaptation and sustainable management of natural resources	Implementation indicators: - Area of restored or protected ecosystems. - Number of ecosystem-based adaptation projects implemented. - Number of coordinated actions with forestry, biodiversity, and water authorities. Outcome indicators: - Improved ecosystem resilience. - Increased natural flood retention capacity. - Improved condition of forests, river corridors, and biodiversity supporting climate adaptation.
Strengthen multi-level governance and stakeholder participation	Implementation indicators: - Number of stakeholder consultation events/initiatives using alternative feedback collection tools. - Number of institutional coordination meetings. - Number of cooperation agreements or joint initiatives. Outcome indicators: - Increased stakeholder participation in municipal climate governance. - Improved coordination between local, regional and national institutions. - Increased local ownership of adaptation measures.

3.2 Supportive elements for effective CRM

The successful implementation of CRM in Garmen Municipality depends not only on the identification of appropriate adaptation measures but also on the existence of a set of enabling

conditions that provide the institutional, technical, financial, environmental, and social foundations for implementation. While the CRM objectives presented in the previous section define what the municipality seeks to achieve, the enabling conditions described below determine its capacity to plan, finance, implement, monitor and continuously improve climate adaptation measures over time. Strengthening these enabling conditions therefore represents a strategic priority for increasing the municipality's long-term resilience to climate change and ensuring the effective implementation of the updated Climate Change Adaptation Strategy.

The refined CRA demonstrated that climate resilience is determined by considerably more than the physical characteristics of climate hazards. The municipality's resilience capacity also depends on the availability of reliable knowledge and information, effective governance arrangements, political commitment, financial resources, resilient infrastructure, stakeholder participation, healthy ecosystems, effective communication, and the ability to learn from experience and continuously adapt to changing climatic conditions. These enabling conditions are mutually reinforcing and collectively determine the municipality's capacity to manage current and future climate risks.

The implementation of the CRAG project has already contributed significantly to strengthening several of these enabling conditions. The refined CRA has established a robust evidence base by integrating European and local datasets into a comprehensive multi-risk assessment, while the participatory process undertaken throughout Phases 1 and 2 has strengthened institutional cooperation, stakeholder engagement and local ownership of climate adaptation planning. At the same time, the municipality has demonstrated strong political commitment through the adoption of its Climate Change Adaptation Strategy and its active participation in the CLIMAAX project, thereby creating favourable conditions for integrating climate risk considerations into municipal planning and decision-making. Nevertheless, the assessment also can be used as a foundational guide towards further strengthening institutional capacity, technical expertise, financial resources, climate monitoring and inter-institutional coordination, all of which remain essential for the successful implementation of long-term climate risk management.

An equally important conclusion emerging from the refined CRA is that climate resilience should be understood as a systemic characteristic of the municipality rather than as the result of individual adaptation measures. Structural interventions for reducing flood risks, improvements in public infrastructure, emergency preparedness, public awareness, and institutional cooperation contribute to resilience, but their effectiveness ultimately depends upon the broader enabling environment within which they are implemented. Consequently, climate risk management should be approached as an integrated governance process that combines scientific knowledge, institutional capacity, stakeholder participation, sustainable financing, and adaptive management to reduce climate risks while supporting the municipality's broader sustainable development objectives.

The enabling conditions (supportive elements) presented in Table 3-1 should therefore be regarded as mutually reinforcing components of Garmen municipality's climate risk management system. Together they establish the conditions necessary for translating the findings of the refined CRA into effective adaptation measures, evidence-based decision-making, and long-term climate resilience. Their continued strengthening will support not only the implementation of the municipality's Climate Change Adaptation Strategy but also the preparation of the Municipal Climate Risk Management Plan and the integration of climate resilience into future municipal policies, investments, and development planning.

Table 3-1 Supportive elements for effective CRM for Garmen municipality

Supportive elements for effective CRM	*Description*
Knowledge and information systems	Effective climate risk management depends on the availability of reliable, up-to-date and locally relevant information on climate hazards, exposure, vulnerability, and resilience. The refined Climate Risk Assessment provides Garmen Municipality with a robust evidence base by integrating European datasets with local information, while continuous monitoring, data updates, and access to scientific expertise will enable evidence-based planning, implementation and evaluation of climate adaptation measures.
Governance and institutional capacity	Strong institutional arrangements are essential for coordinating climate risk management across municipal departments and sectors. The municipal administration in cooperation with regional and national institutions provide the governance framework necessary for planning, implementing, monitoring, and continuously improving climate adaptation measures. Clearly defined priorities as outlined in the CRA will serve for increasing the effectiveness of institutional coordination to enhance the municipality's capacity to manage climate risks.
Political leadership and strategic commitment	Sustained political support is fundamental for integrating climate risk management into municipal decision-making, spatial planning, and investment policies. Long-term political commitment ensures continuity of adaptation efforts beyond individual projects, facilitates cross-sectoral cooperation, and enables climate resilience to become a strategic municipal development priority.
Financial resources and investment capacity	The implementation of climate adaptation measures requires adequate financial resources from municipal, national, European, and private sources. Although municipal resources remain very limited, the refined CRA strengthens the municipality's ability to secure external funding by providing robust evidence to support project proposals and investment decisions. Sustainable funding is essential for implementing both structural and nature-based adaptation measures.
Technical capacity and resilient infrastructure	Technical expertise, resilient infrastructure, and appropriate equipment enable the municipality to reduce climate risks and maintain essential services during extreme weather events. Climate-resilient public infrastructure, effective drainage systems, flood protection measures, digital technologies, and emergency response capabilities increase the municipality's ability to prevent, withstand, and recover from climate-related impacts. Considerable shortcomings exist at the present moment in respect to this supportive element and the CRA will be utilized to address them.
Stakeholder engagement and social capital	Climate resilience is strengthened through active cooperation among municipal authorities, residents, businesses, scientific experts, civil society organizations and disproportionately

	affected groups. Stakeholder participation improves the quality of decision-making by incorporating local knowledge, increasing public ownership of adaptation measures and strengthening trust and cooperation within the community. With the CRAG project the municipality has laid the foundations of an ongoing stakeholder outreach on climate risks and CRM.
Ecosystem resilience and natural capital	Healthy ecosystems constitute a fundamental component of climate resilience. Forests, river corridors, agricultural land, and protected natural areas contribute to flood regulation, erosion control, water retention, biodiversity conservation, and temperature regulation. Protecting and restoring these ecosystems increases the municipality's adaptive capacity while providing multiple environmental and socio-economic co-benefits through nature-based solutions. Considerable shortcomings exist at the present moment in respect to this supportive element and the CRA will be utilized to address them.
Risk communication and public awareness	Effective communication improves the municipality's ability to prepare for and respond to climate risks. Public awareness campaigns, early warning systems, risk communication and educational activities help residents understand climate risks, adopt appropriate protective behaviors and actively participate in adaptation efforts. Well-informed communities are more resilient and better prepared for climate-related emergencies. The municipality will aim to enhance its communication efforts on the basis of the CRAG experience.
Innovation, learning and adaptive management	Climate risk management is a continuous learning process that requires regular monitoring, evaluation, and incorporation of new knowledge into policy and practice. Participation in projects such as CLIMAAX and periodic updates of the CRA will enable the municipality to continuously improve adaptation strategies and respond effectively to evolving climate conditions. The municipality plans on the basis of the CRA to establish local data collection mechanisms in respect to the priority risks.
Regional cooperation and multi-level governance	Climate risks extend beyond municipal boundaries and require coordinated action across administrative levels. Effective cooperation with neighboring municipalities, regional authorities, the West Aegean River Basin Directorate, civil protection authorities and national institutions supports integrated flood risk management, knowledge sharing, coordinated emergency response and more efficient implementation of adaptation measures throughout the wider region. The municipality plans to use the CRA continuously to improved coordination and cooperation on the basis of a shared evidence-based understanding of the priority climate risks.

3.3 Potential CRM measures

The potential Climate Risk Management (CRM) measures presented in this section build directly upon the findings of the refined Climate Risk Assessment (CRA) developed during Phase 2 of the CRAG project and the strategic priorities established in the Climate Change Adaptation Strategy of Garmen Municipality. Their purpose is to translate the evidence generated through the climate risk assessment into practical actions that reduce current and future climate risks while strengthening the municipality's long-term resilience. Rather than representing a new planning framework, the proposed measures operationalise the municipality's existing adaptation strategy by providing a structured basis for future planning and implementation.

The proposed measures respond primarily to the two priority climate risks identified through the refined CRA - river floods and heatwaves, while simultaneously strengthening the municipality's overall adaptive capacity. Consistent with the principles of climate risk management established throughout this deliverable, the measures combine structural and technical interventions, nature-based solutions, non-structural planning measures, governance improvements, stakeholder engagement, and capacity-building activities. This integrated approach recognises that reducing climate risks requires coordinated action across multiple sectors and governance levels rather than reliance on individual engineering solutions alone.

The selection and prioritisation of the proposed measures have been guided by several complementary considerations. In addition to their expected effectiveness in reducing climate risks, particular attention has been given to their feasibility within the municipal context, consistency with the Climate Change Adaptation Strategy, potential environmental and socio-economic co-benefits, contribution to protecting disproportionately affected population groups, and opportunities for mobilising national and European funding. The measures also recognise that climate resilience should be integrated into wider municipal development and investment processes. Consequently, the proposed actions include not only dedicated adaptation interventions but also investments and development activities that should systematically incorporate climate adaptation considerations, such as the construction and renovation of public buildings, infrastructure development, and spatial planning.

An important principle underpinning the proposed CRM measures is that they should contribute to equitable and inclusive climate adaptation. The refined CRA demonstrated that climate risks are not distributed uniformly across the municipality and that certain population groups are disproportionately affected by river floods and heatwaves. The proposed measures therefore seek not only to reduce overall climate risks but also to strengthen the resilience of vulnerable residents, improve access to essential public services during extreme events and ensure that the benefits of adaptation are shared fairly across the municipality.

The measures presented in Table 3.2 should therefore be regarded as a flexible implementation framework rather than a fixed investment programme. Their implementation will depend upon available financial resources, institutional capacity, technological availability, and evolving climate risks. The future Municipal Climate Risk Management Plan will further develop these measures by defining implementation priorities, responsibilities, financing mechanisms, implementation schedules and monitoring arrangements, while allowing sufficient flexibility to respond to new knowledge and changing climatic conditions.

Table 3-2 Potential CRM measures for Garmen municipality in response to CRA priority risks

Key climate risk	*CRM measure*	*Effectiveness / Risk reduction (high, medium, low)*	*Contribution to CRM objectives*	*Possible co-benefits*	*Timeline (short, medium, long term)*	*Responsible organisation*	*Possible adaptation limits*
River floods	Integrate flood risk information from the refined CRA into municipal spatial planning and future development decisions.	High	Reduces exposure of people, infrastructure and economic activities to flood risk.	More sustainable territorial development; reduced disaster losses; improved investment planning.	Short–medium term	Garmen Municipality	Existing development patterns and legal planning procedures may limit relocation of exposed assets.
River floods	Restore and maintain river corridors, riparian vegetation and natural flood retention areas.	High	Reduces flood hazard while increasing ecosystem resilience.	Biodiversity conservation; erosion control; improved water quality; carbon sequestration.	Medium–long term	Garmen Municipality; West Aegean River Basin Directorate	Financial constraints; Competing land-use interests; long ecological restoration periods.
River floods	Improve maintenance of riverbeds, drainage systems and flood protection infrastructure.	High	Reduces flood hazard and protects settlements and critical infrastructure.	Reduced infrastructure damage; improved public safety; lower maintenance costs over time.	Short–medium term	Garmen Municipality	Financial constraints; Increasingly intense rainfall events may exceed infrastructure design capacity.
River floods	Climate-proof critical municipal infrastructure and public buildings through resilient	High	Reduces vulnerability of essential public services and infrastructure.	Improved continuity of public services; lower recovery costs; increased public safety.	Medium–long term	Garmen Municipality	Financial constraints; ageing infrastructure; increasing climate extremes.

	design and retrofitting.						
River floods	Strengthen flood preparedness, early warning, emergency planning and regular simulation exercises.	High	Improves municipal preparedness and emergency response capacity.	Increased public awareness; reduced disaster losses; stronger institutional cooperation.	Short-medium term	Garmen Municipality; Fire Safety and Civil Protection Directorate	Extremely rapid-onset flood events may reduce available response time.
Heatwaves	Increase urban and village tree canopy, shaded public spaces and green infrastructure.	High	Reduces heat exposure and improves thermal comfort.	Improved air quality; biodiversity enhancement; recreational benefits; reduced urban heat island effects.	Medium–long term	Garmen Municipality	Water availability during prolonged droughts; maintenance requirements; Financial constraints.
Heatwaves	Integrate passive cooling and climate-resilient design into new municipal buildings and major renovations.	High	Reduces heat-related risks in public buildings and improves long-term resilience.	Lower energy consumption; improved indoor comfort; reduced greenhouse gas emissions.	Medium–long term	Garmen Municipality	Higher initial investment costs; existing building constraints.
Heatwaves	Introducing “cool standards” - Solar Reflectance Index (SRI) criteria for building facades and paving materials in public spaces when public funding is used.	High	Reduces heat-related risks in public spaces and buildings and improves long-term resilience.	Increase public awareness and ownership of adaptation measures due to proximity and visibility of the measure.	Short-medium term	Garmen Municipality	Extent to which this measure will impact old municipal buildings and public spaces depends on financial resources for renovation.

Heatwaves	Develop targeted heat-health action plans for disproportionately affected population groups.	High	Improves protection of elderly people, children, persons with disabilities and other vulnerable residents.	Reduced health inequalities; improved social resilience; enhanced public health preparedness.	Short term	Garmen Municipality; Regional Health Inspectorate	Extreme heat events may exceed existing health system capacity.
River floods & Heatwaves	Update the Municipal Climate Change Adaptation Strategy and prepare the Municipal Climate Risk Management Plan using the refined CRA.	High	Integrates climate risk management into long-term municipal governance and planning.	Improved policy coherence; stronger institutional coordination; evidence-based planning.	Short term	Garmen Municipality	Limited administrative capacity; evolving policy requirements.
River floods & Heatwaves	Strengthen stakeholder engagement, public awareness and climate risk communication through regular consultation and education activities.	Medium	Increases community preparedness and supports participatory climate governance.	Greater public ownership; stronger social cohesion; improved behavioral adaptation.	Short term	Garmen Municipality	Sustaining long-term public engagement may require continuous resources.
River floods & Heatwaves	Strengthen municipal climate monitoring, data management and periodic updates	Medium–High	Supports evidence-based decision-making and continuous improvement of CRM.	Better investment prioritization; improved monitoring and evaluation; stronger adaptive governance.	Medium term	Garmen Municipality	Availability and continuity of local climate and socio-economic data.

	of the Climate Risk Assessment.						
River floods & Heatwaves	Develop project proposals and mobilize national and European funding for climate adaptation measures identified in the refined CRA.	High	Accelerates implementation of adaptation priorities and strengthens municipal adaptive capacity.	Increased investment; local economic development; improved institutional capacity for project implementation.	Short–long term	Garmen Municipality	Competition for external funding; changing funding priorities and eligibility criteria.

3.4 Integration into planning and decision making

The refined Climate Risk Assessment (CRA) provides Garmen Municipality with a robust evidence base for systematically integrating climate risk considerations into municipal planning, investment and decision-making. Once integrated into the existing municipal Climate Change Adaptation Strategy, the results of the refined CRA should be considered for revisions of municipal strategic documents, spatial planning, sectoral programmes, emergency planning, and infrastructure investment decisions. In particular, climate adaptation considerations should be integrated into the planning and design of new public buildings, transport infrastructure, water supply and drainage systems, and public spaces to ensure that future development remains resilient under changing climate conditions.

The CRA provides a practical basis for strengthening concrete existing municipal policy instruments. As an immediate follow-up, the Municipality intends to update its Climate Change Adaptation Strategy by introducing a dedicated chapter on Climate Risk Assessment, thereby formally integrating the findings of the refined CRA into the strategic framework for climate adaptation. Similarly, the Municipality will consider incorporating climate risk assessment into the Municipal Integrated Development Plan (MIDP) through the introduction of a dedicated section accompanying the chapter on climate change mitigation, adaptation, and disaster risk reduction. In parallel, the Municipality will review its Municipal Energy Efficiency Programme to integrate climate adaptation considerations. Furthermore, the Municipality intends to propose that the Municipal Expert Council on Spatial Planning (MECSP) adopts internal methodological guidance regarding the application of Solar Reflectance Index (SRI) criteria for building facades and paving materials in public spaces when public funding is used. Several of these actions build upon the proposal for introducing "cool standards", submitted during the stakeholder engagement process by the Association Climate Risk Institute. The proposal aims to strengthen resilience to increasing heat stress through improved planning, energy efficiency and construction practices, and its principles coincide with the direction of the planned updates of the Climate Change Adaptation Strategy, the Municipal Energy Efficiency Programme, and the proposed methodological guidance for spatial planning. Together, these initiatives demonstrate how the findings of the refined CRA can be translated into concrete planning instruments that strengthen climate resilience across multiple municipal sectors while ensuring that future investments systematically incorporate climate adaptation considerations.

The refined CRA should also support the preparation of the Municipal Climate Risk Management (CRM) Plan, which will translate the strategic objectives of the Climate Change Adaptation Strategy into operational measures, implementation responsibilities and monitoring procedures. Furthermore, the assessment provides a strong scientific basis for preparing project proposals and attracting national and European funding for climate adaptation measures, thereby strengthening the municipality's capacity to implement long-term resilience actions.

Table 3-3 Proposed integration of the refined Climate Risk Assessment into municipal policy and planning instruments

Municipal policy instrument	*Proposed integration of the refined Climate Risk Assessment*	*Expected contribution to Climate Risk Management*
Climate Change Adaptation Strategy of Garmen Municipality	Introduce a new dedicated chapter entitled "Climate Risk Assessment", incorporating the findings of the refined CRA into the Municipality's strategic climate adaptation framework and updating adaptation priorities, implementation measures and monitoring	Ensures that future climate adaptation policies are evidence-based and directly linked to the municipality's most significant climate risks.

Municipal policy instrument	*Proposed integration of the refined Climate Risk Assessment*	*Expected contribution to Climate Risk Management*
	arrangements. Establish databases and mechanism for collecting and recording data in these databases on river flood protective infrastructure, its technical condition, flood occurances, heatwave occurances, and other risk-relevant factors.	
Municipal Energy Efficiency Programme (2021–2027)	Revise the Programme to incorporate climate adaptation considerations, including the introduction of cool standards proposed during the CRAG stakeholder engagement process.	Strengthens the resilience of buildings and public spaces to increasing heat stress while generating energy efficiency and public health co-benefits.
Municipal Expert Council on Spatial Planning (MECSP)	Adopt internal methodological guidance on the application of Solar Reflectance Index (SRI) criteria when assessing facade materials for buildings and paving materials for public spaces when public funding is used.	Integrates climate resilience considerations into urban design and construction practices, reducing heat accumulation and improving thermal comfort in settlements.
Municipal Integrated Development Plan (MIDP)	Introduce a new dedicated section entitled "Climate Risk Assessment" immediately before the chapter on climate change mitigation, adaptation and disaster risk reduction, ensuring that the refined CRA informs future strategic development priorities and investment planning.	Mainstreams climate risk management into the Municipality's long-term development planning and strengthens the integration of climate resilience across municipal sectors.
Municipal Climate Risk Management (CRM) Plan	Use the CRA as the basis for the CRM Plan	Strengthens overall planning and coordination of adaptation and prevention efforts, improves disaster response quality

The implementation of Climate Risk Management in Garmen Municipality benefits from important synergies with existing municipal policies on disaster risk reduction, sustainable development, biodiversity conservation, and environmental protection. Many of the proposed CRM measures generate multiple environmental, social and economic co-benefits while simultaneously reducing river flood and heatwave risks. Cooperation with regional authorities, national institutions and neighbouring municipalities will further support the management of climate risks that extend beyond municipal boundaries. At the same time, successful implementation of CRM will require addressing several challenges, including limited municipal financial and administrative resources, the need for stronger cross-sectoral coordination and continued dependence on external funding for larger adaptation investments. Continued political commitment, institutional cooperation and stakeholder engagement will therefore remain essential for sustaining long-term climate resilience.

Although the refined CRA significantly improves the municipality's understanding of climate risks, further development of climate information and monitoring systems will continue to strengthen future decision-making. Priority areas include improved local climatic and hydrological observations, regular updating of exposure and vulnerability information, improved monitoring of critical infrastructure and ecosystems, and continued cooperation with national scientific and environmental institutions. Participation in future research and innovation initiatives will further support the periodic updating of the Climate Risk Assessment and the continuous improvement of municipal climate knowledge.

To support effective implementation, Garmen Municipality should establish a monitoring and evaluation framework based on the Climate Risk Management objectives and indicators presented in Section 3.1. The monitoring system should assess both the implementation of adaptation measures and their contribution to reducing climate risks and strengthening municipal resilience. Regular monitoring reports, periodic evaluation of implemented measures and post-event assessments following major floods or heatwaves should provide the basis for updating the Climate Risk Assessment, revising the Municipal Climate Risk Management Plan and continuously improving adaptation policies.

Climate Risk Management should therefore be regarded as a continuous and adaptive governance process rather than a one-off planning exercise. By systematically integrating climate risk information into municipal policies, investments and decision-making, while regularly monitoring progress and updating adaptation priorities, Garmen Municipality will strengthen its long-term resilience to climate change and support sustainable local development.

4 Project Evaluation

4.1 Usability of the results

The CRAG project has generated substantial practical value for Garmen Municipality by transforming climate risk information into a more precise, locally relevant and operational evidence base for policy-making. The refinement of the initial workflow results with local data has made the assessment more understandable and usable for municipal decision-makers, technical experts and non-expert stakeholders. In particular, the integration of information on riverbed conditions, protective infrastructure, vulnerable population groups, socially significant facilities and concentrations of economic activity has enabled the Municipality to move beyond a substantially improved understanding of climate hazards towards the spatial prioritisation of adaptation needs and investments.

An important benefit of the project is the development of new institutional knowledge and analytical capacity within the municipal administration. Through the application of the CLIMAAX framework, the municipal and external expert teams strengthened their understanding of the relationship between hazard, exposure, and vulnerability and developed practical experience in selecting, verifying and combining European and local data. The process has also helped the Municipality identify how its limited institutional resources can be used more strategically and where additional capacity, information systems and expertise will be required in the future. The CRA has therefore been valuable not only as a final analytical product but also as a capacity-building and institutional learning process.

The results have direct policy usability. The refined CRA provides the evidence-based foundation for updating the Municipal Climate Change Adaptation Strategy, initiating the preparation of a Municipal Climate Risk Management Plan, and strengthening the justification and prioritisation of preventive adaptation measures. It also supports the integration of climate risk considerations into the Municipal Integrated Development Plan, the Energy Efficiency Programme, spatial-planning practice, and future municipal investment decisions. Proposed policy changes include the introduction of dedicated climate risk assessment sections in key municipal strategic documents and the development of internal methodological guidance on Solar Reflectance Index criteria for building facades and public-space paving when public funding is used. In this way, the project results can

influence not only dedicated climate policy but also construction, energy efficiency, territorial development and infrastructure planning.

The project also improves the Municipality's ability to climate-proof investments. The CRA can be used to screen new public buildings, roads, water infrastructure, public spaces, and other capital projects for their exposure to river floods and heatwaves before design and funding decisions are finalised. It provides a stronger basis for avoiding new development in high-risk locations, integrating resilience requirements into technical specifications for public procurement, and prioritising the protection or upgrading of critical infrastructure. The assessment is therefore relevant both to dedicated adaptation investments and to broader development projects that must incorporate a climate adaptation component.

A further benefit concerns funding and advocacy. The refined CRA gives the Municipality a scientifically grounded and locally validated basis for applying for national and European funding, advocating preventive investments before national authorities and presenting adaptation opportunities to potential partners and investors. It strengthens the argument that prevention is more cost-effective and environmentally responsible than repeated recovery after climate-related disasters. The results are also to support a better coordinated regional approach to flood prevention, emergency preparedness and adaptation planning, particularly where risks extend beyond municipal boundaries.

The participatory process has increased the social usability and legitimacy of the results. Stakeholder consultations helped validate the assessment, identify where greater local detail was required and demonstrate how community knowledge can influence technical analysis and policy choices. By presenting climate risks through locally recognisable exposure and vulnerability factors, the project made an otherwise complex subject more relatable and increased public awareness, stakeholder confidence and local ownership of forthcoming adaptation measures. Stakeholders also have stated that the approach helped them understand how climate evidence can be translated into strategic documents and practical action.

Finally, the project has identified concrete opportunities for improving future municipal information management. These include establishing structured databases on protective infrastructure and its technical condition, systematically recording flood events and associated river levels, and regularly updating demographic, infrastructure and ecosystem information relevant to exposure and vulnerability. Such systems would allow the Municipality to monitor changing risks, assess the effectiveness of implemented measures and periodically update the CRA.

Overall, the usability of the CRAG results extends well beyond the preparation of the project deliverables. The refined CRA provides Garmen Municipality with a durable framework for evidence-based decision-making, policy development, investment prioritisation, stakeholder engagement, and funding mobilisation. Its long-term value lies both in the knowledge contained in the assessment and in the institutional capacity, methodological confidence, and participatory practices developed through the process.

4.2 Lessons learned

The third phase of the CRAG project confirmed that the principal value of a Climate Risk Assessment lies in its use as a basis for policy change rather than in the assessment document alone. Translating the refined CRA into amendments to the Climate Change Adaptation Strategy, proposals for integration into other municipal planning instruments and the initial framework for a Municipal

Climate Risk Management Plan required the project team to move from technical analysis towards policy design and practical implementation. One of the main lessons was that the transition from assessment to climate risk management requires clear prioritization, realistic allocation of responsibilities, and the translation of scientific findings into actions that are understandable and applicable for municipal decision-makers.

The greatest difficulties have been connected to limited municipal administrative and financial capacity, the need to coordinate climate risk management across several departments and policy areas, and the continued shortage of locally specific climatic and hydrological data. The project nevertheless demonstrated that the absence of local climate records does not prevent meaningful policy action where European climate information is combined with local data on exposure, vulnerability, infrastructure, and past events. At the same time, Phase 3 reinforced the need to establish more systematic municipal information management, including databases on protective infrastructure, its technical condition, flood occurrences and other risk-relevant indicators. The mechanisms for this data collection will be incorporated in the municipal climate change adaptation strategy to be practically introduced in the short term.

Stakeholders have continued to play an important role in ensuring that CRM recommendations are locally relevant and socially legitimate. Engagement during the earlier analytical stages had already validated the selection of river floods and heatwaves as priority risks and highlighted the importance of greater spatial precision. During the policy-oriented phase, stakeholder input also generated concrete proposals, including the introduction of new “cool standards” into municipal energy-efficiency and spatial-planning practice. This experience demonstrated that stakeholder participation can produce direct policy outcomes rather than serving only as a consultation exercise. Feedback generally supported the preventive and evidence-based orientation of the CRM recommendations, particularly measures that protect disproportionately affected groups, improve public spaces and infrastructure, and strengthen preparedness.

Learning was ensured through the close cooperation between the CMT and the EET, regular internal reflection, continued exchange with stakeholders and the practical process of applying CRA findings to strategic documents. The municipal team strengthened its ability to interpret climate-risk evidence, connect it with sectoral responsibilities and identify feasible policy instruments. The CRAG project therefore functioned as a learning-by-doing process, consolidating existing municipal capacities while identifying areas in which further expertise, data, and coordination mechanisms are required. This institutional learning is one of the most sustainable project outcomes because it will support future updates of the CRA, preparation of funding applications, and implementation of adaptation measures after the formal end of the project.

The communication approach focused on the meaning and practical implications of the results rather than on the technical details of the workflows. This worked well for non-expert audiences, as locally recognisable information on exposed settlements, infrastructure, businesses and vulnerable groups made the findings more understandable and demonstrated how stakeholder feedback had influenced the assessment and subsequent policy recommendations. The Municipality also intends to share the acquired experience through institutional networks in order to support replication of the CRA-based approach by other municipalities.

Several aspects of project implementation worked particularly well. The continuous cooperation between the municipal and external expert teams allowed technical knowledge to be combined with local institutional experience. The CLIMAAX methodology provided a clear analytical framework,

while the use of local data and stakeholder knowledge made the results sufficiently detailed and actionable for policy-making. The decision to focus on two priority risks also allowed limited resources to be concentrated on areas of greatest relevance to the municipality. Less successful aspects were primarily linked to the time required to identify, collect, and verify fragmented local information and to the absence of established systems for continuously recording climate-related events, infrastructure conditions, and adaptation progress.

Overall, project resources were used efficiently. Municipal staff contributed local knowledge, access to administrative information and institutional coordination, while the External Expert Team supplied specialised methodological and policy expertise that was not available internally. This division of responsibilities reduced duplication and enabled the Municipality to obtain a level of analysis and policy support that would otherwise have been difficult to achieve with its own resources. Nevertheless, the experience confirmed that effective long-term CRM will require dedicated staff time, continued capacity development, and external funding for larger adaptation measures.

The impact of Phase 3 is assessed as substantial in terms of improved understanding of climate risk and increased capacity for action. The project has strengthened institutional knowledge, improved public awareness, created a more informed basis for stakeholder participation and established concrete pathways for integrating climate risk into municipal strategies, sectoral programs, spatial-planning practices, and investment decisions. It has also improved the Municipality's position when advocating for national support, applying for European funding, and presenting adaptation projects to potential partners and investors. The most important lesson is therefore that CRM should be maintained as a continuous process of assessment, policy integration, implementation, monitoring and learning, rather than treated as a one-time project activity.

5 Conclusions Phase 3

Phase 3 of the CRAG project has successfully translated the results of the refined Climate Risk Assessment into a practical framework for Climate Risk Management (CRM) within Garmen Municipality. While Phase 2 focused on improving the precision, relevance, and actionability of the climate risk assessment through the integration of local data and stakeholder knowledge, Phase 3 has demonstrated how this evidence can be systematically incorporated into municipal governance, strategic planning, and future investment decisions. The project has therefore completed the transition from climate risk assessment to climate risk management, providing the Municipality with both a scientific basis for decision-making and a structured approach for implementing adaptation measures over the long term.

One of the principal achievements of Phase 3 has been the further development of the Municipal Climate Change Adaptation Strategy through the integration of the findings of the refined CRA and the formulation of a comprehensive Climate Risk Management framework. Building upon the analytical work completed during Phase 2, the Municipality has defined strategic CRM objectives, established enabling conditions for effective implementation, identified priority adaptation measures and developed recommendations for integrating climate risk considerations into municipal policies, sectoral programmes, spatial planning, and investment processes. Particular emphasis has been placed on ensuring that adaptation measures contribute to the protection of disproportionately affected population groups while supporting sustainable territorial development and generating wider environmental, economic, and social co-benefits.

An equally important outcome has been the establishment of a practical implementation pathway for future climate resilience actions. The project has demonstrated that the refined CRA can serve as the principal evidence base for updating municipal strategic documents, initiating a Municipal Climate Risk Management Plan, prioritising investments, and supporting applications for national and European funding. The proposed integration of climate risk considerations into the Climate Change Adaptation Strategy, the Municipal Integrated Development Plan, the Municipal Energy Efficiency Programme, and spatial-planning procedures illustrates how climate adaptation can be mainstreamed across multiple areas of municipal governance rather than remaining confined to a single policy document.

The project has also confirmed the value of stakeholder participation throughout the policy development process. The continued engagement of municipal departments, regional institutions, businesses, civil society organisations, and local residents has strengthened both the quality and legitimacy of the proposed CRM framework. Importantly, stakeholder engagement has extended beyond validating the climate risk assessment to generating concrete policy proposals, including recommendations for introducing "cool standards" into municipal planning and construction practices. This demonstrates that participatory climate governance can directly influence municipal decision-making while strengthening local ownership of adaptation policies.

Phase 3 has further reinforced the institutional capacity of Garmen Municipality to manage climate risks. Through the close cooperation between the CMT and the EET, the Municipality has strengthened its understanding of the CLIMAAX methodology, improved its ability to apply climate evidence to policy development and identified practical mechanisms for monitoring implementation and periodically updating the Climate Risk Assessment. The project has therefore produced lasting institutional benefits that extend beyond the preparation of the project deliverables.

At the same time, Phase 3 has confirmed that several challenges remain. The Municipality continues to face limitations related to financial and administrative resources, the availability of high-resolution local climatic and hydrological data, and the complexity of coordinating climate risk management across multiple sectors and governance levels. Many of the proposed adaptation measures will require sustained political commitment, continued stakeholder engagement, and successful mobilisation of external financial resources. These challenges, however, do not diminish the value of the project. Rather, the refined CRA and the Climate Risk Management framework developed during Phase 3 provide the Municipality with a substantially stronger foundation from which to address them in a systematic and evidence-based manner.

Overall, the principal conclusion of Phase 3 is that CRM should be regarded as a continuous governance process rather than a one-time planning exercise. The Climate Risk Assessment, the updated Climate Change Adaptation Strategy and the future Municipal Climate Risk Management Plan should operate as mutually reinforcing components of an adaptive management cycle based on regular monitoring, stakeholder engagement, policy revision, and continuous institutional learning. In this respect, the CRAG project has provided Garmen Municipality not only with improved knowledge of climate risks, but also with the governance mechanisms, institutional capacity, and strategic direction necessary to strengthen long-term resilience to climate change.

The experience gained throughout the three phases of the project demonstrates that the CLIMAAX framework offers municipalities a scientifically robust yet practical methodology for translating climate risk assessments into concrete policy action. For Garmen Municipality, the project has established a durable foundation for evidence-based decision-making, strengthened cooperation

among local and regional stakeholders, improved preparedness for future climate challenges and enhanced the Municipality's capacity to attract funding and investments for climate adaptation. The Municipality considers these achievements to represent the beginning of a continuous process of climate resilience building that will evolve through future implementation, monitoring, and periodic revision of climate policies and measures.

6 Progress evaluation

6.1 Project outputs

Phase 3 successfully delivered the activities foreseen in the Individual Follow-up Plan and achieved the corresponding Key Performance Indicators (KPIs) and milestones. While the previous project phases focused on developing and refining the Climate Risk Assessment, the emphasis of Phase 3 was placed on translating the assessment results into practical policy instruments, strategic planning, and implementation mechanisms. The completed KPI and milestone tables demonstrate that the project has progressed from analytical work towards establishing the governance framework required for long-term climate resilience in Garmen Municipality.

The principal outputs of Phase 3 include the preparation of amendments to the Municipal Climate Change Adaptation Strategy based on the findings of the refined CRA, the initiation of the drafting process for a Municipal Climate Risk Management Plan, and the development of proposals for integrating climate risk considerations into additional municipal strategic documents and planning instruments. In parallel, the Municipality designed the process for engaging regional and national authorities to advocate for stronger regional coordination and to support future funding and investment in climate adaptation measures. These activities establish the institutional foundation for implementing the recommendations developed throughout the CRAG project and demonstrate that the refined CRA is already being translated into concrete governance actions.

Phase 3 also continued stakeholder engagement and communication activities initiated during the earlier phases of the project. Building upon the consultation process undertaken during the CRA, communication materials and official outreach mechanisms were prepared to facilitate the dissemination of project results and promote the integration of climate risk considerations into regional and national planning processes. Together with the completed strategic and policy outputs, these activities contribute to strengthening institutional capacity, stakeholder ownership and the long-term sustainability of CRM in Garmen Municipality.

Overall, the completed KPIs and milestones confirm that Phase 3 has achieved its primary objective of providing Garmen Municipality with the strategic, institutional and procedural foundations necessary to implement evidence-based Climate Risk Management beyond the lifetime of the CRAG project. The remaining scheduled activity - the participation in the final CLIMAAX workshop in Brussels - is expected to further support knowledge exchange and dissemination of project results at the European level.

Table 4-1 Overview key performance indicators

Key performance indicators	*Progress*
two workflows – 1/ River floods and 2/ Heatwaves - successfully applied on Deliverable 1.	*Completed with European data*

one meeting with local and regional stakeholders to collect input on climate risks but also to share information and build awareness about the ongoing process of climate multi-risk assessment.	*Completed in February 2025*
five communication actions taken to share results/progress with stakeholders, including any of the following media publications and social media posts, and in-person and online events, dissemination and delivery of presentations, whereby two would be the following: *- one meeting with local and regional stakeholders (residents, CSOs, local business, the media, regional authorities) to present the results from the multi-risk climate assessment, share plans for next steps and collect feedback relevant to policy decisions;* *- dissemination of project results through the National association of municipalities to its members.*	*Completed in Phase 2:* *- one meeting with local and regional stakeholders (residents, CSOs, local business, the media, regional authorities) to present the results from the multi-risk climate assessment, share plans for next steps and collect feedback relevant to policy decisions;* *- press release sent out and published on project progress and the participation of the Garmen team at the Barcelona workshop;* *- social mead publication on project progress and the participation of the Garmen team at the Barcelona workshop* *Completed in Phase 3:* *- consultation with stakeholders to share refined CRA results, share plans for incorporation in municipal policies, and collect CRM policy ideas from stakeholders.* *- Designed communication package to disseminate to fellow municipalities through the national association in September.*
five stakeholders involved in activities relevant to the project (citizens, media, local business, regional authorities, national authorities relevant to climate adaptation);	*This is a KPI to be completed for the entire duration of the project. During Phase 1: Citizens, local businesses, municipal administration officials, and regional authorities have been involved to the extent that they could provide input in the process leading up to the completion of this deliverable.* *During Phase 2: a multi-stakeholder public stakeholder consultation meeting was held to present the D1 CRA findings, gather feedback to validate and refine the results. Stakeholder input was taken into consideration for the refined CRA.* *During Phase 3: multi-stakeholder outreach continued, including preparation of official communication process (design of steps, tools, and content) to be sent out to the respective authorities at regional and national level in September 2026.*
two outreach initiatives to policy makers to share results and advocate for next steps building on the multi-risk assessment – one in respect to the relevant regional authority to enable and advocate for the use of the assessment in regional planning and one to the national authorities to advocate for funding for climate change adaptation measures.	*KPI completed in Phase 3 as the initiatives have been devised and official communication tools and content have been prepared and will be sent out to the respective authorities at regional and national level in September 2026.*

Table 4-2 Overview milestones

Milestones	*Progress*
M1: Test of workflow 1 made (Phase 1)	Completed
M2: Workflow 1 successfully applied (Phase 1).	Completed
M3: Test of workflow 2 made (Phase 1).	Completed
M4: Workflow 2 successfully applied (Phase 1).	Completed
M5: Meeting with local and regional stakeholders to collect input on climate risks completed (Phase 1);	Completed in February 2025
M6: Submission of Climate Multi-Risk Assessment Report (Deliverable 1) (Phase 1).	Completed
M7: A library of resources with additional regional/local data created (Phase 2).	Completed
M8: Attend the CLIMAAX workshop in Barcelona (Projected for Phase 2 but depends on CLIMAAX coordinator).	Completed
M9: Submission of the Refined local multi-risk assessment (Deliverable 2) (Phase 2).	Completed (with the submission of the current report)
M10: Meeting conducted for presentation of the results from the multi-risk climate assessment to local and regional stakeholders – citizens, CSOs, media, business, regional authorities (Phase 2).	Completed 01/08/2025
M11: Climate Change Adaptation Strategy of Garment municipality reviewed and updated in light of the climate multi-risk assessment (Deliverable 3) (Phase 3).	Review and update amendment suggestion completed in Phase 3. Official adoption will be initiated in September/October 2026 session of the Municipal Council. Other relevant municipal regulations and strategic documents have also been studied additionally and amendments to incorporate the CRA findings/approach have been prepared and suggested for political review and adoption.
M12: The drafting process of a municipal risk management plan with a particular focus on prevention and support for disproportionately affected by climate risks segments of the local community started (Phase 3).	Milestone completed in Phase 3 as the drafting processes has been initiated and a structure of the document has been proposed for approval by municipal leadership.
M13: A process of advocating for national funding or attracting investments for climate adaptation measures in the municipality on the basis of the multi-risk assessment started (Phase 3).	Milestone completed in Phase 3 as the process has been designed and official communication tools and content have been prepared and will be sent out to the respective authorities at national level in September 2026.
M14: Advocacy effort for an improved regional approach to planning and prevention in respect to climate change impact and disasters, based on the multi-risk assessment, initiated with regional authorities (Phase 3).	Milestone completed in Phase 3 as the process has been designed and official communication tools and content have been prepared and will be sent out to the respective authorities at regional level in September 2026.
M15: Attend the CLIMAAX workshop held in Brussels (Projected for Phase 3 but depends on CLIMAAX coordinator).	To be completed in December 2026.

7 Supporting documentation

- Deliverable 3 main report – current document, submitted via the CLIMAAX Deliverable Platform.

Outputs listed below are in Bulgarian and available upon request for the CLIMAAX team due to their status as draft policy documents:

- Proposed amendment updating the municipal Strategy for Adaptation to Climate Change to incorporate CRA findings.
- Proposal for amendment to the Integrated Development Plan of Garmen Municipality to integrate the CRA findings.
- Proposal for amendment to the Municipal Energy Efficiency Program to integrate “cool standards” in accordance with CRA findings.
- Proposal to the Municipal Expert Council on Spatial Planning (MECSP) for the adoption of internal methodological guidance on the application of Solar Reflectance Index (SRI) criteria on buildings facades and surface materials for public spaces when public funding used.
- Climate Risk Management Plan design and steps to finalize.
- Strategy, engagement tools, and content for outreach to regional and national stakeholders.
- Communication package for the National Association of Municipalities in Bulgaria.

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