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Alpine Space

X-RISK-CC

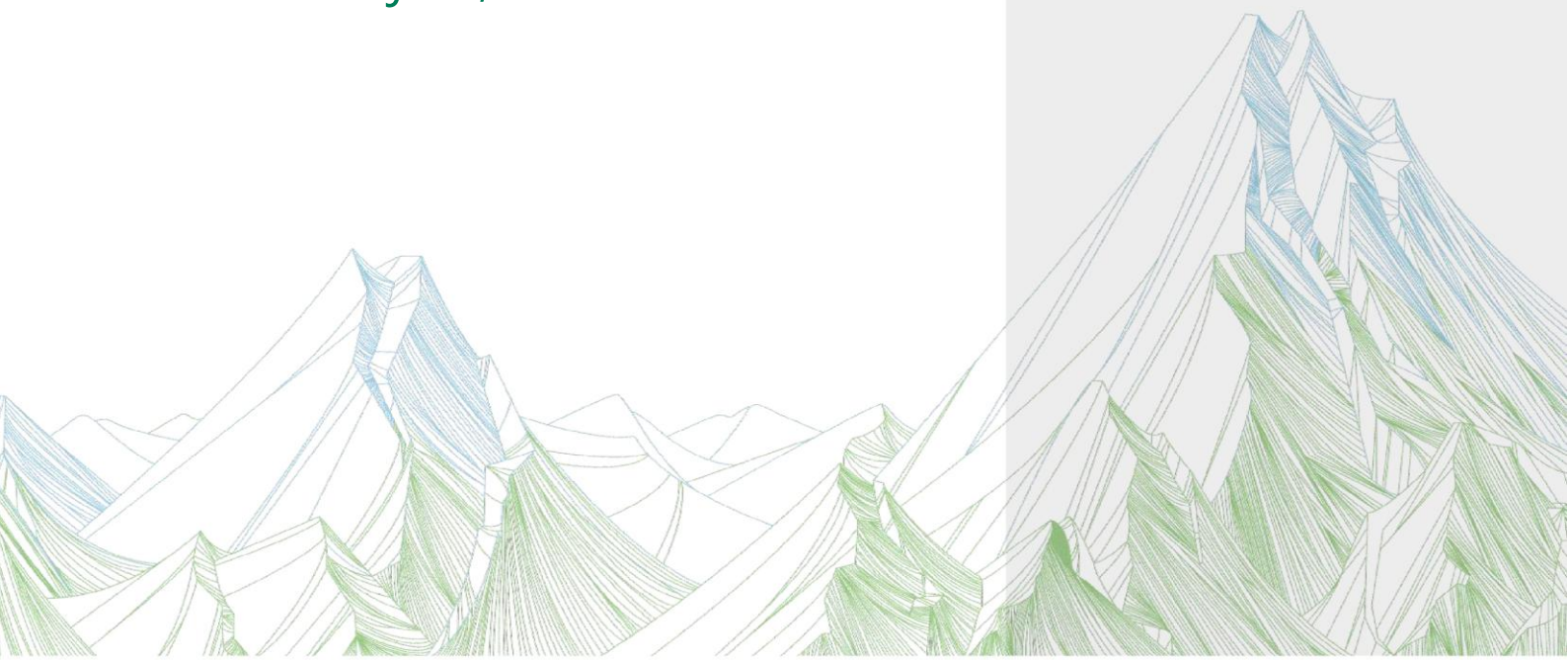
TAILORED ACTION PLAN
FOR RISK MANAGEMENT IMPROVEMENT

Interreg Alpine Space X-RISK-CC project – 2023/2025

PILOT AREA:

Sora Catchment

In Gorenjska, Slovenia



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PROJECT: **X-RISK-CC**

How to adapt to changing weather eXtremes and associated compound RISKs in the context of Climate Change

IMPRESSUM:

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X-RISK-CC - Alpine Space Programme

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INTRODUCTION TO THE X-RISK-CC PROJECT

Project Background and Objectives

The X-RISK-CC project addresses the increasing challenges posed by climate-related extreme weather events across the Alpine Space. Recent years have demonstrated that compound and cascading extremes—such as storms combined with heavy precipitation, or heatwaves followed by drought and flooding—can challenge current risk management capacities. The unexpected magnitude and intensity of these extremes can cause compound impacts and domino effects that turn into complex, long-lasting, or even irreversible consequences. While scientific evidence links climate change to the increasing intensity and frequency of such events, knowledge and management of their cascading impacts and risks remain insufficient. The X-RISK-CC project aims to improve risk management of such extreme events in the context of climate change. By considering selected pilot areas across the Alpine Space, co-designed, context-specific interventions are elaborated based on a comprehensive assessment of past extreme events, future climate projections, and systematic evaluation of existing risk management capabilities and gaps. This document presents the Tailored Action Plan developed for one of the project pilot areas.

The Pilot Area of Reference

The Gorenjska region and the Sora Catchment in Slovenia are increasingly affected by droughts (including flash droughts), heatwaves and river or flash floods. These events often co-occur and amplify impacts across sectors such as agriculture, forestry, water supply, tourism, hydropower and ecosystems.

Flooding is mainly driven by intense precipitation. A major event occurred in September 2007, when nearly 200 mm of rain fell in Železniki within one day, triggering flash floods exceeding the 100-year return period, causing three fatalities and almost EUR 100 million in damages. Another severe flood occurred in August 2023, again resulting in extensive regional damage. In addition, prolonged dry and hot periods lead to drought conditions, affecting soils and shallow aquifers, and may increase subsequent flood risk due to reduced infiltration.

For further details on the pilot area, the natural hazards that occurred and the activities that led to the co-creation of the tailored action plan, refer to the document “PILOT DOSSIER: SORA CATCHMENT, IN GORENJSKA” available at the project website under “Outcomes”.

Outcomes:
X-RISK-CC - Alpine Space Programme
https://www.alpine-space.eu/project/x-risk-cc/

X-RISK-CC – Web GIS:
Information on intensity and frequency of weather extremes in the entire Alpine Space
https://cct.eurac.edu/x-risk-cc

Based on the results of participatory workshops with local stakeholders, this document presents the Tailored Action Plan (TAP) which outlines the priority actions to strengthen the region's capacity across all phases of the risk management cycle. The TAP addresses key gaps in early warning systems, data integration, coordination mechanisms, infrastructure resilience, legal frameworks, and public awareness. The actions are designed to be implementable, measurable, and aligned with both regional and transnational objectives of the Alpine Space for disaster risk reduction and climate change adaptation.

Purpose and Concept

While this document provides the overall structure and documentation, the TAP itself is conceived as a living set of implementation-oriented actions, forming a dynamic and evolving database of priority measures. The actions can be continuously updated and adapted over time and serve as a practical reference for identifying next steps, tracking ongoing initiatives, and maintaining a clear overview of progress in strengthening regional resilience. This flexible approach acknowledges that effective risk management in the context of climate change requires ongoing learning, adaptation, and coordination among stakeholders.

Methodology

The methodology employed to develop the TAP for each pilot area of the project follows a **Community-Based Approach** engaging stakeholders across all phases of the risk management cycle (prevention, preparedness, response, recovery). **Participatory workshops with local stakeholders** were conducted **between 2023 and 2025** in each pilot area.

In the pilot area of Sora Catchment, two workshops involving stakeholders in the process of sharing experiences and challenges in the emergency management process were organised. A carousel moderation method was used, enabling all stakeholders to become familiar with various proposed solutions in a relatively short time, with everyone having the opportunity to learn about the ideas of others and build on them. As part of the first workshop, participants shared their past experiences, primarily with the management of floods and landslides that occurred in August 2023. They highlighted the key challenges they face in their work and proposed possible solutions that could, among others, improve the cooperation of the institutions involved. The issue of droughts was discussed in parallel by means of interviews with stakeholders. In the second workshop, participants were divided into two groups to discuss future challenges related to floods and to droughts combined with heat extremes in a future climate context.

Participants in the workshops of the pilot area Sora Catchment, in Gorenjska:

- Administration for Civil Protection and Disaster Relief (URSZR)
- Centre for Sustainable Rural Development Kranj
- Chamber of Agriculture and Forestry of Slovenia - Regional Unit Kranj (KGZ Kranj)
- Civil protection and firefighter unit (CZ)
- Development Agency Sora (RAS)
- Development Centre of the Heart of Slovenia
- Environmental Agency Slovenia (ARSO)
- Komunala Škofja Loka d.o.o. (public utility company)
- Local Energy Agency of Gorenjska (LEAG)
- Local fishing associations
- Municipality of Škofja Loka
- Municipality of Železniki
- Municipality of Gorenja vas-Poljane
- Municipality of Žiri
- Radio SORA
- Slovenia Forest Service, Regional Unit Kranj (ZGS Kranj)
- Slovenian Water Agency (DRSV)

Prioritization Strategy

Prioritization was carried out separately for each pilot area in the project and is therefore not uniform across pilot regions, reflecting different risk contexts, institutional settings, and capacities.

In the Sora Catchment pilot area, participants prioritized the measures proposed based on the urgency to enable safety and based on feasibility within an appropriate time period. For the purposes of the action plan, the prioritization of proposed actions was further refined by the project team using a five-level classification method, which allows for a comparable and transparent assessment of the importance of each measure.

The assessment is based on a combination of the following criteria:

- **realistic feasibility** of the measure (financial and personnel requirements, time frame),
- **added value of cooperation** between different institutions and stakeholders**,**
- **impact on reducing the vulnerability** of residents, infrastructure, and the environment**.**

Each measure was assessed based on the above criteria and classified into one of the following five levels:

- **Level 1 – Lowest priority**: measure has limited impact, is not necessary, or its implementation is difficult to achieve in the near future.
- **Level 2 – Lower priority**: measure is reasonable but not essential to reducing the risks; feasible only over a longer period of time or with significant limitations.
- **Level 3 – Medium priority**: measure is important; it contributes to risk reduction, but its impact is limited to a specific area or group.

- **Level 4 – Higher priority**: measure is very important for risk reduction, is relatively feasible and has clear added value for the region.
- **Level 5 – Highest priority**: measure is urgent, as it addresses a key gap, is essential for the safety of residents; its implementation brings the broadest positive impacts and is therefore considered a priority. It is also feasible financially and personnel-wise.

The method described above enables a uniform classification of actions and ensures transparency in the selection of measures that will have the greatest impact on reducing risks in the region[1].

[1] Ortiz, G. et al., 2018. Participatory multi-criteria decision analysis for prioritizing impacts in environmental and social impact assessments. Sustainability: Science, Practice and Policy, 14(1), 6–21. https://doi.org/10.1080/15487733.2018.1510237

TAILORED ACTION PLAN

Table of actions

Table 1 provides an overview of all identified actions. Actions are coded according to the system described in the previous section. **Detailed descriptions of each action are provided in the Annex**, outlining the rationale of each action, the gap or need it addresses, its position within the risk management cycle, the institutional ownership and actors involved, the intended target groups, and the current state of implementation.

FLOODS	DROUGHTS
A1 – Establishment of a special hydrological forecast for the Sora Catchment	A5 – Development of concept for tasks and inter-institutional cooperation at the local level before/during/after drought events
A2 – Update of hazard assessments and protection & rescue plans for floods and landslides in the municipalities of the Sora Catchment	A6 – Improving drought monitoring
A3 – Establishment of floodplain areas for watercourses	A7 – Implementation of irrigation systems and water retention structures
A4 – Establishment of torrent-control wooden check dams	A8 – Informing the public at the municipal level
A9 – Communication activities for better preparedness for extreme weather and hydrological events in the Sora Catchment	

***TABLE 1**: List of actions for floods (blue), droughts (orange) and both (purple) for the Sora Catchment pilot area in Gorenjska.*

In particular, the detailed description of each action listed in Table 1 includes:

- **IDENTIFICATION:** Unique code, title, and summary
- **GAP ADDRESSED:** Specific weakness or need in current risk management
- **FRAMING:** Position in risk cycle, action type, governance level, ownership, target groups, priority level
- **DESCRIPTION:** Detailed explanation of the action, preliminary steps, expected benefits, and potential challenges
- **VALIDATION:** Indicators and parameters for monitoring progress and success
- **FEASIBILITY:** Timeline, funding status, responsibilities, and implementation pathway

- **LINKS AND DOCUMENTS:** References to supporting documents, reports, technical studies and other resources relevant to understanding or implementing the action.

CONCLUSIONS AND NEXT STEPS

This document represents a living framework for improving risk management in the X-RISK-CC pilot area of the Sora Catchment in response to increasing climate-related extreme events. The actions identified through participatory workshops with local stakeholders address critical gaps across all phases of the risk management cycle.

Key Outcomes:

- Comprehensive inventory of 9 tailored actions co-designed with local stakeholders
- Systematic coding system enabling efficient tracking, monitoring and coordination
- Clear prioritization framework to guide implementation
- Integration of scientific climate projections with local knowledge and practical experience

Implementation Approach

The tailored action plan focuses on measures that are **most feasible and implementable in the Sora Catchment**. The readiness to proceed with implementation is high at the end of the project.

Based on the identified gaps—highlighted by Civil Protection commanders—the implementation of some selected actions has already been initiated. In particular, in the field of early warning for floods, it was identified that existing alerts were not sufficiently precise or locally tailored. Through a collaborative process involving Civil Protection commanders and the Slovenian Environment Agency (ARSO), this gap has already been addressed by an automated alert and notification system for extreme weather and hydrological events. In addition, within the project, municipal protection and rescue plans as well as flood and landslide risk assessments were improved, thereby strengthening preparedness, response capacities, and overall risk management at the local level. Furthermore, a wide range of communication and awareness-raising activities were carried out, focusing on climate change, extreme weather events, and risks related to floods and droughts. These activities included the production of awareness-raising videos, educational radio programmes, and the installation of high-water level markers to increase public awareness of flood risks. In addition, numerous practical tips and guidance materials were shared with the public and residents to support better preparedness and self-protection during extreme events.

ANNEX

In the following, each action presented in Table 1 is described individually.

A1 (FLOODS) – Establishment of a special hydrological forecast for the Sora Catchment

GAP THE ACTION ADDRESSES

- In a changing climate, in addition to rising temperatures, also expected in the future are changes in the intensity and frequency of the heaviest precipitation, which increases the risk of torrential floods. With global warming of 4°C, the intensity of one- and two-day extreme precipitation events will increase by more than 20% in spring and by 15% in other seasons. The number of days with the heaviest precipitation is expected to increase slightly in all seasons, most in spring and winter, and least in summer. The largest autumn one-day precipitation events with a 50-year return period in today's climate (1991–2020 period) could become up to 2.4 times more likely with global warming of 3 and 4°C.
- Due to the torrential nature of the watercourses in the Sora Catchment, intense local rainfall can trigger floods very quickly and only in part of the catchment. A rapid response in the area is key to mitigate the consequences of torrential floods.
- Current forecasts from the Hydrological Forecasting Service cover the entire catchment, so a more accurate, locally adapted forecast would enable more efficient deployment of resources and teams in the area, which would contribute to better preparedness and rapid response to flood events.

FRAME THE ACTION

- **Risk Cycle Phase**: preparedness, response - a forecast that takes into account local conditions and possible impacts contributes to better preparedness for the event – establishing flood control measures and deploying resources and teams for the fastest possible response on the ground during an event.
- **Type of Action**: information – providing current forecasts of meteorological and hydrological conditions.
- **Levels of Action**: national-local level.
- **Ownership**: Slovenian Environment Agency (ARSO), Civil Protection (CZ) units in the Sora Catchment.
- **Target Groups**: Civil Protection, firefighters.
- **Priority**: 5
- **Connections**: Related to Action A2 (FLOODS) – Update of hazard assessments and protection & rescue plans for floods and landslides in the municipalities of the Sora Catchment.

DESCRIPTION OF THE ACTION

The action upgrades the existing cooperation between the Slovenian Environment Agency (ARSO) and Civil Protection (CZ) in the Sora Catchment. The objective is to establish a specific regional hydrological forecast that will complement existing national forecasts with a locally adapted forecast with probabilities for different levels of consequences on the ground. The basis for the forecast is close cooperation with local Civil Protection commanders and other stakeholders who know the characteristics of individual parts of the catchment and the consequences that different levels of flooding can cause. This will improve the operational applicability of the forecast for decision-making on the ground.

Steps:

1. Field data collection: local civil protection commanders and other stakeholders examine the impacts of flood events in their municipalities. Based on instructions from ARSO, they determine which discharge rates or water levels at hydrological stations represent critical thresholds and set newly defined limit values for watercourses.
2. Issuance of special forecasts: in the event of predicted meteorological events that are likely to exceed thresholds, ARSO sends the forecast directly to civil protection commanders, fire brigades, municipalities and other key stakeholders.
3. A special hydrological forecast is sent to key stakeholders when limit values are exceeded 72, 48 and 24 hours before the event.
4. Operational use: based on the forecast, stakeholders on the ground optimise the deployment of teams and resources and regularly modify the response to the event.
5. All newly established collaborations and actions also involve or inform the Regional Civil Protection Commander from Administration for Civil Protection and Disaster Relief – Unit Kranj.

POSITIVE OUTCOMES

- Better preparedness, faster and more targeted response: teams are deployed based on the risk level of individual areas, which shortens response time. Limited human and technical resources are used more optimally.
- Reducing consequences: protection of critical infrastructure and residents in a timely manner reduces material damage, risk for humans, and long-term consequences for the local community.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Uncertainties in meteorological and hydrological models: meteorological and hydrological forecasts are always associated with uncertainty; the area of the most intense precipitation may shift by tens of kilometres compared to the model forecast, which significantly affects the hydrological response on the ground.
- Selective preparedness risk: relying only on a special forecast could create a false sense of security. A special forecast cannot replace the basic preparedness of all units in the catchment but only serves as an additional tool to guide action.

- Additional coordination: introducing a new forecasting system requires adapted communication protocols, which can cause a lack of clarity and an additional burden in the initial phase.

VALIDATION/ INDICATORS – ANALYSIS

- User feedback: systematic collection of responses from civil protection commanders, firefighters and municipalities on the usefulness of special forecasts in their operational work.
- Performance analysis: monitoring issued special forecasts and comparing them with actual flood events and consequences.

FEASIBILITY AND TIMELINE

The Action A1 and its testing of a specific hydrological forecast was carried out as part of X-RISK-CC, which is co-financed by the Interreg Alpine Space programme. During the project, the special notification by means of a form sent via electronic messages was upgraded with the HFSvis application.

For this purpose, an additional expert consultation on the topic of improved communication during extraordinary weather and hydrological events was conducted as part of the project. The HFSvis application by ARSO was presented to representatives of municipal Civil Protection units and municipalities in the Sora Catchment. It enables monitoring of measured and forecast precipitation and discharge rates in one place. Several time series are available, each also taking into account measurements for two days back, while a simulation is available for six days ahead. Forecasts are updated six times a day, providing expert services with a more accurate picture of the conditions of watercourses. The application also provides access to forecasts for neighbouring river basins or areas.

This gives the Civil Protection insight into the application and enables individual consultation with the on-call forecaster. Furthermore, SMS notification was also pilot tested as part of the upgrade and integration with other projects. Civil Protection commanders receive SMS notifications from ARSO when the limit value is increased.

Such tools can significantly contribute to better preparedness for flood events and, once an agreement is concluded and obligations are defined, will be made available in the future.

Time frame	A special forecast is tested during the implementation of the project; during this time, further cooperation after the completion of the project (31 January 2026) is also defined.
Financing and responsible persons	The Slovenian Environment Agency (ARSO), the Sora Development Agency (RAS) and Civil Protection commanders of the municipalities of Škofja Loka, Žiri, Gorenja Vas - Poljane and Železniki; Administration for Civil Protection and Disaster Relief - Kranj unit. Municipal services also participate in the implementation, if necessary.
Participants	Hydrological Forecasting Service of ARSO, local Civil Protection units

A2 (FLOODS) – Update of hazard assessments and protection & rescue plans for floods and landslides in the municipalities of the Sora Catchment

GAP THE ACTION ADDRESSES

- Each municipality is obliged to prepare a hazard assessment for individual types of disasters, including floods and landslides. A protection and rescue plan (PRP) must be prepared based on the risk assessment. Municipal hazard assessments and flood and landslide protection and rescue plans are part of the system of protection against natural and other disasters in Slovenia, which is regulated by the Protection Against Natural and Other Disasters Act and relevant secondary legislation. Municipal documents must be coordinated with regional and national hazard assessments and plans prepared by Administration for Civil Protection and Disaster Relief (URSZR), i.e., their units.
- Currently, the existing municipal plans are not up to date with the regional plan (updated in March 2025) and the national plan (updated in July 2024). Documents not being up to date mainly refers to outdated data such as, for example, intervention values for water levels; it is necessary to update the contact details of key stakeholders, data on contractors for emergency measures and elimination of the consequences of floods and landslides, food providers, evacuation areas and data on the possibility of using shelters, etc. Plans not being up to date means greater exposure to risks, poorer coordination with the regional and national levels, and the risk of non-compliance with the legal obligations of municipalities. The mentioned gap makes effective protection and rescue in the event of floods and landslides more difficult, thereby reducing the preparedness of municipalities and rescue services.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention/preparedness; the content of the PRP covers all phases - prevention, preparedness, response and recovery.
- **Type of Action**: legislation, knowledge and data.
- **Levels of Action**: local, coordinated with the regional and national plan.
- **Ownership**: the municipalities of Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri and their Civil Protection units, Administration for Civil Protection and Disaster Relief (URSZR) - Kranj unit, ARSO (hydrological data), the Geological Survey of Slovenia (landslides), fire brigades and utility companies, other contractors, if necessary.
- **Target Groups**: Municipalities, municipal Civil Protection units and fire brigades, public services, residents in areas at risk.
- **Priority**: 5
- **Connections**: A1 (FLOODS) – Establishment of a special hydrological forecast for the Sora Catchment (related to determining discharge rate/water level action values); A3 (FLOODS) – Establishment of floodplain areas for watercourses

DESCRIPTION OF THE ACTION

The action envisages the updating and drafting of municipal hazard assessments and protection and rescue plans (PRPs) for floods and landslides. The purpose of the action is to

ensure that municipal plans are up to date with the regional plan (March 2025) and the national plan (July 2024), and that they include current data on floods and landslides and clearly define procedures and responsibilities in the event of a disaster. Special emphasis will be placed on the up-to-date inclusion of local specifics (e.g., vulnerable areas, important infrastructure, cooperation with local contractors, evacuation areas, etc.), as this enables more effective and targeted protection of residents and property. The goal is to increase the preparedness of municipalities, improve coordination with the regional and national levels, and ensure legal compliance of municipal documents with parent documents.

Steps:

1. Reviewing existing municipal plans and identifying areas that are not coordinated with parent plans, i.e., due to outdated and missing data.
2. Collecting current data and information (e.g., integral map of flood risk classes, flood warning map, flood risk and flood hazard maps, warning map for the probability of landslides and rockslides, list of key infrastructure, updated contacts of contractors and services) that will serve to prepare new hazard assessments.
3. Creating new hazard assessments while taking into account current data and information.
4. Developing new PRPs and coordination with the URSZR - Unit Kranj on the basis of hazard assessments to ensure compliance with the regional and national framework.
5. Involving public services (firefighters, utility companies, healthcare institutions) to verify coordination of procedures and response.
6. Drafting of annexes and addenda.
7. Public notice.

POSITIVE OUTCOMES

- Better preparedness for flood events and landslides.
- More effective protection of residents.
- Availability of clear, up-to-date scenarios that enable faster and coordinated response on the ground (reduced risks of loss of life, material damage and recovery time after a disaster).
- Enhanced cooperation between municipalities, the region and the state and their institutions.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Financial and human resource challenges for municipalities (hiring professional services and external contractors).
- A lengthy and participatory drafting process (coordination, involvement of various actors), which depends on the many stakeholders involved.

VALIDATION/ INDICATORS – ANALYSIS

- Number of municipal hazard assessments and PRPs that are up to date with the regional plan (2025) and the national plan (2024).
- Conducting a test protection and rescue exercise at the local/regional level.

FEASIBILITY AND TIMELINE

This is a specific and feasible action, as municipalities are obliged by law to draft and harmonise municipal risk assessments and PRPs. Implementation is therefore urgent and a priority. Currently under way is the drafting of a hazard assessment and PRPs for floods and landslides

for the municipality of Škofja Loka, funded from the X-RISK-CC project. Also taken into account in the drafting of the assessment are the project results and findings.

Time frame	Until 2026
Financing and responsible persons	Municipal budgets (funds earmarked for protection and rescue). Funds from the Interreg Alpine Space programme. Potential support from EU funds (e.g., cohesion funds, Recovery and Resilience Facility).
Participants	Responsible entities: municipalities (Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri). Coordination: Administration for Civil Protection and Disaster Relief - Kranj unit. Professional support: the Ministry of Natural Resources and Spatial Planning (MNVP) and Slovenian Water Agency (DRSV) (flood maps), ARSO (hydrological data), the Geological Survey of Slovenia (landslides). Operational support: fire brigades, utility companies, public services.

LINKS AND DOCUMENTS

- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the Assessment and Management of Flood Risks. https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32007L0060
- List of National Protection and Rescue Plans in Slovenia and Obligations Regarding Regional Ones. https://www.gov.si/teme/nacrti-zascite-in-resevanja/
- Municipal Flood Control and Rescue Plan for the Gorenja vas - Poljane Municipality, 2011. https://www.obcina-gvp.si/assets/obcinske_seje/7._seja_obcinskega_sveta/nacrt_zir_zemeljski_plaz_osnutek_za_os.pdf
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- Municipal Flood Control and Rescue Plan for the Škofja Loka Municipality, 2006. https://www.skofjaloka.si/DownloadFile?id=75982
- National Flood Control and Rescue Plan, version 4.1, July 2024. https://www.gov.si/assets/organi-v-sestavi/URSZR/Datoteke/Drzavni-nacrti/dn_poplave_azuriran_2024.pdf
- Protection Against Natural and Other Disasters Act (ZVNDN), Official Gazette of the Republic of Slovenia [Uradni list RS], Nos. 51/06, 97/10, 21/18 – ZNOrg, 117/22 and 57/25. https://pisrs.si/pregledPredpisa?id=ZAKO364
- Regional Flood Control And Rescue Plan for the Gorenjska Region, version 4.1, March 2025. https://www.gov.si/assets/organi-v-sestavi/URSZR/Izpostava-Kranj/Regijski-nacrti-zascite-in-resevanja/Regijski-nacrt-ZIR-POPLAVA_4.1-azurirano-marec-2025.pdf
- Risk Assessment on Possible Types of Natural Disasters in the Žiri Municipality, 2000. https://www.ziri.si/objava/57665

A3 (FLOODS) – Establishment of floodplain areas for watercourses

GAP THE ACTION ADDRESSES

- An ideal long-term solution to increase flood safety in the river catchment is to give watercourses more space, which includes the establishment of floodplains. These areas would allow for natural water retention during high water levels and relieve pressure on urban areas downstream. However, there is a major gap in this regard: floodplains often encroach on private land, and there is currently no effective financial mechanism in place to compensate or pay damages to owners. As a result, municipalities find it difficult to plan or include floodplain areas in spatial plans, which limits the possibilities for systemic reduction of flood risk. There is also a lack of cooperation and communication between the Water Agency, municipalities, designers and landowners.
- The lack of spatial planning with up-to-date flood hazard and flood risk maps and the inclusion of floodplain areas in municipal spatial plans can lead to increased urbanisation of floodplain areas, which increases the risk of flood damage.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention
- **Type of Action**: tied to legislation, data, spatial planning
- **Levels of Action**: local (harmonised with the regional and national plans)
- **Ownership**: Municipalities (Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri), Slovenian Water Agency, Ministry of the Environment, Climate and Energy, landowners
- **Target Groups**: local population (especially along watercourses, owners of land along watercourses), spatial planners, water managers, local protection and rescue services
- **Priority**: 3
- **Connections**: A2 (FLOODS) – Update of hazard assessments and protection & rescue plans for floods and landslides in the municipalities of the Sora Catchment

DESCRIPTION OF THE ACTION

Establishing floodplain areas means identifying and designating areas along watercourses where natural flooding is possible during high water levels without urban areas being put at risk. It involves coordination of spatial plans with the actual needs of the river ecosystem, which reduces the risk of flooding in urbanised areas downstream. The action includes obtaining data on historical floods, hydrological models and risks, as well as the drafting of spatial planning documents and designating floodplain areas. The action is based primarily on activities that must be coordinated before the adoption of the spatial plan at the municipal level and with which key stakeholders and designers, landowners and the Slovenian Water Agency must be coordinated in a timely manner.

Steps:

1. Analysing existing data on historical floods and reviewing current flood hazard and flood risk maps.
2. Identifying potential floodplain areas in cooperation with municipalities, the Slovenian Water Agency and spatial planning experts, i.e. drafting of expert bases.

3. Involving and communicating with designers and key stakeholders in a timely manner to include the areas in municipal spatial plans and regulations, i.e. Detailed municipal spatial plans for renovation, which establish the right basis for restricting or prohibiting construction in these areas. Also important is municipal prioritisation of land for the purpose of floodplains and establishing an effective financial mechanism for providing compensation or damages to owners.
4. Raising awareness among residents and landowners about floodplain areas and their importance for nature, the economy and the safety of the population.

POSITIVE OUTCOMES

- Reducing the risk of flood damage in urban areas.
- Preserving natural ecosystems along watercourses.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Possible restrictions on construction on what is currently building land, which may trigger opposition from owners.
- Need for additional funds to purchase land or adjust plans.
- Potential conflicts between different stakeholders due to changes in spatial planning.

VALIDATION/ INDICATORS – ANALYSIS

- Number of identified floodplain areas - intended use of land.
- Area of land where natural flooding is enabled, in comparison with the previous state.
- Number of updated municipal spatial plans that include floodplain areas.
- Level of awareness of local population and landowners about the importance of floodplain areas for flood safety (measured by surveys or educational workshops).

FEASIBILITY AND TIMELINE

The action is based on the following legislative and regulatory frameworks:

- **the Water Act (ZV-1)**, which defines flood areas and related restrictions and prohibits activities that increase flood risk.
- **Directive 2007/60/EC**, which stipulates that EU member states must provide a flood risk assessment and prepare flood hazard maps and flood risk maps and assess activities that have the effect of increasing flood risks. Based on these maps, flood risk management plans are created, which must also take into account, among other things, areas where flood water, such as natural floodplains, could be retained.
- **the Spatial Management Act (ZUreP-3)**, which stipulates that in regulated areas, which include flood areas, no new development projects shall be planned that could cause natural or other disasters or increase the exposure of space to risks. It also enables the adoption of a Detailed municipal spatial plan (DMSP) for the elimination of the consequences of a natural disaster (for reconstruction), by which the intended use of space and spatial implementing conditions specified with the Municipal spatial plan (MSP) can also be changed.

Despite the action having a clear legal basis, its implementation is associated with lengthy procedures, such as the drafting of expert bases and amendments to spatial planning documents (MSP, DMSP), and coordination with landowners and local communities.

Time frame	Until the adoption of the Municipal spatial plan in municipalities
Financing and responsible persons	State and municipal funds EU funds for climate resilience
Participants	Responsible entities: the Ministry of the Environment, Climate and Energy (MOPE) and the Slovenian Water Agency (DRSV) in cooperation with municipalities (Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri). Professional support: spatial planners, protection and rescue services, hydrologists

LINKS AND DOCUMENTS

- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the Flood Risks Assessment and Management. https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32007L0060
- Spatial Management Act. https://pisrs.si/pregledPredpisa?id=ZAKO8249
- Water Act. https://pisrs.si/pregledPredpisa?id=ZAKO1244

A4 (FLOODS) – Establishment of torrent-control wooden check dams

GAP THE ACTION ADDRESSES

The action addresses the challenge of the torrential nature of the Sora Catchment, where many small tributaries quickly swell and flood, and can also quickly become clogged with wood debris from forests. Wooden check dams are constructed on small torrents, where extreme discharge rates are not expected, but where it is still necessary to calm the flow, stop landslide material and protect lower-lying areas.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention.
- **Type of Action**: related to permanent and systematic regulation of watercourses, improvement of the condition of watercourses.
- **Levels of Action**: local, regional
- **Ownership**: Municipalities (Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri), the Slovenia Forest Service – unit Kranj, forest owners, the Slovenian Water Agency (DRSV), the Ministry of the Environment, Climate and Energy (MOPE).
- **Target Groups**: local population (especially along watercourses, owners of land along watercourses), spatial planners, water managers, foresters, forest owners.
- **Priority**: 4
- **Connections**: A2 (FLOODS) – Incorporating information into updated hazard assessments and protection and rescue plans.

DESCRIPTION OF THE ACTION

Torrent wooden check dams are simple hydrotechnical wooden structures placed in the beds of small torrents, especially in mountainous and forested areas. Their main purpose is to reduce the erosive power of water, retain floating debris (branches, logs, rocks) and stabilise the bed in sections where there is a risk of banks collapsing or excessive bottom erosion.

Crib walls are usually made of solid wooden logs connected in the form of a rectangular frame ("box"), which is dug into the bed and often filled with coarse aggregate. Wood (chestnut, oak, robinia or larch) is a natural, affordable and environmentally friendly material that blends well with the landscape. If a crib wall is built from logs of the above-listed tree species of appropriate thickness (30 cm), it can last 50 to 100 years.

Crib walls are constructed on small torrents, where extreme discharge rates are not expected, but where it is still necessary to calm the flow, stop landslide material and protect lower-lying areas. They are part of systemic measures to regulate torrents, in addition to small thresholds, barriers and retention ponds. They can also be used on forest roads and for stabilising erodible terrain.

The advantages of wooden crib walls are:

- natural appearance and ecological acceptability,
- simple construction from local material,
- prevention of vertical and lateral erosion,
- good adaptation to small beds,
- possibility of gradual decomposition without lasting environmental impact.

Type of torrent	Responsible for installation/maintenance	Notes
Large watercourse (state)	Slovenian Water Agency (DRSV)	part of regular water management
Small torrent in the forest	Forest Service / forest owner	protective function of the forest
Torrent in a municipality / settlement	Municipality / utility company	local flood control measures

Steps:

1. Analysis of individual torrential tributaries and inspecting the area for the potential installation of wooden check dams.
2. Establishing cooperation between the Slovenia Forest Service and municipalities, and if necessary, the Slovenian Water Agency, to ensure adequate financial resources.
3. Designating priority areas for the installation of crib walls.
4. Construction and installation of crib walls:
    - procurement and delivery of suitable material (wood of appropriate species and thickness, aggregate),
    - machinery work: excavating the foundation for the crib wall with an excavator,
    - assembly of wooden elements of the crib wall, binding them with iron rods,
    - filling the crib wall with suitable material (rocks, aggregate).
5. Determining who will manage and maintain the crib walls.
6. Presenting the story of wooden check dams (Carniolan walls), which are the historical heritage of the Gorenjska region, primarily by educating the public, landowners, and especially contractors (machinery operators) so that they can learn how to properly construct them.

POSITIVE OUTCOMES

- Natural appearance and ecological acceptability.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- A weakness of crib walls is their limited lifespan – if the crib wall is built with pine or another unsuitable tree species, the wood will rot over time in constant contact with water, so premature replacement of the structure becomes necessary.

VALIDATION/ INDICATORS – ANALYSIS

- Number of crib walls installed.
- Number of crib walls maintained or repaired.

FEASIBILITY AND TIMELINE

The action is based on the following legislative and regulatory frameworks:

- *the Water Act (ZV-1, Official Gazette of the Republic of Slovenia [Uradni list RS], No. 67/02 and amendments)* stipulates that water management is in the public interest, defines the maintenance of water infrastructure and facilities for protection against the

harmful effects of waters, regulates the issuance of **water approvals** and **water permits** for the construction of facilities in and along watercourses, and defines the responsibility of the **Slovenian Water Agency** for the implementation of measures.

- *the Forest Act (ZG, Official Gazette of the Republic of Slovenia , No. 30/93 and amendments)* defines measures for the **protection of forests against erosion and landslides**, enables the **construction of small wooden structures** (e.g. crib walls, thresholds, gates) as part of **forest management plans**, and defines the participation of the **Slovenia Forest Service** in the planning and implementation of these measures.
- *the Protection Against Natural and Other Disasters Act (ZVNDN, Official Gazette of the Republic of Slovenia, No. 51/06 and amendments)* defines preventive measures to **reduce the risk** of flooding and torrential waters; determines the responsibility of municipalities and the state in **maintaining and implementing protective structures**.
- *the Decree on the conditions and method of water management and on the implementation of the public water management service (Official Gazette of the Republic of Slovenia, No. 92/08 and amendments)* determines the **technical and procedural conditions** for designing and constructing water management facilities, and also includes **small flood control structures**, such as **wooden crib walls, thresholds and retention ponds**.
- *the Decree on water protection areas (Official Gazette of the Republic of Slovenia, No. 64/04 and amendments*) determines the restrictions and conditions for construction in areas where there is a risk of groundwater and surface water pollution.
- *the Rules on the methodology for determining flood and torrential water risk areas (Official Gazette of the Republic of Slovenia, No. 60/07)* are used for planning **preventive measures** and siting crib walls in accordance with hydrological and geomorphological analyses.
- The Slovenian Forestry Institute (2022). *Professional starting points and guidelines for forest management in torrential areas (CRP V4-2212)*. Available at: https://www.gozdis.si/projekti/strokovna-izhodisca-ter-smernice-za-gospodarjenje-z-gozdovi-na-hudourniskih-obmocjih-crp-v4-2212/

Time frame	2026
Financing and responsible persons	State and municipal funds EU funds for climate resilience
Participants	Responsible entities: Slovenia Forest Service (ZGS) and Slovenian Water Agency (DRSV) in cooperation with municipalities (Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri). Professional support: district foresters, forest owners, hydrologists.

LINKS AND DOCUMENTS

- Catalogue of technical solutions for forest torrential areas. https://www.gozdis.si/f/docs/aktivni-projekti/kon_Porocilo-3.3---Katalog-tehnicnih-resitev.pdf
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the Flood Risks Assessment and Management. https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32007L0060
- PUH – Podjetje za urejanje hudournikov d. d. https://eionet.arso.gov.si/media/967
- Spatial Management Act. https://pisrs.si/pregledPredpisa?id=ZAKO8249
- Water Act. https://pisrs.si/pregledPredpisa?id=ZAKO1244

A5 (DROUGHTS) – Development of concept for tasks and inter-institutional cooperation at the local level before/during/after drought events

GAP THE ACTION ADDRESSES

- In Slovenia there is no umbrella legally binding document, i.e., drought protocol, which would encompass all phases of management (prevention, preparedness, response and recovery) and all sectors with a clear definition of the necessary measures in individual phases of management and clear criteria for when a certain measure begins to be implemented. The responsible institutions that implement these measures are not specified, and cooperation between institutions is also limited. As a result, a procedure flowchart is not defined at the local level. Current national legislation only covers the period when damage due to drought has already occurred and when the drought is declared a natural disaster (when the damage exceeds 0.3 ‰ of the planned state budget revenue for the year in question). This is when the damage inventory begins in accordance with established protocol, which then results in financial compensation for damages to the injured parties.
- In the period before and during a drought event, various sectors or institutions operating at the local level are already carrying out a series of activities with the aim of preventing damage and improving preparedness (some formal activities that are "put into law" by municipal ordinances, e.g. water supply, and other informal activities, which are not completely interconnected).
- Considering the trends of increasingly frequent and severe droughts combined with increasingly frequent or longer-lasting heat waves, there is a greater likelihood of conflicting water needs in the future at the time of the event (drinking water supply and irrigation water use, ensuring the biological minimum and the operation of small hydro power plants). Therefore, for more effective communication, it is important to establish a connection between all those involved in advance, albeit informally, which can be based on defining procedures and tasks and cooperation at the local level.

FRAME THE ACTION

- **Risk Cycle Phase**: the existence of the scheme covers the prevention/preparedness phase, otherwise the scheme covers all phases and ensures coordinated action of institutions in different sectors in the event of drought conditions, i.e. awareness of the actions of other sectors and easier addressing of potential conflicting interests in the event of water shortage.
- **Type of Action**: the specific action is tied to procedures that will not be put into law, but will contribute to better communication and awareness of individual institutions regarding the responsibility of implementing individual activities (part of these are already being implemented, but they are not clearly specified as being part of drought management) and to improving communication between institutions.
- **Levels of Action**: local level, area of four municipalities, i.e. the Sora catchment.
- **Ownership**: the draft scheme was prepared in the frame of the X-RISK-CC project (RAS and ARSO), which will be reviewed, amended and coordinated by all institutions involved.

- **Target Groups**: institutions involved in drought management, municipalities, citizens, companies, farmers.
- **Priority**: 4; partly already in progress.
- **Connections**: A6 (DROUGHTS) - Improving drought monitoring; A8 (DROUGHTS) – Informing the public at the municipal level, A9 (FLOODS AND DROUGHTS) – Communication activities for better preparedness for extreme weather and hydrological events in the Sora Catchment

DESCRIPTION OF THE ACTION

The action defines the existing and planned activities taking into account climate projections of various organisations and sectors before, during and after a drought event (also combined with heat), and schematically shows their operations with tasks and responsibilities in all phases of drought management and the communication flows between them. The objective of the action is a clearly defined procedure flowchart and clear communication between institutions to achieve more effective and proactive drought management and adaptation to changed conditions.

Steps:

1. All stakeholders, i.e., organisations operating before, during and after a drought or heat event are identified and their tasks (which they currently perform) are defined. It is also sensible to specify the representatives of the organisations that will participate in the action.
2. Activities/tasks that are not currently being implemented but would be necessary taking into account the trends in the incidence and severity of drought events in the area, and the organisations that would carry out these tasks in the future, are also specified.
3. Communication between institutions is defined in all phases of management (who, with whom, when, in what manner - communication channels).
4. The findings are schematically shown, i.e., concept of tasks and cooperation in the event of drought is prepared at the local level.
5. The scheme is available to everyone at the designated location.
6. The concept of tasks and cooperation in the event of drought is tested with all institutions involved (working meeting). In doing so, a recent drought and an extraordinary event that takes into account trends and scenarios for the future (climate storyline) are taken as an example.
7. The concept of tasks and cooperation in the event of drought is a living document that is updated based on newly acquired knowledge and experience. Proposal: annual working meetings of representatives of institutions and, if necessary, updating the document.
   Organiser of annual meetings: municipal commissions involved in damage assessment in cooperation with the Chamber of Agriculture and Forestry of Slovenia - Regional Unit Kranj (KGZ Kranj).

POSITIVE OUTCOMES

- Clearly defined drought management tasks at the local level. Coordinated inter-sectoral and inter-organisational cooperation in the event of an emergency (clear guidelines on who, what and when).
- Knowledge transfer between institutions.

- Better preparedness and more effective response in the event of drought.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Additional task for municipalities and other representatives of organisations (staff).

VALIDATION/ INDICATORS – ANALYSIS

- A shared document defining tasks and cooperation between institutions at the local level in the event of drought in all phases of management and in cooperation with stakeholders (example in Table 2).
- Organising a working meeting once a year with representatives of sectors and organisations, and updating procedures, tasks and the course of cooperation.

The concept of tasks and cooperation before/during/after drought in the Sora Catchment (agricultural and hydrological drought and related events)

BEFORE		DURING			AFTER
Prevention	**Preparedness**	**Response**	**Response**	**Response**	**Recovery**

Slovenian Environment Agency
• monitoring and alerts (Sušomer, weather forecast)
• Forecast that includes potential impacts
• ARSO issues heat alerts in cooperation with NUZ
		National commission for drought
		ARSO, URSZR, MKGP, KGZS, ...
		• Declaring drought as a natural disaster
		  • agricultural sector included so far
		  • other potentially affected sectors
		CPDRA
		• Responsible for damage assessment and the entire Ajda system and data
					MKGP, MOPE
					• Drafting a damage repair programme
					Agency for Agricultural Markets and Rural Development
					• Allocation of damage repair funds

Municipalities of Škofja Loka, Gorenja Vas - Poljane, Žiri, Železniki • Established communication channels • Agricultural land irrigation options **Communication:** • Communicating all alerts, restrictions to residents • Issuance of heat alerts • Companies – worker protection		**Municipalities of Škofja Loka, Gorenja Vas - Poljane, Žiri, Železniki** • Participating in the inventory of damage in agriculture (entry into the Ajda system)			
Sector - agriculture: KGZ Kranj • Monitoring the situation on the ground • Real-time reporting of consequences to ARSO **Communication:** • Advising farmers on the ground (technological recommendations) • Activities related to animal protection		**Civil Protection** • Delivery of drinking water			
Sector - forestry: Slovenia Forest Service – Unit Kranj • Taking action in state forests **Communication:** • Advisory service for forest owners		**KGZ Kranj** • Participating in the inventory of damage			
Sector - water supply: Water supply concessionaires • Monitoring the availability of resources for drinking water • Real-time reporting of consequences to ARSO **Communication:** • Notifying residents and companies of restrictions on water use and quality					
Sector – energy - small hydro power plants: DRSV (Upper Sava area sector) • Issuing water permits to owners of small hydro power plants, restricting extraction of water from the river • Monitoring during low discharge rates					
Sector – ecosystems, fisheries: Institute for Nature Conservation – Unit Ljubljana and Bled (Jelovica), **fishing assisiations** • Monitoring the state of natural ecosystems					

Separately defining regular communication between institutions

+ Periodic/annual meetings of all professional services involved with the aim of sharing experiences and knowledge, increasing the efficiency of procedures and updating the Concept of Tasks and Cooperation

Organiser: municipalities in cooperation with KGZ Kranj

Legend:

National level | Local level | External communication of the institution with stakeholders | XX– activity is not currently implemented

TABLE 2: *Concept of local service operation before/during/after droughts in the Sora Catchment (agricultural and hydrological drought and related events).*

The table is visible by zooming in

FEASIBILITY AND TIMELINE

The proposal for Action A5 was prepared as part of X-RISK-CC, while the implementation itself depends on the municipal services in the Sora Catchment.

Time frame	A working meeting and updating of the document once a year
Financing and responsible persons	Implementation requires primarily human resources. Organisers of working meetings and updating of the document: municipal commissions of the municipalities of Škofja Loka, Žiri, Gorenja Vas - Poljane, Železniki (together or alternating) in cooperation with KGZ Kranj
Participants	Representatives of sectors, organisations involved in drought management at local level; national level representatives are invited if necessary

A6 (DROUGHTS) – Improving drought monitoring

GAP THE ACTION ADDRESSES

- ARSO uses the Sušomer (Droughtmeter) tool to inform residents about drought conditions in 15 regions of Slovenia and prepares a forecast for the next 7 days. The situation is published on the ARSO website and updated every Thursday afternoon. Sušomer includes information about drought conditions in the surface soil layer, in watercourses and in aquifers.
- Representatives of various organisations that need information about drought conditions for their work have expressed the need for more spatially accurate information (not only at the regional level) and for a forecast that takes into account possible impacts on various sectors, especially in agriculture.
- A forecast that takes into account possible impacts is linked to real-time data on the consequences of drought in various sectors, which are not systematically collected in Slovenia at the national or local level, except when drought is declared a natural disaster. The basis for establishing a forecast that takes into account impacts is in the initial phase of obtaining data on the consequences of drought in different sectors.

FRAME THE ACTION

- **Risk Cycle Phase**: preparedness – more spatially accurate information and forecasting of impacts enables more effectively adaptation of preventive and preparatory activities on the ground to actual conditions (better support of the operation of advisory services with monitoring and forecasting).
- **Type of Action**: more precise information and knowledge about drought conditions.
- **Levels of Action**: more spatially accurate information will be implemented at the national level; the establishment of a forecast that takes into account the impacts could start with a test collection of data on the consequences of drought at the local level, in the Sora catchment (an area of four municipalities).
- **Ownership**: As the national meteorological and hydrological service, ARSO is in charge of drought monitoring and its possible improvements based on the needs of professional services and the public. ARSO can establish/develop improved spatial information, while in order to establish a forecast that takes into account impacts, data on the consequences of drought needs to be collected in different sectors, which requires the cooperation of sectors/services operating at the local level.
- **Target Groups**: professional and advisory services, municipalities, citizens, companies, farmers, decision-makers at local/regional level
- **Priority**: 3; partly already under way as part of the project
- **Connections**: A5 (DROUGHTS) – Development of concept for tasks and inter-institutional cooperation at the local level before/during/after drought events (related to reporting real-time data on the consequences of drought).

DESCRIPTION OF THE ACTION

The action consists of two parts related to monitoring drought conditions. In one part, a more accurate spatial representation of drought conditions is established as part of the Sušomer tool

(inclusion of information on water balance conditions by points/stations within regions), which is in the domain of ARSO, and a forecast of drought conditions that takes into account possible impacts is established in the other. The latter could in principle be developed at ARSO, but this requires accurate data on the consequences of drought in different sectors, including for different drought intensities. To establish this, it is first necessary to establish real-time collection of data on the consequences of drought by sector and the flow of this data towards monitoring by ARSO. This step can be tested in a smaller area in the Sora Catchment, with the participation of services such as the agricultural advisory service, water supply company, etc., which operate at the local level.

Steps:

1. Preparing a more accurate spatial representation of drought conditions in the Sušomer tool (ARSO).
2. Establishing near real-time collection of data on the consequences of drought to enable the possibility of subsequent forecasting of impacts.
    - Identifying organisations that have information on the consequences of drought in various sectors – agriculture, water supply, forestry, etc.
    - Agreements on the collection and type of data on the consequences that is to be collected, and on the method of data flow between organisations that have access to information on the consequences and ARSO, which is in charge of monitoring drought conditions.
    - Test establishment of collection and transfer of data on the consequences, starting in the agriculture and water supply sectors.
3. Real-time analysis/comparison of drought indices with field data.
4. At a later stage, developing a forecast that takes into account the impacts with the participation of all sectors and organisations involved.

POSITIVE OUTCOMES

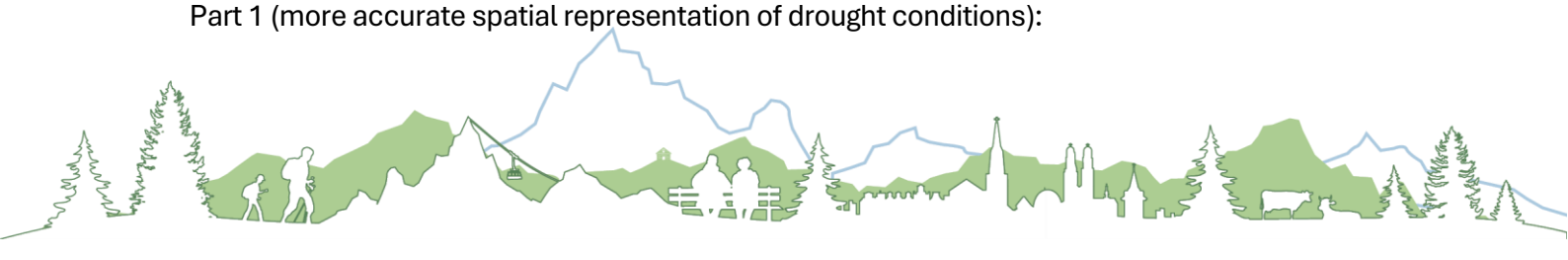
- Collections of systematically collected data on the consequences can enable further analyses and development of forecasts of drought impacts, which would enable better preparedness and more effective action in the event of drought and consequently reduce negative impacts, such as loss of income in agriculture and other water-dependent activities.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- The consequences of drought in different sectors are tied to many factors that do not depend only on meteorological/hydrological conditions, so there is a possibility of a forecast of impacts being underestimated or overestimated.
- In addition, establishing a data collection and reporting system can be an additional administrative and human resource burden for the organisations that provide the data, especially when it comes to real-time reporting or obtaining new data from the field.

VALIDATION/ INDICATORS – ANALYSIS

Part 1 (more accurate spatial representation of drought conditions):



- A more accurate spatial representation of drought conditions as part of the Sušomer tool - inclusion of information on water balance conditions by points/stations within regions.

Part 2 (forecast that takes into account the impacts):

- Agreements on the continuous collection and transfer of data on the consequences of drought.
- Number of data transfers by different sectors (number depends on agreement on reporting frequency).
- Results of an analysis of the comparison of drought indices with data on the consequences of drought and their correlation.
- Establishing a forecast that takes into account the impacts by sector.

FEASIBILITY AND TIMELINE

The stakeholders expressed the need for a more accurate spatial representation of drought conditions, which is in the domain of ARSO, and it is planned to be implemented.

ARSO and RAS can organise meetings with relevant organisations to establish the collection and transfer of data on the consequences of drought in various sectors. Implementation depends on the willingness of individual sectors/organisations to participate in this process, which would constitute a regular obligation. Given the expressed need for this information, a positive response is expected.

A forecast of drought conditions that takes into account possible impacts – real-time collection of data on the consequences of drought:

Time frame	In the year 2026: making agreements with different sectors on the real-time collection of data on the consequences of drought and on the possibility of ARSO accessing the data.
Financing and responsible persons/participants	implementation requires primarily human resources ARSO and RAS organise meetings with relevant organisations as the initial phase in establishing the collection and transfer of data on the consequences of drought in various sectors. Organisations that could potentially have data on the consequences of drought on the ground: • Agriculture and forestry: KGZ Kranj – agricultural advisers, the Kranj unit of the Slovenia Forest Service - district foresters (drought reporters) • Water supply: Komunala Škofja Loka, Jeko-IN (Železniki), public utility unit (Gorenja Vas - Poljane and Žiri) • Other: e.g. the Fisheries Research Institute of Slovenia, small hydro power plants (data on reduced production due to low discharge rates), the Institute for Nature Conservation (ZRSVN) (impacts on habitats), etc.

Real-time data on drought impacts will enable further analyses, i.e., comparison between drought indices and actual consequences in space, and the development of forecasts that take into account possible impacts. This is a long-term task of ARSO, under the assumption that all necessary data will be available.

LINKS AND DOCUMENTS

- Slovenian Environment Agency (ARSO). Sušomer (Droughtmeter). https://meteo.arso.gov.si/uploads/probase/www/agromet/bulletin/drought/sl/
- Federal Office of Meteorology and Climatology MeteoSwiss. Hazard maps – drought (current state and warnings per sectors). https://www.meteoswiss.admin.ch/services-and-publications/applications/hazards.html#tab=natural-hazards-map&hazards-tab=drought

A7 (DROUGHTS) – Implementation of irrigation systems and water retention structures

GAP THE ACTION ADDRESSES

- Given the trend of increasingly frequent and intense droughts, irrigation is an effective measure to ensure crop yields. On the basis of the *Plan for the development of irrigation and the use of irrigation water in agriculture in the Republic of Slovenia until 2023 and the programme of measures for the implementation of the Plan for the development of irrigation and the use of irrigation water in agriculture in the Republic of Slovenia until 2023*, one large irrigation system, Godešič – Reteče, is currently proposed for the area of the Sora Catchment. It is expected to cover 100 ha of land (MKGP, 2017) but has not yet been implemented. The project to prepare and build an irrigation system is in itself quite lengthy and complex, usually lasting several years, as it requires that many permits and approvals be obtained from various operators and users of space, and first of all, the owners of agricultural land must be interested in building the system, and should work on the municipality also showing interest in irrigation. Water permit records show that there are a few irrigation permits for the area, which implies a potential for expansion of irrigation systems (Table 3). In the long term, the availability of water resources should be explored, considering climate change scenarios, and the possibilities of enriching water resources by water retention should be considered.

Municipality	Water resource	No. of irrigation permits	Note - quantities	Additional number of permits for abstraction from the public water supply system for irrigation, process water, swimming pools and other uses
Škofja Loka	Watercourse	2	- up to 110	19
	Borehole/Well	2	- up to 2,000 m^3/year, - up to 140 m^3/year	
Železniki	Watercourse	1	- up to 60 m^3/year	1
Žiri	Watercourse	1	- up to 3,150 m^3/year	0
Gorenja Vas - Poljane		0		

TABLE 3: *Number of water permits for irrigation in the Sora Catchment, situation on 4 July 2025, Source: Environmental Atlas*

- A study that would deal with the possibilities of irrigation and water retention in the area of the Sora Catchment and enable systematic consideration of the possibility of introduction from the aspect of the availability of water resources, space and the interest among farmers and residents has not yet been carried out.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention/preparedness – planning to ensure enough water for food production during drought conditions, including extreme ones.

- **Type of Action**: the action is tied to obtaining data and knowledge (research) that serves as support for determining the extent of the availability of water resources and space enables irrigation and water retention in the area, and the interest among potential users.
- **Levels of Action** level: local level, the area of four municipalities or the Sora Catchment.
- **Ownership**:
  - municipalities can conduct the research themselves in cooperation with institutions that have the required information, or commission it from an external contractor (depending on their capacities),
  - institutions that are the source of data/information: municipal spatial planning departments, water supply companies, the Slovenian Water Agency (overview of available water quantities); KGZ Kranj (agricultural advisory service), the Regional Irrigation Group and the Farmland and Forest Fund of the Republic of Slovenia; and other institutions identified in the process of preparing the research.
  - target groups (below) - participation in determining interest.
- **Target Groups***:* agricultural companies, farmers, residents – gardeners.
- **Priority***:* 4
- **Connections***:* A5 (DROUGHTS) – Development of concept for tasks and inter-institutional cooperation at the local level before/during/after drought events (related to the cooperation of institutions in establishing and operating irrigation/retention systems).

DESCRIPTION OF THE ACTION

The action explores potential opportunities for a more intensive introduction of irrigation and irrigation systems and for retaining excess water by a) determining interest among agricultural companies, farmers and residents and b) researching the availability of water resources for irrigation, c) the possibilities for water retention and d) the availability of space in the municipality for this type of infrastructure, also taking into account the private land of interested parties. The objective of the research is to obtain information that will support decision-making regarding the planning and systematic introduction of measures that enable greater resilience of the area to future droughts.

Steps:

1. Exploring interest in irrigation and water retention in the target group (survey, meeting, etc.); educational material with basic information about irrigation and retention systems (including small, private ones) should also be prepared in order to obtain a more comprehensive response. Result: information on how many people would be part of a larger system, who is considering an individual system both regarding irrigation and water retention.
2. Overview of good practices in irrigation and water retention in Slovenia and Europe.
3. Research – assessment of available water resources for irrigation in the Sora Catchment.
4. Research – possibilities of retention of water, including flood water, in the Sora Catchment for different types of retention ponds (depending on the water resource, larger/smaller, public/private) and examining the possibilities for revitalising abandoned retention ponds.
5. Research – possibilities of siting of large irrigation and water retention systems in the Catchment (depending on the preliminary results of points 2 - 4).

6. Based on the results, drafting a plan for potential irrigation and water retention at the municipal/ catchment level, also taking into account the impact on the landscape and habitats.

POSITIVE OUTCOMES

- The possibility of strategic decision-making on the introduction of irrigation systems and retention ponds based on expert bases with respect to real needs and feasibility.
- In combination with other agro-technical measures in the event of the introduction irrigation and water retention, greater resilience to agricultural drought and more reliable food production.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- In the event of the majority interest in introducing irrigation and/or water retention systems and positive results of research regarding the feasibility of implementation, there is a likelihood of opposition from, for example, certain owners of specific plots of land, which may result in conflict in the local environment.
- Based on previous experience, there are potential problems after these systems are introduced (in the long term), such as: management problems - poor utilisation, poor organisation of users regarding schedules, maintenance, system insurance as well as the likelihood of unprofessional – incorrect irrigation (Černe, 2017) and, due to the above, potentially high operating and maintenance costs.

VALIDATION/ INDICATORS – ANALYSIS

- **Results of a survey** that shows interest in irrigation and water retention among residents, farmers, agricultural companies.
- **Conducted research**.
- **Drafting of an irrigation and water retention plan** in the event of positive research results in the sense that there is interest in introducing the selected systems.

FEASIBILITY AND TIMELINE

Recommendation: RAS and ARSO can help establish a project mandate for the area of the Sora Catchment. The implementation of the action as a whole depends on the municipality's interest in managing the action and the response of the local community/residents to the inquiry about interest, and on the interest in introducing irrigation and retention systems.

If the municipality decides to set up an irrigation system, it is highly recommended that a person responsible for the implementation of the project be appointed, as it can be quite demanding and time-consuming to prepare the project because approvals and permits need to be obtained.

Time frame	approx. 1 year to prepare the study
Financing and responsible persons	Municipalities in cooperation with KGZ Kranj and the Regional Irrigation Group
Participants	- target groups (agricultural companies, farmers, residents – gardeners) - representatives of sectors, organisations involved in drought management at local level; if necessary, representatives of the national level

	- research institutions dealing with the topic of irrigation and water retention in agriculture - institutions participating in the Life4Adapt project, the Slovenian Rural Development Network, the Sorško Polje Association, Centre for Sustainable Rural Development Kranj, LAS Škofja Loka - the Sora Development Agency, LAS Gorenjska Košarica - BSC Kranj

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- The Studio at 17.00 radio show, 3 July 2025, Drought is already causing damage, why there is not more irrigation? (a talk with Maša Žagar, the State Secretary at the Ministry of Agriculture, Forestry and Food; Marina Pintar, the Dean of the Biotechnical Faculty of the University of Ljubljana; Andreja Sušnik, an agrometeorologist at ARSO and head of the Drought Management Centre for Southeastern Europe; and Marko Černe, an irrigation specialist at the Ptuj Agriculture and Forestry Institute. URL: https://prvi.rtvslo.si/podkast/studio-ob-1700/87/175143957

A8 (DROUGHTS) – Informing the public at the municipal level

GAP THE ACTION ADDRESSES

- In the area of the catchment, communication protocols apply regarding keeping the public informed in the event of a shortage of drinking water, i.e., restrictions (water supply companies/municipalities) or, in the event that drinking water delivery is needed, when citizens contact the Civil Protection. Clear protocols are in place for most natural disasters, including wildfires, for which a rapid response is required. In the event of drought that is developing quite slowly, there is currently no officially adopted protocol for informing, i.e. notifying the public, about drought conditions and heat in the local environment and possible measures to mitigate the consequences.
- Services operating in drought management in the local environment are mostly not connected (agriculture, forestry, water supply), i.e., they operate independently, which limits coordinated public information.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention/preparedness – establishing clear public information procedures (what, where, when).
- **Type of Action**: data and knowledge – information about events such as drought conditions, heat or fires, and potential measures and prohibitions is provided to residents and services operating at the local level through "established channels".
- **Levels of Action**: local level, area of four municipalities, i.e. the Sora Catchment.
- **Ownership**: municipalities in cooperation with institutions responsible for monitoring/warning at the national/regional level - ARSO (drought conditions, heat), the National Institute of Public Health (NIJZ) (heat, human health), the Kranj Agriculture Institute (measures in agriculture, animal health), Slovenia Forest Service - Regional Unit Kranj (measures in forests, fire risk), Administration for Civil Protection and Disaster Relief (URSZR) (fire risk), water supply companies (restrictions, ban on the use of drinking water), Radio Sora, etc.
- **Target Groups**: Institutions, residents, farmers, companies.
- **Priority**: 3
- **Connections**: related to communication activities in connection with other extreme weather/hydrological events (A9).

DESCRIPTION OF THE ACTION

The action establishes a plan of communication on extreme weather conditions such as drought and related content (heat, fire risk) at the municipal level and its implementation with the aim of better awareness and informing of residents and companies so that they can take appropriate action and thereby reduce, i.e., eliminate, the possible consequences of such events.

Steps:

1. **Define information "channels"**, i.e., established **at the municipal level**. Possible proposals, depending on accessibility: websites of municipalities; screen(s) in a public place commonly frequented by people; local radio station (Radio Sora); social networks, etc.

2. **Determine the content that you would like to convey to residents through selected communication channels** and prepare links to information: e.g. drought conditions (the Sušomer tool), heat (weather forecast by ARSO and warnings by NIJZ), fire risk, restrictions on water supply, prohibition of open-air fires and other relevant topical information, measures prepared by various professional services (e.g., agricultural advisory service, ...)
3. **Prepare a municipal plan for communication on drought and related content** that defines the channels and content (who prepares it, the planned period/time when certain content is communicated).
4. **Implement** the communication plan in the municipalities of the Sora Catchment.

POSITIVE OUTCOMES

- People start to become aware of the severity of drought and its impact and are more likely to adopt water-saving measures.
- Better awareness and informing of residents consequently lead to more measures taken to prevent, i.e., reduce, the consequences (less damage to the economy, better preparedness of vulnerable groups).
- Encouraging cooperation and long-term adaptation of local services and residents to extreme drought events and heat waves.
- Increased trust in local authorities.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Trust can be lower if information is inadequate - if information is not accurate or provided in a timely manner, i.e. people do not take the situation seriously if information is provided too frequently.
- The possibility of spreading misinformation that can cause panic, uncertainty, and consequently excessive hoarding of bottled water.
- There is also the possibility of opposition to action if the recommendations are perceived as excessive or pointless.
- Information does not reach all residents, for example, older people who do not use the internet or social media may remain less informed.
- Negative impact on tourism.
- Costs associated with establishing and maintaining communication channels (screens, applications, regular updating of websites).

VALIDATION/ INDICATORS – ANALYSIS

- A prepared municipal communication plan regarding communication on drought and related topics.
- Notifications on drought and related content on agreed communication channels.
- Monitoring the reach of notifications (number of website views, followers on social networks).

FEASIBILITY AND TIMELINE

The design of the communication plan content was initiated in the framework of the X-RISK-CC project, while municipalities define communication channels through which information would be conveyed to residents.

Since municipalities already have established websites, social media profiles, and access to local radio stations, implementing the action is not very demanding – what primarily needs to be done is to coordinate and prepare the content of the messages.

Time frame	One year
Financing and responsible persons	- In determining content for communication and links to topical content – assistance is provided by the X-RISK-CC project partners – the Sora Development Agency (RAS) and the Slovenian Environment Agency (ARSO). - Displaying topical content on selected local media: municipalities in cooperation with the media, e.g. Radio Sora, website administrators…
Participants	Institutions responsible for monitoring the situation in a specific area

LINKS AND DOCUMENTS

- Daily forest fire risk forecast with the FWI-INCA model - web application, the Slovenia Forest Service. https://www.zdravgozd.si/prognoze_zapis.aspx?idpor=41
- National Institute of Public Health of the Republic of Slovenia. https://nijz.si/

A9 (FLOODS and DROUGHTS) – Communication activities for better preparedness for extreme weather and hydrological events in the Sora Catchment

GAP THE ACTION ADDRESSES

The action addresses the lack of awareness about preparedness and self-protection during extreme weather and hydrological events such as floods and landslides, as well as droughts, heat and the associated high fire risk. Workshops with key stakeholders have shown that the public is not sufficiently informed about the preventive measures they can take during such events. Also, the optional subject of protection against natural disasters is not taught enough in primary schools. Awareness-raising is not implemented through various channels and adapted to target groups. Workshops have also shown that the public wants to repeat the “nothing must surprise us" exercises, by which both the main actors of the Civil Protection and the public are empowered for better preparedness during floods and droughts.

FRAME THE ACTION

- **Risk Cycle Phase**: prevention.
- **Type of Action**: communication and awareness raising.
- **Levels of Action**: local, regional.
- **Ownership**: the Sora Development Agency (RAS), the municipalities of Škofja Loka, Gorenja Vas - Poljane, Železniki, Žiri, Radio Sora
- **Target Groups**: general public – from children, adolescents, active population to the elderly
- **Priority**: 4, increasing awareness of greater self-protection and flood preparedness
- **Connections**: A8 (DROUGHTS) – Informing the public at the municipal level

DESCRIPTION OF THE ACTION

It is key to raise awareness among the local population about emergency preparedness (self-protection) and about possible preventive and protective measures. Public announcements regarding self-protection measures should be as short and clear as possible to achieve their purpose. Short educational videos featuring key measures to take before, during and after a flood are also recommended.

During periods when the probability of individual emergencies is highest, **awareness-raising campaigns** are carried out (“Setting up high water signs”, “Nothing must surprise us”, “Better prepared than flooded”, etc.) **and communication regarding self-protection (short videos, leaflets, brochures)**. **Awareness raising is taking place on key local channels** (local newspapers, radio, leaflet in the mailbox, social networks (FB, IG), website, etc.). Awareness-raising campaigns should include children in **extracurricular activities** (scouts, etc.), material can also be sent to schools, etc. Press and video material, which is prepared by Administration for Civil Protection and Disaster Relief (URSZR), can be adapted to the local situation by means of notifications. One of the awareness-raising campaigns is the **"Setting up high water marks"**, which the Slovenian Environment Agency (ARSO) has carried out since 2014 in cooperation

with the Hydrogeography Commission of the Union of Geographers of Slovenia. The main objective of the action is to raise awareness and educate the general public about high waters as a periodic natural phenomenon.

One of the objectives of the actions for greater awareness among residents is to **install a screen** in a public place where visitors in the waiting room can read more about individual actions (e.g., the Sušomer tool, discharge rate, water temperature, weather forecast, etc.). Communication campaigns could also address tourists, who would be made aware that they are in a flood area by being given suggestions regarding which channels they should monitor in the event of an emergency (targeted adjustments with the tourism sector is required).

Steps:

1. Overview of communication channels, target groups and the possibility of cooperation in the local environment (associations, schools, volunteer fire brigades, scouts, etc.).
2. Preparing communication packages for individual target groups (flyers, short videos, FB and IG posts, texts for publication, visualisations, etc.)
3. Overview of implementation and collaboration options, sending a call for participation.
4. Carrying out campaigns and awareness-raising and communication activities.

POSITIVE OUTCOMES

- Better preparedness of residents for emergencies.
- Lesser burden on the Civil Protection and firefighters during an emergency.
- Harm reduction and protection of human lives, better mental health.

POSSIBLE CRITICALITIES/ SIDE EFFECTS

- Through awareness-raising campaigns, people remember past flood events, which can cause unpleasant feelings, such as anxiety and being unable to control the situation.
- Campaigns are not understandable and do not achieve the right effect.

VALIDATION/ INDICATORS – ANALYSIS

- Number of followers/views of individual posts, videos.
- Number of flyers distributed and campaigns carried out.
- Number of participations at the municipal level.

FEASIBILITY AND TIMELINE

Time frame	At the time of more frequent downpours that can lead to flooding; summer with heat waves and more frequent droughts; Civil Protection Day, Natural Disaster Day, etc.
Financing and responsible persons	Municipalities, the Sora Development Agency (RAS) EU financial mechanisms the Recovery and Resilience Plan (RRP), state funds, etc.
Participants	the Sora Development Agency, Radio Sora, municipal PR services, Administration for Civil Protection and Disaster Relief (URSZR), associations, schools,

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