Deliverable Phase 1 – Climate risk assessment

CLIMAAX in Valcerrina

Italy, Unione dei Comuni della Valcerrina

Version 2.0 | May 2025

HORIZON-MISS-2021-CLIMA-02-01 - Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach

Document Information

Deliverable Title	Phase 1 – Climate risk assessment
Brief Description	Preliminary climate risk assessment for Valcerrina Union of Municipalities in Piedmont, Northern Italy.
Project name	CIVAL – CLIMAAX in Valcerrina
Country	Italy
Region/Municipality	Valcerrina Union of Municipalities – Piedmont Region
Leading Institution	Unione dei Comuni della Valcerrina (UCV)
Author(s)	• Fabio Olivero (UCV) • Enrico Lucca (TR2) • Andrea Bertolotti (UCV) • Maroussia Terrana (TR2) • Marco Bonamente (UrbyetOrbit) • Mauro Venanzi (UrbyetOrbit)
Deliverable submission date	05/09/2025
Final version delivery date	dd/mm/yyyy
Nature of the Deliverable	R – Report
Dissemination Level	PU - Public

Version	Date	Change editors	Changes
1.0	04/09/2025	Unione dei Comuni della Valcerrina	Deliverable submitted
2.0	…	CLIMAAX's FSTP team	Review completed

Table of contents

List of figures

List of tables

Abbreviations and acronyms

Abbreviation / acronym	Description
a.s.l.	Above sea level
CRA	Climate Risk Assessment
UCV	Unione dei Comuni della Valcerrina
UoM	Union of Municipalities
MCPP	Municipal Civil Protection Plan
MoU	Memorandum of Understanding
PGRA	Piano Gestione Rischio Alluvionale (Flood Risk Management Plan)
SI	Supporting Information
UAA	Utilized Agricultural Area

Executive summary

This deliverable presents the results of Phase I of the Climate Risk Assessment (CRA) for the Union of Municipalities of Valcerrina (Piedmont Region, Italy), undertaken within the framework of the CLIMAAX in Valcerrina (CIVAL) project. The analysis applied the CLIMAAX Handbook's harmonised methodology to assess three priority hazards: river floods, agricultural drought, and wildfires. The approach combined regional and global datasets with local knowledge and stakeholder input, ensuring relevance to the specific socio-economic and environmental context of Valcerrina.

The CRA responds to a gap in existing regional and national risk management frameworks, which often lack fine-scale, community-specific data on hazard, exposure and vulnerability. Valcerrina's declining and ageing population, reliance on agriculture, and increasing trend of land abandonment heighten its vulnerability to climate impacts, underscoring the need for targeted local assessments and development of adaptation pathways.

Main results of Phase I include:

- **River floods**: Risk from the Po River is concentrated in Gabiano, Moncestino, and Camino, with potential agricultural losses reaching tens of millions of euros per event. While hazard magnitude under the RCP4.5 mid-century scenario remains stable, the frequency of extreme events is uncertain.
- **Agricultural drought**: Identified as the highest-priority risk. Projected yield losses reach 56% for maize, 32% for soya beans, and 23% for wheat. Estimated annual revenue losses for the crops assessed range from €200,000 to €900,000, excluding premium crops such as vines and hazelnuts. Lack of irrigation infrastructure and limited availability of water resources in summer months significantly increase the vulnerability of the agricultural sector.
- **Wildfires**: Currently a low-to-moderate risk but projected to rise modestly under future climatic conditions due to increase in the fire season length and in the weather conditions favouring forest fires. Ecological vulnerability is highest in the Po River Natural Park.

Stakeholder engagement was a central element of Phase I, involving online surveys to explore the residents' perception of the impact of climate change and of the level of preparedness, and a stakeholder's workshop gathering over 30 participants. These activities validated the hazard prioritisation, identified data gaps, explored local priorities, and highlighted the need to expand the CRA to include hydrogeological risks (heavy rainfall and landslides).

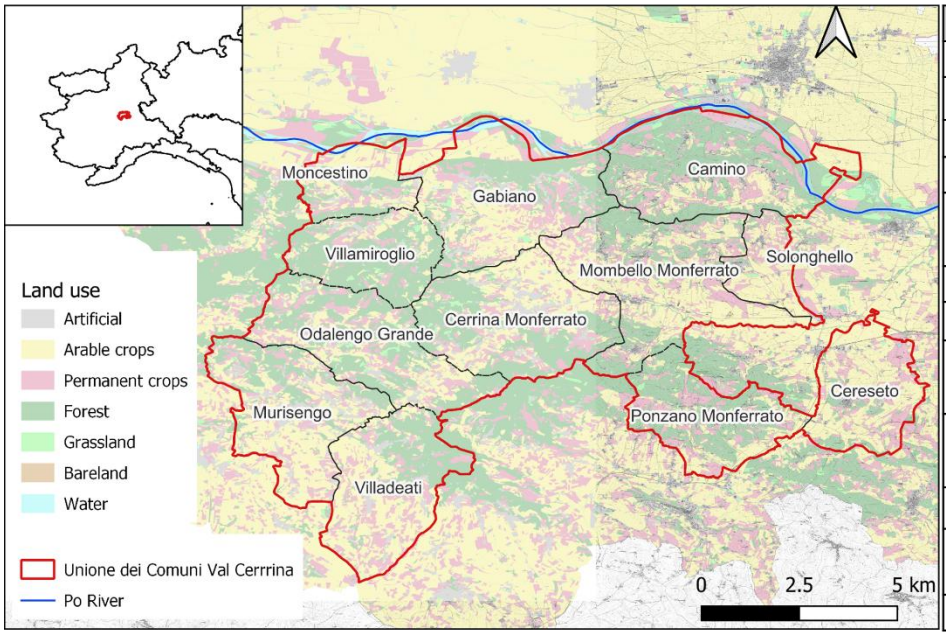
Phase I establishes a comprehensive baseline for Valcerrina's multi-risk profile, confirming drought as the most urgent hazard, floods as a persistent agricultural threat, and wildfires as an emerging but lower-priority concern. The results will inform Phase II, which will focus on refining hazard models with local data, assessing additional risks, and improving the operational integration of CRA outputs into local and regional planning.

1 Introduction

1.1 Background

L'Unione dei Comuni della Valcerrina (UCV), hereafter Valcerrina UoM, is a Union of Municipalities located in the southeastern Piedmont region, Northern Italy. It compromises 12 municipalities (Figure 1-1) for a total population of approximately 7500. The Union was first established in 2002 to strengthen cooperation among member municipalities, particularly in civil protection, social services, and the promotion of tourism, gastronomy, and cultural initiatives. Geographically, Valcerrina borders the plain of the Po River to the North and the rolling hills of Monferrato to the South, with an elevation ranging from 100 to 400 meters above sea level (a.s.l).

The area forms part of the "Langhe-Roero and Monferrato" UNESCO World Heritage site, renowned for its wine-producing landscapes, hilltop villages, castles, and farms[1]. Covering an area of around 162 km², land use in Valcerrina includes agriculture (56%), woodlands (36%), artificial surfaces (7%), and water bodies (1%), Figure 1-1. The region's clay-calcareous hills support premium crops such as vines and hazelnuts, alongside forage crops. In contrast, maize, soybeans, barley, and other cereals predominate closer to the River Po plain.



Municipality	Population
Camino	730
Cereseto	372
Cerrina	1290
Gabiano	1021
Mombello Monferrato	919
Moncestino	190
Murisengo	1269
Odalengo Grande	407
Ponzano Monferrato	328
Villadeati	461
Villamiroglio	292
Solonghello	193

Figure 1-1: Location, boundaries and land use in Valcerrina (left). The red line delineates the boundary of the Valcerrina UoM. Names of member municipalities alongside their population are provided (right) (ISTAT, 2021).

In line with trends observed in other rural regions of Piedmont, Valcerrina has undergone a significant population decline during the latter half of the 20th century, primarily due to the migration of men and youths to cities, which has led to the abandonment of cultivated land. The demographic profile is characterized by an ageing population, with approximately 25% of inhabitants over the age of 65. The local economy is largely based on agriculture and the agri-food sector, with notable emphasis on viticulture. In recent years, tourism and the hospitality sector have witnessed growth thanks to the international acclaim of the "Langhe-Roero and Monferrato" UNESCO site. Factors such as low population density, an ageing demographic, land abandonment, and strong dependence

[1] https://whc.unesco.org/en/list/1390/

on agriculture render Valcerrina susceptible to social and environmental shifts, including those resulting from climate change. Nevertheless, the community demonstrates a proactive response to these challenges and is committed to driving the socio-economic transformation needed to adapt to new social and environmental conditions. This commitment is showcased by initiatives led by the Valcerrina UoM, aimed at promoting youth involvement and training in local administration (such as the "SMART EUROPE"[2] and "Unione dei sentieri lenti"[3] projects), alongside efforts to advance digitalization across the territory (the "Seniortech: Il Digitale Per Tutti In Valcerrina" project).

1.2 Main objectives of the project

The North of Italy is positioned at the interface between two hotspots of climate change, the Alps and the Mediterranean. An analysis of climate data undertaken by the Regional Environment Protection Agency (ARPA Piemonte) for the period 1958 - 2010 indicates an increase in the maximum and minimum temperature of 2.5°C and 1.5°C, respectively, well above the global average. Precipitation shows a less homogenous signal of change, with declining summer precipitation in the plain and an increase in both summer heavy rainfall and in the duration of dry spells (Regione Piemonte , 2020). Projections for the future point to an acceleration of these trends, both in the mean climate and in the frequency and intensity of climate extremes, such as rainfall, heatwaves and droughts (Regione Piemonte, 2020).

There is thus a widespread need to adapt to a changing climate and to increase the preparedness towards future climate conditions. In this direction, the regional authority has published in 2022 the first outline of a strategy on climate change describing the methodological framework used to assess key risks and to identify sectoral measures for adaptation and mitigation. Once ready, the strategy will help integrate and align sectoral plans and programmes, including those on civil protection services, towards the climate adaptation and mitigation goals set at the national and European level. Yet, existing plans only address some of the climate risks that are relevant to the Valcerrina community and, often, do not effectively reflect the diversity and complexity found at the local scale (municipal) in terms of hazard, exposure and vulnerability. Furthermore, the measures proposed by national and regional policies may not suite the local context of Valcerrina, impairing their intended benefits. A complementary approach to climate adaptation that is driven by the local communities is therefore essential to support the socio-economic transformation needed to face an uncertain future climate. The overarching goal of the Climaxx in Valcerrina (CIVAL) project is to promote the climate resilience of the Valcerrina community through a bottom-up approach. This is achieved by working on three specific objectives:

- assessing multiple climate risks enriched with local information on hazard, exposure and vulnerability
- rising awareness of the local community on the impact of climate change
- co-develop adaptation measures with local actors

Through the implementation of the CLIMAAX Handbook the CIVAL project applies a common climate risk assessment framework to multiple hazards, guaranteeing coherence and consistency in the approaches, scenarios and datasets used across multiple risks. This is an important added value to the risk assessment studies currently available at the national and regional level, where

[2] https://www.ilmonferrato.it/articolo/qiKnNj0zOEauorh3r9r6ZA/progetto-smart-europe-consegnati-i-diplomi

[3] Progetto Formativo Core Zone Unesco

knowledge on climate risks has been developed in siloes and to different degree of details. By assessing multiple risks in an integrated matter, the CIVAL project will also provide a holistic assessment of the risk faced by Valcerrina, which may be different than the sum of the single risks (Stalhandske, et al., 2024). Finally, placing participatory processes at the heart of the climate risk assessment framework ensures that the technical analysis responds to the needs of the local community and that the solutions developed are relevant and ultimately useful for local decision-making processes.

1.3 Project team

The project is implemented through the collaboration of three main entities. The Valcerrina UoM, who coordinates the project and drives the stakeholder's involvement process, UrbyetOrbit, a geospatial service provider who supports the undertaking of the Climate Risk Assessment (CRA) and TR2, an innovative small-medium enterprise in the AI sector, who conducts environmental data analysis and support integration of technologies for CRA and monitoring.

Dr. Fabio Olivero (male), President of the Valcerrina UoM (UCV), serves as Coordinator and Community Engagement Expert. He aligns the project with local governance, fosters collaboration among the 12 municipalities and manages partner communication. Fabio leads outreach activities, through workshops, public consultations, regional-level liaison, and media campaigns. Dr. Andrea Bertolotti (male), Environment Department Manager and Coordinator Assistant supports the CRA through the collection of local data and he facilitates communication across the technical offices of the member municipalities. Technical officers from the 12 member municipalities who are responsible for civil protection services and urban planning also critically contribute to the project by steering technical analysis towards local needs and interests in terms of climate adaptation and disaster emergency response.

From UrbyetOrbit, Dr. Marco Bonamente (male), Senior GIS Analyst, integrates diverse geospatial datasets into WebGIS platform for multi-risk visualization, hazard mapping, and scenario simulations. Mauro Venanzi MBA (male), ICT Software Engineer, develops the platform's backend, ensuring robust integration, real-time data visualization, interoperability, and security.

From TR2, PhD. Eng. Enrico Lucca (male), Climate Data Analyst, implements and enrich the risk workflow, models future scenarios, and develops risk indicators, grounding assessments in scientific rigor. Dr. Maroussia Terrana (female), Data Analyst and Dissemination Manager, supports data harmonization, analysis documentation, and dissemination of results to both scientific and public audiences (e.g., press releases, social media, preparation of dissemination materials).

1.4 Outline of the document's structure

This document describes the results of the first phase of the Climate Risk Assessment (CRA) undertaken in Valcerrina and it is organized into three sections. Section 1 introduces the rationale for conducting a multi-risk assessment in Valcerrina and presents the project's objectives; Section 2 illustrates the results of the assessment performed following the CLIMAAX Framework; Section 3 draws preliminary conclusions and lays out the way forward for the second phase of the project.

2 Climate risk assessment – phase 1

2.1 Scoping

2.1.1 Objectives

The purpose of the CRA being undertaken in Valcerrina is twofold. On the one hand, it seeks to provide the Valcerrina UoM with the information and tools needed to manage climate risks in their territories. According to Italian law, municipalities must produce and regularly update the Municipal Civil Protection Plan (MCPP), a strategic plan characterizing the risks affecting the territory, outlining forecasting and prevention measures, and detailing emergency procedures. The preparation and implementation of the Plan is burdensome for the small municipalities of Valcerrina, which have limited human, financial and technical capacity. The Union of Municipality, thus, provides the institutional framework needed to foster sharing of resources and to promote an inter-municipal approach to civil protection services. By providing detailed information on climate risks at the local level, the results of the CRA will help make progress towards the preparation of an Inter-Municipal Civil Protection Plan for the entire Valcerrina and support the revision of the single Municipal Plans. As an example, Supporting Information (SI) SI-5 provides the Municipal Civil Protection Plan for Odalengo Grande, that was given to the project team to support the preliminary development of the CRA. On the other hand, the CIVAL project will provide evidence that a bottom-up approach to CRA and adaptation can complement and reinforce the operationalization of the regional strategy on climate change. The analysis undertaken at the regional scale will be validated with local assessments, providing new insights on climate adaptation strategies and constituting a role model for other communities wanting to increase their resilience towards climate change. Limitations to the achievement of the CRA's goals are found in the availability of data for performing the CRA at a spatial resolution useful for local decision making and the willingness of local actors to be actively involved in the process. The impact of such limitations is actively controlled by the core members of Valcerrina UoM (Fabio Olivero and Andre Bertolotti), who have a large network of personal and professional contacts with residents, farmers, entrepreneurs and politicians. Such network has already facilitated data collection through the administration of ad-hoc surveys, and the organization of the first stakeholders' workshop held in Gabiano on 31st July, which was participated by over 30 people.

2.1.2 Context

In Italy the assessment and management of risks fall under the civil protection sector, a complex system of tasks, roles and responsibilities assigned by the National Civil Protection Code (2021) to all levels of governance, from national to local. Until now, the assessment of natural hazards has largely relied on regional-scale studies conducted by public institutions such as ARPA Piemonte and ISPRA (Italian Institute for Environmental Protection and Research). Knowledge of those hazards that have been occurring more frequently across the Piedmont Region, such as river flooding and wildfire, is already advanced and it is reflected in the development and regular update of single-risk management plans, such as the regional Plan on Hydrological Risk (Piano di Assetto Idrogeologico) and the Forest Fires Plan (Piano Antincendio Boschivo). Other risks, instead, such as heatwaves, droughts and landslides, have not been extensively assessed yet, and even less so the impact that climate change might have on their magnitude. Furthermore, assessments targeting specific communities, such as Valcerrina, remain limited, leading to a gap in planning emergency response and in increasing the preparedness towards climate risks. According to the results of the survey developed under the framework of the CIVAL project and disseminated among the residents of

Valcerrina in July 2025, the large majority of respondents (78%) think that their municipality is either not prepared to face climate risks (41%) or show a neutral level of preparedness. Only 20% of respondents think their municipality is somewhat prepared to face climate risks. Prevention and emergency response at the municipal level is governed by the MCPP, whose development and implementation are challenged by the lack of actionable information at a localized level. This is the operational gap that the CIVAL project wants to tackle by performing a multi-risk assessment that is locally relevant for Valcerrina and that effectively supports decision making.

The main economic sector in Valcerrina is agriculture, with a strong vocation for the cultivation of tree crops such as vine and hazelnut, followed by tourism and the hospitality sector. Both sectors are affected by climate change. Farmers have already experienced firsthand the consequences of a changing climate in terms of a shift in the start and duration of the vegetative season, in the period of grape harvesting, in the spreading of plant diseases and in increasingly longer periods of water stress. Residents of Valcerrina who responded to the survey unanimously (94% of responses) report that agriculture is the sector most impacted by climate change because of increasing temperature and more frequent droughts. It is followed by the infrastructure sector (70% of respondents) which is affected by more intense and frequent hydro-geomorphological extremes such as heavy rainfall, flashfloods and landslides, causing damage to the road network, private properties and utilities. Finally, there is also concern (32% of respondents) about the impact that climate change may have on tourism and the hospitality sector through the degradation of the natural landscape (e.g. wildfires, biodiversity loss). If climate change may influence the biophysical conditions and natural capital on which these sectors rely on, trends in each sector are also affected by wider social, economic and policy factors. This is particularly relevant for the agricultural sector, whose dynamics are dictated by the complex interplay of European policies (e.g. CAP, Green Deal), the global prices of commodities (soya, maize), local market opportunities and socio-demographic trends (e.g. land abandonment, aging population). In Valcerrina all these factors are contributing to gradual changes in the cropping pattern, such as an ongoing replacement of vineyards with hazelnut trees and the uptake of olive groves.

Overall, Valcerrina is undergoing intertwined transformations in its climatic, biophysical and socio-economic conditions that need to be managed and supported by informed decision making and practices. Residents of Valcerrina think that adaptation to the changing climate should happen through technical, economic and political interventions. On a technical level, regular maintenance of road network and drainage systems is a declared top priority (74% of survey respondents) for mitigating hydro-geomorphological risks, while implementing more climate resilient agricultural practices (e.g., irrigation, drought resistant crops, rainwater harvesting) is considered critical to face the impact of more frequent droughts (56% of survey respondents). At the political level, reinforcing the municipal plans for civil protection services and investing in training and awareness rising are key to help the community face the impact of climate change.

2.1.3 Participation and risk ownership

Involving stakeholders in the CRA is pivotal to fulfilling CIVAL's goal of generating knowledge on climate risks that is both locally relevant and instrumental for informed decision-making. Accordingly, the stakeholder engagement process was initiated by Valcerrina UoM at the outset of the project, leveraging its extensive network across civil society, business, and policymakers. Initially, local stakeholders representing various sectors—government, civil society, and industry—were identified and categorized based on their level of interest in the project and their capacity to influence its outcomes (see Supporting Information SI-1, Table A). Engagement strategies tailored

to each category of stakeholders were then developed. Active engagement of key players, such as the member municipalities and the local civil protection teams, is sought through workshop and bilateral meetings to tailor the CRA analysis to the local needs and to gain feedback on the results obtained. Public authorities at higher governance level, i.e., province of Alessandria and Piedmont Region, are instead proactively consulted to create synergies with their initiatives on climate adaptation, such as the regional strategy on climate change. These stakeholders play an important role in the uptake of the project's results into regional plans and policies, and in the promotion of the CIVAL approach to other communities. Stakeholders that have high interest but medium influence over the project, such as local residents, environmental associations and farmers, are regularly informed on the results of the project and actively involved in the dissemination and awareness raising activities. Finally, actors that have low influence and interest in the project, such as the Po River Basin Authority or the National Civil Protection Department, are monitored to check for potential changes in their interest status and for identifying any potential synergy with the project.

To date, two main stakeholder engagement steps have been completed. First, an online survey was developed to assess Valcerrina residents' perceptions of climate change and related risks. Survey questions addressed the experience of past climate trends and extremes, anticipated key future risks, and perceived vulnerability and preparedness towards the impact of climate change. The survey, launched in July 2025, has garnered over 54 responses, contributing already to the development of this deliverable. SI-2 contains the complete survey results. Second, a stakeholder workshop was organized on 31st July 2025 in Gabiano, gathering over 30 participants, including residents, policymakers, farmers, and representatives of local and provincial associations. SI-3 provides the list of attendees and the materials utilized during the workshop. The event featured presentations on the project objectives and the preliminary CRA results, focusing particularly on river flooding, drought, and forest fire risks. The workshop allowed for the validation of initial findings through the experience-based knowledge of local stakeholders, for the collection of feedback on specific areas of interest, and for the identification of additional climate risks relevant to Valcerrina.

A second online survey has been developed and is currently being administered (August 2025) with the scope of collecting information from the technical offices of the member municipalities on key challenges and opportunities in the development and implementation of the MCPP.

2.2 Risk Exploration

2.2.1 Screen risks (selection of main hazards)

The screening of key climate risks in Valcerrina was informed by a profound knowledge of the territory, the results of the online survey and the insights gained during the first stakeholders' workshop on 31st July 2025. 92% of the survey's respondents state that they have experienced at least one extreme climate event in the past 20 years. The most frequent events were reported to be heavy rainfall, followed by droughts, landslides, heatwaves and flooding (Figure 2-1a). Annotated evidence of such events is also found in local news' outlets (see SI-1, Table B). Past extreme events affected both the lives of residents through damage to private properties and disruption to public infrastructure, as well as the local economy through the interruption of work and damage to commercial activities (Figure 2-1b).

Residents of Valcerrina have noted patterns in local climate, including changes in average conditions, such as temperature and precipitation, and in the frequency of extreme events (Figure 2-2). The survey results indicate that heavy rainfall, heatwaves, and droughts have become more

frequent. Increases in floods and landslides have also been recorded, though to a lesser degree, while variations in wildfire extent and frequency are not clearly apparent.

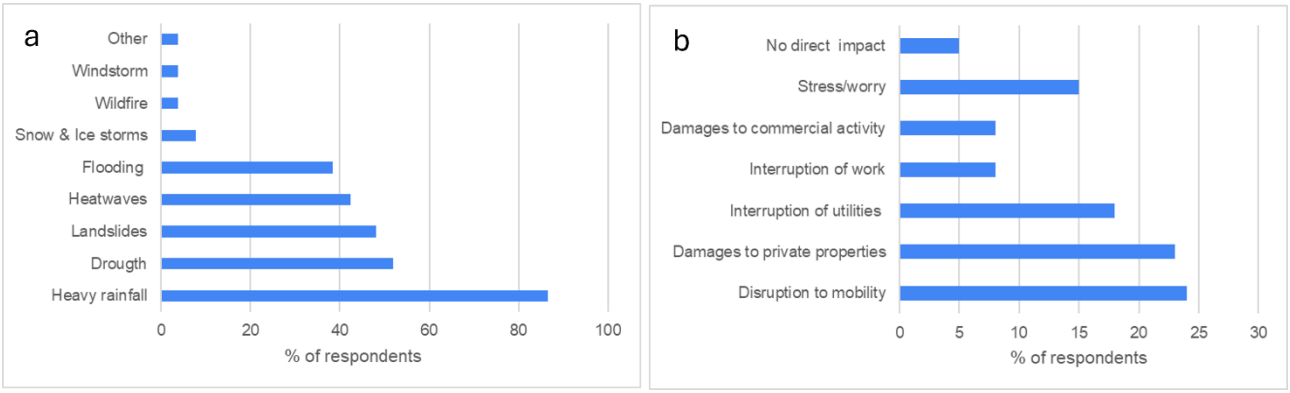


Figure 2-1: (a) extreme events experienced in the past in Valcerrina and (b) reported damage.

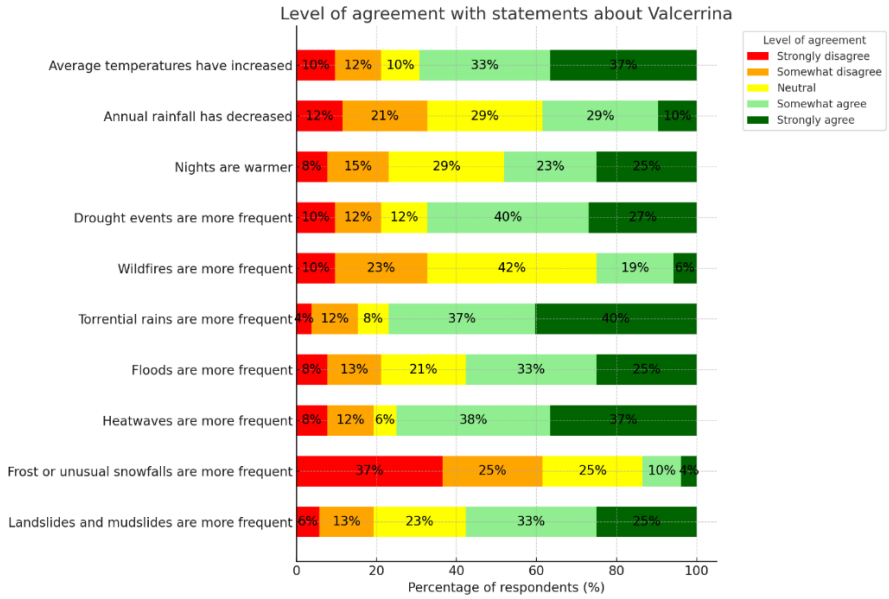


Figure 2-2: Perceived changes in climate conditions in Valcerrina

Heavy rainfall, floods and landslide hazards in Valcerrina are intrinsically interconnected and often difficult to isolate one from another. Besides the flooding from the Po River Po along the northern boundary of Valcerrina, which is a well distinct hazard, flooding in other parts of Valcerrina mostly occurs along secondary streams as a consequence of localized intense rains. Thus, heavy rainfall and flooding often occur conjunctively during the same extreme event. Similarly, landslides are generally associated with antecedent rainfall. As such, the attribution of extreme events to any of these specific hazards is affected by uncertainty and subjective interpretation of the event. During a recent event in Valcerrina on March 2024, for example, both heavy rainfall, landslides and flooding from secondary watercourses were reported[4]. In this deliverable we refer to flooding as the hazard generated by large watercourses, i.e., the Po River in Valcerrina, while we use the term

[4] https://www.ilmonferrato.it/articolo/jYMRULygRkSnwrjPjxSuOA/il-maltempo-colpisce-la-valcerrina-chiuse-diverse-strade

hydrogeological hazard to indicate heavy rainfall, localized flooding from the secondary hydrographic network and landslides.

If the impact of climate change has already been clearly observed in Valcerrina, local residents are also worried about the future. 58% of respondents declare to be moderately or highly worried about the future impact of climate change, while 36% maintain a neutral position and 6% state that they are not worried. People expect that changes to the way of living due to climate change will be either significant (38%) or moderate (46% of responses). When asked about the expected key hazards for the future, heavy rainfall was the most selected option, followed by landslides, drought, heatwaves, floods and forest fires, Figure 2-3.

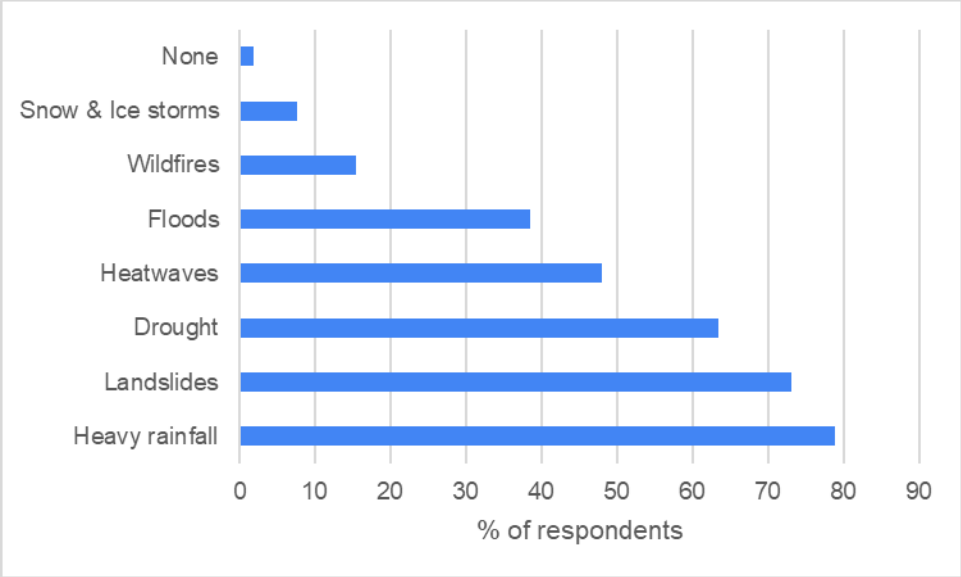


Figure 2-3: Perceived key future hazards in Valcerrina.

Based on the screening of current and future risks presented above, the climate risk assessment will focus on floods, hydrogeological risks (landslide, heavy rainfall), drought and wildfires. For the hydrogeological and flood risks, a stepwise approach is used. First, the risk of flooding from large watercourses, i.e. Po River in Valcerrina, will be assessed using the ready-to-go CLIMAAX river flood workflow so that its impact on the territory can be isolated. Then, in Phase II of the project the hydrogeological risks associated with the secondary hydrographic network will be assessed by conducting more detailed analysis of heavy rainfall and landslides phenomena. The heatwave risk will instead not be assessed by the project since it is considered more relevant to large urban areas, rather than Valcerrina, where only 7% of the land is covered by artificial surfaces. The large number of responses received on heatwaves are to be interpreted as the experience of a hotter climate, rather than the persistence of high temperatures over a period of time.

2.2.2 Workflow selection

2.2.2.1 Workflow #1: River floods

The river floods workflow is applied to estimate the risk of flooding from the Po River along the northern boundary of Valcerrina. The areas that may be impacted are the alluvial plains of Mocestino, Gabiano, and Camino, which are primarily used for agriculture, particularly the cultivation of maize, cereals, rice, and premium horticultural crops (e.g. strawberries). Notably, in April 2025

extensive damage to agricultural fields was caused by the flooding of the Po River in Gabiano[5]. While only a limited number of municipalities in Valcerrina are potentially affected by the Po River, implementing the workflow allows us to further explore the impact that flooding may have on the agricultural sector.

2.2.2.2 Workflow #2: Agricultural droughts

The agriculture drought workflow is applied to estimate yield and revenue losses resulting from water scarcity for several crops cultivated in Valcerrina. Drought is considered a significant risk in Valcerrina since it affects a key sector of the local economy and because the community is largely unprepared to face it. It is an emergent risk that has only been manifested recently and for which no management plans at the regional or national level have been developed. Based on the latest agricultural census conducted in 2020, the main crops cultivated in Valcerrina are wheat, soya, hazelnut, maize, vine and barley, followed by sunflower and rise, Figure 2-4. In Phase I of the project the agricultural drought risk was computed for maize, wheat, soya, barley, sunflower and rice. All together they represent 38.7% of the utilized agricultural area (UAA) of Valcerrina. Hazelnut and vine, which are premium crops and a significant source of income for farmers, will be considered during Phase II as these are not represented in the global datasets used in the workflow.

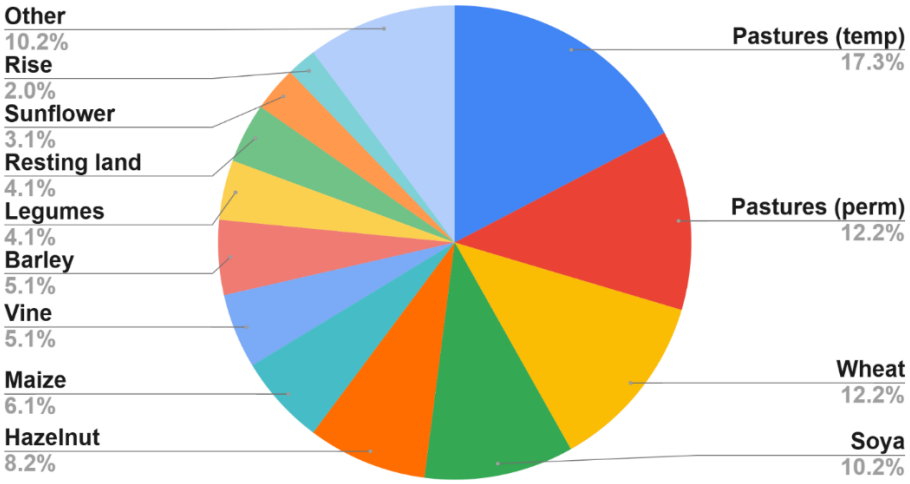


Figure 2-4: Cropping pattern in Valcerrina (ISTAT, 2024)

2.2.2.3 Workflow #3: Forest fires

Although forest fires are not a major hazard for Valcerrina, it remains important to preliminary assess its risk. Approximately 36% of the region is covered by woodlands, and ongoing agricultural land abandonment has resulted in extensive rewilding with minimal or no active management. Consequently, an evaluation of whether forest fires could evolve into a greater risk under future climatic conditions of extended dry periods and higher temperatures is needed. Areas exposed to the risk of fire are broad leaf forests. Municipalities with the largest extent of woodlands are Odalengo Grande, Villadeati e Villamiroglio. Along the northern boundary of Valcerrina, brushes in the fluvial zone of the Po River represent the main type of fuel. The fluvial zone hosts the Po River Natural Park, the only nature reserve partly included in Valcerrina. Since Valcerrina has not historically experienced frequent wildfires, but may face increased risk due to changing climatic

[5] https://comune.gabiano.al.it/dettaglio/danni-al-comparto-agricolo-a-seguito-alluvione-del-16-17-aprile-2025.html

conditions, the Fire Weather Index (FWI) workflow was selected instead of the machine learning approach. The latter incorporates past burnt areas as a core factor in wildfire risk assessment.

2.2.3 Choose Scenario

The socio-demographic characteristics of Valcerrina are expected to remain stable in the near future (2050) or to follow the trends observed in the recent past. Aging population and the abandonment of rural areas are likely to continue but more moderately than over the second half of the 20th century. Feedback provided by local residents during the stakeholders' workshop suggested that potential future changes in cropping patterns should be considered, as these may occur within timeframes of 20 to 30 years. For instance, there has been an observed shift from vineyards to olive groves and to other permanent crops that require less labor (e.g. almond). These possible agricultural scenarios will be incorporated into the refinement of the agricultural drought risk assessment during Phase II.

In terms of climate change scenarios, the time horizon most relevant for Valcerrina is the mid-term (2050) given the average age of local residents and the mandates of local politicians, which usually last for not more than 8 to 10 years. Over such time horizon, the intermediate scenario 4.5 RCP is considered appropriate to assess the risks of flooding, drought and forest fires.

2.3 Risk Analysis

2.3.1 Workflow #1 – River Floods

Table 2-1: Data overview - River floods

Hazard data	*Vulnerability data*	*Exposure data*	*Risk output*
JRC high resolution flood maps RP10 to RP500	JRC LUISA depth-damage curves	100m x 100m land use map (JRC LUISA 2018 Base Map)	Damage (€) maps for different return periods
Aqueduct Floods Hazards maps RP250 and RP500	JRC LUISA land use economic values adjusted to the Italian GDP of 34088 USD per capita		

2.3.1.1 Hazard assessment

The JRC high-resolution flood maps were used to assess the risk of flooding from the Po River for events with different probability of occurrence (i.e., return periods). The return periods 20, 100 and 500 years were selected since they represent events of low, medium and high rarity, respectively. They are also the return periods most frequently considered in regional and national flood risk management plans. Figure 2-5 shows that flooding from the right bank of the Po River is contained within a relatively narrow strip along the northern boundary of Valcerrina. Flooding occurs in the municipality of Moncestino, Gabiano and Camino. The return period of the flood event does not significantly affect the extent of the flooded area within Valcerrina. This is due to the alluvial plain being delimited by hills to the south. The impact of climate change on the flood hazard for different return periods was assessed using the Acqueduct Floods Hazards maps. The analysis shows that in 2050 the increase in the inundation depth along the Po River will remain lower than 0.2 m in the RCP 4.5 scenario. Accordingly, the risk assessment was conducted for the present-day scenario,

recognizing that events with historically high return periods may occur in the future with increased frequency.

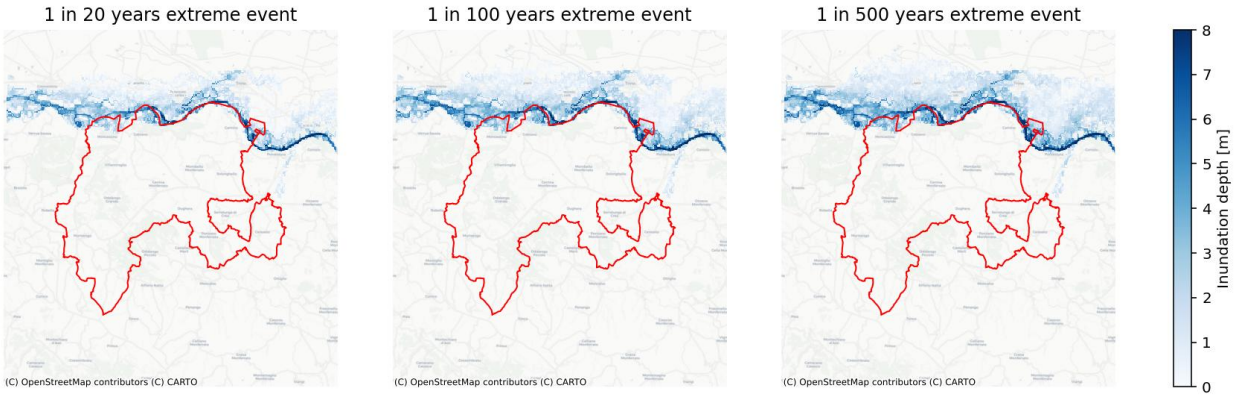
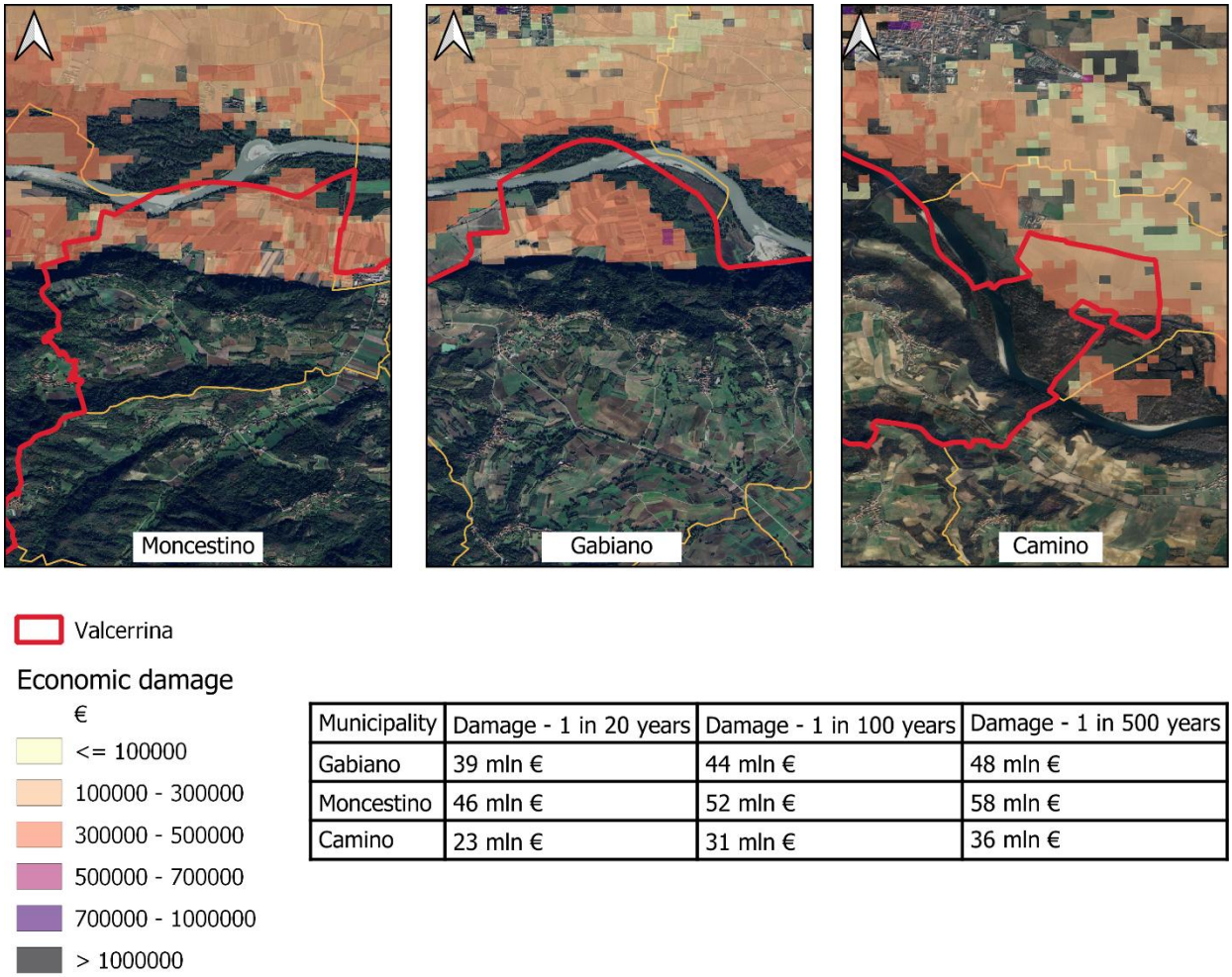


Figure 2-5: Flood hazard along the Po River for different return periods and in the present-day scenario. The river flows from west to east. Line in red represents the boundary of Valcerrina.

Before conducting the risk assessment, the flood extent indicated by the JRC maps was compared against regional flood maps (Regione Piemonte, 2021). The latter are produced by the regional authority through high-resolution hydraulic modelling that incorporates flood defenses and bridges under the framework of the European Flood Directive. The regional maps display only the extent of the flooded area (i.e., flood zones) and do not include information on inundation depths. The comparison is shown in SI-1 (Figure A), highlighting a good consistency between the two datasets for the 1 in 500 years extreme event along the northern boundary of Valcerrina. On the opposite riverbank, that is beyond the extent of Valcerrina, the match is poorer because of the effect of flood defenses not being represented in the JRC maps. Overall, the JRC maps used in the workflow are considered an accurate dataset for estimating flood hazard in Valcerrina.

2.3.1.2 Risk assessment

The risk assessment was focused on the areas within Valcerrina that are affected by the flooding. Figure 2-6 shows the spatial distribution of economic damage in Moncestino, Gabiano and Camino during the 1 in 100-year extreme event, alongside the total damage for each municipality for the 20-, 100- and 500-year return period flood events. The highest economic damage is expected in Moncestino driven by the larger agricultural area that would be flooded. The very limited number of residential and industrial buildings in flood-prone areas contributes to keeping the damage to moderate levels. Yet, the damage to the agricultural sector shall not be overlooked as it constitutes a major source of income in Valcerrina.



Municipality	Damage - 1 in 20 years	Damage - 1 in 100 years	Damage - 1 in 500 years
Gabiano	39 mln €	44 mln €	48 mln €
Moncestino	46 mln €	52 mln €	58 mln €
Camino	23 mln €	31 mln €	36 mln €

Figure 2-6: Spatial distribution of economic damage during the 1 in 100 years extreme flooding event and table reporting the total damage in the three municipalities. Basemap: Google Earth

2.3.2 Workflow #2 – Agricultural drought

Table 2-2: Data overview workflow #2 - Drought

Hazard data	*Vulnerability data*	*Exposure data*	*Risk output*
EURO-CORDEX climate projections Time horizon: 2046 – 2050 Scenario: RCP 4.5 Model combination: mpi_m_mpi_esm_lr, smhi_rca4	Irrigation availability data from FAO GAEZ v4 repository	Crop production data from MapSPAM (2010)	Revenue loss (€)
Available Water Capacity data (Hengl & Gupta, 2019)		Crops aggregated value data from FAO GAEZ v4 repository	
Elevation data from USGS GDTEM 2010 digital elevation model (Danielson & Gesch, 2011)			

Hazard data	*Vulnerability data*	*Exposure data*	*Risk output*
Termal climate zones data from FAO GAEZ v4 repository			

Due to the low resolution of the climate datasets (approx. 11x11km) compared to the extent of Valcerrina, i.e. 162 km^2, the agricultural drought workflow was run over a larger area defined by the union of the two provinces (NUTS level 3) closest to Valcerrina. These are the provinces of Alessandria and Asti. Nevertheless, only the results for Valcerrina will be presented and discussed.

2.3.2.1 Hazard assessment

The drought hazard workflow was run for six different crops (namely wheat, maize, soya beans, barley, rice and sunflower) to estimate future losses in yield due to a deficit in the water demand-precipitation balance. The water demand is estimated by calculating the actual evapotranspiration according to the Penman-Monteith equation (Allen, et al., 1998). The mid-century time horizon (2046-2050) and the RCP 4.5 scenario were used in the simulation of the crop water balance. Figure 2-7 shows the spatial distribution of the expected loss in yield by 2050 for wheat, soya beans, maize and barley, while in Table 2-3 the average crop loss across Valcerrina is given for all simulated crops.

Table 2-3: Averaged yield losses for the six simulated crops across Valcerrina.

Crop (in order of extent)	**Expected loss in yield by 2050 (RCP 4.5)**
Wheat	23%
Soya beans	32%
Maize	56%
Barley	22%
Sunflower	37%
Rice	53%

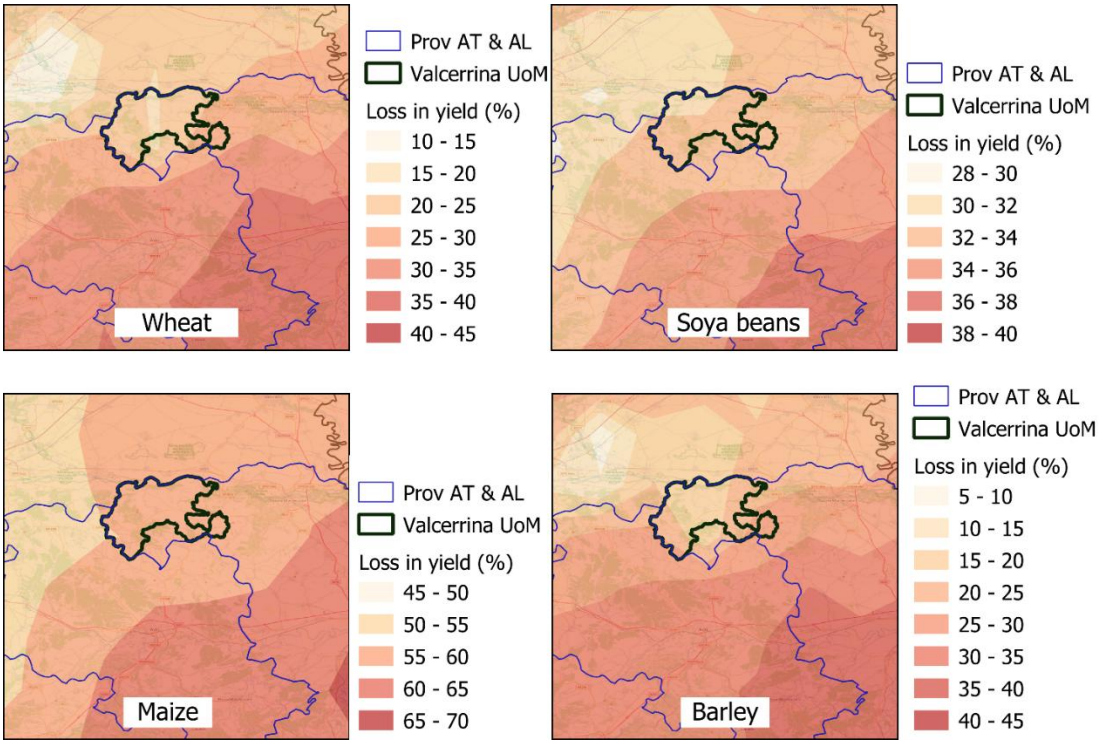


Figure 2-7: Yield losses of major crops by 2050 under the scenario RCP 4.5. Lines in black and blue are the boundary of Valcerrina and Alessandria/Asti provinces, respectively.

Higher losses observed for maize compared to soya and cereal crops, such as wheat and barley, are consistent with the climate conditions in Valcerrina. The crop water requirement for maize is largest in July, a period coinciding with increased likelihood of meteorological and hydrological droughts. In Northern Italy, maize is typically irrigated during the summer months, whereas cereal crops are cultivated over winter and generally do not necessitate irrigation. Although soya's vegetative season also occurs in summer, its irrigation needs are typically lower than those of maize, resulting in a comparatively reduced impact of drought on yield, as demonstrated by the findings. Furthermore, the calculated value of 53% for rice does not appear plausible for Valcerrina, as rice is traditionally grown via submersion in late spring, the season when water resources are plentiful due to mountain snowmelt. During Phase II of the project, local crops data will be gathered to address any such inconsistencies and to expand the assessment to permanent crops, such as vines and hazelnut.

It shall be noted that the agricultural drought workflow was not run with the version of the Handbook released at the end of August 2025. The required updates will be implemented during Phase II.

2.3.2.2 Risk assessment

In the risk assessment, the estimated yield loss for each crop was integrated with information on crop production (ton) and crops aggregated value (€) derived from MapSPAM and the FAO GAEZ v4 datasets, respectively. The total revenue loss across all simulated crops was calculated and is presented in Figure 2-8. By 2025, in Valcerrina, the expected economic damage to the agricultural sector due to water scarcity ranges between 200000€ and 900000€. Such figure is an underestimation of the total potential damage, considering that the simulated crops only represent 38.7% of the UAA. Furthermore, a review of the MapSPAM dataset for Valcerrina (year 2010) against the national agricultural census (year 2020) points to an overestimation of the fraction of wheat in the cropping pattern at the expenses of soya and maize, SI-1 (Table C). These inconsistencies will be addressed in Phase II when local data on economic crop value will also be collected.

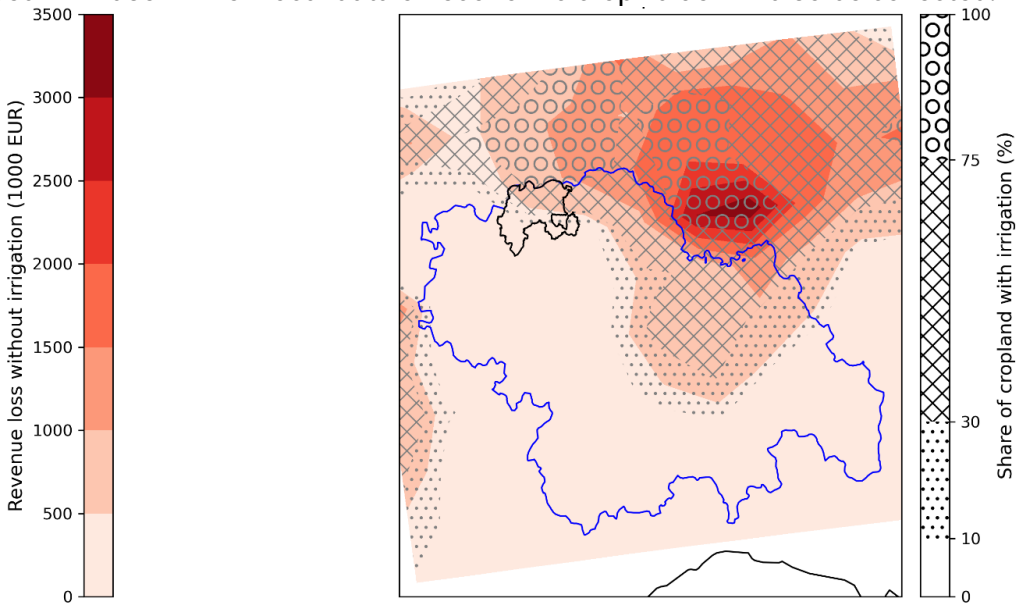


Figure 2-8: Expected revenue loss for the agricultural sector due to precipitation deficit by 2050 (RCP 4.5). Lines in black and blue are the boundary of Valcerrina and Alessandria/Asti provinces, respectively.

Even though the implementation of the workflow only captures a portion of the expected damage, it is evident that the risk of drought is high in Valcerrina, particularly compared to neighboring areas in Asti and Alessandria provinces. During the stakeholders' workshop held in July 2025, farmers noted that, contrary what is shown in the global irrigation dataset, most of the Valcerrina territory is currently not equipped with irrigation systems, increasing thus its vulnerability.

2.3.3 Workflow #2 – Wildfire risk

Table 2-4: Data overview workflow #3 - Wildfire

Hazard data	*Vulnerability data*	*Exposure data*	*Risk output*
EURO-CORDEX Canadian Fire Weather Index (FWI) System dataset Indicator: Seasonal and daily FWI Time horizon: 2045 - 2054 Scenario: RCP 4.5 Climate models: ensemble mean	The following dataset from the European Forest Fire Information System (EFFIS): – Population at the Wildland Urban Interface (WUI) – Fraction of Protected Area – Ecosystem Irreplaceability Index – Population Density – Ecosystem Restoration Cost Index	Bare areas data from ESA-CCI Land Cover	Seasonal FWI
		Burnable area data from EFFIS	Areas of high fire risk

Similarly to the agricultural drought risk workflow, the forest fires workflow was applied to a broader region comprising the two nearest provinces (NUTS level 3) to Valcerrina: Alessandria and Asti.

2.3.3.1 Hazard assessment

The impact of climate change on fire hazard in Valcerrina was evaluated by projecting future changes in two FWI metrics: the seasonal FWI and the length of the fire season. The latter is defined as the number of days with FWI above 22. The threshold value of 22 is based on the information contained in Regional Forest Fire Plan (Regione Piemonte, 2024), which specifies monthly thresholds for the different fire danger classes (i.e., from “very low” to “very high”). 22 represents the lower limit for the “very high” fire danger class averaged from May to September. Figure 2-9 and Figure 2-10 indicate that by mid-century, both the seasonal FWI (with an increase between 4.4 and 4.8) and the number of days with FWI greater than 22 (showing a percentage increase between 25% and 50%) are projected to rise.

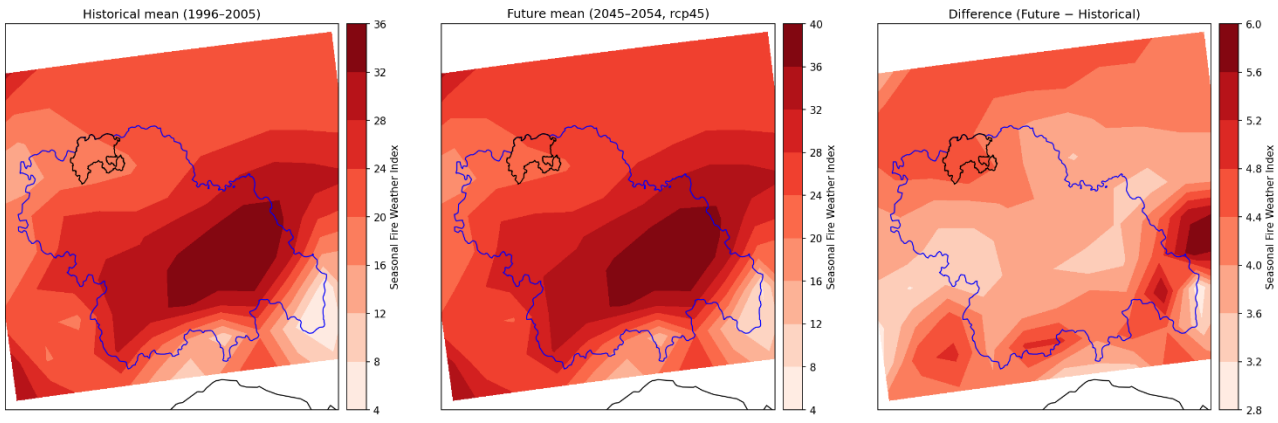


Figure 2-9: Comparison of the Seasonal Fire Weather Index (FWI) in the historical and future period (2045 – 2055) under scenario RCP4.5. Lines in black and blue are the boundary of Valcerrina and Alessandria/Asti provinces, respectively.

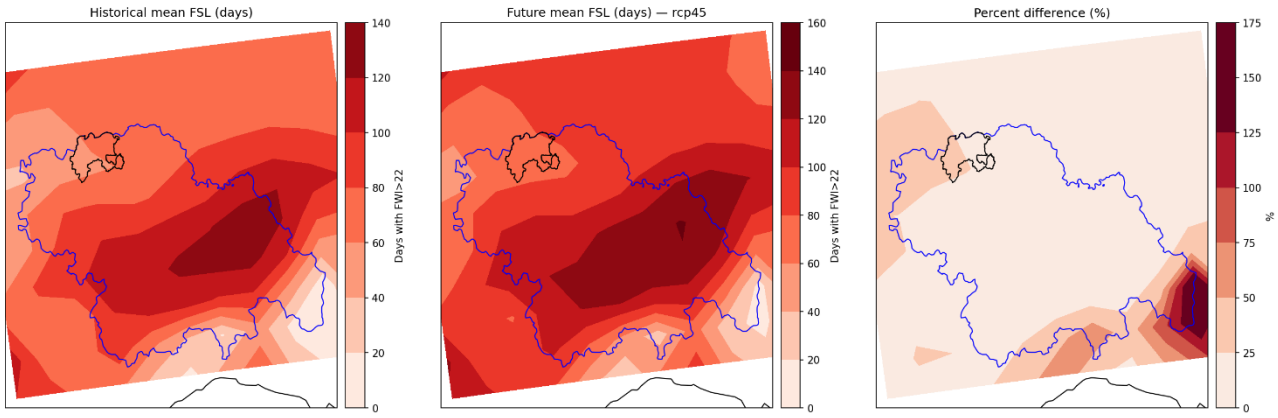


Figure 2-10: Percentage change in the fire season length between the historical and future periods under scenario RCP4.5. Lines in black and blue are the boundary of Valcerrina and Alessandria/Asti provinces, respectively.

2.3.3.2 Risk assessment

The analysis indicates that, although forest fire is not presently a significant threat in Valcerrina, it has the potential to develop into a greater hazard in the future. Therefore, it is essential to evaluate its risk through the integration of data on exposure and vulnerability. The average seasonal FWI for the mid-century under the scenario RCP4.5 was first combined with the burnable area to generate the fire danger index (hazard + exposure), see SI-1 (Figure B). Despite Valcerrina showing large value of burnable areas, coherently with its landscape being dominated by woodlands, the FWI seems to be driving the fire danger index, which remains low to moderate compared to other areas in Alessandria and Asti provinces. The fire danger index was then combined with datasets representing human, ecological and economic vulnerabilities from the EFFIS data portal using Pareto analysis to indentify the areas of highest risk. The results are presented in Figure 2-11. The integration of the vulnerability dataset does not significantly affect the risk of forest fires in Valcerrina, except along the northern boundary where an area of high risk is indicated. Locally, the risk is driven by the ecological vulnerability represented by protected area and the ecosystem irreplaceability datasest, which coherently reflects the presence of the River Po Natural Park, a fluvial nature reserve on either banks of the River Po. The human vulnerability instead remains low across the entire Valcerrina given the low density and predominently rural population.

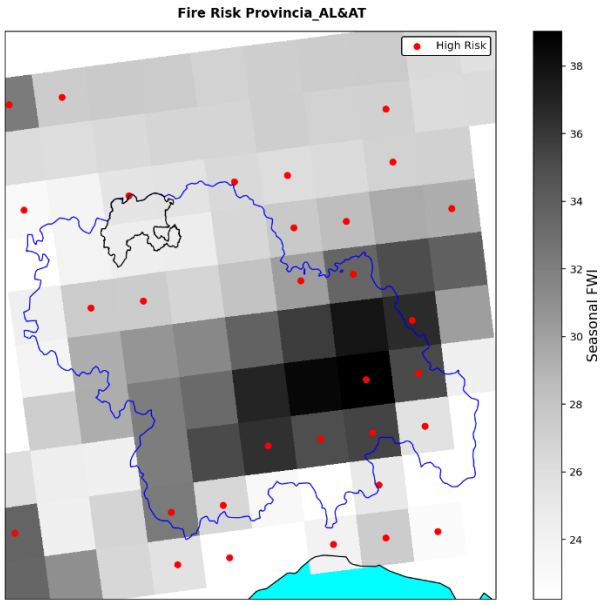


Figure 2-11: Expected wildfires risk by 2050 under scenario RCP4.5

2.4 Preliminary Key Risk Assessment Findings

The risk analysis step generated quantitative information on key current and future risks in Valcerrina, with a focus on river floods, drought and forest fires. The output of the risk analysis was collected and processed for presentation to the local stakeholders during the 1st stakeholders' workshop in July 2025. During the meeting the raw results were discussed with the stakeholders and the risks collectively evaluated in terms of severity, urgency and capacity for resilience. The results of the preliminary key risk assessment are shown in Figure 2-12. Drought emerges as the top priority risk followed by river flooding and wildfire. In the next paragraphs supporting information on the scoring of each individual hazard is provided.

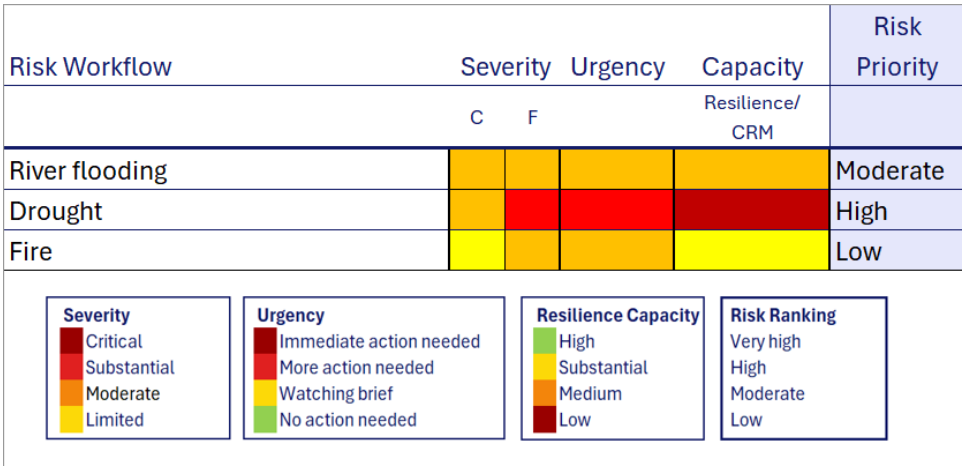


Figure 2-12: Preliminary risk prioritization for Valcerrina UoM.

2.4.1 Severity

The climate risks assessed for Valcerrina—river floods, agricultural drought, and forest fires—vary in spatial extent, recurrence, and sectoral impact, but all pose threats to the community's socio-economic and environmental systems.

- Flooding from the Po River only affect few municipalities (Gabiano, Camino, Moncestino) and the impact is mostly limited to the agricultural sector. The damage however is significant, in the order of the tens of millions of euros per event. There is also concern that more frequent flood events might in the long term lead to the loss of agricultural land. During the flooding in april 2025, it was already reported a substantial loss of topsoil, exposing the unproductive alluvial pebbles layer. **Moderate severity**
- More frequent water scarcity and drought conditions in the future might cause yield losses up to 56% for maize, 32% for soya beans, and 23% for wheat, with conservative estimates suggesting annual revenue losses of €200 000 to €900 000. Given that only 38.7% of the utilised agricultural area is currently represented in the analysis, actual losses are expected to be significantly higher once vine and hazelnut production are included. **Substantial severity**
- Wildfires currently pose a low-to-moderate hazard but are expected to intensify under projected mid-century conditions, with moderate increases in the Fire Weather Index and fire season length. **Limited severity**

2.4.2 Urgency

The urgency of each risk was evaluated considering the anticipated changes for the future, the timeliness of risk mitigation measures needed, and the time required to adapt to the risk.

- The analysis suggests that the magnitude of flooding along the Po River is not expected to change significantly in the future **(Watching brief).** However, it cannot be excluded that the frequency of extreme events will instead increase, and therefore a heightened risk persists over time. There remains a knowledge gap in the impact that climate change may have on the frequency of occurrence of extreme food events. Efforts to address such limitations will be made in Phase II, however a full analysis would be out of scope for the CIVAL project given the complexity involved.
- Agricultural drought is an urgent and escalating hazard requiring near-term planning and adaptation, given its slow-onset nature and projected intensification over the next two to three decades. **More action needed**
- Wildfire risk is currently stable and is not expected to change markedly by mid-century. If future trends indicate an increase, measures can be implemented by the community. Valcerrina maintains an intercommunal forest fire team with more than thirty years of experience in responding to forest fire incidents. **Watching brief**

2.4.3 Capacity

Valcerrina's ability to address climate risks is uneven across hazards:

- Flooding from the Po River is a well-studied hazard and risk management plans are already in place and updated regularly at the regional level. The alert system and the activation of the civil protection services is also considered well developed having been tested several times. Yet the resilience of the agricultural sector, which is the most impacted sector, is still limited due to low investments and profitability, low adoption of flood insurance mechanisms and lack of recovery plans. **Medium**
- The community is largely unprepared for droughts, an emerging risk for which no long-term regional or national plans have already been developed. The risk is predominantly owned by the farmers with only limited support received by public authorities in terms of compensation and fundings to implement irrigation systems. The lack of water resources readily available in Valcerrina partly hinders the uptake of irrigation, which however may be increasingly needed in the future. **Low.**
- Substantial capacity to deal with wildfire risk is present at the regional and local level. The recent Forest Fires Plan (Regione Piemonte, 2024) provides a detailed analysis of wildfire risks and outlines a set of prevention measures to be implemented across the region. Locally, Valcerrina can count on an experienced team of volunteers that can intervene during wildfire incidents. **Substantial**

2.5 Preliminary Monitoring and Evaluation

The first phase of the CRA has delivered a baseline multi-hazard assessment for Valcerrina, identifying critical risks, knowledge gaps and priority areas for further analysis. In Table 2-5, lessons learned and feedback received from stakeholders are presented.

Table 2-5: Lessons learnt, and feedback received from stakeholders on key aspects of the CRA in Valcerrina

Topic	Evalutation
Flood risk	A knowledge gap persists on the influence of climate change on the frequency of extreme flood events. Having estimates of how the recurrence of these events may change would help assess the persistence of flood risk over time. Closing this gap, however, requires complex scientific analysis beyond the current scope and resources of the CIVAL project. The Po River Basin Authority has initiated a research program on this topic in collaboration with several Italian universities. The current workflow is limited to assessing flood risk generated by the Po River along the northern boundary of Valcerrina. Stakeholders note that flood and hydrogeological risks are more widespread throughout the area and are frequently attributable to the overtop of secondary watercourses. The method for estimating economic damage to agriculture from river flooding applies a general monetary value assigned to agricultural land in Italy. Consequently, it may not accurately reflect the specific values of fields and crops in Valcerrina.
Drought risk	The assessment of potential crop yield losses due to precipitation deficit was considered insightful by local stakeholders. However, only some of the crops that are relevant to Valcerrina could be simulated. In particular, vines and hazelnut, which together account for 13% of the UAA were not analysed. The spatial variation of drougth risk across Valcerrina could not be appreciated due to the low resolution of input datasets.
Wildfire risk	The wildfire risk is considered a low priority by stakeholders. During Phase I, we have also learnt about the regional Forest Fire Plan, which contains a detailed assessment of wildfire risk incorporateing hazard, exposure and vulnerability datasets at a higher spatial resolution that the one used in the workflow. The further application of the workflow, thus, would only bring to marginal added value compared to the information already available.
Risks not yet assessed	Local stakeholders emphasised the need to consider heavy rainfall and landslides risks since they are already causing extensive damage to road infrastructure and private properties. These are together referred to hydrogeological risks and are mostly associated with the seocndary hydrographic network.
Stakeholder involvement	The initial steps of the stakeholder engagement process proved that local actors have a great interest in the project and wish to remain informed and involved. Stakeholders at higher governance levels (provincial and regional) were perhaps more difficult to engage, but this is deemed in line with the initial status of the project. Provincial and regional authorities are to be targeted when the approach and results of the CIVAL project are more consolidated.

2.6 Work plan

In the coming phases, the CIVAL project will move from the initial scoping towards refined, high-resolution risk assessments and the co-design of actionable adaptation strategies with local stakeholders. The activities planned in Phase II for each aspect of the CRA in Valcerrina are presented in Table 2-6, while the associated Gantt is included in SI-1 (Figure C).

Finally, Phase 3 (July 2026 – February 2027) will consolidate outcomes into a multi-risk Intermunicipal Protection Plan. This phase will prioritize adaptation interventions using participatory methods and cost–benefit analysis, aligning recommendations with regional strategies and national

adaptation policies. The plan will define investment needs, risk ownership responsibilities, and monitoring protocols to secure long-term resilience for Valcerrina.

Table 2-6: Planned activities in Phase II and III

Topic	Planned Activities in Phase II
Flood and hydrogeological risk	The activities of the Po River Basin Authority will be closely monitored, and any newly acquired insights regarding the effects of climate change on flood hazards will be incorporated into the flood risk analysis. The assessment of flood risk from the secondary hydrographic network will be conducted in conjunction with the assessment of heavy rainfall and landslide risks. To address these combined hazards, a new workflow "hydrogeological risk" will be developed, integrating elements from both the flood risk and the heavy rainfall existing workflows, along with landslide susceptibility maps. A University expert has been engaged to help build such workflow. Local cadastral and land economic value data will be collected and integrated in the CRA to enhance the accuracy of the economic damage assessment, allowing decision-makers to visualize the vulnerability of critical infrastructures and agricultural assets.
Drought risk	Local data on crop characteristics will be gathered from scientific literature and through ad-hoc surveys with farmers, and integrated in the workflow to expand and refine the analysis. Local data on cropping patterns and economic value of harvested crops will also be collected to improve the assessment of the total revenue loss. To address the low spatial resolution of the drougth risk assessment, modification to the drought workflow will be attempted so that the resolution of the outputs is driven by the total available water capacity, thus representing spatial variation in the soil properties, rather than the resolution of the climate dataset.
Wildfire risk	At the offset of Phase II, it will be discussed with key stakeholders how the wildfire risk workflow will be further refined. A thorough review of the information already available locally and regionally will be made to identify knowledge gaps that can be addressed by the CIVAL project.
Risks assessement integration	The output of the refined risks assessment will be integrated in an operational WebGIS platform (June 2026), a decision-support tool for the Valcerrina UoM. The tool will be validated through four workshops and training sessions with municipalities, farmers, and civil protection, ensuring that technical results are directly translated into operational outcomes, e.g. the Municipal Civil Protection Plan
Stakeholder involvement	Active engagement of member municipalities to further adapt the CRA to their operational and decision-making processes needs, including the development and revision of the Municipal Civil Protection Plan. Consultation with provincial and regional authorities to present the outcomes of the CIVAL project and foster synergies with their ongoing climate adaptation initiatives. Active involvement of local environmental organizations (such as Legambiente and Madre Selva) in initiatives aimed at increasing public awareness.
Communication and Dissemination	At least twenty outreach actions — from local media to international events such as the ESRI User Conference — will ensure visibility and uptake of the project's results. Policy briefs

3 Conclusions Phase 1- Climate risk assessment

The first phase of the CIVAL project has delivered a baseline, multi-hazard climate risk assessment for the Valcerrina UoM, applying the CLIMAAX framework to evaluate river floods, agricultural drought, and wildfire risk. The methodology has proven effective in producing locally relevant outputs while ensuring methodological consistency with broader European climate risk assessment practices.

The analysis confirms that:

- Agricultural drought is the most urgent and severe risk, with significant projected yield and revenue losses and low adaptive capacity due to limited irrigation infrastructure and scarce water resources.
- River floods from the Po River present a spatially limited but economically significant threat to agricultural areas in three municipalities.
- Wildfires currently pose a limited threat but may intensify under future climate scenarios, particularly in ecologically sensitive areas such as the Po River Natural Park.

Local residents and stakeholders responded positively to the activities of the project, showing interest in the results of the analysis and demonstrating availability to help tailor the CRA to their needs and priorities in terms of risk management and adaptation to climate change. The interaction with local actors also emphasized limitations and challenges of the technical analysis conducted so far, in particular:

- the need to assess hydrogeological risk (heavy rainfalls, landslides) associated with the secondary hydrographic network in addition to the riverine flood risk along the Po River
- partial coverage of the local crop mix by the agricultural drought risk assessment, excluding premium crops such as vine and hazelnut
- the use of national and global data for the economic value of agricultural land and crops, which may reflect the local market conditions.

To overcome some challenges, Phase II of the project will expand the scope of analysis to unassessed hazards, refine economic damage estimates with local data, and enhance the spatial resolution of tools. These steps will increase the operational value of the CRA, ensuring it supports both short-term preparedness and long-term adaptation strategies for the Valcerrina community.

4 Progress evaluation and contribution to future phases

Table 4-1: Overview of key performance indicators

Key performance indicators	*Progress*
Number of workflows implemented based on the CLIMAAX framework: 3	Achieved. **Evidence:** the results of the three workflows are presented in this deliverable
Number of Local Municipalities engaged: 11* *during the first phase of the project, the Solonghello municipality formally joined the Valcerrina UoM, making the number of member municipalities 12.	Achieved. **Evidence:** • Feedback on climate risks from local residents were received from all 11 municipalities through the online survey • Mayor and/or counselors from 7 municipalities were engaged through the first stakeholders' workshop held on 31st July. (Ponzano, Odealengo Grande, Villadeati, Mombello, Villamiroglio, Moncestino) • Feedback from the technical offices of the 12 municipalities is being sought through a second survey investigating their needs in terms of the development of the Municipal Civil Protection Plan
Number of Regional Civil Protection Agencies engaged: 1	Achieved. **Evidence:** the local civil protection team from the municipality of Villadeati was engaged through the first stakeholders' workshop held on 31st July
Number of Key Stakeholder Groups engaged: 5	Achieved. **Evidence:** the following groups were engaged through the first stakeholders' workshop: • Residents of Valcerrina (n. 25) • Farmers, agrifood entrepreneurs, winemakers and representatives of farmers association (n. 4) • Local politicians and decision makers (n. 10) • Representatives of local and provincial environmental associations: Madre Selva APS, Legambiente, and Parco del Po Piemontese (n. 6). In Phase 2 of the project, further emphasis will be placed on engaging stakeholders at higher governance level, such as the Piedmont Region and the River Po Basin Authority.
Number of National Clergy Authorities involved: 1	Achieved. **Evidence:** Memorandum of Understanding (MoU) signed with the Istituto Diocesano Sostentamento del Clero di Casale Monferrato (Clergy Authorithy) for dissemination and stakeholder involvement activities. See SI-6
Number of Universities engaged: 1 confirmed, 1 potential	Achieved **Evidence:** MoU with Università degli Studi di Roma - TOR VERGATA – to support the development of the

Key performance indicators	*Progress*
	hydrogeological risk worflow and to refine the risk assessment. See SI-6
Technical and Operative Support	Achieved. **Evidence:** • UrbyetOrbit and TR2 were engaged to provide technical and operative support to the CRA. • Enrico Lucca, post-doc researcher at the University of Florence and climate risk data analyst at TR2, was engaged to implement the CLIMAAX workflows. • Fabio Olivero, the President of Valcerrina UoM, serves as the Community Engagement Expert

Table 4-2: Overview of milestones

Milestones	*Progress*
ML 1.0 Barcelona May-June Event Attended	Achieved. **Evidence:** participation of Enrico Lucca (TR2) in the Barcelona event with a poster showcasing the workplan and preliminary results of the CRA.
ML 1.1. Ready for phase 2 – Framework integrated | CRA Workflow Setup	Achieved. **Evidence:** the work conducted in Phase I in terms of CRA and stakeholders' involvement constitutes a strong foundation for the analysis to be undertaken in Phase II. Preliminary results from CRA have been produced and already presented to the local stakeholders, gaining feedback on what else needs to be investigated.

5 Supporting documentation

The following outputs have been produced during Phase I of the CIVAL project:

- CIVAL Project - Main Report – Deliverable Phase I (pdf)
- SI-1: annexes to the Main Report (pdf)
- SI-2: results of public surveys (pdf)
- SI-3: first stakeholders' workshop (pdf)
- SI-4: list of communication outputs (pdf)
- SI-5: Municipal Civil Protection Plan (pdf)
- SI-6: Memorandum of Understanding (zip folder)
    - University of Rome TOR VERGATA
    - Clergy Authority
- SI-7: Handbook workflow codes and outputs (zip folder)
    - Flood Risk
    - Drought Risk
    - Forest Fire Risk

6 References

Allen, R., Pereira, L., Raes, D. & Smith, M., 1998. *Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56.* Rome: FAO - Food and Agriculture Organization of the United Nations.

Danielson, J. & Gesch, D., 2011. *Global multi-resolution terrain elevation data 2010 (GMTED2010):U.S. Geological Survey Open-File Report 2011–1073,* s.l.: s.n.

Hengl, T. & Gupta, S., 2019. Soil available water capacity in mm derived for 5 standard layers (0-10, 10-30, 30-60, 60-100 and 100-200 cm) at 250 m resolution (v0.1) [Data set].

ISTAT, 2021. *Censimenti Permanenti.* [Online]
Available at: http://dati-censimentipermanenti.istat.it/

ISTAT, 2024. *Risultati del 7° Censimento Generale dell'Agricoltura.* [Online]
Available at: https://www.istat.it/statistiche-per-temi/censimenti/agricoltura/7-censimento-generale/risultati/

Regione Piemonte , 2020. *Analisi del clima regionale del periodo 1981 - 2010 e tendenze negli utilimi 60 anni,* Torino: Regione Piemonte.

Regione Piemonte, 2020. *Analisi degli scenari di clima regionale del periodo 2011 - 2100,* Torino: Regione Piemonte.

Regione Piemonte, 2021. *Mappe di Pericolisità.* s.l.:s.n.

Regione Piemonte, 2024. *Piano Regionale Antincendi Boschivi,* Torino: Regione Piemonte.

Stalhandske, Z. et al., 2024. Global multi-hazard risk assessment in a changing climate. *Scientific Reports,* Volume 14, 5875.