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ADAPTATION TO CLIMATE CHANGE



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Strengthening flood resilience by integrating flood risk management into local governance frameworks

Locally adapting to climate change in Navarra, Spain

Navarra is proactively enhancing flood resilience by developing municipal self-protection plans. These plans provide local governments with structured strategies to mitigate flood risks, protect communities, and improve emergency responses in their municipalities.

Key Learnings

- **Adaptation Planning:** The framework of self-protection plans ensures that flood-prone municipalities can systematically assess, plan, and implement risk reduction measures.
- **Early Warning Systems:** Integrating real-time rainfall and streamflow observations improves emergency risk prediction, municipal response and population warning.
- **Community Engagement:** Active collaboration between municipalities, local authorities and regional governments increases public awareness and preparedness for flood risks.
- **Ongoing Improvement:** Regular plan evaluations and training sessions with local authorities and local workers strengthen the efficiency of emergency response actions.

About the region

The Navarra region, located in northern Spain, spans approximately 10,400 km² and has a population of approximately 680,000. The region features a varied landscape, from the Pyrenees Mountains to the Ebro River, making it vulnerable to extreme weather events. Climate hazards include frequent flooding due to increased rainfall intensity and winter fronts, along with prolonged droughts and rising temperatures.

Climate Hazards

Flooding, Storms

Sector

Disaster Risk Reduction, Water Management,

Land Use Planning

Key system

Water Management, Critical Infrastructure,

Health and Wellbeing



Figure 1: Location of the Navarra region within Spain and Europe.

Climate Threats

The Navarra region is experiencing increasing climate-related challenges, including a rise in floods and winter oceanic fronts. Over the last decade, extreme storms and heavy rainfall events have become more frequent, leading to widespread flooding around many of Navarra's rivers. In July 2019, a severe Mediterranean-style storm struck several municipalities, including Tafalla and Olite. Similar events in May and July 2023 caused extensive damage in both the northern (Bera) and southern (Caparroso) parts of the region. Many of these floods occurred in small catchments, where intense rainfall can trigger flash flooding within just one or two hours. Additionally, winter rainfall systems – such as the “Barra” front in December 2021 (Figure 2) – have also had severe impacts, including one fatality, significant infrastructure damage, and multiple evacuations. Climate projections suggest that extreme weather events will become increasingly common, further exacerbating flood risks in Navarra's municipalities.



Figure 2: Flooding affected the municipality of San Adrian, where Ebro and Ega River join, during the December 2021 floods that affected several municipalities all along the region. Image Credit: Civil Protection Service of the Government of Navarra.

Municipal collaboration to achieve flood resilience in the region

Local authorities grew increasingly concerned following the severe flooding in 2021 and are expected to increase in the future. In response, **17 municipalities across the Navarra region collaborated** to develop customised self-protection plans. These plans not only strengthen local flood resilience but also serve as valuable tools for the regional government's civil protection service.

Local Flood Risk Management Plans support municipalities in organising resources, establishing early warning systems, and integrating flood risk management into local governance frameworks. The [Special Emergency Plan for Flood Risk in Navarra](#) outlines the Local Plan Structure and follows the guidelines specified in the broader [Navarre Climate Change Roadmap](#) (KLINa).

As part of the [LIFE-IP NAdapta-CC](#) project, municipalities collaborated to draft, test, and implement their own self-protection plans. These plans include the following components:

- **Providing information** on how to respond adequately to the risk, drawing on local experience. Measures include preventive road closures, restricting access to flooded areas and infrastructure, and conducting door-to-door warnings for residents etc.
- **Definition of structure and local resources.** Each town identifies and organises its available resources and services to effectively manage flood events. City councils work closely with technical teams to develop the plans, scaling actions to fit local capacities – particularly important for smaller councils with limited resources.

More specifically, collaboration between city councils, the project team, and other key stakeholders, such as local brigades, police, and relevant authorities, involved the following activities:

1. **Preparatory meetings** to draft the self-protection plans,
2. **Field visits** to assess on-site conditions and better understand local flood-prone areas (Figure 3),

3. **Evaluation meetings** to review the effectiveness of the self-protection measures following flood events,
4. **Training and dissemination sessions** to raise awareness about the project actions.



Figure 3: Local council workers and local police officers identified critical points involved in flood risk in each municipality during the field visits. Image Credit: LIFE-IP NAdapta-CC project.

Once the stakeholders elaborated the plans, the city councils presented them to residents and disseminated information leaflets detailing how to respond in case of an emergency. In addition to these information campaigns, the project team organised workshops and community engagement meetings to provide ongoing training and strengthen emergency preparedness.

Flood risk plans provide municipalities and communities with **up-to-date information, including forecasts, real-time rainfall and streamflow data, and clearly defined emergency measures**. To support this, the project team – comprising hydrology and data experts – developed a specialised monitoring tool with support from software development companies. This tool enables real-time flood risk monitoring and facilitates timely communication between municipal authorities, operational teams, and the local population.

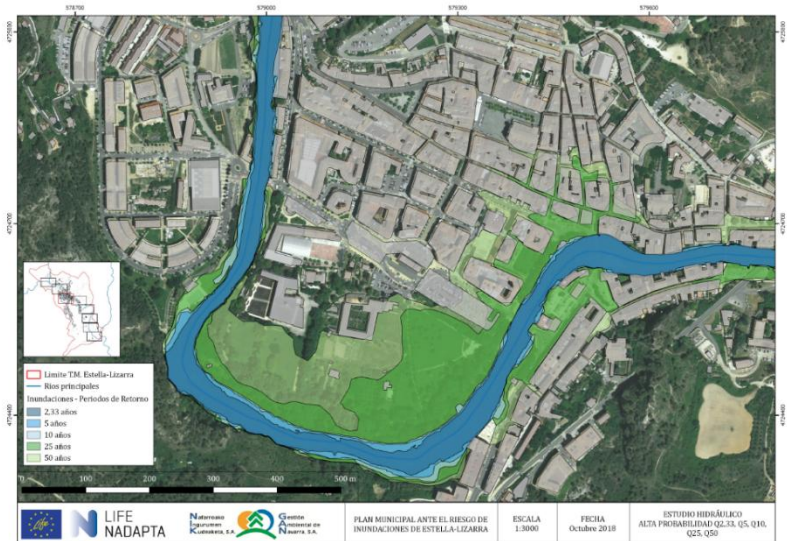


Figure 4: Hazard map for different return periods: 2, 33, 5, 10, 25 and 50 years in the Ega River in the city of Estella-Lizarrar. Image Credit: LIFE-IP NAdapta-CC project.

The system leverages data from 104 rain gauges and 75 streamflow measurement stations across the region, operated by various public agencies. Thanks to financial support from the LIFE-IP NAdapta-CC project, the team installed six additional stations in catchments with limited existing data – some in sparsely populated areas such as the Pyrenees valleys.

Each Local Emergency Plan includes a **cartographic annex**, detailing the location of streamflow and precipitation monitoring stations. The annex features maps that illustrate key information, including flood hazard zones (based on different return periods (Figure 4)), flood risk maps, and targeted action zones where specific measures should prevent or minimise damages.

Emergency response ensuring flood resilience

All local plans in Navarra follow the standardised structure and definition of emergency levels, defined as follows:

- **Emergency 0:** River streamflow has significantly increased, but the river has not overflowed yet.
- **Emergency 1:** Floods and overflows have started in low-lying areas close to the riverbank, without causing severe damage.
- **Emergency 2:** Floods will cause serious damage in urban areas. Vehicles and personal mobility have to be restricted.
- **Emergency 3:** Flooding causes serious and widespread effects that cannot be addressed with municipal resources alone. At this point, the activation of the Regional Plan is required.

For each plan, the project team has **defined** rainfall rates and/or river streamflow **thresholds**. Once at these thresholds, local authorities activate the corresponding emergency level. A **mass SMS warning system** then disseminates this information quickly and effectively to the local population. Each Operational Group, as outlined in the plan (Figure 5), performs the **designated actions according to the established procedure**.



Figure 5: Regional roads and rural paths closed by local police in the municipality of Arguedas in December 2021. Image Credit: LIFE-IP NAdapta-CC project.

The project team also digitised the Local Plans by developing an app and a dedicated website to manage each plan (Figure 6). These digital tools enable efficient monitoring of the plan's implementation, including an early warning system that tracks the emergency level thresholds and sends warning notifications to plan managers (3 to 5 local authorities).

The **web-based tool and app** allow real-time monitoring of the actions taken, with a colour-coded system: green for completed actions, orange for actions in progress, and red for actions not yet carried out. Figure 6 (right image) shows a screenshot of the app interface, highlighting the screen that local mayors use to easily activate different emergency levels.

Local authorities and workers participate in annual **training sessions**, as shown in Figure 7, to test and familiarise themselves with the plan's implementation. Each year, teams review and update the planned actions and involved personnel.

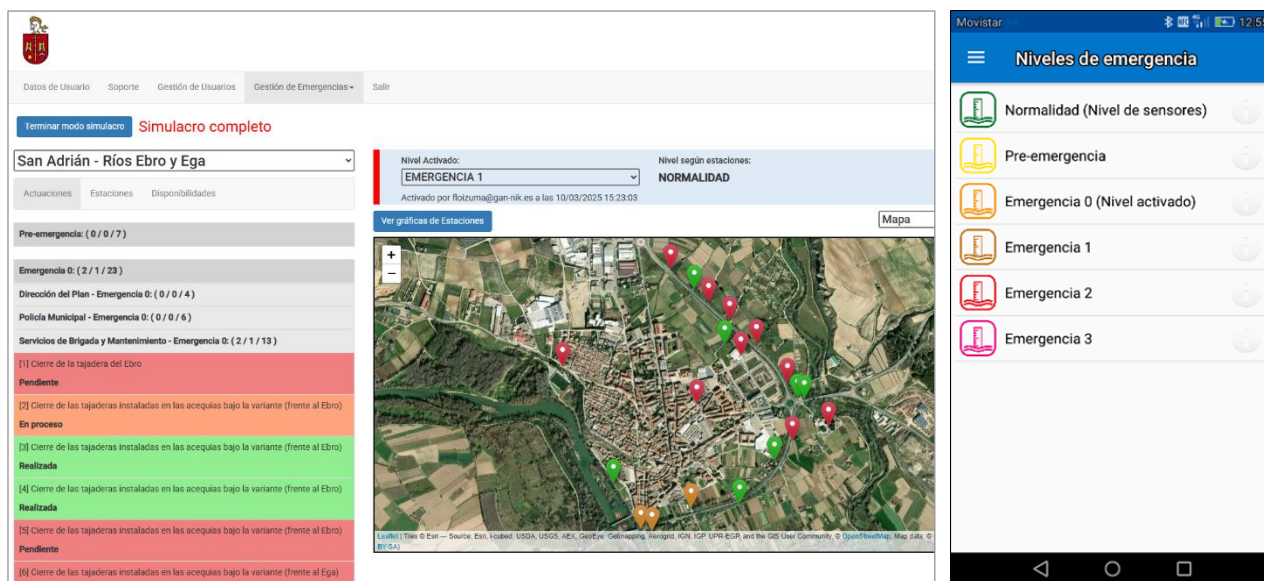


Figure 6: Computer-based tool for managing and supervision of the plan's application in the municipality of San Adrian. Image Credit: LIFE-IP NAdapta-CC project.



Figure 7: Practice session on the risk plan management carried out in the municipality of Tudela. Image Credit: LIFE-IP NAdapta-CC project.

“Drafting municipal emergency plans incorporating robust early warning systems in towns with significant flood risk facilitates local level integration, being closest to the population in managing flood emergencies. This allows each city council to practice coordinated emergency management with the Regional Civil Protection, as well as better preparation for potentially significantly increasing risks due to climate change.”,

Luis Sanz Azcárate, Technical Director, GAN-NIK

Summary

After the devastating flood event in Navarra in December 2021, 17 municipalities in the region came together to develop tailor-made self-protection plans. These efforts have strengthened local emergency preparedness, integrated digital monitoring tools, and fostered collaboration between municipalities and the regional Civil Protection Service.

These newly developed Local Emergency plans provide a consistent, practical framework that increases preparedness when a flood threatens a town in Navarra. The plans include defined thresholds (based on observed rainfall and/or streamflow), pre-defined actions, a mass SMS alert system, and social media communications to the local population.

Quick response, clear actions, and effective communication are essential in areas like Navarra, which are frequently impacted by storm events. Despite the growing risks posed by climate change, Navarra's proactive approach serves as a model for other regional adaptation strategies.

Further information

The work presented within this adaptation story is part of the [LIFE-IP NAdapta-CC](#) project.

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- Navarra Climate Change Roadmap (KLINa): [Website](#)

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