**RESILIENT COMMUNITIES THROUGH AWARENESS AND PREPAREDNESS AGAINST THE RISKS OF FIRE, FLOOD, AND LANDSLIDE**

# CHAPTER 2. FLOOD DISASTER

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CHAPTER

# 2

## FLOOD DISASTER

Floods are one of the most devastating disasters that can strike communities, causing widespread damage to property, infrastructure, and, tragically, loss of life. These catastrophic events result from a variety of factors, including heavy rainfall, snowmelt, storm surges, and the overflow of rivers and lakes. Climate change and urbanization have also exacerbated the frequency and intensity of floods in many regions, making it imperative for individuals, communities, and governments to prioritize flood disaster preparedness as a means of building resilience against this relentless force of nature.

The consequences of a flood disaster can be overwhelming. Homes and businesses can be submerged, roads can become inaccessible, and critical infrastructure such as water treatment plants and power stations may be compromised. The aftermath of a flood often brings economic hardship, displacement, and a profound emotional toll on affected individuals and communities. It is, therefore, crucial to understand the importance of flood disaster preparedness and take proactive steps to mitigate the impact of these events.

Flood disaster preparedness encompasses a wide range of strategies and actions aimed at minimizing the risks associated with floods and their aftermath. These efforts involve not only government agencies but also individuals, households, and local communities. The core principles of flood disaster preparedness include:

1. Risk Assessment: Understanding the flood risk specific to a given location is the first step in effective preparedness. Comprehensive flood risk assessments take into account factors like historical data, topography, hydrology, and climate trends. By identifying areas most vulnerable to flooding, authorities can plan more effectively and allocate resources where they are needed most.

2. Early Warning Systems: Timely information is essential in ensuring people have the opportunity to evacuate and protect their property. Advanced weather forecasting and early warning systems are critical components of flood disaster preparedness. These systems provide communities with crucial information, enabling them to take action well before floodwaters arrive.
3. Infrastructure Resilience: To minimize damage to essential infrastructure, investments in resilient engineering solutions are essential. This includes flood-resistant building codes, improved stormwater management, and the construction of flood barriers. Ensuring that critical infrastructure, such as hospitals and emergency services, remains operational during a flood event is of paramount importance.
4. Community Engagement: Active involvement and awareness among residents play a central role in flood disaster preparedness. Communities that are educated about flood risks and emergency response plans are better equipped to protect themselves and their neighbors during a disaster. Preparedness initiatives often include public education, outreach, and training programs.
5. Emergency Response and Evacuation Plans: Establishing clear protocols for emergency response and evacuation is vital for ensuring the safety of residents during floods. Local authorities should have well-defined plans in place, along with designated evacuation routes and shelters. Regular drills and exercises can help reinforce these plans and enhance their effectiveness.
6. Insurance and Financial Preparedness: Adequate insurance coverage can help individuals and businesses recover after a flood disaster. Encouraging people to secure flood insurance and have a financial safety net in place is an important aspect of preparedness.
7. Long-Term Resilience: Flood disaster preparedness should not be limited to immediate response and recovery efforts. Long-term resilience measures involve sustainable land use planning, the preservation of natural buffers like wetlands, and climate change adaptation strategies.

Flood disaster preparedness is an essential component of safeguarding communities against the devastating effects of floods. It is a comprehensive approach that requires cooperation at all levels of society, from individual homeowners to government agencies and local communities. By understanding the risks, implementing early warning systems, fortifying infrastructure, engaging communities, and planning for emergency response, we can better

prepare ourselves to face the challenges posed by floods and ultimately build a more resilient future.

### 2.1. Preparing for Flood Disaster

With climate change and other several climatic factors, floods occur more often. It is essential for public agencies and communities to be prepared to withstand floods. Preparedness is crucial in mitigating the impact of flood disasters and ensuring the safety and well-being of individuals and their families. There are comprehensive plans that delineate critical factors to identify risks and hazards and what protective measures need to be taken when a disaster strikes.

Before taking steps to prepare for a flood disaster, emergency managers need to understand the flood risks that might threat the area. Flood risks can vary widely based on geographical location, geological conformation, topography, proximity to water bodies, and historical flood patterns. Some valuable sources of information for understanding flood risks include:

1. ***Floodplain Maps*:** Many communities have floodplain maps that delineate areas at risk of flooding. These maps are often available from local government agencies, and they highlight flood-prone regions within your community. Examining these maps can help emergency responders determine the level of threat of the flood-prone area.
2. ***Community Alerts*:** Local authorities may issue flood alerts and warnings. These warnings Sign up for community alert systems or notifications through apps and services that provide real-time information about weather-related risks.
3. ***Weather Forecasts*:** Monitoring weather forecasts can provide early indications of potential flood events. Pay attention to forecasts that predict heavy rainfall, snowmelt, or storm systems, as these are common precursors to floods.
4. ***Climate Data*:** Understanding long-term climate data can help assess the changing patterns of rainfall and flooding in your region. Access to historical flood data can provide insights into the frequency and severity of past flood events.

For emergency management agencies, flood preparedness encompasses a multifaceted and dynamic set of activities designed to bolster their response capacity and effectiveness in the face of impending or ongoing flood events. These proactive measures aim to enhance the agency's readiness, coordination, and adaptability to effectively manage the multifaceted

challenges posed by floods. These activities are pivotal in mitigating the potential impact of flood disasters and safeguarding the well-being of affected communities.

At the core of flood preparedness for emergency management agencies lies a comprehensive strategy, meticulously developed and continuously updated, that encompasses a variety of key components. These components serve to empower agencies to act swiftly and decisively during a flood event while minimizing risks and ensuring the seamless deployment of resources and aid to the affected population.

- **Risk Assessment and Monitoring:** To effectively prepare for floods, agencies conduct detailed risk assessments. These assessments involve evaluating historical flood data, geographical vulnerability, and climatic trends. Agencies monitor current weather patterns and flood alerts, utilizing advanced meteorological and hydrological data to predict potential flood events. This information forms the knowledge base of their response strategy.
- **Preparedness Policy-making:** Flood preparedness planning is a meticulous process involving the development of comprehensive strategies, protocols, and standard operating procedures. These plans detail specific response activities, resource allocation, and communication strategies. Agencies must ensure that their personnel are well-trained and capable of executing their roles effectively during a flood event.
- **Resource Allocation and Stockpiling:** Emergency management agencies stockpile essential resources and equipment, including food, water, medical supplies, communication tools, and emergency response vehicles. These stockpiles are strategically located to ensure rapid distribution to areas affected by floods.
- **Public Education and Awareness:** Effective flood preparedness extends to public education and awareness campaigns. Agencies aim to inform and educate the community about flood risks, evacuation procedures, and the importance of having personal emergency plans and kits. This proactive outreach fosters a more resilient and informed population that can take appropriate actions during a flood event.
- **Early Warning Systems:** Collaborating with meteorological agencies, emergency management organizations establish early warning systems that provide timely and accurate flood alerts to the public. These systems are essential for facilitating evacuation and response efforts.

- **Community Engagement:** Building partnerships with local communities is integral to flood preparedness. Agencies work closely with community leaders, organizations, and volunteers, empowering them to be active participants in the response process. This collaborative approach strengthens the community's ability to cope with and recover from flood disasters.
- **Training and Exercises:** Regular training sessions and simulation exercises are conducted to ensure that emergency responders are well-prepared to handle various aspects of flood response. These exercises help personnel practice coordination, communication, and decision-making in a controlled environment.
- **Resource Mobilization:** Emergency management agencies establish mechanisms for rapidly mobilizing additional resources, including personnel and equipment, from neighboring regions or through state and federal assistance. Ensuring the availability of resources beyond the agency's capacity is crucial during large-scale flood events.
- **Continual Evaluation and Improvement:** Flood preparedness is an ongoing process. Agencies regularly evaluate their plans, response procedures, and the outcomes of actual flood events. This evaluation leads to refinements and improvements that enhance their ability to manage floods more effectively in the future.

In essence, flood preparedness is a dynamic and evolving framework that allows emergency management agencies to operate with agility and effectiveness in the face of the unpredictable and destructive forces of floods. By engaging in these multifaceted activities, agencies bolster their ability to respond to floods with swiftness, precision, and compassion, ultimately minimizing the impact of these disasters and safeguarding the welfare of affected communities.

### 2.1.1. Developing a flood emergency plan

A flood emergency plan constitutes a set of agreed-upon arrangements serving as a framework for flood management. It provides the progression of emergency management tasks and the respective roles of each participant. This includes defining the responsibilities of various agencies and outlining strategies for executing key flood management functions. These plans serve as a common point of reference for decision-making. The overarching goal of planning is to enhance community resilience in the face of flood risks, thereby mitigating the consequences when floods do occur (ADRI, 2020). Supplementary documents may support flood emergency plans.

These plans are typically developed at various levels, aligning with different tiers of the incident management structure, encompassing communities, local government areas, regions, zones, and state levels.

The essential stages involved in crafting a flood emergency plan are taken from the Australian Institute for Disaster Resilience (AIDR,2020).

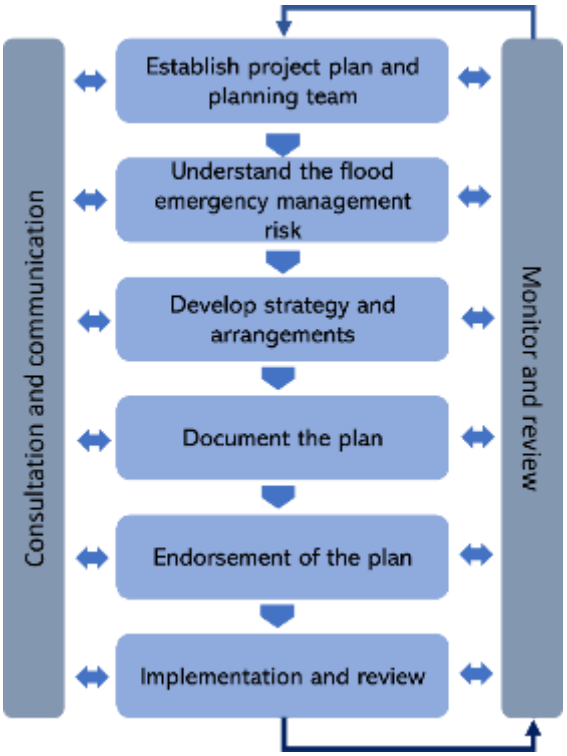


Figure 2.1. Flood emergency plan (Adapted from ADRI, 2020).

The ultimate goals of the flood planning process should encompass two main objectives. First, it involves creating a well-documented flood emergency plan, which serves as a detailed blueprint for how to respond to a flood event. Second, it aims to establish a deep and comprehensive understanding of this plan, as well as a strong commitment to its implementation, among all stakeholders who may be called upon to manage a flood emergency. The plan should be clear, comprehensive, and readily embraced by everyone involved in flood response, ensuring that they are well-prepared and committed to the established emergency arrangements. The following steps are at the core of the planning process:

- ***Establish project plan***: Developing an emergency plan is akin to a project, necessitating the establishment of a project plan to guide the process. Project planning allows for a comprehensive understanding of the key stages involved, and project

management methodologies can be employed for this purpose. Involving key stakeholders in the planning process is crucial for fostering understanding, acceptance, and utilization of the emergency plan. Stakeholder analysis helps identify the relevant parties, such as flood control agencies, local governments, flood hazard leaders, and community representatives. A core flood emergency planning team takes responsibility for plan preparation, while outside expertise and community input are encouraged. The team operates under the governance of relevant emergency management committees and is led by the lead agency for flood emergency management. The involvement of knowledgeable and senior team members is vital, and separate committees may be necessary for different communities. The planning process often involves consultation with technical specialists and agencies responsible for specific flood-related tasks. Lastly, engaging flood-prone communities is essential, as their participation fosters a sense of ownership and commitment to the flood emergency plan.

- ***Understand flood emergency management risk***: Flood risk arises when the potential for flooding intersects with valuable elements of the community and the physical environment. To develop effective emergency management strategies, it's imperative to comprehend the flood behavior, its consequences, likelihood, and associated risks thoroughly. This understanding should encompass all magnitudes of flooding, whether triggered by natural events or human-made factors like dam failure or storm surges. Collaborating with flood risk management and dam management agencies and professionals is essential in this process. Analyzing the emergency management risks posed by floods requires planners to conduct a risk analysis. Guidance on gaining this understanding can be found in Chapter 3 of "Managing the Floodplain" (AIDR 2017), which further details the flood study process. The culmination of flood information and flood emergency management risk analysis should be summarized in flood emergency plans using clear and easily comprehensible formats, such as tables, maps, and flood intelligence records, to facilitate the work of incident management teams.
- ***Develop strategy and arrangements***: Flood emergency plans should outline the operational goals and priorities. The plans should also lay out the strategies and agreements necessary to achieve these goals, specifying the roles and responsibilities for implementation. These strategies should be developed through a thorough analysis of the required actions. The flood emergency planning team can brainstorm various feasible approaches to address identified risks and plan objectives. Subsequently, the

most practical ideas are further evaluated by considering the practical challenges posed by flooding. Conducting plan exercises can help assess the effectiveness of different strategies. In cases where multiple strategies are proposed, criteria can be applied to determine which strategy is the most suitable for meeting the operational goals.

- ***Document the plan***: Plans should be well-documented to ensure clarity for their intended audience. They should be succinct and considerate of the individuals who will rely on them. The use of templates can be valuable in achieving this goal, promoting uniformity in format and content across various plans. It's essential that these templates offer flexibility in their content, enabling users to tailor them to the specific needs of the areas covered by the plans.
- ***Endorsement of the plan***: Plans must receive official approval from a suitable authority, such as emergency management, disaster management, or counter disaster committees. The endorsement process may be outlined in legislation or emergency management policies specific to each jurisdiction. Before presenting a plan for endorsement, it is essential to engage in consultation with key stakeholders. This should involve considering their feedback and subjecting the plan to a quality assurance process to ensure it meets the necessary standards.
- ***Implementation and review***: Flood emergency plans and associated intelligence records inform decision-making for incident management teams and stakeholders. They should also guide incident action planning and be made available to the public to provide insights into strategies, arrangements, and risk information. For plans to remain effective, regular implementation is crucial. They should be kept up to date through exercises, reviews, training, and community engagement. Exercises help identify necessary strategies, responsibilities, and procedural improvements, while educating emergency personnel and the community. Regular reviews ensure that plans remain relevant and accurate, involving an evaluation after each flood operation, in response to significant changes in land use or community characteristics, new flood-related study findings, alterations to flood warning systems, changes in flood control or mitigation works, adjustments to agreed plan arrangements, significant personnel changes, or when inquiries or research recommend new practices.
- ***Consultation and communication***: Effective communication and consultation are critical at every stage of the planning process. Involving stakeholders, including the community, fosters a sense of ownership. Therefore, project planning should include

well-thought-out strategies for communication and consultation among agencies and community stakeholder groups. The active participation of communities in the planning process is especially important.

### 2.1.2. Identifying flood-prone areas and potential hazards

Flood hazards are typically categorized based on their sources and characteristics. These sources can include river flooding, coastal or storm surge flooding, flash flooding, and urban flooding. Each type of flood hazard has its unique characteristics and requires specific methods for identification. To effectively address these hazards, we must have a comprehensive understanding of the geographical, hydrological, and meteorological factors that contribute to flooding.

Several tools and technologies are in use nowadays to identify flood-prone areas and relative hazards. Most of these techniques are used by GIS analysts, planners, geologists, and emergency managers to easily analyze terrain configurations. Below, it will be provided a general overview of such tools.

1. **Geographic Information Systems (GIS)**

GIS is a powerful tool for analyzing and visualizing spatial data. It combines geographical information, such as elevation, land use, and precipitation, to create maps that highlight flood-prone areas. By integrating various layers of data, GIS can provide valuable insights into the susceptibility of specific regions to flooding. This technology enables planners and emergency managers to make informed decisions about land use, infrastructure development, and evacuation planning.

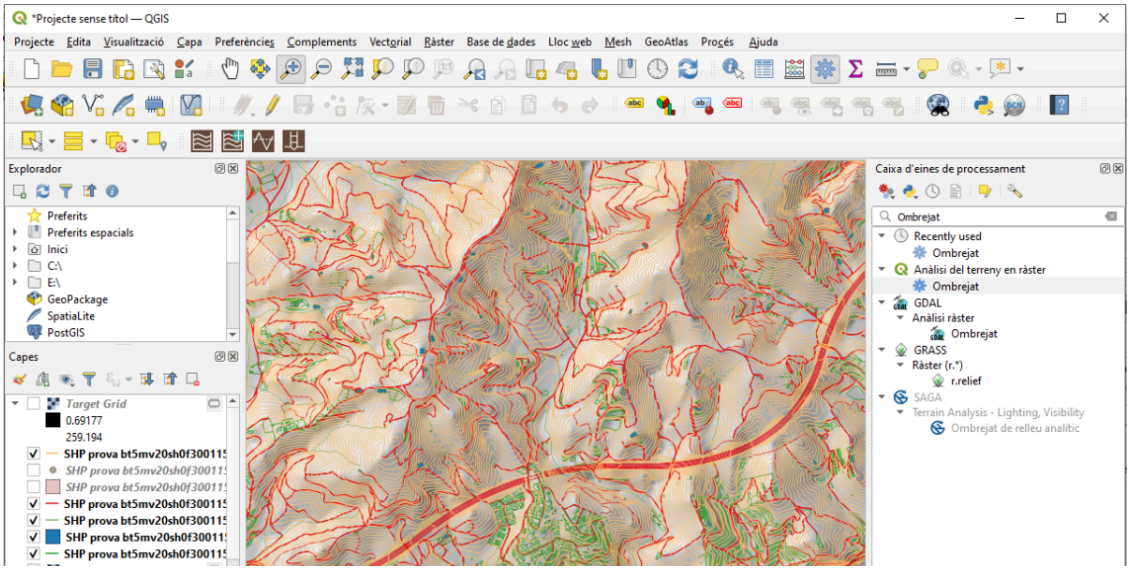


Figure 2.2. GIS application: QGIS.

## 2. Remote Sensing

Remote sensing involves the use of satellite imagery, aerial photography, and other airborne sensors to collect data on the Earth's surface. This data can be used to monitor land cover changes, detect flood events, and assess the impact of flooding. Remote sensing technology can help identify areas that are prone to floods, monitor water levels, and evaluate the extent of damage during and after a flood event.

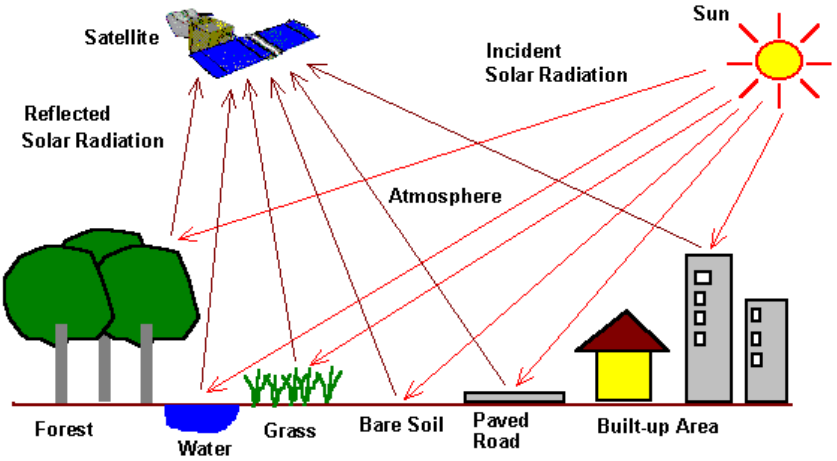


Figure 2.3. Remote sensing - system framework.

## 3. Hydrological Models

Hydrological models simulate the movement of water within a watershed. These models use rainfall, topography, soil properties, and land use data to predict river discharge and flood

extent. Models such as HEC-RAS (Hydrologic Engineering Center's River Analysis System) and HEC-HMS (Hydrologic Engineering Center's Hydrologic Modeling System) are widely used for flood hazard assessment and floodplain mapping.

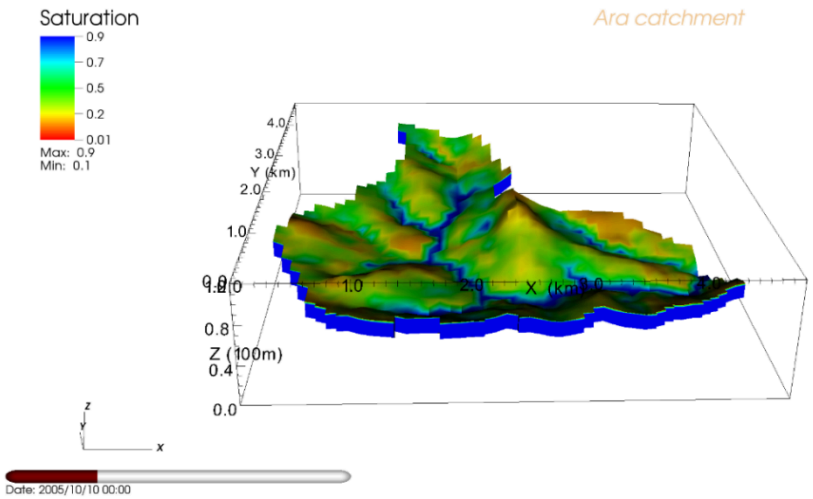


Figure 2.4. Representation of Hydrological modelling system.

## 4. Radar Technology

Weather radar systems can provide real-time information on precipitation intensity and movement, which is crucial for monitoring and predicting floods. Doppler radar technology can track the speed and direction of rainfall, helping meteorologists issue timely flood warnings. Dual-polarization radar can also distinguish between different types of precipitation, aiding in flood prediction.

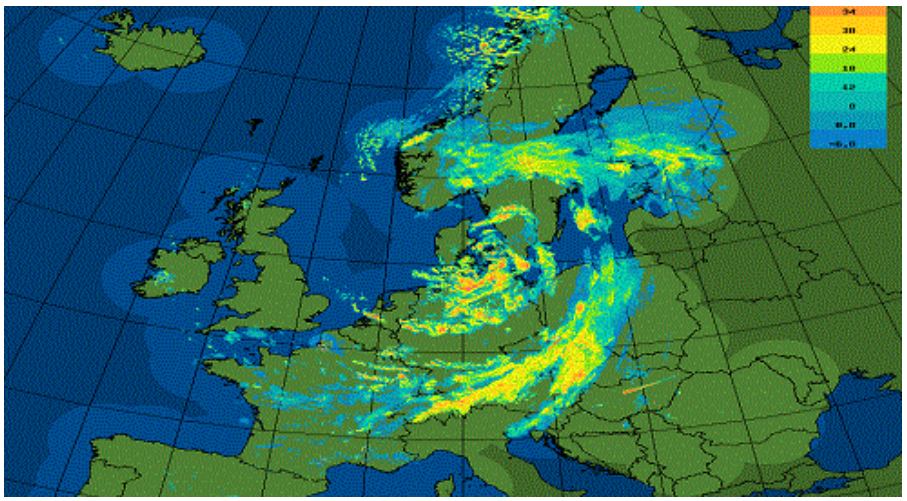

Figure 2.5. Representation of radar weather forecast.

## 5. LiDAR (Light Detection and Ranging)

LiDAR technology uses laser beams to create highly detailed and accurate elevation models of the Earth's surface. This data is valuable for mapping terrain and identifying flood-prone areas, as it allows for the precise measurement of ground elevation and the creation of high-resolution floodplain maps.

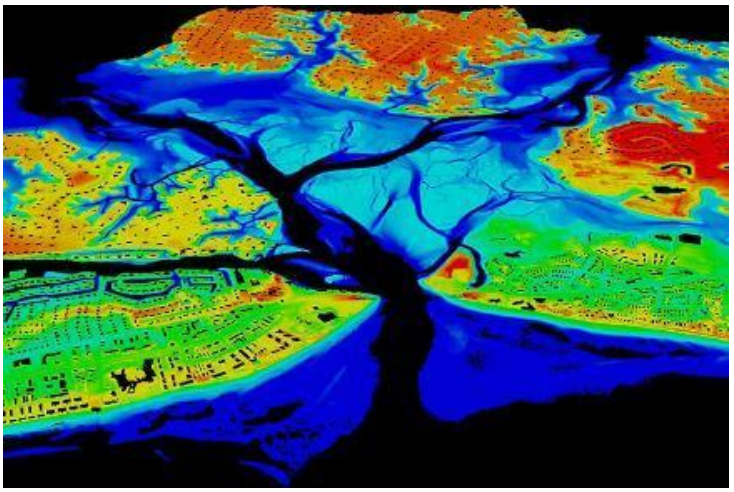

Figure 2.6. LIDAR model.

### 6. Floodplain Mapping

Floodplain maps are essential tools for identifying flood-prone areas. These maps are created through a combination of data sources, including GIS, remote sensing, LiDAR, and hydrological models. They delineate the boundaries of flood-prone regions and indicate the likelihood and severity of flooding, helping local authorities make informed decisions regarding land use and infrastructure development.

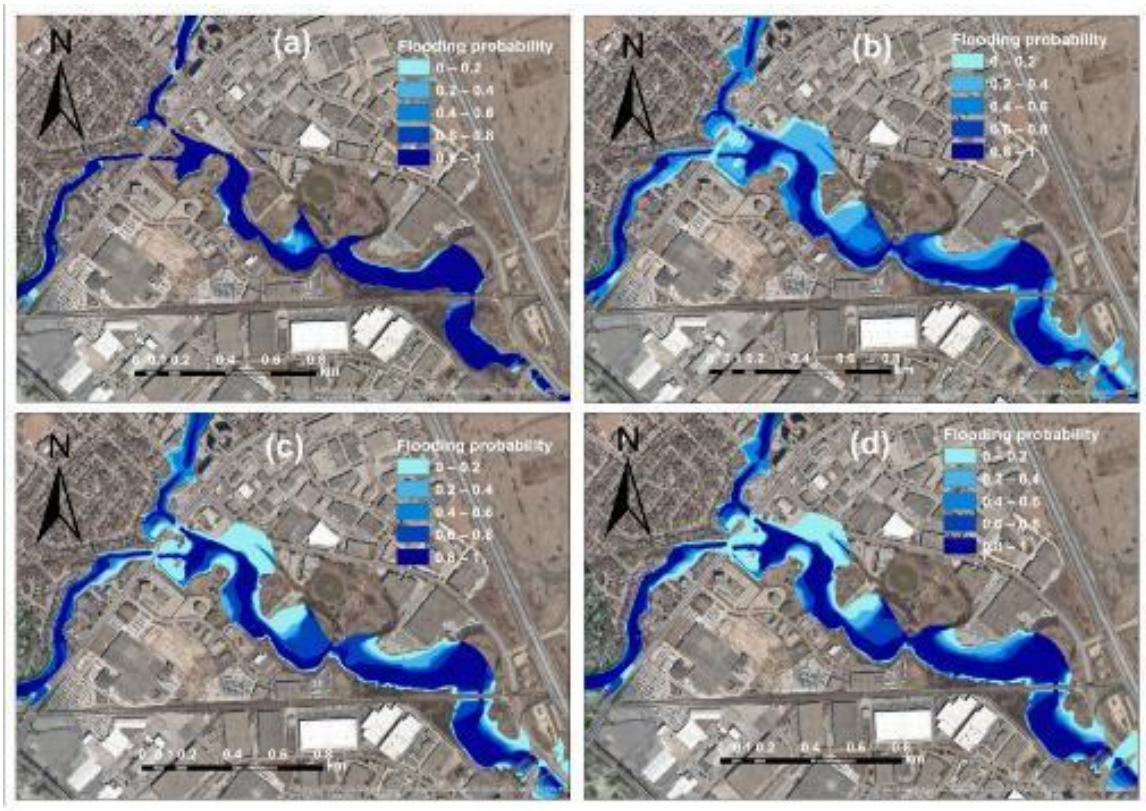


Figure 2.7. Representation of a floodplain mapping process.

### 7. Weather Forecasting and Early Warning Systems

Weather forecasting technology, including numerical weather prediction models, allows meteorologists to predict rainfall patterns and intensity. Coupled with early warning systems, this technology can provide advance notice of potential flood events, giving communities time to prepare and evacuate if necessary.

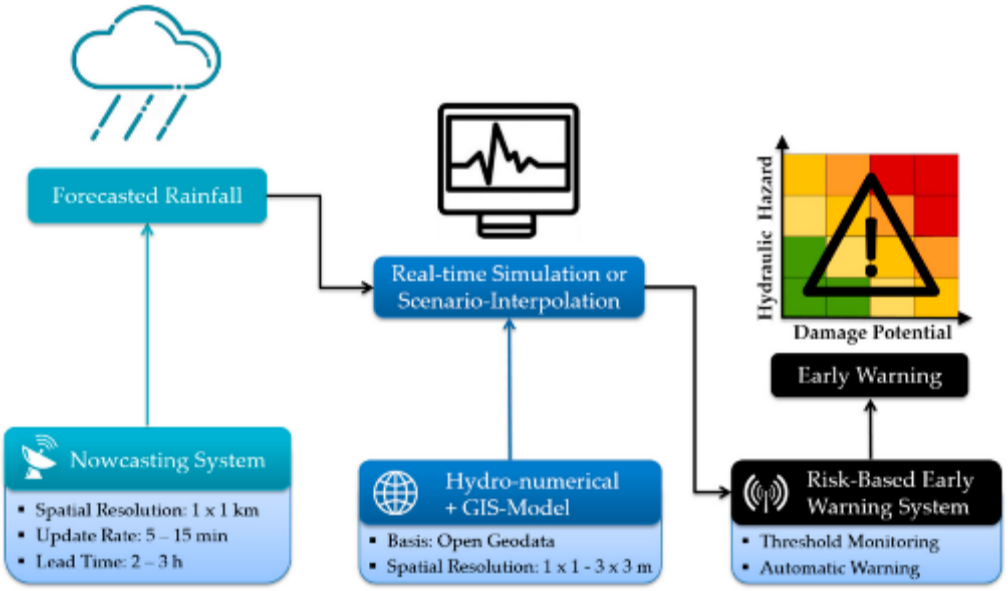


Figure 2.8. Early Warning system architecture.

### 8. Crowdsourcing and Social Media

In recent years, social media and crowdsourced data have become increasingly valuable in identifying flood hazards. Crowdsourcing refers to the practice of gathering information, data, or contributions from a large and diverse group of individuals, typically using digital platforms and technology. In the context of flood hazard identification, crowdsourcing has emerged as a valuable resource for collecting real-time data, reports, and observations from the public. Crowdsourcing leverages the power of the crowd to provide real-time information on flood events. This can include reports of flooded streets, rising water levels, and even the impact of floods on homes and infrastructure. The immediacy of this information can be crucial for emergency response and decision-making.

Crowdsourced data can be validated and cross-referenced with official data sources to ensure accuracy. This verification process helps in reducing false alarms and misinformation, ensuring that emergency responders are working with reliable information.

Crowdsourced data continues to be valuable even after a flood event has occurred. It can assist in assessing the extent of damage, identifying areas in need of immediate assistance, and tracking recovery progress.

While these tools and technologies have significantly improved our ability to identify flood-prone areas and potential hazards, several challenges and limitations exist:

1. Data Quality and Availability: Accurate and up-to-date data are essential for effective flood hazard identification. In some regions, data may be limited or of poor quality, hindering the accuracy of flood risk assessments.
2. Funding and Resources: The deployment and maintenance of advanced technologies can be costly. Many regions, especially in developing countries, may lack the financial resources to invest in these tools.
3. Complex Interactions: Flood hazards often result from complex interactions between various factors, including climate change, land use, and urban development. Identifying the specific causes of flooding can be challenging.
4. Human Error: Even with advanced technology, human error in interpreting and acting on data can still lead to inadequate flood preparedness.

Identifying flood-prone areas and potential hazards is a fundamental aspect of flood disaster preparedness. Modern tools and technologies, including GIS, remote sensing, hydrological models, radar technology, LiDAR, floodplain mapping, weather forecasting, early warning systems, and crowdsourced data, have revolutionized our ability to assess flood risks and take proactive measures to mitigate their impact. While challenges remain, the ongoing advancement of technology and the integration of these tools into comprehensive flood hazard assessment strategies offer a promising future in building resilience against one of nature's most formidable forces.

### 2.1.3. Assessing risks and vulnerabilities

A Flood Risk Assessment (FRA) is a comprehensive evaluation aimed at determining the potential risk of flooding from various mechanisms, identifying effective flood mitigation measures, and offering guidance on actions to be undertaken both before and during a flood. Floods can originate from diverse sources of water, including groundwater (saturated groundwater), vadose (water flowing through the ground in an unsaturated state), surface water, artificial water (burst water mains, canals, or reservoirs), rivers, streams, watercourses, sewers, drains, and even flooding in low-lying coastal regions due to sea level rise. Each water source presents different hydraulic intensities, and floods may result from a combination of these sources, such as high groundwater coupled with an inadequate surface water drainage system. To conduct a thorough flood risk assessment, one must consider the topography, hydrogeology, and physical attributes of the existing or proposed development,

ensuring a comprehensive evaluation of the flood risk, its consequences, impact, and vulnerability.

The foundation of a Flood Risk Assessment is reliant on obtaining updated information about existing and proposed developments, Environment Agency modeled flood levels, and topographic levels on the site. At its simplest and most cost-effective level, an FRA can provide an initial indication of whether a development is permissible at a given site. Each Environment Agency presents a flood map website and can offers an initial overview of flood risk in a local area, providing a starting point for assessment.

However, a more in-depth FRA involves a detailed analysis of available data to inform the Environment Agency of flood risk at a specific site, recommending mitigation measures to the developer. More intricate analyses of flood risk can be achieved through detailed flood modeling.

A comprehensive Flood Risk Assessment (FRA) typically comprises several core elements to evaluate the potential risk of flooding, identify mitigation measures, and guide decision-making. The key components of a typical FRA include:

1. **Site Description and Context:**
    - Provides a detailed description of the existing and proposed developments.
    - Offers context on the surrounding environment, including topography, hydrogeology, and land use.
2. **Identification of Flood Sources:**
    - Analyzes various sources of flooding, such as groundwater, vadose, surface water, artificial water, rivers, streams, watercourses, sewers, drains, and coastal regions.
    - Considers potential combinations of these sources that could contribute to flooding.
3. **Hydraulic Intensity Analysis:**
    - Examines different hydraulic intensities associated with each water source.
    - Evaluates the potential impact of flood events with varying intensities on the site.
4. **Topographic and Hydrogeological Considerations:**

- Considers the topography and hydrogeology of the site, as these factors influence how water behaves in the area.
- Examines the physical attributes of the site, including elevation and soil permeability.

5. **Environment Agency Modeled Flood Levels:**
    - Utilizes data from relevant authorities, such as the Environment Agency, to understand modeled flood levels in the area.
    - Compares and integrates this data with site-specific information for a comprehensive analysis.
6. **Vulnerability and Consequence Assessment:**
    - Assesses the vulnerability of the site and surrounding area to flooding.
    - Considers the potential consequences of flooding, including damage to property, infrastructure, and the environment.
7. **Climate Change Considerations:**
    - Incorporates considerations for climate change impacts on future flood risk.
    - Anticipates potential changes in weather patterns, sea levels, and other climatic factors.
8. **Mitigation Measures:**
    - Recommends specific measures to mitigate the identified flood risks.
    - May include both structural (e.g., flood defenses, barriers) and non-structural measures (e.g., land use planning, early warning systems).
9. **Local Area Impact Assessment:**
    - Examines how the proposed development may impact flooding in the local area.
    - Considers both direct and indirect effects on the broader community and ecosystem.
10. **Recommendations for Risk Reduction:**
    - Provides clear recommendations on how to reduce the risk of flooding to the development.
    - Offers guidance on sustainable and resilient development practices.
11. **Incorporation of Latest Scientific Insights:**
    - Adapts to evolving scientific knowledge and incorporates the latest research in flood risk assessment.
    - Ensures that the FRA remains current and relevant over time.

**12. Regulatory Compliance:**

- Ensures that the FRA adheres to relevant regulatory standards and guidelines.
- May be required to meet specific legal requirements and planning regulations.

The Flood Risk Assessment plays a pivotal role in informing decision-making processes related to development in flood-prone areas. By identifying potential risks, recommending mitigation measures, and considering the broader impact on the local environment, the FRA serves as a valuable tool for sustainable development. As climate change continues to influence weather patterns and sea levels, the importance of thorough and accurate FRAs becomes even more pronounced in safeguarding communities, infrastructure, and the environment from the increasing threat of flooding.

### 2.1.4. Developing evacuation plans

Evacuation is a strategic measure employed to minimize the loss of life and mitigate the impact of a hazard on a community, whether it occurs before or during a disaster. This proactive approach involves relocating individuals under threat from a hazard to a safer location and ensuring their secure and timely return. The removal of people from the imminent danger is often the most effective means of safeguarding public safety, emphasizing the need for meticulous planning and execution to maximize effectiveness (Australian Institute for Disaster Resilience, 2017; North Somerset Council, 2023).

The duration and nature of the evacuation process depend on the hazard and its potential effects on communities. Evacuations may unfold in an unprecise span of time, with varying levels of urgency and distances covered. For instance, swift evacuations might be prompted by warnings to move to higher ground in anticipation of a potential tsunami or flash flooding. In contrast, individuals may be advised to relocate only a short distance away from a rural-urban interface to escape a bushfire threat (Australian Institute for Disaster Resilience, 2017).

Evacuations can be categorized into two types: pre-warned and immediate. A pre-warned evacuation occurs when a community receives advance notice of an impending hazard, allowing for coordinated preparedness and response actions in line with an evacuation plan, such as those for floods, cyclones, or bushfires. On the other hand, an immediate evacuation is triggered by a rapidly onset hazard, providing little to no opportunity to warn those affected.

Events like earthquakes, structural collapses, gas explosions, active shooter incidents, or transport accidents necessitate swift and urgent protective movements.

In scenarios involving complex and simultaneous events, a two-step evacuation process may be required for both immediate and pre-warned evacuation situations. The initial step involves moving communities out of harm's way from the hazard, while the second step focuses on relocating communities to designated evacuation centers once the risk has dissipated.

According to the Australian Institute of Disaster Resilience (2017), evacuations can further be classified based on their scope:

- *Total evacuation*: Everyone in the affected communities is recommended or directed to evacuate.
- *Partial evacuation*: Only specific residents, such as those in low-lying areas directly impacted by floodwaters, are required to evacuate.
- *Phased evacuation*: Affected communities are recommended or directed to evacuate at different times, either due to the gradual onset of a hazard or to avoid congestion on transport routes.

The approach to evacuation is influenced by the emergency's characteristics, whether it is a rapid-onset situation requiring immediate evacuation or a slow-onset or pre-warned event allowing more time for the implementation of evacuation strategies.

Evacuation methods can be:

- *Ordered evacuation*: Implemented when a relevant government organization exercises legislated powers requiring people to evacuate.
- *Recommended evacuation*: Involves issuing evacuation warnings, allowing individuals the option to remain or evacuate.
- *Self-initiated evacuation*: Occurs when individuals independently choose to move to safer places prior to or in the absence of official evacuation warnings. This proactive decision-making involves personal transportation and shelter arrangements, with individuals potentially relying on their own resources or formal support services. Planning for self-initiated evacuation is crucial, particularly in the shelter and return stages, considering the expectation of access to support services.

### 2.1.5. Creating a communication plan

Creating a communication plan is no easy job. There is no unique recipe that will fit every single situation. Having a comprehensive communication plan is crucial for effectively managing the risks associated with flooding and ensuring the safety of communities. A well-designed communication plan facilitates timely and accurate dissemination of information, raises awareness, and guides individuals on appropriate actions before, during, and after a flood event. Emergency managers, agencies and voluntary organization must strive to find the correct balance in crafting the message to deliver to the communities in case of imminent flood and subsequent evacuation. Creating a communication plan entails several key steps.

First, is it necessary to understand the community: to develop an effective communication plan, it is essential to understand the demographics, language preferences, and communication channels preferred by the community at risk. Demographic factors such as age, socio-economic status, and cultural background can influence the effectiveness of communication strategies. Tailoring messages to resonate with the specific needs and characteristics of the community enhances the plan's overall impact.

Second, using a multi-channel approach, will ensure agencies to reach the widest possible audience. Utilizing various platforms such as social media, local news outlets, community bulletins, emergency alert systems, and mobile applications enables comprehensive coverage. Recognizing that different segments of the population may rely on different channels necessitates a diverse and adaptable communication strategy.
Moreover, implementing early warning systems is an essential aspect of flood hazard communication. Leveraging technology, such as automated alerts, sirens, and mobile notifications, allows for timely dissemination of warnings. Coordination with meteorological agencies and the integration of real-time data into communication systems enhance the accuracy and effectiveness of early warnings.

Effective communication requires clear and actionable messaging. During a flood hazard, agencies should prioritize clarity and actionability. Messages must be concise, easily understandable, and provide specific guidance on protective actions. Clear instructions on evacuation routes, shelter locations, and emergency contacts empower individuals to make informed decisions in a time-sensitive environment.

During “peace times”, it is essential for agencies to engage with the community, carrying out education and preparedness programs. Events like workshops, drills, and educational campaigns can inform residents about flood risks, preparedness measures, and the importance of heeding official warnings. Engaging the community in the planning process fosters a sense of ownership and collective responsibility.

Emergency management agencies must also collaborate with relevant stakeholders, including local government agencies, emergency responders, community leaders, and non-profit organizations. This will strengthen the not just the communication plan, but the overall communication process among stakeholders and within the community.

It is also important to remember that in some places exist communities with diverse needs, for example linguistic minorities, that do not speak the national language. Agencies mandated with the task of developing the communication plan should consider the inclusion of such needs - individuals with disabilities, non-English speakers, and those with limited access to traditional communication channels – and be able to provide information in multiple languages, utilizing visual aids, and incorporating accessible formats contribute to the inclusivity of the communication plan.

Communication continues also after an event. Emergency managers and agencies must consider that effective communication extends beyond the immediate response phase. Providing post-event updates, recovery information, and resources for affected individuals fosters a sense of community support. Addressing concerns, sharing progress, and maintaining transparent communication contribute to the overall resilience of the community in the aftermath of a flood.

As the events progress, in the disaster aftermath it is imperative that the communication plan is regularly reviewed, through a feedback mechanism and a post-incident evaluation. This will allow stakeholders to analyze the effectiveness of communication strategies, identifying areas for enhancement, and incorporating lessons learned from past events contribute to the plan's adaptability and effectiveness over time.

### 2.1.6. Understanding warning systems and alerts

The process of issuing warnings plays a pivotal role in disaster management, particularly in the context of potential hazards such as floods, earthquakes, and volcanic eruptions. Warnings

are recommendations or orders for action based on predictions or forecasts, with the responsibility typically falling on public administrators, especially at the regional or local authority level. The warning process involves three interconnected subsystems: technical, administrative, and social.

The effectiveness of warnings is influenced by various factors, beginning with the predictability of the hazard. Challenges arise when predictions are imprecise, especially in cases where there are no clear precursors, or the speed of onset limits the time available for assessment and warning issuance. Different hazards exhibit varying levels of predictability; for instance, floods, snow avalanches, hurricanes, and storms often provide identifiable precursors, while earthquakes remain largely unpredictable in the short term.

A well-designed warning system comprises technical and social components, monitoring and evaluation procedures, technology and organization, planning, and communication. Each of these components is integral to the overall effectiveness of the warning process. The stages of implementation involve recognizing the need for a warning, deciding whom to warn, designing, installing, and testing the system, and educating the public on understanding and responding to warning messages.

The content of a warning message is crucial, including details on the nature, timing, geographical scope, expected consequences, required actions, and contact information for further inquiries. The communication means are diverse, ranging from traditional media such as television and radio to newer methods like SMS text messages delivered to mobile phones. The choice of communication channels depends on factors such as the time of day and the accessibility of the target audience.

Understanding how people react to warnings is complex. There is a continuum of responses, with some individuals acting promptly, others evaluating or delaying action, and some possibly denying the threat altogether. Factors influencing reactions include personality, individual experience, and social context. Confirmation behavior, the tendency to seek verification from authoritative sources, is a significant aspect of how individuals process warnings.

The warning process is not without challenges, one of which is the potential for false alarms. False alarms can affect public trust in warnings, and their impact varies among different individuals and communities. The success of warnings relies on accurate predictions, clear

messaging from official sources, and the continuous monitoring of reception and compliance rates.

### 2.2. Post-Flood Recovery and Restoration

Post-flood recovery and restoration are critical phases in the aftermath of a flood event, focusing on rebuilding communities, infrastructure, and ecosystems. Before introducing the necessary steps for achieving a successful post-flood recovery, it is necessary to briefly introduce the concept of recovery. The concept of recovery in emergency management refers to the coordinated activities and strategies that aim to restore the social, infrastructural, and economic fabric of communities after disasters (Cavaliere, 2019). Recovery is a complex process that takes place at distinct stages and presents different results and outcomes. Key elements play critical roles in achieving successful recovery, including debris removal, shelter/housing, damage and needs assessment, infrastructures, and financial assistance (Phillips, 2015). These processes aim together to restore normalcy, enhance resilience, and reduce future vulnerabilities. The post-flood recovery and restoration efforts involve a combination of social, economic, and environmental measures, such as:

1. **Infrastructure Rehabilitation:**
    - *Housing and Buildings:* Rebuilding homes and structures damaged or destroyed during the flood is a priority. This may involve repairing existing structures, constructing new resilient buildings, or relocating communities away from flood-prone areas.
    - *Transportation:* Repairing roads, bridges, and other transportation infrastructure is essential for restoring connectivity and facilitating the movement of goods and people.
    - *Utilities:* Restoring and upgrading water supply, sewage, and electrical systems is crucial for ensuring basic services and preventing health hazards.
2. **Economic Recovery:**
    - *Small Business Support:* Supporting small businesses affected by the flood through financial assistance, low-interest loans, and technical support can contribute to local economic recovery.
    - *Agriculture:* Rehabilitating damaged agricultural areas, providing seeds and livestock, and offering training on flood-resistant farming practices help restore livelihoods in rural communities.

- *Employment Opportunities:* Creating temporary employment opportunities through public works projects can provide income for affected individuals while contributing to community reconstruction.

3. **Social Rehabilitation:**
   - *Psychosocial Support:* Addressing the mental health and well-being of individuals affected by the flood is crucial. Counseling services, community support groups, and mental health resources can aid in recovery.
   - *Education:* Rebuilding and reopening schools, providing educational materials, and supporting students and teachers affected by the flood contribute to the restoration of normalcy.
   - *Community Engagement:* Involving affected communities in the decision-making process and planning for recovery fosters a sense of ownership and resilience.
4. **Environmental Restoration:**
   - *Ecosystem Rehabilitation:* Restoring damaged ecosystems, such as wetlands and riverbanks, helps enhance natural flood defenses and biodiversity.
   - *Riparian Zone Protection:* Implementing measures to protect riparian zones and natural vegetation along water bodies helps prevent future flooding and erosion.
   - *Waste Management:* Proper disposal of debris and waste generated during the flood is crucial for environmental conservation. Recycling and sustainable waste management practices should be considered.
5. **Risk Reduction and Preparedness:**
   - *Infrastructure Resilience:* Integrating flood resilience into infrastructure planning and construction helps mitigate future flood risks.
   - *Early Warning Systems:* Enhancing and expanding early warning systems improves preparedness and reduces the impact of future flood events.
   - *Community Education:* Educating communities about flood risks, evacuation procedures, and preparedness measures is essential for building resilience and reducing vulnerability.
6. **Government and Policy Actions:**
   - *Policy Reforms:* Governments may need to review and reform land-use planning, building codes, and zoning regulations to minimize future flood risks.
   - *Financial Assistance:* Governments and international organizations may provide financial assistance and grants to support recovery efforts, especially in developing countries with limited resources.

7. **International Cooperation:**
    - *Collaboration:* International cooperation and collaboration among governments, non-governmental organizations, and international agencies can provide additional resources, expertise, and support for post-flood recovery and restoration.

The period following a flood disaster presents significant challenges, necessitating a proactive engagement of disaster recovery managers to mitigate these challenges (Cavaliere, 2019). While the restoration of pre-disaster conditions may not always be feasible, effective flood disaster recovery is pivotal in establishing a new normalcy. Recovery managers must oversee multifaceted operations spanning various sectors, such as rebuilding housing, restoring businesses, and reviving critical infrastructures. The strategic nature of recovery planning enhances the capacity of public agencies to execute recovery operations proficiently and enables them to anticipate necessary changes and implement measures to minimize the impact of future hazards.

### 2.2.1. Assessment of damage and needs

Post-flood disaster damage and needs assessment is a complex and multifaceted process that plays a crucial role in understanding the extent of devastation and formulating effective strategies for recovery (Bollin & Khanna, 2007; FEMA, 2016; Jeggle & Boggero, 2018). Floods, being one of the most common and destructive disasters, can result in widespread destruction of infrastructure, displacement of populations, loss of lives, and economic upheaval. Conducting a comprehensive assessment in the aftermath of a flood is indispensable for various reasons, ranging from providing immediate relief to formulating long-term recovery plans (FEMA, 2016).

Post-flood assessments include a variety of task to be conducted, in order to have a grasp of the severity of the damage. The first aspect of post-flood damage assessment involves evaluating the physical infrastructure affected by the deluge. This encompasses a meticulous examination of buildings, roads, bridges, and other critical structures. Engineers and experts in structural integrity can determine the extent of damage and the feasibility of repair or reconstruction. Not only does this provide insights into the immediate repair needs, but it also helps in identifying vulnerabilities in existing infrastructure and devising strategies for building resilience against future flood events (Jeggle & Boggero, 2018).

The economic fallout of a flood constitutes another critical dimension of the assessment. This involves an in-depth analysis of the economic losses incurred by businesses, agricultural activities, and overall productivity in the affected region (Bollin & Khanna, 2007). Economists, business analysts, and agricultural experts collaborate to estimate the financial toll, considering factors such as damaged crops, disrupted supply chains, and the closure of businesses. Understanding the economic impact is crucial for the development of targeted recovery plans that aim to restore livelihoods and promote economic stability in the post-flood scenario.

Environmental repercussions also need to be considered within the assessment process. Floods can result in soil erosion, water pollution, and the disruption of ecosystems. Environmental scientists and conservationists work to evaluate the ecological damage and formulate strategies for environmental restoration. This includes assessing the quality of water sources, the impact on flora and fauna, and the long-term implications for biodiversity. Integrating environmental considerations into the overall assessment is essential for sustainable recovery efforts that not only rebuild communities but also ensure the health and resilience of the natural environment (Bollin & Khanna, 2007; Jeggle & Boggero, 2018).

Humanitarian aspects of the assessment process must be considered, especially when flood disasters strike in underdeveloped countries. The assessment involves a detailed survey of casualties, injuries, and the displacement of individuals and communities. Humanitarian organizations (such as the International Federation of Red Cross Red Crescent; Doctors without Borders) and healthcare professionals collaborate to understand the immediate medical needs of the affected population, including the provision of emergency medical care, shelter, and clean water. Additionally, the mental health impact of the flood is often assessed, as trauma and stress can have long-lasting effects on the well-being of the affected communities.

Another aspect to consider when assessing damages and needs, is the social and cultural sensitivity of a country. Floods can profoundly affect the fabric of communities and their cultural heritage. Experts in social and cultural studies are usually deployed in specialized teams to collaborate with community leaders to understand the social dynamics, community cohesion, and the preservation of cultural assets. This aspect of the assessment is crucial for designing recovery plans that respect and integrate the cultural identity of the affected communities, fostering a sense of continuity and belonging amidst the upheaval.

Once the damage assessment is complete, the identification of immediate and long-term needs emerges as the next critical step. In the immediate aftermath, the focus is on addressing urgent and life-saving needs. This includes the provision of emergency shelter, food, clean water, and medical care (Bollin & Khanna, 2007; FEMA, 2016; Jeggle & Boggero, 2018). Coordination between governmental agencies, non-governmental organizations (NGOs), and international aid organizations is vital to ensure a swift and effective response to the most pressing needs of the affected population. At the same time, the assessment informs agencies and policy-makers for the development of a comprehensive and strategic recovery plan. This plan considers the findings of the damage assessment and aligns with the broader goals of rebuilding a resilient and sustainable community. Infrastructure reconstruction, economic revitalization, environmental restoration, and social and cultural preservation become integral components of the recovery plan (Bollin & Khanna, 2007; Jeggle & Boggero, 2018).

Post-flood disaster damage and needs assessment form the foundation of an effective and sustainable recovery process. The multidimensional nature of the assessment, covering physical infrastructure, human and humanitarian aspects, economic considerations, environmental impact, and social and cultural dimensions, ensures a holistic understanding of the challenges and opportunities presented by a flood. The transition from assessment to recovery planning and implementation requires collaboration, community engagement, and a long-term perspective that goes beyond immediate relief to build resilient and adaptive communities in the face of future flood events.

### 2.2.2. Identifying and addressing immediate needs

Floods are devastating and can cause widespread damage. Roads are useless; lifelines are disrupted; communities are isolated and hard to reach. People might suffer not just the loss of their houses, but might be in need of immediate assistance, eg. medical. What is tantamount after a flood, is to identify and address immediate needs to ensure the safety and well-being of affected individuals. It will be briefly described several major areas of internvantion when addressing immediate needs.

1. **Assessment of immediate needs:** After a flood, the first step is to conduct a thorough assessment of immediate needs. This involves evaluating the extent of damage to homes, infrastructure, and essential services. Emergency responders, local authorities,

and humanitarian organizations play a crucial role in this assessment. They should prioritize identifying the following:

a) **Shelter:** determine the number of displaced individuals and assess the availability of safe and secure shelter options.
b) **Food and water:** ensure access to clean drinking water and assess the availability of food supplies, especially for those who have lost their homes.
c) **Medical care:** identify and address immediate medical needs, including injuries, illnesses, and the potential spread of waterborne diseases.
d) **Search and rescue:** prioritize search and rescue operations to locate and assist individuals who may be stranded or in immediate danger.

2. **Emergency shelter and accommodation:** providing emergency shelter is a top priority after a flood. Local authorities and voluntary organizations should establish temporary shelters in safe locations (high raise buildings or far from the affected area), equipped with basic comforts such as bedding, sanitation facilities, and medical services. Additionally, arrangements should be made for vulnerable populations, including the elderly, children, and individuals with special needs.
3. **Food and water distribution: e**stablishing food and water distribution points is crucial to ensure that affected individuals have access to essential supplies. Coordination with local food banks, government agencies, and non-governmental organizations is vital to efficiently distribute food and water to those in need. Hygiene and sanitation measures should also be implemented to prevent waterborne diseases.
4. **Medical assistance:** floods often result in injuries, waterborne illnesses, and the exacerbation of existing health conditions. Immediate medical assistance and the setup of mobile health clinics are essential to address the health needs of the affected population. Adequate supplies of medications, first aid kits, and medical personnel should be made available. In addition is it vital to provide psychosocial support through counseling services, support groups, and community engagement initiatives is essential. This helps individuals cope with the emotional impact of the disaster and promotes resilience within the community.
5. **Search and rescue operations:** swift and effective search and rescue operations are critical (see chapter 5), especially in the early stages after a flood. Trained personnel equipped with appropriate tools and resources should be deployed to locate and evacuate individuals stranded by floodwaters. Communication systems must be established to facilitate coordination between rescue teams.

6. **Communication and Information Dissemination:** establishing effective communication channels is essential for providing accurate information to the affected population. Clear and timely communication about available services, evacuation routes, and safety guidelines helps people make informed decisions. Utilize various communication methods, including social media, radio, and community meetings.
7. **Infrastructure repair and restoration:** as soon as the situation stabilizes, damage assessment is a top priority. This should focus on to repairing and restoring essential infrastructure, such as roads, bridges, and utilities. This helps communities regain a sense of normalcy and facilitates long-term recovery efforts.
8. **Secondary mitigation measures:** in the aftermath of a flood, it is crucial to reflect on the disaster response and identify areas for improvement. Investing in preparedness measures and community education on flood risk mitigation can help minimize the impact of future disasters.

### 2.2.3. Working with emergency services and other organizations

During a disaster, a multitude of actors will gather to manage the response and recovery phase. It is though important that among organizations exist a pre-established coordination system or a command-and-control system, eg. ICS. Therefore, effective coordination among emergency services and various organizations is paramount to ensuring a swift and comprehensive response. Disasters and other emergencies require a seamless collaboration between first responders, government agencies, non-governmental organizations (NGOs), and international aid groups. There are opportunities and challenges about coordinating different actors in managing the disaster.

To better achieve successful response, is it widely accepted that a unified command (or coordinating) structure is essential. This very much depends on the type and extension of the event and national legislation. One of the fundamental aspect of having a unified command structure is the span of control over the operations with the presence of representatives from different emergency services and organizations under a single command, facilitating decision-making and resource allocation. This approach ensures that efforts are synchronized, and each entity operates within a cohesive framework.

Coordination among agencies relies heavily on strong communication systems. Timely and accurate information exchange among emergency services, government agencies, and NGOs

is crucial for informed decision-making. Utilizing advanced communication technologies, such as satellite communication, radio networks, and dedicated emergency response channels, enhances the efficiency of coordination efforts.

Disasters often strain available resources. Coordinated efforts involve the sharing of personnel, equipment, and supplies among various organizations. This sharing of resources helps prevent duplication of efforts, optimizes the use of available assets, and ensures that affected areas receive the support they need promptly.

In addition to the prior key elements, establishing clear roles and responsibilities for each organization involved is essential for smooth coordination. From first responders managing immediate rescue operations to NGOs providing humanitarian aid, delineating specific tasks ensures that everyone contributes in a targeted and efficient manner. This clarity minimizes confusion and maximizes the impact of collective efforts.

Every disaster is unique, presenting its own set of challenges. Coordinated emergency services and organizations must exhibit flexibility and adaptability in their approach. This involves continuously assessing the evolving situation, adjusting strategies accordingly, and being prepared to address unforeseen complications.

In the case of large-scale disasters or those with global implications, international collaboration becomes vital. Coordinating efforts with foreign aid organizations, governments, and international agencies ensures a more comprehensive response. This collaboration facilitates the rapid deployment of resources and expertise to areas in need.

### 2.2.4. Addressing long-term recovery needs

"*Recovery is not only about the restoration of structures, systems and services – although they are critical. A successful recovery is also about individuals and families being able to rebound from their losses, and sustain their physical, social, economic" and spiritual "well-being*" (FEMA, 2014). Recovery does not run out after every single person has returned home, or got back to the workplace. It is a continuous process that can prolong for many years after a disaster (National Voluntary Organizations Acitve in Disaster, 2012; Phillips, 2015; Rubin, 2009). For years, researchers have highlighted the challenges of long-term recovery, and how to address the long-term needs people face (Rubin, 2009).

After a disaster, the first action to undertake is to meet the immediate needs of the population, providing a safe shelter, food, hygiene, psychological and religious support. These tasks can take months, before there is a clear transition to the recovery phase. Public agencies and all the stakeholders involved start planning the activities to help communities recover. Neither short-term nor long-term recovery have a pre-established span of time and sometimes there is no clear line between the two (Phillips, 2015).

Long-term recovery after a flood can be a complex and challenging process that extends well beyond the immediate aftermath. A multitude of studies have highlighted that the process is complex and burdensome, for both the agencies and organizations and the communities. Below it is highlighted some of the challenges and the possible ways to address the recovery needs.

1. **Infrastructure Damage:** floods can cause extensive damage to infrastructure such as roads, bridges, utilities, and buildings. Rebuilding and repairing these structures can be a time-consuming and costly process. Public agencies must establish special public works teams mandated with the task of inspecting the infrastructures; planning for the repairs to be done; prioritizing the repairs.
2. **Housing Issues:** many individuals may lose their homes during a flood (see Katrina 2005; Storm Sandy 2012), leading to a significant demand for temporary and permanent housing solutions. Rebuilding or constructing new homes takes time, and in the interim, there may be a need for adequate shelter. For example, after Storm Sandy, communities faced years of inadequate recovery, leading to extended and inadequate reconstructions; frauds and other financial crimes perpetrated by construction agencies (Cavaliere, 2020).
3. **Economic Impact:** Floods can have a severe impact on the local economy. Businesses may be disrupted or destroyed, leading to job losses and economic downturns. The recovery process involves not only rebuilding businesses but also reestablishing economic stability. This is feasible only by having a vision for the future. Local municipalities and business must have an holistic plan of what a future local business would look like.
4. **Health Concerns:** Flooding can lead to water contamination and the spread of waterborne diseases. Long-term recovery efforts must include measures to ensure public health, such as restoring clean water sources and providing medical care.

5. **Environmental Restoration:** Floods can have a lasting impact on the environment, affecting ecosystems, wildlife habitats, and water quality. Long-term recovery efforts may involve environmental restoration projects to mitigate these impacts (also see par 2.2).
6. **Community Displacement:** Some communities may need to be relocated due to the risk of future flooding. This process can be challenging as it involves not only physical relocation but also preserving the community's social fabric and cultural identity. Several cases are exemplary of community displacement. After Storm Sandy, local agencies opted for buying out acres of land that were flood prone, forcing people to move elsewhere (Binder, 2014). This led to several protests and ferocious debate between survivors and recovery agencies. Communities are generally attached to a single place and do not plan to leave even after a disaster.
7. **Psychological and Mental Health:** Individuals and communities affected by floods often experience psychological and mental health challenges. Long-term recovery efforts should address these issues through counseling, support services, and community initiatives to promote resilience.
8. **Insurance and Financial Challenges:** Navigating insurance claims and securing financial assistance for recovery can be a lengthy and complex process, especially if insurance companies try to lower or even avoid payments (Cavaliere, 2020). Some individuals may be underinsured or not have insurance coverage at all, adding to the financial burden. In this case, the establishment of long-term recovery groups that can establish a case management for helping individuals and families will be beneficials to disaster survivors (National Voluntary Organizations Acitve in Disaster, 2012).
9. **Governmental and Policy Considerations:** Effective long-term recovery requires coordinated efforts from local, regional, and national governments. Developing and implementing policies that promote resilient infrastructure, land use planning, and early warning systems is crucial.

Addressing these challenges requires a multidisciplinary and collaborative approach involving government agencies, non-governmental organizations, the private sector, and the affected communities. Additionally, proactive planning and preparedness can contribute to more effective long-term recovery efforts after a flood.

### 2.2.5. Managing volunteers and resources

Volunteers and voluntary organizations (also called nonprofits) are a vital component of emergency management efforts. They are often the first to respond to disasters and provide immediate assistance to affected communities. Nonprofit organizations are characterized by their ability to mobilize volunteers and resources to provide immediate assistance to affected communities (Velotti & Cavaliere, 2017).

One of the key features of nonprofit organizations in disaster response is their ability to collaborate with governmental organizations at various levels of coordination, from local to international (Kapucu, 2006). In some cases, nonprofit organizations work in partnership with government agencies to provide disaster relief and recovery services.

Nonprofit organizations are not an arm of the government as they operate independently from it. They are often able to provide more flexible and innovative solutions to disaster management challenges than government agencies as well as play a vital role in identifying community needs or gaps in services, advocating for citizens, and undertaking community projects (Kapucu, 2007; Velotti & Cavaliere, 2017).

While most of the nonprofit organizations are formalized and structured organizations (Scott & Blau, 1962), a new phenomenon is taking place more often. It is the case of spontaneous volunteers showing up after an event in support of relief operations. If on one hand – it is the case of formal organizations – it is easier to collaborate and manage personnel, on the other hand there are some substantial issues when facing such a improvised work.

Figure 2.9. Spontaneous volunteers after 2023 Emilia-Romagna Flood.

Spontaneous volunteers or emergent groups are social phenomena that have been largely studied by disaster researchers (Barraket, Keast, Newton, Walters, & James, 2013; Bier et al., 2023; Cottrell, 2012; Drabek & McEntire, 2003; Mayorga, Lodree, & Wolczynski, 2017; Paciarotti, Cesaroni, & Bevilacqua, 2018; Penta, Kendra, Marlowe, & Gill, 2021; Quarantelli, 1984; Saaroni, 2015; Twigg & Mosel, 2017). The phenomenon, although exceptional and heartbreaking, poses several challenges when it comes to assign tasks and manage the overall operations. These volunteers, motivated by various reasons, can pose significant problems for themselves, disaster-affected individuals, and professional organizations. The issues include a lack of coordination, knowledge, and skills, as well as security concerns and legal liabilities. Professional responders often hesitate to work with these volunteers, labeling them as a "disaster within a disaster." (Daddoust, Asgary, McBey, Elliott, & Normand, 2021; Yükseler & Yazgan, 2022).

As said, managing spontaneous volunteers after a disaster can be challenging. According to a coordinated report (FEMA, UPS Foundation, & Point of Light, 2003), spontaneous volunteers can be a significant resource, but they are often used ineffectively and can even hinder emergency activities by creating health, safety, and security problems, distracting responders from their duties, and interfering with ongoing operations (Fernandez, Barbera, & Van Dorp, 2006). The report suggests that the challenge for emergency managers is to harness the availability of volunteer resources while ensuring safety and maximizing the ability of

responders to effectively perform tasks within the established command system (Fernandez et al., 2006).

One of the biggest challenges of managing spontaneous volunteers is the lack of organization and knowledge about emergencies and disasters among these volunteers. This creates challenges and risks like liability and security issues (Yükseler & Yazgan, 2022).

There are risks associated with the ineffective use of spontaneous volunteers by emergency and disaster managers, leading to a poor public perception of response efforts and an increased likelihood of casualties. Unorganized and untrained volunteers can hinder resource efficiency and jeopardize the safety of both responders and victims.

There are other three drawbacks to using spontaneous volunteers: liability concerns due to legal uncertainties, physical and emotional challenges, and the potential lack of internal readiness within agencies. Liability issues, including legal liability and lack of insurance cover, contribute to the reluctance of professional emergency managers to engage spontaneous volunteers. Security problems, such as looting and abuse of the disaster situation, are mentioned, along with the physical and emotional risks associated with unorganized and uneducated volunteers.

Another challenge is the difficulty in coordinating and communicating with a large number of volunteers who may have different skill sets, motivations, and expectations. Therefore, it is essential to have an established communication channel (mass messaging system, eg. Telegram) that can be used to send target messages or requests, to volunteers that have the required skills. Therefore, effective communication is also critical for managing spontaneous volunteers. This includes providing clear instructions and expectations, as well as regular updates on the situation and the role of volunteers.

To overcome these challenges, it is important to have a well-planned volunteer management system in place before a disaster strikes. This system should include a clear plan for volunteer recruitment, training, and deployment, as well as a system for tracking and managing volunteers. The first task for institutional emergency managers is to setup a volunteer recruitment center, where spontaneous volunteers can register (with screening and credentialing), get some basic safety training, and then be deployed to the ground. Finally, it is important to recognize and appreciate the contributions of spontaneous volunteers. This can

be done through formal recognition programs, such as certificates or awards, as well as informal recognition, such as thank-you notes or public acknowledgments.

In addition to the above discussion, there are some general pros and cons of having spontaneous volunteers on the ground:

***Pros:***

- Spontaneous volunteers can provide additional resources and manpower during an emergency; Engaging affected people who want to help provides organizations with a means to shift away from encouraging passivity in communities, to fostering a proactive and connected community that assumes shared responsibility for emergency management.
- Spontaneous volunteerism also benefits staff welfare by boosting staff morale and productivity.
- Using spontaneous volunteers can save on ongoing service delivery costs and also safeguard business continuity immediately following an emergency event.
- Spontaneous volunteers can significantly speed up community recovery.

***Cons:***

- Determining a local government approach to responding to spontaneous offers of in-kind support is complex. There are risks and benefits associated with policies and legal constraints.
- There are risks and benefits associated with policies that refuse spontaneous volunteers integrating with local emergency management activities.
- Refusing to take advantage of and value the input of spontaneous volunteers may lead to a degradation of organizational reputation.

Overall, the use of spontaneous volunteers during an emergency can be beneficial, but it is important to balance the benefits and risks of working with spontaneous volunteers. Local governments should develop guidelines and best practices for working with spontaneous volunteers to ensure that they are effectively managed during an emergency.

### 2.2.6. Planning for future disasters

In an era of heightened environmental concerns, the specter of disasters looms large, casting a shadow of uncertainty over the future. Among these severe threats, floods stand out as a persistent and devastating force, causing widespread damage, economic losses, and

displacement across the globe. With climate change exacerbating the frequency and intensity of extreme weather events, the need for proactive measures to prepare for future flood disasters has never been more urgent.

After every flood disaster there is the need to rethink a new approach in mitigating and preparing for future disasters. This requires a multifaceted approach that involves individuals, communities, and governments working in tandem to reduce vulnerability and enhance resilience.

The first step towards effective flood preparedness lies in understanding the nature and extent of the flood risk, and to what extent this will modify throughout the time. This involves conducting thorough risk assessments that identify new likely flood-prone areas, analyze historical flood patterns, and predict potential flood inundation zones. These assessments provide valuable insights into the likelihood and severity of flood events, enabling individuals and communities to make informed decisions regarding preparedness measures.

What is also essential for the future, is a much stronger individual and community-based approach. This includes individual preparedness and community preparedness. Although different in scale, preparation is vital for people to withstand floods. At the individual level, flood preparedness revolves around taking proactive steps to safeguard homes and families from the detrimental effects of flooding. This includes:

- Determining whether homes reside within a flood zone. This is crucial in assessing the level of risk. Flood maps and risk assessment tools provided by local governments and organizations can assist in this process (for reference, see FEMA and Ready.gov).
- Formulating a comprehensive flood plan that outlines the actions to be taken before, during, and after a flood event. This plan should include evacuation routes, emergency contact information, and a designated safe shelters.
- Implementing flood mitigation measures can significantly reduce the potential damage homes. These measures include elevating houses, installing flood vents, sealing basements, and constructing flood barriers.
- Assembling an emergency kit stocked with essential supplies, such as food, water, first aid kits, flashlights, and batteries. This ensures that everyone has the necessary resources for living during and after a flood.

Aside from the individual and household dimension, the community-based approach to flood preparedness is a priority for every community lying in flood-areas. Communities play a key role in strengthening flood preparedness by bolstering infrastructure and fostering a culture of flood awareness. There are several strategies that communities can adopt, with the help of local agencies and NGOs and include:

- *Infrastructure Enhancement***:** Upgrading drainage systems, constructing floodwalls, and elevating critical infrastructure like power plants and hospitals can significantly reduce the impact of floods.
- *Public Education and Awareness Campaigns*: Implementing public education campaigns and disseminating flood preparedness information through various channels, such as community forums, workshops, and media outreach, can raise awareness and empower individuals to take action.
- *Emergency Response Plans:* Developing comprehensive emergency response plans that outline the roles and responsibilities of various community actors during a flood event ensures coordinated and efficient disaster response.

There are also governmental responsibilities in managing flood risks and disasters. Local, state and national agencies must coordinate and cooperate to implementing new mitigation plans, preparedness and response plans for future disasters. Governments at all levels, can enact policies and procedures; promote initiatives for comprehensive flood management. There is a plethora of different ways to enhance flood preparedness and risk mitigation. Some of these are:

- The implementation of new land use regulations. Through land use planning, local agencies can determine new directions in using flood-prone land, for example, restricting new construction; turning flood area to grassland and meadows, or creating new nature-based solutions to mitigate flood risks (Burby et al., 1999; Burby & Dalton, 1994).
- Engaging the community in hazard management is an exceptional strategy. Several studies have shown the role of communities in determining and deciding how to best manage and plan for reducing future flood risks (Berke, Godschalk, & Kaiser, 2006; Brody, Godschalk, & Burby, 2003; Godschalk, Brody, & Burby, 2003; Horney, Simon, Grabich, & Berke, 2014; Oulahen & Doberstein, 2012; Pearce, 2003; Sarzynski & Cavaliere, 2018; Sperry, 2013; Stevens, Berke, & Song, 2010)

- Whereas available, national insurance programs for flood disasters can provide financial protection to homeowners and businesses against flood losses. A well-known case is the establishment of the National Flood Insurance Program (NFIP) in the USA, with the direction of the Federal Emergency Management Agency.
- Supporting research and development efforts aimed at improving flood forecasting, modeling, and mitigation strategies can enhance overall flood preparedness.

In the face of a changing climate that is amplifying the frequency and intensity of flood events, proactive and comprehensive flood preparedness is paramount. To create more resilient communities, there must be the awareness and the willingness to integrate a climate-change perspective in the planning process. Embracing resilience in a changing climate is an imperative response to the evolving environmental challenges communities face. As the climate undergoes profound shifts, characterized by heightened risks of disasters such as floods, communities and individuals must cultivate adaptability. Resilience involves not only the ability to withstand the impacts of climate change but also to proactively prepare for and recover from its inevitable consequences. This mindset prompts the development of sustainable practices, innovative solutions, and a collective commitment to mitigating the adverse effects of a changing climate.

### 2.3. Case Studies

#### 2.3.1. 2010 Pakistan floods

In the summer of 2010, Pakistan faced one of the most devastating flood disasters in its history, affecting millions of people and causing widespread destruction. Triggered by heavy monsoon rains, the floods led to the displacement of communities, loss of lives, and extensive damage to infrastructure. This case study delves into the causes, impacts, and the subsequent management strategies employed to mitigate the effects of the 2010 Pakistan flood disaster.

Figure 2.10. 2010 Pakistan Flood.

**Causes of the Flood Disaster:** The monsoon season in 2010 brought unusually heavy and prolonged rainfall to various regions of Pakistan, leading to the swelling of rivers and subsequent flooding. The excessive rainfall, coupled with the already saturated soil, created a situation ripe for disaster. The Indus River, the country's lifeline, overflowed its banks, submerging vast areas of land and displacing millions of people. The unprecedented nature of the rainfall and the lack of proper infrastructure to manage such a large volume of water exacerbated the crisis.

**Impacts on Communities:** The flood disaster had severe social, economic, and environmental impacts on the affected communities. Millions of people were forced to abandon their homes and seek refuge in makeshift camps or with relatives. The loss of crops and livestock devastated the agricultural sector, upon which many communities depended for their livelihoods. The destruction of infrastructure, including roads and bridges, hindered access to affected areas, complicating rescue and relief efforts.

**Response and Relief Efforts:** The Pakistani government, along with national and international humanitarian organizations, mobilized to provide emergency relief to the affected population. The response involved a multi-faceted approach, including search and rescue operations, provision of shelter, food, and medical aid. International aid organizations and neighboring countries also played a crucial role in providing financial assistance and resources to support the relief efforts.

Figure 2.11. 2010 Pakistan Flood.

**Challenges in Relief Operations:** Despite the concerted efforts, relief operations faced numerous challenges. The sheer scale of the disaster overwhelmed existing resources and infrastructure. Access to remote and isolated areas proved difficult due to damaged transportation networks. Furthermore, the risk of waterborne diseases and the lack of clean water and sanitation facilities posed additional health concerns for the displaced population.

**Rehabilitation and Reconstruction:** As the floodwaters receded, the focus shifted from immediate relief to long-term rehabilitation and reconstruction. The rehabilitation process involved rebuilding homes, restoring infrastructure, and supporting communities in re-establishing their livelihoods. The government, along with international partners, initiated projects to improve flood management infrastructure, such as the construction of dams and levees, to prevent similar disasters in the future.

**Lessons Learned and Policy Changes:** The 2010 Pakistan flood disaster prompted a reevaluation of disaster management policies and practices. The need for improved early warning systems, better infrastructure, and community-based disaster preparedness became evident. The government implemented changes in land-use planning to reduce vulnerability to floods and enhance the resilience of communities in high-risk areas. The disaster also underscored the importance of regional cooperation in managing transboundary water resources, as the Indus River flows through multiple countries.

**Community Engagement and Capacity Building:** Recognizing the importance of community involvement in disaster management, efforts were made to enhance local capacities. Community-based organizations were established to empower local communities in preparing for and responding to disasters. Training programs on disaster risk reduction, first aid, and evacuation procedures were conducted to build the resilience of vulnerable populations.

**Conclusion:** The 2010 Pakistan flood disaster serves as a poignant reminder of the devastating impact of natural disasters on communities and the need for comprehensive disaster management strategies. The response and recovery efforts, while challenging, demonstrated the resilience of the affected population and the effectiveness of coordinated national and international efforts. The lessons learned from this disaster have informed policy changes, emphasizing the importance of early warning systems, improved infrastructure, and community engagement in building resilience to future disasters. As the global climate continues to change, the case of the 2010 Pakistan flood disaster provides valuable insights for governments and organizations worldwide in enhancing their preparedness and response mechanisms.

### 2.3.2. Hellenic General Plan for Emergency Response 'DARDANOS 2'

The "DARDANOS 2" plan aims to address the challenges posed by flooding phenomena, providing a comprehensive framework for emergency response and management of its immediate and short-term consequences. The plan is designed to enhance the capacity of the Greek civil protection authorities and relevant stakeholders in dealing with flood events, thereby minimizing the risks to human lives, property, and the environment.

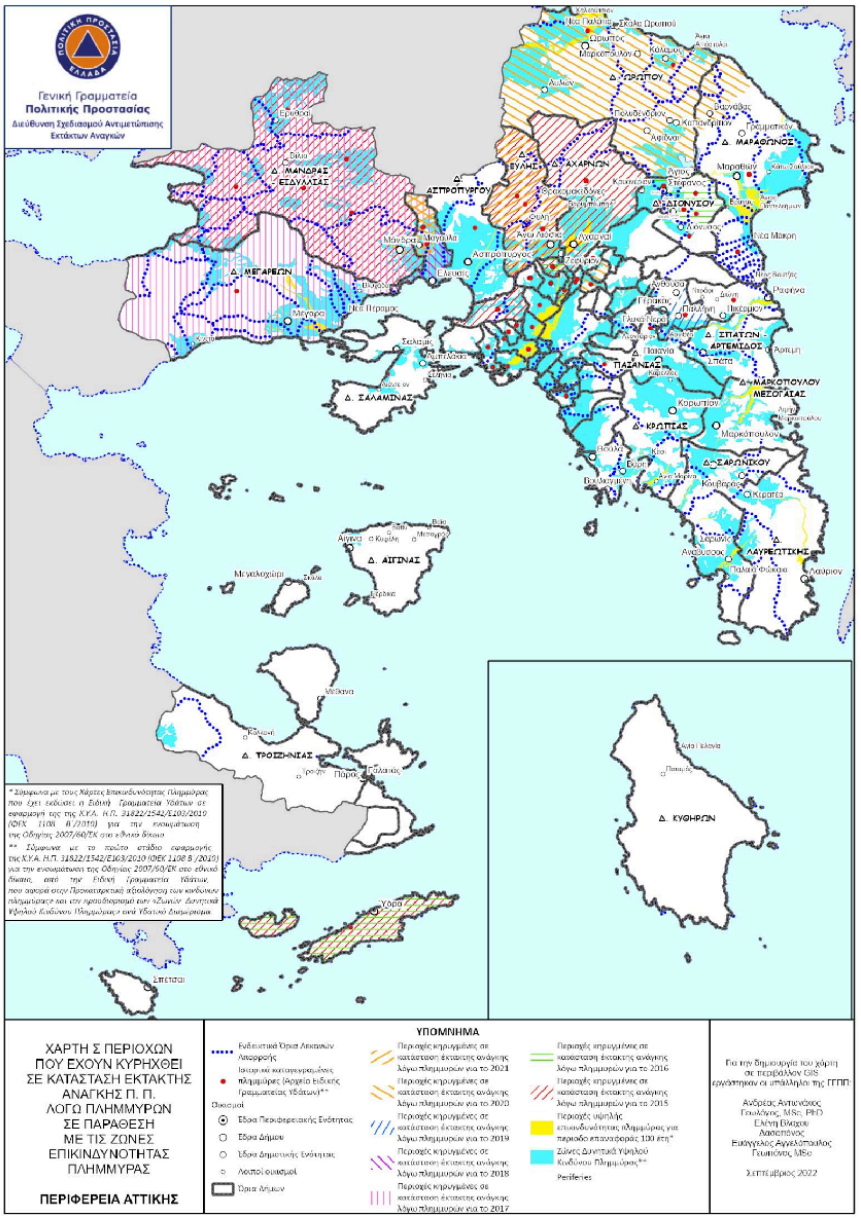


Figure 2.12. Map of Areas Declared in a State of Emergency for Civil Protection due to Floods, compared with Flood Hazard Zones.

Key components of the "DARDANOS 2" plan include:

1. **Risk Assessment and Early Warning Systems:** In-depth risk assessment involves a multidisciplinary approach. Geologists, hydrologists, meteorologists, and engineers collaborate to analyze factors such as topography, soil types, rainfall patterns, and river flow rates. Advanced flood modeling software is used to simulate various scenarios and predict potential flood extents. This data feeds into sophisticated early warning systems that utilize real-time data streams from weather stations, rain gauges, river level sensors, and satellite imagery. These systems employ algorithms to detect

sudden changes in water levels, triggering automatic alerts to emergency response teams and the public.

2. **Emergency Response and Evacuation Protocols:** The plan outlines the hierarchy of command during emergencies, specifying the roles of local, regional, and national agencies. Emergency responders, including firefighters, paramedics, police, and the military, receive specialized training in flood response tactics. Evacuation plans are meticulously designed, considering factors like population density, transportation routes, and the location of safe shelters. Evacuation simulations are conducted regularly to identify potential bottlenecks and improve the efficiency of the evacuation process.
3. **Community Engagement and Education:** Public education initiatives involve partnerships between government agencies, non-profit organizations, and educational institutions. Workshops are conducted to teach community members about flood preparedness, including creating emergency kits, designing evacuation plans, and learning basic survival skills. Mock evacuation drills are organized to familiarize residents with evacuation routes and shelter locations. Community leaders and influencers play a vital role in disseminating accurate information and fostering a culture of preparedness.
4. **Coordination and Communication:** An incident command system (ICS) is established to facilitate communication and coordination among agencies. This system assigns specific roles to different responders, ensuring that efforts are synchronized. Regular coordination meetings are held to discuss strategies, share information, and address any emerging challenges. Communication technology includes dedicated emergency communication networks, social media platforms, and public information officers who provide updates to the media and the public in real-time.
5. **Search and Rescue Operations:** Search and rescue teams are composed of highly trained professionals equipped with specialized gear. These teams include swift water rescue experts, trained divers, and drone operators. Search and rescue operations are coordinated through a central command center ‘E.S.K.E.D.I.K’ that monitors ongoing efforts, assigns resources, and ensures the safety of responders. Advanced technology, such as sonar-equipped boats and underwater cameras, is employed to locate individuals in submerged areas.

Figure 2.13. National Coordination Center for Operations & Crisis Management (ESKEDIK) in Athens.

6. **Infrastructure Protection:** Infrastructure vulnerability assessments are conducted on critical facilities like power plants, hospitals, and water treatment plants. Flood-resistant construction methods, such as raising the elevation of structures or building flood barriers, are employed. Infrastructure protection extends to transportation networks, where flood-resistant road surfaces and elevated bridges are designed to minimize disruptions. Regular inspections and maintenance schedules are established to ensure the integrity of protective measures.

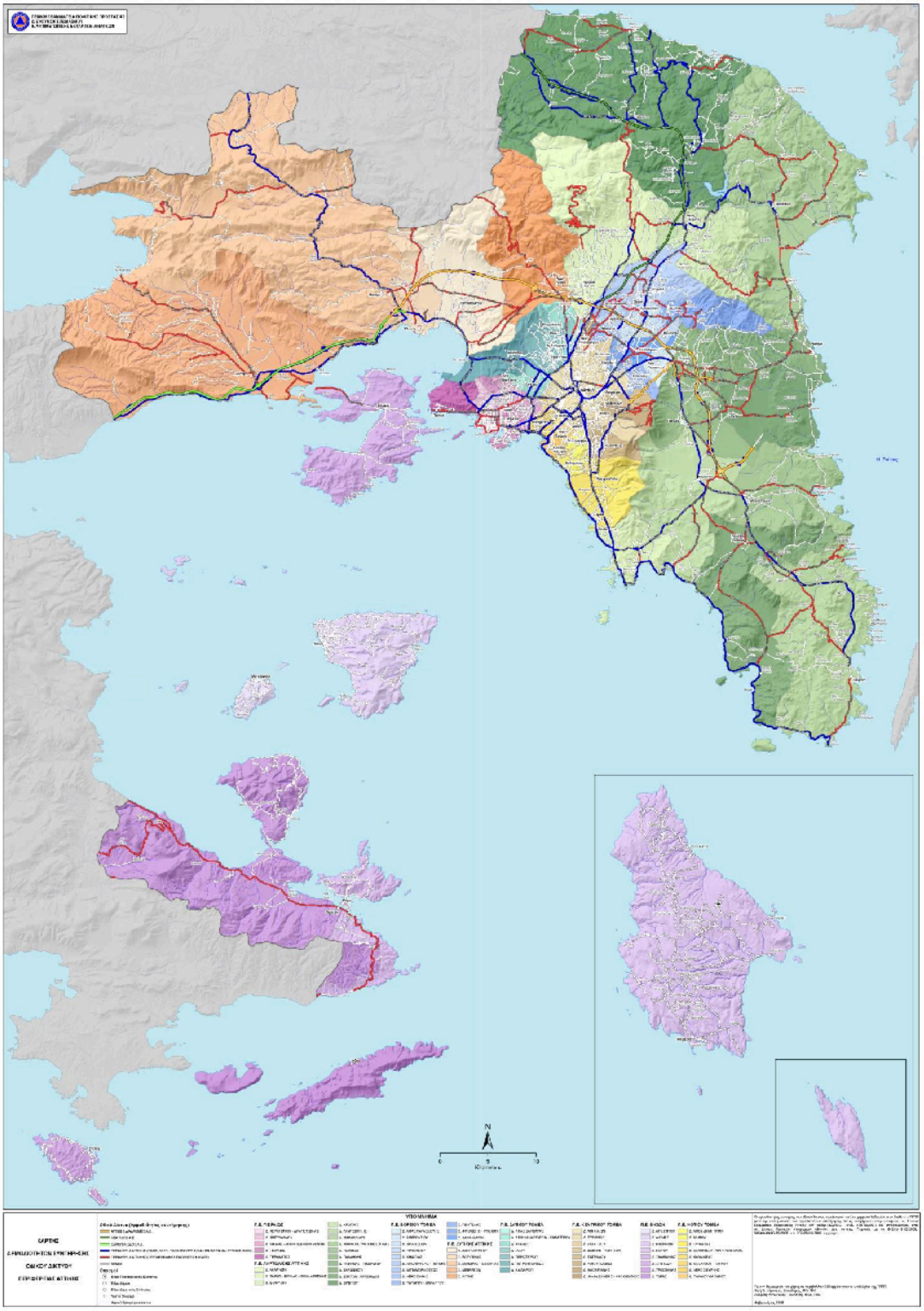

Figure 2.14. Road Jurisdiction Map, Region of Attica.

7. **Data Management and Information Sharing:** Flood monitoring systems are integrated into a central data hub accessible to all relevant agencies. Automated algorithms analyze incoming data to predict flood behavior and assess potential risks. These predictions guide decisions related to evacuation timing, resource allocation,

and emergency response prioritization. Geographic Information Systems (GIS) allow responders to overlay flood predictions with maps of infrastructure, population density, and critical facilities, enabling informed decision-making.

8. **Recovery and Rehabilitation:** Post-flood recovery is a comprehensive process that involves multiple phases. Initial damage assessment teams evaluate the extent of destruction and prioritize areas in need of immediate attention. Debris removal and cleanup operations are carefully planned to prevent environmental contamination. Affected communities receive support through counseling services, financial assistance, and access to temporary housing. Lessons learned from each event contribute to refining response plans, updating flood risk assessments, and incorporating new technologies.

The "DARDANOS 2" plan represents a culmination of scientific expertise, technological advancements, and collaborative efforts aimed at enhancing society's resilience to flooding. By delving into intricate details within each component, authorities can create a comprehensive strategy that effectively mitigates the impacts of flood events and ensures the safety and well-being of communities.

### 2.3.3. 2023 Sanliurfa Province Flood Disaster


Figure 2.15. Sanliurfa Province.

Flood disasters occurred in southeastern Turkey on March 15, 2023, due to excessive rainfall, particularly affecting Adiyaman and Sanliurfa. A total of 17 people lost their lives in

Sanliurfa. It was reported that the residences, workplaces, vehicles, and various household items of 3,154 people were damaged in both provinces.

As of March 17, 2023, in Sanliurfa province, 17 people had died due to floods. Following heavy rain, almost all neighborhoods were flooded, and the water level rose to the first floor of buildings. Tents and containers set up due to the 2023 Kahramanmaras earthquakes were flooded in most places. A bridge between Subasi and Taskale village collapsed, a public hospital was flooded, and hundreds of houses and vehicles were submerged. Nearly 2 thousand houses and workplaces were reported as damaged. The iconic Balikligol in Sanliurfa could not withstand the rain and overflowed.

On the other hand, education in all schools throughout Sanliurfa province was suspended for one more day on 15-16-17 March, and in Haliliye, Karakopru, and Eyyubiye districts on 20 March 2023.

The Sanliurfa Metropolitan Municipality announced that tap water would not be supplied to three districts in the city center temporarily due to excessive pollution in the Atatürk Dam basin. The statement mentioned that heavy rain in the city resulted in excessive pollution in the dam basin. Water supply to Haliliye, Karaköprü, and Eyyubiye would be temporarily halted, and citizens were urged to be cautious during this period.

**170 kilograms of rainfall per square meter**

In a statement issued by the Sanliurfa Municipality, it was emphasized that the city was grappling with its most significant flood disaster in recent memory. The statement highlighted, 'We have witnessed a catastrophe unprecedented in the last 65 years, with a record-breaking precipitation of 170 kilograms per square meter. We are committed to healing our wounds and swiftly recovering from this calamity.

**RESCUE AND RESCUE EQUİPMENT**

**After the Flood Disasters**

As a result of evacuation efforts conducted in and around the region, water levels in the Balikligol areas have receded, and the lake's water level has returned to normal. Eyyubiye Municipality teams have initiated cleaning operations in the Balikligol areas and other districts.

Balikligol Environmental Protection Foundation Director, Siracettin İlhan, stated that there is no evidence of fish perishing in the lake. İlhan explained, 'Since the fish in Balikligol are carp species and swim at the bottom, we did not observe any fish outside the lake during the flood. We do not anticipate the fish leaving the lake.'

Due to the overflow of the Karakoyun stream in the city, surrounding streets and avenues were flooded. AFAD, Gendarmerie, Fire Brigade, and Police teams dispatched to the region entered the flooded streets with boats. The teams successfully evacuated citizens trapped in their homes, extending stairs for rescue. The rescued citizens were promptly sent to hospitals as a precaution.

A woman, evacuated from a building, was seen expressing gratitude by hugging the soldiers who assisted in the rescue. Search and rescue efforts are ongoing at Abide Koprulu Junction and underpass, which filled with water due to the downpour. Pumps are being operated to evacuate the water in the area where three people were taken to the hospital. The continuous rainfall in the region is affecting the rescue work negatively.

Elderly citizens, rescued from their homes by boat in the same neighborhood, were handed over to medical teams with the assistance of diving teams.

Figure 2.16. DSİ[1] (Turkey directorate general for state hydraulic works) Provincial Center Water Flood Maps.


Figure 2.17. Afad (Aydes)[2] Water Depth Maps with Provincial Center.

**ROADS CLOSED TO TRAFFIC FOR SECURITY REASONS**

1. Abide intersection tunnel was closed to traffic due to the cleaning work of the tunnel evacuation channels after the flood that occurred on 15.03.2023.
2. Sehit Cuma Uçar Street Ataşehir Junction, in front of the Haliliye Police Department construction, was closed to traffic due to road collapse.
3. The road between Bediuzzaman Junction Piazza Shopping Mall and Museum Car Park is closed to traffic due to puddles and mud.

[1] DSİ Mission is to make in Turkey's water resources available for use in accordance with science and technology, and to ensure that our water and related land resources are developed within the principles of environmental awareness and sustainability.
[2] AYDES is a web-based application built on Geographic Information Systems, with decision support mechanisms that can effectively manage all resources in disasters and emergencies.

Figure 2.18. Closed roads.

NUMBER OF WOUNDED AND DEATHS ACROSS THE PROVINCE

AFAD

**HOSPITAL-BASED INJURED AND INPATİENT PATIENT TABLE OF RESCUES**

| ORDER NO | HOSPITAL NAMES | TOTAL | SERVICE BOARDING NUMBER | URGENT IN SERVICE WAITING PATIENT | BUSY CARE | DISCHARGE NUMBER |
|---|---|---|---|---|---|---|
| 1 | Şanlıurfa EAH (EYYÜBİYE) | 3 | 0 | 0 | 0 | 3 |
| 2 | SBÜ Mehmet Akif İnan EAH (HALİLİYE) | 24 | 1 | 0 | 1 | 22 |
| 3 | Harran Üniversitesi Has. (HALİLİYE) | 0 | 0 | 0 | 0 | 0 |
| 4 | Balıklıgöl DH (EYYÜBİYE) | 34 | 0 | 0 | 0 | 34 |
| 5 | Akçakale DH | 0 | 0 | 0 | 0 | 0 |
| 6 | Ceylanpınar DH | 0 | 0 | 0 | 0 | 0 |
| 7 | Harran DH | 0 | 0 | 0 | 0 | 0 |
| 8 | Bozova DH | 0 | 0 | 0 | 0 | 0 |
| 9 | Birecik DH | 0 | 0 | 0 | 0 | 0 |
| 10 | Siverek DH | 0 | 0 | 0 | 0 | 0 |
| 11 | Suruç DH | 0 | 0 | 0 | 0 | 0 |
| 12 | Halfeti DH | 0 | 0 | 0 | 0 | 0 |
| 13 | Hilvan DH | 0 | 0 | 0 | 0 | 0 |
| 14 | Viranşehir DH | 0 | 0 | 0 | 0 | 0 |
| 15 | Özel Metrolife Has. (KARAKÖPRÜ) | 1 | 0 | 0 | 0 | 1 |
| TOTAL | | 62 | 1 | 0 | 1 | 60 |

**DİSTRİCT BASED LOSSES AND DEATH TABLE**

| ORDER NO | DİSTRİCT | LOSSES | DEATH |
|---|---|---|---|
| 1 | AKÇAKALE | 0 | 0 |
| 2 | BİRECİK | 0 | 0 |
| 3 | BOZOVA | 1 | 0 |
| 4 | CEYLANPINAR | 0 | 0 |
| 5 | EYYÜBİYE | 0 | 4 |
| 6 | HALFETİ | 0 | 0 |
| 7 | HALİLİYE | 0 | 11 |
| 8 | HARRAN | 0 | 0 |
| 9 | HİLVAN | 0 | 0 |
| 10 | KARAKÖPRÜ | 0 | 1 |
| 11 | SİVEREK | 0 | 0 |
| 12 | SURUÇ | 0 | 0 |
| 13 | VİRANŞEHİR | 0 | 0 |
| TOTAL | | 0 | 17 |

Figure 2.19. Number of Wounded and Deaths Across the Şanlıurfa Province. (This info taken from Şanlıurfa Provincial Disaster Emergency Management Directorate).

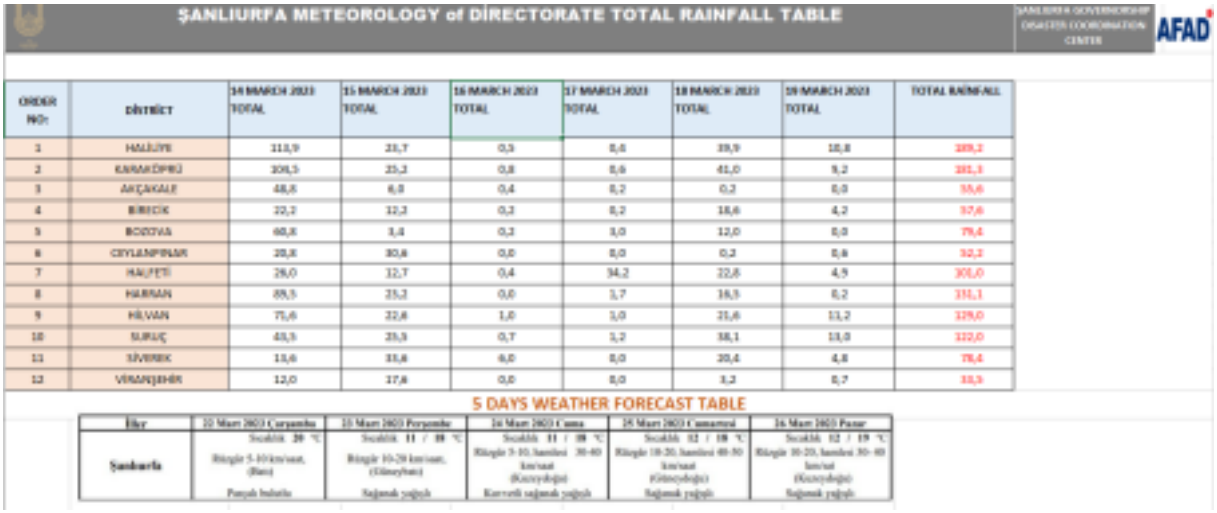


Figure 2.20. Amount of rainfall and weather forecast tables during flood disasters in Sanliurfa province. (This info taken from Sanliurfa Provincial Disaster Emergency Management Directorate).

Table 2.1. The Detailed Vehicle Summary used for flood disasters. (This info taken from Şanlıurfa Provincial Disaster Emergency Management Directorate).

| ORDER No: | TYPE OF VEHICLE | NUMBERS |
|---|---|---|
| 1 | BOBCAT | 22 |
| 2 | MOTOPOMP | 10 |
| 3 | SEWAGE TRUCK - KOMBINE | 10 |
| 4 | BACKHOE LOADER | 15 |
| | **TOTAL** | **77** |

Table 2.2. The Vehicle Summary used for flood disasters (This İnfo taken from Şanlıurfa Provincial Disaster Emergency Management Directorate).

| **ORDER No:** | **District Name / Directorate (Offical)** | **Official Persons Numbers** |
|---|---|---|
| 1 | METROPOLITAN MUNICIPALITY and 3 CENTRAL DISTRICT MUNICIPALITIES | 3310 |
| 2 | GENDARME | 316 |
| 3 | POLICE DEPARTMENT | 711 |
| 4 | AFAD | 24 |
| | OTHER PUBLIC INSTITUTIONS | |
| | **TOTAL** | **4.361** |

| **Order No:** | **District / Directore (Official) Name** | **Dispatched Vehicle** |
|---|---|---|
| 1 | AKÇAKALE | 49 |
| 2 | BOZOVA | 6 |
| 3 | EYYÜBİYE | 266 |
| 4 | HALİLİYE | 368 |

| | | |
|---|---|---|
| 5 | HARRAN | 19 |
| 6 | KARAKÖPRÜ | 100 |
| 7 | SURUÇ | 10 |
| 8 | MOBILE | 25 |
| 9 | 20.ZRHL. KOM. | 11 |
| 10 | POLICE DEPARTMENT | 146 |
| 11 | GENDARME | 137 |
| 12 | IRRIGATION UNIONS | 38 |
| 13 | DEDAŞ (electricity provider company) | 96 |
| 14 | Ministry of family and social services | 87 |
| 15 | DSİ* | 106 |
| 16 | KARAYOLLARI | 50 |
| 17 | FOREST REGIONAL DIRECTORATE | 55 |
| 18 | ŞANLIURF AFAD | 22 |
| 19 | EYYÜBİYE MUNICIPALITY | 123 |
| | **TOTAL** | **1.706** |

*Leading organization in the protection, development and management of water resources in Türkiye.

Table 2.3. AFAD Teams Personnel Summary. (This İnfo taken from Şanlıurfa Provincial Disaster Emergency Management Directorate).

| NUMBER OF AFAD PERSONNEL AND VEHICLES DİSPATCHED DUE TO THE FLOOD DISASTER IN ŞANLIURFA PROVINCE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SIRA NO | DİRECTORE OF PROVİNCE | PERSONS NUMBERS | VEHICLE NUMBERS | MOTOPOMP | GENARATÖR | DİYER POMP | DRENAJ | DİYER | AMFİBİK VEHİCLE | DİT |
| 1 | ŞANLIURFA AFAD | 17 | 6 | 10 | | | | | 1 | |
| 2 | YALOVA AFAD | 3 | | | | | | | | |
| 3 | MUŞ AFAD | 3 | 1 | | | | | | | 2 |
| | **GENERAL TOTAL** | **23** | **7** | **10** | **0** | | | | **1** | **2** |

Table 2.4. Underwater teams due to the flood disaster in Şanliurfa Province, under the coordination of AFAD. (This info taken from Şanlıurfa Provincial Disaster Emergency Management Directorate).

| UNDERWATER TEAMS DUE TO THE FLOOD DISASTER IN ŞANLIURFA PROVINCE, UNDER THE COORDINATION OF AFAD | | |
|---|---|---|
| **Order No** | **DİRECTORE** | **PERSONS NUMBERS** |
| **1** | VAN EMNİYET | 6 |
| **2** | ŞANLIURFA | 7 |
| **3** | MERSİN EMNİYET | 4 |
| **4** | BİTLİS EMNİYET | 5 |
| **GENEL TOPLAM** | | **22** |

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