RESILIAGE
Revolutionising community resilience

D4.1

Needs analysis and training requirements definition

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Table of Abbreviations and Acronyms

Abbreviation	Meaning
C	Citizens
CORE lab	Community resilience lab
D	Deliverable (e.g. D1.1)
DSS	Decision Support System
FR	First responders
GIS	Geographic Information System
K, S, A	Knowledge, Skills, Abilities
LA	Local authorities
RAISE	Resilient Assessment Interactive Self-Enabler
SyRI	Systemic Resilience Innovation framework
T	Task (e.g. T4.1)
WP	Work Package

Executive Summary

This report presents the comprehensive findings of Task 4.1, which investigated gaps, expectations, and disaster management needs across various communities. The focus of the research within this task was centred around current communication practices, available solutions, training opportunities, and capacity building initiatives. These elements were examined with the goal of identifying needs for soft solutions (preparedness toolkits, raise awareness campaigns, communication guidelines) as well as training needs to enhance risk awareness, societal resilience, and overall disaster management capabilities.

Data collection employed a multifaceted approach, encompassing both qualitative and quantitative methods. Cross-sectional surveys, focus group sessions, semi-structured interviews, and eye-tracking data (addressing the experiment conducted in T2.3) provided valuable insights to the understanding of the different COREs under analysis. The report offers a detailed explanation of how these methods were implemented and how the collected data forms a holistic picture of current needs within the communities.

To gain deeper knowledge of communication processes, coordination strategies, as well as existing solutions and training the study focused on past disaster events. By analysing these events, researchers examined the information flow and how interactions unfolded throughout three different phases of the event, namely: before, during, and after the disaster. This analysis provided insights into the preparedness levels of citizens, first responders (FR), and local authorities (LA) prior to the event. It also allowed for the evaluation of actions taken during the crisis (both successful and unsuccessful strategies) along with any solutions implemented afterwards to improve preparedness for future events.

By identifying gaps in interactions, resources or solutions during a crisis, stakeholders' needs could be highlighted. This, in turn, shed light on the conditions necessary for more effective responses and for building more resilient communities. As a result, a series of user requirements could be formulated. These initial requirements are categorized based on the potential solutions offered by the RESILIAGE project. As stakeholders' needs are matched with specific solutions designed to address identified gaps, the user requirements will become progressively more detailed. This increased specificity will be crucial during solution validation processes, ensuring the developed solutions effectively meet the established and evolving needs of stakeholders.

It is important to note that D4.1 only reports on the Famenne-Ardenne CORE's results and the overarching methodological approach that has been applied in case of all the CORE labs, while the results from Naturtejo, Karsiyaka, Crete and Trondheim will be reported in the upcoming deliverables of the project.

1. Introduction

This deliverable reports on the process and outcome of T4.1. aiming at identifying the current gaps and needs about solutions, training and capacity building activities to improve risk awareness, societal resilience and disaster management.

The deliverable introduces the methodological approach and research tools that have been applied to collect empirical data and conduct a comprehensive needs assessment. The methodological approach introduced in this deliverable is based on the knowledge baseline developed within WP1 and is strongly interlinked with WP2 due to the joint focus group sessions conducted during the field activities in the five CORE labs.

Based on the results of the assessment, these needs are translated into high-level user requirements for the digital (WP3) and soft solutions (T4.3., T4.4.) with a special focus on the user groups of citizens, first responders (FR) and local authorities (LA).

The outlined user requirements are to be considered as a starting point for the development and refinement of the solutions that might address the needs identified. Further refinement and characterisation of these specifics will be carried out through the validation and initial revision of the digital tools and soft solution with the CORE Labs.

The deliverable is divided into the following sections:

Chapter 2 ("Methodology") provides a comprehensive overview of the methodological approach applied within the framework of T4.1., offering a detailed description of the cross-sectional survey, the focus group sessions, the semi-structured interviews and the eye-tracking experiment as research methods as well as an explanation of how data gathered through these methods are interlinked and complement each other.

Chapter 3 ("Results from the CORE labs") provides an overall description of the 2021 flood preparedness, response and recovery, based on which current gaps, best practices as well as needs and user requirements related to soft solutions, digital solutions and training are identified.

Chapter 4 ("Conclusions and next steps") provides a comprehensive conclusion about the findings and recommendations reported in the deliverable as well as it stresses the immediate, medium - and long-term steps to follow related to the needs assessment.

2. Methodology

The objective of the empirical research in RESILIAGE T4.1. is to collect and identify citizens, FR, and local authorities' current needs about soft and digital solutions and capacity-building activities, in order to improve their risk awareness, societal resilience and disaster management. As part of this task, we also aim to investigate current gaps between the already existing solutions and practices and the needs communicated by the key actors.

As the expected outcome, we aim to:

- gather specific needs and formulate them into requirements for the design of soft & digital solutions;
- identify end-user training needs and requirements in a comprehensive needs assessment.

In order to reach these objectives, a comprehensive, multimethod research design has been developed for all of the five CORE labs. Based on this approach, the combination of the following research methods has been applied:

- **Cross-sectional survey** to gather a larger amount of quantitative data about the perceptions of the already existing solutions, and the needs about future soft and digital solutions.
- **Focus group sessions** to systematically explore the already existing communication network, its characteristics and its gaps among key actors within the community.
- **Semi-structured interviews** to deep dive into the understanding of the gaps identified during the focus group sessions and to discuss the requirements of potential future solutions to fill these gaps.
- **Eye-tracking experiments** to identify participants' perceptions and attitudes towards the design and usability of various risk signs.

Based on the gaps and needs identified, results will support the future design and development of RESILIAGE digital solutions (WP3), soft solutions and training materials (WP4) to be validated in WP5, as well as serve as the basis for improved preparedness planning (WP6) and awareness raising campaigns (WP7) (see Figure 1).

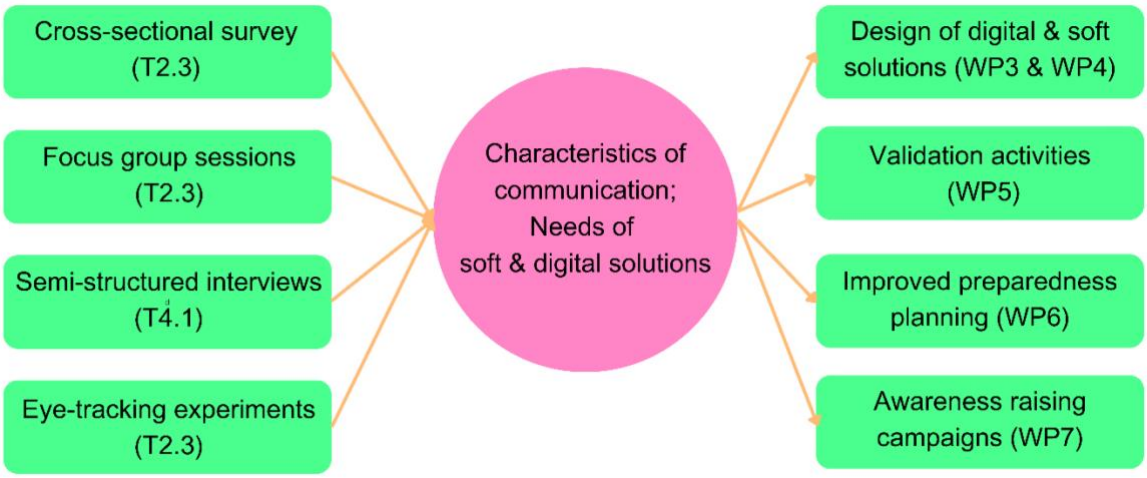


Figure 1: T4.1. Research methodology expected outcomes and their connection to other work packages within RESILIAGE's project.

2.1. Cross-sectional Survey

The objective of the cross-sectional survey within RESILIAGE project is two-folded: on the one hand, it aims to explore the temporal dimension of risk perception and adaptation of community members of the CORE labs. On the other hand, it aims to gain a general understanding about the perceptions and attitudes of the key actors of the community (e.g., citizens, local authorities, FR) towards the already existing communication practices and solutions. As a result, the data acquired by the cross-sectional survey feeds into two different tasks: while the results of risk perception and adaptation feed into T2.3. and are therefore reported in D2.2., results of the perceptions of and attitudes towards already existing and future solutions feed into T4.1. and are therefore reported in this deliverable.

The overarching aim of using surveys as a part of a complex research design is that it enables the systematic investigation of a phenomenon by gathering quantifiable data and performing statistical analysis on them. As one of the most important characteristics of a quantitative survey, responses are transformable into numeric variables, therefore, feasible to establish causal relationships between them. As a consequence, by applying a quantitative survey we gained the opportunity to statistically compare the opinions of certain key actors (citizens, FR, local authorities) about the already existing solutions and future needs. In addition, the quantitative survey allows us to run statistical analysis in order to find relationships between certain socio-demographic characteristics of the community (age, gender, socioeconomic status, marital status, etc.) and opinions about the already existing solutions and needs for future ones. The survey was available both in online and paper-pencil format, in order to include participants who have difficulty accessing online sources or difficulty using information technology. In order to make sure that participants are able and willing to provide reliable information through the survey, all questions and answer options have been translated into the national language of the CORE labs.

The survey was built according to the following structure (note that only questions related to the objectives of T4.1. are reported here):

After a short introduction and informed consent, participants were introduced to a number of demographic questions and questions asking their opinion about communication channels used through a crisis. After this section, respondents were grouped into four different sub-groups and redirected to a different set of questions accordingly, depending on whether they identified themselves as citizens, FR, formal volunteers or local authorities. The division of participants into subgroups was a necessary step, as perceptions, attitudes, awareness and factual knowledge of crisis communication and solutions might differ across these subgroups. In addition, some questions required rephrasing depending on the target group they were introduced to (e.g. "Perceived difficulty of *delivering* official warnings" if addressed FRs, OR "Perceived difficulty of *understanding* official warnings" if addressed citizens). Finally, all respondents were asked a number of sociodemographic questions (see Figure 2). Response options to the questions were dichotomous, multiple choice, 5-point Likert scale and open-ended questions (the full list of questions along with the response options are reported in the **Annex 1**).

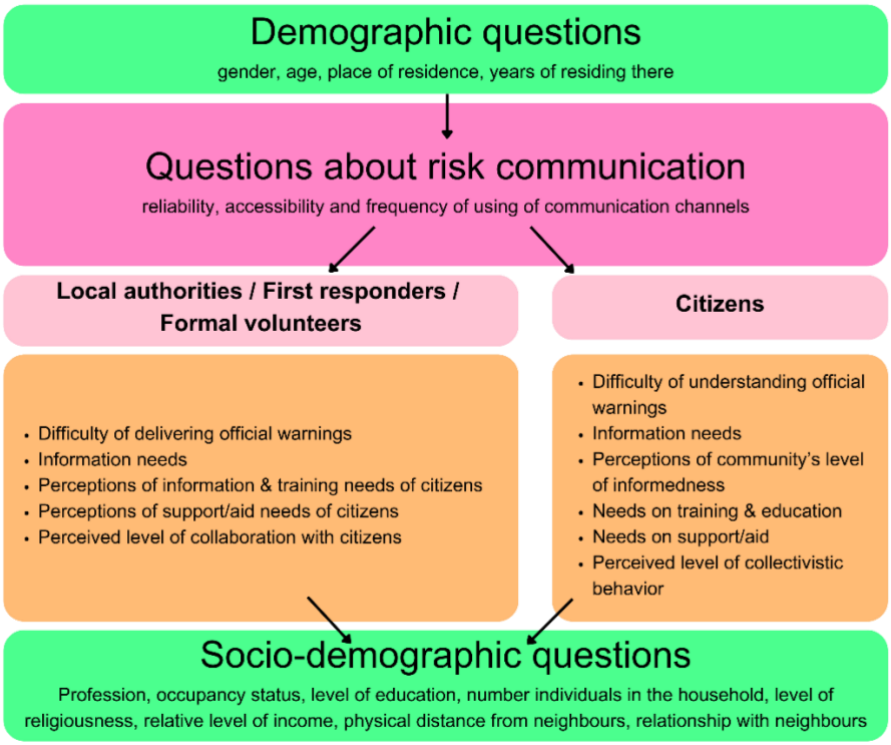


Figure 2. Structure of the cross-sectional survey feeding into T4.1.

2.2. Focus group sessions

Although the quantitative survey allowed us to investigate statistically significant relationships between our questions, it did not provide insights into the reasons behind the patterns of these relationships or certain answers. In order to have a deeper, more detailed understanding on certain communication practices and needs of solutions among the CORE labs, the qualitative method of focus group session was applied.

Focus groups are small groups of targeted, carefully selected, participants who gather to openly discuss a research question and share ideas related to it. The selected participants should represent the larger population, so that results can become generalisable to the represented population. Combining this qualitative research methods with quantitative ones allows a research process to explore and better understand topics that could not be addressed in full depth during the quantitative stage. Members of the focus groups have the opportunity to freely talk and express their ideas, feelings, thoughts and attitudes towards the analysed topic. In addition, the discussion among focus group members might result in some original ideas or knowledge that has never been shared across before.

Similarly to the survey, the general objectives of the focus group discussions were two-folded: on the one hand the activity aimed at exploring the existing communication network and its gaps, and to discuss the communities' *needs* for future solutions. On the other hand, it aimed at exploring the available formal provisions (e.g., protocols, policies) as well as the *coordination* between formal actors and citizens. The specific aims of the focus group discussions were to:

- understand who the key actors within the CORE Lab's communication/cooperation network are and what communication channels they use both before, during and after a crisis event;
- explore existing good practices in communication, cooperation and information sharing, as well as the gaps where communication and information flow do not seem to be efficient both before, during and/or after the crisis event;
- define the needs of key actors in terms of communication, cooperation and information sharing;
- explore the organisational set up of the key crisis management actors including multi-agency forms of cooperation;
- identify the cooperation of formal and informal actors in response to crises, especially focussing on involving civil society and protection of vulnerable groups;
- explore what role cultural heritage plays in cooperation and communication patterns between key actors;
- contrast formal international/national/local Disaster Risk Management policies with Front Line Responders' practices;
- identify intangible/tangible factors that play a pivotal role in collaboration and that might not be fully understood, while locals might have a clearer picture of those.

As understanding coordination and communication between key actors are strongly interlinked aspects of the same disaster management practices, the same logic, structure and tool were used to address these topics during the focus group sessions. As a result, the data acquired by the focus group sessions feeds into two different tasks: while the results of formal provisions and coordination feed into T2.2. and are therefore reported in D2.1, results of the communication network characteristics and needs of solutions feed into T4.1. and are therefore reported in this deliverable (D4.1).

Logistics

The focus group sessions took place in presence, between April and June 2024, as part of the CORE Labs' onsite field activities (see Table 1). The field activities were two-day long onsite works, organised and facilitated by WP2 (VICESSE) and WP5 (SINTEF). Each onsite activity has started with a field study to gain first-hand understanding and experience of the crisis-affected areas of the CORE lab. Following the field study, the participants were welcomed and informed about the project's objectives by the Coordinator and local partners. The onsite activity also hosted a Workshop related to extracting the lessons learned from Cultural Heritage and Community resilience, organized by POLITO (T2.6). Finally, the onsite activity offered a meaningful opportunity for discussing the aspects of the RAISE tool to be developed in T3.2.

Table 1: Timetable of the field activities

	Famenne-Ardenne Geopark	*Naturtejo*	*Karsiyaka*	*Crete*	*Trondheim*
Date of the onsite activity	3rd- and 4th of April, 2024	22nd and 23rd of April, 2024	7th and 8th of May, 2024	21st and 22nd of May, 2024	12nd and 13rd of June, 2024
Hosted by	Geopark Famenne-Ardenne	Naturtejo – Empresa de Turismo EIM	Karsiyaka Belediyesi, De Surdurulebilir Enerji Ve Insaat Sanayi Ticaret Limited Sirketi	Panepistimio Kritis	Trondheim Rode Kors

The focus group session was divided into two subsequent sessions, each of them lasting 90 minutes. The reason behind splitting the sessions into two includes the aim of preventing participants from fatigue and subsequently, from losing engagement and motivation to actively participate. In addition, the two subsequent sessions allowed their focus to be placed on different phases of disaster management: while the first session focused on the "during" phase of a crisis, the second session explored what happened "before" and "after" the actual crisis occurred. In Table 2 the focal topics of the different sessions are illustrated:

Table 2. Description of the time frames in focus at the 1st and 2nd focus group session

1st Session	**2nd Session**	
DURING	**BEFORE**	**AFTER**

• Crisis is unfolding or occurring. • Immediate response and management of the crisis. • Efforts to address the emergency, protect lives and property, ensure the continuity of essential services. • Minimising the harm.	• Preceding the occurrence of a crisis. • There are no immediate risks, disruptions or threats to normal activities and operations. • Prevention activities to raise awareness. • Planning and preparation • Prevention and mitigation of a possible crisis.	• The time frame following the resolution or conclusion of a crisis. • Efforts are focused on restoring normalcy, rebuilding affected areas, addressing long-term impacts, and learning from the crisis experience. • Damage assessment, recovery planning, resource reallocation, community support, stakeholder engagement.

Applying these three phases instead of the 5-phase Disaster Management cycle (prevention, mitigation, preparedness, response, recovery) aimed at reducing the risk of confusion among participants when distinguishing between the phases. In Figure 3 the phases before/during/after are mapped onto the DM cycle to provide a reference.

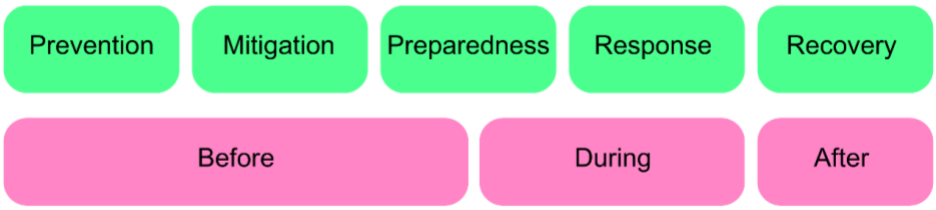


Figure 3. Transformation of the five-phase DM cycle into three phases

The three consecutive phases were defined as follows:

- **Before the crisis event** refers to the timeframe preceding the occurrence of a crisis. It encompasses the time when there are no immediate risks, disruptions or threats to normal activities and operations. During this phase Local Authorities, Organisations, Citizens, and FRs may engage in prevention activities made to raise awareness and to train communities in the planning and preparation that could prevent, or mitigate, possible crises. They are engaged in their usual functions and roles within their organisations' missions, in which their work might be unrelated to each other or related in different ways than during the crisis. For this purpose, the "Before" phase might also include the time when the normal,

day-to-day, routine collaboration between actors is disrupted and re-structured, to prepare for the crisis.

- **During the crisis event** refers to the timeframe when a crisis is unfolding or occurring. It encompasses the immediate response and management of the crisis, including efforts to address the emergency, protect lives and property, ensure continuity of essential services, and mitigate the impact of the disaster. During this phase Local Authorities, Organisations, Citizens, and FRs may activate emergency response plans, mobilise resources, coordinate response activities, communicate critical information, and make decisions in real-time to address the evolving situation and minimise harm.
- **After the crisis event** refers to the timeframe following the resolution or conclusion of a crisis. It encompasses the recovery, rehabilitation, and post-event analysis phases, during which efforts are focused on restoring normalcy, rebuilding affected areas, addressing long-term impacts, and learning from the crisis experience to improve future preparedness and response actions and training activities. After a crisis, Local Authorities, Organisations, Citizens, and FRs may engage in activities such as damage assessment, recovery planning, resource reallocation, community support, stakeholder engagement, and might produce debriefings, evaluations, lessons learned reviews to facilitate the transition from response to recovery and promote resilience-building for the future.

To ensure that all participants from all of the CORE Labs would feel comfortable and confident enough to share information, focus group sessions were conducted in the national language of the CORE Labs. This required native language speakers from the CORE partners to be in charge of facilitating the sessions. For this purpose, a detailed and comprehensive guidebook has been developed detailing thoroughly the structure, aims and content of the focus group sessions envisioned. The Facilitators' Guide document (reported in its full length in **Annex 2**) was shared with the facilitators, to support them in their preparation as well as to make sure that the same methodology was consequently applied in every CORE Lab. In addition to the sharing of the document all facilitators were trained during one online session of 90 minutes where an overview of the objectives of the activity was formally shared, and questions and concerns could be discussed in depth before the actual focus groups. For the focus group session in Famenne-Ardenne CORE lab, the colleagues of UNIMES, while in the case of Naturtejo CORE lab, colleagues from Asociacion Pasos Solidarios were facilitating the focus group session. In the case of Karsiyaka, colleagues from DEMIR, while in the case of Crete, colleagues of the University of Crete supported the sessions as facilitators. Finally, in the case of Trondheim CORE lab, the colleagues of Trondheim Rode Kors were facilitators of the activities.

Participants for the field activities (and therefore the focus group sessions) have been selected and recruited directly by the COREs partners so there was no control on the participating list of people in advance. Depending on the final list that would be shared a couple of days before the events, participants were assigned to the parallel focus group sessions. Two main criteria of assignment were considered in the assigning process: 1) the number of participants could not exceed the maximum number of 15 per focus groups; and that 2) key actors investigated (i.e., citizens, FRs, Local authorities) had to be preferably represented in both focus groups.

2.2.1. The Interaction Map

An important objective of the focus group sessions was to identify the gaps in the communication and collaboration network of the key actors. This aim required a methodological approach where gaps, already existing connections, as well as best practices and lessons learned, could systematically be explored.

For this purpose, the "Interaction Map" tool was developed and applied in each of the sessions. The Interaction Map is a co-creation tool by which participants are encouraged to contribute to the identification of the present connections between the key actors in a crisis. The tool allows to systematically identify, visualise and evaluate connections and information flows between these actors as well as channels used to communicate and relevant good/bad practices that applied to the crisis analysed. Focus group participants are guided by the facilitator in the engagement with the tool and through a variety of specific question groups described in the Facilitators' Guide. The use of the Interaction Map allows participants to acquire a holistic picture of their existing connections and put their attention on links that are either non-existent or require improvement in order to better prepare the community for a potential future disaster.

The Interaction Map tool consists of:

- **a blank sheet**, printed in the size of A0;
- **a variety of "actor" icons**, representing the following 13 actor groups: FR / Government agencies / Non-governmental organisations / Community based organisations / Educational institutions / Private sector / Media and communication outlets / Citizens / Volunteers / Heritage experts / Emergency management coordination centres / International Organisations / Vulnerable groups;
- **a variety of "communication channel" icons**, representing the following 12 types of channels: Face-to-face communication / Television / Printed media / Regulations, formal instructions / Radio communication / Social media / Radio / Email / Postal letter / Online media, websites / Phone communication / Guidelines, checklists.

To provide a context in which the real communication network – alongside with its challenges – can be explored and discussed, participants were asked to refer back to the last major crisis/disaster event that occurred within their community and discuss communication and collaboration in that specific real crisis event.

Participants were firstly asked to introduce themselves, their role and organisation, and choose an actor card corresponding to their role. In cases when they represented multiple roles in their own community (e.g., First Responders being FRs as well as citizens), they were asked to choose the card that best described their role when in a crisis event. After their introduction, participants were asked to identify all the roles that might have not been present in the focus group but play an important role in crisis communication and collaboration. The actors mentioned would be placed on cards again, and participants at this point were asked to place them on the map according to what they thought best represented the network and communication flow between the different actors. They were free to create horizontal groups, place them constructing a vertical hierarchy, use physical proximity among roles to stress specific dynamics, etc. As the next step of the co-creative process, participants were asked to visualise communication flows between actors by drawing arrows between the cards. Arrows could be unidirectional, bidirectional or circular, according to their perception of their flow

of communication. Finally, participants were asked to identify the channels of communication used to facilitate information sharing between these actors, and to place the icons that best represented them on the arrows between actors. They were free to use more than one channel between actors if needed, according to how they thought the flow of information sharing could be best represented.

Once the Interaction Map was co-created, participants helped by the facilitator would start discussing communication and collaboration patterns as well as practices of the depicted network, based on the following group of questions:

1) **Information quality**

   Examples for questions in this group:

   "Were there communication practices that proved slow compared to the unfolding event's pace? How did communication with volunteers impact their ability to collaborate and to effectively engage in crisis response? Were there any issues related to misleading, distorted information or communication? Were there any issues related to the reliability of the source?"

2) **Needs of soft solutions**

   Examples for questions in this group:

   "Were/are there any specific materials available on how to respond to a crisis? How would you evaluate their effectiveness in crisis response? How could these materials be improved to make them more effective in responding to crisis? What content should they include? Where, through what channels should they be advertised/spread in the community?"

3) **Needs on training**

   "Do you have suggestions for future training? What would be the skills and knowledge to be acquired through training? How long should the training last? Who should engage in the training? What would be the preferred format of the training (online, offline, individual, group)?"

4) **Good and bad practices / Lessons learnt**

   "What was considered the most effective channel of communication? What was considered the most effective content to be shared? What went particularly bad/well? With whom? Why? Are there any lessons learnt that could improve communication in the future? And between which actors?"

5) **Vulnerable groups**

   "Was there any specific strategy to communicate with vulnerable groups? What would be their needs regarding communication during the crisis event? What could be improved in communication to best support these groups in responding to the crisis?"

6) **SyRI framework**

   Question in this question group were altered according the corresponding SyRi cluster that the CORE Lab represented (e.g. Adaptive governance, Health and wellbeing, Active memory, Social interaction and Inclusiveness, Socio-economic resilience).

7) **The role of Cultural Heritage**

"Are there any traditions around collaboration, communication, information sharing that played a role in responding to the crisis (e.g. word-of-mouth information/ words, phrases frequently used that refer to one specific aspect of the crisis / traditional gatherings where information was or could be shared) - Were these cultural heritage-related communication forms supporting or rather hindering the spread of reliable and up-to-date information in response to the crisis?"

8) **Needs on digital solutions**

"Are there any digital tools (e.g., apps, GIS maps, risk scenario dataset or analysis..) you use for decisions during a crisis? If yes: What are those tools? What do you like/dislike about your current tools? Based on your previous experiences, what features do you consider essential in a digital tool designed for natural disaster management? How do you think a digital tool can best facilitate collaboration among different users such as first responders, authorities/policymakers, heritage managers, civil society organisations, and citizens?"

These examples within each question group served as a support for the facilitators to effectively lead the focus group session, however, neither their order nor the order of the question groups was fixed, allowing a free flow of ideas and discussion during the sessions.

Each focus group session was followed by a 15-minute debriefing where facilitators introduced the overarching results of the sessions as well as explained elements of the Interaction Map in English to WP2 and WP4 Leaders. Debriefing sessions were video recorded to make sure that the researchers, who did not speak the CORE's native languages, were able to understand the general context and use the Interaction Map at later stages in the research. For translation purposes, all focus group sessions were audio recorded. After the field activities CORE lab facilitators prepared a detailed transcript of the discussions in English and made it available to RESILIAGE researchers. All recorded data handled is strictly confidential, according to the ethical guidance reported in D8.3.

2.3. Semi-structured interviews

Semi-structured interviews were conducted with 1-2 key informants identified during the focus group sessions who were identified as important sources of information related to the needs of solutions. Based on the overarching results of focus group sessions, some of the key aspects were identified and translated into more detailed, more targeted questions, in order to deep dive into the understanding of how certain soft and digital solutions, as well as training, could support the community in risk preparedness and crisis management. The specific list of questions for each CORE Lab is reported in the **Annex 3**.

Semi-structured interviews were conducted online and lasted 45-60 minutes. Similarly to the focus group sessions, all of the interviews were conducted in the national language of the interviewees, led by the facilitators of the focus groups.

For later translation and research purposes, interviews were video recorded, and handled as strictly confidential material, according to the ethical guidance reported in D8.3. After the interviews took place a detailed transcript of the discussions in English was made available for RESILIAGE researchers.

2.4. Eye-tracking experiments

As a final, supplementary step of the data gathering process a set of questions were developed to assess community members' perceptions about the usability and design of selected risk-related infographics.

In order to make sure that participants' (as well as the CORE Labs' and researchers' efforts) were optimised, this set of questions was structured and inserted into the eye-tracking experiment on risk perception, conducted within T2.3. The detailed description of the methodology as well as the results related to risk perception are therefore introduced in D2.2.

As part of the experimental research design, participants were randomly assigned into three groups, and were exposed to three different sets of visual stimuli (see Figure 4.).

After arriving at the mobile laboratory room set in each one of the CORE's fields, participants were introduced to the aim of the experiment as well as they were asked to sign an informed consent. As the next preliminary step, the eye tracking tool ("Smart Eye AI-X") would be calibrated according to the participants' physiological parameters. After the calibration, participants were exposed to 10 visual stimuli (warning signs) according to the group which they have been assigned to.

The main characteristics these groups of infographics are listed as follows (see **Figure 4**):

- **Only icons:** this group of infographics aimed at representing the simplest visual stimuli, by depicting simplified, bicolor icons (dark blue + white), with a yellow background.
- **Icons+text:** this group of infographics aimed at providing slightly more input for participants, by providing the very same icons as the ones in the first experimental setup but complementing them with a simple description of what the icon represents.
- **Illustrations+text:** finally, this group of infographics aimed at being the richest source of information, by providing multicolor, more complex icons, and in addition to that, the same, simple description of the icon represents.

***Figure 4**. Comparison of the same warning sign corresponding to the three experimental setups. From left to right we find: Only icons, Icons+text, Illustrations+text*

After having been exposed to these set of visual stimuli, participants were introduced to a list of questions related to their perception about the design and usability of the stimuli in crisis. Responses to the questions were based on a quantitative scale going from 0 to 10. Examples for the questions developed for the purposes of T4.1 are described in the following (the full list of questions developed is reported in **Annex 4**):

> *"On a scale from 0 to 10, how easy were the colours chosen to visualise the [material] easy to read?"*
>
> *"On a 0 to 10 scale, how understandable do you think the material was for non-native speakers?"*
>
> *"On a scale from 0 to 10 how relevant was the content?"*

Similarly to the previously introduced research methods, research material in the case of the eye-tracking experiment has been translated into the national language of the participants.

2.5. Challenges of the methodology

As one striking limitation of the methodology, language barriers are to be mentioned. In order to make sure that participants of the CORE Labs were able and willing to provide valuable information related to crisis communication, research methods were all applied in the national language of the CORE Labs, resulting in a series of precautions to take into consideration as well as resulting in limitations to the fast-paced requirements of the timeline the project had put in place.

Firstly, all the materials and questions for data gathering (from the focus groups' questions, through the cross-sectional survey and semi-structured interviews to the eye tracking experiment) had to be translated into several different languages (i.e., French, Portuguese, Turkish, Greek, Norwegian). As the translation process could have impacted the validity of the questions, resulting in a higher chance of distorted data, all translations were carefully double checked by native speakers before being delivered or sent out to participants.

Secondly, native speaking facilitators were required to be trained by WP2-WP4 researchers in order to conduct and facilitate on their premises the focus groups (hence the need of the Facilitator's Guide). This approach necessarily incorporates the chance

of information distortion, as facilitators, while being very willing and helpful, had a set of different backgrounds and expertise and were not closely following the methodological process used to build the research activities. Moreover, having different backgrounds in knowledge, culture and expertise, the aim and role of such activities in the successful progress of concurrent tasks within WP4 and within the project might have not always been clear. In order to minimise this risk, the Facilitator's Guide had been designed to provide the most detailed and comprehensive instructions. In addition, all of their questions, concerns have been discussed during the online training that was set up with the specific purpose of walking them through the methodology undertaken, the objectives of the focus group session, as well as the potential risks foreseen associated with group dynamics during the session.

Moreover, as everything had to be carried out in native languages, the access to the data was delayed up to the receival of the transcripts of the different sessions carried out. To add to this limitation, such transcripts had to be provided to WP4 leaders as soon as possible after the sessions in order for them to start the analysis but this was often not possible as concurrent trips to the other COREs and the new activities would occupy the facilitators and the whole consortium in the organisation of subsequent tasks. This impediment significantly slowed down the receival of the translated material and, as a consequence, the analysis of the gathered data.

Finally, as the RESILIAGE project's objective was to gain information through the diverse populations of each community, recruitment processes aimed at inviting community members with diverse socio-demographic backgrounds. This, in some cases, resulted in difficulties to customise the research tools to the needs of some participants (e.g. the ones having difficulties using technological tools such as the eye-tracking tool). To mitigate this risk, quantitative research tools such as questionnaires were available to the community both in online and offline form. In addition, during experiments that require technological familiarity, all participants have been offered guidance and support in the form of a native-speaking assistant.

3. Introduction to the data collection processes and results

In the following, the process conducted to gather data in Famenne-Ardenne CORE is described in its specific modalities and considering all the methods previously described in the methodological section.

3.1. Cross-sectional survey

3.1.1. Famenne-Ardenne Geopark CORE Lab results

The cross-sectional survey has been distributed between 22nd of April and 27th of May 2024 by the Geopark Famenne-Ardenne as well as LOBA. Within this time frame a total number of 50 responses have been collected from which 35 were complete, answering all the questions of the survey. Regarding their status, 29 of the responders (82.9%) are civil residents of their community, 5 respondents (14.3%) are formal volunteers, and 1 respondent (2.9%) is a member of the local authority.

In terms of demographic characteristics of the participants, 57.1% of them are female while 42.9% are male, with the average age of the respondents being 51.23 years (SD=13.01). Participants reported to have been living in the area for the average of 24.97 years (SD=17.19). The majority of them share their household with other relatives (31.4% with a partner, 11.5% with children, 45.8% with partner and children, 5.8% with other relatives) while only 5.7% live alone. The majority of them (85.7%) are owners of a single-family house. In terms of education, no one reported not to have any school certificate, nearly half of the participants have a high school or secondary school degree (48.6%), while 51.4% reported to have bachelor's, master's or doctoral degree. The majority of the respondents (65.7%) are not at all religious. In terms of economic status, the larger proportion of respondents have a household income that is higher (45.7%) or much higher (11.4%) than the average, while a smaller percentage reported to have a slightly lower (31.4%) or much lower (5.7%) income than the average. In terms of physical proximity to other residents, 91.4% of them reported to live within 2 minutes of walking distance from their closest neighbour, while only 2.9% reported to live more than 30 minutes away from their closest co-resident. Respondents rated their relationship with their closest neighbour quite heterogeneously: while one half of the participants (48.6%) have a weak or very weak relationship with their neighbour, the other half (51.4%) reported a strong or very strong relationship with them.

One striking result of the survey is related to the differences in communication channels that the three groups of participants (citizens, first respondents, local authorities) use to consult, especially in the case of social media (Figure 5).

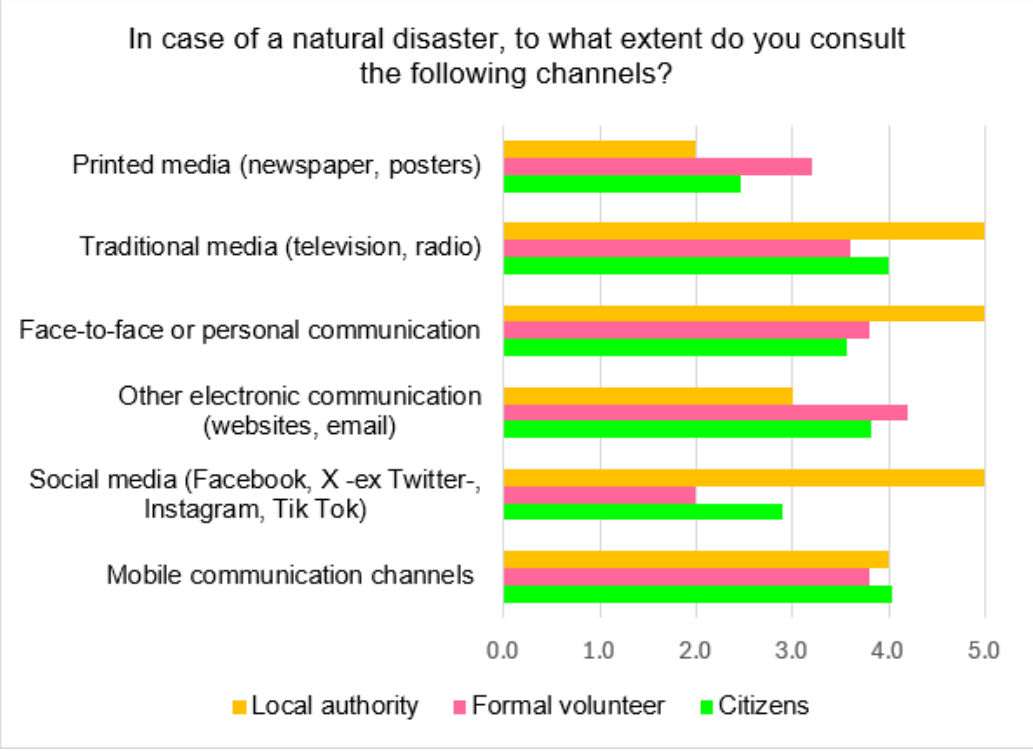


Figure 5. Communication channels consulted by local authority, volunteers and citizens.

3.2. Focus Group session

3.2.1. Famenne-Ardenne Geopark CORE Lab results

The Focus Group sessions took place as part of the field activity organised in the Domaine de Lomme event facility in Rochefort, on the 3rd and 4th of April 2024. A total of 27 participants were present on the first day and 30 on the second day. The participants represented a vast stakeholder group, namely: University of Namur (Hydrogeology Department representative), Famenne-Ardenne town planning centre, Lesse River Contract, River contract for the Lesse, Compagnie Ardennaise De Randonnee (company in charge of the trail activities), Municipality of Nassogne (alderman), Municipality of Commune (technical services chief), Rochefort Cultural Centre, Emergency Planning Marche-en-Famenne, Famenne-Ardenne Tourism Office, Escap'ânes Famenne Ardenne and Le Fond des Vaulx, Nassogne Tourism Office, Municipality of Durbuy, Nassogne Tourism Office, Geopark Famenne-Ardenne (Geologists, Partnerships development officers, Tourism office, Coordinators), DINAPHI Rescue Zone, Governor's Office, House of Speleology and Underground Heritage (MASEPAS), SPW - Nature and Forest Department, Han-sur-Lesse Royal Tourist Office, SPF Intérieur - Federal Services of the Governor of the Province of Luxembourg, ASBL Fond des Vaulx Marche en Famenne, Attractions and Tourism, Ourthe River Contract, Royal Tourist Office of Durbuy, Rochefort Tourist Office, Federal Office of the Governo, Office of the Governor of the Province of Luxembourg, Municipality of Rochefort (alderman), Lesse et Lhomme Police zone, Matélé (local television), Belgian Red Cross, Mayor of Rochefort, SPF Intérieur - Federal Services of the Governor of the Province of Luxembourg, Water services of the Province of Luxembourg.

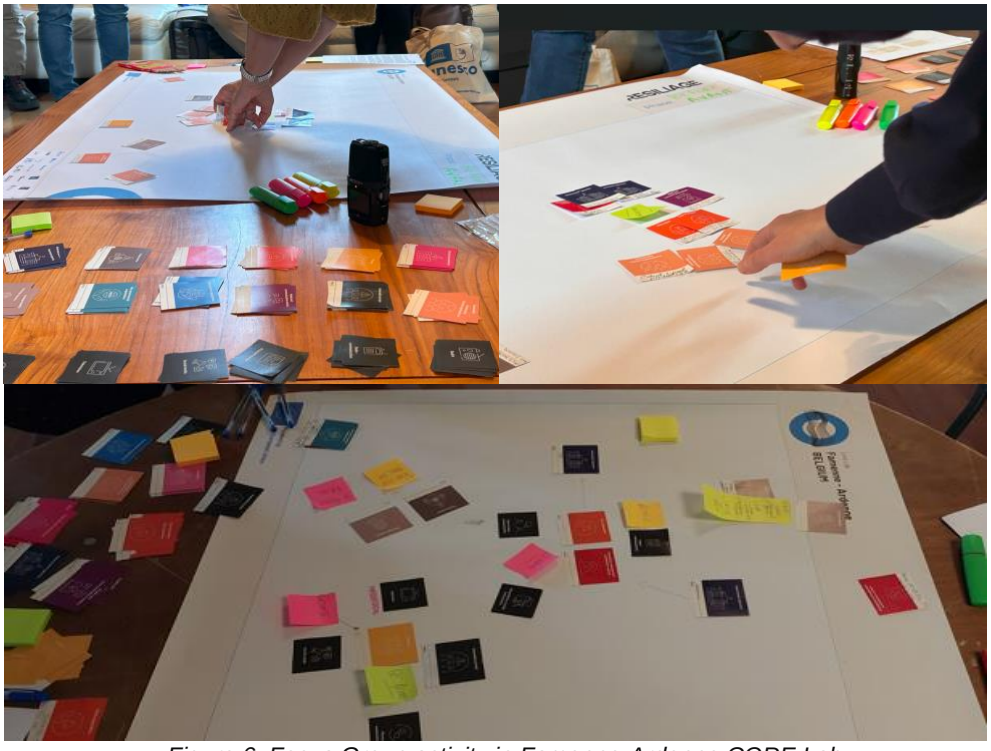


Figure 6. Focus Group activity in Famenne-Ardenne CORE Lab

On the afternoon of Day 1, the first 90-minutes focus group session was conducted. The second session took place on Day 2, in the morning. Due to the high number of participants in the field activity, two focus groups have been created and were running in parallel, both on Day 1 and Day 2, focusing on the same exact question groups, as introduced in the Methodology Chapter (see Section 2). After a general welcome session introducing the project's aims and partners, participants have been more specifically introduced to the objectives of the focus group session, the methodology and the research tool (Interaction Map). Before starting the parallel activities, a short presentation on the flooding that impacted Famenne-Ardenne Area in mid-July 2021 was also presented, so as to frame the past scenario that would have been under analysis during the whole activity. The information shared was based on the crisis description delivered in D1.1 (see Section 5.1.2, p.83-91). At the end of the presentation, participants have been assigned to one of the two parallel focus groups, by following the principle of the key actors being evenly represented in both of the groups. Consequently, the group compositions were the following: the first session of the focus group was carried out during Day 1 with two groups composed of 13 and 14 participants each and the second day, two parallel groups of 15 participants each were created. After each focus group session, facilitators were briefly video interviewed by the researchers of Deep Blue and Vicesse, asking for a high-level explanation of the topics discussed during the session, along with the most relevant results and gaps identified as well as explanation of the Interaction Map created by the participants.

3.3. Semi-structured interviews

3.3.1. Famenne-Ardenne Geopark CORE Lab results

Following the focus group sessions, three participants who demonstrated exceptional knowledge and active engagement during the discussions were identified. These individuals were subsequently contacted to participate in follow-up interviews aimed at delving deeper into specific topics raised during the focus groups. The primary objective of these meetings was to conduct semi-structured interviews 1:1 to gain a more nuanced understanding of soft and digital solution needs and requirements based on the discussions previously made in the Focus Groups. Additionally, a better understanding of existing training programmes and the identification of potential gaps or areas where new training initiatives seemed necessary was to be reached. Due to scheduling constraints, only one interview out of three was secured. However, the insights gathered from the in-depth session proved to be valuable and significant to the analysis.
The session took place on the 3rd of May, online, with a representative of Lesse River Contract. It took place in French, lasted for 60 minutes, and it was facilitated by one of RESILIAGE's team of French-speaking partners. The facilitator was provided with several prompt questions to be covered in an unstructured way during the unfolding conversation with the interviewee. The questions were prepared based on the debriefings with the Focus Groups facilitators, in order to deep dive into the key issues reported in the focus group sessions and their potential mitigation by digital and soft solutions and training (Annex 3). At the end of the interview with the participant, the facilitator and DBL held a half-hour debriefing to summarise the discussed topics. Later on, the transcripts of the interviews were provided to DBL in their whole length for further analysis.

3.4. Eye-tracking experiments

3.4.1. Famenne-Ardenne Geopark CORE Lab results

The eye-tracking experiments took place on the field in a mobile set-up laboratory of Rochefort between the 3rd and 12th of April 2024. All together 7 individuals participated in the experiment from which 2 were assigned to the "icons only", 3 to the "icons+text" and 2 to the "illustrations+text" experimental condition.
The most relevant results are illustrated in Figure 7. In the figure, it can be seen how the participants assigned to the "illustrations+text" condition rated their visual stimuli as the least understandable, least relevant and remarkably less useful compared to participants evaluating the other two types of stimuli. They also rated the multicoloured nature of this type of stimuli as the least readable, least eye-catching, and remarkably less able to convey the intended message. In addition, they rated this condition as being the least comprehensible for non-French speakers.
In contrast, participants assigned to the "icons+text" condition rated visual stimuli as being the most relevant, most useful and the best in conveying the warning message.
It can therefore be concluded that participants of the experiment in Famenne-Ardenne Geopark expressed a strong preference for a simple, bi-coloured design of warning signs with a short description of what the actual sign depicts.

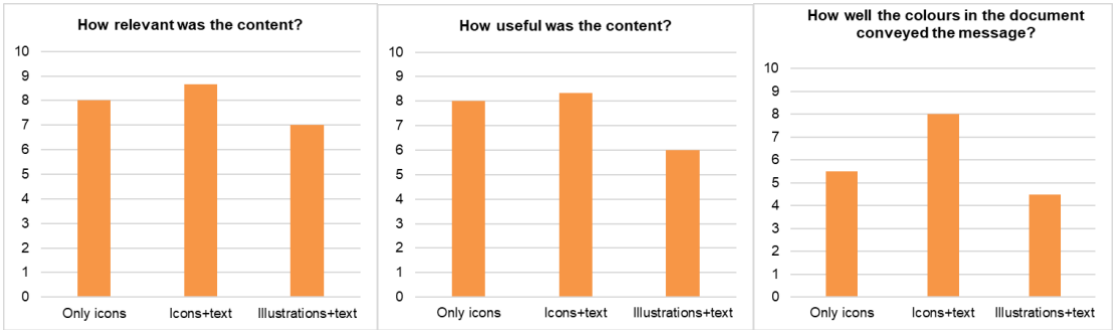


Figure 7. Comparison of the ratings of "only icons", "icons+text", "illustrations+text" condition. Left: How relevant was the content? Centre: How useful was the content? Right: How well the colours in the document conveyed the message?

3.5. Famenne-Ardenne Geopark CORE

"We live accordingly to the rhythm of the river. She is our big boss"
(Representative of Geopark Famenne-Ardenne)

To best represent the core values and key message gathered from each CORE Lab, results are introduced starting with a quote that was being said by one of the participants of the field activity. As it has been learned in the Famenne-Ardenne CORE Lab, the population who has lived on the territory of the geopark has been accustomed its lifestyle and habits according to the "rhythm of the river", referring also to modern and traditional observation techniques that have been developed throughout the past centuries to closely follow and predict the river's behaviour. As the Geopark area is largely built on tourism, the "rhythm" of their "big boss" not only directly affects their everyday life, but also indirectly, as precautionary measures taken according to the water level impacts tourists who may or may not be allowed to enter the area.

In Table the key stakeholders participating in Famenne-Ardenne Geopark's CORE sessions are clustered, in order to give an overview on the roles that were part of the conversation and that actively co-shaped the discussions on the past crisis, from which the data analysed here was gathered from.

Table 3. Stakeholder groups in Famenne-Ardenne CORE lab

KEY STAKEHOLDER	DESCRIPTION
LOCAL AUTHORITIES	• Mayor (Head of municipality); • Governors; • Administrative authorities at local and provincial level (e.g., Communes, Provinces); • Minister of Interiors department (leading the federal response in large-scale disasters)
FIRST RESPONDERS	• Fire fighters • Police • DINAPHI Rescue Zone • Forestry department • Security units • Volunteers • Volunteering Organisations (e.g., The Lesse River Contract)
CITIZENS	• Residents • Tourists • Scouts

The key stakeholders' information flow, communication channels and interactions were mapped in the different focus group sessions through the Interaction Maps provided. The major highlights that are to be reported on the maps are summarised in Figure 8, where a simplified Interaction Map was recreated by DBL, visualising the communication chain of the most relevant stakeholders.

Regarding the communication between these actors (Table), the most important factor to emphasise is that the communication strategy and network are built depending on the number of municipalities affected by the emergency situation. This is a decisive factor whether or not higher-level authorities (e.g. Governors, Minister of Interiors) and certain FR groups (e.g. DINAPHI rescue zone) are to be involved in the crisis response communication. It is important to highlight that some relevant stakeholders seem to be excluded from the formal communication (e.g. SPW Nature and Forestry Department and tourism stakeholders), partially resulting in tourists becoming the most relevant vulnerable groups to respond to the crisis event. Focus group participants also highlighted the issue of authorities on different levels not communicating effectively with each other. In the following Sections (from Section 4.2.2 to 4.2.4) the discussions that took place in the before, during and after sessions are reported and summarised. Moreover, the major gaps, lessons learned and needs identified by the participants are visualised in a relevant table divided into the key stakeholders under analysis (i.e., Citizens, First Responders and Local Authorities).

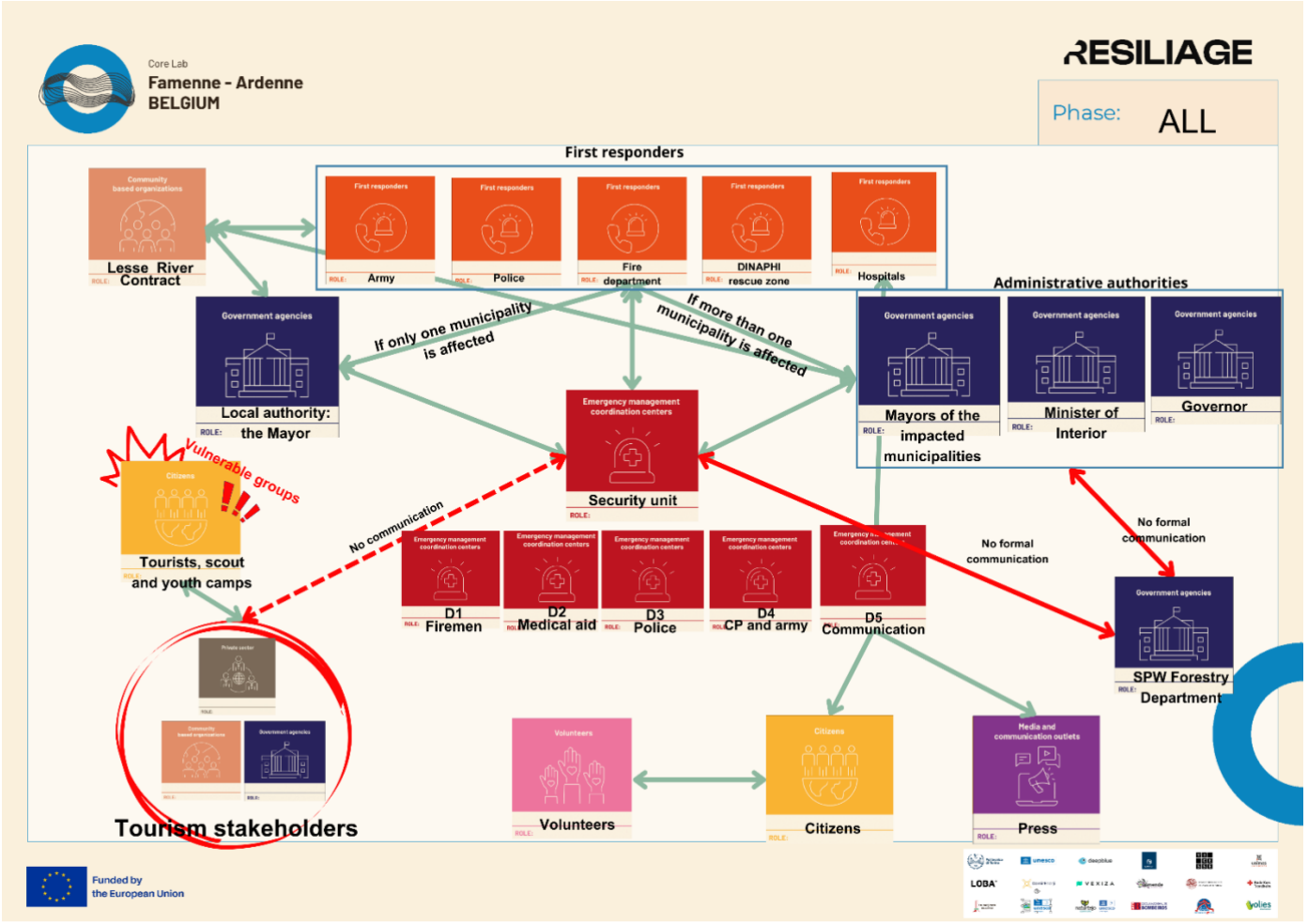


Figure 8. Recreated Interaction Map, visualising the communication of key stakeholders in the Famenne-Ardenne CORE lab

3.5.1. Before the crisis

Introduction to the context

The participants in the workshop described that the administrative authorities (Minister of the Interior, Provincial Governor, Mayor) are the stakeholders responsible for preparing crisis management plans and organising crisis management exercises. The emergency planning and crisis management coordinator for the government of the province of Luxemburg stressed that the general perception they have since the 2021 flooding is that the public is not aware of their existence.

There are regional general emergency and response plans drawn up in a general way, based on monodisciplinary plans (D1 = firemen, D2 = medical aid, D3 = police, D4 = civil protection and army, D5 = communication). These are pre-established preparedness plans, and on the basis of the information and the crisis unfolding the plans are applied by authorities at local, supra-provincial, and national levels.

Generally, when a flood starts it first impacts a single commune, to then spread and impact several communes afterwards. Only after this happens it can be said that a Province is flooded and further down the line a whole country. It is generally very rare for flooding occurrences to start an emergency directly at the provincial level. This is the reason why local communes' preparedness is very central to mitigating a crisis because they have the power to slow down the disaster while it is happening, as well as to alert neighbour communes of the status of the flooding.

In the workshop it was discussed how provincial alerts can be activated only after 20 hours since the trigger of a disaster phase needs to be sent out by *two* communes. In fact, only when two communes are impacted, the Province is to be considered in charge of the disaster's coordination. When a crisis alert is activated, whether at a communal or provincial level, the aim is to gather around all key local authorities (i.e., Mayors and/or the Governor), as these key roles are called "the disciplines". Their coordination is then directed to the fire department, medical and psycho-social aid, police, logistics, civil protection, and the army, who are the ones who will coordinate the actions directly on the field. The emergency plans at the local or provincial level must be able to issue information before the crisis expands further, so before the water reaches its maximum capacity level. **Information is to be issued via social networks and via the channel "b-alert" which is used to alert citizens**. The provinces of Namur and Luxembourg do cooperate in times of crisis and the civil protection system has been reorganised into a zonal structure to improve cooperation. As there are 44 communes in Luxembourg and 22 in Namur, if communes from both provinces are impacted, then they are asked to try and deal with the problem in their communes first. Furthermore, **an appendix has been created in the Province of Luxembourg to help communes set up Emergency plans in a 2-page Flood Risk Preparedness Plan**, to facilitate the reading instead of having to go through an Emergency Plan of several hundred pages. **No follow-up was given to support local authorities in the development of this local version of the Flood Risk Preparedness Plan. No major meetings across different authorities levels were organised to align on a common shared strategy**

The Geopark specifically lies in the two provinces, on a border, and royal decrees explain how organisation in practice should work in times of crisis. The province of Namur and the province of Luxembourg depend on the same legislation which helps cooperation between the two. Although, it was highlighted by participants that while on paper they are supposed to evolve and act during the crisis in the same way, this does not always

happen this way in the field. For instance, the participants explained that during the 2021 floods, the Geopark was supported by the army in the Rochefort area, but not in the Famenne-Ardenne area. In Famenne Ardenne specifically, the army intervened *after* but not *during* the crisis. This **misalignment on coordination strictly depends on the commune directions and the available FRs on the ground.**

The Geopark bases its preparation on the geologists' assessment of the flow rate at the gauging station: depending on the flow rate, they know that water is potentially going to reach specific areas in the cave. Hence, based on that, they can adapt the type of touristic visits changing the regular paths to prevent inconveniences. However, in the past crisis, based on the flow observed, no one suspected the importance of the water rise detected nor had imagined the magnitude of the event. **No specific internal action plans are currently in place for future crises.**

The Province of Luxembourg in the past crisis proposed to act as a refuge centre, identifying points in an area that could be used as a refuge. This was proposed as they have many contacts, they know who has the key of different establishments, the number of public toilets in certain areas etc. Despite their proposal, the system back in 2021 did not prove to be very efficient as **citizens and authorities were not aware of the refuges nor a clear mapping of refuges available was shared upfront with them.** The participants highlighted that if the public is not aware about the refugee centres existence before a new disaster crisis, it could have a significant negative impact on citizens in several ways. It could increase the sense of danger and confusion as citizens might procrastinate in taking action and evacuation procedures staying in unsafe locations during an evacuation order. As a cascade effect, this would waste valuable time in searching for shelter on their own, delaying evacuation and increasing risk of injury or death for themselves and for FRs. Delays in reaching designated shelters could lead to increased injuries or fatalities due to exposure to the elements or dangers of the crisis and consequent greater property damage as people might not be able to secure their belongings before evacuating during a preparatory phase.

Participants agreed that in order **to be better prepared for future crises it is necessary to talk about watercourses and to reiterate the different river contracts as communication and preparedness actions might depend on whether the watercourse under observation relies on communal, provincial, or regional contracts.** It was clarified that the further upstream in the river one moves at, the more it relies on communal authorities, and the further downstream one goes, it relies more on regional authorities. **Developing a functioning preparedness plan should clarify the space within which the different authorities are responsible for and where to intervene first in the event of a crisis**. Main issues to be clarified on the matter:

- The set-up of a buffer zone
- Shared agreement between different levels of power

The participants highlighted how the public is not aware nor prepared enough to face the risks that could occur in the area. Reinforcing knowledge and information on these risks could have enhanced citizens' awareness and crisis preparedness. In terms of preparedness, **The Lesse River Contract is in charge of raising awareness and organising events to set up projects between different communes**. Their role is to

be considered relevant when talking about preparedness. Their job entails also going out to the communities in the area and spreading awareness on the risk of flooding, explaining how to behave, or identifying the main problems that the citizens might encounter, to try to come up with an action plan for that.
The participants stressed that as citizens**, having a very simple set of information** (what to do, what number to call to get the information, etc.) **would have been already beneficial in the preparedness phase**, to better face the crisis, emphasising the importance for the average citizen to reach a simple and functioning system that everyone knows about and that you should not start searching for while the crisis is happening. **In the focus group it was highlighted that a local emergency number already exists but only few of the same participants knew about these numbers and channels.**

Identification of gaps, best practices, needs

In the following, the key stakeholders analysed (Local Authorities, FRs, Citizens) are described in more detail. A comprehensive overview of the existing gaps that hinder their response capabilities are identified and best practices to address these issues are presented, if available. Best practices include possible implementation priorities that were addressed by participants during the Focus Group sessions, as well as successful strategies already put in place that represent success examples and/or inspiring approaches that could be considered to support key stakeholders in the enhancement of their preparedness.

- **Local authorities**

Local authorities, such as mayors and governors develop emergency plans. However, these plans are often lengthy and complex, making them difficult for the public to access and understand. Moreover, the public itself is not involved in the definition of the plans themselves. This lack of public involvement obstructs preparedness efforts. Communication between local authorities and certain organizations in charge of liaising with the general public (e.g. Lesse River Contract) primarily rely on email and phone calls. While this allows for a fast information exchange, it offers limited opportunities for public outreach and awareness raising. Additionally, there is no central system for identifying and sharing the location of refuge centres with the public during emergencies.

To improve communication and preparedness, there is a need for standardised and simplified emergency plans. An important best practice mentioned during the focus group session was a 2-page Flood Risk Preparedness Plan developed in the Province of Luxembourg. However, this plan should be readapted and further developed by local authorities. Furthermore, organisations like the Lesse River Contract should be actively included in overall preparedness strategies to leverage their expertise and liaise between the authorities and the public needs. Finally, establishing a clear system for identifying, mapping, and disseminating information about refuge centres is crucial for a more coordinated response during emergencies.

- **First responders**

FRs (firefighters, medical teams, police) encountered issues of communication and coordination strategies applied before the past emergency situation in 2021. This stems from the fact that each responder group relies on its own internal disaster management plan, which has not been effectively integrated to facilitate smooth communication and collaboration among different key actors. To address this, follow-up support is needed to help first responders share and refine their internal plans, ensuring they all contribute to a unified and coordinated response during emergencies.

- **Citizens**

Citizens are largely unaware of existing crisis plans, the communication channels that can be used during emergencies and the resources available to them prior to a crisis. This lack of knowledge is not yet fulfilled by public education efforts and resources. This was evident during a past crisis, where the public was not informed about the refuge centre plan, highlighting the need for improved communication and public outreach.

3.5.2. During the crisis

Introduction to the context

During a disaster, the first information is generally sent from the **emergency services** on the ground (i.e., firefighters, police), who, depending on the situation, simply contact the authorities (i.e., the **mayor**) asking to activate an emergency phase if necessary. If the disaster is impacting a single municipality, the mayor follows a municipal emergency plan. However, if there are several municipalities to be impacted, the **authorities and governors** are informed, and the governor decides whether to activate a provincial plan. Hence, the mayor acquires a central role during the evolving of a crisis by having the responsibility to initiate communication with the various departments (at the provincial management level). In fact, the **administrative authorities** (Minister of the Interior, Provincial Governor, Mayor), while being responsible for preparing plans, and organising exercises are also **the ones coordinating emergencies**. Depending on developments, the commune's general emergency and intervention plan is triggered, which covers all the disciplines, and if there is a real increase in provincial power, the lead is taken over by the governor and his departments.

In the case of a classic flood, the **fire department** is in charge of sending the first alarm. As floods are not abrupt events, their occurrence is relatively gradual (as compared to an earthquake for instance). Moreover, there are rivers that could rise in the span of one week. In the 2021 crisis the raising of the flood took several hours, still giving the chance to the FRs to make a succession of phone calls and plan surveillance, which means that the event was predictable. **The problem they faced was rather quantifying and being able to plan sufficient FRs manpower** according to what was going to happen. **In 2021, communes had to wait a long time for a federal plan to be actually triggered.** And at that point the federal plan was taken over by the Minister of the Interior. Apart from firefighters and police officers, there is also an operational department in the area

(DINAPHI rescue zone) who can intervene during a crisis when they are authorised to do so, but only in the case when several villages are affected.

The administrative authority, (i.e. the mayor, or governor or minister of the interior, depending on the level of crisis), convenes its **security unit**, made up of a representative of each discipline, whose players vary slightly depending on the level (communal, provincial, etc.). **Discipline 5** is represented by a member of the municipal services or the governor's team who is responsible for **alerting the population** and **communicating the emergency situation**, and who acts as **spokesperson with the press**. These people meet around their authority during the emergency and draw up and validate the emergency plan together. According to the focus group participants, the person in charge of communication reaches out to specific sectors, hospitals, etc. providing information on the risks existing in the area, and on how to mitigate the risk, or the best way to act when the risk occurs.

A frequently mentioned difficulty during the past crisis was that **some citizens had to be evacuated under the authority of the mayor**, because they did not want to leave their homes. Lots of **teams of volunteers knocking on doors** have been **reminding people not to stay** as well as **distributing sandbags**, **sharing their number to be contacted** in case of emergency. Apparently they were contacted back very often during the crisis, to ask for information or help. Participants during the crisis witnessed firefighters **and police officers walking door to door** in the neighbourhoods that were going to be flooded alerting citizens about the upcoming evacuation. However, **people would refuse and would decide to stay at home as they could not see the danger yet and the flooding seemed a faraway scenario**. Only a couple of hours later they reportedly contacted firefighters back to get rescued. Focus group participants highlighted the **importance of communicating through the right channels to convey reliable, undistorted messages,** and thus avoiding endangering not only citizens' lives but that of the rescuers, as well as saving human efforts and resources during a crisis.

Participants of the session pointed out a confusion related to the role of the mayor during the crisis. As it was raised, the mayor is also a citizen whom local residents know and trust, thus expecting to see him actively engaged in the resolution of the crisis. Moreover, the authority itself wanted to play a practical part in the recovery (shovelling, scooping, etc.). **This, however, created confusion and tension around what the mayor's role entails, as the mayor should solely fulfil his role at the community centre by answering the telephone, and making administrative decisions.**

In addition, **tourism stakeholders** have raised the issue of **not being put in contact with official representatives, nor given clear directions and recommendations on how to liaise with tourists and visitors**. As a result of this communication gap, youth movements and scout camps were asking the mayor to be helped to evacuate, which presumably slowed down the information flow and consequently, the rescue process. **Problems also arose when it came to notifying foreign scout camps that are not French speaking** (many scouts come from the Netherlands).

Another important issue raised during the focus group session was related to the **SPW Nature and Forestry Department**, which -despite its knowledge of the forests, trails, and people who frequently visit them (including park rangers)- was unable to share critical real-time information during emergencies. For example, they could not report flooding in specific areas of the forest, which could have impacted public safety. While they **informally communicated with mayors and emergency offices, there was no**

official channel to disseminate their observations. This lack of a formal system hinders overall vigilance and response efforts.

During the focus group it was also highlighted how **firefighters and police did not receive information from RIM but from 112**.

During the crisis websites such as **hydromètrie.be** and similar tools **did not report the emergency sign on the site nor a pre-alert messaging was shared, even when the water was already quite high**, outside the Ourthe. **The need for a reliable site with a direct sensing system to the area and predictive capabilities** was raised in the workshop.

The media that are mostly used during the crisis were: **local and national television**, social networks, and **smartphone communications** (e.g., through the channel **Be-alert**). Citizens received risk-related information through these channels. At one point of the crisis, however, these means of communication stopped working, leaving **megaphone** and **face-to-face communication** the only channels through which the most recent information has been provided.

The emergency channel mostly used during the crisis before the power went off was **B-alert, which was considered a very powerful and easy-to-use system**. When the network was not available anymore, **ASTRID radio network** channel was the only communication channel still functioning and reliable as luckily Belgium's network has very few white zones. Based on the participants' opinion ASTRID is **valid only if limited solely to the management of the emergency services**, excluding a set of key actors' inputs, otherwise too much information noise is generated. Moreover, ASTRID could inform and identify already impacted areas but could not help in making any predictions on the evolution of the disaster. Participants highlighted the necessity of a **shoreline elevation map depicting the areas that might be affected** before they are actually affected.

Identification of gaps, best practices, and needs

In the following, the key stakeholders analysed (Local Authorities, FRs, Citizens) are described in more detail. A comprehensive overview of the existing gaps that hinder their response capabilities are identified and best practices to address these issues are presented, if available. Best practices include possible implementation priorities that were addressed by participants during the Focus Group sessions, as well as successful strategies already put in place that represent success examples and/or inspiring approaches that could be considered to support key stakeholders in the enhancement of their preparedness.

- **Local authorities**

  As raised in the focus group session, the practical implementation of regulations can be inconsistent at the local and provincial level, indicating the lack of clear and easily applicable protocols to intervene during crises. Moreover, as a result of disagreements between different levels of the government (communal, provincial, regional) regarding watercourse management, they reported to have faced difficulties in establishing buffer zones. The process for escalating a crisis and activating emergency plans for flooding crisis seems slow as Mayors need to wait for the crisis

to be spread out in more communes at the same time for a federal plan to be triggered, hindering conjunct response efforts. Regarding role clarity, the roles of different authorities in terms of communication seem unclear, leading to confusion and tension among citizens and FRs.

During the crisis, the most frequently consulted media by local authorities are face-to-face communication as well as traditional media (TV, radio), social media and SMS, while the least consulted one and also rated as the least intuitive is printed media, along with forms of electronic communication (websites). As gaps within their communication, they reported to have had difficulties to reach non-native speakers (e.g. foreign scout camps) during the crisis, as well as they pointed out the difficulty of clear and timely communication with the public. In addition, as mentioned earlier, the SPW Forestry department lacks a formal communication channel in connection to authorities and FRs to share real-time observations from the forest, the paths available and their status.

Besides some existing regulations for inter-provincial cooperation, local authorities have also understood the importance of taking the necessary measures (e.g. issuing administrative police orders of evacuation) to save time and help FRs speed up the evacuation process by using their authority to provide precise instructions to be followed by citizens. Moreover, since the past crisis, governments have understood the importance of effective communication with citizens and started to increasingly communicate disaster and risks related information on social networks, which was not necessarily the case back in 2021.

In addition to the above-mentioned lessons learned, local authorities expressed their strong need to receive up-to-date information about the unfolding event, to receive clear, actionable instructions to promptly intervene as well as to receive continuous feedback from citizens about their needs. They also reported a need for a clear and unified communication strategy across different authority levels related to watercourse management. They pointed out that clear and timely communication with the public about risks, evacuation procedures, safety measures, and recommendations would be very important with a carefully chosen time when to make this information available to the public. In terms of soft solutions, they highlighted that awareness campaigns targeting citizens would remarkably support the public's understanding of risk and, therefore their collaboration with authorities. For the same purpose, they pointed out the importance of future training provided to citizens on how to make their homes as safe as possible, how to prepare for emergencies and how to best collaborate with other agents (e.g. FRs). They also expressed their need for communication guidelines related to how to best address citizens and certain vulnerable groups (e.g. tourists and scouts) to effectively communicate with them. Regarding digital solutions, they pointed out that alert systems that citizens are aware of and can use would be important to minimise the risks related to potential future floods. In addition, as they reported, having an application for all the key actors (local authorities, FRe, citizens), that could geolocate FRs or other agents, send out warnings, and other necessary information would be crucial.

- **First responders**

FRs usually convey information via email, SMS, and via face-to-face communication. As pointed out, however, during the field activities, communication between emergency services in the field and the command centre can break down during emergencies (e.g. due to power outages). In addition, they reported a lack of smooth coordination between different response teams (firemen, medical, police, etc.), due to the separate internal management plans. Moreover, firefighters and police rely on 112 calls and direct observations instead of receiving information from the official RIM system, presumably excluding them and fragmenting relevant information across different FR teams. FRs have also highlighted that they perceived B-alert as the best channel to communicate during the crisis until it broke down and did not serve its purpose anymore. Although "ASTRID" radio network has served as the main communication channel during the past crises -as it worked without connection-, it is now being replaced, but there is no additional information on what will be replacing it.

Concerning volunteers within the community, their most frequently consulted media is electronic communication (email, websites), which is also considered as the most intuitive one, along with traditional media. They reported social media as their least consulted communication channel. Volunteers, who have ever had to deliver an official warning reported difficulties doing it, mostly due to the overload of communication channels and their doubts related to the correctness of the information to be conveyed. They expressed a strong need to receive clear and actionable instructions during the crisis to promptly intervene. According to volunteers, it would be very important for community citizens to receive training on how to make their homes safe during floods, how to identify misleading and distorting information, as well as what kind of services and safety measures are available during a crisis.

FRs expressed their need for follow-up support to assist them in sharing their internal crisis management plans as well as better shape and align them with the internal plans of other FR teams. In addition, as they reported, a well-established communication channel that includes all FRs would be crucial: this way they could receive information from the SPW Nature and Forestry Department. As ASTRID is being currently replaced, they also expressed a very strong need for a steady communication channel to use for the case when all other channels would break down. Similarly to local authorities, they also reported the importance of carefully planned communication with citizens in terms of content and timing. In addition, they could also profit from the smart application that would target all the key actors, including FRs too, to have a shared platform of communication, warnings and additional important information.

- **Citizens**

During the crisis, the most frequently consulted media by citizens were mobile communication (texts, text apps, calls) and traditional media (TV, radio), and they also considered these two types of communication the most intuitive ones. As the least frequently consulted media they mentioned printed and social media (the latter

one indicating a discrepancy with authorities as they have been putting efforts to enhance their communication with citizens via social media).

As very important gaps to mention, during the focus group session -which took place years after the actual crisis- some participants still did not know about the existence of B-alert or ASTRID, indicating a lack of awareness of these channels. Closely related to this issue, there is a general unawareness of existing crisis plans, channels and resources (e.g. the local emergency number is not widely known by citizens), nor were they properly informed about the refuge centre plan during. In addition, citizens who have ever received an official disaster warning during the past crisis had difficulty understanding it, as the message was too long, too detailed, as well as it was written in a language they did not understand (too scientific, too technical). Moreover, some participants reported having difficulties to understand what the warning personally meant to them.

As mentioned earlier, the most important vulnerable groups in this CORE Lab are tourists who -due to their geographical position and different mother tongue- were largely excluded from the flow of relevant information. During the 2021 flood, tourism stakeholders were not provided with precise guidelines by FRs and local authorities, therefore they could not share reliable information to tourists. Respondents also mentioned children and the elderly as potentially vulnerable groups due to their difficulty accessing updated information and their ability to act accordingly.

An important best practice to mention is the Belgian website “monplandurgence.be” which is a canvas of emergency plans drawn up by the national crisis centre, free of charge for all citizens. By answering a list of targeted questions, citizens can download their personalised emergency plan to follow in case of an emergency. In addition to this website, governments have understood the importance of effective communication with citizens and started to increasingly communicate disaster- and risk-related information on social networks. However, as participants of the cross-sectional survey reported social media as their least consulted communication channel, communication coming from the government should be extended to include mobile communication and traditional forms of media, too (TV, radio).

Citizens expressed a very strong need to receive timely and credible information, among others in the form of alert systems and mobile applications to serve as a shared platform for all the key actors (FRs, local authorities, citizens). It would be crucial for them to be informed about the available channels and resources to be used during a crisis, as well as to be provided with clear and simple protocols to follow when an emergency event occurs. They also reported the importance of receiving training on how to collaborate with FRs during a crisis and what safety measures and services are available in the community. As participants mentioned, training and education could take advantage of the strong sense of community and eagerness to share information and best practices with each other. In addition to training, citizens expressed their need to be informed about the availability and location of refuge centres. Concerning tourists, it would be crucial to establish communication between tourism stakeholders, authorities and FRs, thus enabling them to liaise with tourists and inform them about the status of the crisis.

3.5.3. After the crisis

Introduction to the context

An audit organised by the Emergency Planning coordinators of the Marche en Famenne commune was carried out on 24 and 25 July 2021, during which a questionnaire was placed in **citizens' letterboxes and people were asked in person** to what extent they had been affected by the floods and what damage had been caused. In addition, a study was carried out by a university consortium that spent several months interviewing people. The conclusions of this study showed that the vast majority of those affected **(87%) did not call the emergency services** during the crisis. The majority of people were able to look after themselves, which meant that the emergency services were overwhelmed compared to usual but could have been even more overwhelmed if some of these 87% had been able to make an emergency call.

In the days following the crisis, teams of citizens were out on the streets and volunteers cleaned people's homes. As the **telephone networks were not working properly** and some towns had no network at all for several days, the teams went directly to the residents or hung messages on the doors **using traditional methods (printers and adhesive tape)**. This was a sign of community solidarity which was also evident in the province of Luxembourg in the days that followed: communities that were not or only slightly affected by the floods **called neighbouring communities** to find out how they could help. The affected part of the Geopark endeavoured to set up an internal network of speleologists from Flanders or the Netherlands, who helped to clean up the sites, for example. In the Geopark, it was impossible to obtain information about the damage caused by the floods, as even the speleologists/geologists were helping the local people and were of course occupied with cleaning up and supporting the citizens. It was only after the first six months that a 50% inventory of the most affected caves was available, in which a problematic level of hydrocarbons in the groundwater was found.

After the crisis, the major impact was the **socio-economic impact on tourists**, as the areas were inaccessible for a while, but also most people in the villages were not insured and therefore had to cope with the damage without economic help. Some citizens were insured, but **not for fire insurance, which is not compulsory but includes the risks associated with flooding** of which citizens were unaware. As a result, many houses were put up for sale, and in most cases it is stated that they are not located in a flood zone. On the map of the Walloon region, there are affected municipalities that are at risk of flooding after 2021 but are not currently designated as a flood zone. Therefore, people are trying to sell their house and buyers don't realise why the price is low and how high the water has risen since 2021.

A project called 'Environment Week' and 'Tree Week' was launched on the theme of hedges. The aim of the project was to plant 4,000 kilometres of hedges, and the target was achieved. In the province of Luxembourg, the **emergency planning officer**, together with the **local authorities**, is mapping the hedges in the drainage areas to ensure that runoff is kept behind the hedges. As part of the university's 'Yes We Plant' programme, the trees to be planted were supported by the 'Resilience PGRI' (Flood Risk Management Plan) grant and they received money for implementation. Through the same grant, some local authorities covered the cost of tractors to cut the hedges and plant the trees.

In terms of education, a course for safety professions has been set up in Belgium, which begins in the 4th year of secondary school. Young adults and teenagers can follow the

whole safety course and then have the opportunity to become firefighters, soldiers, police officers, security guards, etc. This course is currently under development and the tendency is to set it up for more than just one discipline. In addition, the students have days off throughout the year, days when they have no activities planned as their teachers are preoccupied marking exams. In one year, they have up to 8 days that are not dedicated to learning. Participants suggested that civil actors (e.g. the fire brigade) could organize events and provide insights into the safety profession and basic principles of life during these days.

Moreover, the commission of inquiry set up by the Walloon Parliament after the floods proposed in some of its recommendations the development of **disaster risk management training**. The **Walloon Region** has granted a budget (an ASBL called 'Be-faid'), the aim of which is in particular to structure the resources of citizens on Belgian territory, organise training and set up a **citizens' network**. One of the recommendations was also to organise meetings on water and flooding to try to discuss the two problems that have accumulated in 2021: the rise in rivers, but also the problem of runoff. In 2022, such meetings were organised with the involvement of local actors such as **municipalities, provinces and river managers** in order to raise awareness among local actors in the field.

Identification of gaps, best practices, and needs

In the following, the key stakeholders analysed (Local Authorities, FRs, Citizens) are described in more detail. A comprehensive overview of the existing gaps that hinder their response capabilities are identified and best practices to address these issues are presented, if available. Best practices include possible implementation priorities that were addressed by participants during the Focus Group sessions, as well as successful strategies already put in place that represent success examples and/or inspiring approaches that could be considered to support key stakeholders in the enhancement of their preparedness.

- **Local authorities**
  After the crisis, proactive communication needs emerged as a critical focus. The authorities recognized the need to enhance their pre-crisis communication strategies, drawing valuable insights from past flood experiences. Leveraging social media platforms and warning systems, they now disseminate crucial information more effectively utilising different channels. Additionally, the authorities are taking steps to ensure residents receive timely updates during emergencies. Information letters are being prepared, detailing the designated communication channels, including the B-alert application, and outlining evacuation procedures.

  In response to challenges faced by FR during previous incidents, the mayor took decisive action. A municipal regulation was enacted, specifically prohibiting scout camps in flood-prone areas. This measure aims to prevent difficulties in locating tourists and scouts during emergencies.

  Looking to the future, the emergency planning coordinators in Marche en Famenne are proactively involving stakeholders. Their aim is to set up a joint information source involving both the tourism sector and local farmers. By

encouraging cooperation, they hope to enable these groups to play a central role in disaster management, not only for floods but also for forest fires. Furthermore, the Water River Contract forged an agreement with the Walloon region to address risk culture. Over the coming years, they plan to create tools in collaboration with relevant stakeholders, beginning with educational training in schools. During a recent workshop, participants emphasised their relative lack of competence in crisis management. Consequently, any assistance related to prevention would be highly valued. However, some attendees rightly pointed out that enhancing risk culture necessitates first addressing the collective memory of past disasters.

- **First responders**
  A decisive step towards improving the operational readiness of the emergency services when it comes to locating citizens, tourists and scouts on the site was the creation of a comprehensive database for all campsites in Rochefort. This contains GPS coordinates and details of access routes. Following the crisis, the operational departments of the DINAPHI Rescue Zone are now frequently consulted, both by scouts asking for directions to certain areas and by the mayors themselves, who want to know if there are any local problems related to the flooding and/or accessibility. As the FRs do not request information directly from the operational department of DINAPHI, a communication channel between all FRs and the forestry department would need to be established. In this way, information and the status of the available routes in the communities and in the forest could be distributed directly.

- **Citizens**
  One of the critical gaps in citizens' crisis preparedness is the lack of awareness regarding existing emergency plans, refuge centres and available resources. For instance, many citizens are unfamiliar with the local emergency number, hindering their ability to seek help promptly during a crisis. Communication efforts towards the residents have been conducted with informative letters outlining the designated communication channels for emergencies, such as B-alert and evacuation procedures. However, during the focus group session it became apparent that some participants still did not know about the existence of the applications (B-Alert) in place.
  At the state level, an innovative solution has been implemented to address this gap by creating the website monplandurgence.be which serves as a canvas for emergency plans.
  Many residents feel ill-equipped to play a significant role in mitigating the impact of future floods. This lack of confidence has been mitigated in the past by volunteers encouraging residents to take proactive measures to minimize flood damage, such as raising furniture and using sandbags to protect entrances. According to the focus groups, the need remains to empower residents to actively engage in flood containment efforts.
  After the crisis, it was realised that there was a lack of school courses on flood prevention. Information on crisis prevention is primarily provided through training courses for teachers or civil servants. However, pupils and the local population in general are not addressed with flood prevention training. To close this gap, an agreement was already reached with the Walloon Region as part of the river contract, focussing on risk culture. Over the next few years, the parties involved will develop training courses. Efforts should also extend to educating the public,

particularly with regard to crisis management and prevention, as this was identified as a shortcoming by the participants.

3.6. Overview on the needs identified for the key stakeholders under analysis

The stakeholders' needs presented in the before/during/after phases are summarised as main outcomes of this analysis in Table 3.

Table 3 offers a comprehensive overview on the analysis of local authorities', FR and citizens' gaps and needs, relevant to the analysed phase. The table shows the existing gaps that hinder the response capabilities of Local Authorities and presents best practices to address these issues. Best practices include possible implementation priorities that were addressed by participants during the Focus Group sessions, as well as successful strategies already put in place that represent success examples and/or inspiring approaches that could be considered in order to address the needs of the key stakeholders supporting in the enhancement of their preparedness. Should the circumstances also arise in more than one phase of the crisis, this is also indicated in the left-hand column.

Table 4. Overview of needs according to the phases before, during and after the crisis (Famenne-Ardenne CORE lab)

PHASE	KEY STAKEHOLDERS	GAPS	BEST PRACTICES	NEED
LOCAL AUTHORITIES				
Before	Local Authorities (Mayor, Governors, Admin authorities at local/provincial level)	Emergency plans do not involve the public in developing preparedness measures.	Standardising and simplifying local emergency plans (e.g., 2-page Flood Risk Preparedness Plan) can improve access and implementation. An appendix was created in the Province of Luxembourg to help communes set up Emergency plans in a condensed 2-pager Flood Risk Preparedness Plan as they realised nobody was reading the whole Emergency Plan consisting of several hundred pages.	Follow-up support is needed to assist local authorities in developing these simplified plans.
Before / After	Local Authorities (Hans sur Lesse Commune)	Hans-sur Lesse Commune exchanged information with the Lesse River Contract by E-mail and telephone, but few meetings in presence were organised to proactively involve and sensitise the general public on the preparedness plans and the risks of possible future disaster. Currently, the role of organisations like the Lesse River Contract is underused by local authorities in their potential active role of raising awareness and supporting preparedness efforts	The Water River Contract established an agreement with the Walloon region to work on risk culture. Over the next few years, they are going to develop tools with the stakeholders concerned, starting with training in schools. During the workshop, participants have stressed that on crisis management they are less competent, so any support on everything to do with prevention would be much appreciated.	Actively integrate organisations such as Lesse River Contract into the overall preparedness strategy and training delivery on risk culture.

Before	Local Authorities (Communes and Provinces)	No refuge centres map currently exist; authorities lacked a clear system for sharing refuge location information.	N/A	Authorities need to establish a clear system to identify and provide an updated mapping of refuge centres available in the different Communes and the whole Province.
During	Local Authorities (Mayor, Governors, Admin authorities at local/provincial level)	Inconsistent practical implementation of regulations.	Improved inter-provincial cooperation.	• Receive up-to-date information about the unfolding event. • Receive clear, actionable instructions about how to intervene. • Unified communication strategy about watercourse management. • Smart application as a platform for all the actors (authorities, FRs, citizens). • Tourism stakeholders and SPW Nature and Forestry Department to be included in the formal communication.
During	Local Authorities (Mayor, Governors, Admin authorities at local/provincial level)	Role ambiguity of authorities on the different levels.	Awareness of the importance of measures to ensure smooth intervention of FRs (e.g. evacuation orders).	• Clear, actionable instructions about how to intervene. • Unified communication strategy about watercourse management.

During	Local Authorities (Mayor, Governors, Admin authorities at local/provincial level)	• Difficulty of timely and clear communication with citizens. • Difficulty of reaching out to non-native-speaking individuals (e.g. tourists).	Increased communication about disaster and risks related information on social networks.	• Communication guidelines on how to communicate with citizens, and vulnerable groups in a timely and effective manner. • Tourism stakeholders to be channelled in the formal communication flow.
After	Local Authorities (Mayor)	Difficult locating citizens especially tourists and scouts.	The mayor has implemented municipal regulations to restrict scout camps in high-risk areas.	N/A
After	Local Authorities (Emergency Planning coordinators Marche en Famenne commune)		The Emergency Planning coordinators are planning to engage stakeholders coming from the tourism sector as well as farmers to find a common source of information that could lead them into playing a pivotal role during disaster management both for floods but also for forest fires.	N/A
After	Local Authorities (Hans sur Lesse Commune)	No specific flood prevention and preparedness courses in schools for scholars or the general public.	The Water River Contract established an agreement with the Walloon region to work on risk culture. Over the next few years, they are going to develop tools with the stakeholders concerned, starting with training in schools.	Educate the general public and scholars about emergency management and related topics: what to do, who to contact, and how to access resources.
PHASE	**KEY STAKEHOLDERS**	**GAPS**	**BEST PRACTICES**	**NEED**
FIRST RESPONDERS (FRs)				

Before	FR	Lack of coordination between different response teams (firemen, medical, police, etc.) due to their separate internal disaster management plans.	N/A	Follow-up support is needed to assist FRs in sharing their crisis management internal plans and better shaping them so as not to occur in lack of communication and coordination.
During	FR (Firefighters, Police, DINAPHI Rescue Zone, Forestry department, Security units, Volunteers, Volunteering Organisations (e.g., The Lesse River Contract))	Lack of smooth communication and coordination between different emergency response teams due to different internal plans and sources of information.	ASTRID radio network as reliable means of communication.	● Alignment of internal plans of different response teams ● Well-established and steady communication channel that includes all FRs. ● Smart application as a platform for all the actors (authorities, FRs, citizens) to support effective communication and coordination across FR teams.
During	FR (Firefighters, Police, DINAPHI Rescue Zone, Forestry department, Security units, Volunteers, Volunteering Organisations (e.g., The Lesse River Contract))	Reliance on door-to-door warnings during emergencies was ineffective as citizens disregarded FRs.	Awareness of the importance of measures to ensure smooth intervention of FRs (e.g. evacuation orders).	● Communication guidelines for FRs to effectively communicate with citizens ● Training for citizens on how to best collaborate with FRs ● Smart application as a shared platform to enhance collaboration between the actors (FRs, Local authorities, Citizens).

During	Volunteers	Difficulty to deliver warnings due to the overload of communication channels and doubts related to the correctness of the information to be conveyed.	N/A	Receive clear and actionable instructions during the crisis to promptly intervene.
After	FR	Difficult locating citizens especially tourists and scouts.	Comprehensive database for campgrounds including GPS coordinates and access path details	N/A
After	FR	No consultation or demand on forest status from FRs to DINAPHI operational department.	N/A	Communication channels including all FRs allowing the Forestry department to inform about available paths.
PHASE	**KEY STAKEHOLDERS**	**GAPS**	**BEST PRACTICES**	**NEED**
CITIZENS				
Before/After	Citizens	Unawareness of refugee centres.	N/A	Inform citizens about the availability and location of refugee centres and their characteristics.

Before/After	Citizens	No specific courses in schools on flood prevention and preparedness are implemented or were implemented after the crisis targeting the general public.	Information related to crisis preparedness exist but are shared through training courses targeted solely for instructors or officials and are delivered on specific channels (i.e. Aqualigne).	Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis.
Before/During/ After	Citizens	General unawareness of communication channels (e.g. b-alert, emergency numbers).	● Increased communication by the government about disasters and risks related information on social networks ● Monplandurgence.be - a website to create one's own emergency plan (e.g. where is the electric meter, where to find a flashlight, car keys etc.)	● Receive information about communication channels and protocols of who to contact. ● Training and education on how to best collaborate with FRs.
During	Citizens	General unawareness of existing crisis plans and resources.	● Increased communication by the government about disaster and risks related information on social networks. ● Monplandurgence.be - a website to create one's own emergency plan.	● Receive information about what to do in case of a crisis and what resources are available. ● Inclusion of other communication channels for crisis communication with citizens: calls, texts, text apps, TV, radio) ● Training and education on existing resources and safety measures and how to best collaborate with FRs

During	Citizens	Difficulty understanding official warnings (too technical, too long, too scientific, not clear what it personally means to citizens).	N/A	● Simple, short, clear and easily applicable solutions ● Communication guidelines for local authorities and FRs to enhance smooth and effective communication with citizens.
During	Citizens	Unclear, outdated information related to the status of the crisis.	Increased communication by the government about disaster and risk-related information on social networks.	Receive updated and clear information and warnings and have a shared platform to geolocate citizens, FRs and authorities, through alert systems and mobile applications.
During	Tourists (as vulnerable groups)	● Lack of awareness and knowledge of what to do in case of an emergency (due to tourism stakeholders being excluded from communication flow). ● Difficulty in reaching out to non-native speaker tourists.	N/A	● Preparedness toolkits, smart applications, alert systems in several languages, informing tourists about what to do in a crisis. ● Well-established communication between tourism stakeholders, FRs and authorities. ● Receive effective communication from authorities and FRs to tourism stakeholders and tourists.

After	Citizens	Residents do not have the perception they could play a pivotal role in minimising future flood impact.	Residents are encouraged and involved through volunteer efforts by distributing information and sandbags to protect their entrances.	Greater empowerment of residents to actively participate in flood mitigation.

3.6.1. Overview of solutions and user requirements

As the final step of the analysis of the needs in Famenne-Ardenne CORE Lab, a preliminary tentative matching has been created between a selection of needs and the solutions that RESILIAGE project has to offer, namely: **soft solutions** (Risk awareness campaigns, Preparedness toolkits, Communication guidelines), **training** and **digital solutions** (RAISE tool, Monitoring Dynamic Resilience Dashboard, Multihazard Early Warning Detection System, Multi-agent Social Network Modelling, CORE Digital Network, Decision Support System, ATLAS tool). At this stage, the table only contains a preliminary comparison of the selected needs that could potentially be addressed by RESILIAGE solutions and tools in order to discuss and prioritise them further with the research and CORE laboratory partners. In addition to mapping the needs, this table also contains generic, high-level user requirements that are results of the combined research process of T4.1. and should be taken into consideration when developing the solutions.

3.6.2. Soft solutions

The following table reports the preliminary match between key stakeholders' (local authorities, first responders, citizens) needs and requirements and the soft solutions to be developed within RESILIAGE project: risk awareness campaigns, preparedness toolkits and communication guidelines.

Table 5. Preliminary match of needs and requirements with soft solutions (LA= local authorities, FR= first responders, C= citizens)

Type of solution	*Stake-holders*	*Needs*	*User Requirements*
Risk awareness campaigns	**LA**	Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources.	• Diversify the different communication channels in order to reach as many people as possible. • Face-to-face contact is the preferred approach, but also websites, email, television and radio. • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Language used should be easily understandable (not too technical, not too scientific).
	FR	N/A	N/A
	C	• Inform citizens about the availability and location of refugee centres and their characteristics. • Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis. • Greater empowerment of residents to actively participate in flood mitigation.	• Diversify the different communication channels in order to reach as many people as possible. • Face-to-face contact is the preferred approach, but also websites, email, television and radio. • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Language used should be easily understandable (not too technical, not too scientific).

Preparedness toolkits *(infographics, safety plan checklist, safety plan templates)*	**LA**	• Follow-up support is needed for local authorities in developing simplified plans. • Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources.	• Actively integrate volunteering organisations such as Lesse River Contract into the overall preparedness strategy and training delivery on risk culture. • Diversifying the different communication channels in order to reach as many people as possible. • Face-to-face contact is the preferred approach, but also websites, email, television and radio. • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Language used should be easily understandable (not too technical, not too scientific). • Communication and information should explicitly explain how the recipients are personally affected so that it is easy to recognize what the warning means for them.
	FR	N/A	N/A
	C	• Inform citizens about the availability and location of refugee centres and their characteristics. • Receive information about communication channels and protocols of who to contact. • Receive information about what to do in case of a crisis and what resources are available. • Greater empowerment of residents to actively participate in flood mitigation.	• Diversifying the different communication channels was identified to reach as many people as possible. • Face-to-face contact is the preferred approach, but also websites, email, television and radio. • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Language used should be easily understandable (not too technical, not too scientific). • Communication and information should explicitly explain how the recipients are personally affected so that it is easy to recognize what the warning means for them.
Communication Guidelines	**LA**	• Receive clear, actionable instructions about how to intervene.	• Actively integrate volunteering organisations such as Lesse River Contract into the overall preparedness strategy and training delivery on risk culture.

		• Communication guidelines on how to communicate with citizens, vulnerable groups in a timely and effective manner. • Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources.	• Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Several languages available. • Language used should be easily understandable (not too technical, not too scientific). • Communication and information should explicitly explain how the recipients are personally affected so that it is easy to recognize what the warning means for them. • Simple, schematic warning signs, with 2 or 3 contrasting colors and simple explanations.
	FR	Communication guidelines for FRs to effectively communicate with citizens.	• Communication and information should explicitly explain how the recipients are personally affected so that it is easy to recognize what the warning means for them. • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Language used should be easily understandable (not too technical, not too scientific).
	C	• Communication guidelines for local authorities and FRs to enhance smooth and effective communication with citizens..	• Actively integrate volunteering organisations such as Lesse River Contract into the overall preparedness strategy and training delivery on risk culture. • Communication and information should explicitly explain how the recipients are personally affected so that it is easy to recognize what the warning means for them. • Care should be taken to provide clear and simple guidance on how messages should be disseminated.

3.6.3. Training

In Table the preliminary match between key stakeholders' (local authorities, first responders, citizens) needs and requirements and the *trainings* to be developed within RESILIAGE project has been mapped. The table also marks which needs should be fulfilled with training, focusing on knowledge (K= bodies of information that are applied directly to the performance of work functions), skills (S= technical or manual proficiencies which are usually acquired through training) and/or abilities (A= proficiency to be innate or acquired without formal instructions).

Table 6. Preliminary match of needs and requirements with training (LA= local authorities, FR= first responders, C= citizens) with a tentative mapping of the type of training to be developed, if to address the knowledge, skills, and/or abilities of the key stakeholders

Stake-holders	***Needs***	***USER REQUIREMENTS***
LA	• Follow up support is needed for local authorities in developing simplified plans (K, S). • Receive instructions about how to intervene (K, S, A). • Communication guidelines on how to communicate with citizens, vulnerable groups in a timely and effective manner (K, S). • Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources (K, S, A).	• Language used should be easily understandable (not too technical, not too scientific). • Clear and actionable instructions related to what to do in crisis.
FR	• Communication guidelines for FRs to effectively communicate with citizens (K, S). • Training for citizens on how to best collaborate with FRs (K, S). • Receive instructions during the crisis to promptly intervene (for volunteers) (K, S, A).	• Language used should be easily understandable (not too technical, not too scientific). • Clear and actionable instructions related to what to do in crisis.
C	• Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis (K, S, A) • Receive information about what to do in case of a crisis and what resources are available. (K, S) • Training and education on how to best collaborate with FRs (K, S) • Training and education on existing resources and safety measures (K) • Greater empowerment of residents to actively participate in flood mitigation (K, S, A)	• Language used should be easily understandable (not too technical, not too scientific) • Care should be taken to provide clear and simple guidance on how messages should be disseminated.

		• Clear and actionable instructions related to what to do in crisis.

3.6.4. Digital solutions

In Table the preliminary match between key stakeholders' (local authorities, first responders, citizens) needs and requirements and the digital solutions to be developed within RESILIAGE project is reported. The digital tools taken into consideration for the mapping are the following: RAISE tool, Monitoring Dynamic Resilience Dashboard, Multihazard Early Warning Detection System, Multi-agent Social Network Modelling, CORE Digital Network, Decision Support System, ATLAS tool.

Table 7. Preliminary match of needs and requirements with digital solutions (LA= local authorities, FR= first responders, C= citizens)

Type of solution	*Stake-holders*	*Needs*	*USER REQUIREMENTS*
The Resilience Assessment Interactive Self-Enabler tool (RAISE)	LA	Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources.	Language used should be easily understandable (not too technical, not too scientific).
	FR	N/A	N/A
	C	• Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis. • Education on existing resources and safety measures. • Inform citizens about the availability and location of refugee centres and their characteristics. • Receive clear, actionable instructions about how to intervene.	• Language used should be easily understandable (not too technical, not too scientific). • Clear and actionable instructions related to what to do in crisis.

Monitoring Dynamic Resilience Dashboard	LA	• Identify and provide an updated mapping of refuge centres available in the different Communes and the whole Province. • Receive up-to-date information about the unfolding event, in a timely and effective manner.	• Language used should be easily understandable (not too technical, not too scientific). • Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	FR	• Receive up-to-date information about the unfolding event, in a timely and effective manner. • Communication channel including all FRs allowing the Forestry department to inform on available paths, to make decisions and monitor.	Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	C	• Inform citizens about the availability and location of refugee centres and their characteristics. • Receive up-to-date information about the unfolding event, in a timely and effective manner.	• Language used should be easily understandable (not too technical, not too scientific). • Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors. • Clear and actionable instructions related to what to do in crisis. • Simple, schematic warning signs, with 2 or 3 contrasting colors and simple explanations.
Multi-hazard early warning detection system	LA	Receive up-to-date information about the unfolding event, in a timely and effective manner.	Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	FR	Receive up-to-date information about the unfolding event, in a timely and effective manner.	Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.

	C	• Alert system, mobile applications to receive updated and clear information and warnings, and to have a shared platform to geolocate citizens, FRs and authorities • Receive up-to-date information about the unfolding event, in a timely and effective manner	• Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors. • Clear and actionable instructions related to what to do in crisis. • Simple, schematic warning signs, with 2 or 3 contrasting colors and simple explanations.
Multi-agent social network modelling for Resilient Behaviour	LA	Smart application as a platform for all the actors (authorities, FRs, citizens) to support effective communication and coordination and geolocation of each other.	Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	FR	Smart application as a platform for all the actors (authorities, FRs, citizens) to support effective communication and coordination and geolocation of each other.	Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	C	N/A	
CORE Digital Network	LA	• Platform for all the actors (authorities, FRs, citizens) to support effective communication and coordination. • Follow up support in developing simplified plans. • Receive clear, actionable instructions about how to intervene. • Communication guidelines on how to communicate with citizens, vulnerable groups in a timely and effective manner. • Educate the general public and scholars about emergency management and related topics: what to do, who to contact, how to access resources.	• Language used should be easily understandable (not too technical, not too scientific). • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Clear and actionable instructions related to what to do in crisis.
	FR	• Communication guidelines for FRs to effectively communicate with citizens.	• Clear and actionable instructions related to what to do in crisis.

		• Smart application as a platform for all the actors (authorities, CR, citizens) to support effective communication and coordination and geolocation of each other and spread information to the other users and exchange past experiences. • Receive information in a timely and effective manner.	• Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	C	• Inform citizens about the availability and location of refugee centres and their characteristics. • Receive clear, actionable instructions about how to intervene by studying the experience of others and monitor any messages from the authorities. • Receive information in a timely and effective manner. • Training and education on existing resources and safety measures. • Greater empowerment of residents to actively participate in flood mitigation (by exchanging best practices and know-how).	• Language used should be easily understandable (not too technical, not too scientific). • Care should be taken to provide clear and simple guidance on how messages should be disseminated. • Clear and actionable instructions related to what to do in crisis.
Decision Support System (DSS)	LA	• Provide an updated mapping of refuge centres available in the different Communes and the whole Province. • Receive up-to-date information about the unfolding event. • Communication guidelines on how to communicate with citizens, vulnerable groups in a timely and effective manner.	• Language used should be easily understandable (not too technical, not too scientific). • Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors.
	FR	N/A	N/A
	C	• Inform citizens about the availability and location of refugee centres and their characteristics. • Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis.	• Digital solutions remain stable in use even with a high number of simultaneous users and enabling location services to the response actors. • Clear and actionable instructions related to what to do in crisis.

		• Training and education on existing resources and safety measures	• Simple, schematic warning signs, with 2 or 3 contrasting colors and simple explanations
The Multidimensional Atlas for Community Resilience	LA	Provide an updated mapping of refuge centres available in the different communes and the whole province	N/A
	FR	Communication channel including all FRs allowing the Forestry department to inform on available paths and share information with other users	N/A
	C	• Educate the general public and scholars about emergency management and related topics on behaviour, communication and access to resources during a crisis. • Greater empowerment of residents to actively participate in flood mitigation. • Inform citizens about the availability and location of refugee centres and their characteristics.	Language used should be easily understandable (not too technical, not too scientific).

While a wide range of solutions may be identified for each need, the engagement of the CORE Labs, WP3, and WP5 the validation plan can then be used to prioritize and select the most feasible and impactful solutions to move forward with.This analysis can be considered a dynamic and evolving document. User requirements and acceptance criteria can be further refined as the project progresses and new insights are gained. The results of this analysis will be valuable not only for the immediate project but also for future reference and collaboration with other partners.

4. Conclusions and next steps

This report presents the initial findings of the context analysis of Famenne-Ardenne CORE held on the 3rd and 4th of April, 2024. A series of key stakeholders needs and possible solutions to address those needs were listed, together with user requirements.

The most important result to underline related to Famenne-Ardenne CORE lab, is a strong need for greater empowerment of residents to actively participate in flood mitigation, by educating the public about emergency management, including specific information about the location of available refuge centres. To achieve this goal, the development of simplified emergency plans would be important along with digital solutions that aim smooth and effective communication between actors as well as up-to-date information sharing related to the unfolding event. As the collaboration between first responders and citizens has been reported as a specific challenge of the CORE lab, communication guidelines to support first responders in effective communication is a priority to address by the soft solutions of RESILIAGE project.

User requirements related to these needs are not static but rather mark a *starting point* for further discussion and validation within the consortium. In T4.3 workshops with relevant stakeholders from the five CORE labs (citizens, vulnerable groups, First Responders and local authorities) will be organised to design and find suitable solutions for improving citizens preparedness and risk awareness. In this occasion, a prioritisation of the needs and the relevant solutions along with associated user requirements will be carried out with the help of all the relevant COREs. This activity will be beneficial also for validation purposes definition (WP5). Central actors in this validation process will be partners involved in WP3 to address digital solutions, partners involved in WP4 for soft solutions and training, and WP5 as they will be in charge of validating the design solutions with the COREs. Hence, CORE partners will be fundamental in the next steps of the process in prioritising the needs and solutions that could be provided to address those gaps, as well as defining user requirements that are actionable and that could lead the design of the solutions moving forward. Therefore, it is expected that in further iterations, user requirements will become much more detailed leveraging the collective knowledge gained from each context and its communities, which is at the core of RESILIAGE project.

Analysing data from the remaining COREs is the next key step envisioned for T4.1. The established approach and overall structure of the investigation here described will remain consistent, ensuring a comprehensive and comparable analysis across all communities. It is important to stress that by systematically examining the data across all contexts, critical contextual aspects might be uncovered. More importantly, such comparative analysis has the potential to reveal common needs and requirements shared by various communities and the key stakeholders. These shared elements can serve as invaluable guiding principles informing future design decisions and developments.

5. References

1. RESILIAGE D1.1. Repository of International Standards & Inventory of Lessons Learned of Disaster Management Preparedness.

2. RESILIAGE D8.3. Ethical guidance of RESILIAGE

3. RESILIAGE Grant Agreement (GA) Number 101121231

6. Annexes

Annex 1. Cross Sectional Survey questions

Demographic Questions

ID1. How do you define yourself? *Man / Woman / Other or don' want to comment*

ID2. What is your year of birth? .....

ID3. In which city do you live? .....

ID4. How long have you lived in your town? *Indicate your answer in years. If you have lived less than a year, enter 0.5.* ……

Questions about risk and crisis communication

RC1. In case of a natural disaster, to what extent do you consult the following channels? *Please answer on a scale of 1: "I never consult it" to 5: "I always consult it".*

- Mobile communication channels (text, text apps, calls)
- Social medias (Facebook, X -ex Twitter-, Instagram, TikTok)
- Other electronic communication (websites, email)
- Face-to-face or personal communication
- Traditional media (television, radio)
- Printed media (newspaper, posters)

RC2. In case of a natural disaster, how intuitive do you consider the channels to be? *Answer on a scale of 1: "Not at all intuitive" to 5: "Totally intuitive".*

- Mobile communication channels (text, text apps, calls)
- Social medias (Facebook, X -ex Twitter-, Instagram, TikTok)
- Other electronic communication (websites, email)
- Face-to-face or personal communication
- Traditional media (television, radio)
- Printed media (newspaper, posters)

RC3. In the case of a disaster, how difficult is it to access information for the following categories of groups? *Indicate your answers on a scale from 1: "No difficulty at all" to 5: "A lot of difficulty".*

- Mobile communication channels (text, text apps, calls)
- Social medias (Facebook, X -ex Twitter-, Instagram, TikTok)
- Other electronic communication (websites, email)
- Face-to-face or personal communication
- Traditional media (television, radio)
- Printed media (newspaper, posters)

RC4. Which of the following groups do you most identify with? *Please tick only one answer.*

- I am a civil resident of my community.
- I am a member of the local authority.
- I am a first responder.
- I am a formal volunteer

First Responders, volunteers and local authorities questions

Only for participants who answered: I am a first responder, ***or*** *I am a formal volunteer of my community,* ***or*** *I am a member of the local authority during disaster to question* ***RC4***

Q(FR-A)1. Have you ever had difficulty delivering an official disaster warning*? Please tick only one answer*

- Yes
- No
- I have never delivered an official disaster warning

Q(FR-A)1bis. If yes, what were the difficulties you had to deal with communication-wise during a disaster? *You can tick several answers.*

- Write a short message while providing enough contextual information
- Write the message in multiple languages
- Reaching the right target
- Finding the right channel to communicate the info
- Other, please specify:

Q(FR-A)2. In case of a disaster, how important are each of the following information needs to you/your team*? Indicate your answers on a scale of 1: "Not important at all" to 5: "Very important".*

- To receive clear and actionable instructions that can help my team to promptly intervene.

- To receive continuously updated information about the unfolding of the disaster event to avoid loss of effort and resources.
- To receive continuous information about citizens' needs.
- Being aware of other actors' activities and actions in order to be synchronous during the disaster management.

Q(FR-A)3. In your opinion, to what extent do the citizens of your community need the following information to prepare effectively for a disaster? *Please indicate your answers on a scale from 1: "not at all important" to 5: "very important".*

- How to make their own homes as safe as possible during disaster
- What to store at home as a preparedness package for crisis (e.g. drink or food)
- How to activate and best use their communication network to receive updated information about the disaster event.
- How to identify misleading, distorting information about the disaster event.
- How to best collaborate with first responders and local authorities during the disaster event.
- What kind of services and safety measures are available within the community during the disaster event (e.g. shelter, food).
- First aid course.
- Fire safety training.
- Search and rescue techniques.
- Emergency preparedness.
- Early warning systems.
- Others (please specify) .....

Q(FR-A)4. In your opinion, how important do you think the following solutions would be in your community to help citizens react during a natural disaster*? Indicate your answers on a scale of 1: "Not important at all" to 5: "Very important".*

- Alert system
- Mobile application
- Web service or other digital service
- Awareness campaigns and trainings
- Call centres
- Community ambassadors
- Community of practice
- Guidelines and plans
- Psychological support

Q(FR-A)5. During past disasters were citizens collaborative following the recommendations shared by authorities and emergency organizations? *Indicate your answers on a scale of 1: "Very collaborative" to 5: "Very uncollaborative".*

Q(FR-A)6. In past disasters, beyond the formal required collaboration, how would you rate the level of cooperation between actors involved in the crisis management? *You can tick several answers.*

- Everyone was trying to accomplish their own task
- Actors were willing to collaborate if it was explicitly requested
- Actors were offering help, information and resources only after full completion of their own tasks
- Actors were continuously offering help, information and resources without having been explicitly asked

Citizens questions

Only for participants who answered: I am a civil resident of my community to question ***RC4***

Q(C)1. Have you ever had trouble understanding an official disaster warning? *Please tick only one answer.*

- Yes
- No
- I have never received or had the necessity to understand an official disaster.

Q(C)1bis. If yes, what were the difficulties in understanding the warning? *You can tick several answers.*

- The message was written in difficult language or technical language
- It was written in a language I do not speak
- I did not understand the context
- I did not understand if and what it means for me
- The message was too long, too detailed
- Other, please specify:

Q(C)2. In case of a natural disaster, how important are each of the following information needs to you? *Indicate your answers on a scale of 1: "Not at all important" to 5: "Very important".*

- To receive information that can help me talk about the situation with others.
- To receive information that can help me feel as part of the community/nation.
- To receive information that can distract my thoughts from the situation.

- To receive credible information
- To be able to actively share information with the authorities/relevant organizations acting on the situation.
- To receive information that can make me feel positive emotions (e.g., happiness, amusement, joy).
- To receive information as fast as possible.

Q(C)3. How well do you think your community is informed of the available solutions to prepare for a crisis? Indicate your answers on a scale of *1: "Not very well informed" to 4: "Very well informed".*

Q(C)4. How well do you think you personally are informed of the available solutions to prepare for a crisis? Indicate your answers on a scale of 1*: "Not very well informed" to 4: "Very well informed".*

Q(C)5. Have you ever participated in an (educational) event on dealing with disasters (e.g. first aid course, event for fire safety officers)?

- Yes
- No

Q(C)6. How much training do you think you would need in the following areas in order to effectively prepare for a disaster event? Indicate your answers on a scale *of 1: "No training needed" to 5: "great need for training".*

- How to make my own homes as safe as possible during disaster
- What to store at home as a preparedness package for crisis (e.g. drink or food)
- How to activate and best use their communication network to receive updated information about the disaster event.
- How to identify misleading, distorting information about the disaster event.
- How to best collaborate with first responders and local authorities during the disaster event.
- What kind of services and safety measures are available within the community during the disaster event (e.g. shelter, food).
- First aid course.
- Fire safety training.
- Search and rescue techniques.
- Emergency preparedness.
- Early warning systems.

Q(C)7. How important do you think the following solutions would be in your community to help citizens react during a natural disaster? *Indicate your answers on a scale of 1: "Not important at all" to 5: "Very important".*

- Alert system
- Mobile application

- Web service or other digital service
- Awareness campaigns and trainings
- Call centres
- Community ambassadors
- Community of practice
- Guidelines and plans
- Psychological support

Q(C)8. In past disasters was there individualistic or collectivistic behaviour undertaken by community members? Please tick only one answer.

- Everyone was trying their best to save themselves
- Everyone was in the same situation, so collaboration became key in facing the difficult scenario
- I do not know because I have never been involved in a disaster crisis

Socio-demographic questions

ID5. In which socio-professional category do you belong?

- Farmer
- Craftsman, tradesman and equivalent, company director
- Liberal profession or similar
- Company executive, civil service executive, senior intellectual and artistic profession
- Intermediary profession (technician, foreman, supervisor, schoolteacher, primary school teacher, nurse, educator, etc.)
- Employee: Non-executive and non-public servants
- Manual worker
- Housewife, househusband
- Pupil, student
- Retired
- Looking for first job
- Other, not working

ID6. Who do you share your home with?

- Alone
- A partner
- Minor child(ren)
- Major child(ren)
- With other relatives
- Others, please specify:

ID7. In which type of accommodation do you live in?

- A council flat

- Another type of apartment
- A social housing
- Another type of single-family house
- Other, please specify:

ID8. What is your occupancy status?

- Owner/landlord
- Tenant
- Other:

ID9. What is your highest level of study?

- Without diploma
- Secondary school degree
- High school degree
- Bachelor's degree
- Master's degree
- PHD's degree

ID10. What is your level of religiousness?

- Strongly religious
- Religious
- Not at all religious

ID11. How would you rate your monthly household income?

- Much higher than average
- Somewhat higher than average
- Average
- Somewhat lower than average
- Much lower than average

ID12. How far is your nearest neighbour from your home? (Walking distance). *Please indicate only the number in minutes.*

ID13. How close a relationship does you have with your neighbours?

- Very weak, no relationship at all.
- Weak, rare connection with my neighbours.
- Rather close, we connect on a regular basis.
- Very close relationship

Annex 2. Focus Group Guide

The general aim of the CORE lab Focus Group sessions is to provide qualitative data to RESILIAGE WP2 (T2.2.) and WP4 (T4.1.).

*"**T2.2** will investigate the 5 COREs to assess their level of implementation reviewing the available formal provisions (plans, protocols, guidelines) and organisational practices (incl. past cases). Using the SyRI framework, it will conduct 5 focus groups with key crisis managers and front-line responders in each CORE to identify LL, local best practices dealing with limited capabilities, communal strategies to serve the needs of vulnerable groups."*

*"**T4.1** aims to collect and identify citizens, first responders, local authorities' current needs about solutions and capacity building activities to improve risk awareness, societal resilience, and disaster management. Current gaps will be also investigated. The field research activities will be conducted within T2.2 where 5 focus groups will be organised in the 5 CORE labs. Specific needs will be gathered and formalised into requirements for the design of digital and soft solutions in WP3 and Tasks 4.3-4.4. Moreover, this task will identify end user training needs and requirements in a comprehensive needs assessment."*

More specifically, the Focus Group sessions focus on:

- the understanding of who the key actors within the CORE lab's communication/cooperation network are and what communication channels they use before, during and after the crisis event;
- the exploration of good practices in communication, cooperation and information sharing as well as the gaps where communication information flow does not seem to be efficient before, during and/or after the crisis event;
- defining the needs of key actors in terms of communication, cooperation and information sharing in order to improve risk preparedness and disaster management;
- the organisational set up of the key crisis management actors including multi-agency forms of cooperation;
- the cooperation of formal and informal actors in response to crises, especially focussing on involving of civil society and protection of vulnerable groups
- to explore what role cultural heritage plays in cooperation and communication patterns between key actors;
- contrasting formal international/national/local Disaster Risk Management policies with Front Line Responders' practices;
- identify intangible/tangible factors in collaboration that represent a unique local knowledge researchers are not aware of.

Format & methodology

The role of facilitators

A focus group is a qualitative research method, with a previously selected group of 6-12 participants. It is considered a guided discussion aiming to deep dive into participants' opinions, perceptions, and attitudes regarding a specific topic. As the session is moderated by a skilled facilitator, the role of this person is one key to the success of data gathering. Conducted in a neutral environment, focus groups ensure participants to freely associate between certain links of the topic at hand, discuss divergent opinions and co-design potential solutions to a variety of issues (it is not a "test" eliciting "correct" answers, but collect different perspectives). To achieve this goal, a psychologically safe atmosphere where ideas are welcome to be shared and discussed is a crucial pre-requisite for the facilitator to continuously monitor. As focus groups involve a variety of participants, paying attention to the dynamics of the session is another cornerstone of the process. An efficient facilitator ensures that all the participants are involved in the flow of ideas and everyone's opinion is well represented, without being suggestive on potential answers. Focus groups are built on a number of topics/questions to be discussed during the session. Facilitators are expected to make sure these key topics are addressed, however, handle them flexibly to leave room for the free flow of thoughts (follow the conversation flow of participants). In this discussion we are interested in learning any specific characteristics of this region, particular geographic, infrastructure, socio-, economic, demographic or cultural aspects, that inform the day-to-day work and as well as crisis response. It is important to prime participants with this at the introduction, to encourage them to make references to such specific circumstances and contextual factors.

.....

The sequence of question groups introduced below are therefore flexible to any change, providing a free flow of discussion, while also ensuring that each question group is covered. However, the Introduction and warm up sessions are fixed at the beginning of the sessions.

.....

The ideal number of facilitators per group would be two, with one facilitator focusing on leading the discussion, while the other facilitator assisting participants in data visualization as well as taking notes of key information during the session.

Logistics

To ensure that no information is lost in the process, focus group sessions will be audio recorded. **Audio recordings** should serve as the basis for data extraction and translation after the sessions. Participants of the focus group sessions will sign informed consent sheets to confirm their participation and processing of personal data, including agreeing to being recorded at the opening of the session. In addition to audio recording, facilitators will be video interviewed right after each session to share their overall impression, as well as the most outstanding results of the session, while explaining what, how and why is placed on the interaction map.

Participants for the focus group sessions should be selected in a way that diversity of CORE lab key actors are ensured, and **all the key actors relevant to managing the respective CORE specific crisis scenario are represented.**

In case there are two focus groups running in parallel, a homogenous and balanced set of stakeholders should be ensured in both sessions, to dive into the actual needs of the target groups involved.

Physical space: as the RESILIAGE focus group involves a task of network visualization, the meeting room for the sessions should be equipped with a table that all participants can gather around and share the same vision of the task as well as can see each other's faces. Facilitators are not supposed to create the Interaction Map according to what participants share, but rather encourage FG participants to create the map themselves while using the icons of actors and icons of communication channels – they can show examples of how the interaction map can be created, and also for this purpose, the introductory presentation will include one example of the outcome of the activity (see Chapter 1.3., Figure 1.)

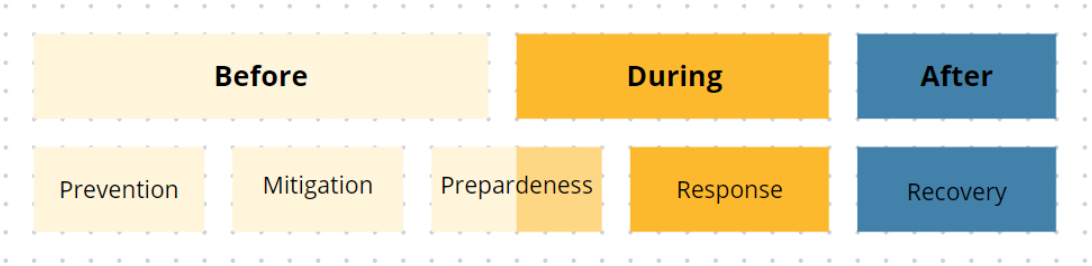
Duration of the session: 2 x 1,5 hours.

Context specificity

To ensure that the real patterns of communication, cooperation, practices, protocols are explored, the session should start with the introduction of one important real past crisis (usually done in the plenary session before) or a hypothetical crisis which encapsulates the most important characteristics of a real situation, depending on whether they are available in the specific CORE lab or not. Cascading crises can be taken into account, but it is difficult to cover multiple unrelated crises in this format.

Time frame:

While RESILIAGE is taking the general approach of the DM cycle in understanding gaps, needs and potential solutions, for the sake of simplicity, the FG sessions will be divided into the three major stages of Before / During / After the crisis event.



Before the crisis event refers to the timeframe preceding the occurrence of a crisis. It encompasses the time when there are no immediate risks, disruptions or threats to normal activities and operations. During this phase Local Authorities, Organisations, Citizens, and FRs may engage in prevention activities made to raise awareness and to train communities in the planning and preparation that could prevent, or mitigate, possible crisis. They are engaged in their usual functions and roles within their organisations' missions, in which their work might be unrelated to each other or related in different ways than during the crisis. For this purpose, the "Before" phase might also include the time when the normal, day-to-day, routine collaboration between actors is disrupted and re-structured, to prepare for the crisis.

During the crisis event refers to the timeframe when a crisis is unfolding or occurring. It encompasses the immediate response and management of the crisis, including efforts to address the emergency, protect lives and property, ensure continuity of essential services, and mitigate the impact of the disaster. During this phase Local Authorities, Organisations, Citizens, and FRs may activate emergency response plans, mobilize resources, coordinate response activities, communicate critical information, and make decisions in real-time to address the evolving situation and minimize harm.

After the crisis event refers to the timeframe following the resolution or conclusion of a crisis. It encompasses the recovery, rehabilitation, and post-event analysis phases, during which efforts are focused on restoring normalcy, rebuilding affected areas, addressing long-term impacts, and learning from the crisis experience to improve future preparedness and response actions and training activities. After a crisis,

this phase Local Authorities, Organisations, Citizens, and FRs may engage in activities such as damage assessment, recovery planning, resource reallocation, community support, stakeholder engagement, and might produce debriefings, evaluations, lessons learned reviews to facilitate the transition from response to recovery and promote resilience-building for the future.

The Interaction Map

The Interaction Map is a tool designed to visualize the network of relevant actors related to a specific scenario within a specific timeframe. With its use the connectedness, hierarchy, or even geographical proximity of key actors can be systematically mapped and visualized through a co-creative activity within a focus group session.

The Interaction Map consists of:

- An A0 printed blank **sheet** with the name and logo of the CORE lab and the phase on which the session focuses on (before/during/after).
- **Icons of "actors":** general icons of the following groups of actors:
  - **Government agencies** (*e.g. Local government authorities, National or federal government agencies, Public health agencies, Military and defence forces, Legal authorities and judges, etc.)*
  - **Non-governmental organizations** *(Humanitarian organizations, Relief agencies, Disaster response NGOs)*
  - **International organizations** *(e.g. UN agencies, WHO, International Committee of the Red Cross (ICRC))*
  - **First responders** *(Firefighters, Police and law enforcement, Emergency medical services (EMS), Search and rescue teams, etc.)*
  - **Community based organizations** *(Religious and faith-based groups, Community and neighbourhood associations)*
  - **Educational institutions**
  - **Private sector** *(businesses and corporations, Utility companies, Transportation and logistics companies, private security firms)*
  - **Media and communication outlets** (news organizations)
  - **Citizens**
  - **Volunteers**
  - **Vulnerable groups**
  - **Emergency management coordination centres** *(Emergency operations centres (EOCs), Coordination teams and personnel, Information and communication hubs)*
  - **Heritage experts**

- **Icons of "communication channels"**: general icons of the following channels:
  - Regulations, formal instructions
  - Printed media
  - Television
  - Face-to-face communication
  - Guidelines, checklists
  - Phone communication
  - Online media, websites
  - Postal letter
  - Email
  - Radio
  - Social media
  - Radio-communication (walkie-talkie)

The cards will be placed on the map (using double-sided tape or blue-tack) according to what the participants think best represents the network and communication flow between the different actors and through the different channels (we will describe how we expect this to play out in Session I. details).

.....

As participants might not interact spontaneously with the map, the facilitator is encouraged to guide them in the first moments of the activity, actively showing how cards can be placed and moved on the map. Doing so, will guide the participants and make them better understand what it is expected from them (e.g., the facilitator could ask each participant individually to place the card on the map accordingly to the other roles in order to create a first mapping of the network).

.....

As the next step they are asked to mark the communication between the actors, by drawing arrows from one actor to the other. Arrows between actors might be unidirectional or bidirectional (or even loops) according to the identified flow of information. Participants are recommended to use pencils for marking the arrows, as they might want to revise it during the session (at the end of the session, arrows can be finalized with markers). As the next step, the icons of certain communication channels are placed (using double-sided tape or blue-tack) on the arrows, according to how they best represent the real communication flow. There can be more than one type of channel icon

placed between two actors. As optional steps, participants are welcome to put additional notes on the sheet if they wish to emphasize any other aspects of the network.
By systematically exploring the characteristics of the network, potential gaps, best and bad practices of communication between actors can be identified and discussed by the participants, focusing on future solutions.

……..

At the end of both of the sessions, facilitators are encouraged to ask participants how difficult they have found to place themselves on the map, to find their role, responsibilities and their connection to other actors before, during and after the crisis. This feedback would be valuable for us to understand whether there is a well-built network existing among the actors or, on the contrary, they are less (or not at all) aware of how they are or they should be connected to each other for collaboration and communication in times of crisis.

……..

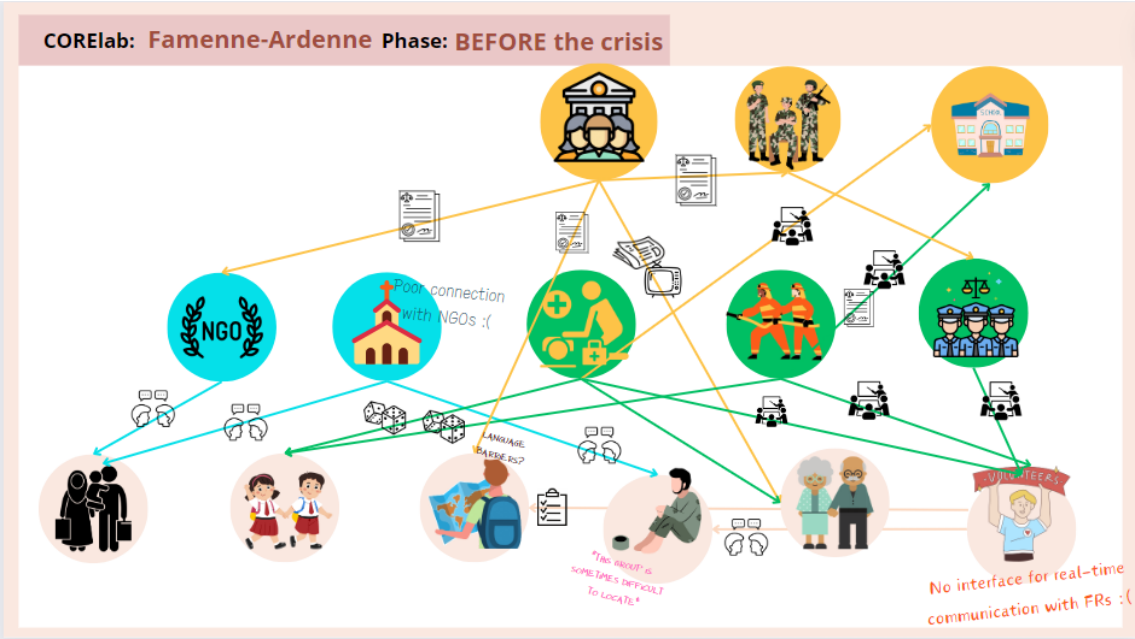


Figure 1. Representative example of what we are aiming for with the network and communication representation and on how the map could potentially look like after the activity

Session I. in detail:

1. Introduction to the Focus Group goals

Tools needed: projector, PC – presentation material

Suggested duration: 15 mins

In this first, preparatory phase participants of the two parallel focus group sessions are together. Facilitators introduce themselves (and the partners that might be present as assistants during the activity), as well as they familiarize participants with the overall aim of the focus group activity which are (see Section 1.):

- The organizational set-up of the key crisis management actors
- Cooperation between formal and informal actors in response to crises
- The exploration of past practices in communication between these actors
- To understand whether and how communication and information sharing between actors could be improved
- To explore what role cultural heritage plays in cooperation and communication patterns between key actors.

Participants are reminded of the main ethical points, including data confidentiality and individual inputs will be aggregated and used (referring to the informed consent they sign upon their arrival). They are made aware that the sessions will be audio recorded for research purposes only.

As the next step, the Interaction Map is briefly introduced as a research tool to be used throughout the FG sessions (see section 2.4.). Facilitators also introduce the approach of focusing on before, during, and after the crisis, and define these timeframes to the participants.

Finally, the scenario in focus (hypothetical or real past scenario) is introduced to the participants (see the presentation material).

After that, participants and facilitators split into two groups according to how they are assigned to the FG session.

2. **Warm up: introduction of participants & identification of key actors**

Tools needed: Nametags of participants, Interaction Map, “icons of actors”, icons of “communication channels”, markers

Suggested duration: 20 minutes

In this phase, participants are asked to:

- Introduce themselves (name, role, organization) and express with a sentence what the CORE lab means to them and/or how they are related to this field;
- Describe their roles and responsibilities in moments of crisis;
- Take the representative card from the different actors card, that best represents their role the best and write on the card the role of the participant and the name of the organization that the participant is a member of.

Potential risks: Participants might feel like they are representative of more roles at once (e.g., they are Citizens of the community first of all, while also representing other Organisations) but they should be encouraged to try to choose the card that most represents them as stakeholders around the table and to stick with that specific “hat” for the whole duration of the activity. If they think they have something valuable to share from another perspective (e.g. FR as also the citizen of the community wants to share how he/she perceived communication as a citizen), they are welcome to do so – but in this case, it should be very clearly stated from which perspective they share their thoughts.

After each participant introduced themselves, the facilitator should encourage the group to:

- identify and collect all the key actors that are *not* represented by any participant around the table, but that still play a key role in the crisis management network (some actors might not be identified right at the beginning of the activity but might come up later as the dynamics of the task evolve);
- place all the roles on the map, according to their network and how they relate to each other. To do so, the facilitator could ask as a prompt question who [during] the crisis started the communication flow giving the alarm to whom. This way, a flow of communication should start emerging from recollecting the past event and flow of information. This is also a way to move from the "warm up" session to the next step on "information chain, direction and quality".

3. Information chain, directions and quality

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions, facilitators will ask participants to reflect on the information sharing and communication between the key actors. The goal here is to understand who communicated with whom during the crisis, what content and through what channel(s). To do that, participants are first asked to build the network in the interaction map, by placing the actor icons on the map (using blue-tack or double-sided tape). They should place the actors on the map according to how they see it represents their network best, by visualizing hierarchy, physical proximity, etc. They should be free to design it without any further suggestions, but the facilitator could prompt them in the usage of the map by guessing some initial positioning of the actors and asking the participants for validation and active feedback. Next, they are asked to visualize the communication between these actors by drawing arrows from one actor to the other, or use bidirectional arrows, loops, etc. On the arrows they can finally place the communication channel icons that best represents the communication between those actors.

We would like to understand whether these communications were unidirectional or bidirectional (in other words, whether the recipients of the "messages" had the opportunity to clarify on the content of the message, whether they could give feedback on their needs, etc). It would be important to see whether there were certain gaps existing in the network (certain actors are poorly connected or excluded from certain information flow), and hear participants' needs on what should be made differently to change the network (if they find it necessary). We would like to understand whether there were any difficulties experienced by FRs and authorities related to communicating with citizens (incl. Vulnerable groups). If so, what was the difficulty and how was/could it be solved in the future? This would be important for us to develop communication guidelines on how to effectively communicate with citizens. Facilitators could also ask participants to reflect collaboration

and communication with volunteers – what kind of information was shared with them compared to citizens? What channel(s) were used to collaborate with them? Were there any difficulties in terms of communication when it comes to collaboration between citizens and local authorities or FRs? Lastly, participants should discuss the quality of information shared in the communication network: was it reliable, misleading, distorted, vague or concise? What were the consequences of the information quality on crisis response?

4. Needs on soft solutions

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this question group our aim is to understand what kind of soft solutions are currently available in crisis response and how they worked in the past. Also, we would like to understand what the needs are related to these soft solutions, in terms of their content (what information should they include?), target groups (to whom they should be designed?) and channels to share (where and how should they be spread in order to reach the target group?).

5. Needs on training

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions, we aim to explore the community's needs related to training. We would particularly like to understand what type of training they would need for improving risk response, in terms of content (what skills, knowledge should be acquired?), length (how long would they prefer the training to last?), target group (who should engage in training), format (online or offline, individual or group-based).

6. Good and best practices / lessons learnt

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions our aim is to understand whether there are certain practices from the past crisis that turned out particularly effective when the actual event occurred, or practices that proved inefficient or even counterproductive. In addition, we would like to explore what were the key take-away messages and lessons learnt by these actors related to activities during the crisis and how they could be best utilized in a potential future crisis scenario.

Potential risks: since this question group also addresses aspects of communication and collaboration that proved to be inefficient, there might be a risk of tension between participants, including the risk of blaming one another. In case of that, facilitators should direct participants' attention to focus on potential ***solutions*** of how collaboration and communication could be improved in the future. Participants should be reminded that this session is an ***opportunity to change and improve*** practices and to focus on the future.

7. Vulnerable groups

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions our aim is to understand how vulnerable groups are involved in the communication network, what kind of information is shared with them and through what communication channels. We would like to understand what aspects of the inclusion of vulnerable groups should be improved in the future and how this could be done, what are the gaps, missing links between certain actors, how communication with certain vulnerable groups was efficient/inefficient in the past to make them active and efficient agents in crisis response.

Potential risks: facilitators are asked to pay specific attention that the inputs provided by the participants are non-discriminative, respectful, constructive and politically correct.

8. The role of Syri framework (social interaction and inclusiveness)

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions, we would like to understand what aspects of the Syri framework (more specifically, "Social interaction and inclusiveness" for Naturtejo Geopark) are related to collaboration and communication. About the fire in 2023 August: The fire near Odemira began on Saturday and was driven south into the hilly interior of the Algarve, Portugal's main tourism region, by strong winds. It has destroyed some 6,700 hectares (16,600 acres) of land, while a total of 19 villages, four tourist accommodations and a camping site have been evacuated. The fires in August 2023 are made possible by hot and dry periods paired with strong hot winds, however it was human behaviour (open fires) that started the initial wildfire. The CORE is facing a loss of heritage due to emigration out of the Geopark by younger cohorts (due to lack of economic opportunity) who do not take on the lifestyle and knowledge taking care of the Geopark forests increasing risk factors such as lack of maintenance of woodland and inappropriate behaviour (open fires) during heat waves and hot winds.

We would therefore like to understand how the demographical situation in the geopark (residents vs. tourists; emigration of younger people from the Geopark) impact the knowledge about the risk of fires, and their management as well as the management of the forest areas of the Geopark? How can information and communication be different? How could specific demographic groups be included in the flow of communication and knowledge sharing regarding safe behaviour in the park?

9. The role of cultural heritage

Tools needed: Interaction Map, Icons of actors, Icons of channels, blue-tack or double-sided tape, pencils, markers

With this group of questions our aim is to understand whether and how tangible/intangible parts of cultural heritage play a role in collaboration and communication between key actors when a crisis occurs. An important cultural heritage related part might be the loss of knowledge among younger generations on how to nurture or take care of the geopark. It could be important to understand what could be done to avoid the loss of the knowledge of the older generation and to channel it into crisis preparation, response and mitigations. Which solutions could be found to avoid or mitigate this loss?

10. Needs on digital solutions

With this group of questions, our aim is to understand whether there are any already existing digital tools to support FRs, local authorities and/or citizens in responding to a crisis. If so, we would like to know how participants evaluate their overall effectiveness, and how they could be further improved.

Session II. BEFORE and AFTER crisis

Title	Aim	Tools, equipment needed	Duration	Topics to be covered, Example of potential questions to support the facilitator
Recap of FG aims	Facilitators briefly re-introduce the aim of the FG. Participants are reminded of the real past scenario (or the hypothetical crisis scenario) introduced the previous day.	Projector, PC	5 min	Introduction to the aim of the second focus group activity Main ethical points addressed (audio recordings, data confidentiality, how data will be aggregated and used).

Warm-up: brief recap of Session I	Reminder of the methodology, identification of key actors (if necessary)	Projector, PC	5 min	Facilitators introduce the before/during/after process of the network, as well as define what we mean by before, during and after (where the time frame starts and ends). Facilitators set the scene for the first part of the activity that will focus on the *before and after* phase. Key actors are collected and identified only if they differ from the "during phase".

Identification of the information chain; Directions of communication; Information quality	Participants are asked to create the communication network/chain (by using the icons for actors and channels) on the interaction map reflecting on the time frame before and then after the crisis. Participants are asked to reflect on the directions of the communication and mark it on the map with arrows. Participants are asked to reflect on cases of misleading, distorted information sharing.	Interaction map, “actor” icons, “communication channel” icons, markers, post its, blue-tack	55-60 min	*Before crisis:* *What were the main channels for information sharing in preparation for the crisis? Was there any difficulty related to FR’s or authorities’ communication with citizens? If yes, what was it? How were volunteers involved in the chain of information? What specific information were they provided compared to citizens in general? Between which actors was the communication unidirectional/bidirectional? From which citizen group do you hear most? Whom do you reach least? What were the consequences of these directions? How frequently were the resources of information updated? Were there any issues related to misleading, distorted information/communication? Were there any issues related to the reliability of the source? How was the information filtered, altered, extended? Were there any policies, guidelines, protocols on when, how and what type of information should be shared? Was the communication to the public coordinated between different services and channels? Do you have ways to coordinate with media outlets? What are the main messages regarding preparation you want to reach people with? Do you have methods to understand the success of raising awareness?* *After crisis:* *How were community members informed that the crisis has ended? Where did citizens learn about the site being safe again to reenter? What was the major content of communication with citizens after the crisis? How did citizens learn about the immediate steps to be taken to recover from the crisis? Were there any difficulties related to communication with citizens or communication between different actors after the crisis event? What were they? How do you think communication could be improved after the crisis? What are the information that would be essential for citizens to know after the crisis? What would be an effective channel to use for this purpose?*

Needs on soft solutions				***Before crisis:*** *Were/are there any specific materials available for informing and preparing citizens for the crisis? If so, what are they? (Infographics, risk preparedness plans, safety checklists, etc.) What are the target groups? How would you evaluate their effectiveness in preparation for the crisis? Are there any features of these materials that stand out by being very effective or ineffective? Why do you think so? How could these materials be improved to make them more effective in preparation? What content should they include? Where, through what channels should they be advertised/spread in the community? If no such materials exist, what would be the basic principles for designing them? Who would be the target groups (general/specific)? What would be the content to include in this material? How and where should it be spread/advertised within the community? Were/are there any risk awareness campaigns available related to the crisis event? How would you evaluate its overall effectiveness? Why was it effective/ineffective? Is there any guideline on how to communicate with citizens to prepare them for crisis? How would you evaluate its effectiveness? How could this guideline be improved (e.g. specific target groups, concise practices, etc). If no such materials exist, what would be the basic principles for designing them? Who would be the target groups (general/specific)? What would be the content to include in this material?* ***After crisis:*** *Are there any soft solutions (infographics, guidelines) available for citizens to support them in the aftermath of the crisis? What is their content? How would you evaluate its overall effectiveness? How should it be improved in the future? What information would be essential to include in these solutions related to the period after the crisis?*

Needs on training				***Before crisis**:* *Were/are there any training available in the community related to crisis preparation? If so, what are they? To whom are they available? In what format? How would you evaluate their overall effectiveness, and why? How do you think they could be improved?* *Do you have suggestions for future training? What would be the skills and knowledge to be acquired through training? At which level should these skills be acquired (basic / intermediate / advanced)? How long should the training last? Who should engage in the training? What would be the preferred format of the training (online, offline, individual, group)?* ***After the crisis:*** *Were/are there any training available in the community related to skills and competences essential after crisis? If so, what are they? To whom are they available? In what format? How would you evaluate their overall effectiveness, and why? How do you think they could be improved?* *What skills and competences do you think are essential in recovering from a crisis? How do you think these should be improved by training?*

Good and bad practices on Lessons Learned	Participants are asked to reflect on past practices & lessons learned related to communication that went particularly well or badly.	Interaction map, “actor” icons, “communication channel” icons, markers, post-its, blue-tack		*How is crisis preparation different from your everyday tasks, objectives, and procedures? How do you prepare with respect to the crisis? Together with other services? Do you cooperate with other services in your everyday work? How? Do you rely on specific cooperation mechanisms (shared protocols, policies, responsibilities, systems)?* *How is the work of different services foreseen to be coordinated? Who takes the lead? How does it affect the internal hierarchy and reporting? How are responsibilities and mission sets different? Are they clear internally and what other services do? How does decision-making in command and on the ground? Are you working with informal services (farmers, businesses, ...) which have specific tools or knowledge? How do you integrate volunteers into crisis preparation? What are challenges associated working with non-professional services? What are the benefits?* *What was considered the most effective channel of communication? What was considered the most effective content to be shared? What went particularly well/bad? With whom? Why? Lessons learnt that could improve communication in the future? And between which actors?* *What are the mechanisms for learning from disasters and reviewing missions and practices? Do you have internal debriefs, reporting, mission review, as well as support for staff? How are these done? Do you do this together with other agencies? Is information shared? Are external agencies reviewing your work?* *When – in your estimation – does the crisis mission stop? How do you know? What happens then?*

Vulnerable groups	Participants are asked to reflect on past practices related to reaching members of vulnerable groups.	Interaction map, “actor” icons, “communication channel” icons, markers, post its, blue-tack		***Before crisis:*** *Whom do you consider as vulnerable groups in your region? Why/in what way? Was there any specific strategy to communicate with vulnerable groups? How were the different vulnerable groups reached? Through what channel? What kind of difficulties did arise related to communication and information sharing among different vulnerable groups? How did you gather information about their needs for preparation? What would be their needs regarding communication before a potential future crisis? What could be improved in communication to best support these groups in preparation? Which are the most affected vulnerable groups within your community? Which are the groups hardest to reach (independent of vulnerability)? Are they more at risk?* ***After the crisis:*** *Was there any strategy to communicate with vulnerable groups after the crisis event? What information would be essential to share with different vulnerable groups after the crisis event? What would be an effective communication channel / who would be a trustworthy communication actor for different vulnerable groups after the crisis?*

SyRI	Participants are asked to reflect on aspects of SyRI related to their CORE (Social interaction and inclusiveness)	Interaction map, “actor” icons, “communication channel” icons, markers, post its, blue-tack		**Socio-economic resilience** (Fammenne-Ardenne Geopark’s CORE): *When it comes to preparation for the crisis, how do you think communication and information sharing between actors could be improved in order to ensure socio-economic resilience? How could reliable, undistorted communication content be ensured in the media about the actual, real state of the geopark? What channels should be used in order to properly and reliably inform tourists about the actual state of the geopark?* **Social interaction and inclusiveness** (Naturtejo Geopark’s CORE): *When it comes to preparation for the crisis, how do you think communication and information sharing between actors could be improved in order to ensure improved social interaction? How could reliable, undistorted communication content help social inclusiveness and resilience? What channels should be used in order to properly and reliably inform locals and tourists about the actual state of the Geopark? How do you think communication and information flow could be extended to visitors of the park in order to promote safe behavior? What kind of knowledge do you think would be important to share with visitors to make sure they do not mean additional fire risk to the geopark?* **Adaptive Governance** (Karsyiaka’s CORE): *When it comes to responding to the crisis, how do you think communication and information sharing between actors could be improved in order to ensure effective collaboration? How could reliable, undistorted communication content help improve community dialogue and information before the crisis situation occurs? What channels should be used in order to properly and reliably inform locals and tourists about the onset of a crisis event in Karsiyaka? How could the government ensure that citizens are active and capable partners during a crisis event? What would be the vital information to be shared coming from the citizens in*

				a bottom-up process? What would be the essential information to be shared with citizens in order to empower them in a crisis? Are there any stakeholders who are currently not but should be involved in the crisis communication? What would be their added value and the challenge related to their involvement? **Active Memory** (Crete's CORE): *What would be the vital information to be shared coming from the citizens in a bottom-up process? How could the government ensure that citizens are active and capable partners during a crisis event? What measures are / could be taken to create and nurture and share an active collective memory within the community related the past event? How do you think this collective memory could support the community in preparing for and responding to a potential future disaster? What would be the citizens responsibility in this? How was this collective memory built? What methods were used? What would be a feasible way of sharing this collective memory with younger generations?*

The role of cultural heritage	Participants are asked to reflect on how they think cultural heritage played a role in preparing for and recovering from the crisis event.	Interaction map, “actor” icons, “communication channel” icons, markers, post its, blue-tack		*Are there any traditions around collaboration, communication, information sharing that played a role in preparations for the crisis (e.g. word-of-mouth information/ words, phrases frequently used that refer to one specific aspect of the crisis / traditional gatherings where information or knowledge was or could be shared) - How could they be used in the future for crisis preparation? Were these cultural heritage-related communication forms supporting or rather hindering the spread of reliable and up-to-date information and preparation for the crisis? Did the crisis affect any of these heritage-related aspects in preparation for the crisis? (e.g. some of the traditional forms of information sharing disappeared because it turned out to be unreliable or dangerous)... Any stories, events related to preparations for the crisis that have been built in the collective memory of the community as a lesson learnt or good practice?* ***After the crisis**:* *What is the aftermath of the crisis in community communication? Were there any forms of culture-related gatherings, events that supported communication or information sharing between community members on how to recover from the crisis?* **Additional customised questions for Karsiyaka’s CORE**: *How has the knowledge about dealing with heatwaves changed? What is the relationship between young and old people? How has the knowledge about the weather conditions making heatwaves more likely changed? How has the knowledge about risky behaviors regarding heatwaves changed?*

Needs on digital solutions				Are there any digital tools you use for decision-making regarding preparedness and disaster risk prevention? If yes: What are those tools? What do you like about your current tools? What do you dislike? If no: What are other digital tools you consult Disaster Risk Management. Is there a digital tool (webpage, digital repository, local inventory) that you consult often for finding best practices and/or lessons learnt in Disaster Risk Management? Currently is there a digital space which can help collecting the memories of past disasters? If yes: Please provide more information about this tool. What do you like about your current tools? What do you dislike? If no: How do you think you could use such a digital tool in your work? What does your communication/collaboration within your team and/or partners look like during the different phases of Disaster Risk Management in terms of sharing information, development of new strategies and coordinating tasks? Which tools do you use for communication and coordination within and between teams? Based on your previous experiences, what features do you consider essential in a digital tool designed for natural disaster management? How do you rate the importance of these tools being adaptable to different types of disasters (floods, wildfires, heatwaves, etc.)? What is your comfort level with using digital technologies, and would it be useful or adequate to have training to effectively use these tools? How important is it for these digital tools to have collaborative features, such as discussion forums or information exchange platforms, for you and your community? How do you think a digital tool can best facilitate collaboration among different users such as first responders, authorities/policymakers, heritage managers, civil society organizations, and citizens? **After the crisis:** What do you think the greatest added value of a digital solution could be when the crisis is over? What features would support citizens in recovering from the crisis?

Session II. in detail:

Recap of FG aims

Tools needed: projector, PC – presentation material

Suggested duration: 5 mins

In Session II., participants are first briefly reminded of the general aim of the focus group activity and ethical highlights, then facilitators briefly re-introduce the past scenario (if necessary, by using the presentation material from Session I.).

Warm up: brief recap of Session I.

Tools needed: projector, PC – presentation material

Suggested duration: 5 mins

Facilitators briefly re-introduce the methodology of the Interaction Map as the general approach to gather data, by highlighting that in Session II., the main focus is on the time frames of “before” and “after” the crisis event. Then, participants are asked to identify and collect all the actors who might be relevant in preparation and recovery ONLY if they differ from those in the “before” phase.

Participants may choose to

a) analyse the during and the after phase after each other,

b) discuss the two timeframes interconnectedly, in parallel with each other.

Whatever strategy they decide to take, it would be still important to visualize the network on two separate sheets (during/after the crisis event) to better understand the changes in communication and collaboration over time.

Facilitators' Debriefing Space

The data recorded throughout the activity will be analysed through a "Cluster" thematic approach, where common themes will be clustered through post-its with the goal of highlighting what stood out during the discussion. Although, as this clustering and analysis process will start only after DBL will have received the translated transcripts from the FG sessions, we realised that it would beneficial to save up 15' time to have a debriefing session with the facilitators after each Focus Groups has ended. Hence, a 15' video will be set up with someone from DBL or VIC to go through the map in English, with a detailed explanation from the facilitators. Aside what is explicitly communicated during the activity, the analysis would benefit of the facilitator's observations throughout the whole FGs sessions. Facilitators will therefore be asked whether there were any visible tensions within the group and, if any, if they were related to specific topics; if any moment or quote during the discussion stood out particularly, and others.

General feedback on how the organisation of the FG sessions went will also be collected so as to ensure a better delivery and organisation for the next field work activities.

Annex 3. Questions for the Semi-structured Interview

Famenne-Ardenne CORE

1. **As we learned, tourists and scouts are considered vulnerable to the risk of a flooding event due to their lack of knowledge of the territory.** What are the most important information/knowledge that these individuals should possess / acquire when visiting the geopark? What channel and language(s) should be used to contact tourists?
2. **We understood that on the community level, the most frequently used way of information sharing is face-to-face communication.** Do you see any problem with this communication? How do you think communication could be further improved or supplemented with other methods (e.g. distributing brochures)?
3. One striking result of the focus group session is that there are certain websites like „Be Faid" and „Mon Plan d'Urgence.be" with guidelines on how to make an emergency plan for citizens (e.g. what emergency kit they should have). **Participants, however, pointed out that people do not know about these websites. What do you think the reason is behind citizens being unaware of them? How should they improved and promoted to reach their target group?**
4. **If there was a smartphone application that citizens, authorities and FRs could use to communicate during crisis, what would be its most important features?** What kind of information would it contain?
5. **As we understood from the focus group sessions, the community does not yet have a solid recovery plan after crisis.** What do you think the most important information within your community would be to be share during recovery?
6. **If there were training/education available to the community related to the crisis, what do you think should be the content of it?** What kind of knowledge, skills, abilities should they gain through training? Who should engage in training? What format do you think would be most effective for which content (online, offline, workshops, classroom courses, gamification)? Who do you think should deliver the training?
7. **How do you think children at kindergartens and schools should be educated about what to do in case of a flooding event?**
8. **What do you think an ideal risk communication material related to preparedness looks like?** What would be the ideal size (bank card, A5 notebook, A3-A2 poster to hang on the wall of homes)? What information would it contain? Was there anything similar distributed in the community before?
9. **What do you think an ideal risk awareness campaign created for the community would look like?** Where/through which channels do you think it would be most useful to advertise? What would be the main message(s) to convey with the campaign? Was there anything similar promoted in the community before?

Naturtejo Geopark CORE

1. As we learned from the Focus Group session, there is a lack of social media use and the use of formal websites for citizens to inform themselves about the crisis. What are the alternatives used in the community to receive up-to-date information about the state of the fire? Is there any way this alternative should be improved to improve citizens' ability to prepare or respond to the crisis?
2. During the FG session it was mentioned that the government implemented some programs with checklists for village representatives of what to do step-by-step in case of a fire event. However, they seem to be reluctant to take charge or responsibility. Why do you think it is the case? What do you think would be needed for them to take this responsible lead?
3. As we understood from the FG session foreign individuals who camp (reside) in the area are vulnerable due to them being excluded from communication and information sharing. How do you think they could be reached with the essential information about the crisis itself and what to do in case it occurs?
4. An important piece of information acquired during the FG session is that the attitudes of citizens towards firefighters asking them to leave have changed radically, often resulting in them refusing to leave after being explicitly notified to do so. Why do you think it is the case? **How do you think firefighters' or authorities' communication towards citizens should be changed in order to convince them to leave their properties? What would be an "ideal" communication in your point of view?**
5. **How do you think the already existing application for citizens to follow fire events around their area should be improved? Do you have anything that you would add to it as a feature?**
6. **We understood that on the community level, the most preferred way of information sharing is face-to-face communication.** What are the difficulties related to this method? What kind of information is shared like this? What kind of content would be important to exchange this way? How do you think communication could be further improved or supplemented with other methods (e.g. distributing brochures)?
7. What kind of training and education are currently available to citizens? How do they work? **If there were additional training/education available to the community related to the crisis, what do you think would be the content of it?** What should they be trained for the period before, during and after the crisis? What format do you think would be most effective for which content (online, offline, workshops, classroom courses, gamification)? Who do you think should deliver the training? If offline, which point, location within your community would be ideal to organize these training?
8. **How do you think children at kindergartens and schools should be educated about what to do in case of a flooding event?**
9. **If there was a risk communication material related to preparedness available for the community, what do you think it should look like?** What

would be the ideal size (bank card, A5 notebook, A3-A2 poster to hang on the wall of homes)? What information would it contain?

10. **As we understood from the conversation, the already existing risk awareness campaigns (running on TV) are not effective anymore due to them being repeated every year, the same way. How do you think this campaign should be modified in order to catch attention again?** Where do you think it would be most useful to advertise? What would be the main message(s) to convey with the campaign?
11. As we learned from the FG session, firefighters from other regions often join the local forces during a fire event. **Do you see, perceive any difficulties in their communication between each other and with citizens?**

Karsiyaka CORE

1. **As we learned, elderly people, pregnant women and individuals with chronic diseases are considered vulnerable to the risk of heatwaves.** What is the most important information/knowledge that these individuals should possess related to an upcoming heatwave? What channels should be used to contact these groups? Who do you think they consider as reliable sources of information? Which format do you think should be used to transfer this knowledge?
2. As it has been expressed during the focus group sessions, heat waves are „silent killers" as they are not visible, compared to natural disasters. **Do you think that a risk awareness campaign addressing this issue would be useful within your community? What format do you envision for this campaign? Where do you think this campaign should take place?**
3. Based on our understanding, Muhtars (neighbourhood representatives) could play an important role in informing people due to their extended social network**. How do you think this role could be best utilised in preparing and informing citizens in the neighbourhood? What kind of information should be transferred by Muhtars? Do you think they require any specific training/education to undertake this role?**
4. As one of the long-term mitigation strategies, urban planning masterplan has been frequently mentioned during the focus group sessions. **How do you think this masterplan should be communicated to better reach citizens? What are the aspects of this masterplan that could be implemented on the individual level? Would these aspects require citizens to engage in any training? If yes, what would it be?**
5. Based on the results of the focus group sessions, communication about the heatwaves seems to be unidirectional, coming from the government to the citizens. **Do you think there would be a need for citizens to express their needs and ideas related to mitigation before and during the heat wave (bottom-up communication). What kind of information would be important and useful to share in this direction (coming from the citizens to the**

government? What would be an ideal platform of a bi-directional communication before and after the crisis?

6. The importance of education/training about heat waves has been identified as one crucial means of knowledge transfer. **What would be the ideal format of this education targeting a) children b) young citizens c) pregnant women d) individuals with chronic diseases e) elderly?** Supporting questions related to the format: Would it be online or in person? For small or larger groups of participants? What would be the duration of the training? Would it be theoretical, practical or the combination of the two? Would it be a frontal education or rather a discussion where participants can share ideas and practices? What kind of knowledge would be transferred (e.g. causes of heatwaves, personal mitigation strategies, sharing of best practices among citizens, basic first aid training, etc.)
7. As it has been expressed during the focus group sessions, it would be important to map the areas within the city with the highest proportion of vulnerable groups and compare them to the areas where there are cooling places (e.g. urban parks) available. **Do you think that this information would be useful to include in a smart application? If so, how would this smart application work in your opinion? What other important features, functions would it have related to the risk of heat wave? If vulnerable groups (e.g. elderly) do not use smart applications how do you think they could access the very same information?**

Crete CORE

1. It has become apparent that local authorities' efforts have not been visible enough to the affected population leading to frustration in the community after the earthquake in 2021. What do you think is an effective solution for improving communication and **bridging the gap between the local authorities and the affected population**? Which communication means can be implemented to effectively keep the community informed? What digital solutions or online platforms could enhance communication between authorities and residents? What could be included in specific guidelines for communication that should be followed by the local authorities? **What would be the content and the style (informal, language style etc.) of communication that would sooth community members and lower their level of frustration?** How can the community take a proactive role in organizing themselves while waiting for local authorities to address their concerns? In regard to the tension and frustration coming from citizens towards the authority members - do you think the local authorities should engage in some kind of conflict management training? It has been raised within the focus group that some residents do not prepare for the event of an earthquake. How can **unprepared individuals** be reached adequately before and during a crisis? What content strategies can be employed to engage unprepared individuals? What low-threshold communication mediums can be used to convey risk information? Could for example daily routines,

campaigns, or advertisements serve as effective channels? Could you think of specific examples? How can clear and actionable explanations be provided for why and how people should prepare?

2. Here are some questions related to **improving communication practices among volunteers, citizens, and first responders, as well as integrating volunteers into the communication chain**: How can communication be enhanced between first responders (FRs) and volunteers? (e.g. consider strategies such as regular meetings, joint training sessions, and shared communication channels…)? How can community volunteers be involved in the emergency response communication? How can FRs and volunteers collaborate effectively during emergencies? Can you identify solutions for seamless communication, mutual understanding, and cooperation?

3. During the session the **need for training for community member**s was stressed. Children have been prepared on how to behave during the crisis event, but many adults did not know how to respond. Who would be the target group (kids, citizens, teachers etc.) for preparedness training? What skills, knowledge, and abilities should participants acquire during the training? Consider aspects such as basic first aid, emergency communication, evacuation procedures, and risk awareness. Who would be the most effective trainers? (citizen, volunteers, local authorities, or a collaboration?) Should the training be a one-time event or a recurring series? What frequency would be ideal? What format would best suit the delivery of training content? Could it be workshops, online modules, interactive simulations, or a mix of these? How can we ensure that the training effectively reaches the target audience?

4. As you have been involved in the actions and may have identified **experiences and good practices** that could be crucial for community empowerment and self-empowerment, do you see a benefit and opportunity to disseminate these in the community? How can best practices and lessons learned be disseminated effectively? Target audience? Promptly to inform the community on future actions in a timely manner? What channels are useful for sharing best practices and lessons learned? How can we ensure continuity in adaptation programs and activities? How can continuity be ensured? What communication solution would enable **effective communication and up-to-date information sharing**, especially in the aftermath of overloaded communication channels?

5. Overcoming psychological challenges in times of change and adaptation is essential and was defined as a necessity after the earthquake in the focus group session. **What kind of psychological support do you think was needed?** (e.g. depression and post-traumatic stress, adaption to new circumstances, life skill training, parenting support, community-level support…) **In which format could**

this support be provided (e.g. helplines, community centres, applications, online chat…)?

6. During the focus group the idea of a festival was raised to remember the earthquake and support each other. What kind of **programs, initiatives, and memory collection strategies would be interesting for a festival**?

7. Let's broaden our perspective a little and include other more touristic regions of Crete. How can **tourists be (actively) involved** in the preparation and response mechanisms for similar earthquake scenarios?

Annex 4. Eye-tracking experiment

Socio-demographic data

Q1. What year were you born? ***Open question***

Q2. What gender do you identify with?

· Woman

· Man

· Other / Does not wish to comment

Q3. What is your nationality?

· Portuguese (or Norwegian, Greek, Turkish)

· Other (Specify)

Q4. What city do you live in? *Open question*

Q5. Do you play an official role in disaster management (member of the local administration, NGO, medical institution, scientific community, etc.)?

· Yes (Specify)

· No

· I don't know

Q6. What is your socio-professional category?

· Self-employed farmer

· Craftsperson, Shopkeeper, Manager of a small business

· Company director, civil service executive, higher intellectual and artistic profession

· Intermediate profession

· Clerk

· Manual worker

· Liberal profession or similar

· Retired

· Homemaker

· Student

· Unemployed

· Other (please specify)

Q7. What is your highest level of education?

· No diploma

· Secondary education diploma (1st cycle)

· Secondary education diploma (2nd cycle)

· Post-secondary non-tertiary education (law degree, DAEU, etc.)

· Short-cycle higher education (BTS, etc.)

· Higher education at licence level or equivalent

· Higher education at master's level or equivalent (including doctorate in health)

· Higher education at doctorate level or equivalent (excluding health doctorate)

Evaluating the material

You are going to look at certain parts of the document you observed earlier, one by one.

[Picture

Q1. Which image have you just seen?

Picture

Q2. Which image have you just seen ?

Q3. ….

Q4. Regarding the document as a whole, on a scale of 1 to 10 (1 Not at all, 10 Absolutely)...

· ... how well did you understand the message conveyed by the document?

· ... how relevant the content was?

· ... how useful the content was?

Q5. Choose one of the 3 possible answers for each sign.

· I didn't understand the message, nor do I have the basic knowledge needed to act on it.

· I understood the message but I don't have the necessary knowledge to act accordingly.

· I have understood the message and I have the necessary knowledge to act accordingly.

Q6. In your opinion, which instructional images could be improved, and how?

Q7. With regard to the document as a whole, please indicate on a scale of 1 to 10 (1 Not at all, 10 Very much so)...

· ... how easy to read the colours used to display the images were.

· ... how well the colours in the document attracted your attention.

· ... how well the colours in the document conveyed the message.

Q8. Are there any other accessibility features or parameters that you would like to see implemented for users with disabilities?

Q9. On a scale of 1 to 10 (1 Not at all understandable, 10 Perfectly understandable)...how comprehensible do you think the document is for non-native speakers?

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