0. Methodological sequence of participatory project

The suggested process for drafting the implementation strategy was based on the following specific objectives: [1] to initiate the implementation process in accordance with the indications established in the Special Plan for Civil Protection and Emergency Care due to volcanic risk in the Autonomous Community of the Canary Islands (PEVOLCA per its initials in Spanish -Plan Especial de Protección Civil y Atención de Emergencias por riesgo volcánico en la Comunidad Autónoma de Canarias-); [2] to generate a meeting point that fosters a discussion forum that has continuity over time and facilitates the promotion of collaboration between agents linked to the implementation of the Island Action Plan against Volcanic Risk (PAIV per its initials in Spanish -Plan de Actuación Insular frente al riesgo Volcánico de la isla de Tenerife-) [8]; [3] to detect shortcomings, strengths, procedures, capacities, and needs of the PAIV by the agents involved; and [4] to generate information and knowledge collectively for the definition, proper orientation, and elaboration of the implementation.

The proposed methodological sequence begins by identifying needs to initiate the participatory process and continues with direct contact with agents from a participatory workshop that includes a panel of experts (*Second Island Conference on Civil Protection and Emergency Management–Volcanic risk management: a multi-sectoral vision*) [7] in which operatives participating in the volcanic emergency in La Palma shared their experiences. Subsequently, a stage of analysis, processing, and systematization of the information for drafting the implementation strategy is initiated, ending the project with a presentation, collection of contributions, and validation of the next steps in the short and medium terms.

Methodological stages						
Month 1	**M 2**	**M3**	**Month 4**	**M5-7**	**M8-9**	**M10**
Stage 1: identifying needs			Participatory workshop	**Stage 2:** analysis, information processing, and drafting of the implementation strategy	Presentation, feedback, and validation	Final delivery

Table 1: proposed structure for the participatory project. Prepared by the authors.

1. Stage 1: identifying needs

This phase mainly focuses on knowledge of the context of DRR and DRM in relation to volcanic hazards in Tenerife with: (1) a documentary review and (2) agent mapping, both critical aspects for the participatory workshop; (3) facilitating knowledge and access to the PAIV; (4) preparing the meeting space and designing the participatory workshop; and (5) implementing the workshop within the framework of the *Second Island Conference on Civil Protection and Emergency Management*. Steps 1 and 2 are described in detail in the presented study. This document describes steps 3, 4, and 5 in greater detail. Step 2 is repeated because of its direct connection with the following steps.

1.2. Agent mapping

For agent mapping, it was necessary to review the objectives of the research, context, and time and resources allocated. The use of PAR methodologies in risk planning and management makes sense when these tasks involve a series of actions in which administrations, scientific entities, associations, economic sectors, and the overall population have certain quotas of responsibility and commitment [1]. Throughout the project, a stakeholder analysis was conducted to define participation, considering: (a) which stakeholder groups should participate at the island scale with the objective in mind, (b) where decision participation can be assured, (c) when it is appropriate to promote a participatory project or process, and (d) which commitment is available in the medium and long term to provide continuity to the project and implement actions [2].

This took into account: (a) the objective of initiating a long-term island-wide preparedness process, driven by the insular administration and government, with a given responsibility and competences; (b) the budget allocated for this project and the plausible commitment for the continuation of the project, due to the proximity of the elections to the autonomous Parliament and Island Councils and municipalities; (c) the local context and circumstances in 2022 already mentioned; and (d) the lack of previous DRR meetings due to the volcanic threat and the lack of knowledge about the predisposition for the coordination and development of the implementation with the quotas of responsibility and commitment that this implies for each of the parties. Thus, efforts focused on generating the first meeting space with the participation of: (1) all the organizations and entities related to the Local Action Organization Chart planned in the PAIV (Figure 1); (2) all areas of the Island Council that could develop actions in the preparation process; (3) representatives of the local councils of the entire island, or at least of the municipalities with a Very High and High threat level in the risk assessment of the PAIV; and (4) representatives of emergency management in La Palma, both from the Island Council of La Palma and the Government of the Canary Islands.
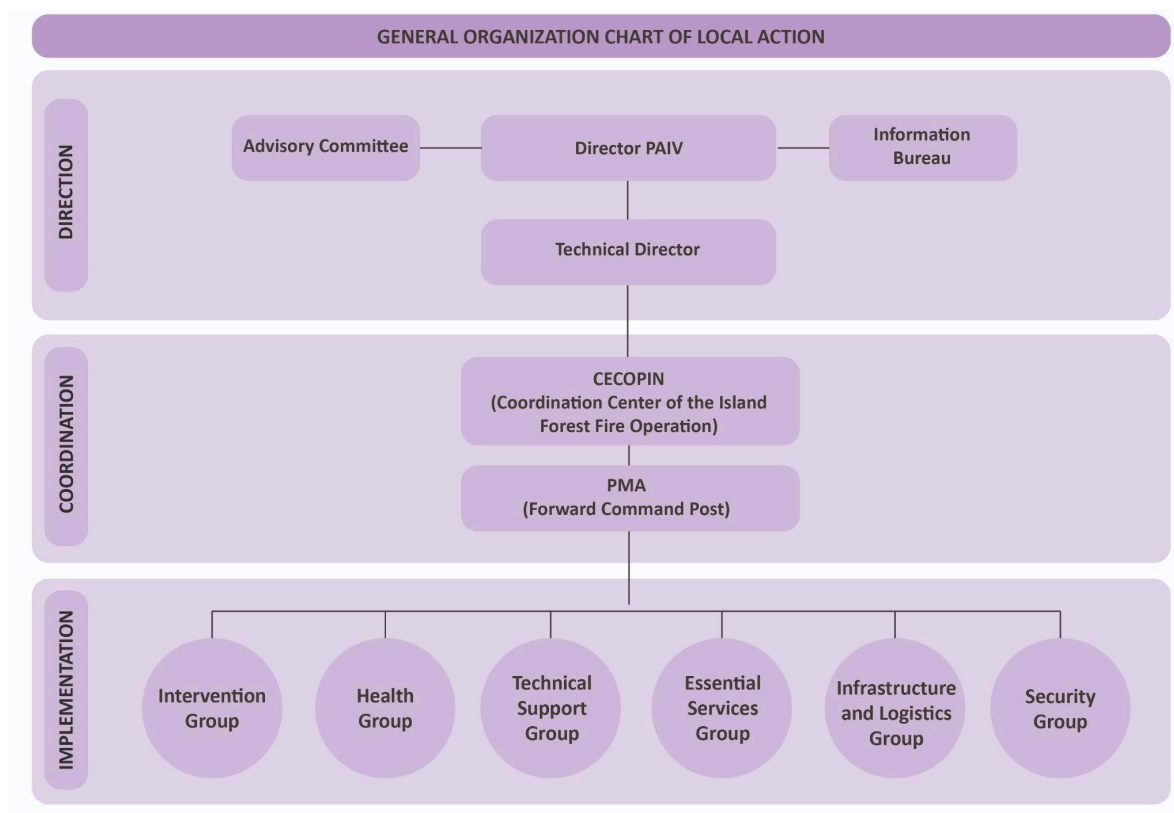

Fig. 1: General Organization Chart of Local Action [8].

This implementation process should progressively increase organizational complexity and involve a greater number of actors [3, 4] to gradually develop actions, reviews, and improve implementation and preparedness proposals.
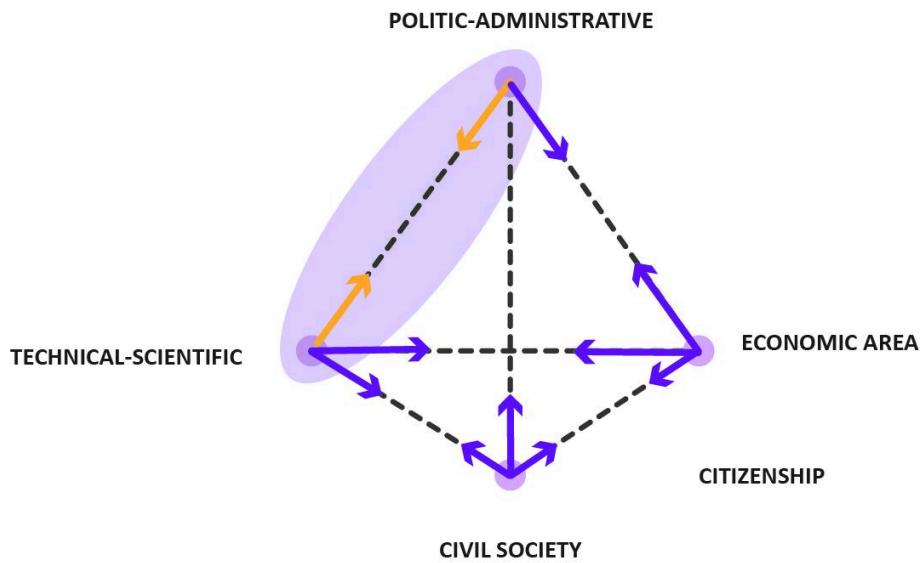
Fig. 2: activation of changes among the three categories of actors and possible breakdown of actors and agents.
Source: adapted from Marta Donadei [5].

Following the equilateral construction of the triangle proposed by Marta Donadei [5] (Figure 2) and based on the research of De Manuel Jerez [6], the construction of a collective learning process where the responsibility for making decisions that affect the habitat falls on society as a whole is observed in the scheme, based on the creation of spaces for participation and consultation where politicians, technicians, and citizens are called upon to share the will to initiate a long process of consultation, co-creation, and cooperation [5]. This drive started from a technical-political perspective. Once this base has been built (and, thus, strengthened), work must be done to include the missing vertex to increase its impact on the final objective of risk reduction.

1.2. PAIV information summary, preliminary questionnaire, and design of participatory workshop

After the initial agent mapping was performed, invitations to all entities and organizations were formalized. Once the dialogue with each agent began, a preliminary questionnaire was administered to explore the degree of knowledge that people had about the existence of the PAIV and its content. In addition, suggestions were collected related to the PAIV area or sub-plan in which they believed they could make the most significant contribution to reflections and experiences, or the one that could be most useful for their organization and team. The information gathered was then organized according to the PAIV sub-plans, and an informative process was initiated. To carry out this process, each chapter of the plan was summarized, simplifying and adapting the content with graphic material and summaries to facilitate reading and understanding, and to facilitate possible contributions. Public access to all the contents of the PAIV was also ensured through the council's website.

Subsequently, to generate a meeting space to promote collaboration among agents and the participatory drafting of the strategy, a participatory workshop was designed. It is important to remember that the workshop took place within the framework of the *Second Island Conference on Civil Protection and Emergency Management–Volcanic risk management: a multisectoral vision*. The purpose of this conference was to promote the knowledge and awareness of volcanic hazards. At the first session, held on November 16, 2022, a day of discussion was held [7]. This meeting was designed as an open space for the exchange of ideas, where the transmission of knowledge, meetings, interactions, and debates were encouraged through talks, video projections, and presentations. The second session, held on

November 17, was planned as a participatory workshop, one of the key tools for actively involving the participants (see Section 1.1). This workshop was organized as a dynamic and collaborative space to share knowledge, reflections, doubts, and problems; generate proposals; and plan concrete actions.

The participatory workshop was related to three of the specific objectives of this stage of the research, described in Section 0: (2) to generate a meeting point; (3) to detect shortcomings, strengths, procedures, capacities, and needs; and (4) to collectively generate information knowledge.

1.3. Participatory workshop

The participatory workshop took place throughout the morning, and organized three main dynamics to delve deeper into the different topics and to advance the planned objectives. Prior preparation sought to promote knowledge of the approved PAIV and explain the objectives of the meeting, making it easier for each participant to take an active part, knowing that they would benefit from the knowledge and that they would be jointly responsible for the agreements reached.

The workshop began with a presentation on the PAIV, purpose and objectives of the meeting, methodology and schedule of the dynamics planned throughout the morning, and how this day was part of the preparation process promoted by the drafting of the implementation strategy. The morning sessions were conducted as shown in Table 2. Each of the dynamics, except for the plenary session, was carried out in smaller groups of six to 12 people, organized according to the sub-plans of the PAIV: (1) Evacuation plan, (2) Supply, shelter, and social assistance plan, (3) Restoration of essential services plan, (4) Island transmission plan, and (5) Communication and information to the population plan.

PARTICIPATORY WORKSHOP	DESCRIPTION
PRESENTATION (all attendees)	Presentation of the participatory workshop
DYNAMIC 1: **BRAINSTORMING** (smaller groups of 6 to 12 people)	Presentation by the facilitator of the sub-plan's content that corresponds to each group, involving the participants and using graphic material created for each group. Subsequently, each group's contributions, reflections, and needs related to the plan they are working on are presented
BREAKFAST	Space for informal meetings and networks
DYNAMIC 2: **PRIORITIZATION AND PLANNING OF ACTIONS FOR IMPLEMENTATION** (smaller groups of 6 to 12 people)	Priorities of the contributions made in Dynamic 1 are identified through a prioritization matrix relating them to the courses of action of Chapter 7 of the PAIV - Implementation: (1) fine-tuning required infrastructure for PAIV activation; (2) assignment and training of the components involved in the PAIV; (3) establishment of the necessary protocols, agreements and arrangements; (4) education and qualification programs; (5) public information campaigns; (6) training exercises; (7) PAIV maintenance. Dynamic 2 is closed with a summary and joint evaluation of the process carried out and it is decided who will be in charge of sharing the work undertaken in the plenary
PLENARY (all attendees)	Sharing of the work undertaken by groups with all the participants, collection of contributions or reflections on the work done, and validation of the proposals. General input to the plan, or to the workshop, is also provided online, in case there is not enough time to address all the issues. The plenary ends with an evaluation and closure, recording all the contributions

Table 2: structure of the participatory workshop. Prepared by the authors.

In this way, each group had: (1) a facilitator to develop the dynamics and help foster a participatory and horizontal environment, transforming challenges or debates into learning and concertation opportunities, and dynamizing the entire process; (2) a backup person to provide support in everything that was necessary throughout the workshop; (3) support

graphic material for each of the participants and the same graphic material adapted for group work; (4) support stationery; and (5) people from outside the groups who observe, provide support, and manage the time for all the groups. Subsequently, all these people were responsible for facilitating, taking notes, and providing support during the Plenary. All data from the workshop were recorded and organized digitally so that they could be used as a reference for contributions that, although they may exceed the competencies of the Island Council or may not have been prioritized by the participants, could be considered later or in possible future processes.

Figs. 3 and 4: Photographs of the participatory plenary workshop. Prepared by the authors.

2. Stage 2: analysis, information processing, and drafting of the implementation strategy

The methodological proposal for the development of this phase included: (1) the organization, analysis, and systematization of the information gathered; (2) presentation of the results in conjunction with the participants in the workshop to validate the contributions, reach consensus on the follow-up indicators and planned time schedule, and incorporate possible observations and modifications; and (3) review of the implementation and delivery strategy (Table 1).

The systematization and processing of all content generated in the workshop began by organizing and analyzing the information gathered and recorded during meetings. Minutes and summary notes, visual records such as diagrams and photographs of the materials produced, and lists of observations in group dynamics and plenary sessions were collected and recorded. The material was organized by grouping the information according to the contents of the PAIV—corresponding to Chapter 5 and each of its sub-plans, and to Chapter 7 and the courses of action, once prioritized (Dynamic 2), combining repeated topics. Figure 5 schematizes this process.
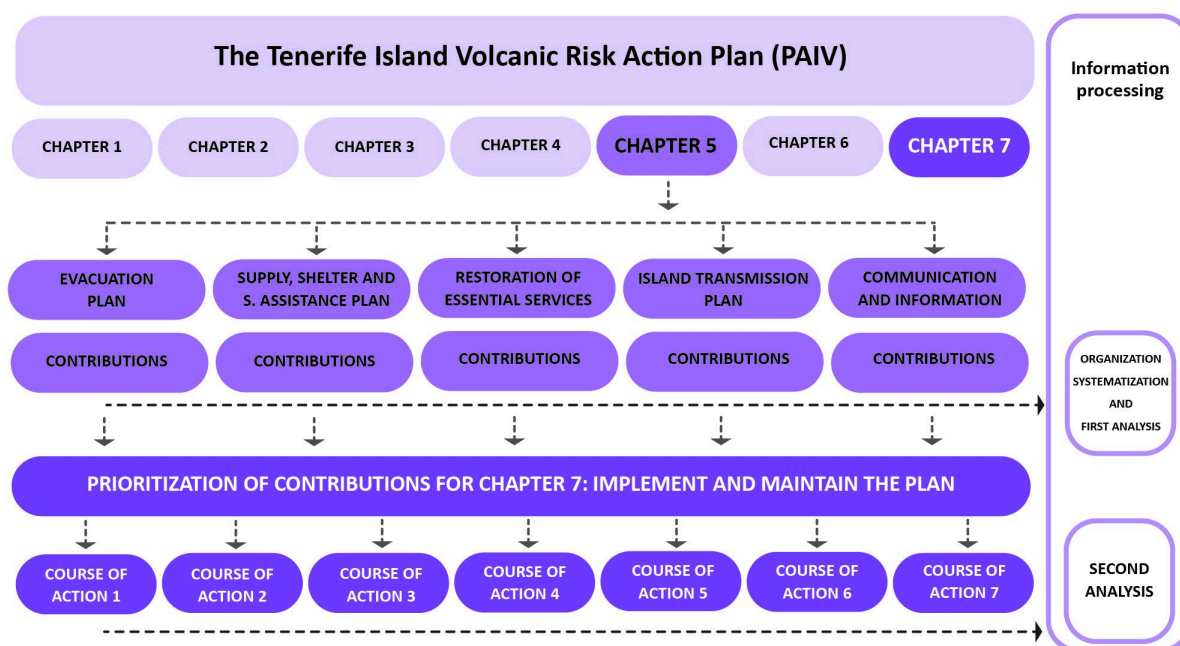
Fig. 5: process of organizing, systematizing and analyzing the information collected during the participatory workshop. Prepared by the authors.

In addition, a content analysis of all the contributions was carried out. Once all the information generated in Dynamic 1 was organized and systematized, the first analysis was conducted considering the thematic categories presented in Table 3. From this analysis, it can be deduced that: (1) the number of contributions for each of the working groups was between 30 and 55 per group; (2) the total of all contributions was approximately 220; and (3) of all the contributions, most were related to the theme category 1-Infrastructure, means, and resources in all the groups, except for *Group 5: Communication and information,* where the largest number of proposals focused on issues related to category 3-Training and Capacity Building (24%) and 4-Communication and information (22%). The contributions were analyzed and organized using a spreadsheet and methodological processes of content analysis and coding.

Theme categories
1. Contributions related to Infrastructure, means and resources
2. Contributions related to the criteria, approach and procedures of the PAIV
3. Contributions related to Training and Capacity Building
4. Contributions related to Communication and information
5. Contributions related to Coordination, organizational structure and functions

Table 3: analysis categories of the contributions made in Dynamics 1. Prepared by the authors.

Of the 220 contributions made in Dynamic 1, 79 were prioritized and organized according to the courses of action (Dynamic 2) foreseen in Chapter 7 of the PAIV (Table 4). The second analysis (Figure 5) was conducted using the information collected that had already been prioritized.

Courses of action

Course of action 1: fine-tuning required infrastructure for PAIV activation
Course of action 2: assignment and training of the components involved in the PAIV
Course of action 3: establishment of the necessary protocols, agreements and arrangements with the different administrations and organizations
Course of action 4: development of education and qualification programs
Course of action 5: public information campaigns
Course of action 6: training exercises
Course of action 7: maintenance

Table 4: courses of action in Chapter 7 of the PAIV. Prepared by the authors.

This second analysis was developed around two major groups: (1) fit in the sub-plan, organized according to the theme categories of the PAIV (25 established categories), and (2) operational situations in which the action should be carried out (green light, yellow light, orange light, red light, or if it is an action related to all operational situations). The results highlight the relevance given to the green light (pre-alert) operational situation: 57% of the contributions, which contrasts with 4% related to orange (maximum alert) and red (emergency). This makes sense with the parallel analysis of which theme category of the PAIV the prioritized contributions would fit into: 27% of the contributions fall into the 1-Infrastructure, means, and resources category and 15% into the 2-Training and Capacity Building category.

The following comprise a series of contributions that are particularly relevant to the proposed approach of the study: (1) establishing internal communication channels and tools (between entities and institutions involved); (2) training of informants in the communities; (3) synthesizing information and adapting it for the recipient groups; (4) removing the fear of alerting the population in preparedness processes and trusting them; (5) informing and training the population to act responsibly in emergency situations; (6) generating information flyers for visitors and the local population; (7) establishing an early warning network through neighborhood associations; (8) promoting the implementation of emergency plans by neighborhoods in green light operational situation; (9) identifying small associations (third sector) that can facilitate and collaborate in emergency preparedness and management; (10) improving institutional coordination and coordination with the entities involved; (11) conducting drills in all areas and sub-plans of the PAIV.

Finally, work began on each of the courses of action (Table 4), analyzing the determinations found in the PAIV to transform them into necessary actions already foreseen in the PAIV and incorporating those generated during the participatory workshop. It is important to emphasize that when planning the actions, their degree of relevance identified by the participants was taken into account. However, in view of the final strategy document, it should be noted that the presentation proposed to finalize the project could not be carried out, thus making it difficult to obtain validation and possible feedback and modifications.

The entities represented in the participatory workshop included technical personnel in some cases, and managerial, coordinating, or political personnel in others. This diversity enriched the variety of contributions and knowledge generated. Table 5 lists the entities that presented papers at the *Second Island Conference on Civil Protection and Emergency Management*, indicating the lessons learned in La Palma in 2021, among others. Finally, Table 6 lists the institutions and organizations that participated in the workshop.

Second Island Conference on Civil Protection and Emergency Management–Volcanic risk management: a multisectoral vision [7]

Tenerife Island Security Directorate and Technical Co-Direction of PEVOLCA during the volcanic crisis on La Palma 2021
Civil Protection and Emergency Attention Service of the Government of the Canary Islands
Tenerife Island Council: Safety and Civil Protection Technical Service
Department of Public Administration, Justice and Security
General Sub-Directorate for Civil Protection and Emergencies of the Government of the Canary Islands - PEVOLCA Management
Operations Group during the volcanic emergency in La Palma 2021
Geophysical Center of the Canary Islands - National Geographic Institute in the Canary Islands: PEVOLCA Scientific Committee
Geological and Mining Institute of Spain-CSIC, PEVOLCA Scientific Committee and the Advisory Committee of the Civil Protection Emergency Plan of La Palma (PEINPAL per its initials in Spanish).
Gas Geochemistry and Thermography at INVOLCAN and PEINPAL Scientific Committee
Military Emergency Unit
Tenerife Island Fire Prevention, Fire Fighting and Rescue Consortium
Logistics and Emergency Management Center of the Red Cross in the Canary Islands
Candelaria and Icod de los Vinos Town Halls: volunteers
Civil Guard Operations Area
General Corps of the Canary Islands Police
Communications Office of the Department of Security of the Government of the Canary Islands
Canary Islands Radio Television

Table 5: entities in charge of the presentations of the *Second Island Conference on Civil Protection and Emergency Management.* Prepared by the authors.

Work table: small groups of 6 to 12 people	entities, institutions, areas or organizations
Group 1: EVACUATION	Tenerife Island Council: Safety and Civil Protection Technical Service
	Tenerife Island Council: Tourism
	Civil Guard
	Canary Islands Emergency Service
	Garachico Local Police
	Red Cross
	Consortium of Firefighters of Tenerife
	Military Emergency Unit
	Guía de Isora Town Hall
	Municipal Operational Coordination Center - Santa Cruz de Tenerife
	Emergency and Security Coordination Center (CECOES per its initials in Spanish)
	Interurban Transportation of Tenerife (TITSA per its initials in Spanish)

	Chair of Tourism of the University of La Laguna
	La Palma Island Council
Group 2: SHELTER	Red Cross
	Insular Institute of Social and Socio-Sanitary Attention of Tenerife
	Canary Health Service and the ULL (University of La Laguna)
	Ashotel: Hotel and Extrahotel Association of Tenerife, La Palma, La Gomera and El Hierro.
	Military Emergency Unit
	Consortium of Firefighters of Tenerife
	Local Police of Guía de Isora
	Local Police of El Tanque
	Sta. Cruz de Tenerife Town Hall: Civil Protection
	Tenerife Island Council: Safety and Civil Protection Technical Service
Group 3: REHABILITATION OF ESSENTIAL SERVICES	Spanish Electricity Network
	Tenerife Island Water Council
	Tenerife Island Council: Safety and Civil Protection Technical Service
	Aena Tenerife (State Company that manages airports in Spain)
	Santa Cruz de Tenerife Port Authority
	Civil Protection and Emergency Attention Service of the Government of the Canary Islands
	La Guancha Town Hall
Group 4: TRANSMISSIONS	Coordination Center of the Island Forest Fire Operation (CECOPIN per its initials in Spanish)
	Tenerife Island Council: Information Technology and Communication Service
	Brifor Operation
	Consortium of Firefighters of Tenerife
	Sta. Cruz de Tenerife Town Hall: Civil Defense
	Emergency and Rescue Group (GES per its initials in Spanish)
	Canary Islands Emergency and Security Network
	Emergency and Security Coordination Center
Group 5: COMMUNICATION TO THE PEOPLE	Tenerife Island Council Press Unit
	Communications Office of the Department of Security of the Government of the Canary Islands
	Tourism Directorate of the Tenerife Island Council
	Environmental Education Unit of Tenerife Island de Council
	State Meteorological Agency (AEMET per its initials in Spanish)

	Sta. Cruz de Tenerife Town Hall: Communication Office for Public Safety
	National Geographic Institute, Geophysical Center of the Canary Islands
	Insular Council of Natural Environment Management and Safety Area
	Communication Department of Tourism of Tenerife
	Tenerife Island Council: Safety and Civil Protection Technical Service
	Chair of Tourism of the University of La Laguna

Table 6: list of participating entities, areas, institutions, and organizations. Prepared by the authors.

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