

Assessing the management of Arkalochori EQ crisis in Crete, Greece under the implementation of RESILIAGE project in order to strengthen community resilience

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Assessing the management of Arkalochori EQ crisis in Crete, Greece under the implementation of RESILIAGE project in order to strengthen community resilience

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Introduction

It is well documented that only preparedness and prevention can support modern communities in respect to the earthquake risk. Being one of the most seismic prone areas in the world, Greece has invested a lot in the prevention of the impacts of future earthquakes and in the increase of preparedness of the structured and non-structured elements of our societies. Prevention is achieved through interventions and actions aiming at the identification of hazard zones, minimizing the exposures on the build environment and developing plans and regulations to manage crises. In most cases preparedness is achieved by strengthening and improving the behavior of material elements and infrastructures, the increase of knowledge regarding the hazard and its impact, as well as the improvement of the self-protection of citizens. In the past years, repeated Earthquake crises revealed that further improvements both on prevention and preparedness are necessary which can be made only if assessment of past crises' management is performed.

The earthquake of Arkalochori in central Crete is of one the most recent and most peculiar crises in Greece. The foreshock sequence started on the beginning of June 2021, just at the end of the COVID 19 crisis, and lasted almost three months having one strong earthquake of 4,8 R on July 24. The long foreshock period enabled the establishment of many seismic instruments in the broader area to monitor the phenomenon. The main shock took place early in the morning on September 21st, 2021 with a magnitude of 6 R scale and focal point 10 kms below the town of Arkalochori (Ganas et al. 2021). The earthquake took place along a well-known active fault in the area, the Kasteli fault (Fassoulas 2001) that has produced a swam of small eq in 1995 too (Delibasis et al. 1999). The town, that is one of the largest of rural Crete with a population of about 4000 inhabitants and many nearby villages were seriously affected with collapses and damages of old and more recent constructions, while even the city of Heraklion experienced moderate intensities with minor impacts. This was the first strong earthquake onshore Crete for more than a century (Papadopoulos 2011), and fortunately, there was only one human victim that was killed by a strong aftershock that happened few hours after the main event.

The most peculiar feature of this crisis was though the very long aftershock period that lasted almost a year with several events between 4 and 5 R scale. It was estimated that more than 4750 earthquakes took place on the broader area over a period of one year (Vallianatos et al. 2022) challenging the structural behavior of the buildings and the mental health of local population. The response of the Civil Protection mechanism was immediate with first responders and civil protection volunteers taking action soon after the main shock installing temporary camps at the Arkalochori and several other villages, and a more organized shelter at the Exhibition Center of Arkalochori few days after. The response of the local population was remarkable with hundreds of them arriving at Arkalochori from the first day to support the victims. This huge offer of volunteers created problems till a mechanism to manage them was set, but their contribution in compensating the burden of the local people and supporting their daily needs was invaluable even months after the earthquake.

The total toll of impacts counts more than 7000 houses heavily damaged by the main shock and its aftershocks with about 3900 of them to be demolished. Within these structures occur many local schools and churches. Apart from the first financial support that state provided soon after the earthquake to those affected by, the recovery process according to the locals failed totally to cover the needs of local societies (p.c. K. Gantatsios, president of "Elpis" the association of the victims of the earthquake 2024). Three years after the earthquake many families still live at preconstructed houses at the temporary shelter, from the 7000 applications for financial aid to repair houses that have been submitted only few tens have been elaborated by the relative services and the broader area presents images of abandonment and depopulation that was obvious at the recent census.

It is important to mention that the psychological burden of the local communities was not only increased by the long-lasting aftershocks but also from rumors and fake news that were circulated at social media but even the national

broadcasting channels. Rumors for stronger earthquakes were appearing after interviews or posts of “earthquake specialists” in national and international media. Fake news about the reasons of the long seismicity were repeatedly circulated connecting the earthquakes with the construction nearby of a new airport, the existence of a dam few kms away from the epicenters, but even the overfilling of a chapel under the runway of the new airport, that further increased the communication chaos.

The Arkalochori earthquake is a case study under RESILIAGE project funded by the Horizon Europe and coordinated by the Polytechnic of Torino, in which the University of Crete is among the 18 partners that aim to build sustainable resilient communities with local heritage drivers (<https://resiliage.eu/>). In general, recent crises and disasters have affected the European citizens’ lives, livelihoods, and environment in unforeseen and unprecedented ways. These disasters are exacerbated by social inequality, lack of adequate information and technology, as well as economic and political crises, that reduce the effective preparedness and response. The main objectives of the project are thus focused on understanding citizen reaction in case of crisis, on cocreating new knowledge encompassing the local heritage drivers that make communities stronger and new tools that provide more accurate information and make it accessible through easy-to-use tools and finally, lightweighting solutions to support first responders and empower citizens in crisis and disaster situations. The project has defined five Systemic Resilience Innovation (SyRI) frameworks focusing on Adaptive Governance, Health and Wellbeing, Active Memory, Social Interaction and Inclusiveness and Socio-economic Resilience that are examined in five European territories facing variable risks. The Region of Crete is one of them addressed to the Active Memory in respect to the earthquake risk.

Hereby we present the results of two workshops that have been developed in Crete under RESILIAGE in order to assess the management of Arkalochori EQ crisis, to identify the cultural factors that may influence local resilience, to build local networks through synergies and collaborative actions, and to identify the gaps in the management crisis operation in order to develop proposals for future improvement.



Figure 1. Implementation of focus groups discussions during the first workshop of RESILIAGE at Cretan CORE Lab on May 2024.

Methodology

The RESILIAGE project has foreseen the organization of five Community Resilience Laboratories (CORE Labs) in five European territories that have suffered in the past from various disasters. These include the City of Trondheim in Norway that faces the risk of landslides (slow clay) and focusses on Health and wellbeing, the Famenne-Ardenne UNESCO Global Geopark in Belgium which has been affected by serious floods several years ago and focuses on Socio-economic resilience, the Region of Crete focusing on the earthquakes and the Active Memory, the Naturtejo UNESCO Global Geopark in Portugal which repeatedly experiences wild fires and focusses on Social Interaction and Inclusiveness and the town of Karsiyaka in Turkey that is facing risks form heatwaves and focusses on the Adaptive Governance.

The relative partners in these counties were obliged to set the CORE Labs by inviting local stakeholders. In Crete the Natural History Museum of Crete invited various stakeholders that are engaged in crisis management, or represent certain local target groups, education and communication organizations and citizens. The CORE Lab was thus formed by representatives of First Responders (National Center of Immediate Aid, Fire Brigade, and Volunteer groups),

Local Municipalities and the Region of Crete, Local Development Companies, The Church of Crete, Local Museums, Educational Centers, Local Cultural Clubs and Associations, Sport Clubs and Citizens.

Two onsite workshops were organized in Crete using the focus group methodology (Wilkinson 1998) associated by structured interviews and web questionnaires. In each workshop we used boards, concept, interaction and territorial maps, discussion recordings and the assistance of facilitators to gather and analyse local data in a qualitative manner. The first WS took place on the 21st and 22nd of May 2024 at the premises of Natural History Museum with 30 participants (Figure 1). The aims of the WS were to understand how the local community define its territory in terms of main environmental, historical, and cultural characterizations, understand how local community interacts with the environment from a cultural and historical perspective, gather local narratives of disaster risk reduction, extract cascade effects related to the historical, cultural and environmental factors that intervene in crisis response, and identify lessons learned related to the historical, cultural and environmental factors that intervene in crisis response, having as case study the Arkalochori EQ crisis. During the WS field visit to Arkalochori and nearby areas was organized to discuss with the local stakeholders and inhabitants there (Figure 2).



Figure 2. Pupils performing local dances during the visit of RESILIAGE partners at the preconstructed classrooms hosting the primary school of Arkalochori on May 2024.

The second workshop took place on the 7th of February 2025 again at the Natural History Museum of Crete with the participation of 19 people (Figure 3). This WS was aiming on mapping certain heritage elements recorded at the collective memory that can be used to strengthen local resilience and improve preparedness planning. Activities were thus focused on the co-mapping of local cultural elements supportive to strengthen citizen's resilience, on the co-creation of synergies and collaborations to safeguard those heritage elements through the establishment of a local agreement to safeguard them, and on proposing actions for the inclusion of local communities and vulnerable groups in the crisis management plans through the improvement of communications, the raise of awareness and sensitization of citizens and improving adaptive governance. In this second workshop more advanced methodologies and means were used like serious game, stickers, card boards, thematic maps etc. (Figure 4).

The data collected through these onsite CORE Lab activities were further elaborated by the research partners to step on and develop soft solutions and digital tools that will be evaluated by CORE Lab in a second phase of the project implementation.

Results

The main priority of Civil Protection is always the proper management of a crisis putting more efforts and means though on the response phase. Preparedness and prevention are less developed, whereas the recovery phase is the one that is less considered. RESILIAGE invests in the improvement of preparedness of local communities using their cultural assets and local heritage as potential drivers for establishing strong community resilience that can contribute in a more effective recovery phase. The inventory of these drivers and the assessment of crisis management is the main tool to identify the local needs, capacities and strengths, on which new tools and actions are being developed. The main results under the scopes of RESILIAGE project from the CORE Lab activities in Crete may be summarized as follows.



Figure 3. Co-mapping of cultural and natural heritage elements during the second workshop of RESILIAGE in February 2025.

Cultural bonds remain very strong in the island of Crete based on traditions and ethics dated back in time. Dances, songs, “mantinades” (local rhymes) and common celebrations under various occasions tightened relationships between communities and helped a lot the citizens to cope with the Arkalochori EQ consequences and long-standing impacts (Figure 2). The oral traditions and transfer of myths and stories between generations appears to be a key channel for the preservation of values and collective memory, connecting generations through shared narratives. The workshops also highlighted issues related to social ethics and values as well as the strong blood bond that highlights the importance of family ties that can influence social interactions and contribute to shaping the resilience of the community. At the same time, the workshops underscore that in each settlement there are dozens of reference points and monuments that connect residents to the place and history and offer relief and a source of encouragement in times of crisis, that must be preserved. The existence of social interaction spaces where people can meet and promote social interactions is an important foundation in the event of crises that must be maintained during the operation of temporary shelters.

In places where social interaction was intense, like in Arkalochori where a local sport club and the community were organizing various annual events, this played a crucial role in managing the crisis and offering immediate support to the victims. Their role was remarkable in providing food, immediate aid, managing and organizing the many volunteers and retaining community alive for long period. The engagement of young people in such social and community activities enforces the local cohesion and reduces the vulnerability of the communities. The local Church is also a very important actor in the post crisis phase because it has the organization and means to support immediately the victims especially at the rural areas, with material and immaterial aid. The existence of local volunteer groups is also a very important factor to manage a crisis as they can offer assistance to CP mechanism, support the victims and palliate the psychological burden.

The need for reliable information and proper communication, before but especially during the crisis, emerged as the top problem in the case of the Arkalochori earthquakes. The absence of reliable and timely information, as well as of corresponding official state communication channels, contributed to the increase in the spreading of fake news and rumors that increased further the stress of those affected. The battle with fake news and incorrect information was lost very early on as there was no way to deal with this on social networks. Throughout the long post-earthquake sequence, residents felt the lack of communication and information from the official authorities, a problem that was much more intense in elder people. In these cases, the Church could play an important role, if proper cooperation has been developed between the Church, the relevant scientific bodies and the State. To enhance disaster preparedness and response, it is crucial to adopt a more proactive and comprehensive approach to communication. This should include regular awareness campaigns before a disaster, accessible guidance for individual groups after a disaster and ensure that all relevant information sources are easily identifiable and accessible.



Figure 4. The concept board for the assessing of Crisis Management plan after the implementation of the second workshop of RESILIAGE in February 2025.

Regarding the crisis management it was obvious that the CP mechanism responded immediately after the main shock establishing shelters and providing support to the affected societies, following a well operational management plan. However, it is apparent that despite the comprehensive national policies and documentation, shortcomings exist in resources evaluation and cooperation mechanisms at the local level, which hinder effective disaster response. The strong building codes and regulations didn't prevent the numerous damages and destructions, mainly because of the weakness of the relative authorities to monitor and ensure their implementation. The case of Arkalochori EQs underpin the fact that in rural areas older infrastructure remains vulnerable, highlighting a need for reinforcement and modernization. In addition, and under the threat of Climate Change it was highlighted that disaster risk management plans are not integrated with climate adaptation strategies, causing missed opportunities to leverage ecosystems in disaster management.

Under this scope it was also stressed that detailed risk assessments are outdated and require revisions. The risk and vulnerability assessments identify key vulnerabilities within the adaptation plan, such as: socio-demographic factors (population distribution and vulnerable groups), impacts on buildings and infrastructure, and cultural heritage considerations. The assessment should thus consider agriculture, forestry, biodiversity, and fisheries, as well as references to vulnerable groups such as the elderly and disabled at the national or regional level.

The crisis management was further exacerbated by the fact that the financial legislation lacks detailed information regarding funding mechanisms available for disaster management. Alternative financing mechanisms for risk reduction are scarce, while state financial resources for risk reduction are insufficient, limiting the implementation of disaster resilience measures. The total failure of the CP mechanism in the recovery phase is indicated by the fact that three years after the crisis from the thousands of applications seeking state support to reconstruct the damaged properties, only few tens have been elaborated so far. This situation is not only socially inappropriate, but ethically and morally too as a large number of the Arkalochori victims were elder.

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