**Editors:**

**Maria Drakaki | Diego Vega**

# International Conference on Humanitarian Crisis Management (KRISIS 2023)

## Proceedings of the International Conference on Humanitarian Crisis Management (KRISIS 2023)

INTERNATIONAL HELLENIC UNIVERSITY

Institute for the Management of Refugee Flows and Crises

University Research Center

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## Preface

The Institute for the Management of Refugee Flows and Crises of the International Hellenic University (IHU) organized the first International Conference on Humanitarian Crisis Management (KRISIS 2023) in Thessaloniki, at the Thermi campus, Greece, on October 14-15, 2023.

The conference brought together academics, professionals and practitioners working on humanitarian crisis management to present research, development, and field experience in all areas of interest.

Humanitarian crises are growing in numbers and impacts. They are highly complex and often directly and indirectly interconnected. Moreover, they are deeply rooted in social issues and affected by human factors. Disasters, wars, and conflicts among others may trigger or contribute to humanitarian crises. Furthermore, other crises, such as the global financial crisis, may become humanitarian crises. There is growing concern about the more recent humanitarian crises, such as the refugee crisis due to the war in Ukraine, the continuing refugee crisis in the Mediterranean, and the impacts of the COVID-19 pandemic and anthropogenic climate change. Climate related disasters such as floods, droughts, wildfires, and extreme temperatures have severe impacts including human losses and suffering, property losses and economic impacts. Humanitarian crises and disasters severely affect all areas of the globe, yet disproportionately affect the developing countries. Managing and reducing the risks of humanitarian crises and disasters is crucial for achieving sustainable development and resilient societies. Identification and better understanding of the risks eventually leads to better risk management and reduction of humanitarian crises and disasters. Addressing the social roots of humanitarian crises contributes positively to this direction.

In the context of humanitarian crisis management, KRISIS 2023 topics cover mitigation, preparedness, response and recovery phases.

They include but are not limited to:

Risk Management and Reduction

Humanitarian Logistics and Supply Chain Management

Humanitarian Technologies

Tools and Methodologies for Humanitarian Crisis Management Based on Social Sciences

Sphere Standards and Refugee Site Planning and Management

Migration Flows: Trends, Challenges and Lessons Learned

Environmental and Financial Impacts of Humanitarian Crises

Sustainability of Humanitarian Operations

Modelling and Simulation

Case Studies and Field Experience

We are very happy that the conference papers and round tables are multidisciplinary and cover a wide range of issues and areas of humanitarian crisis management. In total, KRISIS 2023 included 33 paper contributions, 4 round tables, and a keynote

speech. Besides Greece, paper contributions come from Finland, Germany, USA, Canada, and Morocco. We want to thank all KRISIS 2023 participants for sharing their research and academic development work.

We want to thank the anonymous reviewers of KRISIS 2023 for their valuable comments and contribution to achieve a high-quality research output for KRISIS 2023. The rejection rate was 10%.

We also want to thank the IT support team for KRISIS 2023, provided by the Department of Information & Telecommunication Systems & Services of the International Hellenic University, namely, Evangelos Grigoropoulos and Ilias Nitsos.

Furthermore, we want to thank the administrative support for KRISIS 2023, provided by Vasiliki Chatzipanagiotou and Krystalia Champoglou.

We also want to thank the students of the MSc in Humanitarian Logistics and Crisis Management that volunteered for KRISIS 2023, namely, Violetta Kyriakou, Elena Alatzas and Vasiliki Neofotistou, who both participated and volunteered to assist during KRISIS 2023.

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# Humanitarian Crisis Management and Resilience

# Constructing the narrative of resilient society: self-organising from relief to recovery

Anna Dziuba[1], Aino Ruggiero[2], Wojciech Piotrowicz[3]

Humanitarian Logistics and Supply Chain Research Institute, Hanken School of Economics, Arkadiankatu 22, 00100 Helsinki, Finland

Email:
anna.dziuba@hanken.fi
aino.ruggiero@hanken.fi
wojciech.piotrowicz@hanken.fi

**Abstract.** This study examines how the narratives of a resilient society are constructed in the midst of the Russian invasion of Ukraine on its way to recovery. The study adopts a constructivist-ontological take on resilience, which extends the view of resilience beyond that in crisis management as a post-disaster strategy and focuses on resilience at-war, as the conflict is ongoing. By analyzing the notes of participant observation and interview data with various actors (Finnish and Ukrainian civil society organisations, municipalities, individuals, and media) the study will explore how narratives of resilience in Ukrainian society on the way to recovery, take shape in the discussions around self-organizing of directly affected people, and citizens willing to help, who are active in groups that build collective structures of support, empowerment, and visible politics. The study aims to make several contributions: firstly, to the humanitarian logistics and supply chain management literature by clarifying insights on the recovery phase in an extended conflict context; secondly, to resilience literature by opening up how the narratives of resilient society take shape in the context of an extended crisis, when the disruption to normality is ongoing and recovery is perceived differently by various actors.

**Keywords:** resilience; self-organising; humanitarian aid; post-war recovery.

## 1 Introduction

Since the early start of the full-scale Russian invasion of Ukraine in February 2022, the topics of recovery and reconstruction have been in the media and reports of international agencies and institutions. With Ukraine step by step returning its territories these topics became more prominent in Ukraine Recovery Conference (URC 2022) in Lugano, the World Urban Forum (WUF 2022) in Katowice, the International Expert Conference on the Recovery, Reconstruction, and Modernization of Ukraine (2022) in Berlin, and the ReBuild Ukraine Conference in Warsaw (2023)) (Udovyk, Kylymnyk, Cuesta-Delgado, and Salvador, 2023). However, for some actors, the idea of recovery and reconstruction still stays elusive and far away, as long as the war continues. While a number of initiatives have been implemented on a governmental level for recovery, such as the Ministry of Reconstruction and the Agency of Restoration (assisted by the Ministry of Digitalization), and civil society initiatives for recovery are visible (e.g. RISE coalition, BUR, Center for Economic Strategy, DiXi Group), there's a lack of clarity on how civil society actors can be included in the planning of postwar reconstruction besides supporting government agenda (Mandaville, 2023). If Ukraine really intends to develop a resilient society, inclusion and transparency should be the key principles of the country's transformation agenda (Grävingholt, Faust, Libman, Richter, Sasse, and Stewart, 2023).

One way to fulfill these principles is enabling civil society actors to raise the challenges created by war. The challenges may be less visible to government structures but well-understood by the civil society actors (Mandaville, 2023). However, transparency and inclusion both are precarious conditions (Dobusch, Dobusch and Müller-Seitz 2019). European partners highlight that Ukraine's recovery also involves tensions, such as unresolved

corruption, and lack of trust in the Ukrainian justice and rule-of-law (Grävingholt et al., 2023). As Udovyk et.al (2023) argue, a listening agency needs to be developed in order to counter potential gaps in inclusion. Listening agency is understood here as "enforcing multi-level governance dynamics, providing both top-down and bottom-up interaction mechanisms" (Udovyk et al., 2023, p. 26) that could facilitate a wider perspective on reconstruction. Currently, as illustrated in the quote below from recent reports, for individual citizens there is a lack of clarity on how various initiatives will benefit the recovery of Ukraine and how inclusive those initiatives are; to what extent different visions of recovery and reconstruction, as well as different pathways towards them as part of the process of enacting resilience, are considered:

"Electronic Management System can only communicate e.g. a number of destroyed schools, it does not give a space to questions "Will we need to rebuild all the schools we had? Or should we build one school for the whole town since almost all the kids are abroad? or should we start a new digital education hub? And what kind of initiatives are already innovating on this in our city? And this is something that we all as a society have to discuss." (Udovyk et al., 2023, p. 27).

In this study, we explore the recovery and reconstruction of Ukraine. Precisely, we investigate how recovery is planned and executed by different actors. Moreover, we study the perceptions of different actors on the recovery in Ukraine and Finland, and what hurdles and bottlenecks are experienced by them. Furthermore, we explore the narrative of a resilient society and how it is constructed by different actors (Finnish and Ukrainian CSOs, municipalities, individuals, and media).

## 2 Theoretical background: perspectives on resilience

We adopt a constructivist-ontological take on resilience, which extends the view of resilience beyond that in crisis management as a post-disaster strategy defined as the "ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management" (UNDRR 2016). Instead, we focus on how resilience is activated to secure and manage life and thoughts (Grove, 2013, 2014; Pugh, 2014; Zebrowski, 2013). In that regard, we examine resilience at war (Kurnyshova, 2023), or in other words, how stories on resilience take shape in the midst of disturbance, as the conflict is ongoing. We approach the narrative of societal resilience in the form of a discussion around the efforts of these actors intended towards recovery and reconstruction in their broader sense, as in self-organizing of directly affected people, and citizens willing to help, becoming active in groups that build collective structures of support, empowerment, and visible politics.

Norris et al. (2009) describe the resilience of a community as consisting of a process linking a network of adaptive capacities (resources with dynamic attributes) and related sub-capacities, which cover information and communication (trusted sources of information, skills and infrastructure, responsible media, narratives), community competence (community action, critical reflection and problem solving skills, flexibility and creativity, collective efficacy and empowerment, political partnership), social capital (attachment to place; sense of community; citizen participation, leadership & roles (formal ties); organizational linkages & cooperation; social embeddedness (informal ties); perceived (expected) social support; received (enacted) social support) and economic development (equity of resource distribution; level and diversity of economic resources; fairness of risk and vulnerability to hazards). Resilience is by their definition linked to a "positive trajectory of functioning and adaptation after a disturbance" (Norris et al., 2009, p. 130), so promotes recovery from a disaster or a crisis.

Hyvärinen and Vos (2015, p. 589) describe the role of communication in facilitating community resilience considered as "an interface function to build partnerships of resilience". In the pre-crisis phase, the role of communication is to create awareness and preparedness via building partnerships and through preparedness education. During and after crises, communication facilitates collaboration through e.g., the exchange of information, supporting engagement, and monitoring of information needs. Moreover, communication helps bridge diversity and stay connected via different communication media. The outcome is empowerment that requires effective networks of cooperation between various societal actors, covering both public and private organisations and civil society groups.

## 3 Method

***The research question for this research is formed as follows:***

How are the recovery of Ukraine and the resilience of Ukrainian society perceived by different actors in Ukraine and those providing help in Finland (CSOs, municipalities, individuals, and media)?

Data for this study will be collected through participant observation, and interviews with different actors participating in reconstruction and recovery directly and indirectly (without categorizing their efforts as such). Additional data will be collected from media sources (social media, reports, newspapers, and journals) and by attending the events devoted to the topic of reconstruction, serving as collaborative and discussion platforms for the attendees. Data access for observation and interviews will be arranged through engaging in volunteering initiatives organized by some of the actors (civil society organisations and grassroots volunteer initiatives in Finland and Ukraine) and snowballing when searching for other actors involved in recovery efforts.

For data analysis, we will follow the narrative inquiry approach (Ludema, 1996; Nye, 1997; Sutton, 1987). In analysing our findings, we will focus on uncovering how various interpretations of reconstruction and recovery are construed by different actors, and which tensions and connections are present in and between these interpretations.

Potential actors to engage with in Finland: Logistics center, Auta Ukrainaa, Operation Hope, city of Helsinki (Espoo, Vantaa, Turku).

Potential actors to engage with in Ukraine: points of invincibility (punkty nezlamnosti) – points in the city for people to get short-term access to food, water, wifi, organized by local citizens and other unorganized civil society actors.

## 4 Expected contribution

The findings of this research could contribute to the crisis management, humanitarian logistics and supply chain management literature by clarifying insights on the recovery phase in an extended conflict context, both of which are areas of research that lack previous knowledge.

Moreover, with this study we hope to contribute to resilience literature by opening up how the narratives of resilient society take shape in the context of an extended crisis, such as the invasion of Ukraine by Russia when the disruption to normality is ongoing and recovery is perceived differently by various actors: as the ongoing focus of efforts vs a stage to await and prepare for, requiring more stability and resources.

We hope this research will provide insights and develop the discussion on different resilience narratives (for example, state resilience vs. societal resilience (Bosse and Vieira, 2023)), and uncover possible learning for other states (see narratives towards a more resilient European society by Manca, Benczur, and Giovannini, (2017) from Ukrainian narratives of resilience.

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# Solidarity urban commons vs resilient cities. Newcomers' right to the city in Athens and Thessaloniki

Charalampos Tsavdaroglou

[1] School of Spatial Planning and Development, Aristotle University of Thessaloniki, 54124, Greece
Email: tsavdaroglou.ch@gmail.com

**Abstract.**

The cities in their historical path are constantly shaped by newly arrived populations, especially Athens and Thessaloniki are characterized throughout time by multiple stories of arrival of refugees and migrants. In this paper, the arrival of newcomers from 2015 onwards, state housing policies as well as self-managed housing commons are studied. Usually the movement of more than a million people from the Middle East, Central Asia and Africa to Central and Northern Europe through Greece in 2015-2016 has been characterized as a "refugee crisis" and therefore raises the question of whether cities of arrival or transit are resilient enough to respond to such "humanitarian crises". However, the question of why migration is a moment of crisis for cities and how exactly the concept of resilience is linked to migration is an open research question. The aim of the paper is the critical confrontation with the rhetoric of the concept of resilience in relation to migration and its comparison with the transformative possibilities of the solidarity urban commons of the newly arrived populations

**Keywords:** solidarity, resilience, commons, newcomers, Athens, Thessaloniki

## 1 Introduction

The cities of Athens and Thessaloniki were in the last decade at the center of the so-called "refugee crisis", as the largest part of the displaced populations that crossed Greece on the journey to the countries of Northern Europe, stayed in Athens and Thessaloniki for long periods of time and some of them settled permanently. At the same time, the Municipalities of Athens and Thessaloniki have been participating for the last decade in the "100 Resilient Cities" international network. Also, the two cities are founding members of the European network "Solidarity Cities with Refugees" (Eurocities network, 2016). However, focusing more specifically on the institutional housing policies implemented in Athens and Thessaloniki, these include settlement of refugees in housing structures - camps, which are located at a great distance from the urban fabric, in areas unsuitable for residential use. Also, refugee housing schemes in rented apartments within the urban fabric were terminated in 2022 and a significant number of refugees are at risk of eviction and homelessness. Therefore, at this point serious doubts are raised as to whether these policies promote the integration or inclusion of refugees and not their exclusion and marginalization. Also, at this point it is worth noting that in parallel and often in opposition to the above institutional housing policies, a wide variety of self-organized housing structures and self-managed solidarity projects were created within the urban fabric of Athens and Thessaloniki, which can be perceived as urban and housing commons of newcomers. In these self-governing structures, refugees have more freedom to co-shape their living conditions, direct access to the city center, as well as more opportunities to contact, socialize and interact with the city's residents. The aim of the text is the critical confrontation with the rhetoric of the concept of resilience in relation to migration and its comparison with the possibilities of the solidarity housing commons of the newly arrived populations. The aim of the text is the critical confrontation with the rhetoric of the concept of resilience in relation to migration and its comparison with the possibilities of the solidarity housing commons of the newly arrived populations.

## 2 Resilience and the newcomers' right to the city. A critical encounter

Resilience is presented as a popular concept addressing risks, threats and crises. Many times it acquires an umbrella character to indicate the ability of a system, a city, a community or even an individual person, to shield but also to adapt to new conditions, so that it then returns by recovering to its original state after a crisis or shock.

At this point it is worth noting that the genealogy of the concept of resilience (Walker and Cooper, 2011) has its origins in the biology and ecology of the early 70s but also in the oil crisis of 1973 and has subsequently expanded to a set of natural and social sciences as well as governance models that examine risks, threats and crises. Migration has recently included in these risks and crises (Rast, et al. 2020). Therefore, until recently resilience was concerned mainly with economic and environmental-natural disasters, however the inclusion of migration shifts perhaps for the first time the concept of risk and threat from an economic-natural-environmental phenomenon to an anthropogenic condition, that of displacement populations. So here an important conceptual and epistemological question arises. Is it possible to interpret the movement of populations in terms of interpreting and dealing with natural phenomena? The transfer from the natural to the anthropogenic environment is not new, yet it is usually relegated to biologism, following the long tradition of environmental determinism and the ecological fallacy (Peet, 1985). This line of thought was founded in the early 20th century Chicago School approach of human ecology, which had its foundations in the German tradition of determinism and 19th century social Darwinism. The Chicago School, without considering the approach of the French school of possibilism that countered German determinism, claimed that the city as an ecosystem is metabolized according to the adaptability of population groups. To strengthen its arguments, it was used terminology and laws 'found in higher animal species [such as] competition, symbiosis, exploitation, invasion, succession' (Leontidou, 2017: 82).

Today, in linking resilience to migration we can find several similarities with the tradition of environmental determinism. In particular, biologism in the Greek case is quite visible as newly arrived refugees are often likened in public discourse as "invaders" and the most common reference term for the movement of refugees is the so-called "refugee flows", referring to threatening natural phenomenon, such as some impetuous flash flood or possibly a threatening tsunami. At the same time, the above naturalizing metaphors, in addition to social stigmatization and the reproduction of xenophobic stereotypes, lead to the homogenization of newcomers by silencing the uniqueness, culture, abilities and desires of each individual mobile subject. So here comes the crucial question: Is migration a problem and a risk, and why are policies of resilience needed to address it?

Against the above considerations, an ever-growing literature of critical approaches to resilience (Evans and Reid, 2015; Kaika, 2017) points out that resilience constitutes a renewed concept of development, as it promises that crises can be overcome in the direction of a new normality of development. Also, the above thinkers argue that the rhetoric of resilience takes the discussion away from the causes of crises, depoliticizes social relations, does not raise questions about the various power relations and does not problematize the role of the state and the market. In more detail, Slater (2021), on the occasion of Hurricane Katrina in New Orleans and the local "stop calling me resilient" campaign, which opposed rehabilitation programs that strengthened the interests of corporations and large landowners, emphasizes that in terms of cities, the most resilient system today is the neoliberal urbanism that displaces those residents it does not consider sufficiently resilient in the name of regeneration of cities. Bourbeau (2015) focusing on migration policy in France argues that the rhetoric of resilience has been linked to the debate on the protection of national security by reinforcing the perception of immigration as a threat to social cohesion. Finally Fawaz et al. (2018) studying the case of Syrian refugees in Beirut argue that the invocation of resilience should not hide the conditions of social and economic deprivation, nor objectify the lives of displaced populations.

More specifically and focusing on the policies applied regarding the management of refugees, there is a growing trend from international organizations and humanitarian organizations that propose resilience strategies. Specifically, urban resilience in relation to refugees concerns housing, health care, infrastructures, employment opportunities, economic development, political and social cohesion, and the management of risks of violent behavior (Kirbyshire, et al. 2017). Also according to UNHCR, resilience is defined as 'the ability of individuals, households, communities, national institutions and systems to prevent, absorb and recover from shocks, while continuing to function and adapt in a way that supports long-term prospects for sustainable development, peace and security, and the attainment of human rights' (UNHCR, 2017). The above statement

and its application in the case of refugees has not yet been sufficiently clarified and remains more of a declarative goal.

Finally, it is worth noting that several cities in both Europe and North America project themselves as “cosmopolitan”, “tolerant” and “pro-diversity” (Hatziprokopiou et al., 2016; Hassen and Giovanardi, 2018) and identify "immigration and difference as a resource that strengthens their economic and global position" (Belabas et al., 2020: 2). Also, other cities cultivate practices of hosting refugees and adopt immigrant-friendly policies in ways that allow them to define themselves as “Solidarity Cities” (Agustín and Jørgensen, 2019; Christoph and Kron, 2019).

However, such policies seem to be quite limited or even absent in the cases of Athens and Thessaloniki. It is even worth noting that the Municipalities of Athens and Thessaloniki joined in 2016 the European network of “Solidarity Cities with Refugees” within the framework of the Eurocities initiative (Eurocities network, 2016). The network was created after the initiative of the Municipality of Athens and had as its main objective the movement of refugees from cities of the European South (Greece, Italy, Spain) to cities of Northern Europe, as well as the pressure on the European Commission to increase the funds for the refugee housing infrastructure. Therefore, the use of the term “solidarity cities” in the case of the Eurocities initiative network, and in particular for the cities of Athens and Thessaloniki, is probably misused as it refers more to the logic of N.I.M.B.Y. (Not In My Back Yard) (Pechlidou, et al. 2020), i.e. the transfer of hosting responsibility to other European cities, rather than the adoption and development of policies of protection, inclusion, active participation and meeting the needs of newly arrived refugees.

## 3 Resilience as a return to an earlier state. State refugee housing policies

The Greek state, in order to manage with the so-called “refugee crisis”, after the joint statement-agreement between the European Union and Turkey, in March 2016, (European Council, 2016) and the closing of the borders in the Balkan corridor, constructed 13 accommodation centers – camps in the perimeter of Athens and an equal number in the perimeter of Thessaloniki. These sites are abandoned former military camps and abandoned factory-industrial sites. In the following years, several of the camps were closed and today there are 5 camps operating in the greater area of Thessaloniki and 4 in Athens. From the summer of 2021, the camps are fenced off with high concrete walls, preventing visual contact, reinforcing the feeling of isolation among the residents and even symbolically transforming from open-type structures to closed-type camps. According to several scholars (Gemenetzi and Papageorgiou, 2017; Tsavdaroglou and Lalenis, 2020; Papatzani, et al. 2022) it is pointed out that the camps violate the Greek urban planning legislation, as they are located in areas that are not allowed for residential use. In addition, camps are places of exclusion, as there is considerable difficulty in accessing places of education, health, employment and minimal possibilities of interaction with local communities. At the same time, from the end of 2015, accommodation programs were launched within the urban fabric, under the management of the UN High Commission in collaboration with NGOs and municipalities. However, the accommodation program ended at the end of 2022, and several thousand asylum seekers and refugees are under threat of eviction and facing homelessness.

Therefore, in terms of urban resilience, the choice of the Greek state to end the housing program in rental apartments within the urban fabric and the choice to maintain only the closed camps outside the cities seems to not correspond to the perception of inclusion and solidarity. On the contrary, state policies can be interpreted with the narrow term of resilience, as a return to the previous situation, i.e. before the arrival of the refugees, without paying attention to the inclusion of the newcomers. They remain in the category of the unwanted foreigner, for whom a kind of “military humanitarianism” is foreseen (Tazzioli and Garelli, 2020), as expressed in the Greek case by the marginalization and invisibility of refugees in camps.

## 4 Beyond resilience. Inventions of solidarity commons

Against the aforementioned state housing policies, alternative housing projects were created in Athens and Thessaloniki, seeking on the one hand to respond to the immediate needs of newly arrived populations and on the other hand to experiment with forms of coexistence and symbiosis within the urban fabric of the cities. These are forms of housing commons that according to several scholars (Lafazani, 2018; Tsavdaroglou and Lalenis, 2023; Tsavdaroglou and Kaika, 2022) are characterized by practices of reciprocity, inventiveness and solidarity. Specifically, in Athens and Thessaloniki, since the fall of 2015, a series of abandoned public and

private buildings within the urban fabric were occupied by groups in solidarity with the newcomers and transformed into housing commons.

At this point it is worth noting that the concept of commons and specifically urban commons has in recent years been linked to the practices of mobile populations. As urban commons in the international literature, a wide variety of projects can be found including urban gardens, housing structures, cooperatives and self-organized health, education and work structures. Blomley (2008: 320) claims that commons 'are not located somewhere, but are produced (...) commons are a form of place-making', while for understanding the connection of commons to refugee practices, is useful Stavrides (2014: 548) proposal that common spaces emerge as "thresholds", which are 'open to use, open to newcomers'. In particular, with regard to the commoning practices of mobile populations, Trimikliniotis et al., (2015: 19) have proposed the term "mobile commons", which refer to 'shared knowledge, affective cooperation, mutual support and care between migrants when they are on the road or when they arrive somewhere'. The above characteristics are evident in the cases of the self-managed housing projects in Athens and Thessaloniki, as the housing commons were inventive thresholds for the entry of refugees into the city, and they experimented with forms of equality, participation, coexistence and negotiation of the various identities and social borders. Of course, it should be noted here that the above projects are not utopian locations, as they are constantly faced with a multitude of challenges and difficulties and several times fail to constitute permanent and safe places of residence for the newcomers. The most important confrontation was with state policies as expressed with the evictions of dozens of squats that took place in the years 2016-2020. The violent police evacuation operations of self-organized housing projects in the centers of Athens and Thessaloniki and the transfer of their residents to state-run camps outside the cities, confirm that urban resilience in relation to refugees and migrants in the Greek case is understood as a mechanistic return in the former state before the arrival of the newcomers.

## 5 Conclusion

The issue of migration is dealt with by most European states, but also in Greece, primarily as a matter of security and humanitarian interventions. In fact, it increasingly takes the form of military humanitarianism, where newcomers are perceived on the one hand as helpless in need of humanitarian aid and at the same time as unwanted foreigners who are hosted in terms of military rule, i.e. through technologies and mechanisms of control, discipline and settlement in state-run camps. The above policies constitute the context in which the rhetoric of urban resilience in relation to migration is installed.

Although the concept of resilience has moved away from the initial mechanistic approaches of returning to the previous situation, and now emphasizes the dimensions of adaptability, decentralization, participation and inclusion, however in Athens and Thessaloniki it becomes clear that this is not the case.

Against the policies of exclusion and marginalization, but also beyond the humanitarian compassion, the self-organized practices of newcomers in self-organized solidarity urban commons opened a new horizon of inventions of coexistence and solidarity. The inhabitants of these projects opened new transnational modalities and transformative territorialities within the urban fabric. These are spatial inventions of personal and collective empowerment, cohabitation and claiming the right to the city.

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# Resilience of Cities in the Face of Disaster Risks as a Pathway to Achieving Sustainability: A Study Using the United Nations Scorecard in city Mohammedia, Morocco

**Abderrahmane Jadouane**

LADES - Department of Geography
Faculty of Arts and Humanities-Mohammedia, Hassan II University of Casablanca – Morocco

Email: jadouane.a@gmail.com

**Abstract.** The city's ability to be resilient and withstand dangers, especially natural hazards, is one of the most important features of sustainable development in this era. The United Nations recognized this in the preparatory committee for the conference on housing and sustainable urban development. In 2015, within the Sendai Framework, resilience was defined as the capacity of a system, community, or group exposed to hazards to resist, absorb, adapt to, transform, and recover from them efficiently and in a timely manner. This includes preserving essential structures, functions, and material entities. The resilience measurement card is a tool used to assess a city's resilience and its capacity to withstand hazards. It also helps local authorities monitor progress and challenges in implementing the Sendai Framework for Disaster Risk Reduction. Furthermore, it assists in developing local strategies for disaster risk reduction. The resilience measurement card was applied to the city of Mohammedia in Morocco to measure the city's resilience in the face of potential hazards, particularly natural ones. Mohammedia faces various natural hazards, making it important to assess its capacity to understand and address disaster risks. This card was developed through consultations and discussions with stakeholders and actors in the city, each contributing their expertise. It also involved reviewing documents, projects, and measures that align with the measurement indicators. The gathered responses, conclusions, and findings were then compiled to answer the 47 indicators in the measurement card, which evaluate the ten foundations of a city's resilience capacity.

**Keywords:** Mohammedia City; Resilience; Risk; Disaster Resilience Scorecard; UN.

## 1 Introduction

The term "resilient city" is one of the modern concepts that has emerged in urban planning and organization, particularly in the face of increasing disasters, both natural and technological, as well as acts of terrorism and the impact on economic systems, among other factors, which have affected many cities. Therefore, it has become necessary to direct urban development pathways in order to build the concept of resilience and the ability to withstand challenges. Cities with these characteristics are capable of facing challenges and minimizing damage in the event of a disaster. Given the importance of these features in cities today, especially with their high population concentrations, a disaster in a city can affect a large number of residents due to interconnectedness and resource sharing, making them vulnerable to high levels of human and economic losses in the event of a disaster. Hence, the concept of a resilient city represents a new way of thinking to achieve sustainable development goals for cities in light of current changes and unexpected crises. Most Arab cities, in general, lack the necessary urban resilience mechanisms to cope with shocks and pressures, whether they are currently experiencing them or potential ones in the future. This hinders the ability of urban systems to effectively respond, adapt, and grow in the face of pressures and shocks. Therefore, the importance of this study lies in deriving a set of recommendations and proposals for decision-makers and city officials to work on the indicators identified in the study. These indicators can enhance the city's resilience and capacity to withstand risks, aiming to avoid danger or at least minimize the damage, Especially the city of Mohammedia it contains the causes of natural or technological hazards[1].

[1] Jadouane, A., Chaouki, A. (2022). Simulation of the Flood of El Maleh River by GIS in the City of Mohammedia-Morocco. Lecture Notes in Civil Engineering, vol 178. Springer, Singapore. https://doi.org/10.1007/978-981-16-5501-2_8

### 1.1 Definition of resilience

The word "resilience" indeed has its roots in the Latin word "RESILIO," which means rebound[2]. In Arabic, it has various synonyms such as "ALLYONA" and "ALROJOIAA." It is defined in Arabic dictionaries as follows: "MOROUNA" (noun) is derived from the source "MARIN", and in the context of nature and physics, it refers to the ability of a body to change its shape and size after the removal of the cause of the change. It can also refer to the flexibility or elasticity of a body, such as the resilience of wood and metal. When referring to a person's body, it means agility, ease of movement, and flexibility. Resilience has a limit that must be observed, and in the field of nature and physics, it refers to the maximum stress a resilient body can withstand without resulting in a permanent change in its shape[3].

The definitions in Western dictionaries are quite similar, and here are some examples:

- Cambridge Dictionary: Resilience is the ability to quickly return to the usual shape after bending, stretching, or compressing[4].
- Merriam-Webster Dictionary: Resilience is the inclination to recover and adapt easily in the face of misfortune or change[5].
- Collins Dictionary: Something that is resilient is strong and not easily damaged by injury, stretching, or pressure, and it can quickly and easily recover from harmful events[6].

As a term, "resilience" first appeared theoretically in the field of environmental studies before transitioning to other specialized fields such as urban studies, planning, and urban design. In the environmental context, it initially implied the fundamental capacity of an ecosystem to maintain and adapt to environmental changes, human exploitation of its resources, and the preservation of the regenerative systems of the ecological system[7]. Resilience was described as a city's ability to absorb disturbances while preserving its essential functions and infrastructure. This definition is an evolved and similar concept to ecological resilience[8]. In essence, resilience, in this broader sense, refers to the ability of systems, whether natural or human-made, to withstand and adapt to various stresses, disturbances, and changes while maintaining their core functions and structures. This concept has gained significance in various fields, including urban planning and design, as it emphasizes the importance of building cities and systems that can effectively respond to unexpected challenges and crises. The term "resilience" in the context of cities focuses on the ability to withstand and bounce back from all kinds of acute shocks, whether they are natural or human-made. These shocks can include floods, earthquakes, hurricanes, forest fires, hazardous material spills, power outages, and more. Additionally, it encompasses chronic pressures that occur over longer time periods, such as groundwater depletion, deforestation, social and economic issues like homelessness and unemployment.

In the framework of the United Nations' "Sendai Framework for Disaster Risk Reduction," a "resilient city" refers to a city that assesses, plans, and works on preparedness and response to all types of risks, whether they are sudden or gradual, expected or unexpected[9]. This definition underscores the importance of cities being proactive and adaptable in the face of various risks and challenges to ensure the safety and well-being of their residents.

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[3] Shadi Raba, Hussein Dridi, Definition and Meaning of resilience in the Comprehensive Dictionary of Meanings.

[4] Dictionary cambridge Meaning of resilient , https://dictionary.cambridge.org

[5] Dictionary Merriam-Webster, Meaning of resilient, https://www.merriam-webster.com

[6] Dictionary Collins Meaning of resilient, https://www.collinsdictionary.com

[7] Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L., & Holling, C. S. (2004) "Regime Shifts, Resilience, and Biodiversity in Ecosystem Management".Annual Review of Ecology, Evolution, and Systematics,557–581 https://doi:10.1146/annurev.ecolsys. 35.021103.105711

[8] Holling, C. S. (2001). "Understanding the Complexity of Economic, Ecological, and Social Systems. Ecosystems", 4(5), 390–405. https://doi:10.1007/s10021-001-0101-5

[9] United Nations Office for Disaster Risk Reduction (2017) "Empowering Resilient Cities Local Government Leaders Guide", contribution to the global campaign My City Gears Up 2010-2020, Geneva-Switzerland.

According to various definitions, resilient cities are cities that possess a set of characteristics and strategies that enable them to absorb, accommodate, and adapt to environmental, social, and economic disruptions and challenges. These definitions emphasize the city's ability to withstand a wide range of shocks, stresses, and pressures. Here are some key aspects of these definitions:

1. **World Bank Definition:** Resilient cities, according to the World Bank, are cities that have the capacity to absorb, adapt to, and prepare for future disruptions economically, environmentally, socially, and institutionally. This capacity is seen as promoting sustainable development, well-being, and comprehensive growth[10].
2. **OECD (Organization for Economic Co-operation and Development) Definition:** OECD defines resilient cities as cities with the ability to absorb future shocks and prepare for them economically, environmentally, socially, and institutionally. The goal is to enhance sustainable development and overall well-being[11].
3. **Researcher's Definition:** One specialized researcher defines urban resilience as the ability of a city or urban system to withstand a wide range of shocks, stresses, and pressures. This definition emphasizes the city's capacity to resist, absorb, adapt to, transform, and recover from hazards while preserving its essential functions and physical entities[12].

In essence, these definitions all converge around the concept of a city's ability to withstand and recover from various risks and challenges. Resilience has become a critical aspect of sustainable development in today's world, acknowledged by the United Nations and integrated into discussions related to housing and sustainable urban development. It emphasizes the importance of communities, systems, and cities being able to effectively respond to, recover from, and adapt to various hazards while maintaining their essential functions and structures[13].

## 2 Characteristics of a resilient city

There are many pillars that guide cities towards achieving comprehensive resilience, including environmental, economic, social, political, institutional, and urban resilience. This was indicated by the Third United Nations World Conference on Disaster Risk Reduction regarding a set of supports that assist cities in becoming more resilient towards environmental, social, economic, and political determinants. In 2015, the United Nations provided support for implementing the Sendai Framework for Disaster Risk Reduction, alongside participation from a group of more than 100 cities. The ten essentials for empowering cities to become resilient were adopted as a first step to measure the application of resilience in these cities, with a commitment from participating governments to follow these ten essentials as a second step in their dissemination to other countries[14].
The ten essentials for empowering cities to build resilience provide extensive coverage of the various issues that cities need to address to become more resilient. Essentials 1 to 3 cover governance and financial capacity, while essentials 4 to 8 cover disaster planning and preparedness. Essentials 9 to 10 focus on disaster response and recovery, as illustrated in the following table[15]:

[10] Bank, W. World Bank Database, 2011, Available from http://data.worldbank.org
[11] https://www.oecd.org/dac/conflict-fragility-resilience/risk-resilience/
[12] Leichenko, R. (2011). "Climate change and urban resilience". Current Opinion in Environmental Sustainability, 3(3), 164–168. http://doi:10.1016/j.cosust.2010.12.014
[13] Preparatory Committee for the United Nations Conference on Housing and Sustainable Urban Development (2016), "Policy Paper No. 8: Urban Ecology and Resilience", Third Session, Indonesia, United Nations. A/CONF.226/PC.3/21
[14] United Nations Office for Disaster Risk Reduction (2017) "Empowering Resilient Cities Local Government Leaders Guide", contribution to the global campaign My City Gears Up 2010-2020, Geneva-Switzerland.
[15] UNISDR, 2017. How To Make Cities More Resilient. A Handbook for Local Government Leaders. P.32

**Table 1. The Ten Essentials for Making Cities Resilient**.

| | Essentials for Making Cities Resilient |
|---|---|
| **1** | Organize for disaster resilience. |
| **2** | Identify, understand, and use current and future risk scenarios. |
| **3** | Strengthen financial capacity for resilience |
| **4** | Pursue resilient urban development and design. |
| **5** | Safeguard natural buffers to enhance the protective functions offered by natural ecosystems. |
| **6** | Strengthen institutional capacity for resilience |
| **7** | Understand and strengthen societal capacity for resilience. |
| **8** | Increase infrastructure resilience. |
| **9** | Ensure effective preparedness and disaster response. |
| **10** | Expedite recovery and build back better. |

UNISDR, 2017. How To Make Cities More Resilient. A Handbook for Local Government Leaders. P.32

The ten essentials for empowering cities to build resilience aim to achieve cities' ability to withstand disasters and crises. Each of these essentials ensures that the city possesses the following characteristics:

1. Strong leadership, clear coordination, and well-defined responsibilities, including effective stakeholder engagement, policy formulation, task distribution, efficient communication channels, and effective management mechanisms.
2. Modern knowledge about risks, including routine risk assessments that form the basis for urban planning and long-term development decisions, as well as current and future investment decisions that contribute to resilience.
3. Adequate financial planning that complements and supports mechanisms for enhancing resilience activities.
4. Urban planning based on up-to-date risk-related information, with a focus on areas and groups most vulnerable to damage. It also involves the application and enforcement of realistic and hazard-resistant building regulations to effectively mitigate physical risks.
5. Identification and monitoring of natural ecosystems within and around the city to preserve their protective characteristics as natural barriers.
6. Support for all institutions related to urban resilience to provide them with the necessary capabilities to fulfill their roles.
7. Social cohesion and a culture of mutual assistance through community engagement, education, and media communication channels.
8. Strategies for protecting and upgrading critical infrastructure to ensure the continuity of services and increase resilience against hazards and climate change impacts.
9. Emphasis on effective disaster response through the development and regular updating of preparedness plans, integration with early warning systems, and capacity-building related to emergency management through preparedness exercises.
10. Alignment of post-disaster reconstruction, rehabilitation, and recovery strategies with long-term planning, aiming to create a better environment for the city after the disaster events.

## 3 Measuring Urban Resilience

The measurement card for urban resilience is designed based on the Ten Essentials for Empowering Cities to Build Resilience, initially developed as part of the Hyogo Framework for Action in 2005 and later updated to support the implementation of the Sendai Framework for Disaster Risk Reduction for the period 2015-2030. The goal of creating the measurement card for urban resilience is to assist local authorities by monitoring the progress made and the challenges faced in implementing the Sendai Framework for Disaster Risk Reduction. Additionally, it helps in developing local strategies to reduce disaster risks. It's worth noting that Morocco is actively engaged in this framework and has achieved significant results in reducing disaster risks[16]. This measurement card consists

[16] Standards & Regulations for Urban Resilience Program (2020), "Safe and Sustainable Buildings to Strengthen Urban Resilience", Evaluation of the Moroccan Regulatory Framework for Risk Prevention in Land

of indicators derived from the Ten Essentials, providing a set of assessments to help decision-makers monitor and review the progress and challenges facing cities. It comes in two different types based on the desired results[17]:

1. The first type is a primary level measurement that aligns with the main goals and indicators of the Sendai Framework, along with some critical sub-issues. It includes 26 indicators organized into four major axes, as illustrated in the following table.
2. The second type is a detailed evaluation measurement, which is somewhat more in-depth compared to the primary measurement. It is intended for stakeholders and decision-makers and forms the basis for creating a detailed plan for urban resilience. It includes 117 indicator standards, each categorized into five major axes.

These measurement tools provide valuable insights and data for cities to enhance their resilience and better prepare for disaster risks.

**Table 2. Evaluation indicators to measure the resilience of cities "initial level".**

| Essentials for Making Cities Resilient | | Measurement Indicators |
|---|---|---|
| 1 | Organize for disaster resilience. | 1. Developing a Strategic Plan to Mitigate Risks for the Purpose of Ensuring the Protection of Development Goals.<br>2. Ensuring that the city has the authority and necessary resources to meet local needs for risk mitigation.<br>3. Developing a mechanism to allocate resources according to priority for effectiveness in reducing risks identified by local assessments. |
| 2 | Identify, understand, and use current and future risk scenarios. | 4. Conduct a technical analysis to identify current and future threats and hazards.<br>5. Incorporate information related to exposure to risks and vulnerability into long-term city planning.<br>6. Learn from the experiences of cities that have a similar risk profile. |
| 3 | Strengthen financial capacity for resilience | 7. Prepare a financial plan and appropriate procedures and allocate resources to enable capacity-building activities for resilience.<br>8. Ensure the availability of suitable financial support mechanisms to address risks.<br>9. Establish a specific budget, provide necessary resources, and make arrangements for the Emergency Risk Reduction Fund. |
| 4 | Pursue resilient urban development and design. | 10. Regularly update urban plans with the latest information related to risks.<br>11. Incorporate any cross-cutting issues related to building urban resilience in urban plans.<br>12. Ensure the existence of mechanisms and processes for urban planning that take into account risks.<br>13. Regulate, develop, update, and implement building laws and standards as they relate to relevant hazards and the impacts of climate change. |
| 5 | Safeguard natural buffers to enhance the protective functions offered by natural ecosystems. | 14. Protecting and preserving environmental systems to adapt to current and future risks and mitigate their impacts.<br>15. Developing solutions to address current and future environmental risks through nature-based or environmental protection solutions. |
| 6 | Strengthen institutional capacity for resilience | 16. Enhancing the knowledge and skills of common stakeholders in building resilience to disasters. |

Use Planning and Construction, International Bank for Reconstruction and Development/World Bank 1818 H Street, N.W

[17] Disaster Resilience Scorecard For Cities, Preliminary Level Assessment ,UNISDR 2017

| | | |
|---|---|---|
| | | 17. Leveraging the capabilities of the private sector and civil society in reducing disaster risks. |
| 7 | Understand and strengthen societal capacity for resilience. | 18. Providing social support to the most vulnerable individuals.<br>19. Strengthening social cohesion and fostering community participation.<br>20. Promoting a culture of disaster risk reduction in educational programs and other awareness initiatives, along with providing training for it. |
| 8 | Increase infrastructure resilience. | 21. Developing an infrastructure plan or strategy and implementing it to protect critical infrastructure, facilities, and essential services.<br>22. Ensuring the existence of resilient infrastructure to mitigate risks and maintain its upkeep. |
| 9 | Ensure effective preparedness and disaster response. | 23. Preserving a disaster management plan to mitigate the impact of local emergencies, preparedness for them, and response to them.<br>24. Taking crisis arrangements for the continuity of vital functions in emergency situations. |
| 10 | Expedite recovery and build back better. | 25. Completing post-event assessments to analyze failures and capabilities, and documenting the lessons learned for incorporation into recovery and reconstruction processes.<br>26. Developing strategies for recovery and reconstruction after disasters, including the essential societal and economic aspects required to restore services. |

**Disaster Resilience Scorecard For Cities, Preliminary Level Assessment ,UNISDR 2017**

## 3 Work Methodology

The preliminary measurement tool was applied to the city of Mohammedia to assess the city's resilience in the face of potential risks. This was done following consultations and exchanging opinions with stakeholders and actors in the city, each according to their expertise, by conducting interviews with them. Additionally, documents, projects, and measures that intersected with the standard indicators were reviewed. Subsequently, the responses, conclusions, and findings were gathered to address the indicators present in the measurement card, which consists of 47 indicators, as illustrated in the 47 responses that make up the assessment of the ten foundations of the city's resilience, as outlined in the final report in Figure 1. (The resilience measurement card for cities was developed by the United Nations Office for Disaster Risk Reduction (UNISDR), with support from USAID, the European Commission, IBM, and AECO, to support the preparation of national reports for the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030.

This card covers the cities' ability to understand disaster risks that they may face in order to mitigate and respond to potential disasters, thus reducing direct and long-term losses, including the number of fatalities, preserving livelihoods, infrastructure, economic activities, and the environment, among others. It should be noted that chronic pressures can affect the likelihood and severity of acute shocks, as illustrated in the following figure.

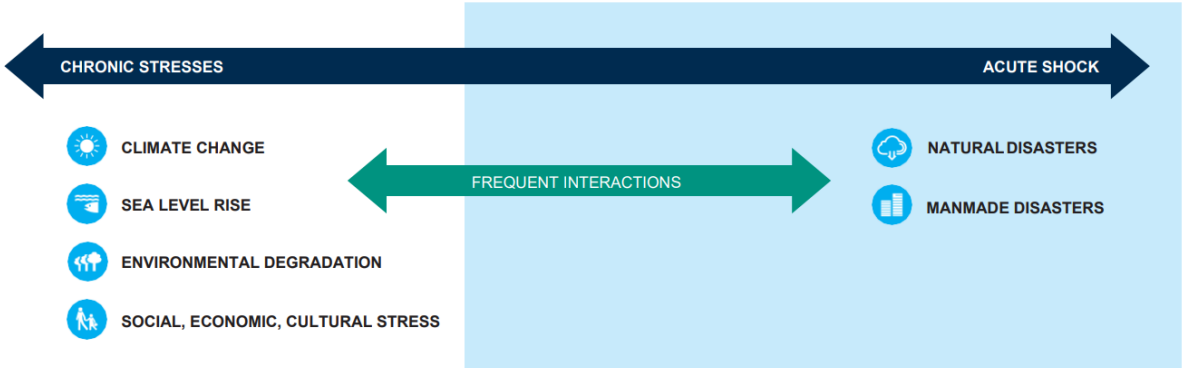


**Figure 1.** Scope Of The Scorecard, (UNISDR 2017)

## 4 Results

The final results obtained by the city of Mohammedia in terms of measuring resilience are based on official statistical data for the year 2014. The General Census of Population and Housing for the year 2014 for the city of Mohammedia was used as the main source of data and figures for the performance card. Based on the answers and conclusions reached through interviews, the city of Mohammedia achieved a score **45/141**.
The result 45/141 cannot be considered as either good or bad in general terms because the objective of the City Resilience Measurement Tool is to monitor the progress made by cities in implementing disaster risk reduction projects and programs, as well as to identify weaknesses and challenges in implementing the Sendai Framework. It also aims to help develop local strategies for cities by extracting plans for implementing resilience-enhancing projects.
The next steps after conducting this assessment involve identifying the weaknesses highlighted in the report and working on them. Over time, this card is updated to evaluate the progress made. The question becomes whether the resilience rate has increased or decreased.
It's worth mentioning that the city of Mohammedia has begun to participate in the campaign for resilient cities. It took part in the regional conference on urban resilience in the Middle East and North Africa in 2019[18] and engaged in several consultations and meetings with representatives from the World Bank to frame and finance various programs in Mohammedia aimed at reducing disaster risks in the city.
By comparing Mohammedia result with several other cities that used the same performance card, we can see that the scores differ. However, this doesn't reflect the degree of resilience because risks vary from one place to another, and each city has its unique characteristics. For example, Amman scored 141/77, and Khartoum scored 141/61, indicating that the risks in these cities are real and affect them. Therefore, efforts have been made to strengthen the foundations to address them, particularly in the areas of enhancing resilience-related infrastructure and effective response to mitigate their impact. It's important to note that most of these projects and programs receive external funding[19].

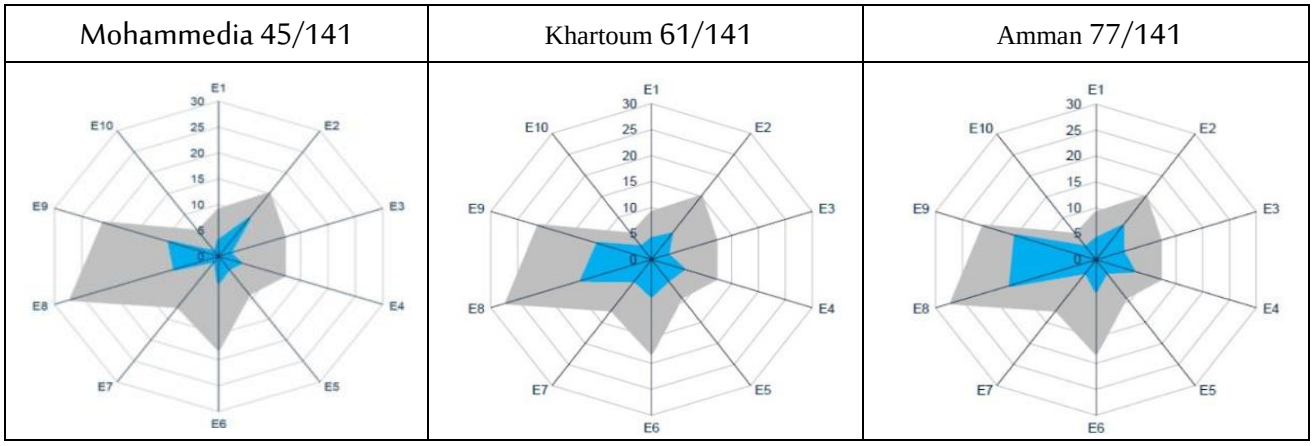


**Figure 1.** The resilience performance scorecard results for both Amman and Khartoum in the year 2017.

Due to the specificities of Arab countries and the interplay of influence and impact among them in the event of risks, stemming from social, geographical, political, natural, economic, and climatic interconnections, ideal objectives have been formulated through the aforementioned indicators (represented in gray) with the aim of enhancing the resilience of the Arab region. These objectives seek to mitigate the impact of interdependence among countries and cities, especially concerning the pressures imposed by migration, urbanization, political instability, climate change, and armed conflict.

[18]Conference Proceedings: Regional Conference on Urban Resilience in the Middle East and North Africa, April 4-6, 2019, Beirut, Lebanon.
[19] Eltinay, Nuha. (2019). "**City-to-city exchange: redefining "resilience**" in the Arab region". International Journal of Disaster Resilience in the Built Environment, 10(4), 222–238. https://doi:10.1108/ijdrbe-05-2019-0028

**Table 2.** Results of the evaluation of the scorecard for the city of Mohammedia with the most important observations.

| | Essentials for Making Cities Resilient | Assessment Points | Observations |
|---|---|---|---|
| **1** | Organize for disaster resilience. | 3/9 | The complete absence or lack of clarity in disaster risk reduction plans and strategies within the city's management methodologies hinders the effective implementation of the Sendai Framework. This, in turn, jeopardizes the city's preparedness for resilience. |
| **2** | Identify, understand, and use current and future risk scenarios. | 9/15 | There is a general understanding of potential risks to the city among various stakeholders, but there is no agreed-upon plan for updating information and developing scientific scenarios for the entire city. |
| **3** | Strengthen financial capacity for resilience | 2/12 | The budget allocated for disasters is often enhanced effectively in the aftermath of risks. However, having a protected and pre-allocated budget for disasters outside of emergencies lacks a clear plan in this regard. |
| **4** | Pursue resilient urban development and design. | 4/12 | In terms of land use zoning based on risks, it takes into account risk conditions and contributes to their mitigation. However, it may lack depth in terms of construction standards and may not be based on resilience principles. |
| **5** | Safeguard natural buffers to enhance the protective functions offered by natural ecosystems. | 3/9 | Awareness and understanding of the functions of natural capital in the city are not comprehensive, and they are often limited, especially in the context of green spaces within the urban area and infrastructure projects. |
| **6** | Strengthen institutional capacity for resilience | 5/18 | There is a lack of training and exchange of useful information among institutions regarding risks, despite the city having the skills and expertise to respond to disaster scenarios, with the potential to benefit from neighboring cities' experiences and knowledge. |
| **7** | Understand and strengthen societal capacity for resilience. | 1/12 | Civil society participation is very limited and seasonal, and it does not deeply and practically understand the concept of disasters, often addressing them as environmental risks. This limited participation affects residents' involvement in disaster risk reduction efforts, which tends to be weak or non-existent. |
| **8** | Increase infrastructure resilience. | 8/27 | A significant part of the city is not protected from known hazards, although some critical infrastructure types have an understanding of risks. This situation could lead to a loss of energy sources and some services, especially healthcare services, as some service infrastructure does not meet the needs of the population in terms of quantity and quality. |

| | | | |
|---|---|---|---|
| **9** | Ensure effective preparedness and disaster response. | 9/21 | The city has an emergency operations center equipped with communication capabilities designed to handle the most severe scenarios. However, there is an issue with routine simulation, and the training on how to use it is not clear with partners. |
| **10** | Expedite recovery and build back better. | 1/6 | There is no comprehensive recovery and rebuilding plan in place for the economic and social aspects following a disaster, except for the presence of a national property insurance system, which is not locally based. Some lessons have been learned, but not in a systematic and in-depth manner to ensure effective utilization. |

## 5 Conclusion and Recommendations

In this chapter, we have explored a new concept that is increasingly discussed today, which relies on assessing cities' readiness to cope with shocks, crises, and disasters. This concept can be quantified using various indicators that cover all organizational, legal, financial, and social aspects, enabling cities to enhance their resilience. The positive aspect is Morocco's overall engagement and the specific involvement of the city of Mohammedia in the global context of resilient cities. Although they are at the beginning of this journey, they seek to learn from other cities, especially those facing similar risks, and benefit from their experiences. This is further supported by financial and technical assistance. Some important areas that require improvement and can be considered recommendations based on the findings of this study include:

1. **Utilize the Results of the Ten Essentials**: The city of Mohammedia should utilize the results of the ten essentials assessment conducted in this study as a foundation for future planning. It is crucial to address the identified weaknesses by providing the necessary financial and human resources to strengthen the city's resilience.
2. **Engagement of Local Authorities**: Local authorities, especially the municipal council, need to be actively engaged in disaster risk reduction initiatives. This includes incorporating disaster risk reduction into their action plans.
3. **Conduct Regular Disaster Drills**: The city should regularly conduct disaster drills and simulations to ensure effective coordination and use of resources. These exercises should involve all stakeholders, including residents and civil society.
4. **Public Awareness and Education**: Public awareness and education campaigns should be created, focusing on disaster knowledge and preparedness. This should target all age groups, with an emphasis on those living in high-risk areas.
5. **Incorporate Disaster Risk Reduction in Education**: Disaster risk reduction should be integrated into educational curricula at all levels. This will help raise awareness and build a culture of resilience from a young age.
6. **Government Investment**: The government should allocate resources to support disaster risk reduction activities. Adequate funding should be provided for these initiatives, especially those related to infrastructure and public safety.
7. **Partnerships**: Encourage partnerships with local and international private sectors and organizations experienced in disaster risk reduction. Leveraging their expertise and resources can enhance the city's resilience.
8. **Insurance Against Disasters**: Encourage individuals, especially those in natural disaster-prone areas, to adopt disaster insurance policies to aid recovery after disasters.
9. **Communication and Early Warning Systems**: Strengthen communication and early warning systems by utilizing information technology, websites, mobile apps, and social media. This will help build trust and ensure residents receive timely information during emergencies.
10. **Community Involvement**: Promote community involvement in disaster risk reduction. Engage residents in identifying and mitigating risks, and empower them to take an active role in enhancing the city's resilience.

By implementing these recommendations, the city of Mohammedia can work towards becoming more resilient and better prepared to face future disasters and crises. It should also continue to learn from other cities and share its experiences to contribute to the global effort of building resilient urban areas.

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# Can international tourism-related activities menace food security in the Least Developed Countries? A preliminary study

Dimitrios Karkanis[1]

[1] Department of Balkan, Slavic and Oriental Studies, University of Macedonia
156 Egnatia Street, GR-546 36 Thessaloniki, Greece
Email: dkarkanis@uom.edu.gr

**Abstract.** The UN World Tourism Organization in 2011 forecasts that international tourist arrivals are projected to reach 1.8 billion by 2030, with an average of 43 million additional tourists joining the tourism market on an annual basis (UNWTO, 2011). In this context, the question that arises is whether the need "to feed the international tourists" can act as a barrier to satisfying food demand in the LDCs, to the extent that the ongoing climate crisis is expected to menace the food security context and, as a result, the highest likelihood of humanitarian crises. The aim of the study is to identify "competition" effects in food demand between the Least Developed Countries (LDCs) and the tourist host countries worldwide, during the 2008-2021 period. The results suggest a positive relationship between food demand in the tourist host countries and the LDCs, which means that the main tourist host economies are both significant importers of food products from the tourist origin economies and significant exporters of food products towards the LDCs. The prospect of an expanding middle class worldwide, especially in the developing countries, could trigger additional pressures on food demand in countries that are both tourist host economies and significant exporters of food products to the LDCs.

**Keywords:** Food trade, Least Developed Countries, Food security, Tourist flows

## 1 Introduction

Several studies have outlined both a direct and an indirect impact of various factors on the outbreak of humanitarian crises, such as climate change and the associated lack of resources in the conflict zones (Anderson et al. 2000, Gleditcsh, 2012). Burke et al (2014) highlight the indirect impact of changing climatic conditions on altering the context of social interactions and, as a result, the probabilities of triggering conflicts and humanitarian crises. Extreme weather conditions additionally exert a direct impact on the context of food security, especially in the less developed countries worldwide, putting pressures on local governments to encourage food imports in order to satisfy internal food consumption demand.

On the other hand, especially in the northern hemisphere, some of the national economies possessing comparative advantages in producing and exporting agrifood products are increasingly exposed to intense tourist inflows, in particular during the summer months. Baidoo et al (2022) confirm an over-reliance on imported consumables and merchandises in order to feed international tourists, in the case of 45 sovereign islands during the 1980-2019 period. While admittedly the context of internal demand for food products in the developed tourist host economies seems different than the corresponding in the less developed economies, the steady and increasing demand for agricultural products is rather global. In that case, the main question of this preliminary study is to determine whether there exist "competition" effects when it comes to satisfying food demand between the Least Developed Countries (LDCs) and the host countries of significant tourist inflows.

## 2 Methodological framework

The log-linear econometric model presented here incorporates some of the common proxies employed in relevant studies, in order to increase the interpretative value of the regressions to be obtained. The dependent variable refers to the tourist host (h) countries' imports ($foodm_a^t$) of food products from tourist origin (o)

countries in year *t* (UNCTAD, Table 1). Each set of the explanatory variables introduced in the model aims to capture the effect of geographical factors ($dist_{ho}$, $contig_{ho}$, $landlocked_{h,o}$}, output and income effects ($y_h$, $income_h$), institutional factors ($EU_{ho}$ and $WTO_{ho}$ dummies) and international price-related factors on food import intensity ($foodcpi_t$, $foodprice_t$, $cerealprice_t$ variables).

$$foodm_d^t = e^{\left[\begin{array}{c}\beta_1\, dist_{ho}+\beta_2\, contig_{ho}+\beta_3\, langoff_{ho}+\beta_4\, langeth_{ho}\\ +\beta_5\, landlocked_h+\beta_6\, landlocked_o+\beta_7\, y_{ht}+\beta_8\, y_{ot}+\\ +\beta_9\, income_{ht}+\beta_{10}\, income_{ot}+\beta_{11}\, foodcpi_t+\\ +\beta_{12}\, foodprice_t+\beta_{13}\, cerealprice_t+\beta_{14}\, x_{ht,ldc}+\beta_{15}\, tot_{ht}\\ +\beta_{16}\, crop_t+\beta_{17}\, EU_{hot}+\beta_{18}\, WTO_{hot}+\beta_{19}\, arrivals_{hot}\end{array}\right]} \times \varepsilon_{hst} \qquad (1)$$

In order to test the validity of the main question mentioned above, an additional proxy is introduced in the model, representing the number of tourists arrived in tourist host economies from the tourist origin economies on an annual basis ($arrivals_{hot}$). We test here the hypothesis according to which the main tourist host countries are expected to be relatively more dependent on imports of food products, *ceteris paribus*, thus the empirical findings are expected to confirm a positive link. Finally, the last variable introduced comes to identify whether the LDCs are food-import dependent from these tourist host countries. In this preliminary study, the least developed countries' food-import dependency is represented here by the value of tourist host countries' food exports to the LDCs ($x_{ht,ldc}$ variable). The model can be summarized by Equation 1, on the basis of similar econometric analyses, as is for example the case of financial flows (Cieślik and Ghodsi, 2021).

## 3 Preliminary findings

The sample of tourist host (h) and origin (o) countries are described in Table 1. The GDP output and trade-related data, as is the case for the dependent variable, are provided by the UNCTAD database. The Food and Agricultural Organization statistical database (FAOSTAT) provides annual estimates on the food and cereal price indexes, while data on tourists' arrivals were available by the World Tourism Organization. Finally, data for geographical proxies mainly derive from the CEPII database (Mayer & Zignago, 2011).

**Table 1.** International tourism intensity effects on food demand in the LDCs.

| Variable | Coefficient | Definition & source |
|---|---|---|
| $foodm_d^t$ | | **Tourist host countries' food imports (value) from tourist origin countries - UNCTAD** |
| $dist_{ho}$ | -0.047*** (13.61) | Geographical distance between partners (log) - CEPII |
| $contig_{ho}$ | 0.058*** (10.59) | Dummy variable, common border (0/1) – CEPII |
| $langoff_{ho}$ | -0.022** (2.42) | Dummy variable, common official language (0/1) - CEPII |
| $langeth_{ho}$ | 0.015* (1.70) | Dummy variable, common ethnic language (0/1) - CEPII |
| $landlocked_h$ | -0.013*** (2.65) | Dummy variable, landlocked tourist-host country (0/1) |
| $landlocked_o$ | -0.010 (1.35) | Dummy variable, landlocked tourist-origin country (0/1) |
| $y_{ht}$ | 0.038*** (14.37) | Tourist-host country's GDP, current USD (log) - UNCTAD |
| $y_{ot}$ | 0.022*** (9.98) | Tourist-origin country's GDP, current USD (log) - UNCTAD |
| $income_{ht}$ | 0.006 (1.39) | Tourist-host country's per capita GDP, current USD (log) - UNCTAD |
| $income_{ot}$ | -0.07** (1.94) | Tourist-origin country's per capita GDP, current USD (log) - UNCTAD |
| $foodcpi_t$ | -0.099** (2.27) | Commodity Price Index (all food) - UNCTAD |
| $x_{ht,ldc}$ | **0.014*** (10.29)** | Tourist-host country's exports to the LDCs - UNCTAD |
| $tot_{ht}$ | 0.001 (1.51) | Terms of trade index, tourist-host country - UNCTAD |
| $EU_{hot}$ | 0.047*** (8.67) | Dummy variable, both partners EU members (0/1) |
| $WTO_{hot}$ | 0.076*** (3.64) | Dummy variable, both partners WTO members (0/1) |
| $foodprice_t$ | 0.002*** (2.50) | Food price index - FAO |
| $cerealprice_t$ | -0.001* (1.73) | Cereals price index - FAO |
| $crop_t$ | -0.001** (2.25) | Crop Production Index – World Bank |
| $arrivals_{hot}$ | **0.015*** (8.72)** | Number of arrivals (log) from tourist-origin country in tourist-host country - UNWTO |
| R-squared | **0.729** | |
| Observations | 1438 | |

Country sample: Australia (o), Austria (h/o), Belarus (o), Belgium (h/o), Bulgaria (h), China (o), Croatia (h/o), Czechia (h/o), Denmark (o), Estonia (o), Finland (h), France (o), Germany (h/o), Greece (h), Hungary (o), Iran (o), Israel (o), Italy (h/o), Kazakhstan (o), Latvia (o), Lithuania (h), Luxembourg (h), Netherlands (h/o), Norway (h), Poland (h/o), Portugal (h), Romania (h/o), Russian Federation (h/o), Slovakia (h/o), Slovenia (h/o), Spain (o), Sweden (o), Switzerland (h/o), Türkiye (h), Ukraine (o), United Kingdom (o), United States of America (o).

The preliminary results confirm the expected positive relationship between food imports and international tourism intensity in the main host countries of tourist flows (Table 1). More specifically, apart from the fact that international tourist flows are indeed beneficial for tourist host economies in stimulating domestic consumption demand, there appears that this positive impact is at least partially offset by the increasing reliance on imports of food products from the tourist origin economies. These preliminary results also suggest that the main tourist host economies are both significant importers of food products from the tourist origin economies and significant exporters of food products towards the LDCs, as can be inferred by the positive coefficient sign of the $x_{d,ldc}$ variable. The gradually expanding middle class in several emerging and developing economies in the world, such is the case of China, may trigger additional international tourist flows over time, an evolution that could possibly put pressures on food demand in the tourist host countries and, at the same time, main exporters of food products to the LDCs. In this context, the question that arises is whether the need "to feed the international tourists" can act as a barrier to satisfying food demand in the LDCs, to the extent that the ongoing climate crisis is expected to menace the food security context and, as a result, the highest likelihood of humanitarian crises.

With regard to the policy implications, it is certain that local governments in the LDCs should take into account the need to ensure the well-functioning of economic institutions, as for example, local market integration with the international food markets could help avoid any future disruptions in the LDCs' internal food demand. Increasing food demand in the main tourist destinations should also be of major concern, as according to relevant studies, about one-third of the human-caused greenhouse gas emissions are related to food consumption (Crippa et al., 2021), thus reminding the vicious cycle between increasing food demand and climate change. The frequency of humanitarian crises outbreaks in the LDCs itself, especially in the African states (e.g. Tigray, Ethiopia), shall be the signal for local governments in order to moderate their dependency on food imports, by implementing policies to integrate innovation and technology into agricultural production processes.

Among the limitations of this preliminary study, and at the same time the next methodological step is to take into account country-time and country-pair fixed effects of our variables of interest on food import intensity (dependent variable), which is the case when studies deal with panel data (Anderson and van Wincoop, 2003; Feenstra, 2004) or aim to capture the effect of time-invariant bilateral trade costs (Yotov et al., 2016). The analysis should be further updated by testing additional variables of interest, in order to obtain robust results on eventual "competition" effects in terms of food demand in the tourist host economies and the least developed countries.

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# Localisation of funding as promoted by the Grand Bargain and supportive funding tools

Violetta Kyriakou[1], Maria Drakaki[2]

[1] Department of Balkan, Slavic and Oriental Studies, University of Macedonia, 156 Egnatia str., 54636, Greece
Email: hlc23002@uom.edu.gr
[2] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14th km Thessaloniki - N.Moudania, 57001, Greece
Email: mdrakaki@ihu.gr

**Abstract**

Starting from the role of localisation in supporting and strengthening local and national actors (LNAs), this paper explores the commitments and evolution of the "Grand Bargain" since 2016 up to date and various funding tools that enhance localisation. The methodology adopted is a review of relevant literature through papers, articles and reports published by research institutes and humanitarian actors. Constant crises around the world continuously increase the need for humanitarian aid. The optimization of existing, finite funding flows towards LNAs is strongly required to address this tight condition where localisation is the vehicle and measurement, reporting, individual planning, visibility, transparency and accountability are the key drivers. Country and regional pooled funds allow donors to combine their funding contributions into single, unearmarked funds giving the possibility to local actors to adopt a decisive role. Innovative, flexible, capacity building, pre-positioned and emergency funding tools and structures that can address small organisations, marginalized groups and communities, act in advance or urgently when needed can align in a direct and targeted way with the purposes of localisation. Although the above seem to be widely understood by multiple policies, overall patterns and quality of funding do not change easily or quickly. The Grand Bargain has been recognized as "a motor for change" and "a platform for reform" but empowered local actors providing for and managing their own disaster responses requires challenging and reevaluating internal mindsets, organizational cultures, policies, procedures and structures.

**Keywords:** localisation; funding flows; funding tools; Grand Bargain; empowered local actors; humanitarian aid.

## 1 Introduction

The latest years, multiple protracted crises and rapid-onset emergencies across the globe have significantly increased the number of people in need from 125 million (2016) to 362 million as of mid-June 2023 (targeted people: 249 million) with funding requirements having reached the sky-high amount of $54.8 billion. However, the finite number of major donors accompanied by some unsuccessful pledges increased the funding gap to its highest ever amount of $43 billion (OCHA, 2023).

Under this extremely tight condition, optimizing the use and allocation of existing funding is a must. The role of localisation and localisation of funding towards this goal has been widely highlighted, understood and called by several policy commitments, such as the Good Humanitarian Donorship, Principle 8 (GHD, 2003), the Grand Bargain, Commitment 2 (Grand Bargain, 2016), the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015) and the 2030 Agenda for Sustainable Development (UN, 2015). The present paper provides an overview of the efforts and commitments of the "Grand Bargain" towards localisation from 2016 up to date and it further explores the localisation of funding via various funding tools and innovative mechanisms.

## 2 The Grand Bargain: a vehicle to localisation

Localisation is about empowering local responders in affected countries to lead and deliver humanitarian aid by strengthening their capacity and resources to respond to crises and promote long-term sustainability. Structures that promote decision-making by the local and national actors (LNAs) and allow the flow of direct and "as direct as possible" funding (Dewulf, 2023) are aspects of the localisation that can make humanitarian action more effective, sustainable and reduce its costs, increase accountability and flexibility of the process (Fabre, 2017) and ensure that crisis preparedness, response capacity and resources lie with the most affected ones.

The aim of the UN World Humanitarian Summit in 2016 was to address the humanitarian financing gap. During its preparations, thirty (30) of the largest donors and humanitarian organizations globally including states, UN Agencies, inter-governmental organizations, Red Cross/Red Crescent Movements and NGOs agreed on the idea of the "Grand Bargain" that enclosed all the promises of the localisation of funding. This year (2023) during the Annual Meeting in June, the signatories reached the sixty-six (66) in number.

Initially, the Grand Bargain was organized in "workstreams" that had targets and indicators for core commitments. Among them, Workstream 2 committed to the allocation of at least 25% of humanitarian funding directly to LNAs until 2020, multi-year investment and identification of political barriers and administrative burdens, national coordination mechanisms that would involve LNAs in international coordination efforts, direct and indirect tracking of funding to LNAs and use of adequate funding tools such as UN-led country-based pooled funds (CBPF), the IFRC Disaster Relief Emergency Fund (DREF) and NGO-led and other pooled funds to enhance and increase assistance delivered by LNAs. It is important to underline that not all organizations are under the umbrella of the LNAs. The term refers to relief organizations that are headquartered and operating in their own aid recipient country - not affiliated to an international NGO – to State authorities of the affected aid recipient country that are engaged in relief, either at local or national level. National Red Cross or Red Crescent National Societies are also considered as LNAs (ICVA, 2022).

By 2021 though, it was understood that the progress towards those goals was very slow. Despite years of commitments to alter funding behavior and patterns, the proportion of unearmarked funding to LNAs declined to its lowest level since before the launch of the Grand Bargain. Funding reached LNAs through one or more intermediaries with local actors being treated often as subcontractors and not as equal partners. Sustainable solutions were lacking. Also, the limited availability of data that would help monitor the funding flows, the resources and the ways they passed from one organization to another, reinforced the need for revision.

In June 2021, signatories endorsed the "Grand Bargain 2.0 Framework & Annexes" that aimed to elevate work from technical to political/ strategic and promote anticipatory action as instrumental in saving lives and reducing response costs, enhancing readiness and localisation. The new organization of this work was based on a series of groups named "caucuses" that aimed to be flexible, agile and time-bound. National Reference Groups (NRGs) have been also introduced for further engagement at national level with representatives of NRGs and/ or of national initiatives taking part in regular exchanges and Grand Bargain meetings to provide feedback and to influence discussions at global level, especially around blockages and barriers at national level. In June 2023, the signatories endorsed a revised framework that included two focus areas:

**Focus area 1:** Continued support to localisation by the participation of affected communities and by more quality funding (flexible and multiyear, including "core funds") to allow an effective and efficient response. At the same time, visibility, transparency and accountability remain core targets that require comprehensive tracking and reporting, commonly agreed criteria/ definitions, reporting of flexible and multi-year funding allocation in absolute and relative numbers to specific platforms (FTS/ IATI) and as real-time as possible data/ analysis from aid organisations to their institutional donors. Greater funding and support to achieve leadership, delivery and capacity of local responders and affected communities in addressing humanitarian needs are added on top of the above.

**Focus area 2**: Catalyse sector wide transformation by better use of existing resources and capabilities to shrink humanitarian needs through strengthened partnerships across sectors and increase prevention, mitigation and preparedness for early action in order to anticipate and mobilise resources for recovery. Secure commitment from Signatories and other stakeholders to scale-up anticipatory action and replicate innovative practices based on evidence, knowledge-sharing and lessons-learned to foresee and respond to future shocks. Bring together all relevant stakeholders. Map, support and scale-up existing financing mechanisms, enabling cross-sector collaboration and innovative financing approaches, that can support protracted crises. (ICVA, 2023).

On top of the two focus areas, two cross cutting issues are addressing gender aspects and integration of new approaches in order to share risks between signatories and partners including local and national actors.

All the above bring back to the agenda, as a planned core theme for Grand Bargain 3, the 'triple nexus': humanitarian, development and peace (HDP), already prompted by the World Humanitarian Summit and the 'Leave No One Behind' theme of the 2030 Agenda. However, this will require structural reforms in several agencies and engagement both by traditional humanitarian actors and by development stakeholders in new

partnerships that may have been unthinkable a decade ago (ALNAP, 2023). Denmark, Ireland, Australia, Luxembourg and Finland are the most recent donors to announce increased mixed humanitarian-development funding to their operational partners while Canada and Sweden worked towards their nexus reforms with cross-team engagement and the Swiss Agency for Development and Cooperation (SDC) went through a major restructuring process, joining together its previously separate humanitarian aid and development cooperation departments to create geographical nexus teams from September 2022 (ALNAP, 2023). Despite this, assessing progress is a challenge due to a lack of clear theories of change or objectives that has created confusion over what the nexus means practically and operationally (Metcalfe-Hough, V. et al, 2023).

As per the summary note of IASC from the annual meeting of this year back in June (2023), main areas of progress and achievements up to date are 1) Quality funding: more than half of the donors allocated 30% or more of their funding as multi-year, with notable increases in the volume of flexible funding as well and in funding to Central Emergency Response Fund (CERF) and Country Based Pooled Funds (CBPF) that we will explore in the next section of this paper; 2) Localisation: investments in strengthening capacity and providing opportunities to local actors for local leadership and influence have been featured under the progress noted within 2022, together with a momentum in the overhead costs (indirect costs not related to project but important for the operation and the sustainability) (IASC, 2023).

These achievements challenge part of the negative narrative that has grown up around the Grand Bargain in recent years. Also, the focus on measurement and reporting will help deploy where the Grand Bargain is proving effective in driving change and where it needs to make greater political investments (Metcalfe-Hough et al., 2023). As it has been extended until 2026, June of that year will be a key milestone for the continuation of the agreement or not.

## 3 Funding tools promoting localisation

Unearmarked funds that can be managed by LNAs support local humanitarian efforts, enable risk sharing and help develop and test new approaches to meet humanitarian financing objectives (ICVA, 2023) as well as empower local actors in dealing with crises in a more sustainable and long-term way.

Country-based pooled funds (CBPFs) are established when an emergency occurs or when an existing crisis deteriorates. They are managed by the OCHA under the leadership of Humanitarian Coordinators (HCs) or UN Resident Coordinators (RCs), in close consultation with the humanitarian community. They are focused on the quality of funding that matches the needs of LNAs, advances their participation to the governance of the Funds, strengthens their capacity and increases visibility (UN OCHA, 2023). The revised CBPF Global Guidelines of 2022 seek to establish localisation as the aim that comes immediately after the primary goal of lifesaving so representatives of LNAs are included in CBPF Advisory Boards as a matter of principle. OCHA has also enhanced the grant conditions for LNAs and others to ensure that improvements in budget flexibility, project periods, eligible costs and sharing of the programme support costs benefit frontline responders.

Disaster Response Emergency Fund (DREF) is the central pot of money through which IFRC can rapidly and transparently release funds to Red Cross and Red Crescent local Societies for early action and immediate disaster response, before launching an Emergency Appeal. It is destined to support small and medium sized disasters that occur "in silence" every year and struggle to attract funding. National Societies request funding from the DREF via an online application process on IFRC emergency operations platform, the IFRC GO.

National Society Investment Alliance (NSIA) is a pooled funding mechanism that is run jointly by the IFRC and the International Committee of the Red Cross (ICRC). It provides flexible, multi-year financing and support for the development of National Societies and it strengthens their capacity to deliver relevant and effective humanitarian services. In 2022, allocations reached the number of 20 national societies. Accelerator funding can be awarded to any National Society over a five-year period by the NSIA and bridge grants can help National Societies prepare the ground for future investment from the NSIA or elsewhere (IFRC, 2023).

The Start Fund is the flagship fund of the Start Network which has become "a network of networks" supporting locally led structures. Start Fund described as the first multi-donor pooled fund managed exclusively by NGOs aiming to provide rapid response, with funding disbursed within 72 hours after members raise a crisis alert. It focuses on under-the-radar, small to medium-scale crises, filling a critical gap in the humanitarian aid system. It is piloting a tiered due diligence model, instead of just a "pass/ fail" model, for LNAs combined with a

capacity strengthening framework. NGO-managed country-level pooled funds have been launched in select crisis-prone countries as Bangladesh and Nepal. It has also piloted the use of block chain technology to drive further transparency, speed and incorruptibility (Thomas, 2022).

Central Emergency Response Fund (CERF) is mandated to directly support UN agencies with LNAs as the key implementing partners. In 2020, 24% of the year's total CERF funding was subgranted to implementing partners. It often funds programmes with a specific localisation objective like local women-led organizations working on gender-based violence (GBV) or those promoting localisation efforts. In 2022, CERF localisation efforts consisted of a specific strategic objective for allocations through its Underfunded Emergencies (UFE) window. The same year, the Emergency Relief Coordinator (ERC) encouraged UN country teams to organize dedicated consultations with LNAs on the design of CERF allocations and strengthen their engagement in implementation. CERF's speed combined with CBPFs' have proved very strong in prompt funding allocation, like in the case of Ukraine.

Pre-positioned funding has been developed by Trócaire, an Irish international development agency (INGO). It is a simple and innovative funding mechanism that involves positioning a small (€10,000 to €25,000), flexible amount of money at the frontline – with local partner organisations – for them to respond to emergencies in their geographies when they occur. For instance, In Sierra Leone, pre-positioning flexible funds to local partners helped them respond to emergencies when needed. In 2021, the pilot initiative was extended to Malawi, Myanmar, Nicaragua and Rwanda and while it was designed particularly in anticipation of floods during 2020 rainy season, COVID-19 pandemic occurred and it enabled partners to be first-responders, take on a leading role in the district-level coordination structures and leverage additional funding (Dewulf, A., 2023).

Regional Funds build on the success of the model of Common Humanitarian Funds for countries with the aim of extending them to more varied contexts and in a more cost-effective manner. The insecurity and the rapid rise in humanitarian needs across the broader Sahel gave impetus to the establishment of the Regional Humanitarian Fund for West and Central Africa (RHFWCA) in 2021 to support humanitarian operations without CBPFs across the region. The first $20 million allocation directly funded eight (8) national NGOs in Burkina Faso for interventions including Water, Sanitation and Hygiene (WASH), food security, protection and shelter and then thirty-two (32) more local NGOs engaged in balanced partnerships. The Sahel Regional fund also started operations this year (2023). It provides predictable, flexible and long-term funding to NGOs and INGOs for protection, empowerment and humanitarian assistance, paving the way for lasting solutions that integrate multi-sector and cross-border responses.

Cash and voucher assistance (CVA) presents rapid increase (US$5.4 billion in transfers to recipients in 2021) which has though increased the challenges of accountability and coordination. A Grand Bargain caucus was initiated to introduce a "cash coordination model" built on the principle of localisation for greater participation of LNAs and decisions for cash interventions closer and with greater accountability to the crisis-affected population. However, in 2022, 97% of requirements for CVA activities were for international agencies and there is a much stronger trend for their CVA projects compared to those of LNAs to receive funding versus other projects. Consequently, the increase of CVA does not necessarily enhance localisation of funding (Development Initiatives, 2022).

## 4 Innovative Mechanisms and structures promoting localisation

Albert Einstein had said that "We can't expect things to change if we continue doing the same things". Indeed, localisation of funding is a big change and it requires innovative approaches, like cross-sector collaborations between humanitarian and non-humanitarian actors that can bring real potential to more efficient, effective and flexible use of available resources.

Innovative response models and new structures for special financing like seed grants and microfinancing can address the needs of small organisations and community-level investments and can enhance the role of women, one of the two cross cutting issues highlighted by the Grand Bargain and other vulnerable groups. DG ECHO encourages its partners to design and submit such models. Also, the Refugee Investment Facility of the Danish Refugee Council was launched in 2022 with a Swiss entity enabling investors to come together and pool funds to support durable solutions for refugees.

Debt swaps can help many low-and middle-income countries that face rising debt burdens. The repayment of external public debt by a creditor, under condition that the borrower "invests" the money in mutually agreed development projects is an innovative debt relief measure agreed between pairs of countries (creditor – debtor), implemented/ coordinated by third parties such as UN agencies and non-governmental organizations. It allows debtor government to repurpose funds previously earmarked for debt towards national development programmes (WFP, 2021). An example are the "debt-for-food" swaps by World Food Programme (WFP) between Germany & Egypt, Italy & Egypt, Russia & Mozambique.

Anticipatory action frameworks are formal mechanisms implemented at country level in order to act ahead of predicted hazards to prevent or reduce acute humanitarian impacts before they fully unfold, respond quickly and efficiently to crises and build resilience. Trigger mechanisms translate the characteristics of a shock (such as drought or flooding) and/or its impact (such as food insecurity) into technical specifications and predetermine who gets how much money, to do what, based on which signal so that a problem can be caught before it becomes a crisis, optimizing the use of funding tools like CERF, DREF and Start Network's funds.

Last but not least, the role of the private sector is considered an untapped source in driving solutions. Impact-linked loans have favorable terms to reach pre-agreed objectives and provide technical assistance and investment know-how. Reinsurance markets help transfer financial risks associated with natural disasters to risk insurance at the cost of an annual premium, ensuring funds are available for national societies to rely on even in periods of excessive or unexpected demand (IFRC, 2023), as in the case of the insurance structure that has been developed by DREF. Although modeling and forecasting future natural disasters becomes harder, new technologies such as AI and machine learning may enable greater data accumulation and more effectively calibrate the risks to vulnerable populations (Gordon, 2023).

## 5 Conclusion

The international humanitarian system was built by and for international actors, multilateral organizations and international NGOs (Fabre, 2017, p.1). However, the challenges that humanitarian aid is facing push more and more all sectors to become innovative in developing solutions (Heinonen & Strandvik, 2020) and highlight the powerful dynamic of LNAs as protagonists in the response to their own crises and in the aim of using existing resources and funding more efficiently and effectively. Greater involvement will also support their empowerment and active participation and leadership in humanitarian contexts (DG ECHO, 2023).

Localisation of funding and its enabling priorities - quality funding and localisation/ participation - require systemic changes. However, direct access to funding remains still a challenge for LNAs. New guidance, frameworks, tools and policies have been put in place ahead of the milestone of 2026 where the future of the Grand Bargain will be decided. Measurement and reporting of the funding and of the support of donors to LNAs, more flexibility and more multi-year funding are mostly required together with a more accountable humanitarian response, earlier allocations and anticipatory/ early action. Various funding tools and mechanisms along with new structures and cross sector collaborations need to be constantly deployed in order to further and fully enhance localisation of funding and empower LNAs to the desired degree that will bring long term, sustainable results.

Along with the above, the next discussion under the politically challenging context, is about risk management and sharing within the humanitarian system which may be the root cause of the up to date "silo approach" that puts barriers to localisation.

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# MEXICAN CRISIS: EXPLAINING THE CRISIS IN THE CONTEXT OF THE IN-COUNTRY VIOLENCE. THE CASE OF THE STATE VERACRUZ DE LA LLAVE.

Elena Alatzas

Department of Science and Technology, International Hellenic University, 14th km Thessaloniki-N. Moudania, 57001, Greece

Email: helenaalatzasm@gmail.com

## Abstract

In Mexico, the number of people that are on the move it is growing, and it is a fact that it also has overcame border areas both in the south and in the north. This means that the needs for humanitarian aid are expanding and intensifying. It is well known that the situation because of the drug violence every day is getting worse. This affects the security and the economic growth of the country, especially when it comes to the young generations. Criminal organizations are fighting to fill the gaps that the largest cartels left. There is also an increase in urbanization, especially in the northern border cities and this contributed to the upsurge of the crime rates and threats the well-being and the security of local citizens. Many have been the efforts from the government in order to win this fight against drug cartels and the violence they spread but, however, there is a state, where there are two powerful organizations that were and still in a one-on-one battle and wish to control entirely the drug markets and the routes of trafficking, making this specific state the most dangerous of Mexico nowadays. The state of Veracruz Llave is without exaggerating the biggest and most dangerous drug market right now in Mexico, a circumstance that makes the state a battleground and the riskiest place in the country for someone to live in. The main aspects in which this paper focuses are the war on drugs in the Mexican country and its consequences among people, focusing on the most threatening state, the one of Veracruz and then, the challenges and solutions regarding those circumstances.

## Keywords

Drug violence, organized crime, human rights abuse, war on drugs.

## Introduction

Latin America and most of its countries, had been facing big humanitarian crisis over the past decades. They have been plagued mostly by violence caused by gangs and the situation has been intense for decades without any improvement or solution regarding the safety of the local habitants. Most of the regions in Latin America have been facing, without exaggeration, big surged of criminal activities that cause deaths, lead to the breakdowns of societies and at the same time they overcome the efforts of humanitarian groups and organizations that try to respond in each possible way. It is well known that Latin America is entangled in this multifaceted and complex situation of drugs and all its related challenges. Obviously, the fact that is the global crossroad not only for the production but also for the trafficking of drugs, has helped the prevalent influence of narcotics in the region over the decades. Cocaine, opiates, marijuana, and other substances of illicit character have been cultivated and transported in and from Latin America, which is their host region. We are talking about a drug situation with repercussions and impacts in the health and safety of the habitants and a bad influence on economies, security and its dynamics and politics.

Mexico is one of the countries that this humanitarian crises has hit in an almost devastating way. Entire communities, mostly rural have been emptied by drug cartels, in their search to appropriate their lands and their natural resources. So many residents decided to flee from their villages, cities, and states because the Mexican military started its armed conflict against the violent organized criminal organizations. Thousands of Mexicans are displaced internally and are under need of documentation, livelihoods, shelter, and support, not only economical but also phycological. Nowadays, the Government of Mexico has arrested and killed the leaders of some of the most dangerous criminal organizations of the nation but, there is still no plan of contingency for those people that

are displaced forcibly, neither for the violence that occurs when the leadership of a criminal group is successfully arrested or killed, but there is a long way to go.

Veracruz de la Llave, where we find the port city Heroica Veracruz which is the most populous city of the state and at the same time the most dangerous, it is a state of the 31 states that the Mexican country has in total. It is located in the east central part of Mexico, and it is bounded by the Gulf of Mexico. Its state capital is Jalapa (Xalapa, in Spanish). The fact that the city of Heroica Veracruz is a famous and important port city, plays a major role to the fact that Veracruz state is a common route for drugs. It was first dominated by the Gulf Cartel and afterwards, by the Zetas that firstly it was the armed wing of the Gulf Cartel but once the split, the Zetas started to dominate completely. Despite the great culture and beautiful landscapes that Veracruz has and the normality that you can tell it has when you visit it as a tourist, the state is one of the most dangerous places to live in the whole country and the most dangerous place in the world to be a journalist. The hundreds of unsolved disappearances, frequent kidnappings, rampant extortions, and journalist getting killed almost every day, literally spread a climate of fear that dominates the entire state. Why is all this happening? There is not just one reason. It's part of the general atmosphere there, along with organized crime, drug violence and everything else that relates.

## A general view

The Mexican nation is now dominated by many powerful criminal organizations that are in a constantly one-on-one battle to control the drug trafficking routes and the drug market. The Mexican government also has hit a great success by arresting and incusing killing some cartel leaders. But this has led the other smaller criminal gangs to an extent that they have been forced to operate just as subsidiaries of the main and powerful cartels. In this way, the territory that is under their control is expanding, which means that at the same time what is also expanding is their business opportunities. The two main powerful organizations named 'Los Zetas' and the Sinaloa cartel, that had as a leader the famous drug trafficker Joaquin Guzman Loera, commonly now as El Chapo, luckily do not operate anymore as their leaders had been arrested. Of course, this gives the opportunity to the other criminal organizations to expand their operations as it was mentioned before, and they see those gaps that those two powerful cartels left behind as their time to become the leaders of the Mexican drug market. They inspire to be present almost everywhere in Mexico and continue the drug war that Los Zetas and Joaquin Guzman started and costed almost 35.000 to 40.000 lives. In general, the country has been plagued by violence because of the gangs and drug cartels. The deadliest year of the Mexican nation was 2018: we are talking about a record of 33,000 homicides. Hundreds of Mexicans are living in such inhuman conditions especially in those warzones where the levels of every day violence displace each day, even more and more people and make them reach for their own safety.

In the year 2011, in the Gulf coast seaport of Heroica Veracruz, 35 tortured and bound bodies were found. The local authorities presumed that the killers of those bodies were aligned with the Sinaloa cartel and the victims were linked apparently to Los Zetas, who took the control of this important seaport during the year 2010. This was the worst of the acts of the cartel of Sinaloa, along with a clash that took place after that, where more than two dozen people of the Zetas, were killed upon their try to pervade the territory of the Sinaloa cartel, in the state of Nayarit, in the Pacific Coast. But the state of Veracruz has been plagued by bloodshed on its streets, shootings, and massacre at many family's gatherings. During the year 2019, Mexico's National Public Safety Secretariat registered a total of 682 homicides from the month of January through March. It also registered 122 kidnappings in total, at the same time. This is why the year 2019 was the bloodiest in the history of Veracruz Massacre. It is without doubt, one of the most important areas of the country when it comes to importing and exporting goods but at the same time, the battleground for this bloody war between the drug cartels. Another terrifying event that was officially registered through the year of 2019, is the homicide of 13 people that were killed at a family party. Among the dead, there was a 1-year-old baby boy who was shot multiple times. His father also died, and his mother was harmed and hospitalized with other three victims. The local authorities said that the Jalisco New Generation Carte, also known by its Spanish acronym CJNG, was involved in the act of massacre which was basically the act of revenge. It was actually an act of common nature for the drug cartels but many times the criminal organizations do not harm children. The terrible killing of the 1-year-old-boy who was shoot multiple times according to local witnesses, it was the characteristic that put this act in the most terrifying ones and established the year of 2019 as the bloodiest. This act took place in the city of Minatitlan, in the southern part of the state. A few days later, a drive-by shooting happened in Mixtla de Altamirano, which is a town that is about 165 miles northwest of Minatitlan. The victims that were killed were three, Mayor Maricale Vallejo Orea, her husband, and their driver. It was clear that the year 2019 was the bloodiest year of the state which was entirely plagued by a wave of violence. There was an increase of 10% compared to last year's violence (2018) that took place in the state.

In the city of The Hague, Netherlands, in October 2022, the headquarters of the International Criminal Court (ICC), presented a public version of a report name 'Hasta encontrarlos: enforced disappearances by security forces in Veracruz constitute crimes against humanity'. This report was elaborated by the International Federation for Human Rights and in general, it gives an account of the context of criminality, violence and corruption that prevailed in the State of Veracruz, during the time of December of 2010-October 2016. It also mentions that the state, contains the two largest clandestine graves in Latin America, with over a total of 600 bodies.

This is a short story of the state of Veracruz, that gives light to the questions like how have violence and crime evolved in Veracruz, or why has this specific state become a reference point for homicides and disappearances during the last years. However, organized crime has been present in the state for at least 40 years, starting at the early years of the decade of 1980. The highland regions were mainly used for the cultivation of marijuana while at the same time the highway network and the port facilitated the transportation of narcotics and of its chemical precursors, as well as the transportation of oil theft and human trafficking. In the past, when we talked about criminal organizations and organized crime, it meant crime in the service of local bosses who were typically the leaders of unions or politicians or other type of leaders. Since the year 2000, crime and illicit activity started to increase in such an aggressive way and the reason for that was linked to the impunity which was almost always prevailed and still is nowadays. Crimes are no longer investigated the way they should be and that, led violence to become a tool for holding power and at the same time extend this power across more and more regions.

Presently, the port of the city of Herocia Veracruz, the port of Coatzacoalcos, and the regions of Sierra Ttotonaca and Cordoba, are the centers for organized crime and the control comes from regional criminal groups. It can't be said that there are no more cartels such as The Zetas or the Cartel of Sinaloa or even if they are not at this level, that they are also not going to be. It is worth of mentioning that the south part of the state of Veracruz, currently is under the control of groups that are considered substitutes of The Zetas, and this part is the most important plaza. A cocktail of criminal groups that have leaders that don't have clear affiliations or haven't fix them yet and are franchises, is the true general caption of the current situation that prevails in the state.

The real problem is that Veracruz is a state that is safety is based on narcopolitics. Everything depends on narcotrafficking: all the political power, the elected positions, the decisions, the politics, they are all negotiated. Between the governorships of Fidel Herrera (from 2004 to 2010) and Javier Duarte (from 2010 to 2016), in September 2011, was when the drug war began. The 35 bodies that were found tortured in Boca del Rio was the point of start of this war. Disappearances, murders, assassinations and mostly assassinations of journalists reached levels of crisis over the following years. It is a fact that since the end of the government of Duarte's, neither the human rights situation nor the security strategy has changed. The governance of Duarte was characterized by a decrease in robberies, but an increase in high impact crimes, such as kidnappings, extorsions and murders. Organized groups of criminals shifted to other type of crimes to maintain their balance and structure. The Jalisco New Generation Cartel has franchises in almost all the state of Veracruz, and they rent them to regional criminals, some of which include people from groups that belong to other groups that are opposed to the Jalisco New Generation Cartel, for example, groups that inspire to be the next Zetas. Now, in the city of Veracruz, there are no franchises, there are only the real leaders of the New Generation Cartel. This state it might be the most economically important, and there have been really few arrests. What became clear because of the arrests of police officials, regarding the situation and regarding the situation of violence in the state in general, is the fact that there has been a brutal collaboration between top-level authorities and criminal groups, something that was caused not only from the state government but also from previous federal administrations. Criminal collusion has been linked to people that are tasked with security in the state, from municipal authorities to the Marines. All these security authorities, committed disappearances in a systematic way, and called them 'limpias 'which means social cleansing and during those, many people and mostly young ones, were disappeared or killed as they were presumed to be parts of criminal organizations. Those type of practices were not obviously part of a strategy that had as a purpose the reduction of crime, but simply were a tactic to end with those type of rival groups under the cover of official activity. The proof that the police leadership was involved were photos and videos that were published not only in national but also in international media. A case that was the Pandora's Box for disappearances in Veracruz, was the disappearance of five young people that were from Playa Vicente. There was captured in a video the moment was this group of five was detained. This case led to the arrest of a total of 21 people, where seven of them were police and eight civilians who claimed to be members of the Cartel New Generation Jalisco. But corruption is not only related to drugs and criminal organizations that spread violence. It is also related to other types of crimes and abuse, like those crimes that were realized during the governance of Fidel Herrera first and of Javier Duarte afterwards, that show very clear that violence has many forms, and it can be easily covered by the people that are supposed to protect society and not to harm it. If a person that holds power and abuses of the trust that society

shows him, then this person is capable of anything, and drug trafficking is considered just an easy way to earn money.

## Challenges and solutions

The safeguard of human rights is one of the biggest challenges globally and maybe the most difficult challenges in Mexico. Violence continues to take place in the country, and this means that the need to continue addressing the need of the affected people is growing. Safeguarding human rights in Mexico, hasn't stop being an ongoing challenge as the country hasn't stop facing multiple human rights issues across many and different areas. Some other key aspects for the safeguard of human rights in Mexico could be the improvement of the current legal framework in order to be more comprehensive when it comes to the protection of human rights. Fortunately, there is the Mexican Constitution and various treaties of international character and conventions that serve as a strong foundation for protecting human rights. The National Human Rights Commission is also an agency the is responsible for the protection and promotion of human right in the country. It is truth that is has been doing a great job when it comes to human rights abuses, investigations, and recommendation of issues. Also, the General Law of Disappearances that passed in 2017, tries hard to address the forced disappearances that most of the times happen as part of the war between cartels. Mexico needs also to work on its freedom of expression rights, defend and protect them as the environment when it comes to drugs is dangerous for journalists and it is well known that the attacks on media are very common. Civil society organizations, international entities and human rights defenders play a crucial role when Mexico tries to monitor and advocates for the protection of its human rights. The work and collaboration among all of them can help the government to remain accountable for the violations of human rights. Also, Mexico hasn't stop making little steps regarding its efforts to improve accountability and training of security forces.

Corruption and criminal complicity have been undermining the legitimacy of not only the Mexican government and its 31 states in general but mostly of the regional government of the state of Veracruz. The state governors have become the authorities of the country that are considered as disreputable. Many have been those one's that have come under investigation and research for related acts of corruption. Particularly in Veracruz, there is a strong alliance between criminal groups and the high levels of local political power. Javier Duarte is a clear example of a governor that has been accused of many types of crimes: buying homes using public funds, money laundering and killing children. The ex-governor is known for total corruption that described the public health system during his governance, as he approved the use of fake medication to treat kids with cancer. The proofs of this barbaric act are the results of laboratory tests that show clear that a medication that was administrated to children in chemotherapy at public hospitals, was a distilled water and not the necessary drug at all for the treatment. Antonio Nemi, the health secretary during Duartes governance, reported also the purchase of thousand fake HIV tests. They were bought between 50.000 and 70.000 and they all gave out negative test results. Without doubt, the corruption that describes the state of Veracruz, reached its top during the governance of Duarte. Of course, before him, the state was being run by other governors that kept up with the corruption system, like for example Fidel Herrera that approved the provision of faked drugs which had no active ingredient and they were sent to the State Cancer Center of Xalapa, which is responsible for treating mostly teens and very young children. Those are cases that show that this is a corruption that reaches a level of audacity. The impunity that describes those cases have generated a level of absurdity and audacity that Mexico had never seen before. This was an excess that pushed Mexicans to a boiling point, especially after Duarte, where governance became the synonymous with corruption. It can't be clearer the fact that when the authorities that are responsible for the safeness of the state and its habitants, are found involved to such stories that are the example of human rights abuse, there can be no trust to the government and at the same time the legitimacy of the government is of course completely undermined. Those were only a few examples of why the habitants in Veracruz decide to leave their state and homes, why there is no trust at all to the public health system, and as all this was not enough, drug war and violence makes them walk in the streets with fear and it obligates them to get used to live under fear even in their own houses. What the state of Veracruz provides is a glimpse into the criminal corruption that the nominal democracy of Mexico is trying to hide. In Veracruz, as it became clear above, there is an alliance between corruption, criminal organizations, and the local political power, and this has been guaranteeing impunity.

This epidemic of violence, killings, and disappearances in the state at least it gave birth to a robust movement of the civil society of the state. This movement is not only an intent to end up with the drug war but also an intent to show the frustration of the society regarding the corruption and abuse during the governance of Duarte. It is a movement that began from some activists that made an important effort to change the narrative that surrounds the victims and to create an environment of empathy. The have been trying to help the victims not to feel shame and

had been helping to the creation of a stronger civic movement. This led to more honest descriptions from the part of the victims and helped the realized that victims can be people from all social societies as the violence started to touch people from all social classes. But there are voices in the society that demand a stronger response from the government.

Now, regarding Veracruz to break impunity, the criminal collusion of the state, to also break this cycle of violence and to restore confidence as the guarantor of rights and basic order in the state, should be considered at on the most important challenges that the authorities of the state should have in mind.

The Veracruz state government needs to follow specific steps to successfully reach those important points of purpose. First, it needs to admit and accept to investigate the involvement of the state in crimes against humanity, such as assassinations and forced disappearances. Second, provide to different types of civil society actors the right to pair with the judicial authorities of the state regarding the initiative of investigations into serious crimes and disappearances. Therefore, support the establishment of an effective witness protection program. Also, transparently, and fairly initiate the removal of criminally and corrupt complicit officials from different state institutions, especially the State Police, as well as the high-level officials that are accused of collusion with organized crime groups and any type of involvement in serious crimes. It is important also the introduction of effective financial and oversight mechanisms and this particularly could begin with the voluntary disclosure of the use of public funds. It also important to demonstrate commitment when it comes to freedom of speech and strengthen the existing mechanisms of protection for human rights activists and journalists. The improvement of the coordination of the state government with the federal government in security improvements, anti-organized crime operations and strategies, support for victims and programs regarding crime prevention is also a necessary step. Last but not least, support the police reform by improving the living standards of police officer's and restore the dignity to their service conditions, implement measures for the prevention to the participation of state forces in crimes such as forced disappearances and in general in any crime against humanity by installing tracking GPS devices in patrol cars and also cameras in police stations and storing freedom of information by strengthening the protection mechanism for human rights defenders and journalists with the introduction of sanctions of administrative character against officials that are non-compliant.

The raise of awareness and the promotion of respect for international humanitarian law and human rights law, are the main goals that should be putted seriously in priority for creating a respectful environment of human life and dignity. International norms and standards need also a reinforcement regarding the protection of international human rights. The maintain of the humanitarian dialogue with the police and the armed forces to promote the protection of the rights and dignity of those people thar are affected by the armed conflicts while creating an environment more respectful and face the need to implement and design better medium and long term strategies that would be able to deal more effectively with hundreds of people that are obligated to abandon their homes or they are obligated to live under danger, should always be a priority. Mexico's journey to protect fully human rights and uphold them is marked by setbacks, progress and efforts that are ongoing, especially in the case of the state of Veracruz. It is of great importance the continued collaboration and vigilance the insurance of human rights so people to be respected, fulfilled, and protected and of course to feel that they truly are.

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# Humanitarian Logistics

# Supply chain risk governance: exploring citizens' role in crisis preparedness

Aino Ruggiero[1], Wojciech Piotrowicz[2]

[1] Humanitarian Logistics and Supply Chain Research Institute, Hanken School of Economics, Arkadiankatu 22, 00100 Helsinki, Finland
Email: aino.ruggiero@hanken.fi
[2] Humanitarian Logistics and Supply Chain Research Institute, Hanken School of Economics, Arkadiankatu 22, 00100 Helsinki, Finland
Email: wojciech.piotrowicz@hanken.fi

**Abstract**

Disruptions have marked the first years of 2020 to an extent that normalcy does not seem to exist anymore, but rather society is marked by a constant flow of dynamic changes where preparedness for crises is of paramount importance. As the COVID-19 pandemic and the Russian invasion of Ukraine in 2022 both showed, all sectors of society are affected by large-scale disruptions, and the participation of all societal actors is needed to mitigate and cope with their effects and ultimately resolve them. This paper presents a research plan for a study that aims to explore citizens' role in the security of supply and crisis preparedness. Citizens' participation is explored from the perspective of supply chain risk governance (Ahlqvist et al. 2020) which combines perspectives from supply chain risk management (SCRM) and risk management and societal safety (RMSS). First, a scoping literature review is conducted to explore existing research on the topic, and second, interviews are conducted with relevant actors to gather data. In terms of a theoretical contribution, the findings of this research could expand the existing supply chain management literature by illustrating the role of civil society in supply chain risk governance. On a practical level, bringing clarity on the roles of citizens in supply chain preparedness could contribute to societal preparedness, and ultimately, resilience.

**Keywords:** crisis preparedness, risk governance, supply chain risk management, societal resilience

## 1 Introduction

Disruptions have marked the first years of 2020 to an extent that normalcy does not seem to exist anymore but rather society is marked by a constant flow of changes where preparedness for crises is needed in all spheres of society. As the COVID-19 pandemic and the Russian invasion of Ukraine in 2022 both showed, all sectors of society are affected by large-scale disruptions, with cascading effects, and the participation of all societal actors is needed to mitigate and cope with their effects and ultimately resolve them.

In this context, this paper presents a research plan for a study that aims to explore citizens' role in the security of supply and crisis preparedness. In this research, citizens' participation is explored from the perspective of supply chain risk governance (Ahlqvist et al. 2020) which combines perspectives from supply chain risk management (SCRM) and risk management and societal safety (RMSS). In doing so, this research focuses on the aspect of the supply chain that has not received much attention yet, namely, citizens. Finland serves as the case country for this study, and citizens' participation is explored as part of the whole-of-society approach to crisis management. The whole-of-society approach to risk governance is a holistic approach to preparedness that is prevalent in the Nordic countries and entails that preparedness for crises is conducted in cooperation with all societal actors (Meriläinen & al. 2020). In Finland, the concept of comprehensive security is used. Accordingly, "vital functions of society are jointly safeguarded by the authorities, business operators, organisations and citizens" (Security Committee 2017, p. 5).

This research is conducted as part of the CORE[1] (sCience& human factOr for Resilient society, https://www.euproject-core.eu/) project that aims to foster a culture of improved preparedness, adaptability, and resilience to multiple risks across organisations and countries in the EU (CORE 2023). This study constitutes a

follow-up study for research where the aim was to map how the security of supply is organized within the disaster management and DRR frameworks of selected EU countries.

## 2 Theoretical background

The theoretical basis of this research is grounded in the intersection of supply chain risk management, and risk/crisis management and societal safety. In the face of turbulences and uncertainties that the global supply chains are facing, supply chain risk management (SCRM) is a research domain that explores strategies for how companies identify, analyse and manage risks involving their supply networks (Ahlqvist et al., 2020). With a focus remaining on the commercial sector, a move away from focal company-centeredness to a more holistic and inclusive approach is that of collaborative supply chain risk management (Friday et al., 2021).

In the sphere of society, risk management and societal safety (RMSS) cover societal risks and deal with a wider array of stakeholders yet often consider the state as the main actor (Ahlqvist et al., 2020). The risk management processes are divided into distinct phases, including e.g., mitigation, preparedness, response, and recovery (Meriläinen et al., 2020). With the complexity of society and related risks increasing, as in the case of critical infrastructures and vital societal functions, the need for solutions that are equally multifaceted and complex and can only be met by a multitude of actors has emerged (Ahlqvist et al., 2020). To answer that call, disaster risk governance is a concept that indicates the multitude of actors, not only the state nor private sector, involved in risk management (Meriläinen et al., 2020; Tierney, 2012). In general terms, governance refers to "an institutionalised decision-making process among many independent actors" which is "operationalised into more detailed and concrete governance mechanisms that may direct various actors' behaviours" (Ahlqvist et al., 2020, 383).

To further add an inter-organisational dimension to risk management, and to combine insights from supply chain risk management (SCRM) and risk management and societal safety (RMSS) in an interdisciplinary and integrated approach, supply chain risk governance has been suggested as a term in the intersection of the two (Ahlqvist et al., 2020). It was proposed for systemic risks involving critical infrastructures, where cooperation across different sectors of society involves multiple actors, both private and public, and in the case of disruption, cascading effects may occur. As the present study focuses on the security of supply and crisis preparedness, which comprises preparedness for the whole society and all societal actors, this concept is considered a fruitful starting point. However, while the related framework is aimed at multi-actor networks, the focus is on public and commercial actors, and civil society actors, including citizens and households, are not addressed. Hence, one of the purposes of this research is to explore how this framework could be expanded to include citizens' perspective.

## 3 Methodology

The empirical part of this study consists of three overlapping phases. First, a scoping literature review is conducted to explore existing research on the topic, and second, a case study on the Finnish security of supply system is conducted. The purpose of the scoping literature review is to 'map rapidly the key concepts underpinning a research area and the main sources and types of evidence available and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before' (Mays et al., 2001, p. 194). In the context of the present study, the aim of the scoping review would be to map past studies involving citizens' role/participation in the domains of 1) risk governance and 2) supply chain risk management. In particular, the purpose of reviewing the literature would be to plot governance mechanisms involving citizens' participation in the literature. To meet these aims, the following research questions were formulated for the scoping study:

RQ1: How is citizens' participation in crisis preparedness characterised/conceptualized in risk governance and SCRM literature?

RQ2: What governance mechanisms are relevant for citizens' participation?

In the second stage, a case study involving the security of supply system of Finland is conducted. The findings of the scoping review are examined in light of the Finnish security of supply system. In particular, the implementation of citizens' participation in the Finnish security of supply system is studied. Moreover, the

governance mechanisms in place are mapped and explored. Interviews will be conducted with organisations that are involved in crisis preparedness and relevant to citizens' participation. In particular, the Security Strategy for Society, which describes the comprehensive security model of Finland, is analysed and parties involved in its implementation concerning civil society participation are interviewed. Moreover, the security of supply system and the related organization is explored from the same perspective, and organisations involved in coordinating and cooperating around citizens' preparedness, are interviewed. In the sphere of preparedness training, organisations and training programs are explored and participants interviewed. For these aims, the following research questions were formed:

RQ3: How is citizens' participation in crisis preparedness actualized/implemented in the Finnish security of supply system?

RQ4: What governance mechanisms are in place for the involvement of citizens in the Finnish security of supply system?

Finally, the findings in the first two parts of the research are brought together and synthesized. In an attempt to advance theory building, combining literature and the findings from the empirical part, an answer is sought to the following research question:

RQ5: How can citizens' participation be conceptualised for supply chain risk governance?

This research follows an interpretive approach (e.g. Derby et al., 2019). Multiple methods and data sources are used to create a holistic understanding of the studied topic (Denzin & Lincoln, 2008). A socially constructed view of reality is assumed, acknowledging the interrelation between the researcher and the studied topic (Berger & Luckmann, 1966). Finland is selected as the case study country as in the Finnish crisis management system citizens are considered important security actors along with governmental, business, and civil society organisations (Security Committee, 2017). Hence, the experiences and perceptions of these actors serve as important insights in co-creating knowledge that can serve as a benchmark and benefit practitioners in other countries. Data collection and analysis can best be illustrated in the form of a cycle where one complements another in an iterative manner (Derby et al., 2019).

## 4 Expected findings

The findings of this research could contribute to the existing supply chain management literature by illustrating the role of civil society in supply chain risk governance, a previously unexplored topic. At the same time, the sphere of risk management and societal safety may also benefit from a more inclusive approach that covers a wider range of societal actors. Hence, it continues on the line of interdisciplinary efforts of Ahlqvist et al. (2020) in an integrated and holistic approach reflecting a systemic paradigm in solving pressing societal issues involving disruptions and crises.

On a practical level, bringing clarity on the roles of citizens in supply chain preparedness could contribute to societal preparedness, and ultimately, resilience, in several ways. The participation of citizens can, for example, help buy time for the governments to initiate their response activities in the case of a natural catastrophe. Moreover, citizens' home preparedness can alleviate indirect harmful effects of crises, such as hoarding, as happened during COVID-19 when people stormed shops to buy pasta and toilet paper in fear that it would end. A home stock would also prevent an ill person from going needlessly to a shop to spread viruses or going to the hospital if he knows how he can help himself/herself at home. A prepared citizen is also a prepared employee with fewer worries, able to perform his duties as an employee if he knows his family is well and safe in the case of a crisis. Hence, when citizens know how to act in case of a disruption, and are prepared both materially and immaterially, they can contribute to the continuity of vital societal functions. Moreover, clarifying the roles of citizens as security actors beyond home preparedness can also improve future communication about crisis preparedness to citizens in the form of different preparedness materials and via different communication channels.

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# Expanding Reinforcement Learning Modeling Capabilities in Emergency Supply Distribution via Action Masking

Rudy Milani[1], Joshua Arnold[1], Maximilian Moll[1], Stefan Pickl[1]

[1] Department of Computer Science, University of the Bundeswehr Munich, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany
Email: rudy.milani@unibw.de

**Abstract:** Mitigating post-disaster human suffering through the provision of emergency resources is a challenging problem from a logistical standpoint. Finding optimal distribution strategies can be a challenging task. In this paper, we apply action-masked Reinforcement Learning to a novel formulation of the problem of emergency resource distribution within the context of disaster relief logistics. Specifically, we propose a solution approach for the scenario of supplying several locations of resource consumption via a single logistics hub. Our main contributions are twofold. Firstly, we extend prior work by defining a more complex mathematical optimization problem including multiple constraints through which we induce spillover effects over multiple time steps in the system dynamics. Secondly, we employ action masking in our reinforcement learning approach to help the agent avoid taking newly generated invalid actions. Furthermore, we compare one-step and two-step greedy heuristics with the action-masked version of Q-learning in a variety of simulated scenarios. Results confirm the usability of action-masked Reinforcement Learning even though the one-step greedy approach achieves the best performance-time ratio.

**Keywords:** Reinforcement Learning; Machine Learning; Humanitarian Logistics; Disaster Relief; Emergency Resource Allocation

## 1. Introduction

Alleviating the negative impact of natural or man-made disasters on the affected communities requires significant logistical effort in their immediate aftermath (Cozzolino, 2012). Allocating basic necessities such as water, food and medicine within a reasonable amount of time, given constrained supplies and means of transport can be a challenging task. The research community has coined the term *humanitarian logistics (*Cozzolino, 2012; Klumpp et al., 2015) to describe this logistical effort to mitigate post-disaster human suffering.

Prior work has discussed and solved a wide range of different formulations of the emergency resource allocation problem. For instance, (Jain and Bharti, 2023) aim to find optimal assignments of response units to emergency locations. (Wang et al., 2022) on the other hand, propose a more all-encompassing approach, i.e., they start from the path planning phase between the logistics hub and the final destinations. Other works such as (Fan et al., 2022) assume that the paths and associated transportation costs are given. Their problem definition will be extended in our work.

Recent years have seen a surge of interest in all areas of machine learning, including Reinforcement Learning (RL) (Schrittwieser, J. et al., 2020). RL's increasing popularity can be attributed to its effectiveness at solving sequential decision problems, which sit at the core of a variety of problems in logistics and operations research in general (Powell, 2022). In the following section, we will first briefly introduce RL and then discuss how (Fan et al., 2022) define their interpretation of the humanitarian logistics problem. Then, we will present our extensions to their optimization task, highlighting particular tricks and challenges in applying RL to such problems. Finally, we will present our solution approach to the aforementioned extended problem.

# 2. Background

## 2.1. Reinforcement Learning

Essentially, we are aiming to solve a sequential decision problem which can be modeled as a Markov Decision Process (MDP) (Sutton and Barto, 2018). MDPs are discrete time stochastic control processes. We can formalize an MDP as a 5-tuple $(\mathcal{S}, \mathcal{A}, \mathcal{T}, \mathcal{R}, \gamma)$, where $\mathcal{S} \subseteq \mathbb{R}^n$ is the state space, $\mathcal{T}: \mathcal{S} \times \mathcal{A} \to \mathcal{S} \times \mathcal{R}$ is the transition function and $\gamma \in [0,1)$ is a discount factor. After choosing an action $a_t \in \mathcal{A}$, where $t \in \mathbb{N}_0$ denotes the time step, the agent enters a new state $s_{t+1}$ and receives a reward $r_{t+1}$ according to $s_{t+1}, r_{t+1} = \mathcal{T}(s_t, a_t)$. The agent's goal is to choose a sequence of actions that maximizes the expected return $\mathbb{E}[G_t]$, where $G_t := \sum_{k=0}^{\infty} \gamma^k r_{t+k+1}$ (Sutton and Barto, 2018). We can easily see how the discounting factor $\gamma$ can be set to place less focus on later rewards. Typically, the agent tries to learn a policy function $\pi: \mathcal{S} \to \mathcal{A}$ which suggests the optimal action in each state. A fundamental quantity in RL is the action value function $Q^{\pi}(s,a) = \mathbb{E}_{\pi}[G_t | s_t = s, a_t = a]$, which measures the expected future return, if, in state $s$, action $a$ is chosen and policy $\pi$ followed thereafter (Sutton and Barto, 2018). Q-learning (Watkin and Dayan, 1992), one of the most-used RL algorithms, attempts to learn the optimal action-value function through a combination of explorative experience and bootstrapping. The policy is derived by choosing the action that maximizes the obtained function. This fundamental setting, however, can only be applied to small and finite state and action spaces. Thus, DQN (Mnih et al., 2015) approximates the action-value function by a neural network and adds some more details to stabilize training.

## 2.2 Related Work

Finding optimal strategies for the humanitarian supply distribution problems are well-known studied challenges. However, the opportunity to consider machine learning-based approaches has not been extensively explored, in particular, in the case of Reinforcement Learning. On this thread, Fan et al. (2022) propose an RL-based approach to solve the problem of allocating a limited number of resources from a single logistics hub to a set of *N* distinct locations where these resources are consumed. The authors focus on the 72-hour time window after the disaster, as they propose that it is the most critical phase for emergency response (Fan et al., 2022). This time frame is partitioned into *T* sub-periods of equal length, i.e. $t \in \{1, \dots, T\}$. During each of these time steps, Fan et al. (2022) aim to allocate resources up to some available amount *C* which represents the resource capacity of the logistics hub. Sending, at time step $t$, some resources $a_t^i \in \mathbb{N}$ from the hub to location $i$ is associated with some cost $c_i$. Fan et al. (2022) trace the evolving state of the system by assigning each location $i$ with a state variable $S_t^i \in \mathbb{Z}$, which denotes the amount of demand at location $i$ at time $t$. Each state can decrease via the allocation of new resources and increase via the inherent resource demand *D* of the location $S_t^i = S_{t-1}^i - a_t^i + D$. Fan et al. (2022) consider three distinct types of costs, namely *accessibility*, *deprivation* and *unfairness*. Fan et al. (2022) summarize their optimization objective as

$$min \underbrace{\xi_1 \sum_{i=1}^{N} \sum_{t=1}^{T} c_i \, a_t^i}_{\text{accessibility cost}} + \underbrace{\xi_2 \sum_{i=1}^{N} \sum_{t=1}^{T} \Gamma\left(S_t^i\right)}_{\text{deprivation cost}} + \underbrace{\xi_3 \sum_{i=1}^{N} \Gamma\left(S_{T+1}^i\right)}_{\text{unfairness cost}}, \tag{1}$$

where the authors model the cost of accessibility by assuming that there is some $c_i \in \mathbb{N}$ associated with the allocation of each unit of resource to location $i$. Hence, the total accessibility cost can be written as $\sum_{i=1}^{N} \sum_{t=1}^{T} c_i \, a_t^i$. Furthermore, Fan et al. (2022) have defined $\Gamma\left(S_t^i\right) = e^a (e^{bL} - 1)(e^{bL})^{S_t^i}$ for $S_t^i \geq 0$ and $\Gamma\left(S_t^i\right) = 0$ otherwise, where $a$ and $b$ are the deprivation parameters, and L is the length of a single time period. Intuitively, the costs of deprivation and costs of unfairness counteract one another, as the former penalize under-delivering while the latter penalize over-delivering resources to locations. Finally, the $\xi_i$ are scalar weighting factors. In the following, we will define our extension to this problem definition.

# 3. Methodology

## 3.1. Optimization Problem Formulation

We formulate our resource allocation problem via an optimization model as follows:

$$min \quad \sum_{i=1}^{N}\sum_{t=1}^{T} c_i \mathbb{1}_{\{a_t^i>0\}} + \Gamma\left(S_t^i\right) \tag{2a}$$

$$s.t. \quad S_t = S_{t-1} + a_t - D \tag{2b}$$

$$C_t = C_{t-1} - \sum_{i=1}^{N} a_{t-1}^i + I_c \tag{2c}$$

$$a_t \leq F \tag{2d}$$

$$\sum_{i=1}^{N} a_t^i \leq C_t \tag{2e}$$

$$-M_S \leq S_t^i \leq M_S \tag{2f}$$

$$0 \leq C_t \leq C \tag{2g}$$

for $t$ = 1,2,...,$T$. Similarly to Fan et al. (2022), we aim to minimize transportation costs. However, we assume that there is no additional cost associated with transporting more units of resource to $i$. Intuitively, this can be interpreted as saying that once we decide to drive a truck to $i$ for transporting one unit of resources, adding another unit of resources to this delivery brings no additional cost. Hence, we can rewrite the allocation cost as in the first part of Equation 2a, where $\mathbb{1}_{a_t^i>0}$ simply is an indicator function that is equal to 1 if $a_t^i > 0$ and else is equal to 0. Furthermore, we absorb costs of deprivation and unfairness into one term, namely into the second part of Equation 2a. Here, we redefine $\Gamma$ such it holds that $\Gamma\left(S_t^i\right) = 0$ for $S_t^i \geq 0$, whereas else we require that $\Gamma\left(S_t^i\right) = e^a(e^d - 1)e^{-dS_t^i}$, with $d = bL$ and $a$ as in the previously defined case.

Note, that we have changed the semantics of the state encoding from the original meaning *demand of $i$ at $t$* in (Fan et al., 2022) to the new meaning of *supply at location $i$ at time $t$*. Thus, the state updates are now described by Equation 2b. Additionally, we introduce a constant $I_c \in \mathbb{N}$ that models an incoming stream of resources to the logistics hub that arrives at each $t$. We assume that at each time step, we can allocate the sum of the remaining capacity from the last time step and the aforementioned fresh resource supply. Thus, we propose to reformulate this aspect as Equation 2c. Note that, in Equation 2g, it holds that $0 \leq C_t \leq C$. We restrict the action space by requiring Equation 2d, where $F \in \mathbb{N}^N$ is a constant vector representing the limitation of supplies that can be sent to each location. Moreover, we introduce action masking for the agent via Equation 2e. Lastly, we added the constraint in Equation 2f in order to limit the possible configurations of the status $S_t$ available to a maximum value $M_S \in \mathbb{N}^N$. In this way, our method could lend itself to scenarios of highly limited amounts of perishable resources, as we penalize both the under- and over-supply of locations as well as consider the arrival of fresh resources to the logistics hub at each time step. In the next subsection, we present the MDP formulation considered for the experiment developed.

## 3.1. MDP Formulation

In order to solve our problem with RL, we have to define three fundamental building blocks of the algorithm: (i) the *state space*, (ii) the *action space* and (iii) the *reward function*. Firstly, we define the states of our MDP as the vector of the status and the remaining capacity at time $t$ as $s_t := (S_t, C_t)$. Moreover, it can also be expressed with all the multiple components referring to each individual location $i$ as $s_t = (S_t^0, \dots, S_t^N, C_t)$. This allows us to summarize all information necessary to take the correct action.

It is important to remark that the dimension of the state space is exponentially growing with respect to $N$. In particular, we have that $|\mathcal{S}| = (C+1)(2M_S+1)^N$. The same problem poses itself for the action space in the case that we model the action performed at time $t$ as $a_t = (a_t^1, a_t^2, \dots, a_t^N)$. Combined with the constraint in Equation

2d, we are able to restrict the action space to $|\mathcal{A}| = \prod_{i=1}^{N}(F_i + 1)$. However, the set of admissible is much smaller. In fact, we have the dynamic updating of the upper capacity of resources that we can supply, represented in Equation 2e. Nonetheless, we consider a static action space in order to keep the problem simple and we solve this issue using action masking (Huang and Ontañón, 2020). This strategy is a well-known methodology in Reinforcement Learning, applied to complex games where multiple rule sets make possible actions feasible (Vinyals et al., 2017). Intuitively, action masking removes all actions from the action space of the agent that are invalid with respect to some constraints. In our case, we are taking out the possible actions that sum up to a higher value than the actual capacity, hence satisfying Equation 2e. Moreover, it is also possible to consider the action masking in order to train just a single RL agent for solving the problem for large size scenarios. In fact, by fixing the values relative to the areas not considered in smaller situations to 0, we can still consider the aforementioned model, masking the invalid actions that would involve the supply of not present areas. In this way, the training time could be extremely decreased.

Finally, we define the reward function our agent aims to maximize. In our case, the selection is trivial since the objective function can already model the most of the environment. The only change is in the sign associated with Equation 2a. In this way, we obtain that the reward as $r_{t+1} = -\left(\sum_{i=1}^{N} c_i \mathbb{1}_{a_t^i>0} + \Gamma\left(S_{t+1}^i\right)\right)$. We have now defined all technical aspects fundamental to understanding the framework considered. In the following section, we will discuss the results of our simulation.

## 4. Results and Discussion

In this section, we assess the performance of our Q-learning approach by comparing it to two heuristic benchmarks, i.e., a one-step and a two-step greedy algorithm. The experiments were conducted on a server with 256 (2 x 64 +Hyperthreading) cores, 2x AMD EPYC 7763 CPU and 1007Gb RAM.

First, we need to declare the instances that have been considered for the test phase. In particular, we focus our attention on three possible values for the number of areas to supply, $N = \{3,4,5\}$, and four possible capacity limits for each of those values. In detail, we consider for $N = 3$ the values $C = 4,5,6,7$, for $N = 4$, $C = 5,6,7,8$ and lastly for $N = 5$ only $C = 6$. The maximum time step was always fixed at $T = 6$, as well as for the increase of the capacity $I_C = 3$, and the limits of the status of each location $i$, $M_S = 3$. The initialization of the states is performed considering a uniform distribution between the bounds of both the status and the capacity. Depending on the dimension of the problem, we constructed similar constant vectors for the demands and the capacity of the supplies. For the former, we created a vector that is equal to 2 in the even positions and 1 in the odd ones, i.e., $D = (1,2,1,\dots)^T$. Using the same idea, we constructed $F = (2,3,2,\dots)^T$, where we used 2 for the odd indexes and 3 for the even. Lastly, we have to declare the parameters associated with the reward function. Principally, the cost vector is generated starting with a fixed amount and, then, constantly adding an increment value for each new location. Therefore, the singular costs follow the rule $c_i = 200 + 50i$. Finally, for the deprivation/unfairness function, we used $a = 3$, and $d = 1.5$.

Under these conditions, we compared the Q-learning method with the one-step and two-step greedy algorithms (Efroni, Y. et al., 2018). These methodologies are simple heuristics based on the idea of taking the action that maximizes the reward obtained in one or two steps, respectively. Therefore, they have to first evaluate all the possible combinations of actions in order to find the correct estimate. However, this approach is extremely expensive since it must iterate the same analysis at multiple time steps. Thus, it is not optimal in terms of time consumption to search for the exact solution. For Q-learning instead, we can directly fix an amount of iterations that we want to consider and train until that point. In this way we can limit the necessary time needed at cost of not finding the best policy. For our experiments, we trained the Q-learning algorithms using a fixed set of hyperparameters: learning rate $\alpha = 0.01$, discounting factor $\gamma = 1$, starting exploration value $\epsilon_0 = 1$, minimum exploration value $\epsilon_m = 0.01$, subtractive decreasing exploration factor $\Delta\epsilon = \frac{1}{\mathrm{L}}$, where $L$ represents the number of iterations used for the training. The latter parameter is chosen accordingly to the size of the problem: for $N = 3$ we used $L = 10^6$, for $N = 4$ we considered $L = 5 \times 10^6$, and lastly, for $N = 5$, $L = 10^7$.

These methodologies are tested over 100 seeded episodes. The results and the time needed for the training are shown in Table 1. Here, the gap is calculated taking into account the best-performing algorithm, i.e., the two-step greedy, and averaging over all the episodes. From these results, we can notice how the Q-learning algorithm is

able to outperform both the greedy approaches for the small set environments, i.e., $N = 3$ and $C = 4$ and 5. However, it starts to get worse when the state and action spaces are larger. In fact, in those cases, it has to visit a higher number of possible states, thus, it is more probable to not find the correct policy to perform. Moreover, the training time of the Q-learning methodology strictly depends on the number of episodes considered. Nonetheless, the longer the training the best are the results achieved. Particularly remarkable are also the performances of the one-step greedy strategy. Indeed, it is the methodology that performs in the best way in terms of quality/time ratio. Obviously, even though there is always a gap with the approach that looks one step further, the times are still increasing in a much slower ratio.

| **Params.** | | | **Two-Step Greedy** | | **One-Step Greedy** | | **Q-Learning** | |
|---|---|---|---|---|---|---|---|---|
| **N** | C | T | Gap | Time (s) | Gap | Time (s) | Gap | Time (s) |
| **3** | 4 | 6 | 0.0% | 15.90 | 8.50% | 0.46 | -5.00% | 548.13 |
| **3** | 5 | 6 | 0.0% | 37.28 | 8.03% | 0.79 | -0.17% | 581.31 |
| **3** | 6 | 6 | 0.0% | 69.34 | 11.17% | 1.20 | 3.96% | 575.82 |
| **3** | 7 | 6 | 0.0% | 107.90 | 27.12% | 1.65 | 15.05% | 606.91 |
| **4** | 5 | 6 | 0.0% | 1116.22 | 5.91% | 11.48 | 10.97% | 3142.67 |
| **4** | 6 | 6 | 0.0% | 2345.01 | 4.51% | 18.97 | 12.37% | 3307.43 |
| **4** | 7 | 6 | 0.0% | 4327.89 | 4.81% | 29.31 | 16.48% | 3432.32 |
| **4** | 8 | 6 | 0.0% | 8974.58 | 2.66% | 44.33 | 28.52% | 3583.66 |
| **5** | 6 | 6 | 0.0% | 62826.83 | 7.38% | 276.27 | 33.40% | 7169.24 |

**Table 1.** Results obtained on 100 episodes.

This is principally due to the explosion of all the possible combinations of actions that can be tested, as can be clearly visible by looking at the training times of the two-step greedy. This quick increase in the dimension of the environment is a major computational problem. Furthermore, we also tested a DQN approach to the problem knowing the high performance capabilities of deep reinforcement learning methodologies. However, we were able to set up the experiment only for the smallest value of $N = 3$ since the memory of the GPU (NVIDA A40 with 138204MiB VRAM) was not enough to store all the data generated. Moreover, the results obtained after 4 hours of training led only to bad results (a gap of 600% compared to the two-step greedy). Therefore, we avoided further exploring this solution.

## 5. Conclusion

In this paper, we extended an emergency supply allocation problem by including a dynamic capacity constraint to the resources and compared a Reinforcement Learning algorithm with two greedy heuristics in solving the aforementioned optimization task. From the simulation generated, we noticed how Q-learning is able to outperform both the greedy approaches for small instances. Therefore, in those scenarios, it is advisable to apply a Reinforcement Learning methodology. However, we need to train it for a longer time compared to the other heuristics considered in this paper. For larger instances, the best solutions, in terms of minimizing the objective function, is obviously the two-step greedy. Nonetheless, the computation time is remarkably high. Therefore, if we want to obtain satisfying results in a decent time (order of minutes), the choice is the one-step greedy.

Fundamental for this experimentation is the action masking strategy, that allowed us to consider a stationary action set. Moreover, a possible direction for future study is the analysis of the results obtained in smaller instances by the masked version of the larger Q-learning agent. Furthermore, it would be interesting to test the

Reinforcement Learning algorithms in contexts where the updating variables are stochastics. In those situations, they could provide interesting results if compared to the classical approaches.

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# Challenges during the procurement cycle that procurement officers face in humanitarian organisations

Koligiannis Georgios[1], Maria Drakaki[2]

[1] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14th
Km Thessaloniki – N. Moudania, GR-57001, Thermi, Greece
hlc23006@uom.edu.gr@ihu.edu.gr

[2] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14th
Km Thessaloniki – N. Moudania, GR-57001, Thermi, Greece
ORCID iD: 0000-0001-9322-7324
mdrakaki@ihu.gr

**Abstract.** Procurement is a significant part of humanitarian logistics as it is how to buy all the items and services needed in the humanitarian field. Procurement includes several stages that permit the humanitarian organisation to obtain the contractually required items in the correct quantity and quality at the right place. However, procurement officers in humanitarian organisations face challenges in each stage of the procurement cycle. Such challenges include the diversity of the technical specifications, the time-consuming nature of the bidding processes and the unstable demand for the goods needed. The authors conducted online interviews with experienced procurement officers to understand their challenges and tried to find ways to overcome them. The research results highlighted that some ways to overcome challenges when procuring goods for the humanitarian field are to define technical specifications and selection criteria and use experienced personnel to evaluate the bidding documents. When long-term agreements are signed with suppliers, humanitarian organisations should never forget that some suppliers might not be able to deliver the contractual items on time, meaning that they have to find alternative solutions apart from imposing penalties on them.

**Keywords:** Bidding, Challenges, Humanitarian Operations, Procurement, Suppliers

## 1 Introduction

Procurement is much more challenging in humanitarian operations as organisations face several challenges. More precisely, they must cope with funding constraints, cultural sensitivity, limited knowledge of actual demand, and time constraints. The research paper aims to answer the following two research questions:

- What challenges do procurement officers face in each of the main stages of the procurement process?
- What can be done to overcome the challenges that procurement officers have to cope with?

The research paper is structured as follows. Section 2 presents recent literature on procurement in the humanitarian field. Section 3 explains the conceptual model conceived by the authors to answer the research questions. Section 4 describes the methodology applied and how the primary data were collected. Section 5 demonstrates the research results. In Section 6, the authors discuss the findings and critically review them; Section 7 presents the limitations of the research project, and the authors conclude in Section eight.

## 2 Literature review

According to Ertem et al. (2010), procurement is critical in humanitarian relief operations as pre-positioned inventory and donations do not meet the demand caused by the disaster. Moreover, procurement activities are also important as they account for 65% of humanitarian organisations' expenditures (Falasca & Zobel, 2011). The lack of inventory to meet the demand, longer lead times, competition for equivalent relief items between the buyers, and the low quality of the items purchased are among the problems that humanitarian organisations have to cope with in the procurement activities (Duran et al., 2013; Bagchi et al., 2011). The distinct nature of procurement

coordination mechanisms, the sources of supplies, and the relief items that need to be purchased during the response and preparedness phase make the procurement cycle more challenging in humanitarian operations (Ertem & Buyurgan, 2013). Funding is another challenge, as large donors have curtailed their humanitarian spending (GHA, 2019). The procurement cycle stages are presented in brief as follows.

### 2.1 Items specification (1st stage)

In this stage, humanitarian organisations define all the items needed to cover the needs in the field. More precisely, they have to define the technical specifications of the items required and estimate the quantity needed and the price of each item needed.

### 2.2 Sourcing the suppliers (2nd stage)

They also have to define the criteria that must be met by the potential suppliers that want to participate in the bidding process. Another critical issue is determining how the offers will be evaluated (i.e., the lowest financial offer or the most advantageous offer).

### 2.3 International tender (3rd stage)

Conducting an international tender is the best way to get the right products at the best price. However, it is a complex and time-consuming process as the evaluation committee has to check thoroughly all the bidding documents submitted by the suppliers. In several cases, they have to provide a sample of the items they offer to be evaluated if they meet the technical specifications defined in the initial stage.

### 2.4 Long-term agreements signed (4th stage)

After the international tenders, the humanitarian organisations sign long-term agreements with the suppliers and mutually agree to follow the terms and conditions defined. The supplier has to provide the items in the proper quantity and quality at the right place and the predefined fixed price. On the other side, the humanitarian organisation has to pay the supplier according to the contract's terms.

### 2.5 Placing purchase orders (5th stage)

When humanitarian organisations need contractual items, they place a purchase order to the suppliers. The purchase order defines the quantity of the products, the place of the delivery according to the International Commercial terms and the value of the purchase order.

### 2.6 Quality control (6th stage)

During this stage, humanitarian organisations check the contractual items delivered to verify if they meet the technical specifications defined in the first phase and sign the quantitative and qualitative acceptance protocols.

## 3 Conceptual Framework

The authors formulated a conceptual framework, illustrated in Figure 1, to visualise the main ideas under research and guide their investigation. As shown in the Figure above, factors affect procurement officers in humanitarian organisations during the procurement cycle.

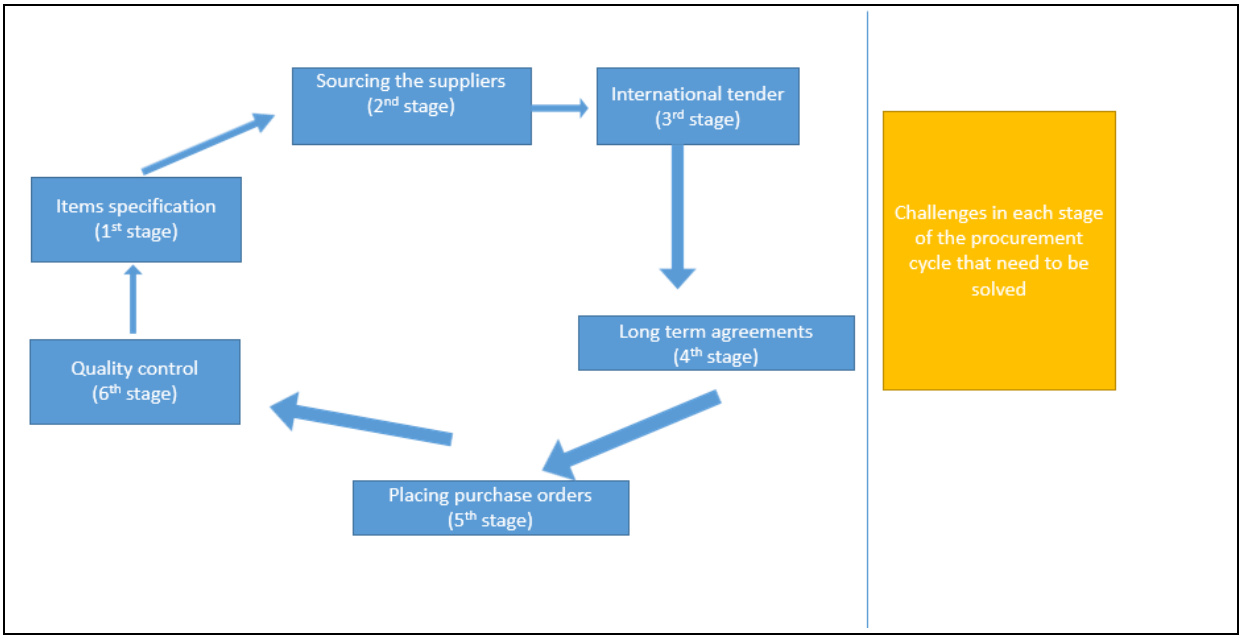


***Figure 1***. Conceptual framework conceived by the authors.

## 4 Data/Methodology

The authors conducted semi-structured interviews with procurement experts to gather primary data. All the interviews were conducted online, which provided flexibility, low cost, voice recording and wide geographical coverage to the authors and the participants. Anonymity was provided to the interviewees, and the participants were informed that they could withdraw from the interview or avoid answering questions that made them feel uncomfortable. The research is descriptive, as the authors tried to demonstrate the challenges that public procurement officers have to cope with during each stage of the procurement process. Peer-reviewed academic papers published in electronic journals were used to collect secondary data. The authors' educational and working background in logistics, procurement processes and supply chain management was beneficial to understand the field and communicate effectively with the participants. Before commencing the interviews, the authors formulated the questions in Table 1. These questions helped the authors prepare the research and inform the participants how they would support the author in the research project.

**Table 1**. Questions formulated as part of the authors' research strategy

| Question No | Description |
|---|---|
| No1 | How many years of working experience do you have? |
| No2 | What is your role in the procurement process? |
| No3 | For each stage of the procurement process, please define the main challenges. |
| No4 | What measures can be implemented to overcome the potential challenges in each stage? |

The authors intended and asked the participants to discuss in a group; however, none agreed with that suggestion.

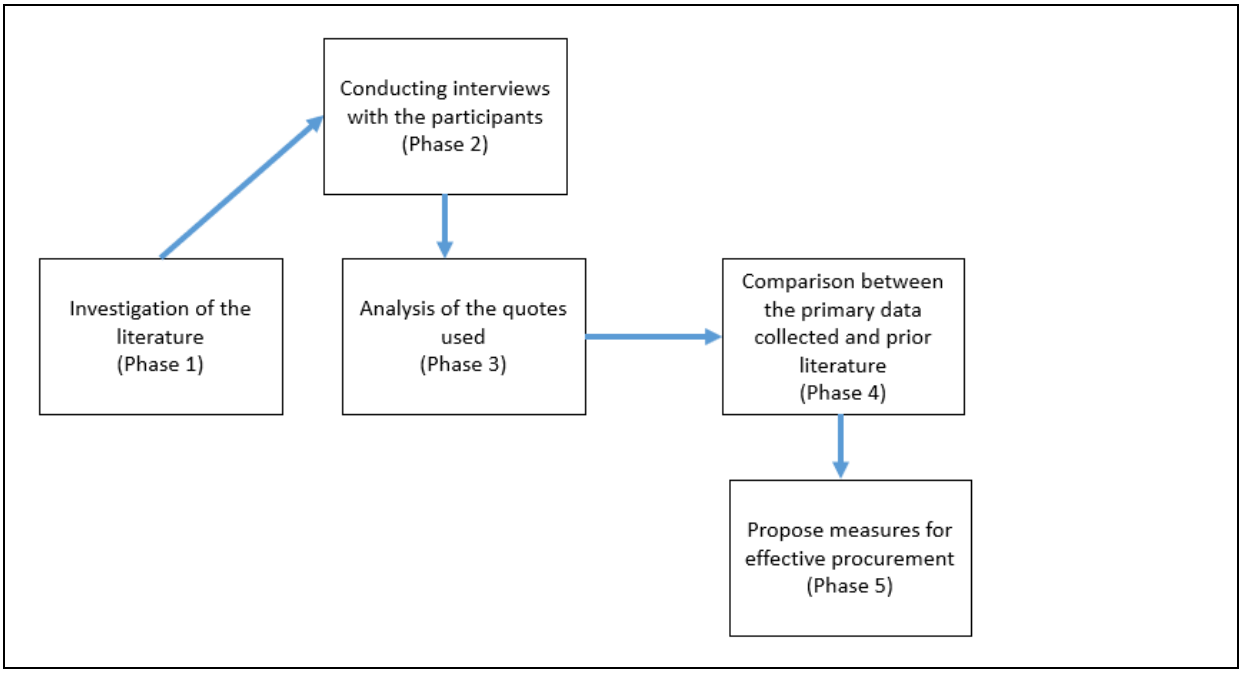


**Figure 2.** Data collection process

## 5 Results/Findings

As illustrated in Figure 3, half of them have more than ten years of experience in procurement processes. The rest have less than 5 years of experience in the same sectors.

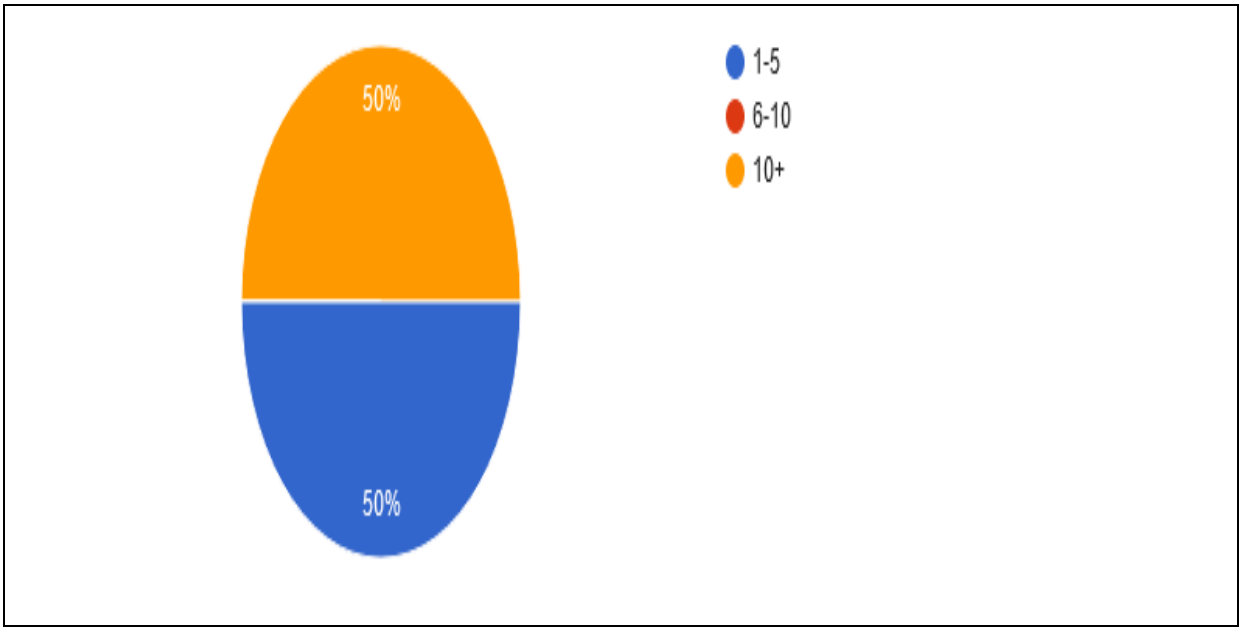


***Figure 3***. Years of working experience

The primary quotations of the participants related to the research questions are presented in Table 1.

***Table* 1**. Quotations retrieved from the participants in the research

| Main Challenges | Participant | Significant quotes from the participants |
|---|---|---|

| | | |
|---|---|---|
| 1st stage | X1 | *"It is difficult to define the quantity of the products needed because you do not know when the disaster will strike and the consequences."* |
| | X2 | *"Technical specifications are always an issue as we need the best quality products that can be supplied from many contractors."* |
| | X3 | *"Technical specifications need to be updated because needs are changing, and we need sustainable solutions."* |
| 2nd stage | X4 | *"All the criteria need to be defined precisely to be understood by all the suppliers that want to participate in the bidding process."* |
| | X1 | *"It takes much time."* |
| | X2 | *"All the documents submitted need to be checked thoroughly".* |
| | X3 | *"If the evaluation committee fails to check them thoroughly, the bidding process might take longer than usual."* |
| 3rd stage | | |
| 4th stage | X2 | *"There is always the possibility that the chosen supplier will not sign the long-term agreement for several reasons."* |
| | X3 | *"Signing the contract seems to be easy as before starting the bidding process,the suppliers know the general terms and conditions of the long-term agreement".* |
| | X4 | *"It is the final stage of the contract award. Then the stage of the contract execution begins. It is a defined process".* |
| 5th stage | X1 | *"As long as you have the funds, you place the purchase orders."* |
| | X2 | *"It is a common issue that the supplier responds to the purchase order with a confirmation. The problems start when you receive an e-mail stating that the contractual items cannot be delivered on time."* |
| | X1 | *"Sometimes the contractual items delivered do not meet the predefined technical specifications".* |
| 6th stage | X2 | *"Items are not delivered on time. Then we have to impose penalties for late delivery".* |
| | X3 | "*Suppliers demand the contractual items be rechecked to see if they meet the technical specifications. This takes more time.*" |
| | X4 | "*It is a nightmare if the contractual items delivered do not fit us. This means that we have to buy them from somewhere else.*" |

Regarding what can be done to solve the problems in each procurement process, the participants voiced the views presented in Table 2.

***Table 2***. What can be done to solve the problems

| Solutions | Participant | Significant quotes from the participants |
|---|---|---|
| 1st stage | X1 | "*Define clearly the technical specifications.*" |
| | X2 | *"Try to facilitate the participation of the highest amount of suppliers in the bidding process."* |
| | X3 | "*Always provide the clarifications asked from the potential suppliers.*" |
| 2nd stage | X4 | "*Define clearly the documents that need to be submitted by the suppliers*" |
| | X1 | "*The evaluation committee should be experienced.*" |
| | X2 | *"If clarifications are needed from the suppliers, the evaluation committee should ask them to give them".* |
| 3rd stage | X3 | "*All the procedures should be conducted according to the contract notice.*" |

| | | |
|---|---|---|
| 4th stage | X2 | "*In case the chosen supplier does not wish to sign the long-term agreement, then the organisation has to find an alternative solution to procure the products needed.*" |
| 5th stage | X1 | "*Funding is always a problem. That is why you must place purchase orders only on items needed.*" |
| | X2 | "*If the supplier declares that the contractual items are not delivered on time, then you must find an alternative supplier to cover your urgent needs.*" |
| 6th stage | X1 | *"You have to ask the supplier to replace them on time."* |
| | X2 | "*When penalties are imposed, the supplier is always reluctant to participate again in a future contract award*". |
| | X3 | "*Some contractual items, because of their nature, should be sent to the proper laboratory to check if they meet the technical specifications.*" |
| | X4 | "*It is a common issue that is why you must define the proper selection criteria in the second stage of the procurement process.*" |

## 6 Discussion

Concerning the 1st research question, the procurement experts highlighted that defining the quantity of the products needed is a significant issue that complies with the findings of previous research (Duran et al., 2013; Bagchi et al., 2011). To the author's knowledge, no prior research has highlighted the challenge that technical specifications need to be updated regularly. The interviewees probably expressed this view based on their experience that needs to evolve and innovative products are produced to cover the beneficiaries' needs. Another major challenge is that procurement activities are time-consuming. The procurement authorities spend much time evaluating the documents submitted by the suppliers to choose the best financial offer that complies with the selection criteria. It was also highlighted that problems start when the products and services delivered by the suppliers do not meet the needs. The interviewees probably wanted to express their stress as they have spent much time without getting the desired products and services. Funding was mentioned as another challenge in humanitarian procurement activities, aligning with prior research findings (GHA, 2019).

Concerning the second research question, the interviewees mentioned that the procurement authorities must define the technical specifications of the products and services needed and define the selection criteria to facilitate the participation of numerous suppliers. That way, the competition increases, and the authorities buy the required products at the best price. It was also highlighted that the evaluation committee members during the bidding process must be qualified and experienced to evaluate according to the contract notice. In this way, the time-consuming nature of the procurement activities minimises. According to the author's experience, two problems arise when the contractual items are not delivered according to the contract. The first is finding an alternative way to procure the products needed on time that will cover the needs in the humanitarian field. The second is that the procurement authority has to impose penalties on the suppliers as the contract has not been performed according to the agreed-upon terms and conditions. Concerning the funding constraints, the interviewees proposed to place purchase orders only when items are needed.

## 7 Limitations

The authors did not gather quantitative data; However, the research paper aimed to highlight the problems in the procurement cycle and propose ways to overcome them. Thus, the authors decided to use only qualitative data. Another limitation related to the secondary data was that only scientific papers published in English were used to present the literature review on the topic under research.

## 8 Conclusions

The authors conducted online interviews with experienced procurement officers working in humanitarian organisations to highlight the challenges they face in each stage of the procurement cycle. The participants expressed that each step has challenges, such as the diversity of the items' technical specifications, the selection

criteria and the time-consuming nature of the bidding process. To overcome such challenges, the selection criteria and all the technical requirements should be defined explicitly to facilitate the participation of many suppliers. During the execution of the contract and after placing a purchase order, humanitarian organisations should thoroughly check the contractual items needed to fulfil the terms and conditions agreed between the parties.

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# The Challenges of Military Logistics in Humanitarian Crisis. Lessons from the Ukrainian War

Margaritis Stavaras[1], Maria Drakaki[2]

[1] Department of Balkan, Slavic and Oriental Studies, University of Macedonia, 156 Egnatia str., 54636, Greece, Email: hlc23008@uom.edu.gr

[2] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14th km Thessaloniki - N.Moudania, 57001, Greece, Email: mdrakaki@ihu.gr

## Abstract

The Ukrainian War has highlighted significant challenges in military logistics when confronted with a complex humanitarian crisis. This abstract examines the multifaceted issues that emerge when military forces are called upon to provide humanitarian assistance in conflict zones. The study draws lessons from the Ukrainian War to illuminate the intricate interplay between military operations and humanitarian efforts. The Ukrainian War reveals the significance of adapting military logistics strategies to suit the unique demands of humanitarian crises. Integrating technology, data analytics, and real-time communication is a pivotal factor in enhancing the efficiency of relief efforts. It also highlighted the ethical and moral dilemmas when military forces engage in humanitarian tasks, exploring the potential blurring of roles and responsibilities. The paper underscores the importance of seamless coordination between military units and humanitarian agencies in crisis scenarios. It delves into the intricate logistical hurdles armed forces face, such as transporting essential supplies, medical resources, and food to affected populations while navigating treacherous terrains and hostile environments. Furthermore, it discusses the criticality of establishing secure supply chains, both for military operations and the delivery of aid, to ensure uninterrupted assistance. In conclusion, the challenges encountered during the Ukrainian War underscore the need for a comprehensive and agile approach to military logistics in humanitarian crises. By drawing valuable lessons from this conflict, stakeholders can better prepare for future challenges, refine strategies, and ensure that military and humanitarian efforts synergize effectively to alleviate human suffering in times of crisis.

**Keywords:** Military, Logistics, Humanitarian Crisis, Ukrainian War

## 1. Introduction

The Russian invasion of Ukraine began on February 24, 2022, and is an ongoing conflict. The brazen attack has led to massive loss of life, enormous displacement of the Ukrainian population, and the decimation of Ukrainian cities and infrastructure. Beyond the terrible human cost, the war's effects have reached countless aspects of life, the price of fuels in the EU has risen because of Russia's unprovoked and unjustified

aggression against Ukraine, which has also led to concerns related to the security of the energy supply. Russia's military aggression against Ukraine is having a direct impact on global food security and affordability (Shapiro, 2023). In this complex situation, logistics have proved a major issue. The coordination of logistical activities is one of the most emphasized challenges faced by humanitarian logisticians (Kovács G. a., 2009). Logistics has often been described as the link between the strategic-level instruments of national power and their expression at the "lower" operational and battlefield level, described as the "timeless logistic-strategy nexus" (Erbel, 2018). In this context, military logistics is growing in supplementing and leading humanitarian assistance and disaster relief logistics (Yuste, 2019). The purpose of this paper is to critically examine the challenges faced by military logistics operations during humanitarian crises, with a specific focus on the Ukrainian War–(2022-present) as a case study, by analyzing the logistical complexities, successes, and failures in providing humanitarian assistance and military support in this conflict.

## 2. Definitions of Military and Humanitarian Logistics

Military supply chains are dedicated to warfare, peacekeeping missions and since the 1990s disaster relief and humanitarian aid. Military logistics and their command-and-control systems are suitable for operations in disaster areas. The lack of stability, infrastructure, and communications in harsh and/or remote areas are situations in which military logisticians are trained and prepared to operate. Military command and control systems can deal with large-scale disaster situations or war. They, like other humanitarian agencies, can deploy very quickly. Military logistics is typically regarded as a tool employed at the tactical or operational level. From NATO's perspective (NATO, 2012), logistics is ''*the science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, the aspects of military operations deal with a. design and development, acquisition, storage, transport, distribution, maintenance, evacuation, and disposition of materiel; b. transport of personnel; c. acquisition or construction, maintenance, operation, and disposition of facilities; d. acquisition or furnishing of services; and e. medical and health service support".*

Humanitarian logistics embeds into local, national, and international disaster management systems and is defined as *"the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information from the point of origin to the point of consumption to alleviate the suffering of vulnerable people. The function encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking, and tracing, customs and clearance*."

## 3. Differences and similarities between Military Logistics and Humanitarian Logistics

Military logistics and humanitarian logistics share some similarities in terms of supply chain management and resource distribution, but they also exhibit significant differences in their objectives,

operational contexts, and priorities. The primary objective of military logistics is to support military operations, maintain combat readiness, and sustain forces during combat missions (Christopher, 2016). On the other hand, humanitarian logistics aims to provide relief and assistance during natural disasters, conflicts, and humanitarian crises, to save lives, alleviate suffering, and aid affected populations (Tomasini, 2009). Another significant difference concerns security against neutrality. Military logistics often operate in a security-driven environment, where force protection and mission accomplishment are paramount. It involves security measures and military assets to ensure operational success (Yuste, 2019) while Humanitarian logistics operates under principles of neutrality, impartiality, and humanity. It focuses on delivering aid to affected populations without taking sides in conflicts and strives to minimize harm to civilians (Bealt, 2018). Response time remains a critical factor, military logistics often requires rapid response and deployment to support military operations, with a focus on agility and quick decision-making (Martin Christopher, 2006 ). Humanitarian logistics also demands rapid response but places a strong emphasis on the coordination of multiple stakeholders, adherence to international standards, and minimizing harm to affected communities (Tomasini, 2009). Military logistics prioritizes the allocation of resources to meet the specific needs of armed forces, including munitions, equipment, and personnel while Humanitarian logistics allocates resources based on needs assessments and prioritizes delivering essential supplies such as food, shelter, and medical aid to vulnerable populations.

Military and humanitarian logistics share many similarities involving supply chain management, encompassing procurement, transportation, warehousing, and distribution of goods and services (Kovács G. a., 2007). Both military and humanitarian logistics must address risk management, including supply chain disruptions, security threats, and environmental challenges. Moreover, information sharing and data analytics are critical in both military and humanitarian logistics to support decision-making, improve efficiency, and enhance responsiveness. Humanitarian and military logistics must be coordinated and synchronized before, during, and after disasters. “Coordination” by itself is a second-order output; the results of such coordination are what matters. It can be challenging to assess the extent to which coordination activities contribute to outcomes, which is why we recommend rigorous monitoring and evaluation through all phases of a synchronized disaster response.

## 4. Why has the Ukrainian War highlighted significant challenges in military logistics?

The Ukrainian War has brought several significant challenges in military logistics to the forefront, underscoring the complexities inherent in managing the flow of resources, personnel, and supplies during an armed conflict. Initially, the Ukrainian War is characterized by its protracted nature, lasting for almost two years and this fact has placed continuous and prolonged demands on military logistics systems, requiring sustained supply efforts to support troops. The longer the conflict, the more critical logistics becomes in ensuring the readiness and effectiveness of military forces (Kovács G. a., 2009).

The fluid and shifting nature of frontlines in the Ukrainian War necessitates constant adjustments to logistics plans. Military logistics must be agile and adaptable to respond rapidly to changing operational requirements and ensure that supplies reach needed troops (Altay, 2006). A paramount challenge is also the fact of ensuring the security (Van Wassenhove, 2006) of logistics operations. The presence of armed groups, militias and hostile actors in conflict zones poses significant risks to the safety of logistics personnel and supply convoys. In addition, the fact that military operations, including artillery bombardment and airstrikes, have caused significant damage to critical infrastructure such as roads, bridges and utilities have caused significant damage and disruption to the supply chain and impeded the movement of supply convoys, requiring extensive repair and reconstruction efforts (Tatham, 2010).

Effective resource allocation is challenging in a conflict with multiple fronts and diverse operational requirements. Military logistics must balance the needs of various units and missions while ensuring that essential supplies, such as ammunition and fuel, are not depleted (Gholami, 2012). Moreover, the conflict has led to access restrictions in certain areas, making it difficult for military logistics to reach troops and deliver supplies, especially on a terrain like Ukraine. This necessitates creative solutions, such as airdrops or humanitarian corridors, and coordination with humanitarian organizations (Maltz, 2018).

The major challenge, in my point of view, is the fact that the Ukrainian War has witnessed the involvement of various international actors, each with its own logistics support requirements. Coordinating the logistics efforts of multiple nations can be logistically complex and politically sensitive. A critical challenge is also the fact that effective logistics relies on accurate and timely information. In a dynamic conflict like the Ukrainian War, obtaining and sharing information about troop movements, enemy positions, and logistical needs is critical but can be hindered by security concerns.

## 5. How did military logistics help provide humanitarian aid in the Ukraine war?

Various countries worldwide have generously provided Ukraine with substantial military assistance to protect its sovereignty. Leading this effort, the United States and the United Kingdom have established, at U.S. Army Garrison Stuttgart in southwest Germany, the EUCOM Control Center-Ukraine/International Donor Coordination Centre (Machi, 2022), or ECCU/IDCC, a multinational logistics centre, to oversee the delivery of military equipment and ensure that Ukrainian forces are properly trained in its use. While the logistics centre initially originated and was led by separate teams from the U.S. and U.K. military forces, it has since expanded to include participants from various global allies and partners.

This multinational team constitutes a "coalition of willing participants," offering various combinations or levels of transportation, assistance, training resources, or financial support as needed. When a nation extends its offer of military support, the centre takes on the responsibility of managing the logistics to ensure the smooth movement of assets from the supplying nation to the Ukrainian border. The process, from one door to another, may require 48 to 96 hours. Numerous servicemen and women, both within and outside of NATO, are divided into specialized groups responsible for planning, providing support, managing

communications, overseeing movements, and conducting operations. Additionally, a rotation of foreign liaison officers is present. A Ukrainian military representative is integrated within the team to identify and address requests originating from Kyiv, which are subsequently handled by the ECCU/IDCC team. Officials have characterized the process as resembling a registry, where Ukraine submits specific equipment requests, and participating nations identify the needs they can meet and to what extent. As a result of the arrival of advanced equipment supplied by NATO and various allied nations, the centre has evolved into a comprehensive hub. It manages the coordination and monitoring of shipments from global sources to Ukraine and oversees the training of Ukrainian armed forces in operating and maintaining the equipment. The key challenge lies in synchronizing the training schedule with the arrival of the equipment.

Besides NATO's military logistics contribution, the following figure introduces the Ukraine Support Tracker, a comprehensive database encompassing humanitarian, military, and financial aid. This tracker unveils notable variations in the scale and nature of assistance pledged by many countries.

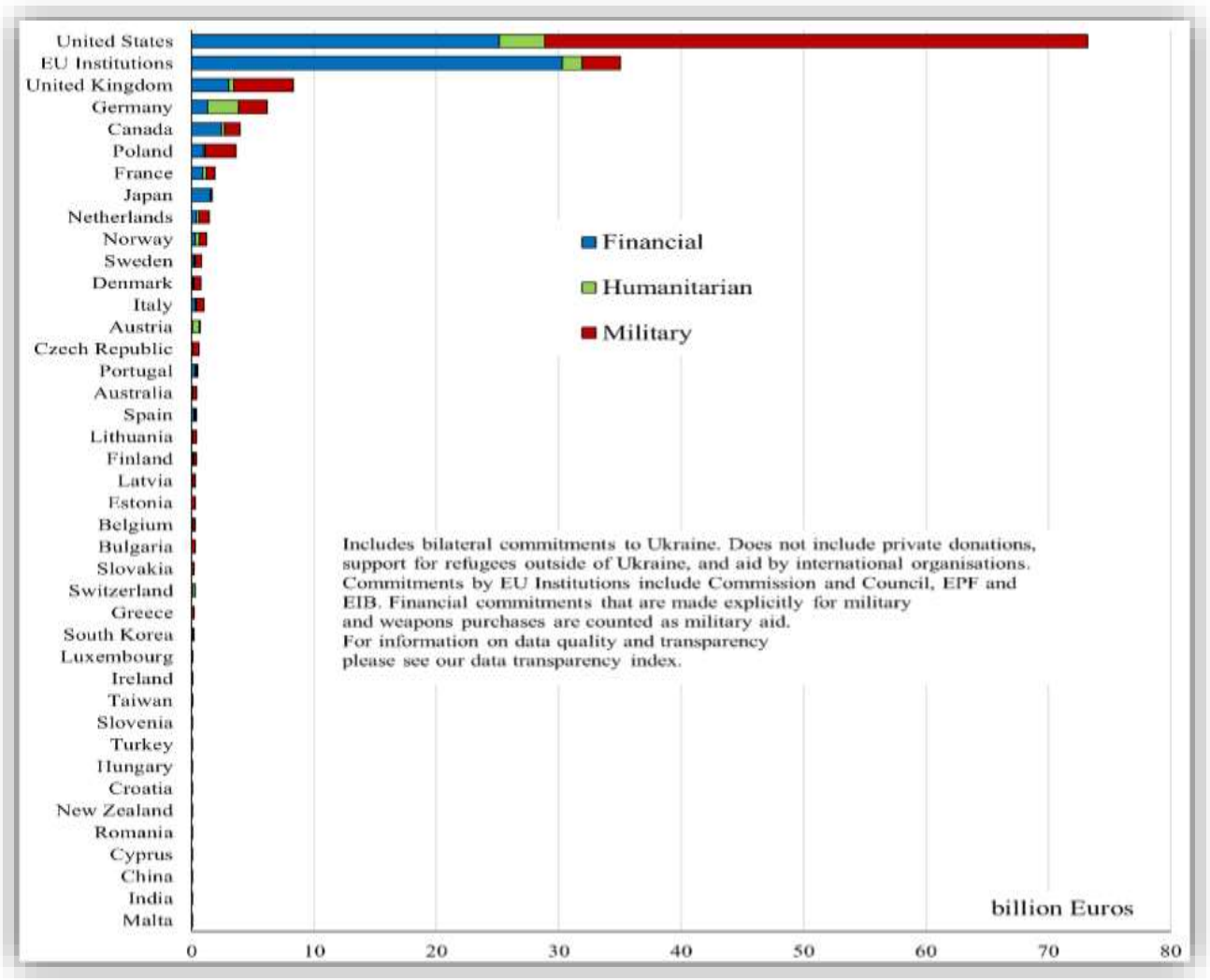

*Figure 2 This figure shows total bilateral aid commitments to Ukraine across donors in € billion (covering 24 January 2022 to 15 January 2023), Source: https://cepr.org/*

## 6. Conclusion

The Ukrainian war has demonstrated the importance of military logistics in humanitarian crises. The challenges faced during this conflict have highlighted the need for effective coordination, communication, and cooperation between military forces and humanitarian organizations. By examining the lessons learned from the Ukrainian war, policymakers, military leaders, and humanitarian actors can gain valuable insights into how to improve future responses to similar crises. This paper has explored some of the key challenges faced by military logistics in the context of a humanitarian crisis and provided recommendations for addressing these challenges. Overall, military logistics plays a critical role in ensuring the timely and efficient delivery of humanitarian aid during times of crisis.

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# Theres something wrong with EMMA: the information gaps in supply side of market based humanitarian response.

Claire Louise Travers[1]

[1] Department of Supply Chain Management and Social Responsibility, Hanken School of Economics, HUMLOG Institute, Arkadiankatu 22, 00100 Helsinki
Email: claire.travers@hanken.fi

**Abstract**

Relief organizations are encouraged to understand, support, and make use of local market-systems before, during and after a crisis. Doing so supports economic recovery of the affected population and contributes to positive socioeconomic change. However, during a sudden-onset emergency, there is little time to assess and map markets to enable market-based programming. In the last 13 years EMMA and PCMA tools have become sector-standard to produce "rough and ready" market analyses. In this paper, a meta-analysis of published EMMA and PCMAs uncovers a skewed focus on the demand side of market-systems, (re)producing information gaps which limit relief organizations from engaging markets in supply side projects, such as local procurement. The paper offers some suggestions for refocusing the tools for both users and researchers, to meet the informational needs for humanitarian procurement.

**Keywords:** humanitarian supply chain management; tool and methodologies for humanitarian crisis management; markets in crisis; local procurement; local market engagement

## 1 Background

A market system is a network of actors engaged in producing, exchanging and consuming a particular (or a type of) item or service. This may include producers, suppliers, processors, vendors, buyers, and end users. The market system encompasses various forms of infrastructure, inputs, and services, and operates within the context of rules and norms that shape this system's particular business environment. As such, a market system is more than a supply chain or a particular organizations logistics, constituting the backdrop of these activities in their entirety.

Market based programming is widely considered best practice in the humanitarian Market based programs work through and support local markets, and are favored over other interventions for their ability to kick start economic recovery and support livelihood development. As such, relief organizations must be market orientated, aware of and close the market systems they regularly act in, to pro-actively strengthen and develop those markets. As such, humanitarian organizations commonly implement short-term market-integrated relief to reach beneficiaries following emergencies – such as through cash and voucher interventions. Recovery activities also regularly include short-term targeted support to market actors that restore the market system after a crisis. Development actors are also encouraged to engage in 'market strengthening and development' to build resilience and strengthen livelihoods in communities.

Emergency Market Mapping and Analysis, or EMMA, is a toolkit designed for humanitarian organizations to assess and understand the state of market-systems immediately after sudden-onset emergencies (eg conflicts, natural disasters). The toolkit was first published in 2010 and aimed to assist humanitarian organizations to make use of local market systems, improving the quality and impact of emergency responses, and engaging early recovery. Since then, the methodology has been readily accepted in practice and conducted in more than 25 countries, with the participation of more than three dozen international and national-level NGOs and UN agencies. The EMMA methodology is designed to support decision makers. EMMA is, therefore, designed for adaptable application in any humanitarian crisis, including sudden-onset, cyclical, or chronic, for any market system, and in any culture or context, be it conflict, natural disaster, or displacement.

The EMMA requires the team find a 'critical market system', which are those which played, play or could play a major role in ensuring survival, and/or protecting livelihoods. These are selected with specific ideas and expectations about the operational value of the EMMA for a target population. The EMMA ties the market with the item, crop, product or service which the organization is interested in. While the handbook also includes a consideration of market systems that provide a direct source of urgently needed income, it also explicitly allows for teams to choose the market system based on the agency or donor interest or mandate (criterion 3) and plans (criterion 5). The market systems are understood in silo, by design. The EMMA handbook suggests that each market system is mapped and analyzed separately. The EMMA team must have the product in mind before the EMMA not after. As such, the supply mapping is already ringfenced within the known existing supply and the method does not push practioners to explore un-leveraged supply.

The first step in EMMA is mapping, for which a rural market map framework has been used. This approach includes a visualization of market chain actors, their links, the environmental factors, and the service providers, usually jointly drawn by the EMMA team and key stakeholders or interested parties. In the reviewed EMMA dataset, XX were rural-based assessments. This paper therefore suggests the mapping approach is maybe ill-suited for urban and peri-urban responses. Additionally, the market map approach seeks to help stakeholders understand the ways they are mutually benefit from improving systematic efficiency (Albu and Griffith, 2005). The method is seeking to understand demand to be filled, not existing supply. In EMMA handbook, a distinction is made between the supply chain and the value chain, with a focus on establishing the links between supply chains and income streams which enable households to access or demand those service or goods. The second phase of the mapping is to focus on the service infrastructure, but again the focus is on those affected by the emergency situation, and not on those that remain after the disaster has strike.

In 2014, the PCMA (Pre-Crisis Market Analysis) was introduced as an alternative methodology to assess markets before a crisis. The initial PCMA guidance was developed with ECHO ERC and USAID funding, by Oxfam and IRC, in response to the systematic failures highlighted after the 2011 crisis in the Horn of Africa. Key reports suggested the traditional methods of the contingency planning and early responses were not based on livelihood and market analyses, which meant that humanitarian agencies did not understand the basic market system dynamics they were entering. The PCMA was not intended to replace the EMMA, or any other market assessment tool, but rather to complement them by providing a pre-emergency analysis of how market systems "normally" function.

In 2016, a revised PCMA guidance was produced by the IRC with funding from USAID and input from several agencies and individuals across sectors and from governance. The EMMA methodology fed directly into the Market Based Programming Framework (MBPF), which was developed by the Markets in Crisis (MiC) Community of Practice in 2015, to unite and enable projects that work through and support local markets or contribute to positive market systems change. As of 2021, USAID has decided to merge the Markets in Crisis and EMME Toolkit, developing a consolidated, knowledge management platform for market analysis and market-based programming in emergency, recovery and development circumstances.

## 2 Methodology

In the broadest sense, the literature considered in this study is grey, in that the reports are not a produce of peer-review processes for publication in scientific journals (Lawrence *et al.*, 2014). This is not to say, however, that the data set is not of scientific value. The inclusion of non-white literature has a myriad of benefits for fields of research, including the potential to weigh against publication bias (Kepes *et al.*, 2012), which results from the suppression mechanisms inherent in peer review and which result in a body of literature which is systematically unrepresentative of the whole (Rothstein *et al.*, 2005). The inclusion of grey material as data for review is also pertinent as it is usually through such literature, for example conference papers, ongoing research, reports, theses or dissertation, that the important interim findings or negative results are collected and disseminated which is important for comprehensive understandings (Paez, 2017).

In humanitarian response, and more specifically in humanitarian logistics and supply chain management, it is becoming commonplace to include grey material as data for scientific review. There are examples in humanitarian waste management (Tuomala *et al.*, 2022), in humanitarian transport (Azmat and Kummer, 2020), and in the

discourse on localization (Frennesson *et al.*, 2021), among others. The inclusion of non-white literature is particularly pertinent for humanitarian research as two specific reasons. Firstly, the vast majority of available material for review is grey as these academic fields are relatively new. Secondly, the humanitarian sector moves extremely fast such that the time-lag instantiated in the process of peer review detrimentally impacts the findings value to the sector. For example, during the acute phases of COVID19, scientific research on the response were desperately sort after, whereas now the appetite for the information has somewhat subsided leaving researchers specialized in pandemic response a smaller window to publish findings. It is reasonable that researchers would forgo white publication in favor of disseminating interim and relevant results in grey literature. .

The paper provides a quality assessment for the dataset, according to the Kepes taxonomy(Kepes *et al.*, 2012), which suggests evaluating the source expertise (i.e. the extent to which the authority of the producer of content can be verified) and the outlet control (the extent to which content is produced, moderated or edited in conformance with explicit and transparent knowledge creation criteria). This categorization recognizes that the expert community can generate literature of scholarly interest and allows for the author to document and make explicit judgements around the relevancy of the grey literature (Adams *et al.*, 2017).

The author is a trained EMMA facilitator with experience running both methodologies in the field. In addition, for this paper, she attended refresher classes on conducting quality EMMA and PCMA and consulted the leadership manual throughout. The source of expertise is known and highly relevant. A sample of authors were taken from the dataset. These constituted a range of international and national nongovernmental organizations, as well as a private sector consultancy firm. The training expectations for completing a report to submission were verified through a target search of job adverts for similar market assessments. The EMMA toolkit website remains the hub for all information on this approach, which is industry standard. However, the source does not publish their control standards widely, so the outlet control is not certain. The methodological guidance must be adhered to qualify as an EMMA or PCMA report for dissemination through the outlet. Overall, the author grades the quality of the grey literature as between 1st and 2nd tier (see Figure 2).

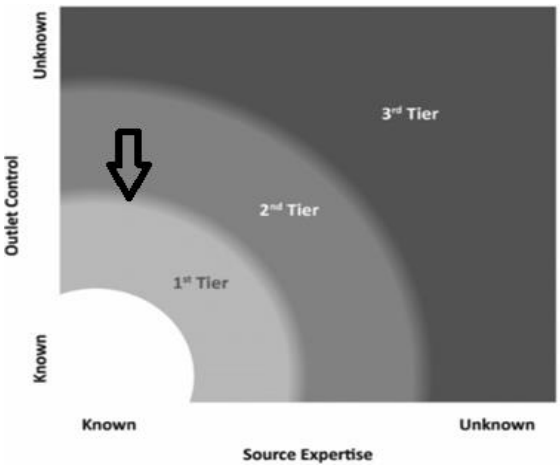


**Figure 1** Adams et al. 2017 graph with added arrow by author

A dataset was drawn from the last 10 years of published EMMA and PCMA (source: https://www.emma-toolkit.org/), from 2013-23. Of these four (4) were duplicates and two (2) were discarded as they were an executive summary of another report. The final dataset included 60 reports, 38 of which were EMMA from 2013-2023 and 22 of which were PCMAs from 2014-2023. The data set included both French (12) and English (47) reports and both languages were admissible. (see Figure 3).

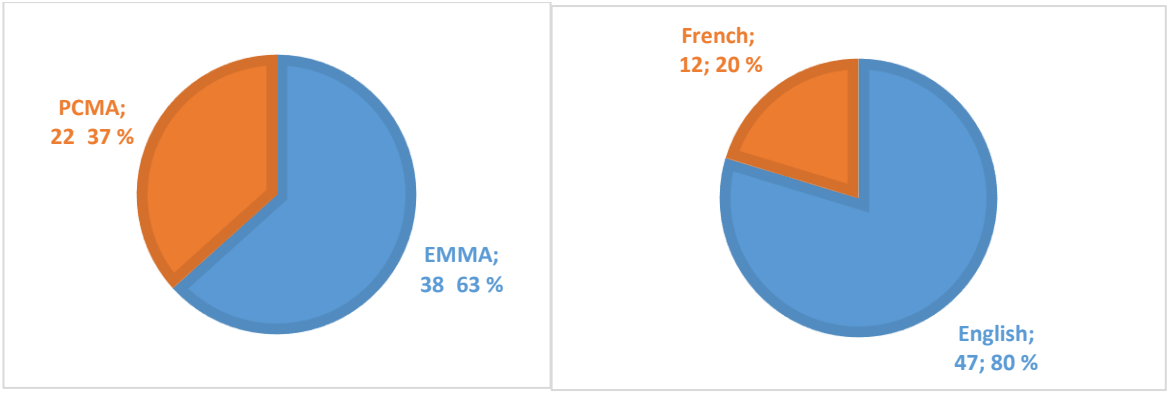


**Figure 2** Pie charts showing division of report type (L) and language of publication (R)

## 2.1 Content Analysis Framework

The content analysis framework was deductively derived from the MBPF. This framework (see Figure 4) includes supply and demand functions (purple and red), where market actors exchange goods and services, policies, norms, and supporting environment for market activities (blue) and infrastructure and services (green). Within this framework, different modalities for engaging markets in response are listed. The framework suggests that during emergency relief phases the market system can be used, then supported during recovery, and eventually changed during resiliency work. Modalities for how to do this are suggested throughout the framework, for examples providing cash to households (HH) is listed as a demand side or access side use of markets suitable for emergency relief, while enhancing the capacity to improve production quality is suggested as a supply or availability side market system change suitable for resiliency building.

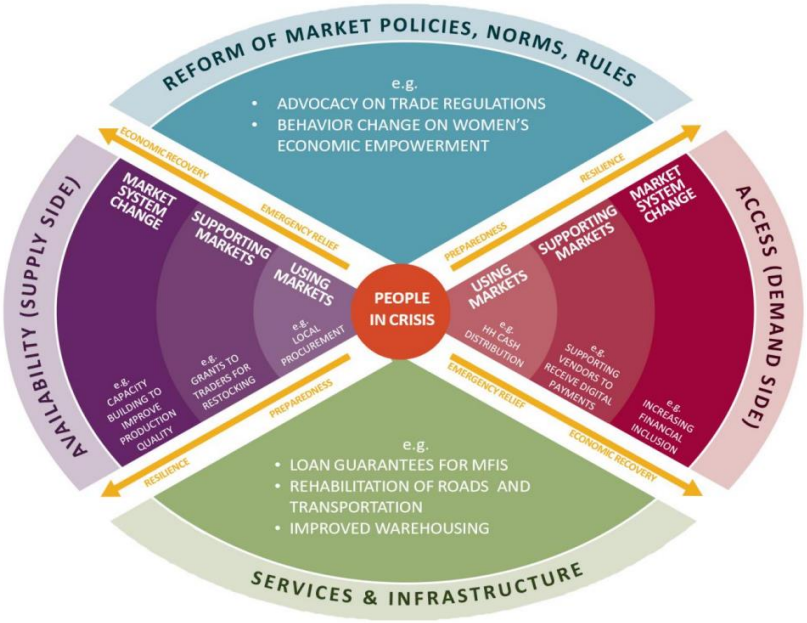


**Figure 3** MiC Group (2022) Market-Based Programming Framework

A codebook was deductively derived from the MBPF, producing five (5) parent codes with which to analysis the content (Linneberg and Korsgaard, 2019; Pearse, 2019). Each is explained in more detail, including some of the questions and sub-codes, to enhance replicability of the study (Roberts *et al.*, 2019).

1. *People in crisis* (orange). Defined as*:* The target population, discretely described, the market system, discretely described, and the ways in which the crisis, discretely described, which is affecting them. Examples: *What is the market system(s)? Who are the target population? Are they area-specific? Is the target population crisis specific? Is the crisis manifest, unfolding, or complex? Is there more than one crisis affecting the target population? Is the target population age or gender specific?*
2. *Services and infrastructure* (green). Defined as*:* The material institutions, including the infrastructure services, available to the community or individual, and how the crisis has affected them. Examples: *What is the connectivity between the target population? How are the roads and transportation links affected the crisis, and what ways does this impact the people in crisis (1)? Which aid organizations or long-term development actors are in the system and what do they (claim to) provide? What capacity for inventory storage exists in the system and its supply chain, and has this been impacted by the crisis?*
3. *Market policies, norms, rules* (blue). Defined as*:* The immaterial and social institutions which influence the market system, and how the crisis has affected them. Examples: *What social welfare or social safety nets are available, and to whom? Which advocacy groups exist and who do they advocate for and to? Are there social norms around market engagement and spending, and how have these been impacted by the crisis? Which policies, processes or soft norms which the institutions are obliged to follow?*

4. *Access, demand side* (red). Defined as*:* The patterns of consumption, investment and expenditure by actors and institutions in the market system, and the ways crisis has impacted, change, or terminated these. *Where access/demand side interventions recommended in the report?*
    a. *Using markets*. Examples: *Who and how are people in crisis using the market system? How have spending habit changed since the crisis, and why?*
    b. *Supporting markets.* Examples: *Are there any areas of high demand, where items or services are needed but not available, and were they there before or after the crisis?*
    c. *Changing markets.* Examples: *Who is not engaging with the market system, and why? Are any social groups are excluded from purchasing due to social taboo or stigma? Which institutions have control of access to markets, and how do they impact individual access to markets?*
5. *Availability, supply side* (purple). Defined as: The patterns of production, procurement, and buying by actors and institutions in the market system, and the ways crisis has impacted, change, or terminated these. *Where availability/supply side interventions recommended in the report?*
    a. *Using markets*. Examples: *Where and from whom are the products and services being sourced in the market system?*
    b. *Supporting markets.* Examples: *Are there any general gluts, an excess of a particular item or service, in the system, and were they there before or after the crisis?*
    c. *Changing markets.* Examples: *Has the quality of the item or service been impacted by the crisis? Which institutions have control of the quality expectations, and how do they implement them?*

# 3 Findings

*People in Crisis.* The content analysis found that the EMMA and PCMAs the reports were characterized by a clear understanding of the target population, who were usually area-specific, and the market system of interest. The majority of published EMMA and PCMAs were interested in food market systems (38), either exclusively (16) or partially (e.g 4 with Water, 7 with Agricultural or Livestock, 3 with Labor). Where an assessment was conducted on multiple market types, this reflected the natural overlap in these markets, for example in food and livestock or food and fishing. However, there were examples in the dataset of a targeted assessment conducted on a specific market overlap, for example a study into sorghum and maize, but also soap market systems (27-14) and another into fish, rice, sesame, maize, sweet potato, cassava and also bleach market systems (51-16). These assessments may reflect the unique market contexts of those overlaps as well as the goal-orientated nature of the methodology. In these cases, the assessment is used as a baseline or as an exploratory study to inform a particular market-based project of interest to the author organizations (e.g. cash to households). The context and crisis of interest in each report was clear but was as often rooted in scenario building as in real crisis response.

*Services and Infrastructure.* Many of the reports included a desk review of the government services and pre-existing national infrastructure. For example, many reports how the crises affected the capacity of the ports and points of entry, or which pre-existing social welfare or support services the target population was accessing. There were a few outlier reports which exclusively focused on the mapping of services, including using geographical information systems (GIS) or price mapping to inform the report. The services and infrastructure required for accessibility, such as transportation capacity and routes to distribution were commonplace across the reports, independent of the market system targeted. It was, however, irregular for the reports to consider the supply chain infrastructure and logistics services which support availability in the market system, for example, warehousing and storage capacity.

*Market policies, norms, rules.* Reports included immaterial and social institutions in vague or abstract ways. Very few reports dealt with the legal or social norms which may be pertinent to understanding the market system dynamics. Most common was an assessment of the legislative and taxation customs which impact business continuity and import constraints of certain items. There was a more infrequent inclusion of social taboo of purchasing items, for example certain hygiene management items. Where reports included a protection lens, usually in a crisis context, gender-based violence was commonly listed as a barrier to access side of the market system for women and girls. Presumably the same would hold for barrier to availability on the supply side of the market, but this was not made explicit in the reports.

*Access and Demand Side.* Throughout the dataset, there exists a heavy focus on access and demand side dynamics. The reports did not include a needs assessment, which is the a crisis-specific demand estimate generated by the humanitarian community after an emergency is declared (see MIRA). All the reports, however,

included an explicit focus of the ways in which conflicts impact access to and demand within a market system. In most cases this impact was negative, making market systems either physically, financially, or socially inaccessible. In a minority of reports, the crisis improved physical access to markets, by relocating people closer together or making travel easier to access (47-16). The majority of programme recommendations in the reports were interventions in the access and demand side of the market system. Advice around providing cash or vouchers were disproportionately found in the reports. Other advice included incorporating financial inclusion strategies, micro-finance initiatives such as VSLA and SILCs, and equipping vendors to receive vouchers/digital cash as payment.

*Availability and Supply Side.* Throughout the dataset, availability and supply were supplemental to the access and demand information. Supply issues were included in light of the demand, or as an impact of the crisis. In some reports, the impact of the aid response on availability and supply was described, with increased supply developed by the unannounced arrival of relief items into the system as having created a disincentive for the commercial supply side activity (48-16). Some reports considered the supply side of the market system in order to inform or verify the suitability of aid and relief items, benchmarking types of items to those locally available in sufficient quantities within local markets which are regularly purchased by the target population (47-16). Where reports included supply chain mapping, many stopped at vendors, both informal and formal, and their wholesale suppliers. Importers and manufacturer were rarely considered, and producers were only commonplace where the report included livelihood or labor in the market system explicitly. Programme recommendations in the reports seldom suggests interventions in the supply and availability side of the market system. A few reports suggested local procurement would be possible, however there were no regular suggestions of other market-based programming such as front financing producers or wholesales, improving national quality standards, or enhancing transport and infrastructural capacity.

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# Humanitarian Technologies

# Artificial Intelligence Technologies in Humanitarian Aid: An Overview

Emmanouil Pikoulis, Evika Karamagioli, Eleni-Panagiota Stoupa, Eleni Chatzi

MSc Global Heath Disaster medicine, Medical School, National and Kapodistrian University of Athens
Email: crisismed@outlook.com

**Abstract.** This paper provides a brief literature review of the use of Artificial Intelligence (AI) in humanitarian aid operations, concentrating on current AI technologies. AI-powered technologies can improve supply chain optimization, information access, emergency preparedness, fundraising, and advocacy among other possibilities. The widespread use of AI technologies however raises ethical and practical issues like bias, data accuracy, and privacy. AI technology has the potential to transform humanitarian aid, but responsible implementation is essential for positive social impact.
**Keywords** Artificial Intelligence (AI), Machine Learning (ML), Humanitarian Aid, Disaster Management, Chatbots.

## Background

Humanitarian actors have utilized digital technologies for decades to assist and safeguard populations impacted by conflict and crises. Recent advancements in the availability of large quantities of data and computational capacity have enabled a wider application of digital technologies in humanitarian aid, while the pandemic of COVID-19 has accelerated the trend of digital technology usage in the sector (Beduschi, 2022). Machine intelligence understanding and AI programs combined have contributed to the great achievements that have been reached today in AI. The 1970s marked the inception of artificialneural networks and deep learning research, with AI studies in finance, climate, and politics seeking solutions for emerging uncertainties. Fuzzy logic in the 1990s facilitated AI in tackling unclear problems, subsequently leading to genetic algorithm research (Efe, 2022).
Our current era witnesses a rapid digital transformation involving unmanned aircraft, autonomous missiles, language translation robots, and research, development, planning, and coding. AI has the potential to enhance resource-constrained humanitarian services by reducing inefficiencies, waste, and ineffectiveness (Ali, 2021).

## Opportunities

With an increasing number of people in need of humanitarian aid (206.4 million in 2018) and high levels of forced displacement (79.5 million by end-2019), humanitarian action is facing significant challenges (Madianou, 2021). Conflict, climate-related disasters and displacement have been the main drivers for the global community to find new ways to support vulnerable communities.. AI has emerged as a possible answer to some of the most complicated humanitarian situations with its ability to learn, forecast, and make informed judgments (NetHope, 2020).
AI is described as "a collection of technologies that combine data, algorithms, and computing power (European Commission, 2020), despite its lack of a universally accepted definition. AI, particularly machine learning, is already widely used and contested in non-emergency contexts in metropolitan states(Marić, Galera-Zarco, & Opazo-Basáez, 2022).AI systems use massive amounts of data-including humanitarian aid data-, to learn, detect patterns, make judgments, and predict future behaviour. Social media and internet user-generated content—text, photographs, audio, and video—contributes to big data generation and is more relevant in humanitarian circumstances. Available text, photo, audio, and video content on social

media platforms offers channels for engagement and communication during conflicts or crises i.e. Facebook's safety check, which enables users to report their status during emergencies (Beduschi, 2022). AI (and machine learning) applications in disaster management, such as monitoring and mapping,geospatial analysis, remote sensing, robotics, drones, and telecommunications, can improve the technical and methodological elements of hazards and disaster research (Abid et al., 2021).

Several early practical implementations have demonstrated the potential of AI in the humanitarian sector to combat forced displacement and assist refugees in crisis-affected areas. Using public data from sources such as UNHCR and the World Bank, the Danish Refugee Council uses AI and ML technologies to anticipate forced displacement in West African countries. The International Rescue Committee uses these technologies to improve refugee service delivery, predict conflicts, facilitate job matching, and provide individualized learning experiences for affected children. Furthermore, the Norwegian Refugee Council's chatbot helps Venezuelan migrants in Colombia understand their immigration rights. Meanwhile, the Carter Center employs artificial intelligence to provide more detailed and timely analyses of the Syrian crisis (NetHope, 2020).

Disaster management is an essential process that includes mitigation, preparedness, response, and rehabilitation to protect communities and infrastructure from natural disasters. The planning for disaster response is influenced by several factors, including geography, climate, ecology, and the availability of resources (Hernandez and Roberts, 2020). Responding to challenges like these, humanitarian aid professionals have attempted to transcend from the "responsive" state of answering to disasters to a more "anticipatory" state with the involvement and use of early warning and forecasting systems that facilitate preparedness, prevention and mitigation (Swaminathan, 2018). Predictive analytics involves identifying patterns in historical data to estimate the probability of future events, entailing the use of large datasets as input for machine learning and statistical models. These models are subsequently employed to estimate the potential key components of humanitarian crises like pandemics, natural disasters, refugee flows and famines. This type of artificial intelligence is used to predict the locations and timing of these disasters, as well as the key features they will exhibit and which populations will be most affected. Precise advanced forecasting enables the strategic allocation of emergency relief funds, resources, and manpower (Hernandez and Roberts, 2020). A study by Hernandez and Roberts (2020) reveals that humanitarian predictive analytics is primarily used to predict event locations (71%), affected individuals (40%), key emergency features (26%), and likely event timing (18%). Also, AI has the potential to transform services in resource-poor environments, mitigating inefficiencies and waste, by providing data analytics to farmers in developing countries, to identify areas prone to conflict or natural disasters, enabling better management of crops and soil (Efe, 2022).

Also, search-and-rescue operations can be aided by AI-supported machines with learning and adaptation capabilities in disaster management. Their autonomy and AI allow them to effectively operate in unpredictably hazardous environments. Climate change as a result of global warming poses severe threats, such as droughts, diseases, floods, cyclones, heatwaves, forest fires, and famine (Efe, 2022). The 48 hours after a disaster occurs are crucial for saving lives; free of exhaustion and psychological effects, robots can operate in hazardous environments, detect structural damage, provide medical assistance, and transport victims, among other tasks. In addition, AI has the potential to streamline supply chains by identifying possible obstacles and recommending alternate routes to efficiently deliver supplies to those in need, particularly in the aftermath of natural disasters. (Efe, 2022). Utilizing operations research and management science criteria can improve the resilience of disaster relief while taking into account the effect of resource allocation on the affected population (Abid et al., 2021).

In disaster risk reduction, researchers, decision-makers, and government officials are aware of the significance of proactive measures. In humanitarian contexts, such as the Emergency Social Safety Net (ESSN) program administered by IFRC Türkiye, AI technology can be used to reduce human error and save time in identifying those in need and at high risk. Automatic decision-making (ADM) uses data or digital profiles to make decisions without human interaction, improve operational efficiency, save costs, mitigate biases, and prioritize personal data autonomy and control in humanitarian action (Coppi,2021). Forecasting crises, assessing migration status, and automating aid delivery are some examples of their applicability.

By anticipating emergency supplies and improving resource management, the integration of AI technologies, such as the Emergency Logistics Planning System (ELPS), has the potential to transform disaster management. Beyond disaster management, AI's applications include precision farming, poverty alleviation, and education gaps. AI-powered self-guided learning programs can help poor people get an education, while AI chatbots can help victims of abuse. (Efe, 2022).

Humanitarian agencies such as UNHCR and WFP, as well as private companies such as X2AI, have made significant strides in chatbot development. For example, 'Refugee Text' presented a chatbot to assist refugees, but it struggled to gain popularity despite being shown in London's Design Museum. Humanitarian organizations have investigated chatbots for information dissemination, community communication, and cost savings. UNHCR built a chatbot in Jordan in collaboration with Facebook, however, it was discontinued due to legal and data protection issues. The World Food Programme(WFP) has been heavily involved in chatbot development, primarily through its mVAM section, since 2016, initially utilizing Telegram and then migrating to Facebook. Chatbots encourage user engagement in surveys and feedback collecting while also being cost-effective. These chatbots can be used for three purposes: information dissemination, data collecting, and feedback systems. The CHITCHAT chatbot, which used Natural Language Processing, was tested in Kenyan refugee camps, but it ran into issues connected to digital inequality, such as phone ownership, internet access, and SIM card availability. The WFP's latest chatbot, 'Agrocha-tea,' gives agricultural commodities market rates via a user-friendly website. It was created in collaboration with the Peruvian government and the Centre for Innovation at Leiden University (Madianou,2021)

A globally accessible chatbot like ChatGPT provides some practical opportunities including creating content to amplify local voices and helping grassroots organizations with limited resources by drafting social media posts, media proposals, and press releases to communicate urgent fundraising requests and raise awareness during emergencies. ChatGPT can provide understandable information about funding options, making it simpler for local organizations to access available financial support when navigating complex funding processes. By streamlining documentation and contractual requirements, ChatGPT can assist in reducing administrative delays for local humanitarian responders, generate listings of local NGOs engaged in humanitarian efforts, and assist international organizations in identifying potential partners for crisis response. (The New Humanitarian, 2023)

The opportunities presented by AI in the humanitarian sector are vast and diverse. AI and machine learning can help stretch limited resources, improve efficiency, and leave a lasting impact. However, alongside these opportunities, humanitarians must be alert to the risks they face(Mahanand, 2023).

**Ethical Considerations and Challenges**

For their use in the humanitarian context, AI/ML integration must overcome several obstacles, with the lack of AI knowledge, especially among non-governmental program staff, being the main impediment. Humanitarian organizations are increasing their capability and

understanding to assess the relevance and appropriateness of AI and ML for long-term deployment. Developing and maintaining AI solutions in many circumstances requires external collaboration, which comes with challenges such as competing with the commercial sector for technical experts, onboarding volunteers from tech companies with cultural differences and timelines to consider, and managerial oversight difficulties. Additionally, the lack of relevant and representative data, resource-intensive data wrangling, and cost-prohibitive methodologies limit the flexibility and impact of AI projects. To attract donors who may be wary of unproven and risky solutions, a new funding approach is needed to support AI development, data infrastructure, and technical expertise, while accommodating exploration and iteration without immediate and significant short-term impact expectations. Addressing ethical concerns in AI, NGOs must establish the capacity to analyze ethical risks in AI and ML and operationalize ethical standards and principles across their operations. Efforts to democratize AI include the development of accessible AI and ML tools and services with no specialist knowledge requirements, such as no-code or low-code platforms (to address lack of expertise)(NetHope,2020).

The implementation of AI-based automated decision-making systems (ADMs) in the humanitarian sector raises concerns about accountability and adherence to humanitarian norms (Coppi et al., 2021). ADMs are able to target people based on particular traits or replace human decision-making, but they pose alarming risks.The governing principles of humanitarian organizations, such as humanism, neutrality, impartiality, and independence, must be carefully considered in the context of automated decision-making (Coppi et al., 2021). Humanitarians must keep in mind that digital data, algorithms, and automated decision-making are solely instruments to be used in conjunction with grounded knowledge of the populations impacted and practitioner experience (Hernandez and Roberts, 2020). Lack of openness can lead to discriminatory and deceptive ADM systems (OCHA, 2019).

More specifically, there are three major areas of concern: data quality, algorithmic bias, and data privacy. Poor data quality can result in substandard AI system outcomes, potentially affecting humanitarian action. For example, if past crime data used to predict future crime events and recidivism risk contains inaccuracies or biases, judicial decision-making might result in unfair and discriminatory consequences. Poor data quality in the humanitarian context may have a direct impact on vulnerable populations affected by conflicts or emergencies, sustaining and exacerbating errors in AI systems. Obtaining high-quality data for humanitarian operations can be difficult due to a variety of obstacles, such as limited internet access in rural areas and incomplete or overlapping datasets collected by diverse parties. (Beduschi, 2022). An overemphasis on predictive analytics may draw attention away from less predictable but equally important issues, potentially silencing the voices and experiences of marginalized populations. Because predictive models frequently use historical data, any biases and inequalities present in that data may continue to exist (Hernandez and Roberts, 2020).

Algorithmic bias is intimately related to issues of data quality and has broader societal repercussions. Bias in AI systems can originate from both technological and human sources, reflecting perspectives and prejudices of the designers and developers. Biased AI systems have the potential to perpetuate unequal outcomes and prejudice, particularly when it comes to gender and race. For example, facial recognition technologies that are less successful in recognizing people with darker skin tones can result in misidentifications and the refusal of humanitarian help(Beduschi, 2022).

Another major issue is the possibility of disinformation if chat bots deliver outdated or wrong information. This has significant consequences, especially in humanitarian situations where correct information is crucial. The source of such deception in human-machine interactions is unclear, raising concerns about accountability. While human oversight is necessary, efficiency concerns may limit the resources available for such oversight. (Madianou, 2021).

International human rights legislation protects the right to privacy, and the GDPR establishes critical criteria for personal data protection. However, due to the power imbalance between humanitarian organizations and beneficiaries, getting fully informed and unambiguous permission in a humanitarian setting may be difficult. The use of artificial intelligence (AI) systems by technology corporations and collaborations with humanitarian organizations raises worries about the effect of corporate interests on system design, potentially ignoring the demands and experiences of affected populations(Beduschi, 2022). An ethnographic study on Typhoon Haiyan recovery revealed that SMS hotlines, intended for feedback and accountability, were primarily used for audit reporting (Madianou et. al, 2016, as mentioned in Madianou, 2021). Another example is the case of AIDA and which used Facebook Messenger without a formal collaboration, leaving the WFP without control over data and metadata safeguards, data that are crucial when working with vulnerable individuals according to ICRC and Privacy International (2018) (as mentioned in Madianou, 2021). McDonald (2019) notes that even when humanitarian organizations develop collaborations with large technological businesses, it is unclear what leverage they have to enforce control and this disparity is amplified in chatbot scenarios where no contract with Facebook has been signed. Innovation in humanitarian settings creates awareness and interest in new products and services, making them appealing to companies seeking branding opportunities (Madianou, 2021).

International guidelines exist for fair, accountable, and transparent AI (Fjeld et al., 2020), but maintaining human, unbiased, and independent principles remains challenging. Distance can prevent digital humanitarians from fully comprehending the needs of affected individuals and organizations, potentially violating the principle of humanity. Merging disparate data sets can compromise impartiality and risk targeting religious, ethnic, or mobile groups. Additionally, lacking free press, data protection laws, civil society organizations, and human rights charters hinders local capacity to audit global humanitarians' geospatial data, tools, and algorithms (Marić, Galera-Zarco, & Opazo-Basáez, 2022). The lack of accountable artificial intelligence in non-emergency contexts in the global North increases the risk of injuring vulnerable populations in emergency contexts in the Global South (Sandvik, Jacobsen, & McDonald, 2017).

**Limitations**

The findings of the review rely on the availability and quality of data sources, which can vary in accessibility and timeliness while the interdisciplinary nature of this research requires a balance of expertise in both AI and humanitarian aid. While every effort has been made to ensure objectivity, the potential for bias in source selection and analysis cannot be completely eliminated. Lastly, as the field of AI in humanitarian aid is rapidly evolving, this review may need additions in the immediate future.

**Conclusion**

The integration of artificial intelligence (AI) in humanitarian aid holds immense promise for revolutionizing the sector's efficiency and impact. Humanitarian organizations may effectively address global concerns and reduce human suffering by using AI ethically and responsibly. There is no one-size-fits-all answer, and ethical commitment, accountability, and openness in the use of AI in humanitarian settings must be improved.

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# Design of an Energy Container for Emergency Relief Preparedness and Provision of Humanitarian Aid

Emmanouil Tzimtzimis[1], Panagiotis Tsikos[1], Thomas Profitiliotis[1], Charisios Achillas[2], Dimitrios Tzetzis[1]

[1] Digital Manufacturing and Materials Characterization Laboratory, School of Science and Technology, International Hellenic University, 57001, Thessaloniki, Greece
[2] Department of Supply Chain Management, International Hellenic University, 57001 Thessaloniki, Greece

**Abstract.** The conceptual design of an energy container is indirectly dealing with the most burning issues in our contemporary global society. Climate change and the destruction of nature cause major natural disasters such as, floods, earthquakes, tsunamis, or hurricanes which in turn lead to great damage and loss of life. Over and above that, international crisis leads to large scale conflicts with more and more nations getting involved into war with devastating consequences for infrastructure and citizens. Thus, disaster preparedness is a great necessity for relief and mitigation purposes to the affected population. Consequently, emergency relief preparedness includes all the needful actions taken to get ready and minimize the outcomes of disasters. It aims to anticipate, prevent, and mitigate the affection on vulnerable populations, and successfully deal with the consequences. Specifically, the purpose of this study is the designing of a 20-foot ISO energy container with the help of the sophisticated software of Solidworks 3D CAD system and the PVsyst 6.8.0 for the study, sizing and a data analysis of a complete off-grid photovoltaic system. This project will be a part of an integrated operations center for providing humanitarian assistance. The project aims at maximizing the production energy that could be generated by exploiting the available space of the container and constitute to integrated operations.

**Keywords:** case study, design, energy container, photovoltaics, disaster, recovery renewable energy.

## 1 INTRODUCTION

In the past two decades, the world has witnessed a steadily escalating humanitarian crisis, with the majority of affected individuals stemming from conflicts, and to a lesser extent, from the impacts of climate change and natural disasters, as recognized by the United Nations. The gravity of this situation becomes evident when examining the statistics, notably the surge in forcibly displaced people, which increased from 59.5 million in 2014 to 68.5 million in 2017. Additionally, natural disasters and climate change consistently affect an average of 350 million people each year, causing immense financial losses (OCHA, 2018). Rapid and immediate response is imperative to aid those affected at the onset of these crises.

The fundamental objective of Humanitarian Assistance (HA) is to safeguard the lives of individuals affected by disasters, both natural and man-made. Global HA intervenes when the governments of afflicted nations are unable to offer effective aid themselves. This assistance is extended in emergency situations to preserve and protect human life, mitigate the impacts of man-made catastrophes, and uphold human dignity (OCHA - Casey, E., 2003). Containerization represents an ingenious system for intermodal freight transport, employing standardized shipping containers that seamlessly traverse various modes of transportation while safeguarding their contents (Hildebrand, 2018). These containers, characterized by their uniform dimensions, facilitate efficient loading and unloading from one transport medium to another.

This study is dedicated to addressing how the concept of the Energy Container can effectively meet the requirements of humanitarian aid, presenting a promising solution to enhance the immediate relief efforts in affected regions. Furthermore, it explores innovative approaches to equip the container's interior with pre-installed and pre-wired equipment. The study will illustrate the concept development process and the final project using the advanced Solidworks (Dassault Systemes, Villavoublay, France) CAD program, offering a comprehensive visual representation of this project.

## 2 METHODOLOGY

This study constitutes an integral yet distinct segment within the overarching cluster of container projects. It embodies a holistic approach and solution aimed at facilitating humanitarian assistance, enhancing emergency relief readiness, and bolstering the capacity for humanitarian aid provision.

The inquiries under examination in this study bear significant weight as they will substantially influence the structure and composition of the development project (Karl T. Ulrich, 2007). These inquiries encompass:

- The selection of an energy system type capable of generating the requisite power.
- The dimensioning of the energy system.
- The identification of necessary equipment for power generation, storage, and distribution.
- Ensuring the reliable operation of the energy system under adverse weather conditions.
- Sizing of supportive equipment to accommodate the energy system components.
- Preserving the initial intermodal characteristics of the converted container.
- Establishing interconnections with other purpose-specific containers (e.g., telecommunications, medical, water treatment, catering, and shelters).
- Adhering to international container standards.

The design principles guiding this product are closely aligned with user and stakeholder needs (Karl T. Ulrich, 2007). In terms of product development, it adopts a complex system perspective, necessitating the decomposition of the system into several subsystems and numerous components (Qiang Zhang, 2011). Furthermore, it can be categorized as a technology-driven product, driven by the integration of new technologies into its subsystems.

Within this study, project generation unfolds via a systematic process consisting of five distinct stages (Eppinger, 2000). These stages encompass problem clarification, external and internal investigation, systematic exploration, and result reflection.

Moreover, the analysis incorporates the FAST method, an acronym representing Function, Analysis, System, and Technique. This top-down approach aids in displaying functions logically, prioritizing them, and evaluating their interdependencies (Gavin Allanwood, 2014). The FAST method is employed in the following manner within the study:

- **Step 1:** *Clarify the problem*, involving a comprehensive understanding of the problem, breaking it down into simpler sub-problems using diagrams.
- **Step 2:** *Search externally*, which includes consulting experts, gathering technical information, and examining related products**.**
- **Step 3:** *Search internally*, focusing on idea generation and initial goal configuration through sketches and drawings.
- **Step 4:** *Explore systematically*, collecting concept fragments to synthesize a complete solution.
- **Step 5:** *Reflect on results*, ensuring the comprehensive exploration of the proposed solution, the thorough decomposition of the problem, and the consideration of alternative function diagrams.

## 3 APPLYING THE PRODUCT DEVELOPMENT PROJECT

In this section of the paper, the mission statement is introduced, highlighting the development of a self-supported intermodal container engineered to generate and store energy for the purpose of supporting existing containers deployed in telecommunications and medical treatment. To address this multifaceted challenge, a structured approach is employed, encompassing problem decomposition and the application of the FAST (Function, Analysis, System, Technique) model to prioritize functions and establish a logical sequence for project development, as figure 1 describes.

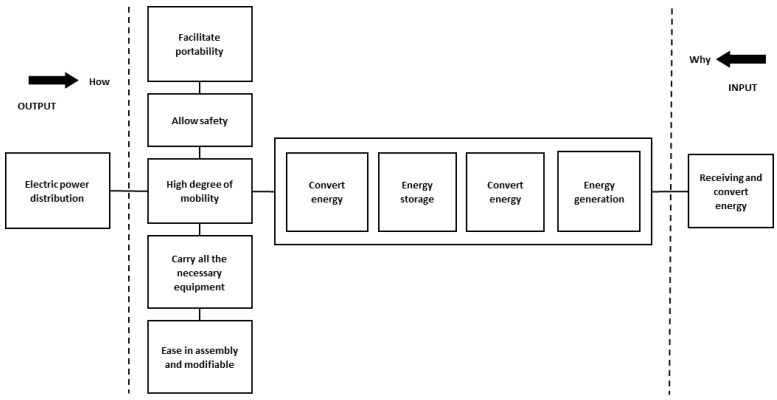


**Figure 1.** F.A.S.T MODEL for the Energy Container.

The concept generation phase is underscored as a critical component of the overall research process. Drawing upon external research and technology investigations, the objective is to adapt successful characteristics to this specific application while concurrently exploring innovative concepts to align with established requirements and specifications. Various methodologies are considered to facilitate the concept generation process.
Subsequently, the discussion focused on the establishment of initial characteristics for the Energy Container, with a specific emphasis on attributes like flexibility, reliability, and portability, especially in contexts susceptible to disasters or located in remote regions. The integration of photovoltaic panels, battery storage systems, and optionally, diesel generators, is elaborated upon, along with the practice of pre-assembly and pre-configuration to minimize on-site labour and cost implications. The paper concludes by highlighting the engineering trade-off encountered between the constrained internal space of the ISO container and the goal of optimizing energy production. Ultimately, the self-supported intermodal container is presented as a viable solution for powering telecommunications and medical treatment facilities, addressing the challenge posed by limited available space.

## 4 CONCEPT SELECTION FOR ENERGY CONTAINER DEVELOPMENT

External research revealed a consistent preference for renewable energy solutions in the context of these containers. Furthermore, to address potential safety concerns, conventional energy systems, specifically diesel generators, were commonly employed as supplementary measures The concept selection process is outlined as a pivotal decision-making stage, guided by user and stakeholder criteria. Concepts are rigorously evaluated, with their relative strengths and weaknesses considered. This process encompasses two key stages: concept screening and concept scoring, following Eppinger's framework (Eppinger, 2000). Concept screening involves filtering a pool of initial ideas and sketches, while concept scoring employs predefined criteria to rate and rank these concepts. Seven distinct concepts (labeled A to G) entered the concept development funnel, but only one emerged as the most promising, achieving the highest score, aligning with Karl T. Ulrich's approach (Karl T. Ulrich, 2007). Figure 2 presents a concept scoring matrix that details the evaluation criteria and ratings for each concept, offering a comprehensive view of the selection process.

| | CONCEPT VARIANTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Selection Criteria** | A | B | C | D | E | F | G | **REFERENCE** |
| energy output | - | + | + | + | + | + | + | 0 |
| energy storage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| fixed tilt of PV array (or seasonaly adjustable) | 0 | 0 | 0 | 0 | 0 | + | + | 0 |
| single axis system | - | - | - | - | - | + | + | 0 |
| Dual axis system | - | - | - | - | - | - | + | 0 |
| intermodal transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| portability | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 |
| quick set up on site (ease assembly) | 0 | 0 | 0 | 0 | 0 | + | - | 0 |
| safety | 0 | 0 | 0 | 0 | 0 | 0 | + | 0 |
| durabilty - (enegy production under harsh weather conditons) | - | - | - | - | - | - | + | 0 |
| re-installation | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 |
| plug and play systems | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| pre-assembled pre-configured | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PLUSES | 0 | 1 | 1 | 1 | 1 | 4 | 6 | |
| SAMES | 9 | 9 | 9 | 9 | 9 | 7 | 4 | |
| MINUSES | 4 | 3 | 3 | 3 | 3 | 2 | 3 | |
| NET | -4 | -2 | -2 | -2 | -2 | 2 | 3 | |
| RANK | 7 | 3 | 3 | 3 | 3 | 2 | 1 | |
| CONTINUE | NO | NO | NO | NO | NO | YES | YES | |

**Figure 2.** The concept scoring matrix.

## 5 ENERGY SYSTEM CALCULATION

The concept development initiated with the pivotal task of dimensioning the energy system. (Ramchandra Pode, 2011). This process generated vital parameters for each module, ensuring precision in the approach. To execute this task effectively, the sophisticated PVsyst V6.80 software (PVsyst SA, Satigny, Switzerland) tailored for photovoltaic systems was employed. Meteorological data and geographical coordinates from Thessaloniki's Mikra region were chosen to bolster result accuracy, acknowledging the importance of locale-specific data in energy system dimensioning. This encompassing dimensioning process involved establishing geographical site parameters, inputting orientation data, defining daily energy consumption patterns, configuring the solar battery bank, and selecting suitable PV modules. Table 1 systematically presents the energy system's characteristics, offering a consolidated overview of its performance and specifications.

**Table 1.** System characteristics.

| Category | Characteristics |
|---|---|
| Energy System | Stand Alone system with batteries |
| Field Type | Dual axis trackers |
| Number of PV modules | 72 |
| Area occupied by the PV modules | 144m$^2$ |
| Power | 3-phase |
| System production | 35.9 MWh per year |
| Average daily energy | 75KWh |
| Battery unit | 2900Ah/2V |
| Battery | Number of units 48 (24 in parallel – 2 in series) |
| Battery Capacity | 5900 Ah |
| Voltage | 48V |
| Battery storage | 227 KWh |
| Autonomy | Over two days of with 50% DoD |
| Battery lifetime | 10 years |

# 6 CONSTRUCTION CHARACTERISTICS AND DESIGN PROPOSAL

This chapter outlines the key characteristics of the construction resulting from the research conducted in this study. Concept G has been developed as a meticulous engineering project, guided by a trade-off equation that balances the available internal space of the energy container with the objective of maximizing energy production and storage. Furthermore, simplicity in construction is prioritized for ease of modification and maintenance. The Energy Container is aptly described as the "Sun in the Box," signifying its role in the production and storage of renewable energy harnessed from the sun. The system has been meticulously designed to deliver generated solar power on demand, with a focus on adapting a 20-foot shipping container to meet the requirements of humanitarian aid. The concept aims to optimize energy generation, mobility, transportation, and resilience to harsh weather conditions. The chapter provides visualizations of the 20-foot container's dimensions and the energy system, demonstrating a spatial arrangement that adheres to human factors and ergonomic principles. The main systems and sub-systems of the energy container installation are comprehensively depicted in figure 3, offering insights into the project's design. The standard ISO container featured in the study is sourced from the ISBU association, and the project leverages knowledge and resources related to shipping containers, including a handbook on container architecture and ISBU technology, which includes essential mechanical drawings used to create 3D renderings. Notably, 51 individual parts have been designed exclusively for the construction of the container, reflecting the meticulous planning and engineering involved in this effort.

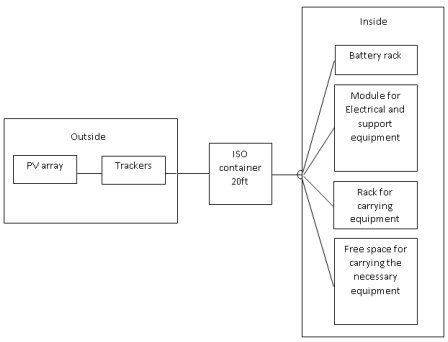


**Figure 3.** The main sub-systems of the project.

Within the energy container, several crucial infrastructure components have been carefully designed to ensure functionality and durability.

- *Modular Battery Rack*: One of the key components is the modular battery rack system, designed to accommodate appropriately sized batteries and withstand challenging transport conditions, including marine and helicopter transportation. The rack's dimensions were calculated based on the energy system's requirements, battery capacity, and the physical dimensions of the batteries, all while considering the space needed for other functions within the container.

- *Rack for Tracker Components*: Another essential element is the rack dedicated to housing the equipment required for assembling photovoltaic trackers. Constructed from structural steel components such as UPN channels, fish plates, tapered washers, high-strength bolts, and prevailing torque nuts, it features a standard UPN 140 channel, a readily available component often used in construction, ensuring ease of repair when necessary.
- *Electrical Module and Support Equipment*: The electrical module within the container facilitates the arrangement of devices according to manufacturer instructions (data sheets) to ensure correct positioning of the units. The module's design adheres to manufacturer guidelines, guaranteeing the proper functioning of the equipment.
- *Free Space for Equipment Transport*: Designing free space within the container was a critical consideration during development. This space is essential for transporting additional equipment, such as PV modules and tracker components. Specifically designed pallets optimize shipping durability and provide the necessary room to accommodate the required number of PV panels.

These foundational elements enhance the efficiency and durability of the energy container, guaranteeing its effective operation even in demanding transportation and deployment situations.

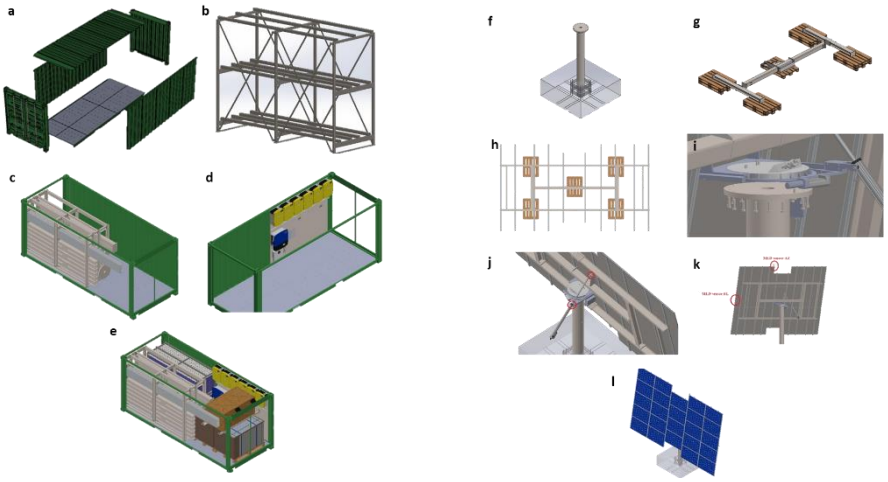


**Figure 4.** Key Stages in Container Design: ***a.*** Container, ***b.*** Battery Rack, ***c.*** Rack Placement, ***d.*** Electrical Module, ***e.*** Perspective View, and Solar Module Tracker Components: ***f.*** Mast and Foundation, ***g.*** Support structures, ***h.*** Aluminum Profiles, ***i.*** Base Frame, ***j.*** Elevation Drive, ***k.*** MLD Sensors, ***l.*** Photovoltaic Panel

Figure (4) provides a visual representation of different stages within the design process conducted via CAD software. This includes the design phases encompassing the container (a-e) and the configuration of the photovoltaic panels (f-l).
The concluding phases of the complete assembly involved the design phase of the tracker system as well as the principal design overview of the concept, including both the container and the tracker system within a relative open area.

- *The Tracker System***:** The chosen energy generation and PV module support system is the Deger tracker D60H, notable for its Dual-axis tracking capability and suitability for high-load regions, a key consideration in system selection. The Deger Tracker employs Maximum Light Detection (MLD) technology, ensuring precise, swift, and energy-efficient dual-axis orientation to maximize energy yield. Two MLD sensors identify the optimal position in the sky for maximum energy capture. These trackers optimize irradiation energy utilization, resulting in approximately a 45% yield increase for photovoltaic applications. The chapter provides a comprehensive presentation of assembly instructions for successful tracker system installation.
- *Design Overview of the Concept***:** Visual representations of the project are provided in Figure (5) through Solidworks visualization, offering a concise yet accurate portrayal of the entire concept. These visual aids offer insights into the design and layout of the energy container and its various components, aiding in a better understanding of the project's overall structure and functionality.

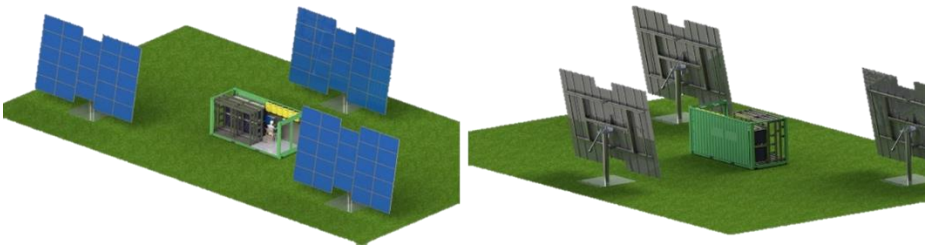

**Figure 5.** Front (left) and rear (right) views of the on-site Energy Container.

## 7 CONCLUSIONS

In summary, this research underscores the adaptability of shipping containers as versatile structures, capable of serving a wide range of functions such as hospitals, offices, classrooms, telecommunication stations, and energy units, among others. These repurposed containers are characterized by their enduring nature, offering substantial flexibility and mobility. Notably, we have demonstrated the successful conversion of a shipping container into an energy cube, equipped with photovoltaic solar cells that directly convert sunlight into electricity, which can be utilized or stored for later use. Our study has presented a novel approach and solution for energy containers, achieving the dual objectives of maximizing energy output and meeting intermodal requirements. Although the need for rapid assembly and disassembly for relocation is not a primary concern, given the prolonged stay of established camps, this research advocates for the deployment of large, stable structures due to their significant advantages in energy production and resilience against adverse weather conditions. This work highlights the promising potential of shipping containers as sustainable, adaptable, and efficient solutions across diverse applications and settings.

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# Design and Use of Portable 3D Printers for Emergencies

Evangelia Kazakli[1], Dimitrios Tzetzis[1]

[1] Digital Manufacturing and Materials Characterization Lab, School of Science and Technology, International Hellenic University, 14th km Thessaloniki-N. Moudania, 57001, Greece

**Abstract.** In emergency response, the ability to adapt rapidly is the key to mitigating the impact of disasters and saving lives. 3D printers have emerged as a groundbreaking technology that is revolutionizing emergency preparedness and relief efforts. In this paper, the focus is on how the 3D printing technology can be adjusted and used in actual rescue environments. Research and exploration are done in the fields of emergency situations and 3D printer technology. In addition to the literature research, primary data for real case situations are gathered from interviewing the Hellenic Rescue Team and a portable 3D printer system is designed based on their needs to service the main fields of action. The design concept takes into consideration not only the possible objects to be 3D printed, but all the processes to practically include this portable 3D printing system in the rescue team's operations.

**Keywords:** 3D printing, emergency, design, crisis

## 1.Introduction

The first known use of the term emergency was circa 1631, according to the Merriam-webster Dictionary, with the definition of it being: "an unforeseen combination of circumstances or the resulting state that calls for immediate action". To deal with crisis like medical emergencies, natural or human disasters or acts of violence, adaptability, customization and fast response are the basic characteristics any provided solution should include. People can never be fully prepared for what is needed in terms of equipment, tools or other fixing or supporting objects. Additive manufacturing or 3D printing, a rapidly growing technology based on these characteristics, is able to create all kinds of objects with a solid material, complex geometries and less connection points, saving material and time comparing to traditional manufacturing.

Hence, it has already started to act like a tool in emergencies, providing practical solutions on-site to produce supplies in demand in multiple situations. The main reasons for this are: the fast production on demand, customization in products like in medical surgical operations where doctors create personalized organ samples (Whelan, 2023), remote production on site-important in unreachable areas like in Nepal after the earthquake in 2015 where the area was unreachable for supplies, and they created small spare and medical parts in the rescue area (Medling,2018) and cost-effective production. Other applications of 3D printing in emergencies includes the production prosthetic parts for underdeveloped countries in very low prices (Choi,2021), medical situations like the COVID-19 where many medical items where printed due to lack of time for traditional ways (Warkiani et al., 2021) and spare or replacement parts in damaged hard to reach areas (Owen,2019). Despite all the advantages and benefits gained from 3D printing used in emergencies, challenges that the newly developed technology needs to face, are there too. Such as the lack of quality control, which according to Minshall can affect the safety and quality that are crucial to avoid more harmful situations (Minshall,2016), material limitations, printing time, training, cost equipment portability and in some cases even property protection.

3D printing as a technology has started to being used as an experimental way of dealing with crisis situations, exploring its possibilities in providing humanitarian aid. The current work focuses on building an organized working 3D printing system, that rescue teams can count on using on field with specifications based on each rescue field's qualifications.

## 2. Why and how 3D printing can be used in emergencies

During the Covid-19 pandemic, we saw how using 3d printing technology was helpful as the industrial production companies couldn't keep up with the fast consumption of medical consumables. The way the consumable parts were 3d-printed and distributed to the hospitals in need, felt that an upcoming technology like that can be widely used in such meaningful ways, other than monetarily profiting. In emergencies that happen in different and unpredicted types of environments every time, such as rescue operations in remote or hazardous location, equipment can't be easily transferred. Most importantly ii isn't possible to predict the required equipment or materials with the specific needed characteristics and carry them wherever needs with no granted access. Here the 3D printing technology excels among others because of the ability to print on demand. Combining that with the feature of portability the rescue teams can gain access to many equipment parts with only carrying one toolkit for many uses and departments, minimizing the carried equipment and time for planning and setting up.

## 3. Methodology

Designing for emergency situations requires understanding them. Hence, the work started from research in literature and online in the fields of emergencies and how the emerging 3D printing technology is involved in them. Second and essential step is gathering raw data, straight from interviews of people with experience in rescue missions. The first interview reviewed as a case study was from the Born to Design – SOLIDWORKS podcast from Dara Dotz, a pioneer in 3D printing in austere environments who started 3D printing as a way of addressing immediate needs two years after the Haiti earthquake and has had a lot of experience since then (Medling,2018). The second interview is a semi-structured live one, with Miltiades Meliadis (Special HRT Secretary & volunteer 12 years in the Water Search and Rescue), Zafiris Trompakas (Training Manager & volunteer 43 years in the Mountain Search and Rescue), Athanasios Moutsiopoulos (IT& European Programs & volunteer for 20 years) experienced members of the Hellenic Rescue Team that gave the main guidelines for the 3D printer system specifications. Data gathered and analyzed from the main interview about objects that are mostly in need and possible to 3D print for each HRT's field of action shown in Table 1. Highlighted importance during the interview is given in the Urban Search & Rescue department for immediate on-site production of unexpected amounts of durable sub-column parts in need for ruin support while carrying humans, in the Water Search and Rescue for flexible patches for inflatable boats damages between the missions and in the Mountain Search and Rescue for climbing equipment replacements during missions in refugee bases. Challenges and problems with potential solutions if using a 3D printing system in their missions can be seen in Table 2. After extracting the data for basic object to be print and the 3D printer needs and challenges from all sources, they are combined giving the 3D printer's specifications, as showcased in Table 3. Interpretation of needs and requirements into solutions and choice of 3D printer type through benchmarking lead to the concept generation. The basis for the design of a Portable 3D Printer System for Emergencies, was to design both for the situations it will be needed and the parts in should produce on each field but at the same time, design it to fit the needs of the user, the Hellenic Rescue Team, a non-governmental organization, whose members participate in Search and Rescue missions in Greece and abroad through the Team's branches on a voluntary basis since 1994.

**Table 1.** Objects/ Parts to be 3D printed for each department according to needs

| | 1. | 2. | 3. | 4. | 5. |
|---|---|---|---|---|---|
| - | **Mountain Search and Rescue** | **Water Search and Rescue** | **Urban Search and Rescue** | **First Aid** | **Research and Technology** |
| A | Shovel with attachment for piolet | Patches for inflatable boat balloons | Sub-columns for ruin support | Human body proplasm | Drone model or parts |
| B | Rope pulleys | - | Pipe/Cable replacement parts | Organs proplasm | Transponders vaulted coverings |
| C | Rock climbing piton | - | Thermal camera extension | Bones problems | Box handles & lids |
| D | Climbing nuts | - | Whistle | - | Protective cases |
| E | Torch of parts of torches | - | Helmets | - | Tools: screwdrivers, wrenches |

**Table 2.** Challenges and problem solutions within HRT potential

| Challenge/Problem | HRT Solution |
|---|---|
| Power Supply | Bringing power generator in all missions<br>In refugee and bases solar panels<br>Power inverter devices existing |
| Portability with safety | Strong & durable waterproof protective cases |
| Dust full or humid environments | Protection of the printing area |
| Low or high temperatures | Device and printing area insulation |
| No internet or cloud connection | Offline standard database for print with no connection or laptop |
| No quality testing available on site | Predesigning, Preplanning for testing |
| Different devices available, brands or types | Connectivity with all kinds of devices |
| No time for design on spot | Predesigning, Preplanning, connecting on cloud /offline database |
| No user training | Preplanning: training, friendly user interface |
| Need to work with many foreigners | Friendly user interface with not difficult words |

**Table 3.** 3D printer's specifications

| 3D printer's specs |
|---|
| Portability |
| Strong protective waterproof cases for transfer |
| Size that fits in helicopters, SUVs cars |
| Weight carriable by vehicles or 1 or 2 individuals (not more than a person's weight) |
| Everything needs to be printed fast due to emergencies |
| Cost-effective with recycling material ability after single use or part break or failing |
| Connectivity with internet & offline printing |
| Autonomous printing for enough time until re-supply |
| Easy use from everybody available |

## 4. Design-final product


**Figure 1.** The full 3D printer system "everprint"

The design aim is creating a 3D printing system to be used in rescue missions. It is called a system because it consists of the physical parts, but also of the plan on how to fit it into the rescue team's operations and an online/offline database with pre-tested models ready to print that can be seen in Figure 1.


**Figure 2.** Main pack & 3 packs according to each sector

The main physical parts are a. the main unit, being a hard case pack with handles, containing a 3D printer, a toolkit and free space for a laptop and connectivity devices, and b. urban, mountain & water pack units containing material filaments according to the mostly needed parts for every sector for easy categorization. The main unit case has 2 horizontal insets on the right and left sides for the side parts to slide into and connect together for easier carrying by 2 people, Figure 4 and a shallower inset on the cap for placing the 3d printer and using the unit as a desktop creating a workspace for every environment seen in Figure 2.

The 3D printer to be used needs to be a Fused Filament Fabrication (FFF) technology model, fulfilling all the specifications shown in Table 3. Since the mechanical design of the printer is outside the scope of this paper, an existing model fitting the qualifications is used with. 495 x 585 x 520mm dimensions, 20,6 kg weight with protected printed area and build size 330 x 240 x 300mm, Wi-Fi, Ethernet & USB connectivity, supporting all OS systems and multiple file types like STL, OBJ, X3D, 3MF, BMP, GIF, JPG, PNG and compatible with a wide range of materials including strong plastics, nylon, carbon fiber for tough use and TPUs for flexible parts.

Organizing and preplanning is a vital need to be ready to act in emergencies. The identity of the system is created with the name ''everprint'' and simple indications of color and graphics are designed for each department to be easily understood internationally. Separation of material packs with materials mostly needed in each sector are prepared with the according signs and handle colors for easy separation. Green for the mountain pack with more strong plastics and carbon fiber material, blue for the water pack with big flexible TPU amounts and yellow for the general disasters with multiple materials but mostly carbon fiber for durable parts, Figure 3. Designing for realistic use, and given the money insecurity the HRT faces, the main 3D printer unit is proposed for training causes, research and testing in the team's headquarters, where the First Aid & Research and Technology operations take place and create tested models to fill the database. The unit is fully packed with its transfer case and full material stock for each department, ready for whenever an emergency occurs. The aim is to start like this with the customizable 3D printer set parts prepared for every occasion and once it starts working as a trustworthy method of dealing with emergencies place main units in the team's bases like the mountain refugee to assist each areas needs but also for faster delivery of produced parts on the field. The main and side unit case parts are made from strong durable plastic for protection of the 3D printer and are designed so that they can be carries from one or two people, fitting into SUVs and helicopters for delivery on the field of action. Each side pack provides enough capacity for continues printing when in rescue, until the refilling of the pack, with 24pcs filament capacity each.

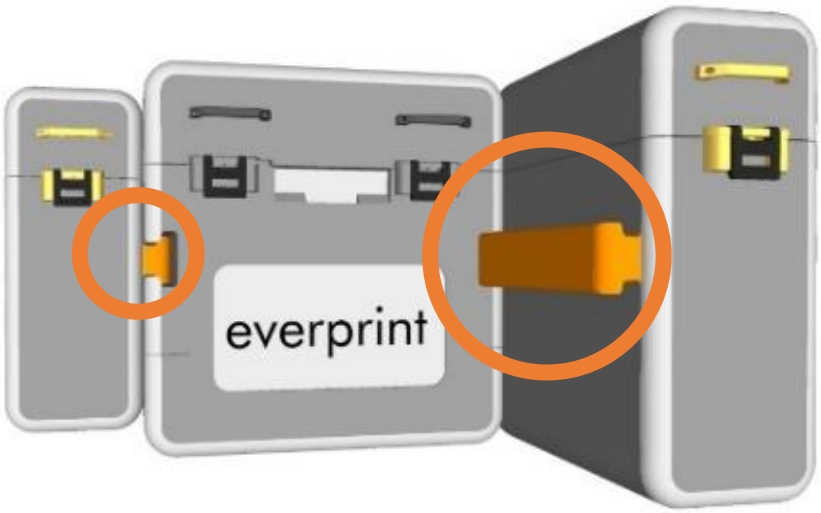

Mountain Search and Rescue


Water Search and Rescue


Urban Search and Rescue

**Figure 3.** Mountain, Water & Urban rescue packs identity design

The online and offline database is built for the everprint system to include all tested and prepared to print models categorized by missions' field of action. The interface is designed having in mind to be user friendly, easy to explain what and where for easy decisions during emergencies. Images and color separations are used instead of words for minimizing international communications. Word indications are kept the minimum possible amount to assist and not steal observing or questioning time, Figure 5.
Possible future additions to the portable 3D printer system to adapt to even more circumstances can be an extra nozzle to 3D print also metallic objects, additional battery kit and an online featured collection of tested models with their material specifications to be sold and bring the organization some income back for supporting the operations. A groundbreaking addition would be the ability to swift the geometry of the pre-tested models and based on their evaluation predict their new qualifications the new model will have so no time is lost in failed trials on field use.




Main unit (690 x 690 x 720 mm)

| | |
|---|---|
| 3D printer: | 20.6 kg |
| Transfer Case & tools: | 10 kg max |
| Total: | 30kg |

Side part units

| | |
|---|---|
| Full material load: | 18-24kg |
| Transfer Case & tools: | 5 kg max |
| Total: | 23 – 29 kg |

Main unit + one side part: 53 - 59 kg
Main unit + two side parts: 76 – 82 kg

Side unit (690 x 340 x 720 mm)
Maximum Diameter 203mm
Maximum height 70mm

Weight minimum 750g
Weight maximum 1000g

**Figure 4.** Connection parts detail& specifications

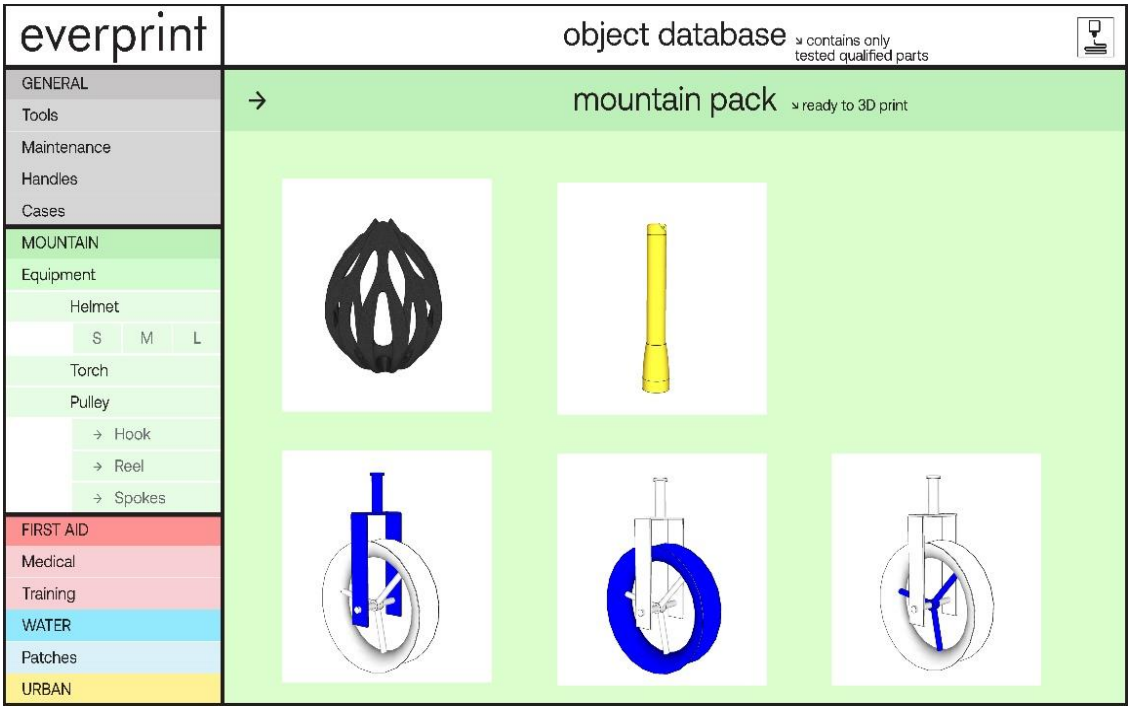



**Figure 5.** Application/database user Interface

## 5. Conclusions

The emergence and integration of portable 3D printers into the sector of emergency response mark a transformative leap forward in our ability to adapt and innovate in times of humanitarian crisis. Aiming to adapt a portable 3D printer into a rescue team's operations to deal better and faster with unpredictable situations, a holistic system concept was planned, designed and presented taking into consideration the most important reasons to do it as long as the challenges it faces. This technology has the potential to bridge the gap between limited resources and immediate demands, offering better solutions to those affected by disasters but needs good pre-planning, organizing, testing and evaluating before missions to make the most effective use when in need. In circumstances that unpredictable as in crises, a toolkit like that which can provide the adjustment to print in place whatever is needed can be liberating as it provides immediate and customizable coverage of multiple needs. Even though this technology is still under development the help it can provide in emergencies is worth the effort because the possibilities are endless for 3d printing to evolve and assist humanitarian aid. There is willingness to do it and so much potential to aiming the multiple needs required very frequently n almost all kinds of emergencies, and It is a promising way to make all these happen so any possible means of supporting the portable 3D printer and the organizing system to be used crisis situations is needed as soon as possible.

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# Leveraging Humanitarian Technologies for Crisis Management

Anastasios Ntabizas[1], Maria Drakaki[1] Panagiotis Tzionas[2]

[1] Department of Science and Technology, International Hellenic University, 14th km Thessaloniki-N. Moudania, 57001, Thermi, Greece

[2] Department of Industrial Engineering and Management, International Hellenic University, PO BOX 141, 57400, Thessaloniki, Greece

## Abstract

Over the last decade, the number of humanitarian crises that emerge has increased, requiring innovative approaches to crisis management. This paper aims to explore the important role of technology in addressing humanitarian crises, emphasizing the potential to revolutionize response and recovery efforts. It provides an analysis on how technology empowers decision-makers with analytical insights and improves coordination among diverse stakeholders. Case studies from the real world from recent crises, including the Mediterranean refugee crises, the Ukrainian conflict and the global response to COVID-19 pandemic are demonstrated to point out the transformative potential of technology in crisis response.

A range of technologies being used in humanitarian crisis management is being explored as well as Ethical and operational challenges and limitations in humanitarian settings. Concerns regarding data privacy and the ethical use of AI in crisis decision-making are being investigated. Furthermore, the paper proposes future directions in regard to potential advancements in humanitarian technology, highlighting the use of blockchain and drone technologies as tools to further enhance crisis management.

In conclusion, the paper emphasizes the significance of the most important technologies employed within the humanitarian sector to mitigate the impacts of crises. Moreover, it provides a glimpse into forthcoming strategies and directions for tackling intricate humanitarian emergencies.

**Keywords:** Humanitarian technologies; Crisis Management; AI technologies.

## 1 Introduction

In todays' era, as the number of humanitarian crises of increased complexity is constantly increasing, the role of technology in crisis management has become more crucial than ever. The use of cutting-edge technologies can transform the capacity to respond to emerging crises to save lives, enhance coordination, and optimize resource allocation. However, in the process of embracing these advances, we also face ethical concepts such as data privacy, algorithm biases, and ethical AI applications to ensure that innovation aligns with humanitarian principles. Ethical review and risk assessment must be contacted with the same urgency that encourages the continuous development of AI based solutions (Tzachor et al.,2020).

## 2 Humanitarian Crisis Management Technologies

The latest innovation in the technological sector revolutionizes humanitarian crisis management in several ways. A large scale of different technologies is deployed in crisis management:

**Data Analytics:** Real time data analysis can provide insights to inform decision-making across all phases of crisis management, from crisis prediction to response planning. It can aid in mapping affected areas and identifying vulnerable populations. For example, data analytics can be retrieved to identify areas that are at high risk of flooding, to predict climate change conditions that can cause a wildfire, or to get informed from satellite imagery to develop wildfire containment strategies.

**Artificial Intelligence and Machine Learning:** AI technologies, though the development of predictive models, can be used to identify potential crises, such as disasters, disease outbreaks and optimize resource allocation and aid delivery. For example, AI technologies can predict the path of a hurricane or the spread of a disease outbreak.

**Communication and Dissemination Technologies:** These technologies such as mobile applications, satellite communication, and digital platforms are vital to crisis management, as they enable rapid dissemination of information and allow better coordination among responders. They can be used to reach affected populations with vital information, such as shelter locations and evacuation routes. Communication tools can also be used to enable real-time coordination among humanitarian parties and government agencies.

In addition to the above technologies, there are a number of other emerging technologies with the potential to revolutionize crisis management, such as blockchain technologies that can be used to improve efficiency and transparency of the humanitarian aid delivery procedures and technologies such as drones that can be used to assess damage in disaster areas.

## 3 Case Studies and Examples

### 3.1 Case Study 1 – The Ukrainian Conflict (U-Report)

During the war in Ukraine, the United Nations Children's Fund (UNICEF) implemented a U-Report program to reach people in affected areas and allow them to voice their opinions and concerns on a variety of issues.(UNICEF, 2022) The mobile-based platform was created to provide an important communication channel for young people to report on the situation, express their needs and receive vital information about all available support services provided. U-Report collected real-time data on the impact of the conflict on young people with the aim of being used by UNICEF and other humanitarian organisations to target aid effectively and identify the needs of young people. As an example, the report data was used to identify areas where there was a shortage of schools and mental health services.

### 3.2 Case Study 2 – The Mediterranean Crisis (Refugee Aid App)

The Mediterranean crisis was an enormous European immigration crisis that began in 2015, leaving the international community trying to address ways to propose actions that would mitigate the impact of social consequences for migrants lives. Some of these were the sharing of accurate information at all stages of migration to improve bilateral, regional, and international cooperation and to provide migrants with adequate information and documentation at all stages to prevent stateliness (Turakova, 2019). During the Mediterranean refugee crisis, a nonprofit organisation developed a smartphone application, called RefAid, designed to provide crucial information to refugees and migrants arriving on European shores. RefAid was one of 1500 mobile applications created for refugees in a 12-month period. It was designed specifically for refugees and was translated into all languages that represented the refugee population served (Kaurin,2020). The application provided information on many topics such as asylum procedures, legal rights, safety and security information, access to healthcare and education and transportation and accommodation options. Humanitarian organisations made use of the application to coordinate activities and rescue efforts, reducing response time and saving lives. The application is a valuable example of how the right use of technology can be utilized to support refuges and migrants to access valuable information and services to rebuild their lives. The case reflects that smartphone applications can play an important role in supporting refugees and migrants in safety and well-being issues and can also provide a tool to humanitarian organisations and government agencies to better coordinate activities.

### 3.3 Case Study 3 – The Covid-19 Pandemic (Contact Tracing and Data Analytics)

Contact tracing and data analytics were widely used during the Covid-19 Pandemic, by various countries and organisations to monitor the spread of the virus and inform public health responses. Between May 2020 and November 2021, 180 contact tracing applications were identified across 152 countries, states, or territories. (Bardus et al., 2022) Contact tracing is the process of detecting and contacting people exposed to the disease thought an infected person, manually of thought the use of tracing applications. Data analytics is the process of collecting and analyzing data to obtain real time insights such as the spread of a virus, identity trends and predict future outbreaks to enable health authorities to make informed decisions on strategies to decrease the Pandemic effects. Some examples of how contact tracing and data analytics were used during Covid-19 pandemic included the case of South Korean where contact tracing such as location data from mobile devices, credit card transactions and circuit television footage was used to identify and isolate inflected individuals at the early stages of the pandemic (Kang et al., 2021) and also the United States case where data analytics was used to identify high-risk areas and populations, where the information was used to public health interventions, like testing and vaccination programs. Furthermore, China used data analytics to track movement of the virus and predict future outbreaks. The information was used to inform the public on lockdowns and travel restrictions.

## 4 Ethical Concerns

The emerging humanitarian technologies can revolutionize the approaches used to respond to crisis, but on the other hand it is important to be aware of the ethical concerns connected with the development and use of these technologies. The biggest ethical concern is data privacy. A large proportion of data about displaced people and people affected by crises is collected by humanitarian organisations, such as personal information, location and health data. Surveillance is another ethical concern. There are emerging technologies that are used to track and monitor people that are affected by crises. The above raises concerns about civil properties and the potential for abuse.

Thre use of AI in decision making during crises raises concerns about the accountability and transparency of AI technologies. Technology can be biased and used in a non-responsible and ethical manner, and this can affect disproportionately marginalized groups. Thus, humanitarian organisations need to implement activities and take steps to mitigate it.

Humanitarian actors need to address these concerns associated with the development and use of technology in many different ways such as implementing data privacy measures, developing ethical guidelines of the use of AI and algorithmic technologies, auditing algorithms for biases and employ mitigation strategies and involving affected communities in decision making. Additionally, they can develop ethical guidelines for the development and proper use of technology and provide training to their staff on the ethical implications of technology.

By taking the above actions, the humanitarian organisations can ensure that the technological advancements will be used to a responsible and ethical manner towards the support of vulnerable groups of people that are affected of future crises.

## 5 Future Direction in Humanitarian Technologies

The future of Humanitarian Technologies relies on global collaboration, innovation, and emerging technological integration to respond to future crises emerged. The key directions include:

### 5.1 Advancement in Humanitarian Technology

Collaboration between humans and AI is one of the most promising areas of AI development. AI systems would have to be designed in a way that will support human experts in work. As an example, AI systems can be used to analyze large datasets of data to identify patterns that would be difficult for humans to detect, allowing for better resource allocation and targeted interventions. Furthermore, predictive analytics can be used to analyze vast amounts of data to predict future disasters and conflicts. Data sharing platforms can help humanitarian organisations to improve coordination and collaboration among different humanitarian actors. For example, the Humanitarian Data Exchange (HDX) is a data sharing platform that is used by over a thousand humanitarian organisations and provides access to a large number of humanitarian data on the location of displaced people, their needs, and the availability of resources. Remote sensing, such as the use of satellites and drone technologies will be used in a wide range of humanitarian activities, such as damage assessment, disaster response and

environmental monitoring. As an example, the United Nations High Commissioner for Refugees (UNHCR) is using drones for the delivery of aid to refugees in remote areas of South Sudan by providing medicine, food and supplies to refugees who are of need and cannot reach out otherwise.

### 5.2 International Collaboration and Innovation

The are many ways for international collaboration and Innovation to develop and use humanitarian technology efficient and effective. Humanitarian actors, such as NGOs, tech companies and government can work together to develop new technologies that can improve the lives of people affected by future crises. Global data sharing is crucial for these actors to have real time data on locations of affected populations to better coordinate response and aid delivery. Technological innovation Hubs will play their role on providing the technologies and space to humanitarian organizations, technological companies, and similar stakeholders to accelerate the development and testing of new technologies and build capacity among them to use all these technologies effectively.

### 5.3 Emerging Technologies

Blockchain and drone technologies can revolutionize the way that humanitarian organisation deliver aid. With the use of the above technologies the humanitarian system can be more effective and transparent. Blockchain as a distributed ledger technology can help in reducing fraud and corruption in the humanitarian field by creating a transparent and secured record of transactions and by doing so humanitarian aid offered can be distributed fairly. An example of a good use of the mentioned technology is the World Food Program (WFP) using blockchain technology to distribute food aid to refugees in Jordan, Bangladesh, Lebanon and Ukraine. WFP makes use of the technology to track the food aid movement from the point of origin to the distribution point. By that it ensures that the food aid reaches the people that need it most, and it is not stolen or used for other purposes. Biometrics can also play a vital role in identity verification, tracking and border controls. (PWC, 2016) Government and international organisations can make use of biometrics technology to establish unique identities of asylum seekers to enable identification and tracking.

## 6 Conclusion

In recent years, the role of technology in humanitarian crisis management has become increasingly important as the number and the complexity of humanitarian crises is on the rise. New technologies are revolutionizing the way humanitarian sector responds to and recovers from crises, improving coordination and optimizing resource allocation.

Today but also in future times, humanitarian crises will rarely be isolated events, but often interconnected. Therefore, to address them properly, a multidisciplinary approach is required that combines community and multi-actor engagement, policy expertise along with the use of innovative technologies. A collaborative approach of all engaged humanitarian parties, tech providers, government and the local communities is crucial for success.

However, it is crucial to be aware of all ethical concerns associated with the proper development and use of humanitarian technologies, such as data privacy, surveillance, and AI bias. Steps have to be taken to mitigate these risks and make sure that technology is used in a responsible and right manner.

The future of humanitarian technology is promising, and the use of new innovative tools and the collaboration between associated parties, the humanitarian sector can be better prepared to respond to future crises and create a more just and equitable world for more people.

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# Technology and Humanitarian Crises

Anna-Olympia Tsoulka[1], Olympia Tsoulka[2], Ilias Kotsireas[3]

[1] MSc University of Nicosia/University of Patras, Greece
Email: annatsoulka98@gmail.com
[2] BSc University of Thessaly, Greece
Email: tsoulka.olyna@gmail.com
[3] Wilfrid Laurier University, Canada
Email: ikotsire@gmail.com

**Abstract.** In recent years, humanitarian crises have been observed which manifest themselves with incidents of inequality, violence, increased migratory flows, poverty, lack of education as well as the absence of social protection. More specifically, humanitarian crises threatens large groups of populations putting them at risk through various ways and situations. It is usually divided into two categories, natural disasters such as floods, earthquakes, fires, volcanic eruptions, tsunamis as well as human-made disasters such as global warming, war, violence, cyber-crime. However, the use of new technologies can aid in preventing natural disasters as well as collecting data correlating the influence of climate and migratory flows. In particular, the aim of this article is to highlight successful examples of the use of new technologies in these contexts. The digital recording of cultural heritage, Geographic Information Systems (GIS), Artificial Intelligence (AI), and drones, can ensure an environment of protection and recovery from both natural and human-made disasters and threats. Machine Learning (ML) can reliably analyze the role of weather shocks in a person's intention to migrate. The present survey papers aims in emphasizing ways to address humanitarian crises through (new) technologies. The goal is to delineate and quantify anthropogenic activities that, if left unchecked, can lead the earth to an interglacial state similar to the Holocene.

**Keywords:** Artificial Intelligence; Holocene; Anthropocentrism; Natural Disasters; Machine Learning; Weather Shock.

## 1 Introduction

The modern industrialized Western world reflects human's alienation from nature, an approach known as anthropocentrism. In particular, human is at the core and treats the rest only subordinately in order to serve human culture, development and prosperity. Intense urbanization as well as biodiversity loss leads to a significant qualitative and quantitative decline in human interaction with the natural world (Spannring, 2015). This implies that people perceive their existence as something separate from nature. They treat nature as an "object" exerting their will on it (Kellert & Wilson 2013). In this way, we are led to lack of unity with nature at the deepest level, as nature is treated as a "resource" to be exploited and ultimately destroyed (Berry 2013, 16 op. ref. in Tsevreni, 2020b).

At the opposite end is ecocentrism, which is based on the value of all elements of nature and focuses on ecosystems or the biosphere. The German psychoanalyst Erich Fromm coined the term "Biophilia", giving it the meaning of human's innate tendency to connect with elements of nature. The concept of love for humanity and nature, independence and freedom is also attributed to this term. In other words, it is an "instinctive bond between human and nature". (Willson, 1984 op. ref. in Kahn & Kellert, 2002).

Human-made disturbances of the global environment are treated as if they were separate issues (such as climate change, loss of biodiversity, environmental pollution). Of course, this does not take into account the non-linear interactions of these disturbances that can bring about additional harmful effects (Richardson, 2023).

## 2 Environmental Crisis: "An ecological proposal of Nicaraguans to tackle toxic gases"

It is necessary to define anthropogenic activities because there is a risk that the earth will be led to a state similar to the Holocene. This is due to the conservative functioning of global environmental systems that do not show much difference compared to older systems. The Holocene period begins after the end of the Ice Age and is characterized primarily by stable, warm planetary conditions. Because of human activities the earth moved from the Holocene to the Anthropocene era (Richardson, 2023).

However, through these disasters of various kinds there is also the hope of solidarity from different parts of the planet which in such situations appears determined to help the affected

populations. A typical example is that of the Nicaraguan people, who cook on hard surfaces to protect the environment, as well as for a healthier lifestyle. Volunteers also took part in this initiative helping the project, as well as sharing it on social media. A group of Canadian volunteers work with the Nicaraguan people and cook together over an open fire to reduce the use of the wood stove. Burning wood contributes particularly to the creation of toxic gases as well as intensifying the greenhouse effect, burdening human health (CBC, 2023).

Action volunteer Janice Rauser points out that during her work at the hospital she has seen several cases of respiratory problems, coughing, asthma, burning eyes and other symptoms. According to a study by the Clean Cooking Alliance at the United Nations burning wood as fuel is responsible for 1.9 to 2.3 percent of greenhouse gas emissions globally. In Nicaragua wood burning is estimated to contribute 5 to 20 percent of the total. In the year 2021 more than two billion people around the world do not have access to clean cooking. (CBC, 2023).

According to a recent study, Nicaraguan people do not have access to modern cooking machines, so they turn to the use and burning of wood. As a response to this phenomenon comes the Justa stove which produces less smoke and does not consume a lot of wood. Johnny Flores who is a trainee travels to help build stoves. He typically mentions the feeling he feels when he sees the faces of these people when they see the special cooking stove completed. In addition, they report that the symptoms they had, such as cough and asthma, were eliminated with the use of the Justa stove. This stove is an important achievement for the protection of the environment as well as for human health (CBC, 2023).

Furthermore, other cultures with an interactive experience or even nature-friendly cultural beliefs sharpen the anthropocentric perspective and perceive the world through a more ecocentric view (Kahn & Kellert, 2002). For example, the Japanese culture, which is considered one of the most technologically and industrially advanced, treats nature as a blessing and a friend to the Japanese people (Murota, 1986 op. ref. in Kellert & Wilson, 2013). Thus, cultural beliefs influence citizens' attitudes, and cultures of people who see themselves as an integral of nature lead to less anthropocentric attitudes.

## 3 The Role of New Technologies in the Environmental Crisis

### 3.1 Geographic Information Systems (GIS)

As a solution to the problem of the imbalance that exists in relation to the changing conditions, the use of new technologies is proposed. In particular, the digital recording of cultural heritage can ensure an environment of protection and restoration both from natural disasters and from human-made threats (Zafeiropoulos, Tzortzis, Ralis, & Doulamis 2023). This can be achieved through Technologies such as: Geographic Information Systems (GIS), Unmanned Aerial Vehicles (UAVs, a.k.a. drones), Artificial Intelligence (AI), Machine Learning (ML), to name just a few.

Geographic Information Systems (GIS) can ensure the preservation of cultural resources, promote tourism in local communities as well as contribute to sustainable development. Its database can update the current status of a cultural monument. Furthermore, it is capable of making correct and timely decisions concerning their protection. Cooperation with the Ministry of Culture, possibility of communication of the municipalities about the cultural routes through their websites, Reflection of cultural proposals for future visitors as well as highlighting the cultural wealth (Zafeiropoulos, Tzortzis, Ralis, & Doulamis 2023).

### 3.2 The Role /Contribution of Artificial Intelligence in the Prevention of Natural Disasters

Regarding the course of development of Artificial Intelligence technologies, it is considered necessary to set the definition of data and requirements, the goal of implementation and the method of implementation based on the security of its design. What is deemed paramount is the need to control the effects and impact of such a system. Furthermore, it is necessary to emphasize the possible risk of exploiting the "weaknesses" of a specific system. According to the European Union Agency for Cybersecurity (ENISA), categories of threats can be identified. In more detail, malicious software with the aim of damaging information systems, attacks on physical infrastructure resulting in natural disasters (floods, fires) as well as legislation issues such as falsification or destruction of data, privacy issues (Kikkos, 2023). Top worldwide AI experts caution that ``AI is a caterpillar that can become a tyrannosaurus".

### 3.3 Tree-based Machine Learning and Migration Flows

In the past ten years, researchers have taken advantage of the availability and quality of climate and mobility indicators, to study the extent to which climate events initiated (or even forced) individuals to migrate. Recently new insights were offered in this literature by adopting tree-based Machine Learning (ML) techniques (Aoga et al. 2023). These insights were not uncovered using traditional empirical approaches. Instead, Aoga et al. used tree-based Machine Learning to conduct thorough analysis of the role of weather shocks as to a person's intention to migrate. The research focuses on six African countries, namely Burkina Faso, Ivory Coast, Mali, Mauritania, Niger, and Senegal, whose economy depends on agriculture. Through the execution of tree-based algorithms (such as XGB and Random Forest) and using the train-validation-test workflow robust and noise-resistant models were built. The main characteristics that appear to have an influence on migratory intention were then identified. The recording was done using the Standard Precipitation – Evapotranspiration Index (SPEI) for various socioeconomic characteristics.

### 3.4 Drones in Wildfire Detection, Prevention and Management

The drones industry has witnessed significant growth in the past few decades. While in the early days, only very few countries (essentially the superpowers) shared the worldwide market, nowadays, several dozens of countries manufacture their own drones. This is because the huge potential for a wide spectrum of applications of drones was realized. One such application is in the detection, prevention and management of wildfires. To this effect, an entire special issue was devoted to this topic (Yfantis, Zamora Ramos, Harris, 2021).

### 3.5 Refugee migration networks via advanced mathematical modelling

The complex phenomenon of refugee migration networks can be modelled using advanced mathematical tools (such as variational calculus, network science and optimization), as exemplified in (Nagurney et al. 2020). The statistics are daunting: 258 million migrants (i.e. 3.4% of the global population) were recorded in 2017, according to the United Nations. One of the important major realizations in (Nagurney et al. 2020) was that the models that arise from refugee migration networks are isomorphic (i.e. mathematically equivalent) to traffic

network equilibrium models, which have been studied very extensively previously. (Mebelli et al. 2023) investigate a similar issue, using other mathematical tools.

## 4 Conclusions

Updates on the functional integrity of the biosphere through analyses as well as through modeling exercises reveal the effects of human intervention. In addition, various scenarios that violate the earth system as well as the limits of climate change are explored. According to (Richardson, 2023). In (Richardson, 2023) it is pointed out that the nine boundaries represent all the elements of the earth system, which are affected by anthropogenic actions. Furthermore, the statistics show that we will soon be led to an alteration and reshaping of the dynamics of the spatiotemporal patterns of the geosphere's interactions (Richardson, 2023).

There are indications that the earth system has exceeded the "safe zone" and evidence is emerging of a rapidly increasing risk. Six of the nine boundaries have been breached resulting in the earth potentially not being a safe place for humanity, in the foreseeable future. Judicious use of new technologies can be a very useful approach that can yield results. Therefore, modeling different levels of climate change boundaries suggests that anthropogenic impacts need to be taken seriously into account, in a more systematic technological context (Richardson, 2023).

## Annex

**Figure 1.** Rapidly expanding forest fire

**Figure 2.** Severe flooding effects

**Figure 3.** Natural Disasters

**Figure 4.** Earthquake destruction

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# Disaster Risk Management

# Addressing the hazard risks of Kolumbo submarine volcano (Santorini, Greece)

Anna Katsigera[1], Paraskevi Nomikou[1] and SANTORY Team

[1] Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Zografou Campus, 15784, Athens, Greece
Email: annakat@geol.uoa.gr

**Abstract.** Volcanic eruptions are one of the most captivating natural phenomena on Earth but pose significant risks to nearby communities due to their associated hazards (earthquakes, tsunami, pyroclastic flows, toxic gasses). The implementation of a proactive volcanic risk management is essential to minimize the threat in close populated areas. Kolumbo is a submerged active volcano, 7km northeast of Santorini Island and part of the Hellenic Volcanic Arc. Kolumbo's most recent eruption, in 1650, generated a tsunami causing destruction in the nearby islands as well as several casualties due to poisonous gasses in Santorini. Eyewitness accounts reported maximum run-up heights of 20m on the southern coast of Ios, 240m inundation on Sikinos, and flooding of up to 2km² of land on the eastern coast of Santorini, prompting major destruction in the proximate towns. Recent studies show that a future explosive event of Kolumbo poses a significant hazard to the northern and east coasts of Santorini, however there is no relevant management protocol in place. Therefore, it is proposed that a combination of scientific research (active monitoring, hazard maps), community engagement, preparedness planning with government agencies (Civil Protection), and timely response strategies is crucial to minimize the hazard risks and avoid casualties and the detrimental consequences to the area's economy and infrastructure. At present, we have deployed state-of-the art sensors to monitor Kolumbo active hydrothermal field under the framework of SANTORY project (www.santory.gr). SANTORY aims to create novel communication tools and provide the scientific community, policymakers, and stakeholders with interregional monitoring protocols for assessment of hazard warning codes.

**Keywords:** volcanic hazards; risk management; submarine volcanoes; monitoring tools.

## 1 Introduction

Volcanic risk management is a multidisciplinary critical field of study aimed at mitigating the threats posed by volcanic eruptions to human lives, infrastructure, and the environment. This strategy involves a combination of preparedness planning, active monitoring, and response measures. Efforts begin with continuous monitoring of volcanic activity through advanced technology and geophysical tools (Bertin et al., 2018). Early warning systems are then established to provide timely alerts to at-risk communities. Disaster preparedness and evacuation plans, coupled with public education campaigns, help communities respond effectively during eruptions (UNDRR, 2015) while post-eruption recovery and rehabilitation efforts ensure swift restoration of essential services and infrastructure (Lavigne et al., 2013). Overall, volcanic risk management demands a comprehensive and collaborative approach that integrates scientific research, policy development, and community engagement to minimize the potential devastation caused by volcanic eruptions.

Santorini, in the Aegean Sea, has a population of 15,457 (Hellenic Statistical Authority, 2021), but this swells to over 500,000 in the summer due to tourism. Most residents work in tourism-related roles, with only a minority in traditional jobs like fishing and viniculture (Dominey-Howes and Minos-Minopoulos, 2004). The entire population's livelihoods are vulnerable to risks from a potential future volcanic eruption, which could significantly impact the local economy and infrastructure. Kolumbo, located 7km NE of Santorini, is a submerged active volcano, considered the most dangerous in the Mediterranean. Its 1650 eruption caused a tsunami and toxic gas, resulting in casualties and damages (Fouque, 1879). Recent study suggests a future eruption could pose a significant hazard to Santorini's east coast (Karstens et al., 2023a), but there's no management protocol in place. We propose a strategy involving scientific research (active monitoring, hazard maps), community engagement, cooperation with government agencies (Civil Protection), and timely response to minimize hazards, prevent casualties, and protect the area's economy and infrastructure.

## 2 Geological Setting

The 450km long Hellenic Volcanic Arc (HVA), where subduction of the African plate occurs beneath the Aegean microplate (McKenzie, 1972; LePichon and Angelier, 1979), includes onshore and offshore volcanoes that extend from the Methana peninsula, through the islands of Milos, Santorini up to Kos, Yali and Nisyros in the west (Nomikou et al., 2013). Volcanism in the southern Aegean was initiated in the Pliocene and has continued throughout the Quaternary (Pe- Piper and Piper., 2005). Located on the Hellenic Volcanic Arc, the Christiana-Santorini-Kolumbo volcanic field (CSK) is one of the most hazardous volcanic fields in the world, accounting for more than 100 explosive eruptions in the past 650 k.y. (Druitt et al., 2019a). The CSK (fig. 1b) lies in a 60-km-long, SW-NE oriented rift zone and hosts the Christiana volcano, the Santorini

caldera, the submarine Kolumbo volcano (fig. 1a), and the Kolumbo volcanic chain that consists of 24 submarine cones (Nomikou et al., 2019, Preine et al., 2022). Santorini has witnessed a minimum of four significant caldera-forming eruptions. Among them, the most recent one known as the "Minoan" eruption, which took place approximately 3600 years ago, is widely recognized as one of the largest volcanic events during the Holocene (Druitt et al., 1999; Johnston et al., 2014; Nomikou et al.,2016a). It is presumed to have caused significant impacts to human populations in the eastern Mediterranean area with the most notable possible outcome the fall of the Minoan Civilization (Bruins et al., 2008).

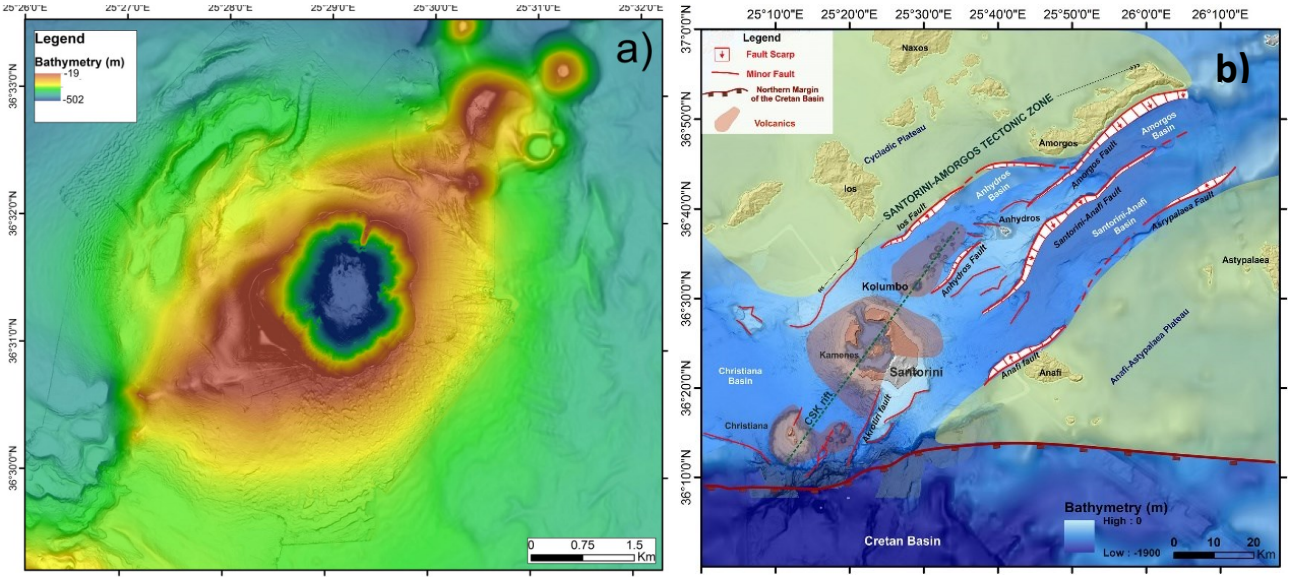


**Figure 1.** a) AUV high-resolution map of Kolumbo volcano (Nomikou et al., 2022) and b) The Christiana-Santorini-Kolumbo rift (Nomikou et al., 2019).

## 2.1 Kolumbo Volcano

Kolumbo is a submerged active volcano, located just 7km NE of Santorini. Kolumbo's edifice was created by at least five eruptive cycles, the earliest dating back more than 1 Myrs (Preine et al., 2022). Its most recent eruption, in 1650 CE, formed a cone consisting of up to ~260 m-thick stratified pumice deposits, which breached the sea surface before being destroyed by a violent explosive eruption that formed a 500 m-deep and 2,500 m-wide crater (Nomikou et al., 2012). High resolution 2m bathymetry data and optical data from past oceanographic expeditions revealed the morphological structure of Kolumbo's crater (Nomikou et al., 2022). The cone that formed after the 1650 eruption consists of highly vesicular pumice (fig. 2b), which was deposited as fallout from the eruption column, where many of the large pumice clasts floated at the sea surface before sinking (Karstens et al., 2023b). The cone had a volume of approximately 5 to 7 km³, which was deposited in a very short timeframe of only two weeks, based on eyewitness accounts (Klaver et al., 2016). The seafloor at the northern part of the Kolumbo crater hosts high (up to 220°C) and low (up to 70°C) temperature polymetallic chimneys (fig. 2c) and hydrothermal vents covered by bacteria (Carey et al., 2013; Kilias et al., 2013; Polymenakou et al., 2023).

## 2.2 The 1650 AD eruption

In 1650 AD, Kolumbo experienced explosive eruptions, with eyewitness accounts documented by Fouque (1879). Activity began with violent earthquakes in March 1650, followed by increased seismic activity. On September 27, ash clouds rose 1.6 km northeast of Santorini, with unpleasant odors appearing inland and a "snow-white" ledge emerging from the sea. Small earthquakes, pumice production, and plumes continued September 29. Lightning, explosive sounds, and powerful earthquakes were felt up to 400 km away in the Dardanelles. Concurrently, there was a notable increase in the frequency of powerful earthquakes, which were felt approximately 100 km away in the island of Crete, and ash fallout reached parts of Turkey. At least one tsunami struck Santorini, resulting in the destruction of buildings, erosion of roadways, and submerging of approximately 2.02 km along the eastern coastline. This tsunami also affected the islands of Ios where it reached 20 m inland and Sikinos (32 m inland), causing damage. After a few days, the eruption gradually subsided. Among the significant dangers faced by local communities were the toxic gas clouds released during the eruptions. These gasses caused various health issues such as eye pain, blindness, and cerebral congestion, leading to temporary loss of consciousness for many residents for several hours. Over 70 individuals perished due to asphyxiation, and numerous animals were killed. A nine-man crew of a ship passing near Kolumbo were asphyxiated. Reports indicated that the gasses also caused discoloration of coins, sacred vessels in churches, paintings, and building walls. In December, earthquake activity marked the end of the eruption. For several years, there were occasional small tremors and elevated water temperatures observed around Kolumbo. However, within a few months after the eruption, the small island eroded beneath the waves.

## Volcanic Risk Management

Managing volcanic risk involves a complex, multidisciplinary approach that integrates scientific knowledge, risk assessment, community preparedness, and emergency response planning. Risk management includes hazard assessment, identifying volcanic hazards linked to the volcano. Historical eruption records offer valuable data on eruption frequency, intensity, and patterns, aiding our understanding of the volcano's behavior and regional volcanic history (e.g., Siebert et al., 2010). Active monitoring and early warning systems are vital in volcanic risk management. They rely on techniques like seismic monitoring, gas measurements, and ground deformation analysis (McNutt, 1996). In the case of terrestrial volcanoes, seismic monitoring detects tectonic activity preceding eruptions, while gas measurements track changes in volcanic gasses, indicating increased activity (Oppenheimer, 2011). These methods enable timely warnings, evacuations, and preparedness measures, reducing the impact of eruptions on communities and enhancing disaster resilience.

Kolumbo is but one of many other submarine volcanoes that are currently not efficiently viewed as a threat, despite their activity. The lack of preparedness of decision makers and scientists has already been proven catastrophic, such as the cases of the 2018 Anak Krakatau collapse and its subsequent tsunami that caused over 400 deaths (BNPB, 2019), as well as the most recent eruption of the Hunga Tonga–Hunga Ha‘apai submarine volcano in 2022 with at least 6 dead, multiple reported people missing and approximately $90.4 million in damages in Tonga island (The World Bank, 2022). Research and monitoring of shallow submarine arc volcanoes in the Mediterranean Sea are still in its early stages, however, in situ seafloor deep observatories have been established to monitor submarine volcanoes over extended periods of time. These observatories include the Azores node of the European Multidisciplinary Seafloor and Water Column Observatory (e.g., Escartin et al., 2015), the Axial Seamount in the NE Pacific - part of the U.S. National Science Foundation (NSF)-funded Ocean Observatories Initiative (OOI) Cabled Array, Ocean Networks Canada's cabled observatory at Endeavour Ridge Ridge (Kelley et al., 2014), and the Mayotte deep-sea eruption observatory in the North Mozambique Channel, established by France (Feuillet et al., 2021). Some of these observatories have successfully tracked changes in submarine volcanic dynamics. For instance, the 2015 eruption at Axial Seamount was accurately forecasted within a one-year window based on volcanic deformation and was monitored in real time by the OOI Cabled Array (Nooner and Chadwick, 2016). Deformation and seismic monitoring are currently being used to predict future eruptions and place them in the next 4-9 years (Chadwick et al., 2022).

Volcanic risk assessment is essential for informed decision-making and disaster readiness. It combines geological, geophysical, and historical data to evaluate volcano hazards (Marzocchi et al., 2012). Vulnerability analysis considers factors like population density, infrastructure, and land use near the volcano (Lavigne et al., 2008). Recent research examines societal vulnerability indicators, including utilities, power grids, healthcare facilities, and critical infrastructure networks (e.g., Lobban et al., 2021; Boyle et al., 2022). Social vulnerability is considered in disaster preparedness initiatives (Gralla et al., 2014) and humanitarian supply chain management (Huang et al., 2015). Risk assessments use probabilistic models and historical records to estimate hazard likelihood and impact (Spence et al., 2007). Communities then create evacuation plans, hazard zones, robust infrastructure, and safety education, aided by specialized hazard maps. Risk mitigation includes land use planning, zoning regulations to limit development in high-risk areas (Haynes et al., 2008), resilient infrastructure construction (Spence et al., 2007), and community education and preparedness programs (Gregg et al., 2004). Besides the probabilistic methods, novel Artificial Intelligence (AI) techniques, mainly machine learning (ML) and deep learning (DL), are used for disaster/hazard risk management, including assessment, disaster detection and forecasting, in combination with real-time measurements (or historical records) of the associated hazards (e.g., Linardos et al. 2022). In the case of Santorini, a general emergency response plan and immediate/short-term management of the consequences of volcanic activity in the Santorini volcanic complex (TALOS) has been designed by the Civil Protection Agency. The plan considers two possible scenarios of an eruption of Santorini volcano, with a subplinian eruption being the worst-case scenario and a "historic type" intracaldera reactivation of the Kameni volcanic centers as the most likely scenario - similar to the volcanic activity that contributed to the creation of the islets of Palaia and Nea Kameni (TALOS, 2023). Santorini volcano is being monitored by an array of instruments including seismographs, gps, temperature and gas measurements (e.g, Moreira et al., 2019) and TALOS has laid out an efficient response strategy, however, there is no mention of a mechanism in case of an eruption of Kolumbo. Therefore, we believe that a strategy for emergency response regarding Kolumbo’s activity is essential to be implemented, that can be designed based on active monitoring of the volcano and its hydrothermal vent field, along with a combination of the already accumulated knowledge regarding Kolumbo.

Our team has multidisciplinary data from past oceanographic expeditions that will help us to understand Kolumbo’s behavior. These include a) High-resolution multibeam bathymetry data and optical data., b) a dense network of sub-seafloor seismic reflection profiles, c) a series of the seafloor and sub-seafloor samples of microbial mat and sediments, d) CTD data, e) several polymetallic (Au, Ag, As, Sb, Pb, Hg, Mo, Zn, Cu, Tl) $CO_2$ diffuser chimney samples and f) tephra in marine sediment cores. Despite the current knowledge that we managed to obtain, monitoring is needed to efficiently assess potential hazards and create early warning systems and management protocols for an imminent eruption from Kolumbo.

## Results

High resolution 2 m bathymetry data (Hannington et al., 2018) were combined along with ROV optical data collected from the cruises of E/V Nautilus in 2010 and 2011 to understand the morphology and construct the geological map of Kolumbo crater. The crater is dominated by highly vesicular pumice and lava deposits on its walls (fig. 3a) that derive from the 1650 eruption. The biggest lava deposits lie on the northeast and southwest walls of the crater. The crater floor is covered by an orange microbial mat and its northern sector hosts the active hydrothermal field of the volcano. Steeper slopes are observed on the northern, eastern, and southeastern walls, making the areas vulnerable to landslides due to tectonic activity. The 1650 eruption and subsequent tsunami had detrimental consequences for the east coast of Santorini, especially at the towns of Perissa and Kamari (fig. 3b). Historical accounts mention flooding of up to 2km² of land on the eastern coast of the island, resulting in the destruction of buildings and erosion of roadways.

Considering the historical record, we can identify (i) toxic gasses, (ii) ash fall, (iii) pyroclastic flows and (iv) tsunami generation as the potential hazards of a Kolumbo eruption. Considering the eruptive history of Kolumbo, as well as its architecture, we can come to the realization that a possible eruptive scenario would be a repetition of the 1650 eruption. Such an event would likely span for several weeks, and it is highly possible that discolored sea surface will indicate underwater volcanic activity (Cantner et al., 2014) and a tsunami like 1650 AD will be generated that will reach the coasts of Santorini within 5 minutes, according to simulation models (Karstens et al., 2023b). By taking into consideration that a repetition of 1650 AD events are one of the most likely scenarios of an eruption, the following measures are proposed.

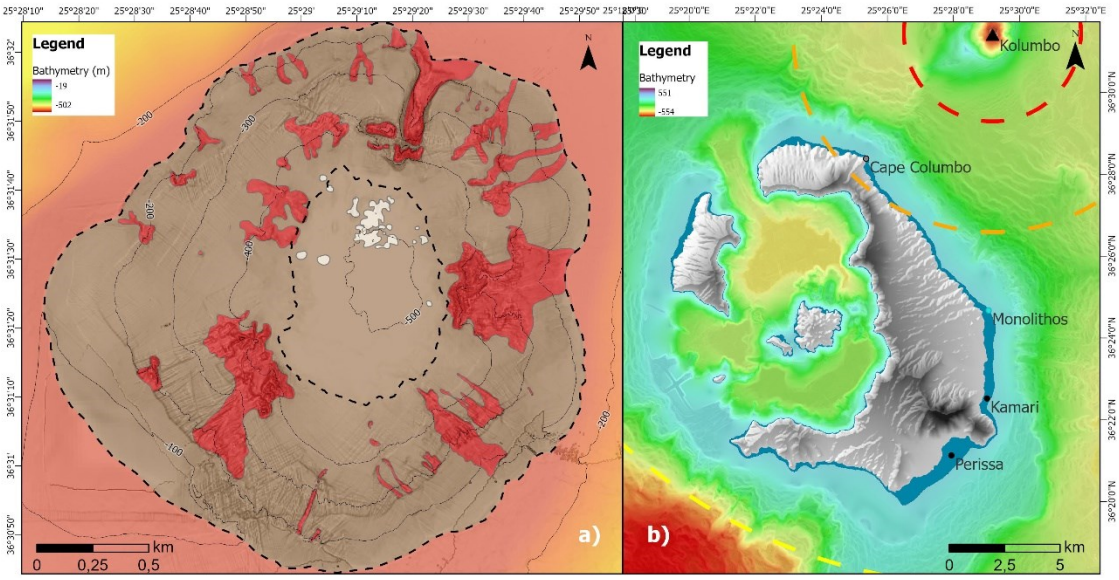


**Figure 3.** a) Underwater Geological Map of Kolumbo crater. Brown areas are pumice deposits, while lava deposits are shown in red. b) Hazard zonation map showcasing the three distinct hazard zones in Santorini. The red dotted line indicates Zone 1 (4km off Kolumbo), the orange Zone 2 (4-9 km off Kolumbo) and the yellow Zone 3 (over 9 km off Kolumbo). Marked with blue are the areas of Santorini affected by the 1650 tsunami according to historical eyewitness accounts accumulated by Fouque (1879). The towns located at the eastern coast are the most affected with maximum water run-up up to 14m.

*Hazard Zonation.* Three hazard zones should be drawn, depending on the degree of the dangers that the above hazards pose to life (fig. 3b). Therefore, we propose the following zones.

- Zone 1 (4 km < Kolumbo): In this zone, access must be strictly prohibited due to danger of asphyxiation caused by toxic gas emissions and the proximity to Kolumbo's crater poses imminent threat due to the pyroclastic flows, ash fall and a potential tsunami generation.
- Zone 2 (4-9 km near Kolumbo): In this zone that ends on the northeast coast of Santorini, ash fall, and tsunami generation pose significant threats to life. The area should be evacuated to prevent a repetition of the 1650 casualties both inland and offshore.
- Zone 3 (over 9 km off Kolumbo): In this zone, the area is less likely to be affected by a tsunami, however toxic gas emissions and ashfall still pose a hazard. The use of protective masks, eye protection goggles and burn resistant clothes is mandatory to avoid health associated risks.

*Prior to the eruption (pre-eruptive phase) measures.* Indicators such as tectonic activity, enhanced hydrothermal activity and water discoloration are expected to last for several days in the vicinity of Kolumbo. During this phase, the Civil Protection

Agency should prepare to inform the public of the volcanic activity and limit access to the vicinity of the volcano. Scientists should aid the government agency and help with early assessments of hazards and action plans. The continuous seismic activity could cause problems to infrastructure, communications, and the area's road network. This should be taken into consideration and authorities should implement the relevant protocol for dealing with risks of seismic activity. The areas that are more likely to be affected are located on the east coast of Santorini and their vulnerability should be assessed thoroughly to consider what should be done in the next phase.

*During the eruption (eruptive phase) measures.* Following the pre-eruptive events, we can expect dense ash clouds approximately 1.6 km northeast of the island and unpleasant odors arriving inland due to the gas emission while minor earthquakes continue, and the first frequent pumice deposits will be observed. Tectonic activity inside or nearby the crater could induce landslides on the inner walls due to the steep slopes observed in the crater. Landslides could cause water displacement and thus generate a tsunami. At this phase, access to the offshore area should be prohibited and tide gauges should be implemented to monitor the area for a possible tsunami generation. A tsunami watch is issued when a tsunami may later impact the watch area. The watch may be upgraded to a warning or advisory or canceled based on updated information. Emergency management officials and the public should be informed and prepared to act with partial or complete evacuation of the eastern coastal area of Santorini and its ports up to Monolithos and other smaller fishing ports at the easter part of the island (fig. 4) and initiate the plan for disaster prevention. The hazards of ash fallout and toxic gas emissions should also be considered for the problems that they cause on transportation (air transportation is limited or canceled, problems with sea transport due to the ongoing eruption), on health (asthma, emphysema and other chronic lung diseases, eye irritation, respiratory issues, suffocation (CDC)) and on the environment (water contamination, loss of cultivation, air pollution). Protective masks and gear should be issued to avoid asphyxiation and burns. Pyroclastic lava flows could also cause telecommunication issues due to destruction of underwater cables, much like the destruction of a vast network of seafloor telecommunication cables by volcanic debris from the Hunga eruption in 2022 that traveled under the sea more than 100 km (Clare et al., 2023). The above should be put into consideration by the relevant authorities to plan for alternative uses of transport, establishment of mobile healthcare facilities and alternative modes of communication.

## Conclusions

Managing the risk that stems from volcanic activity is a complicated and multidisciplinary procedure that involves scientific knowledge, risk assessment, community preparedness, and emergency response planning. Current research shows that Kolumbo volcano poses a significant hazard to the northern and eastern coast of Santorini and a future eruption could cause devastating consequences for the island, to the population, the infrastructure, and the environment. Our current knowledge regarding Kolumbo's mechanisms and eruptive history is still at its infancy. Despite the potential hazard that Kolumbo poses to the nearby communities, it is not taken into account in any strategy for emergency response and risk mitigation. We consider that such a strategy should be designed, where a hazard and risk assessment is conducted, and mitigation measures are stated that all provide a sufficient risk management method. AI techniques, in particular ML and DL, can be used in combination with the active monitoring hazard data and volcanic hazard maps, to develop an on-line early warning system and decision-support system for emergency responders. Moreover, ML and DL combined with high quality volcanic data, can be used to assess the components of risk, namely vulnerability and exposure, towards a holistic and more accurate risk management system for emergency responders and local communities. An important measure for risk management is the active monitoring of a volcano, to gather more information about the volcano's evolution and mechanisms, as well as recognizing early signs of an eruption to inform the public. In the case of submarine volcanoes there are certain limitations. These involve the difficulty of implementing and maintaining monitoring systems underwater for a long period of time as well as developing the necessary instrument for this endeavor, although several prominent efforts have been made globally in recent years.

At present, we are monitoring Kolumbo with a deployed underwater observatory. SANTORY (SANTORini's seafloor volcanic observatorY) is a research project with partners from international institutions (INGV-Palermo, GEOMAR) and universities (NKUA, HCMR-IMBBC, NTUA, ENS-PSL, UNIWA) funded by H.F.R.I. (Hellenic Foundation for Research and Innovation). The project aims to comprehend the links between deep-seated geological processes that have associated risks and their expression in hydrothermal activity. Our international research team monitors Kolumbo by developing and integrating state-of-the-art technology for in situ monitoring along with discrete sampling and measurements. So far, we conducted two oceanographic expeditions funded by the municipality of Thera - Santorini to a) deploy and maintain the seafloor observatory, which is a new generation automated geochemical recording system that collects data of acoustics, dissolved CO2, H2S, O2, T °C, pressure, EC, pH, and turbidity, b) conduct various measurements on Kolumbo's crater with multiple innovative sensors (T-sensors, Inclinometers, Pressure gauges), c) continuously record the active hydro-thermal vent field with Stand-alone optical cameras, multispectra and the "THEIA" stereo camera and d) make for the first time, real-time measurements for radioactivity using gSniffer and γ-radiation imager "SUGI".

This ongoing observation of Kolumbo's activity provides scientists with invaluable information that in turn could aid government agencies and local communities in their efforts to strategize and ready themselves for potential crises. The unique, never seen before, time series data that is collected by the instruments of SANTORY will complement the already

existing database that we have compiled in numerous oceanographic expeditions and provide us the necessary knowledge for Kolumbo's activity and dynamics. This acquisition of knowledge is essential for an implementation of hazard assessments, evaluating volcanic risks and safeguarding vulnerable communities near Kolumbo. By examining volcanic systems over extended periods, we can identify recurring patterns and unusual occurrences, thereby improving our capacity to forecast eruptions and minimize their consequences.

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# Assessing the Impact of the 2021 Evia Wildfires through Social Media Analysis

Vasileios Linardos[1], Maria Drakaki[1]

[1] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14 th km Thessaloniki-N. Moudania, 57001, Greece
Email: vlinardos@ihu.edu.gr
Email: mdrakaki@ihu.gr

**Abstract.** The 2021 Evia wildfires had profound economic, environmental and social impacts, necessitating an in-depth investigation. This study proposes the utilization of large language models and machine learning techniques to extract meaningful insights from Tweets, facilitating a comprehensive analysis of the consequences resulting from this devastating event. Through the application of computational tools, this research aims to illuminate the multiple dimensions of the disaster impacts, encompassing affected population, property loss, environmental impact, community resilience, as well as the efficacy of disaster response and recovery measures. The aim of this research includes an evaluation of the validity of data produced by the developed system via comparison with other sources such as EM-DAT public disaster loss database and Wikipedia. The findings from this research endeavor will contribute to a more nuanced method of identifying and analyzing disaster impacts, while offering valuable insights to enhance future disaster management strategies.

**Keywords:** Disaster management; Large language model, deep learning, social media, Twitter, wildfires.

## 1 Introduction

The 2021 Evia wildfires had a devastating impact on the island of Evia, Greece, necessitating a comprehensive investigation to assess the consequences on various aspects of society. Recent advancements in Artificial Intelligence (AI) methods including machine learning and deep learning have enabled the development and application of AI-based methodologies and tools for disaster management (Linardos et al., 2023, Linardos et al., 2022). ML has been used to extract valuable information from social media platforms, mainly Twitter, for disaster management applications (Christidou et al., 2022).

This study proposes a novel approach utilizing large language models and newly developed tools for disaster analysis through social media specifically for the Evia wildfire. To achieve this, we collected a dataset of English disaster-related tweets of 2021, as well as data from EM-DAT, an international database for disasters. EM-DAT provides comprehensive information on the occurrence and impacts of over 26,000 mass disasters worldwide, compiled from various reliable sources. The EM-DAT and Wikipedia data will serve as the "ground truth" for the evaluation of our system's output specifically for the Evia wildfire.

We aim to create a robust system composed of three main components: a large language model (specifically, gpt-3.5-turbo), a vector database containing 240.000 disaster related vectorized tweets from August and September of 2021, and a tool called Semantic Kernel. The large language model serves as the analytical engine, capable of processing and analyzing the collected tweets to extract valuable insights. The vector database acts as an information retrieval engine, enabling programmatically searching for relevant tweets to feed into the model for analysis and report generation. The Semantic Kernel tool is the building block for this system, enabling the AI model to interact with the database as well as the development of "skills" that enable the model to utilize libraries and functions. To validate the accuracy and reliability of the system-generated report for the Evia wildfire, we will compare its findings with the confirmed data from EM-DAT and Wikipedia. This comparative analysis will enable us to evaluate the usefulness and truthfulness of the system and its potential to assist authorities in understanding and responding to similar events in real-time through social media analysis.

The goals of this research are threefold: first, to evaluate the ability of a large language model to generate reports about the Evia wildfire based solely on social media data; second, to evaluate the truthfulness of the data obtained from social media analysis with the authoritative sources of EM-DAT (EM-DAT, 2023) and Wikipedia; and finally, to provide practical implications for disaster managers, highlighting the potential of similar systems to enhance situational awareness and aid decision-making in managing future disasters. By leveraging the power of social media analysis and advanced AI techniques, this research aims to contribute to a novel approach of identifying the impacts of disasters.

## 2 Relevant Literature

Palaiologou et al. (2021) examines the perceptions of stakeholders in Greece regarding wildfire management and its impacts. The researchers utilized an online survey with a sample size of over 100 participants, including civil protection agencies and research entities. The survey aimed to gain insights into the stakeholders' perspectives on the negative, indifferent, and positive effects of wildfires, as well as their opinions on fire prevention strategies and causes of ignition. The findings of the study emphasize the necessity of reforming wildfire management policies to address societal and agency functioning, as well as the influence of climate change on wildfire frequency and behavior. The respondents expressed a negative viewpoint towards allowing wildfires for resource objectives and attributed most ignitions to arsonists. Additionally, they identified the absence of a national cadaster system as a significant source of wildfire-related issues. While there was limited support for fuel treatments, there was a growing acceptance for the legalization of fire use during firefighting efforts. Overall, this study provides valuable insights into the current perceptions of wildfires in Greece and identifies opportunities and challenges for enhancing wildfire governance and risk management programs.

Karyotakis (2022) investigated the media coverage of the Mati wildfire in Greece in 2018. He examines a total of 1,573 news articles from nine prominent Greek news websites using a method called ideological discourse analysis. The main objective of the study is to determine whether there is a consistent tendency to downplay the human impact on the environment in the news discourse. The results of the analysis indicate that the news outlets primarily framed the wildfire as a political matter rather than an environmental event. The coverage exhibited a populist discourse that favored a specific political group and portrayed the government in a negative light. The study highlights the importance of journalists providing critical explanations about the role of human activity in environmental issues, rather than solely focusing on political debates.

Katzilieris et al. (2022) investigated the behavior of individuals and households during the 2018 Attica wildfires in Greece, specifically focusing on their evacuation decisions. To gather empirical data, a questionnaire survey was administered to residents who were affected by the wildfires. The survey questionnaire was designed based on the Protective Action Decision Model (PADM). Statistical analysis techniques, including logistic regression models and machine learning algorithms, were employed to identify the key factors that influenced the decision to evacuate and the chosen mode of evacuation. The study findings highlight the significance of various factors such as risk perception, age, duration of residence, information-seeking behavior, gender, prior warning, presence of minors, education level, and income in shaping the decision to evacuate. Additionally, factors such as availability of transportation, age, information-seeking behavior, and risk perception were found to be influential in determining the mode of evacuation.

Based on the existing literature we emphasize on two crucial aspects. Firstly, there is a pressing need for a more comprehensive understanding of disasters in Greece, coupled with an improvement in the administration system. Secondly, it is essential to have access to alternative sources of information, distinct from mainstream media, which often prioritize political implications over the actual impact of disasters. By utilizing a public data source, such as a social media platform, valuable "hidden" information from individuals can be surfaced, providing valuable insights.

## 3 Methodology

Our methodology consisted of several key components designed to extract meaningful insights from Twitter data and generate comprehensive reports. The approach we followed is known as RAG which in the context of large language models stands for Retrieval Augmented Generation.

First, a vector database was created to store and organize a dataset of 240,000 English disaster-related tweets

from August and September 2021. To represent each tweet, HuggingFace's sentence transformer all-MiniLM-L6-v2 was used to generate embeddings, which served as the basis for subsequent analysis. It is a clear limitation that we only tweets in english. A much better analysis could potentially happen by incorporating also greek tweets in the system. This would require different development techniques and a change in the approach and in the configuration of the system.

The retrieval process was tested to ensure the accuracy and relevance of the retrieved tweets from the vector database. Table 1 includes some results of the retrieval for the query “big wild fire greece”.

**Table 1.** Some results of the retrieval for the query “big wild fire greece”.

| **Retrieved Text** | **Relevance** |
|---|---|
| Greece is facing a “natural disaster of unprecedented proportions,” as 586 wildfires burn in “all corners” of the country. The nation is broiling under one of its worst heat waves in decades. @EleniGiokos has the details. https://t.co/nNUMZXWgXt #TheLatest #7NEWS https://t.co/jd8InARPJq | 0.6561340411976498 |
| Greece was always a place close to my heart since childhood. Today I've wept at the images of the damage done to people, animals, property and the environment by the fires.<br><br>#firesinmediterranean | 0.5654183534375476 |
| #Israel will dispatch two firefighting aircraft to #Greece to help combat wildfires that Greek PM Kyriakos Mitsotakis described as “a natural disaster of unprecedented proportions.”<br><br>#greeceisburning #GreeceFires | 0.5192656244156442 |

Next, a semantic kernel was developed and connected to the OpenAI API, specifically utilizing the gpt-3.5-turbo language model. The vector database was registered as memory to the semantic kernel, enabling efficient retrieval of relevant tweets for analysis and report generation.

The methodology also involved the development of a custom plugin called TextServices, which contained three key skills: KeywordsGenerator, Summarization, and Composer. The KeywordsGenerator skill created search keywords based on user queries, facilitating the retrieval of relevant tweets from the vector database. The Summarization skill condensed the retrieved information into concise summaries, while the Composer skill combined the summaries from different sources to create a comprehensive report with a focus on the identified keywords.

The functionality of the plugin is presented in Table 2.

**Table 2.** TextServices Plugin Skills

| **Skill** | **Description** | **Parameters** |
|---|---|---|
| KeywordsGenerator | Creates search keywords based on a user query | query (user query), maxkeywords (maximum number of keywords to generate) |

| | | |
|---|---|---|
| Summarization | Summarizes the retrieved information into concise summaries | context (retrieved information), format |
| Composer | Combines the summaries from different sources to create a comprehensive report in bullet points with emphasis on keywords | source1, source2, keywords (identified keywords), maxbulletpoints (maximum number of bullet points in the report) |

We developed an approach that leveraged the semantic kernel in an iterative manner. The process involved inputing the following query: "What was the environmental, social, and economic impact of the Evia wildfire in Greece? How many people died? How many houses were destroyed? How many hectares of forest were burned?"

The KeywordGenerator created the search terms and queried the database, resulting in the extraction of tweet chunks. These chunks were then passed through a summarization module, which produced concise summaries. Subsequently, the summaries were fed into a composer module, which iteratively combined them to generate a comprehensive final report.

## 4 System's Report

The following section presents the report generated by our system, which utilizes large language models and social media analysis to assess the impact of the 2021 Evia wildfires. The report presented below is generated by our system, which utilizes large language models and social media analysis to assess the impact of the 2021 Evia wildfires. We would like to emphasize that we are using the report from the system and in no way take responsibility nor support any offensive content of any kind the model may produce. The purpose of this report is to provide insights and analysis based on the data collected from social media, and it should be interpreted with caution and further validated.

*REPORT ON EVIA WILDFIRE IN GREECE*

*Affected Population:*

*- Hundreds of people displaced due to the Evia wildfire.*

*- Greek government must prioritize safety and well-being of citizens in future disaster response and recovery measures.*

*- Angry Greeks criticize government response to recent wildfires, blaming deliberate political decisions and prioritizing profit over life and human welfare.*

*- Experts developing and applying methods to measure inequities in natural hazard impacts and resources allocated for risk reduction and disaster recovery.*

*- Need to enhance emergency and disaster response measures in local urban constituencies and build local community resilience.*

*Property Loss:*

*- Evia wildfire razed homes, and caused significant property loss, including homes and farmland.*

*- Severe post-fire floods impacted local communities, causing damage to private property, public buildings, infrastructure, and roadways.*

*- Protecting homes against natural disasters becoming more important as extreme weather such as hurricanes and wildfires becomes more common due to climate change.*

*Environmental Impact:*

*- More than 100,000 hectares of land ravaged by wildfires.*

*- Climate change exacerbating frequency and severity of wildfires in Greece and across Southern Europe.*

*- Environmental experts describe situation as a major environmental disaster, and international community has sent support to aid in disaster response and recovery efforts.*

*- Extreme weather, climate change, and rapid urban development in disaster-prone areas have driven ever higher natural catastrophe losses.*

*- Wildfire resilience not just a land management issue, but a matter of public health, equity, safety, and a climate-res.*

*Disaster Response and Recovery Measures:*

*- Prime Minister Kyriakos Mitsotakis declared blazes "a natural disaster of unprecedented dimensions*."

*- Israel sent team of firefighters to help Greece battle wildfires.*

*- EU Commission will support Greece through Technical Support Instrument to help tackle natural disaster of recent wildfires and recover biodiversity loss in Greek island of Evia.*

*- Government's firefighting and disaster relief policies in need of overhaul, and Greece created Climate Crisis ministry to respond to wildfires.*

*- Measures that reduce exposure to natural and man-made hazards lead to good governance.*

*- Assistance available for those impacted by wildfires and other natural disasters.*

## 5 Evaluation

In order to assess the accuracy and reliability of our model, we need to evaluate its output in comparison to the actual data we have collected. Our data sources include the Emergency Events Database (EM-DAT) and Wikipedia.

According to EM-DAT, the summer wildfires in Greece in 2021 resulted in the loss of two lives. Additionally, over 7,000 individuals were affected by these wildfires, and the total damages amounted to more than 580 million units of currency.

Further information obtained from Wikipedia specifically highlights the Evia wildfire, which encompassed an area of 50,000 hectares. In total, the wildfires in Greece in 2021 covered an area of 125,000 hectares. The Evia wildfire resulted in the deaths of three individuals, with approximately 2,000 people being evacuated from the affected area. Moreover, at least 20 individuals sustained injuries during this incident.

Unfortunately there is not much information specifically for the Evia wildfire, but rather a grouped view of 2021 Greece wildfires in both sources. Nevertheless we will assess the model's output based on the facts we were able to gather.

In order to evaluate what the system reported we will review its answers per section.

The system did not provide any information regarding the number of fatalities resulting from the wildfire. However, it reported that hundreds of people were displaced due to the fire which is a fact. It also reported on the sentiment expressed by individuals, highlighting that "Angry Greeks criticize government response to recent wildfires, blaming deliberate political decisions and prioritizing profit over life and human welfare." It is important to note that this sentiment is based on social media data and cannot be independently verified for accuracy. Additionally, the system retrieved information on experts who are employing various methods to assess disparities

in the impact of natural hazards and the allocation of resources.

The system's report acknowledged the destruction caused by the Evia wildfire, including the loss of homes and farmland, as well as property damage. However, it did not provide any specific figures or estimates regarding the extent of the damage or the financial implications. While the system correctly identified the presence of infrastructure damage, it was unable to provide detailed information on the specifics of the damage. Additionally, the system generated a rather generic statement highlighting the importance of protecting homes against natural disasters, attributing the increase in extreme weather events such as hurricanes and wildfires to climate change. It is worth noting that this statement could potentially be a result of the system's exposure to climate change discussions on social media or a manifestation of model hallucination.

The system reported that over 100,000 hectares of land were devastated by the wildfires. However, this information is not accurate for the Evia wildfires, which actually burned 50,000 hectares, but it is accurate for the accumulated 2021 Greece wildfire status. It is important for the system to improve its ability to distinguish specific information related to targeted events, rather than gathering general information mentioned alongside the event. Additionally, the system consistently emphasizes the significance of climate change and the need for environmental resilience in planning.

The system provides an analysis of the disaster response and recovery efforts undertaken in relation to the Evia wildfires. It includes a statement of the Greek Prime Minister and emphasizes the support extended by other countries and the EU Commission to Greece in addressing this natural disaster and restoring biodiversity. Additionally, the report highlights the government's plans to aid individuals indirectly affected by the wildfires. Notably, it acknowledges the establishment of a climate crisis ministry under the civil protection ministry, a valuable piece of information that is tied with the disaster and that we have verified for accuracy.

The assessment of the system's ability to measure the impact of the Evia wildfire reveals certain limitations. These limitations primarily stem from the system's inability to accurately distinguish between information specifically related to the wildfire under study and information that is unrelated to the event. However, despite these limitations, the system still provides valuable insights and information regarding the impact and aftermath of the wildfire. It is important to note that further enhancements to the system are necessary in order to improve all three main components. Firstly, the database should be enriched with Greek language tweets. Secondly, the retrieval engine can be improved. Lastly, the semantic kernel functions should be improved to better assess information and generate more targeted reports.

## 6 Conclusion

In conclusion, this research paper has explored the use of social media analysis and advanced AI techniques to enhance situational awareness and aid decision-making in managing future disasters. By leveraging the power of social media data, valuable insights can be gained regarding the impacts of disasters, as well as the perceptions and behaviors of stakeholders. The evaluation of the system's output revealed certain limitations, particularly in accurately distinguishing specific information related to the targeted event. However, despite these limitations, the system still provided valuable insights and information that can contribute to enhancing situational awareness and decision-making in managing future disasters. This research contributes to a novel approach of utilizing social media analysis and advanced AI techniques to identify the impacts of disasters. Further research in this domain is needed to improve the accuracy and specificity of social media analysis in assessing the impacts of disasters. This includes developing techniques to better distinguish between information related to the targeted event and unrelated information, as well as new approaches in the usage of these systems through the cycle of disaster management.

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# TREEADS Project: A Holistic Fire Management Ecosystem for Prevention, Detection and Restoration of Environmental Disasters

Konstantinos Zapounidis[1,*], Christos Koidis[1], Nikolaos Sakkos[1], Vasiliki Marinoudi[1], Dimitrios Aidonis[2], Charisios Achillas[2]

[1] Engineers For Business S.A., 79 Dekatis Evdomis Noemvriou st, 55534, Thessaloniki, Greece
Email: kz976@efb.gr
[2] International Hellenic University, Kanelopoulou 2, 60100, Katerini, Greece

**Abstract.** Considering the socio-ecological transition of Europe 2030, and towards a more resilient and informed community, focusing on the forests that are near wildfire risk, TREEADS project aims to build upon state-of-the-art high TRL (Technology Readiness Level) products and unite them in a Holistic Fire Management Platform that optimize and reuse per phase the available socio-technological resources in all three main phases of wildfires. For the prevention and preparedness, TREEADS project proposes the use of a real-time risk evaluation tool that can receive multiple classification inputs and work with a new proposed neural network-powered Risk Factor Indicator. To create a model of Fire Adapted Communities (FAC) in parallel to insurance incentives, TREEADS will use Alkali Activated Construction Materials (AAM) integrating Post-wildfires Wood Ashes (PWA) for fire-resilient buildings and infrastructure. TREEADS also uses a variety of technological solutions such as the Copernicus infrastructure, and a swarm of small drones customized for accurate forest supervision. In the area of detection, TREEADS propose a variety of toolsets that will accommodate most needs, stemming from virtual reality for the training, wearables for the protective equipment of the emergency responders to UAV (drones), UAG and airships for improving capacity in temporal and spatial analysis as well as to increase the inspected area coverage. Last, TREEADS will build a new land and field-based restoration initiative that will use all modern techniques such as agroforestry, drones for seed spread, Internet of Things sensors that will be able to adapt the seeding process based on the ground needs and on the same time with the help of AI to determine post-fire risks factors. TREEADS solution will be demonstrated and validated under real operating conditions. Demonstration will involve eight complex pilot implementations executed in seven EU countries and in Taiwan.

**Keywords:** wild fires; prevention & preparedness; detection & response; restoration & adaptation.

## 1 Introduction

TREEADS (https://treeads-project.eu) is a Horizon 2020 Green Deal project (Grant Agreement: 101036926, H2020-LC-GD-2020/H2020-LC-GD-2020-3), with main objective to increase environmental sustainability and urban / rural ecosystems safety, through redefining and reinforcing forests' protection and management. TREEADS pursues this goal by developing and validating an innovative, sustainable, applied, and holistic wildfire management approach.

TREEADS project ecosystem develops a holistic solution with advanced capabilities for before (prevention and preparedness), during (monitoring and real-time management) and after (impact mitigation) the extreme event of a wildfire, as it is schematically represented in Fig. 1.


**Figure 1.** TREEADS holistic solution

The core of TREEADS system is an advanced computational system based on Artificial Intelligence (AI), that provides a risk analysis tool, an evacuation route plan, a fire ignition detector, a fire and smoke propagation tool as well as an adaptive forest restoration decision support system DSS along with mapping services. TREEADS will also use a fleet of UAVs and airships (in three different altitude levels), as well as satellite images to create a four layer surveillance platform for faster fire ignition detection and accurate image processing. Finally, TREEADS also proposes new fire resilient materials, insurance models, health monitoring and AR tools for fire responders, a mobile app that will bring the power of the computational system on the go and drone seeding technology by using special made seed capsules.

## 2. Objectives

The TREEADS system has the following objectives:

1. Contributing to major societal challenges by:
   - Gradually transform forest and fire management into a “management by inclusion” paradigm.
   - Build wildfire resilience and strengthen disaster response and recovery.
   - Bring together expert knowledge, complex adaptive systems, climate change adaptation understanding and artificial intelligence into an adaptive and transparent management context of increasingly informed decisions for ecological restoration.
2. Improving the efficiency of current fire-fighting operations by:
   - Identifying and preventing threats and abnormal events with validated levels of accuracy along with analyzing fire behavior and employing a real-time and 24/7 integrated wildfire detection and strategic surveillance system.
3. Advancing operational reaction and mitigation algorithms by:
   - Developing a novel emergency & disaster response system.
   - Enabling a distributed and resilient event-driven wildfire management system allowing real-time analysis and processing of complex event streams.
   - Providing a multi-response engine offering usable real-time information during a wildfire event.
   - Offering a Common Operational Graphical & Interactive interface with system users
   - enhancing the preparedness and planning capacity of firefighting stakeholders.
4. Deploying, validating and testing the solution in realistic live demonstrations over 8 different climate scenarios, bio-geographical/socio-economic contexts.
5. Protecting human lives, the environment, and the property.
6. Delivering a strong impact, by:
   - Developing an integrated wildfire management ecosystem.
   - Disseminating the project results to accelerate adoption within the forest value chain.
   - Communicating with local communities and the public about wildfire and forest management system.

Figure 2 provides a schematic representation of TREEADS approach.

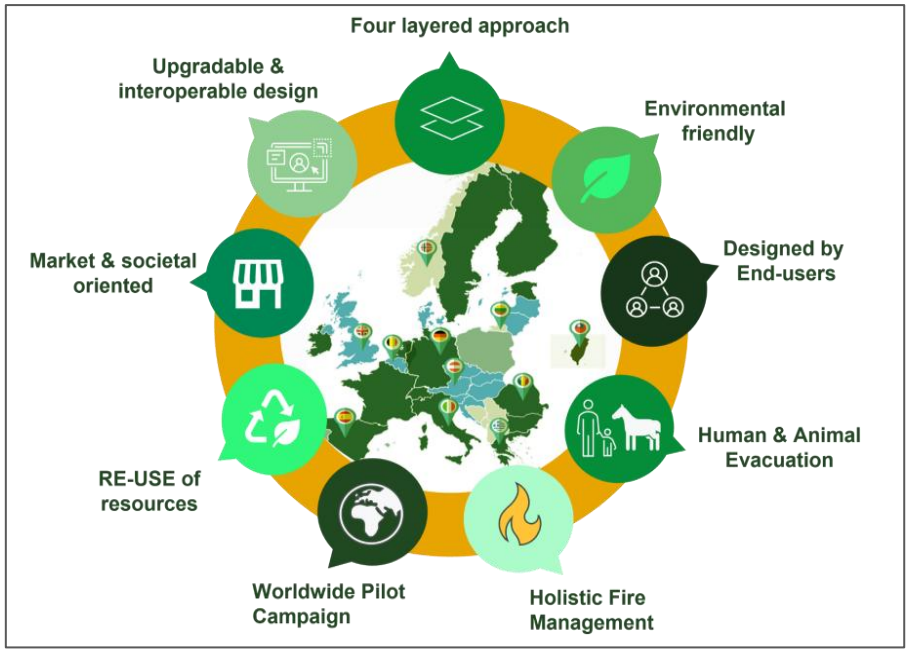


**Figure 2.** TREEADS approach

## 3. Challenge and mission

Wildfires are a severe threat across Europe, causing significant environmental and economic damage. They are becoming more intense and widespread as a result of climate change, particular forestry practices, ecosystem deterioration, and rural depopulation. Extreme wildfire events, in addition to their devastating ecological impact, have an unparalleled social cost in terms of both human life and economic losses.

TREEADS project mission is to reduce the effectiveness of the damage caused by wildfires, while maximizing the benefits of restoration and managing the impact of wildfires on local communities. Under a constantly changing socio-ecological context, TREEADS consortium is establishing a unified Technological ecosystem for integrated fire management and adaptive forest restoration. The TREEADS project will adopt a holistic forest fire management and an adaptive, collaborative governance approach based on the deployment of a new systemic and technological framework covering all three interconnected fire management stages.

The TREEADS project has been designed with a positive impact on society in mind. It contributes to major societal challenges by:

- Improving the efficiency of current fire-fighting operations and,
- advancing operational reaction and mitigation algorithms,

by deploying, validating, and testing the solution in realistic live demonstrations over eight different climate scenarios, bio-geographical and socio-economic contexts.

## 4. Pilot campaigns

The TREEADS ecosystem will be demonstrated and validated in realistic environments under realistic operating conditions with the involvement of different end-users (environmental and nature management organizations, firefighters, local and regional authorities, etc.) from Member States and Associated Countries. Demonstration will involve complex pilot implementations, executed in eight different countries (Norway, Germany, Spain, Italy, Austria, Romania, Greece, Taiwan) under different case scenarios in different environments (as pilot cases will be in southern, central, and northern Europe), testing prototype and demonstrating to meet different first responders' needs. Fig. 3 provides an overview of the TREEADS pilots.


**Figure 3.** Pilot campaigns and their targets

### 4.1 Norwegian Pilot Case

Norwegian forests cover 38% of the land area in the country. Many residential buildings in Norway are in the proximity to wildland vegetation. Besides, a large number of such houses were built using wooden construction materials, posing a great wildland-Urban Interface (WUI) fire risk. Due to the long and narrow territory of Norway, a large population in northern Norway relies heavily on the infrastructures in the forest, such as power grids and telecommunication towers.

Therefore, it is crucial for Norway to reliably detect forest fire in the early stage and to protect the key infrastructures in the forest. To improve prevention and preparedness for the wildland fire, several field exercises on forest fires are carried out each year in Norway by local firefighters, Norwegian Fire School (NBSK), and Norwegian Directorate for Civil Protection (DSB). The Norwegian pilot use case connects to such exercises. Measurements obtained from the field exercises will be used as the inputs to test the passive fire protection technologies provided by partners.

### 4.2 Italian Pilot Case

The pilot case is related to a very important touristic area in Southern Italy, including high density urban settlements and very dense wooded areas on the slopes. The ridge of the Sorrento Peninsula in the proposed area rises up to 390 m above sea level and the slopes are often subjected to extreme wildfires (both natural or malicious); in 2017 a very big fire involved different areas in Campania Region but in particular around the Vesuvius, causing also interruption in public transportation services.

A cable car system will be built to connect a sea level location to the ridge of the Sorrento Peninsula, to integrate the regional rail transport system with connection to remote areas only reachable by car. An ongoing feasibility study promoted by the Regional Transportation Agency, will define the optimal solutions. The final design activities will take place during the project lifetime. The pilot activities could use the available data for the infrastructure design and the fire propagation modelling could support both the feasibility analysis and the final design solutions.

### 4.3 Romanian Pilot Case

At national level, there are on average 166 forest fires per year, with a total affected surface area of approx. 50kHa (data over the last 60 years). However, the average surface of forest fires has increased by 53% and their frequency has doubled in the last decade. National statistics show that 61% of forest fires start by human negligence and 35% are due to unknown causes, most likely also due to human error. The pilot is set in Macin Mountains National Park's. Its available natural potential is making it accessible to a wide range of tourists, interested in hiking, landscapes, flora, local fauna, studies and documentaries (documentations). Among the identified vulnerabilities of the area are uncontrolled tourism, poaching, scattered grazing, illegal logging leading to the suppression of habitats, burning of vegetation, destruction of specimens of spontaneous flora, illegal capture of Dobrogean land turtles (Testudo graeca), extension of farms, extreme sports that disturb the tranquility of the area. Due to this abundance of visitors, human negligence is an important factor to consider in the prevention and mitigation of forest fires.

### 4.4 Spanish Pilot Case

Tiétar Valley, in the south of the province of Ávila is the Spanish pilot location. The southern area of Ávila is the most important forest area in terms of forest surface, with the massive presence of Pinus species and mixed forests. This area together with all its municipalities is considered as "High Risk Zone" according to the regional and national administration. The application of the holistic fire management approach proposed in TREEADS project will be narrowed to some municipalities or forest owners surface, according to the potential application of the foreseen technologies, which will be tested and validated in the Tiétar Valley.
The demonstration sites will be strategic points in the southern of Ávila province covering all the types of forest lands existing in the area, regarding different criteria, such as: proximity to urban areas, available infrastructures, the potential input data collection, forest land ownership and type of trees. Regarding the available infrastructures, there are regional infrastructure where can be located and coordinated the activities, like an extinction base, and there are infrastructures provided by the municipalities that will be collected and standardized in a database to offer accurate information to extinction resources.

### 4.5 Austrian Pilot Case

In Austria forest fires are of main concern and these threats are continually increasing. Long drought periods and more and more heat days together with human induced fire sources are resulting in forest fires which are also threatening the villages and cities often very closely situated to the forests. At the outskirts of Vienna, areas like Stammersdorf are directly located next to woods and vineyards. During dry times in the summer, the risk for a wild fire is extremely high. Since the last years, the area is growing fast and population is increasing. It also resembles a recreational area for a lot of Viennese inhabitants and is an important agricultural and touristic area. Stammersdorf is a prototype of suburban area in Vienna with an existing risk to wildfires.

### 4.6 German Pilot Case

A direct consequence of climate change is longer drier periods of drought, even in countries which traditionally had a lot of rain. In Germany about 32 % of the surface area is covered by forests. The dryness monitor for Germany shows that Saxony-Anhalt and Brandenburg are some of the driest parts of Germany. Most fires in both provinces have been ground fires which are dependent on dryness and dead organic material. Experiments in medium and large scale are undertaken using ground specimen up to several square meters, to evaluate the dependence of the fire spread on various kinds of vegetation as well as different amounts of organic mass in the ground and dryness. Better understanding of fire and smoke development mechanisms allows for more precise prediction of fire and smoke development which is crucial for assessing and improving firefighting tactics. Smoke production of these fires is a health risk for fire fighters as well as for inhabitants of villages close to forest areas. Extinguishment methods need to be water-saving, eco-friendly and efficient. Each fire scenario has different challenges and wildfires can happen in industrial areas as is the case in many areas of Brandenburg. This presents a great danger of pollutants being introduced into the environment together with the water-based extinguish agents, therefore optimal use and delivery of extinguishing liquids, other extinguishing agents and firefighting methods is of high importance.

### 4.7 Greek Pilot Case

It is a fine and warm summer day in the touristic area of Samaria Canyon, with temperatures between 35-40 degrees Celsius. Suddenly an explosion takes place in the middle of the day, and smoke, from the forest of Samaria, is covering the area around the forest. On the edge of the canyon is a sea-side touristic village (Agia Roumeli), with a number of hotels and villas. The only way to evacuate this area is by sea as the road is blocked from the fire. This demonstration will be led by Technical University of Crete and Mediterranean Agronomic Institute of Chania at their premises in the island of Crete, Greece capitalising on the data sets obtained by several devastating fires burst out in the island. Notably, the governance authority of Crete will contribute with regional medical emergency services, fire brigade and law enforcement units as well as the civil protection command and control centre. In this demo, cross organisational collaboration at regional, national and international level will be sought. The scenario will highlight the difficulties encountered in prioritising the employment of resources to different sub-scenarios (e.g., where to allocate available assets in handling heterogeneous causes of crises).

### 4.8 Taiwanese Pilot Case

The pilot case is a house with a dimension of 2mx2mx2m for the length, width and height, respectively. This house will use the alkali-activated material (AAM) concrete, which is produced by post wildfire ash incorporating by-products such ash slag and fly ash. The demo site is located at National Taiwan University Experimental Forest, in Nantou county, Taiwan. There is an existing small house which was utilized for security purpose. The small house will be expected to be rebuilt or refurbished using AAM-based concrete. There are available measurement devices in the demo site, including temperature, humidity, smoke concentration and air pressure. These available data refer to forest. The further measurement devices related to the house are planned to be set up in the demo site.

## 5. Response and results

TREEADS project will tackle a number of major challenges that wildfires pose by building upon state-of-the-art high TRL products and unite them in a holistic Fire Management Ecosystem consisting of various innovative technologies and systems to optimize and reuse the available socio-technological resources in all three main phases of wildfires. By adopting a multi-stakeholder, multi-actor approach at its core, the TREEADS solutions will contribute to sustainable development as an inclusive societal process and secure sustainability and resilience of natural environment, as well as local human societies. Fig. 4 summarizes the main aspects of TREEADS impact.


**Figure 4.** Expected impact

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# Migration Management

# Migration Profiles of Asylum Seekers in Greece

Spyridon Triantafyllou[1]

[1] Department of Balkan, Slavic, and Oriental Studies, University of Macedonia, 156 Egnatia Street Thessaloniki, 54636, Greece
Email: spyrtriantafyllou@uom.edu.gr

**Abstract.** We examine the profile of a sample, gathered between 2017-2019, of migrants mainly from Middle East and North Africa region arrived in Lesvos, Greece and then resided in the Reception and Identification Centre. We show that the there is an association between the skill set of a migrant and the destination country. In addition to that, the most skillful asylum seekers will eventually leave Greece after granted asylum and live in other European countries. The intention to move to European country remains strong, however unskillful migrants or asylum seekers without relatives will finally stay in Greece.

**Keywords:** asylum seekers; migrants; skills; labor market; Greece;

## 1 Introduction

It is difficult to always know exactly the underlying causes of irregular migration. The influx of migration usually implies illegal entry or stay and is linked to several reasons. First, the different opportunities offered in host countries from an economic perspective incentivize irregular migration to rich recipient countries. Second, the lack or laxed legal and border constraints also contribute to this phenomenon. Finally, economic and social factors in the origin and the host countries, as well as ill-informed migrants pose additional challenges to irregular migration. (OECD, 2020)

Theories of Migration may combine four analytical dimensions, which are highlighted across: i) the levels of analysis ("macro-", "meso-", "micro-"), ii) the spatial context (geographical, regional), iii) the different points of time, and iv) the different social groups (taking into account skills, occupation, ethnic origin, etc) (de Haas, 2014). Also, de Haas (2014) suggests four types of migration based on capabilities and external constraints: "precarious migration", "improvement migration", "free migration", and "distress migration". The first and last categories actually refer to "forced mobility such as irregular migrants, failed asylum seekers, Internally Displaced Persons" and "refugees possessing the resources to move abroad legally", respectively. However, research on the field about migrants, mainly focuses on their potential to enter to employment or their potential to different wages in terms of discrimination (Shekhar *et al.*, 2016), and thus in reference to the second and third categories as mentioned above.

"Migrants" are defined as foreign-born or foreigners, along with the acquisition of nationality, while "refugees" are defined as individuals categorized as either "refugees", "asylum seekers", or "other" by the UNHCR (Engler *et al.*, 2020). Comparing "migrants" and "asylum seekers", the second category faces much more challenges to integrate in the labor markets of the recipient countries due to their limited opportunities, impacting upon the macroeconomic situation of the country (Courtney *et al.*, 2020). On top of that, asylum seekers as labor migrants might be motivated by economic purposes, while asylum seekers as refugees or aiming for family reunification might be motivated by social and humanitarian considerations (Schmid and Helbling, 2016). Overall, their perspectives in assimilation to the labor market are dependent upon the language skills, the educational background and skill set obtained from the country of origin, and the network and connections developed in the host country (Kerr and Kerr, 2011).

In the detailed analysis of Ott (2013), a theorization of the main factors to affect refugees' labor market integration is presented, in accordance with findings of both quantitative and qualitative research. Synopsizing such variables, it seems that the profile of asylum seekers is associated with several factors, such as: i) "demographic variables" (gender, age, marital status, household size, country of origin, health and vulnerability situation), ii) "pre-resettlement history" (years as refugee, initial language level), iii) "human capital" (previous work experience, education level, host country linguistic skills, qualifications and recognition to the host country), iv) "resettlement environment" (language opportunities, discrimination, educational opportunities, attitudes towards refugees), v) "social capital" (social networks, feeling member of community, support). Therefore, policy makers and governments upon their decisions to resettlement programs should take into consideration the "refugee gap" in regards to "labor market integration" strategies, to improve migrants' lives and ultimately national economies (Ott, 2013).

This paper emphasizes on large migration waves in the previous years which caused a migration shock in Greece. It is estimated that Greece is not seemed as a country which might attract migrants even under pressure from these waves. However, in practice, the full majority of arriving people immediately apply for asylum so as to stay legally in Greek territory, but it is unknown whether they will finally stay in Greece or move to another country.

The fundamental aim of this paper is to investigate the profile of migrants arrived in Greece during the period 2017-2019, and, based on their skills and educational background, to predict how many of them will stay and ultimately might be integrated in the EU labor markets. One of the main hypotheses here is that the most skillful migrants will eventually leave Greece after granted asylum and live in other European countries with proved capacity to integrate migrants.

## 2 Statistical Analysis

The irregular migration flows in years 2015 and 2016 from Middle East and North Africa region caused a major political shock for EU countries and their economies. However, it is estimated that Greece was seemed mainly as transit -rather than destination- country.

My research was based on data collection from primary sources, which include structured interviews with a significant number of asylum seekers residing in Greece having arrived from 2017 and onwards, as well as from official publications. The model of structured interviews was adopted, which included specific questions, so as to interpret and compare the data for future use through quantitative methods. It is pointed out that during 2017-2018 the population of migrants in Lesvos island was close to 20,000, i.e. 1/3 of those stranding in Greece after the refugee/migration crisis, thus suggesting a representative sample, as well as its randomization for further quantitative analysis.

In Lesvos island there used to be the largest Reception and Identification Center in Greece. The author assumed that the majority of them resided in the Reception and Identification Center and opted for observing the life of the migrants passively, but without actively getting involved in their daily life for reasons of prejudice and privacy. The full majority of arriving people immediately applied for asylum so as to legally stay in Greek territory, but it is unknown whether they would finally stay in Greece or move to another country.

### 2.1 Descriptive Statistics

In total, 994 interviews of adult migrants who arrived between 2017 and 2019 were obtained. Explaining why only these 3 years, it should be mentioned that the number of arrivals in Greece in years 2015 and 2016 were beyond normality due to large inflows, while in year 2020 the number of migrants has been totally minimized due to pandemics and the changing dynamics of Greek-Turkish relations. The main countries of origin of the migrants are Afghanistan, Syria, Iraq, Iran, and the Democratic Republic of Congo followed by several other countries of the Middle East and North Africa (MENA) region.

The majority of the interviewees were males (n=898, 90.34%), while few females accepted to participate in the survey (n=96, 9.66%). Also, of the 994 migrants, 94.16% (n=936) aged 18-34 years and 5,84% (n=58) aged 35-50 years. Moreover, of the 898 males, 656 (66%) aged 18-34 years and 338 (34%) aged 35-50 years, while of the 96 females, 89 (92,70%) aged 18-34 years and 7 (7,3%) aged 35-50 years. There were no minors or elderly interviewees, and thus reference is done only to these two age groups. Of the 994 migrants, 86.3% (n=834) were Muslims, while 10.1% (n=98) were Christians and 3.5% (n=34) belonged to some other religion.

Indicatively, in terms of education, it is stated that of the total sample, 6.1% are illiterate, 25.7% completed primary education, 43.8% completed secondary education and 15.8% completed tertiary education, while in terms of skills, it is reported that of the total sample, 84.2% reported that they possess professional skills. After all, the majority of migrants desires to move to another EU Member State (85.4%).

Of the 994 migrants, 90.95% (n=904) mentioned that they had never stayed in Europe before, while only 9,05% (n=90) admitted previous stay in Europe. Out of 90 migrants, 21 stayed in Germany, 21 stayed in Greece, 4 stayed in Finland and the rest elsewhere in Europe, including Norway, Switzerland, and the United Kingdom. The results also show that only 13.7% (n=858) of the migrants had the necessary travel documents while 61% (n=606) of them were travelling alone. The predominant reason for leaving their country was to find better living conditions and prospects (n=955, 96.1%).

Furthermore, a significant portion of the migrants speak European languages (n=294, 29,6%), and mostly English (n=279), French (n=80), German (n=12), Greek (n=12) and Spanish (n=10). Other European languages spoken are: Portuguese (n=4), Italian (n=3), Norwegian (n=3), Swedish (n=2) and Dutch (n=1). There were also other migrants speaking non-European languages apart from their mother tongue, such as: Turkish (n=43), Russian (n=5), Hebrew (n=1), Hindi (n=1), Chinese (n=1).

Table 1 provides data a synopsis of the characteristics of migrants by year between 2017 and 2019, which in turn shows the potential of the statistical analysis as follows.

**Table 1.** Descriptive results for the entire period 2017-2019

| | | n | % |
|---|---|---|---|
| **Religion** | Muslim | 834 | 86.3% |
| | Christian | 98 | 10.1% |
| | Other | 34 | 3.5% |
| **Travelling document** | No | 858 | 86.3% |
| | Yes | 136 | 13.7% |
| **Travels alone** | No | 289 | 39.0% |
| **Education** | Illiterate | 59 | 6.1% |
| | Primary/ Elementary, | 250 | 25.7% |
| | Secondary | 426 | 43.8% |
| | Tertiary | 237 | 24.4% |
| **Skillset** | None | 157 | 15.8% |
| | Something | 837 | 84.2% |
| **Job in Turkey** | No | 164 | 16.5% |
| | Yes | 830 | 83.5% |
| **Relatives in Europe** | No | 553 | 55.6% |

| | | | |
|---|---|---|---|
| | Yes | 441 | 44.4% |
| **Previous stay Europe** | No | 913 | 91.9% |
| | Yes | 81 | 8.1% |
| **Asylum Granted** | No | 928 | 93.4% |
| | Yes | 66 | 6.6% |
| **Left Greece** | No | 969 | 97.5% |
| | Yes | 25 | 2.5% |
| **Final Destination** | Greece | 145 | 14.6% |
| | EU | 849 | 85.4% |

**2.2 Inferential Statistics**

Multiple regression model (logit analysis) was used to predict: i) whether migrants were granted asylum; ii) whether migrants left Greece; and iii) whether migrants had a final destination in a European Union country.

The results in Table 2 show that a significant predictor of whether migrants took asylum was their level of education (tertiary vs illiterate: b=0.216, z=-2.500, p=0.012, 95% CI= [0.065, 0.718]) and whether they had some kind of skills (b=2.935, z=2.210, p=0.027, 95% CI= [1.129, 7.629]). Overall, the logit model correctly predicts 93.4% of whether migrants were granted asylum.

**Table 2.** Results for predicting whether migrants received asylum

| | Odds Ratio | Std. Err. | Z | P>z | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Religion | | | | | | |
| 2 | 0.905 | 0.455 | -0.200 | 0.843 | 0.338 | 2.423 |
| 3 | 0.451 | 0.466 | -0.770 | 0.440 | 0.060 | 3.412 |
| Document | 1.336 | 0.521 | 0.740 | 0.458 | 0.622 | 2.870 |
| Alone | 0.930 | 0.276 | -0.240 | 0.807 | 0.520 | 1.663 |
| Relatives | 0.662 | 0.184 | -1.480 | 0.138 | 0.384 | 1.142 |
| DaysGreece | 1.000 | 0.001 | -0.840 | 0.402 | 0.999 | 1.001 |
| Members | 1.064 | 0.059 | 1.120 | 0.264 | 0.954 | 1.186 |
| Education | | | | | | |
| 1 | 0.963 | 0.475 | -0.080 | 0.938 | 0.366 | 2.533 |
| 2 | 0.678 | 0.330 | -0.800 | 0.424 | 0.261 | 1.758 |
| **3** | **0.216** | **0.132** | **-2.500** | **0.012** | **0.065** | **0.718** |
| **Skillset** | **2.935** | **1.430** | **2.210** | **0.027** | **1.129** | **7.629** |
| JobTurkey | 0.805 | 0.322 | -0.540 | 0.587 | 0.367 | 1.763 |
| Previous | 0.633 | 0.343 | -0.840 | 0.399 | 0.219 | 1.832 |
| Constant | 0.062 | 0.051 | -3.390 | 0.001 | 0.012 | 0.311 |

The results in Table 3 show that a significant predictor (at 10% level, α=0.10) of whether migrants left Greece was the existence of some kind of skills (b=5.655, z=1.670, p=0.095, 95% CI= [0.741, 43.180]). Overall, the logit model correctly predicts 97.5% of whether migrants left Greece.

**Table 3.** Results for the prediction of whether migrants left Greece

| | Coef. | Std. Err. | Z | P>z | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Document | 1.634 | 0.937 | 0.860 | 0.391 | 0.532 | 5.025 |
| Alone | 1.199 | 0.549 | 0.400 | 0.692 | 0.489 | 2.940 |
| Relatives | 1.107 | 0.468 | 0.240 | 0.809 | 0.483 | 2.537 |
| DaysGreece | 1.001 | 0.001 | 1.030 | 0.305 | 1.000 | 1.002 |
| Members | 1.105 | 0.087 | 1.260 | 0.206 | 0.947 | 1.290 |
| Education | | | | | | |
| 1 | 0.999 | 0.826 | 0.000 | 0.999 | 0.198 | 5.050 |
| 2 | 1.104 | 0.867 | 0.130 | 0.900 | 0.237 | 5.143 |
| 3 | 0.248 | 0.254 | -1.360 | 0.173 | 0.033 | 1.845 |
| **Skillset** | **5.655** | **5.865** | **1.670** | **0.095** | **0.741** | **43.180** |
| JobTurkey | 1.160 | 0.713 | 0.240 | 0.809 | 0.348 | 3.869 |
| Previous | 0.393 | 0.408 | -0.900 | 0.368 | 0.051 | 3.007 |
| Constant | 0.003 | 0.005 | -3.830 | 0.000 | 0.000 | 0.063 |

The results in Table 4 show that significant predictors of whether migrants' final destination was a European Union country was their educational level (tertiary vs illiterate: b=2.591, z=2.430, p=0.015, 95% CI= [1.201, 5.590], secondary vs illiterate: b=2.371, z=2.390, p=0.017, 95% CI= [1.169, 4.809]) and whether they have relatives in Europe (b=6.906, z=7.230, p=0.000, 95% CI= [0.752, 1.255]). Overall, the logit model correctly predicts 86.22% of whether migrants' final destination was a European Union country.

**Table 4.** Results for predicting final destination choice (Europe vs. Greece)

| | Odds Ratio | Std. Err. | Z | P>z | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Religion | | | | | | |
| 2 | 0.669 | 0.190 | -1.420 | 0.157 | 0.383 | 1.167 |
| 3 | 0.873 | 0.450 | -0.260 | 0.793 | 0.318 | 2.400 |
| Document | 0.919 | 0.266 | -0.290 | 0.770 | 0.521 | 1.620 |
| Alone | 1.091 | 0.241 | 0.400 | 0.692 | 0.708 | 1.683 |
| **Relatives** | **6.906** | **1.847** | **7.230** | **0.000** | **4.089** | **11.664** |
| DaysGreece | 1.000 | 0.000 | 1.190 | 0.234 | 1.000 | 1.001 |
| Members | 0.946 | 0.043 | -1.220 | 0.222 | 0.865 | 1.034 |
| Education | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 1.875 | 0.702 | 1.680 | 0.093 | 0.900 | 3.905 |
| **2** | **2.371** | **0.855** | **2.390** | **0.017** | **1.169** | **4.809** |
| **3** | **2.591** | **1.017** | **2.430** | **0.015** | **1.201** | **5.590** |
| Skillset | 1.200 | 0.306 | 0.710 | 0.475 | 0.728 | 1.977 |
| JobTurkey | 1.063 | 0.316 | 0.210 | 0.837 | 0.594 | 1.903 |
| Previous | 1.025 | 0.357 | 0.070 | 0.945 | 0.517 | 2.029 |
| Constant | 1.304 | 0.713 | 0.490 | 0.627 | 0.447 | 3.806 |

## 3 Key Research Questions and Objectives

Economics of Migration is a prominent discipline with plenty of rigorous studies, both with qualitative and quantitative approaches. By applying the statistical analysis, we endeavor to compare profiles of interviewed migrants with real data and extract basic points regarding the labor market integration of asylum seekers in Greece and in EU in total. Based on official data published from Ministry of Migration and Asylum and interviews with migrants, an inference of data to the total number of such people residing currently in Greece might contribute to the overall picture of skillful and non-skillful migrants in country with intention to continue their life in other EU countries, rather than stay in Greece.

The most important conclusions derived from the previous analysis and the logit model used are the following: i) migrants who have completed tertiary and secondary education, have a skill set, and have relatives in the EU, are more likely to arrive in a European country; and ii) there is a positive association between migrants who have been granted asylum or subsidiary protection and have a skill set framework, which further strengthens the first conclusion. To sum up, the above-mentioned concluding propositions verify our very first hypothesis.

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# Immigration-Refugee Crisis and New Types of Immigrant-Refugees in Europe

**Vlachadi Maria**, PhD, Lecturer, Dep.of Political Science, Univ.of Crete, blachadim@uoc.gr , mvlahadi@yahoo.gr

**Kyriakos Koutsautakis,** MSc, Police Lieutenant Colonel, kyriakoskoutsautakis@gmail.com

## ABSTRACT

This study is a product of both a systematic review on population movements (maps, statistical data), new types of migrants and refugees, and a survey, by using a questionnaire, regarding the opinion of police officers on these issues. The aim of this study is to highlight both the significant conditions that affect immigration and refugee, as well as to capture the current situation regarding the movement of people and how to be controlled. Finally, the research shows that illegal immigration can significantly affect the work of Greek Police. For this reason, it is considered particularly important to adopt and implement policies-strategies for the effective management of the immigration-refugee crisis both at the national and European level.

**Key words:** immigration-refugee crisis, new types of immigrants-refugees, conducting research

## INTRODUCTION

The phenomenon of immigration is a reality that has deep roots in history, as man began in tribes, whose needs forced them to constantly move for their survival. Migration is a shocking change in a person's life, they leave behind their ways of life, home environments, loved ones, habits and occupations. They carry with them images and experiences that include painful events and the personal experience of a particularly risky journey. The mobility of a set of integrated two types of movement of people autonomously from the period and reasons constitutes the migration of refugees, displaced persons, economic migrants and people moving for other purposes. Europe (Vlachadi M., 2009) has a long tradition of welcoming immigrants. The member states of the Union are affected both individually and as a whole by the mass migration flows and are called upon to integrate various national and cultural characteristics into their national core. The evolution of this phenomenon and the dimensions it has taken, are now a challenge for the European family, which has set as its strategic priority, the promotion of common migration policy measures, knowing that this targeting can act as a development factor both for itself as well as for the third countries involved. Migration is a complex phenomenon, as it is an instinctive feeling of human evolution where it is influenced by various fields such as politics, economy, society, culture and psychology. Migration is associated with the mobility of individuals and/or large population groups either abroad or within a country, due to crises in both the economic and political sectors, social changes, asymmetric distribution of global wealth, disorganization of the labor market as well as climatic and environmental changes. According to the time period in which the migration takes place, it is distinguished into: Traditional, perceived before World War I and migration was across the Atlantic, Modern, it was perceived in the industrial age for economic reasons, Newer, it concerns modern immigration for socio-economic reasons. In the past, it was observed that the most important reasons for migration were the desire for a better quality of life, family unity and escape for reasons that endanger the life of an individual or a group

such as war zones. As well as the parameters that distinguished migration if it was permanent or temporary in relation to the time of stay and movement, if it was characterized as voluntary or involuntary based on the choice of free will or not, if it was individual or group based on the size of the population, whether it was characterized as legal or irregular by whether the movement is entered in the records of the receiving state and finally whether it was internal or external migration related to the internal or external borders of a country. However, in recent decades, due to Globalization, new reasons and parameters have been created that differentiate the migration phenomenon:1. migration for the purposes of learning and specialization, 2. the repatriation of the population, 3. circular immigration, is the seasonal commercial activity, 4. social immigration is related to family unity, 5. immigration for environmental reasons, 6. the immigration of highly skilled workers (senior executives, technicians, and scientists) who move within the context of multinational companies, international organizations and international NGOs.

## RESEARCH PART

### PURPOSE OF THE INVESTIGATION

This research work aims to study, analyze and present population movements as well as new types of immigrants and refugees. In particular, the opinions of police officers were studied regarding population movements and how they affect the state in general and the Greek Police in particular. Their views regarding new types of immigrants and refugees were also studied. The conduct of this work is considered important as the study of population movements as well as the knowledge regarding the new types of immigrants and refugees will strengthen. Investigating and recording opinions about population movements. Investigating and documenting opinions about new types of immigrants and refugees. The most effective management of these phenomena.

### SAMPLE OF THE RESEARCH

The survey was addressed to police officers and constables of all ranks and different areas. This research was carried out between 1/12/2021 and 28/12/2021. The sampling method used was the simple random sampling method. The simple random sampling method assumes that each member of the population has the same probability of being selected as any other member of the population.

### RESEARCH TOOL

The research approach of the subject was done with quantitative research. For this purpose, questionnaires were created via Google Forms and distributed via e-mail. Before distributing the questionnaires, their validity and reliability were checked. Regarding reliability, it is useful because it checks the extent to which the questionnaire is free from measurement errors due to lack of time or the influence of social or other conditions (Zafeiropoulos, 2015). The questionnaires contained information regarding the research, its purpose and the importance of respondents' participation in it. At the same time, in order to ensure greater participation of respondents, the complete anonymity and confidentiality of the data that would be recorded was emphasized, as well as the use of these exclusively for statistical analysis and drawing conclusions. The purpose of the research was also briefly mentioned. There were also clear instructions on how to complete the questionnaire while it was considered appropriate to avoid vague questions, to place difficult questions at the end, to number all questions and generally to have a logical order. Before the final distribution of the questionnaires, a test survey was carried out on a small sample of people and similar conditions to the real survey in order to identify any errors and omissions and complete the final corrections, according to the methodological approach process. The questionnaire used was structured and based on the

use of various types of questions based on what has been described in the existing literature and articles. It contains closed-ended questions with a single answer, for the convenience of respondents, some open-ended questions as well as respondent agreement questions (Zafeiropoulos, 2015). The Likert scale (Strongly Disagree to Strongly Agree) was used for these questions. The scale used was from 1 to 5, through which they expressed the degree to which they agreed or disagreed and took the values Strongly Disagree, where it corresponded to 1, Disagree, which corresponded to 2, Neither Agree nor Disagree, which corresponded to 3, Agree, corresponded to 4 and Strongly agree, where it corresponded to 5, or took the values Not at all, where it corresponded to 1, A little, corresponded to 2, Moderately, corresponded to 3, Very much, corresponded to 4, and Very much, where it corresponded to 5. For questions of this type, the Cronbach's alpha reliability coefficient was used to check internal consistency reliability. This coefficient measures the degree to which the questions, which measure the same characteristic, show a high coherence or correlation, both among themselves and with the specific characteristic. That is, it expresses the average of the correlation coefficients between the questionnaire questions that contain a scale. When the values of the specific index are greater than 0.7 or 0.8 they are considered satisfactory (Markos, 2012). To better manage the questionnaire, the questions were organized into groups of the same topic. The first questions were about the profile of the respondents regarding their gender, age, marital status, school of graduation and whether additional studies have been carried out, the degree they hold as well as years of service and place of service. The first questions are there to better familiarize the respondent with the questionnaire and to provide information that is solid evidence for the respondent himself. The next questions were more general and related to population movements and new types of immigrants. To carry out the statistical analysis of the questionnaire, the statistical program IBM SPSS 27 was used. First, the appropriate variables were defined and then the data were entered appropriately. To facilitate the analysis, the data were parameterized, where this was deemed necessary. Appropriate statistical analysis was then performed. Highlights of this analysis are shown below.

## RESEARCH METHODOLOGY

For the purposes of the specific research, descriptive statistics was initially applied in order to summarize the data of the statistical research as well as to display them graphically. Then, inductive statistics was applied to draw conclusions regarding the research questions posed. More specifically, a x2 test was applied to check the existence of a relationship between the variables, a mean difference test, t-test and ANOVA, to check the existence of differences between the variables as well as a check for the existence of linear correlations between the variables**.**

## RESEARCH RESULTS

### Part A. Respondent Profiles

The largest percentage of respondents, 83.3% (100 people), are men, while the remaining 16.7% (20 people) are women. The age group 25-34 has the largest percentage with 36.7% (44), with a percentage of 25.8% (31) is the age group 35-44, followed by a percentage of 16.7% (20) are the age groups below from 25 years old and 45-54 respectively while with a rate of 4.2% (5) the respondents are over 55 years old. The marital status is as follows: the largest percentage, 60% (72), is presented as single, while the remaining 40% (48) are married. Of the respondents, the largest percentage, 80.8% (97), graduated from the police school, while 19.2% (23) graduated from the officers' school. In the question that referred to additional studies, the largest percentage, 89.2% (107), stated that they have a second degree. 10% (12) of the respondents stated that they hold a Master's Degree, while only 0.8% (1) hold

a Doctoral Degree. Among the subjects of the second degree were law, international law, mathematics, physics, chemistry, economics, accounting, social work, pedagogy, IT and foreign languages. The years of previous service, including the years of study, are as follows: the largest percentage, 42.5% (51), have 10-19 years, followed by 26.7% (32) 20-30 years, with 15 % (18) less than 5 years, 10.8% (13) 5-9 years and finally with 5% (6) more than 30 years. The place of service with the largest percentage, 89.2% (107), is declared to be in Mainland Greece, while 10.8% (13) is in Insular Greece.

**Part B. Results for the set of questions**

In terms of whether Greece is considered a multi-cultural society, the largest percentage, 33.3% (40), stated that they agree, 27.5% (33) neither agree nor disagree, 24.2% (29) completely agree, 12.5% (15) disagree while 2.5% (3) strongly disagree. The opinion of Greeks towards immigrants is formed as follows: the largest percentage, 46.7% (56), has a moderate opinion, 21.7% (26) has a negative opinion, 13.3% (16) has very negative, 10.8% (13) have a positive opinion, while 7.5% (9) have a very positive opinion. In the question regarding Internal Migration in Greece, the largest percentage, 34.2% (41), considers that it exists to a small degree, 27.5% (33) considers that it exists to a moderate degree, in a percentage of 22.5 % (27) consider that it exists to a fairly large extent, in 10.8% (13) that it exists to a very large extent, while in 5% (6) that it does not exist at all. Regarding External Migration in Greece, the largest percentage of respondents, 36.7% (44), consider that it exists to a fairly high degree, 30.8% (37) that it exists to a moderate degree, 17.5 % (21) that it exists to a very large extent, in 13.3% (16) that it exists to a small extent while in 1.7% (2) that it does not exist at all. In the question regarding the degree to which Primary Migration occurs in Greece, the largest percentage of respondents, 47.5% (57), consider it to exist to a moderate degree, while 30% (36) consider it to exist to a small degree, with a percentage 18.3% (22) that it exists quite a bit, with a percentage of 2.5% (3) that it exists to a very large extent while with a percentage of 1.7% (2) that it does not exist at all. It is believed that Secondary Migration in Greece exists, with the largest percentage of 43.3% (52), considering that it occurs to a moderate degree, with a percentage of 33.3% (40) that there is a little, with a percentage of 17.5% (21 ) that it exists to a fairly large extent, with a percentage of 3.3% (4) that it does not exist at all while with a percentage of 2.5% (3) that it appears very strongly. With regard to Voluntary Migration in Greece, the largest percentage, 34.2% (41), considers that it exists to a moderate degree, with a percentage of 25.8% (31) considering that it exists quite or a little respectively, while with a percentage of 14.2% (17) that there is too much. Regarding Involuntary Migration in Greece, the respondents stated that it exists to a moderate extent in 37.5% (45), a little in 28.3% (34), quite a lot in 17.5% (21), not at all in rate of 11.7% (14) while too much at a rate of 5% (6). In the question regarding the degree of occurrence of Short-term Migration in Greece, the largest percentage of respondents, 41.7% (50), consider that it exists to a moderate degree, 30.8% (37) that it exists to a small degree, 15% (18) that it exists to a fairly large extent, 6.7% (8) that it exists to a very large extent and 5.8% (7) that it does not exist at all. With regard to Long-Term Migration in Greece, the largest percentage of respondents, 32.5% (39), consider that it exists to a moderate degree or to a fairly large extent respectively, in a percentage of 20.8% (25) that it exists to a small degree, in a percentage of 12.5% (15) that it exists to a very large extent while in a percentage of 1.7% (2) that it does not exist at all. In the question regarding the degree of existence of Continental Migration in Greece, the largest percentage of respondents, 40.8% (49), consider that there is moderate, in percentage 28.3% (34) that there is enough, in percentage 21.7 % (26) that there is a little, in 6.7% (8) that there is too much while in 2.5% (3) that there is none at all. Regarding Overseas Migration in Greece, the largest percentage, 40.8% (49), considers that there is a moderate amount, 30.8% (37) that there is a little, 15% (18) that there is a lot and in percentage of 6.7%(8) that there is too much or none respectively. Additionally,

regarding Invisible Migration in Greece and its degree of existence, the largest percentage, 33.3% (40), considers that it exists to a moderate degree, 25.8% (31) that it exists a little, 17%, 5% (21) that it exists quite a bit, 13.3% (16) that it does not exist at all while 10% (12) that it exists to a very large extent. The respondents claimed that the concepts "Immigrants" and "Refugees" do not coincide with each other, at a percentage of 35.8% (43), that they coincide a little at a percentage of 21.7% (26), that they coincide quite a bit at a percentage of 20.8% (25), that they coincide moderately at a rate of 13.3% (16) and that they coincide very much at a rate of 8.3% (10). Regarding whether migrants want to repatriate, respondents stated that they are not at all likely to ask for it at a rate of 25.8% (31), that they might ask for it a little at a rate of 25% (30), that they might ask for it to a large extent at a rate of 24.2% (29), that they might ask for it at a rate of 20.8% (25), while that they might ask for it to a very large extent at a rate of 4.2% (5). Regarding population movements, the largest percentage, 49.2% (59) consider that they have increased too much in recent years, 40.8% (49) consider that they have increased enough, 7.5% (9) that there is a moderate increase, 1.7% (2) that there is a little increase while 0.8% (1) that there is no increase at all in recent years. Population movements affect the constitution of each state according to 78.4% (94) of respondents. 18.3% (22) of the respondents consider that it probably does not affect it, while 3.4% (4) of the respondents consider that the constitution of each state is not affected by population movements. Population movements may improve the standard of living of the state in which they settle according to 28.3% (34). 25.8% (31) consider that they cannot improve the standard of living of the country of establishment, 19.2% (23) state that they can improve it. 15.8% (19) completely disagree with this opinion, while 10.8% (13) completely agree with the opinion that population movements can bring about an improvement in the standard of living of the country of settlement. The entry of immigrants can affect the demographic (social) composition of Greece, according to the largest percentage of respondents, 75% (90), who state that they agree and completely agree with this point of view. 20% (24) of the respondents neither agree nor disagree while the remaining 5% (6) disagree and strongly disagree with this opinion. In the question regarding whether immigrants can be integrated into the respective state, 33.3% (40) believe this can be done to a moderate or small extent respectively, 14.2% (17) that it can happen in quite a large extent, 12.5% (15) that it cannot happen while 6.7% (8) that it can happen to a strong degree. Immigration can affect the respective state in the field of Medical Care, with the largest percentage, 65% (78), arguing that this can happen quite strongly, 25.8% (31) that Medical Care is moderately affected by immigrants, 5% (6) that it is affected a little, while 4.2% (5) consider that it is not affected at all. Immigration can affect the respective state quite a bit or too much in the field of Education - Training, according to the largest percentage of respondents, 50% (60). 27.5% (33) consider that it can affect it moderately while the remaining 22.5% (27) consider that the education sector can be affected little or not at all by immigrants. Immigration can affect the respective state in the field of Economy, according to the largest percentage of respondents, 64.1% (77). 27.5% (33) of the respondents consider that it can moderately affect the economy while 8.3% (10) of the respondents consider that it can be affected from a little to not at all by the immigrants. Immigration can moderately affect the respective state in the field of Psychology, according to the largest percentage of respondents, 31.7% (38). 54.2% (65) consider that immigrants can influence the respective state in the field of psychology to a large or very large extent, while 14.1% (17) consider that they can influence it from a little to not at all. Immigration can affect the respective state from a little to a lot in terms of its Cultural Identity, according to the largest percentage of respondents, 59.1% (71). 25.8% (31) consider that it can influence it moderately, while the remaining 15% (18) consider that the cultural identity of the respective state can be influenced from a little to not at all. Among the respondents, it is considered that immigrants and refugees will seek rights from the respective state in which they settle, fairly to very much

according to 86.7% (104) of the respondents, moderately according to 11.7% (14) of respondents while 1.7% (2) of respondents believe that refugees and immigrants are less likely to seek rights. On the question of whether immigration flows should be suppressed, the majority of respondents, 75% (90), agree and strongly agree, 19.2% (23) neither agree nor disagree, while the remaining 5.8% (7) disagree completely and totally disagrees. On the question of whether the current measures to suppress migration flows are sufficient, 29.2% (35) consider them to be somewhat sufficient, followed by 25% (30) who consider them to be quite sufficient, 23.3% ( 28) moderately adequate, 13.3% (16) very adequate while 9.2% (11) not at all adequate. On the question of whether the distribution of immigrants between EU countries can be political management of the migration crisis, the largest percentage of respondents, 66.7% (80), stated that they agree and completely agree, 20.8% (25) stated that they neither agree nor disagree while the remaining 12.5 % (15) disagree and strongly disagree with this view. With reference to the work of the Greek Police and whether it is inflated by illegal immigration, 86.6% (104) agree and completely agree with this point of view, 7.6% (9) neither agree nor disagree while 5.9 % (7) of respondents disagree. In the question regarding the extent to which immigration has affected the Greek Police in terms of Human Resources, the largest percentage of respondents, 36.7% (44), stated quite a lot, 35.8% (43) stated too much, the 19.2% (23) stated moderately, 5.8% (7) stated a little while 2.5% (3) stated not at all. In the question regarding whether immigration has affected the Greek Police in terms of Working Hours, the largest percentage of respondents, 35% (42), stated that it affects quite a bit, 31.7% (38) stated too much, 25 .8% (31) said it was moderately affected, while 7.5% (9) said it was a little affected. In the question regarding whether immigration has affected the Greek Police in terms of Working Conditions, the largest percentage of respondents, 38.3% (46), stated that it affects a lot, 35.8% (43) stated that it affects enough, 21.7% (26) said it affects them moderately, 2.5% (3) said it affects them a little while 1.7% (2) of respondents said it does not affect them at all.In the question regarding whether immigration has affected the Greek Police in terms of Psychology, the largest percentage of respondents, 33.3% (40), stated that it has affected them a lot, 32.5% (39) stated that has affected her quite a bit, 25% (30) said moderately, 6.7% (8) said a little while 2.5% (3) said it has not affected her at all. The present work could be extended, forming a basis for further research, to another type of environmental migration, as climate changes are rapid. Digital nomads, who are a source of income for both businesses and states while tending to shape new management and employment conditions, can be a future research.

**DISPUTE CONTROL**

The t-test was carried out in order to study the existence of a difference between a qualitative two-valued variable and the questions concerning population movements as well as new types of refugees and immigrants. The following results were observed from this control: A statistically significant relationship was observed between the school of education and to the question "Do you think that the concepts Immigrants and Refugees coincide?" ($p = 0.028 < 0.05$), to the question "Do you think that population movements have increased in recent years?" ($p = 0.012 < 0.05$), to the question "Do you think that illegal immigration increases the work of the police?" ($p = 0.040 < 0.05$). A statistically significant relationship was also presented by the place of service and the question "Do you think that Greece today is a multicultural society" ($p = 0.016 < 0.05$), the question "What do you think is the opinion of Greeks towards immigrants" ($p = 0.049 < 0.05$), the question "To what extent do you consider that the following types of migration exist in Greece - External Migration ($p = 0.019 < 0.05$), the question "To what extent do you think that the following types of migration exist in Greece - Invisible Migration ($p = 0.05 < 0.05$), the question "Do you think that the concepts Immigrants and Refugees coincide" ($p < 0.001$), the question "To what extent do you think that immigration can affect the respective state in Education - Training ($p = 0.028 < 0.05$),

Cultural identity ($p = 0.044 < 0.05$), the question "To what extent do you think that immigration has affected the Greek Police in terms of Human Resources ($p = 0.015 < 0.05$), Working Hours ($p = 0.03 < 0.05$), Psychology ($p = 0.03 < 0.05$). An ANOVA test was then carried out in order to study the existence of differences between qualitative variables with more than two values and the questions related to population movements and new types of immigrants and refugees. The relationships that emerged as statistically significant are the following: Age and the question "To what extent do you think that the following types of immigration exist in Greece - Primary Migration" ($p = 0.010 < 0.05$), the question "To what extent do you consider that the following types of migration exist in Greece (Short-term Migration) ($p = 0.047 < 0.05$), the question "To what extent do you consider that the following types of migration exist in Greece (Overseas Migration) ($p = 0.008 < 0.05$), the question "Do you think that the concepts Immigrants and Refugees coincide?" ($p < 0.001$), the question "Do you think that population movements can improve the standard of living of the state in which they settle?" ($p = 0.031 < 0.05$), the question "To what extent do you think that immigrants can integrate - be integrated into the respective state?" ($p = 0.011 < 0.05$), the question "To what extent do you think that immigration can affect the respective state in the field of Care" ($p = 0.014 < 0.05$), the question "To what extent do you think that immigration can affect the individual in Education - Training" ($p = 0.034 < 0.05$), the question "To what extent do you consider the current measures to suppress migration flows to be sufficient ($p = 0.002 < 0.05$), the question "To what extent do you think that immigration has affected the Greek Police in terms of Human Resources ($p = 0.002 < 0.05$), the question "To what extent do you think that immigration has affected the Greek Police in terms of Working Hours" ($p = 0.019 < 0.05$).

**RELATIONSHIPS**

Pearson's r correlation coefficient was used to find the existence of linear correlations between the variables. The values of this coefficient range from -1 to 1. Negative values indicate the existence of a negative relationship between the two variables. This means that as the value of one variable increases, the value of the other variable decreases. Conversely, positive values indicate a positive correlation. In other words, when the value of one variable increases, so does the value of the other variable. The zero value indicates that there is no linear relationship between the two variables (Zafeiropoulos, 2015). The results from the statistically significant correlations are presented below: A positive correlation was observed between age and the question of whether respondents consider Greece to be a multicultural society ($p < 0.01$, $r = 0.321$). A positive correlation was also shown between the school of education and the questions "Do you think that the concepts Immigrants and appeals coincide" ($p = 0.007 < 0.05$, $r = 0.245$). The school of education also showed a negative correlation with the questions "Do you think that population movements have increased in recent years ($p = 0.012 < 0.05$, $r = -0.229$) and "Do you think that illegal immigration increases the work of the Greek Police ($p = 0.020 < 0.05$, $r = -0.213$).

**CONCLUSIONS-SUGGESTIONS**

Some key conclusions about immigrants and refugees emerged from the research carried out. According to the majority of respondents, Greece, today, is a multicultural society, which has a rather neutral attitude towards immigrants. This is a direct consequence of the ever-increasing movement of populations in recent years. These movements affect the constitution of the state and the democratic composition of the country of settlement, such as Greece. Nevertheless, immigrants are not always easy to integrate or even join this state. Among the types of migration, external and long-term migration are the most common. Immigrants greatly affect various sectors of society, such as medical care and the economy. For this

reason, the interviewed police officers expressed the opinion that there should be suppression of migration flows while the suppression measures so far are not satisfactory. One measure, which is considered satisfactory, is the correct distribution of immigrants among the countries of the European Union. Regarding the work of the Greek Police and how it is affected by the existence of refugees and immigrants, the respondents stated that illegal immigration definitely increases their work while it has affected them to a very large extent in terms of human resources, hours and conditions work as well as their own psychology. The present work could be extended, forming a basis for further research, to another type of environmental migration, as climate changes are rapid. Digital nomads, who are a source of income for both businesses and states while tending to shape new management and employment conditions, can also be a future research.

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# On mops and maids: Repercussions of paid domestic work on female Albanian migrants in Greece

Sintorela Chamiti [1], Theodoros Fouskas [2]
[1] MSc in International and European Governance and Politics, Department of Political Science and Public Administration, School of Economics and Political Sciences, National and Kapodistrian University of Athens, Greece, Email: sintorelachamiti@gmail.com
[2] Assistant Professor, Department of Public Health Policy, School of Public Health, University of West Attica, Greece, Email: tfouskas@uniwa.gr

**Abstract:** The aim of the paper is to unravel the multiple effects of domestic work on the living conditions and integration of these women in the host country. The study implements the tool of research literature review. This method was chosen as it includes an objective approach and evaluation of the body of qualitative/quantitative research literature, in order to answer focused questions about the effects of domestic work on migrant women from Albania in Greece, using appropriate keywords in two databases. A review of the literature reveals that the low wages and precarious working conditions that characterise domestic work and care, allow for physical and moral exploitation, while at a social level there is marginalization and difficulty of access of domestic workers to social security, healthcare, community organization and labor representation.

**Keywords:** feminization of migration, women, Albanian migration, gender, domestic work, care work, Greece

## 1 Migration from Albania to Greece

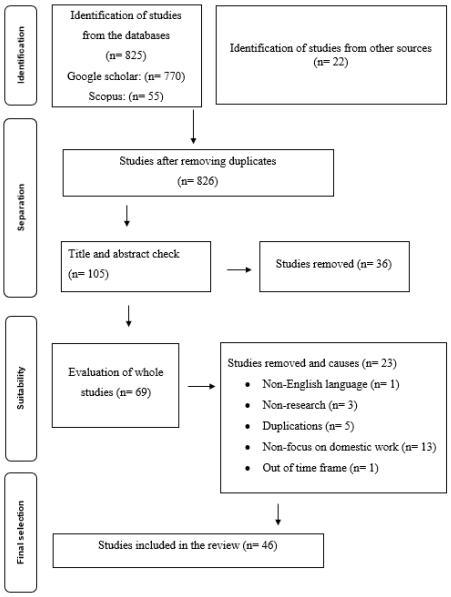
Greece has a long history of migration, either as a sending country or, particularly in recent decades as a transit and receiving country for a significant number of migrants and refugees. A key feature of Greek migration history throughout the 19th and 20th centuries has been the emigration of the active Greek population. Immigration flows changed around the late 1980s, with Greece experiencing a migration transition and transforming from a mainly sending country to a country of entry of migrant populations (Kotzamanis, 2008:12). In order to understand the magnitude of the migratory inflows, it is worth mentioning that in 1991 it was estimated that there were about 167.000 foreigners residing in the Greek territory, while in 2001 this number had increased almost fivefold, with foreigners estimated at about 800.000 (Bagavos and Papadopoulou, 2002:52). As to the presence of women in these migratory flows, it is estimated that according to the 2001 census, 45% of the foreign population consisted of female migrants (Maratou-Alipranti et al., 2007:39). The massive influx of immigrants into the country during this period was the result of the collapse of the regimes of the existing socialism in the countries of Eastern Europe and the Balkans, as well as the crises at multiple levels (economic, social, political) that erupted in these countries and especially in Albania (Kotzamanis, 2008:14). The study of Albanian migration occupies an important place in literature, and this is because - among others - men and women from Albania comprise approximately two thirds of the country's migrant stock (Maratou-Alipranti et al., 2007:14). As emerges from the 2011 Census data regarding the countries of previous residence of third country nationals settled in Greece, migrants from Albania made up 31.9% (ELSTAT, 2011:9). Moreover, according to the data of the Ministry of Migration and Asylum (2022) regarding the total of 455.806 legally residing third country nationals, Albanian nationals constitute the 1st ethnic group with 285.842 valid residence permits, which is 60.5% of the total.

### 1.1 Migrant women from Albania as domestic workers in Greece

Domestic work presents certain characteristics that make it special. Firstly, domestic work is a significantly "feminised" sector of employment (Cancedda, 2001:45) in which, especially on the European continent, immigrant women tend to be increasingly employed (Triandafyllidou, 2013:2). At the same time, it

falls into the broader category of low prestige work, i.e., those forms of employment "with low or no prestige, which are precarious, secondary, i.e., all those forms of paid and unpaid work that are outside the boundaries of formal employment as unrecorded and considered subordinate by modern society and are usually hidden from the State to avoid taxes, social security and labor rights" (Fouskas, 2012). Therefore, informal economy and low pay are the rule and not the exception for domestic workers. In addition, among its specific characteristics, domestic care and work takes place in a "by definition non-formal" workplace (Triandafyllidou, 2013:2), which is at the intersection of "private" and "public" work (Kambouri, 2007:42) and makes it difficult for the institutions responsible to control working conditions. Domestic work, whether internal or external, establishes a personal relationship with the employer as the very nature of the work itself involves personal tasks, such as taking care of people as well as their personal belongings, therefore a "high level of intimacy" is developed which may be implicit or even unwanted (Triandafyllidou, 2013:2). The intimacy that occurs in the context of domestic work in turn allows room for exploitation, given that the relationship between employer and employee in the informal economy professions is not equal, especially when it is a relationship between native employer and foreign worker. Developments in the field of domestic work in Greece seem to follow the pattern of developments in current domestic work internationally. More clearly, as in the bigger picture, domestic work in Greece started to change towards the end of the 20th century into a labor "enclave" almost exclusively reserved for migrant women (Kassimati, 2003:165). This evolution was associated with the simultaneous participation of Greek women in the labor market, and indeed in the case of Greece, a decisive factor is considered to be the gradual questioning of the role of other family members such as grandmothers, as caretakers of young children (Vasilikou, 2009:113). We can see, therefore, that in the majority of countries, including Greece, women's participation in paid work did not alter the traditional gender roles within the household (Marchetti, 2022:17), nor was there any kind of contestation of gender hierarchies in Greek society as Greek women assigned the "burden" and "responsibilities" that were theirs to foreign domestic workers (Kambouri, 2007:51). Domestic work in Greece has been associated with Albanian migration and this is because the majority of Albanian women were readily employed in this sector upon arrival and continue to do so (Maratou-Alipranti et al., 2007:169). In fact, domestic work seems to be the only "profession" that the Greek labor market "generously offers" to Albanian female migrants (Psimmenos and Skamnakis, 2008:25). For this particular migrant group, it is worth pointing out that the fact that it has family migration characteristics is mainly related to the tendency of Albanian domestic workers to opt for external domestic work -with cleaning as the main task- in order to be able to balance their work and family obligations (Sakellis and Spyropoulou, 2007:77).

## 2 Methodology




This paper takes the form of a literature review, emphasizing the secondary analysis of research on the effects of domestic work on female migrants from Albania in Greece. The literature review carried out was a non-systematic review and was conducted according to the principles of systematic literature review using the PRISMA method. The aim of such reviews is to minimise bias, which is achieved initially by pooling all studies around a topic and at the same time by adopting a rigorous methodological framework with predefined a priori eligibility criteria, so that ultimately the review is not left to the researcher's personal choice and availability, but follows a clear methodological protocol (Moher et al. 2015:1). Through the literature review, based on the "PRISMA" method, a search of appropriate research in Google Scholar and Scopus databases was conducted to answer the following research questions: How do the characteristics of domestic work affect women migrants from Albania in Greece on a personal and social level? How are these effects reflected in their primary and secondary ties (family, society)? What are the implications for their community organisation and representation? How are these effects reflected in their access to social protection and health care?

## 3 Findings

**Personal level and primary bonds:** Before documentation of the effects of domestic work on Albanian migrant women begins, it is worth mentioning that almost all the effects are related to the specific characteristics of domestic work, as analysed in the previous section. In particular, the fact that domestic work is classified as a low prestige occupation and therefore relatively low paid, women are pushed into overworking, which may include working in several different homes, overtime and even working on weekends and holidays in order to increase earnings. Indeed, Albanian domestic workers are paid less than other migrant women (Lazaridis, 2000). All these conditions affect, according to a wealth of empirical evidence, the daily lives of third-country women, family relationships - lack of personal and quality time - and are associated with fatigue and health problems (Syrigou-Rigou, 2000; Stratigaki and Vaiou, 2007; Mousourou, 2007; Kambouri and Lafazani, 2008; Kassimati and Mousourou, 2008; Papataxiarchis et al., 2008). Indeed, as Sakellis and Spyropoulou point out, domestic workers are often confronted with a "feeling of exhaustion, endless routine and stress in trying to successfully meet their work, financial and family obligations" (Sakellis and Spyropoulou, 2007:88). According to the research data, it follows that Albanian domestic workers perceive their employment in the domestic sector as devaluing. This is related to the fact that most of the workers either have vocational training or even a university degree or they used to work in clerical posts in Albania, which they lost due to the economic-social changes after the fall of the communist regime. Therefore, the fact that they have now agreed to perform unskilled labor, such as domestic work, which is not in line with their educational and work profile, is perceived by them as a downgrading (Damianovic, 2011; Lambrianidis and Lymberaki, 2001; Vaiou, 2002). This phenomenon is often found in contemporary domestic work theory and is even identified in literature under the term "brain waste", which describes the employment of migrant women in inferior positions that are not related to their qualifications (Kofman et al. 2000:61). In terms of employment-related effects, central to domestic work are the interpersonal relationships that develop between female workers and their employers. Undoubtedly, the fact that domestic work is performed within the domestic space gives the relationship between worker and employer a strong interpersonal connotation, which is not found to a similar extent in other occupations. A review of the research shows that this interpersonal contact ultimately works to the detriment of migrant women, because the remuneration, the subject matter and the terms of employment are agreed on at a personal level and can be changed at any given moment depending on the employer's intentions and the trust he or she feels towards the migrant women (Charalampopoulou, 2004). Therefore, the volatility and instability of working hours and wages are constantly experienced by domestic workers as a result of their personal relationships with their employers (Sakellis and Spyropoulou, 2007; Tastsoglou and Hadjicostandi, 2003). At the same time, interpersonal relationships make women workers easily exploitable and manipulable, creating perceptions of obligation towards their employers (Psimmenos and Skamnakis, 2008; Lazaridis and Romaniszyn, 1998; Anderson, 1999), while they also seem to create higher expectations on the part of employers (Styliou, 2004).

**Social level and secondary bonds:** At the social level, domestic workers from Albania experience what is often found in literature under the term "triple invisibility" and describes the position of migrant females as women, foreigners and with socio-class origins of low social status (Maratou-Alipranti et al., 2007:39; Athanasopoulou, 2008:272; Vasilikou, 2007, 2009; Kambouri, 2008; Thanopoulou, 2007; Hantzaroula, 2008). This "triple invisibility" from the social fabric is also experienced by domestic workers as a consequence of their employment. As Olsson's research shows, Albanian domestic workers face phenomena such as isolation and social marginalization, either due to their working conditions (domestic space, long hours, etc.) or due to the very nature of their work - especially in the case of domestic work (Olsson, 2014). Continuing, at the social level, Albanian domestic workers often face racist and discriminatory attitudes, mostly related to the work they perform (Olsson, 2014; Sakellis and Spyropoulou, 2007; Kassimati, 2009). As Browne and Mirsa explain, the fact that domestic work has historically been associated with the employment of ethnic minority women, has contributed to the perpetuation of discriminatory attitudes against them by employers and the social environment (Browne and Mirsa, 2003). Racism and discrimination do not only extend beyond the boundaries of ethnicity but in many cases take on a social connotation, with racism taking on a class dimension. In particular, Olsson's research data shows that domestic workers from Albania are, due to their gender, ethnicity and employment, placed in the lower strata of the labor market, resulting in a growing status gap between them and their employers (Olsson, 2014).

**Community organization in associations and labor rights claim:** In terms of participation in migrant community associations, socioeconomic precariousness has deepened Albanian domestic workers feelings of isolation and has distanced them from other migrant women, has reproduced individualism and reinforced individualistic attitudes towards others in Greek society. It has also further encouraged dependence on employers and/or on representatives of migrant communities, leaving them exposed to exploitation, further compromises to employers' demands and the formation of a patron-client relationship between migrant workers, employers, representatives of migrant community associations and lawyers (Fouskas, 2012). Due to a global demand for domestic work and unskilled manual labor that isolates the migrant worker, along with the diminishing need for collectivity and the absence of occupational options, there are extremely limited instances of workplace resistance and rights claims by migrant female workers in host societies. Migrant women are more likely to be disciplined by the demands of their employers or completely abandon claims for their labor rights (Fouskas, 2012).

**Access to healthcare and social protection:** As can be seen in almost all the studies included in the review, the most significant impact of domestic work on Albanian female migrants concerns their interaction with the welfare state and the extent of their access to social benefits. This effect confirms the theory on the marginal position in which migrant domestic workers in Greece tend to find themselves in terms of social protection due to their gender, legal status and the nature of their work (Xypolytas and Lazarescu, 2013; Anthias et al., 2013). According to empirical evidence, the majority of Albanian domestic workers work without social security benefits (Skamnakis and Malekaki, 2017; Charalampopoulou, 2004; Bacharopoulou et al, 2007; Balli, 2009; Psimmenos, 2007, 2011; Maroukis, 2018). The reasons that prevent them from accessing health care and social protection can be divided into three levels. First, in many cases there is no intention on the part of the migrant women themselves to find insured work, as in their initial years in the country they desired higher earnings and "more cash in hand" without focusing on social benefits (Skamnakis and Malekaki, 2017:122). Additionally, immigration policies and bureaucratic restrictions - such as linking social security to residence/work permits rather than individual incentives such as retirement - further distanced them from the welfare state (Psimmenos and Skamnakis, 2008:167; Psimmenos, 2011); and finally, at the employer level, the indifference on the part of the employers to provide social security benefits for domestic workers, and even in many cases the refusal to hire domestic workers who sought insurance contributions, sealed uninsured domestic work in the country (Charalampopoulou, 2004). These conditions trap female workers in an environment of informal work, without health care, social protection and retirement prospects. In order to fill this gap, domestic workers resort to self-insurance or insurance through their spouse. In particular, Albanian domestic workers have attempted to buy their own insurance in order to enjoy social benefits. However, this possibility became a burden in the last decade as a result of the recession, with social security contributions being felt as a financial drain and avoided as much as possible (Skamnakis and Malekaki, 2017; Xypolytas, et al, 2017). Regarding insurance through the husband, it is worth mentioning that especially for Albanian migrant women, social insurance through family reunification is not only due to their employment under an informal domestic work regime but has deeper roots and is linked to the means and process of their entry to Greece through the strategy of family reunification (Vullnetari, 2009). Although insurance through a family member seems to bridge the gap created by domestic work, it negatively affects women's empowerment and independence and ultimately renders them dependent on their husbands.

## 4 Conclusions

Domestic work not just another occupation. On the contrary, it brings together certain characteristics that affect domestic workers in a particular way. It is notable that even nowadays, the occupation of the domestic sphere remains worldwide largely a "female affair", with migrant women being hired either to "substitute" or to complement the gender roles of other women (Labadie-Jackson, 2008:70; Lymberaki and Maroukis, 2005). This model is also found in Greece with migrant women, mainly from Albania, almost monopolizing the domestic work and care sector. The link between female migration and domestic work goes back in time and is based on the fact that domestic work is a kind of unskilled labor, in many cases performed under "harsh, anarchic, stigmatised and poor working conditions", which almost exclusively only female migrants are equipped to endure (Farris, 2015:12).

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# Challenges and strategies on border management and return in the European Union

Ioanna Vasiliki Papakosta[1], Maria Drakaki[1]

[1] Department of Science and Technology, University Center of International Programmes of Studies, International Hellenic University, 14 th km Thessaloniki-N. Moudania, 57001, Greece
Email: ipapakosta@ihu.edu.gr & ioannapapakosta3@yahoo.com
Email: mdrakaki@ihu.gr

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## Abstract

A critical aspect and integral part of migration management as a complex and multifaceted phenomenon is border management and return. Border management and return involve several key components and processes such as border control, customs procedures, search andrescue activities, return management as well as migration management.

Several challenges in this area exist and the impact of the relevant risks and threats cannot be underestimated. Instrumentalization of migration in some cases, war in Ukraine, cross border crime, hybrid threats, terrorist threats are only a few of the risks and threats identified for the next decade.

Addressing those challenges involves various aspects of immigration, security and humanitarian concern. Moreover, it requires comprehensive strategies that prioritize security, human rights, and efficient administration. The goals to be achieved through those strategies are related to the facilitation of legitimate border crossings and increased efficiency of return policy, prevention and detection of cross border crime, safe, secure and well-functioning external borders, good governance and other equally important goals. Those goals should be aligned with the needs and priorities of each MS and SAC but also in broader context, in European Union level. This paper aims to provide an overview of the existing challenges in border management and return in the European Union area, as well as approaches and strategies for addressing them and achieving defined goals.

**Keywords:** European Union, migration and border management, challenges, policies - strategies - initiatives.

## 1. Historical Data of border management challenges and strategies:

Article 3 of the Treaty on European Union states inter alia that “the Union shall offer its citizens an area of freedom, security and justice without internal frontiers, in which the free movement of persons is ensured in conjunction with appropriate measures with respect to external border controls, asylum, immigration and the prevention and combating of crime”, in order to build the basis for an ever closer union between the people of European countries, in full respect and protection of fundamental rights.

Moreover, the foundations of a borderless area inside Europe were laid down with the signature of the Schengen Agreement on 14 June 1985 by five of the ten Member States of the European Economic Community, which was supplemented by the Schengen Convention and entered into force in 1995. With the “Schengen acquis” the abolition of internal border controls was introduced inside the so-called Schengen area, which currently includes 27 European countries. Since then, the Schengen Borders Code constitutes the basis for the external border management.

With the founding and functional Treaties of the European Union and the Schengen Convention and Agreement was placed the basis of the free movement of persons and goods within this area. Currently, 'the border-free *Schengen* Area ensures free movement to more than 400 million EU citizens and non-EU nationals living in the EU as well as for tourists visiting the EU, student exchange, or for business purposes' (Wagner, 2021) [10]. Further, it was fully conceived that to succeed in this policy it was fundamental to have effective migration management.

Nevertheless, in recent years the unprecedented pressure of the European Union area from the extreme migratory flows, have highlighted the shortcomings and in parallel the necessity and importance of effective integrated migration management in a long-term basis. The migratory crisis of 2015-2016 raised up this issue and made this policy area as one of the first priorities of the European Union community to ensure the continuity of the prosperity, security, and safety. Therefore, European Union bodies took important initiatives and decisions related to this policy. One of thee important initiatives is related to the preparation of two consecutive regulations, (EU) 1624/2016 (EU Regulation, 2016) and (EU) 1896/2019 (EU Regulation, 2019) with which there were set new EU political guidelines for the materialization of the new objectives as regards migration and border management policies.

## 2. Challenges in Border Management

Challenges and threats in border management have persisted and evolved over the years. Migration and Refugee crises, terrorism and radicalization, cybersecurity threats, illegal trade activities, public health emergencies are few of the main risks and threats European Union is facing. Those risks are related mainly with the instability in neighbouring or other non-EU countries, such as the invasion of Russia to Ukraine or the conflicts in the middle East, Libya, Syria, but also Azerbaijan, or the political instability in Tunisia and other countries, the impact of which is profound on the border management of the European Union as they have and will continue to have consequences as regards migration and border management in the European Union. Moreover, equally important pull factor influencing migration patterns, necessitating a proactive and comprehensive approach to migration management is the climate crisis which over the last many years appears to influence lives of more and more people and countries (fluids, fires, extreme weather conditions leading to progressive lack of water and food), or big virus outbreaks such as COVID-19 pandemic. Those challenges have significant impact of course at the EU external borders.

Main identified Risks are related to FRONTEX Risk Annual Analysis (2023):

1. Irregular migration at the sea borders
2. Irregular migration at the land borders
3. Clandestine entry
4. Document Fraud
5. Secondary Movements
6. Risks related to returns
7. Smuggling of illicit drugs
8. Firearms smuggling
9. Detection of stolen vehicles and parts
10. Tobacco smuggling
11. Trafficking in human beings
12. Terrorism

More specifically, the instrumentalization of migration continues to be used in the context of regional conflicts and growing violence which generates large inflows of Third Country Nationals and asylum seekers, complex diplomatic relationship with Iran, Turkey and several countries in Africa which might decide, for example, to 'turn a blind eye' to orchestrated/coordinated flights towards countries neighbouring the Union to exercise pressure on the EU should the East/West divide continue to grow.

Moreover, cross-border crime on the EU's external borders will continue to pose a grave threat to the internal security of the EU. And as recently observed few Member States and Schengen Associated Countries decided to

reintroduce border checks inside Schengen border area which results on delays on journeys but most importantly financial cost due to the delays of products and leads further to the risk of ruining the reputation of the European structure.

## 3. Policies, strategies and plans to address existing and evolving challenges in the border management

Nowadays in a globalized world, and due to continuous instabilities in many regions of the world deriving from wars, invasions, climate change phenomena and other factors, effective external border management in the European Union constitutes one of the main priorities for maintaining the fundamental objectives and guiding principles of the Treaties which created the European integration.

Furthermore, border management involves a range of initiatives and developing strategies to ensure effectiveness and reach all the goals towards the evolving challenges. As above mentioned, the crucial turning point in the recent years, as regards irregular migration phenomenon, was in 2015 with the unprecedented migration crisis in European Union due to the war in middle East in addition to the continuous instability in many regions of the African continent. Since then, it became thoroughly understood from the decision makers that the policies and strategies as regards migration management and mostly border management should change and being adapted to the new more complicated environment. Therefore in 2016 a new Regulation (EU Regulation, 2016) had been established for the enhancement of the mandate of European Border and Coast Guard Agency. However, the relevant framework still needed to be further improved and therefore at the end of 2019 the new, "improved" Regulation (EU Regulation, 2019) had been introduced, through which it was given an even stronger mandate to the European Border and Coast Guard Agency to address all the emerging challenges by placing emphasis to provide all the necessary capabilities in an integrated way. With those two Regulations the approach on border management changed in a more coherent and integrated way as an issue of common interest and shared responsibility for all the Member States of the European Union and the Schengen Associated Countries.

More specifically, with the last Regulation two main novelties have been established. The first one was the setup of a European Border and Coast Guard Standing Corps Standing Corps which is being characterized as the operational backbone of the European Border and Coast Guard Community and the purpose of which is to complement the efforts undertaken by the Member States in national level. The capacity of the Standing Corps should be up to 10.000 operational staff.

The second novelty introduced is related to Integrated Planning. The complex and multifaceted challenges in migration management had proven that in order to have effective integrated border management it was necessary to have integrated planning between the Member States and the Agency within border and return operations. Therefore, according to the relevant Regulation (EU Regulation, 2019) an integrated planning process should be established, including Operational, Contingency and Capability Development Planning. In more details, as regards contingency plans, the Member States shall describe all the necessary capabilities and measures to be taken in case of crises. As regards Capability Development Planning there is obligation for the Member States to adopt Capability Development Plans in line with their National integrated border management strategies which will describe the medium to long term development of national capabilities in border management and return. And the EBCG Agency shall prepare an Overview of the National CDPs and a Capability Roadmap, a Multiannual Acquisition Strategy and Multiannual planning as regards Standing Corps. Last component of the integrated planning is the adoption of operational plans in border management and return by the Member States / Schengen Associated Countries and the EBCG Agency (Frontex).

**Cooperation/Collaboration with Third Countries** in EU level efforts. A representative example is the EU-Turkey Statement (EU-Turkey Statement, 2016) established on 18 March 2016 to address the migration crisis affecting Europe at the time. The crisis saw a significant influx of refugees and irregular migrants crossing from Turkey to Greece seeking asylum in EU countries. The agreement was a joint effort between the European Union and Turkey to manage and reduce irregular migration flows. The objectives of the EU-Turkey Statement were (EU-Turkey Statement, 2016):

1. Return of irregular migrants: Any newly arrived irregular migrants crossing from Turkey to the Greek islands after the entering of the Agreement into force should be returned to Turkey,

2. Resettlement of Syrian Refugees from Turkey to Greece: For every Syrian irregular migrant returned to Turkey, a Syrian refugee from Turkey would be resettled in the EU,
3. Financial assistance to Turkey: In order to support with the needs of the Syrian refugees to Turkey,
4. Visa liberalization for Turkish Citizens,
5. Re-energizing EU Accession Negotiations with Turkey,
6. Humanitarian support and projects for Syrian refugees in Turkey and
7. Implementation, monitoring and regular review to assess progress and make the necessary adjustments.

In parallel, and as the crisis of 2015 revealed the lack of preparedness as regards not only the processes in national and European level but also the capabilities, equipment (aircrafts, vessels, vehicles), adequate and well trained staff, necessary IT systems and other related resources, the decision makers realised the need for a dedicated EU Fund which would have as central goal the support of the Integrated Border Management through enhancing the capabilities of the European Border and Coast Guard Community, both Member States and Frontex. Therefore, although there was a predecessor fund with two areas, the so called Internal Security Fund, within the new Multiannual Financial Framework 2021-2027 in addition to the Internal Security Fund it has been created the Border Management and Visa Instrument (EU Regulation, 2021) as part of the Integrated Border Management Fund, and it has two specific objectives (Integrated Border Management Fund): (i) to support an effective European integrated border management at the external borders, implemented by the European Border and Coast Guard as a shared responsibility with the national authorities responsible for border management, to facilitate legitimate border crossings, to prevent and detect illegal immigration and cross-border crime and to effectively manage migratory movements and (ii) to support the common visa policy, to ensure a harmonised approach with regard to the issuance of visas and to facilitate legitimate travel, while helping to prevent migratory and security risks.

**Quality Control Mechanisms:** Schengen Evaluation and Vulnerability Assessment mechanisms which are complementary for guaranteeing the quality control of the Schengen area. The latter is performed by European Border and Coast Guard Agency, based on objective criteria in order to assess the capacity and readiness of the Member States to face current and future challenges at the external borders.

## 4. Conclusions

The recent crises, especially those of 2015 in the Central Mediterranean area and that of 2022 due to the invasion of Russia to Ukraine as well as the emerging risks and threats as regards irregular migration deriving from the instability in middle East and African continent , made clear in practice more than ever that it is of utmost importance to build high and uniform EU standards to ensure security and stability at the external borders, with solidarity, shared responsibility and full respect and protection of fundamental rights with the aim to safeguard the right of all the persons in need to be accepted and protected within European Union and Schengen area. Besides, this has been pointed out from the decision makers of the European Union many times currently:

It is apparent that irregular migration together with other forms of cross border crimes are multifaceted phenomena and therefore it is needed to be confronted in an integrated manner and with systematic approach. Since nowadays, it is a necessity to integrally confront the emerging challenges by policymaking, strategic and integrated planning to be able to predict the future risks and threats, cure any vulnerabilities and prevent the potential cross border crimes which jeopardise the principles of the Treaties upon which, inter alia the European integration was created.

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Regulation (EU) 2019/1896 of the European Parliament and of the Council of 13 November 2019 on the European Border and Coast Guard and repealing Regulations (EU) No 1052/2013 and (EU) 2016/1624.

Regulation (EU) 2016/399 of the European Parliament and of the Council of 9 March 2016 on a Union Code on the rules governing the movement of persons across borders (Schengen Borders Code).

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# Tearing down the communication barriers: Towards the Greek register for Public Service Interpreters

Stefanos Vlachopoulos[1], Sotirios Livas [2], Stavros Kozobolis [3]

[1] Department of Foreign Languages, Translation and Interpreting, Ionian University, Corfu, Greece
Email: vlachopoulos@ionio.gr
[2] Department of Foreign Languages, Translation and Interpreting, Ionian University, Corfu, Greece
Email:sotlivas@ionio.gr
[3] Department of Foreign Languages, Translation and Interpreting, Ionian University, Corfu, Greece
Email:kozompolis@ionio.gr

**Abstract.** The creation of a PSI register in Greece, primarily for asylum and immigration purposes, represents a significant stride towards a register of proficient and qualified interpreters for the entire Greek public sector. This initiative marks a pivotal turning point in the crisis management process, as it addresses the communication and language requirements of foreigners lacking a knowledge of Greek. Given the ongoing arrival of refugees and immigrants since 2015 (and the resulting issues) and noting that the Greek Ministry of Migration and Asylum uses contracted providers for all relevant interpretation services, setting up an interpreter register would be an appropriate and sustainable response to the increased interpretation requirements of the said Ministry, as well as of other public sector services. This paper presents an overview of the project launched to lay the necessary foundation for the establishment of a training, accreditation, and management framework for PSIs in the Greek public sector, spanning from untrained bilinguals to fully trained and academically recognized interpreters. The paper aims to position PSI in the broader problem-solving effort of the refugee and immigration crisis in Greece since 2015.

**Keywords:** Public Service Interpreting; asylum and immigration procedures; social justice;

## 1 Introduction

The paper discusses the collaborative initiative between the Department of Foreign Languages, Translation and Interpreting at Ionian University (DFLTI) and the Greek Ministry of Migration and Asylum (MOMA) to enhance the interpreting services by establishing a register of public service interpreters. Interpreting is a complex activity that requires more than mere proficiency in two languages. It involves communication, speech production, language usage, creative problem-solving, and decision-making skills, as well as complex information processing. Public Service Interpreting (PSI) is a multifaceted task that require specific skills and knowledge (Vlachopoulos and Ioannidis, 2022, 157-169). According to Wadensjö (1998), PSI encompasses "interpreting in public services to facilitate communication between staff and lay people meeting for a specific purpose" (p. 49). The role of PSIs in refugee settings presents notable difficulties while also being fundamental to the fair and just management of vital matters for both non-citizens and government bodies.

The implementation of a PSI registry in Greece - initially for asylum purposes and immigration registering - is a significant stride towards the integration of a registry of qualified and accredited interpreters extending to the public sector in Greece. Additionally, it serves as a crucial milestone in managing crises related to the language and communication necessities of, among others, asylum seekers. Given the continuous influx of asylum seekers since 2015 (and the related problems it has created), and the reliance of the Greek Ministry of Migration and Asylum on contracted providers for all relevant interpreting services, including interviews for asylum seekers, an interpreter register could offer a suitable and long-term solution for the Ministry's enhanced interpreting needs, as well as for other public sector services.

This paper presents an outline of the project, which aspires to design an accreditation and management system for providing interpreting services at authorities as a crucial element for promoting social justice by giving non-

Greek speakers a voice and allowing the authorities to make fair judgements. In this context, A public service interpreter is a professional language service provider who aims to facilitate the access of speakers of other languages to the provision of a service by balancing the power relationship between the state and the citizen. To this end, s/he conveys information through spoken or sign language alternately to both parties (Grbić and Pöllabauer, 2006), with linguistic competence, accuracy, completeness, neutrality, impartiality, and confidentiality.

The objective of the PSI is to enable equal access to public services; the interpreter conveys information alternately in spoken or sign language to both parties with linguistic competency, accuracy, completeness, impartiality, and confidentiality. This is achieved through interactivity in a triadic (foreigner-interpreter-agent) public service setting, resulting in a structured final message.

## 2 The path we chose: Professionalization step by step through training and accreditation

The project has been designed as follows: First, the groundwork needed to be laid: It is more than obvious that in a field with multiple terminologies as in the realm of interpreting before authorities, the clarification of terminology is crucial. Not only does it define the focus of the research, the focus of the service to be provided, but it also sets the framework for a process of professionalization in the field. We have chosen the term PSI - rather than other terms used internationally (community interpreting, institutional interpreting, etc.) - because we are convinced that this term clearly defines the boundaries of the field of professional PSI.

Since lifelong learning, ensuring progression within the register from lower to higher levels requiring more skills and knowledge, is a prerequisite for an accreditation and training system, other relevant systems have been studied and best practices have been evaluated. The need for professionalization equates to the need for an accreditation system that provides credibility and gives the interpreter 'a licence and a mandate' (Skaaden & Felberg, 2012: 8).

When creating the accreditation system in the form of a dynamic registry to enhance the professionalism of PSI, the team carried out a survey tailored to agents who have hands-on experience in asylum procedures as well as a series of interviews. In the first phase of the project, a PSI register was set up. It contained defined profiles for each level of the system. Moving forward, the next stage will be to devise a code of ethics to endorse, enhance, and sustain an empowering and ethical environment for PSI. Ethics is regarded as fundamental to interpreting and serves as a foundation for training PSI ((Vlachopoulos and Ioannidis, 2022, 173). Subsequently, a legal framework will be developed to integrate it into the immigration and asylum procedures.The next step will be a language test for candidates who will be evaluated on their language proficiency, including foreign languages in demand within the public sector, as well as Modern Greek. The candidates will then undertake instruction specifically focused on interpreting ethics; the aim of this introductory training on interpreting ethics is to acquaint PSI register candidates with the distinction between interpreting and other language services, including translation and other forms of intercultural information brokering and to prepare them for linguistic, cultural, interpersonal and legal challenges they might encounter in their line of work.

## 3 The situation in Greece today: Mapping the field[1]

The provision of interpreting services in asylum and immigration settings needed to be assessed. Our analysis had three objectives. Firstly, to draw objective conclusions on how public servants in the asylum and immigration context perceive interpreters and their collaboration with them. Secondly, to identify measures that can be taken to enhance language service provision in the asylum context. Lastly, to gather data on the language requirements of different departments. The processed data showed that Arabic, Farsi, Urdu, Dari, Punjabi, Somali, Sorani, Kurmanji, both English and French (as linguae francae) are the languages that are currently in high demand.

In this context, the research team decided to gather and analyze data from three sources. Initially, quantitative data related to asylum seekers in Greek competent authorities were collected and analyzed, which were sought on the official website of the Ministry of Migration and Asylum. The second source also includes quantitative data resulting from the responses to a questionnaire designed and compiled by the research team; the questionnaire was distributed to and answered by employees in Greek public services related to asylum. Finally, the third source

[1] For a comprehensive image of the interpreting needs throughout the Greek public sector see Vlachopoulos (2016) and Kozobolis (2022).

includes qualitative data resulting from interviews conducted by members of the research team with employees of Greek public services related to asylum and immigration proceedings. The combination of data from different sources aimed to triangulate them in order to achieve the extraction of results that could be considered reliable.

The results provide a detailed description of the asylum, refugee and immigration situation in Greece regarding the provision of language services (specifically interpreting) in relevant public services - a description that has taken into account both the developments in asylum and immigration studies (Profanter & Owtram, 2013) and the developments in the legal framing of minority and less spoken languages in Europe (Τσίγκου & Λίβας 2019). Firstly, it is very important that the perception that the provision of language services by trained interpreters is urgent has now emerged among public officials in this field, in order to achieve the optimal outcome during interpreter-mediated meetings. Furthermore, the difficulties and challenges faced by language service providers in their work have become quite understandable.

On the other hand, there is still much ground to be covered. Despite a clear willingness on the part of public service officials to understand the importance of providing professional language services to their users and the difficulties and challenges interpreters face, there is often mistrust towards interpreters, mainly due to their language deficiencies in both the source (the language of the beneficiaries) and the target language (Greek). Mistrust also stems from interpreters' practices and behaviours, especially those associated with ethical violations (e.g. direct conversation with beneficiaries without informing public officials, interpreters adding their personal thoughts and proposals, etc.).

It is evident that a framework must be established to regulate the provision of language services in the public sector, with an initial focus on sectors challenged by the refugee and immigration crises.

## 4 Towards the creation of a register of public service interpreters in Greece

Taking into account the registers and certification systems of interpreters in other countries, as well as the Greek reality, where there is no tradition of certification exams for either translators or interpreters, and drawing on the practices of professional associations in Greece and abroad as to the way they differentiate their members, we propose the creation and implementation of a Greek Register of Public Service Interpreters. This register will comprise multiple tiers. The proposed register aims at guaranteeing minimum quality standards for public service interpreting; it is founded on the following principles: (a) structural simplicity and flexibility, (b) inclusion of different professionals that work as interpreters without having studied interpreting, (c) professionalization of public service interpreting (PSI) and (d) a possibility for ascending through the ranks of the register and reaching the highest category through continuous improvement and lifelong learning. As can be seen in table 1, each category of the register matches specific qualifications and an interpreter will be able to rise to the next level/category after meeting the specific requirements of the said tier. The promotion of interpreters into the next tier requires work experience as well as training credentials. The best way to motivate interpreters to add new qualifications, so as to climb the register ladder, is to associate upper register tiers with higher remuneration. Finally, a gradual implementation of the register is proposed, so that all necessary conditions are met progressively (categories D and A at an initial stage, categories C and B after a transitional stage of 3 years).

| Category | Educational qualifications | Professional experience |
|---|---|---|
| **D** | language proficiency test and short seminar on ethics in PSI; or<br>a university degree in translation, foreign or applied languages with Greek as the mandatory language and short seminar on ethics in PSI; | no prerequisites for proof of work experience |
| **C** | such as Category D and general seminar on public service interpreting (30 ECTS) | at least 40 hours of public service interpreting gained within the context of the Register |
| **B** | such as Category C and specialized seminar on interpreting techniques (30 ECTS) | at least 160 hours of public service interpreting gained within the context of the Register |

| | | |
|---|---|---|
| **A** | an undergraduate or postgraduate degree in public service interpreting and language proficiency test in case of a degree issued in a country other than Greece; or | no prerequisites for proof of work experience |
| | an undergraduate or postgraduate degree in conference interpreting with Greek as the mandatory language and a short seminar on ethics in PSI; or | no prerequisites for proof of work experience |
| | any bachelor's degree, language proficiency test in case of a degree issued in a country other than Greece and a short seminar on ethics in PSI; or | at least 150 days of conference interpreting |
| | such as category B (not at the initial stage) | at least 320 hours of public service interpreting within the framework of the Register and/or 40 days of conference interpreting or combination |

Table 1: The Hellenic Register of Public Service Interpreters

## 4. From grey zone to a win-win situation

The project timeframe is limited to one year. Currently, the tasks of designing language tests, conducting the tests, and training successful candidates remain. The Greek register for Public Service Interpreters will establish the professional identity by providing a tool that supports interpreters in lesser-spoken languages. This will give professional status to individuals currently working in a grey area.

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# Lessons from a Quality Improvement Study on the Technology and Service Needs of a Closed Control Accommodation Center (CCAC) in Northern Greece

Isabel Richards[1], Dora Komninou[2], Janet Ellzey[3]

[1] Cockrell School of Engineering, University of Texas at Austin, 110 Inner Campus Dr.
Austin, TX 78712, United States of America
Email: isabelrichards@utexas.edu
[2] SolidarityNow Thessaloniki, 29A Ptolemaion Str. 54630, Thessaloniki, Greece
Email: tseitanidou@solidaritynow.org
[3] Walker Department of Mechanical Engineering, University of Texas at Austin, 110 Inner Campus Dr.
Austin, TX 78712, United States of America
Email: jellzey@mail.utexas.edu

**Abstract:** In May 2023, a partnership between the NGO SolidarityNow and an interdisciplinary team from the University of Texas at Austin pursued a quality improvement study at a Closed Control Accommodation Center (CCAC) in Northern Greece. The study investigated the quality of the current services meeting the connectivity, community, and transportation needs of the residents. Following the analysis of responses to a paper-based survey distributed to the resident population, focus group discussions with residents further explored their technology and service needs through the collection of qualitative data. This paper outlines how insights gleaned from the qualitative portion of the study changed the authors' understanding of the needs of the community from the initial analysis of the survey. This paper focuses on the analysis of three identified needs: access to the public bus system, reliable Wi-Fi connection, and language interpreters. The qualitative aspect of the study revealed essential aspects of each of these needs that were not identified by the survey. Thus, the analysis of this quality improvement study supports expanding needs analyses to include qualitative as well as quantitative data collection in order to more successfully identify the needs of displaced populations and innovate accordingly.

**Keywords:** Technology Needs; Qualitative Research; Closed Control Accommodation Center; Connectivity; Quality Improvement Study; Displaced Population.

## 1 Introduction

UNHCR reports that 22 percent of the world's refugees, an estimated 6.6 million people, reside in camps (UNHCR, 2021). Although camps often present an opportunity for asylum-seekers to find resources and protection, the inherent nature of camps can also pose logistical obstacles to ensuring quality of life for the residents. The increasingly rapid development of new technologies has enabled the mitigation of some of the difficulties associated with life in refugee camps, but significant barriers still remain.

In its 2020 Connectivity for Refugees: Displaced and Disconnected report, UNHCR discussed the benefits of connectivity amongst displaced populations. Included in these benefits were access to education and livelihood opportunities, protection, increased social capital, and the promotion of mental health (UNHCR, 2020). The ability of displaced persons to connect with people, resources, and communities is often dependent on the technology available to them, which can be limited by legal, financial, and logistical constraints.

At the end of 2022, the Ministry of Migration and Asylum in Greece announced that the ESTIA program would be closing. This program, the latest edition of which launched in October 2021, provided funding for a number of asylum-seekers to reside with their families in 1,683 apartments in 19 Greek cities while waiting for the decision on their legal status as refugees (European Commission, 2022). With the end of the ESTIA prohigram, new challenges arose to provide asylum-seekers now living in accommodation centers with the level of connectivity that had been available to them when they were integrated into cities.

In order to meet the diverse technology needs of the displaced populations they host, accommodation centers consistently confront complex logistical issues, often through site-specific innovation. The aim of the quality improvement study analyzed in this paper was to identify opportunities to more effectively meet the technology and service needs of the resident population of a Closed Control Accommodation Center (CCAC) in Northern Greece. This study took place as part of a University of Texas at Austin (UT Austin) summer class abroad on the technology needs of refugee communities, and it is part of a larger partnership on refugee camp logistics between the UT Austin humanitarian engineering department and Dr. Maria Drakaki at International Hellenic University.

## 2 Methods

### 2.1 Survey

The quality improvement study began with a survey that was implemented on paper between May 4 and May 28, 2023 at the CCAC by the NGO SolidarityNow. Residents of the CCAC were given the survey to take individually, and responses were physically collected by SolidarityNow and digitized for analysis. There were a total of 39 responses to the survey.

The survey consisted of six sections. The first section asked about demographic information of the respondent. The second section asked about the type of cell phone used by the respondent and details about how the respondent used SIM cards. The third section asked the respondent to list the five resources they considered to be most important in the CCAC. The fourth section asked the respondent to rate the importance of various resources in the CCAC on a Likert scale. This section of the survey is shown in Figure 1. The fifth and sixth sections of the survey asked respondents to assess the quality/accessibility of resources in the CCAC and their frequency of resource use, respectively.

**RATING THE IMPORTANCE OF RESOURCES**

| Circle the number that best describes the importance of a resource to you | Not Important at All | A Little Bit Important | Moderately Important | Quite a Bit Important | Extremely Important |
|---|---|---|---|---|---|
| Connectivity<br>These are resources that help you access the internet and phones. | | | | | |
| 1. Wi-Fi/Internet | 1 | 2 | 3 | 4 | 5 |
| 2. Cell Phone with SIM Card | 1 | 2 | 3 | 4 | 5 |
| Community<br>These are resources that help you stay involved with others and your culture. | | | | | |
| 3. Space to Relax | 1 | 2 | 3 | 4 | 5 |
| 4. Space to have Recreational Activities | 1 | 2 | 3 | 4 | 5 |
| 5. Space to Pray | 1 | 2 | 3 | 4 | 5 |
| Location and Transportation<br>Resources related to the location of the camp and transportation from the camp. | | | | | |
| 6. Public Bus Service | 1 | 2 | 3 | 4 | 5 |
| 7. Proximity to Local Stores | 1 | 2 | 3 | 4 | 5 |
| 8. Proximity to Local Employment | 1 | 2 | 3 | 4 | 5 |

**Figure 1.** A screen capture of the fourth section of the survey, which asked residents to rate the importance of various resources in the CCAC on a Likert scale.

### 2.2 Focus Group Discussions

The results of the survey were analyzed, and bar graphs were created to reflect the distribution of responses collected. Findings from the survey were used to craft a set of questions for the focus groups held with residents on May 18, 2023. The list of questions used in the focus group discussions can be found in Figure 2. Focus group participants were sorted into four groups based on language. The focus groups were conducted in Arabic, English, Farsi, and French, with the use of an interpreter for non-English groups. Each group had between 5 and 15 participants, and the discussions were one hour in duration.

1. When you first arrived in camp, what was your biggest need?
2. How have your needs changed since then?
3. Tell us about the most important things you use WIFI for.
4. Tell us about what you need transportation for.
   How has transportation affected your life in camp?
5. What would you use an interpreter for?
6. What do you do for relaxation?
7. What is something you wanted us to ask you about that we didn't?

**Figure 2.** A screen capture of the questions asked during the focus group discussions.

## 3 Results and Discussion

### 3.1 Survey Results

The graphs included in this section display notable findings regarding the technology and service needs of the residents in the CCAC from the paper-based survey and the focus group discussions. In Figure 3 and Figure 4, the darker bars represent male respondents, and the lighter bars on top represent female respondents.

As shown in Figure 3, the survey data shows that the public bus was reported to be an "extremely important" resource by over half of respondents. The emphasis on the importance of the bus shown in the survey data was a point that informed the fourth question (shown in Figure 2) used in the focus group discussions.

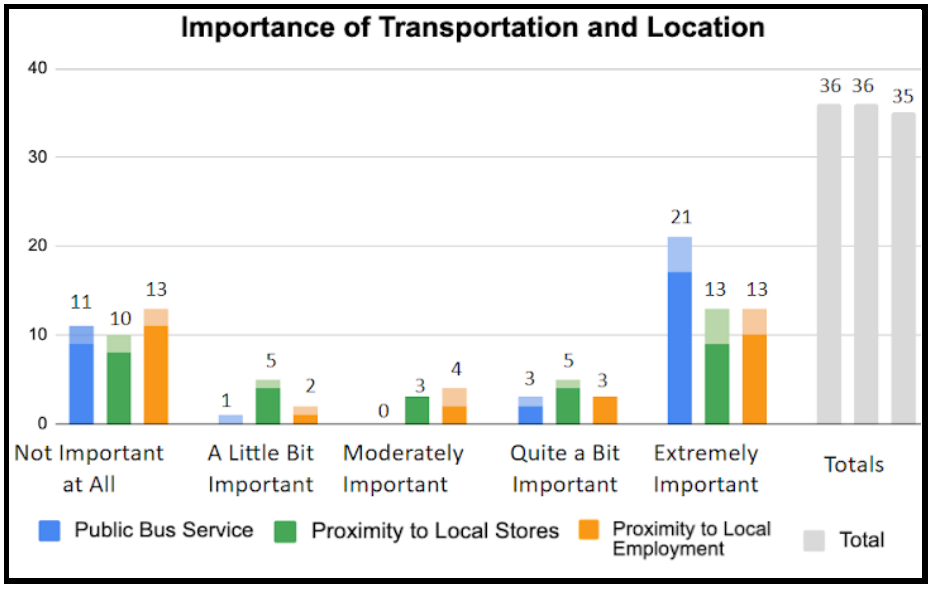


**Figure 3.** A bar graph representing the distribution of responses ranking the importance of the public bus service, proximity to local stores, and proximity to local employment on a Likert scale.

Another conclusion drawn from the survey data is shown in Figure 4, where it is reported that less than one-third of respondents reported that the Wi-Fi in the camp was of "good" or "high" quality/accessibility. It is also important to note that the same number of respondents reported that the Wi-Fi in the camp was of "limited" quality/accessibility or that it was not accessible at all. The third question used in the focus group discussions (shown in Figure 2) aimed to investigate the diversity in responses to this survey question.

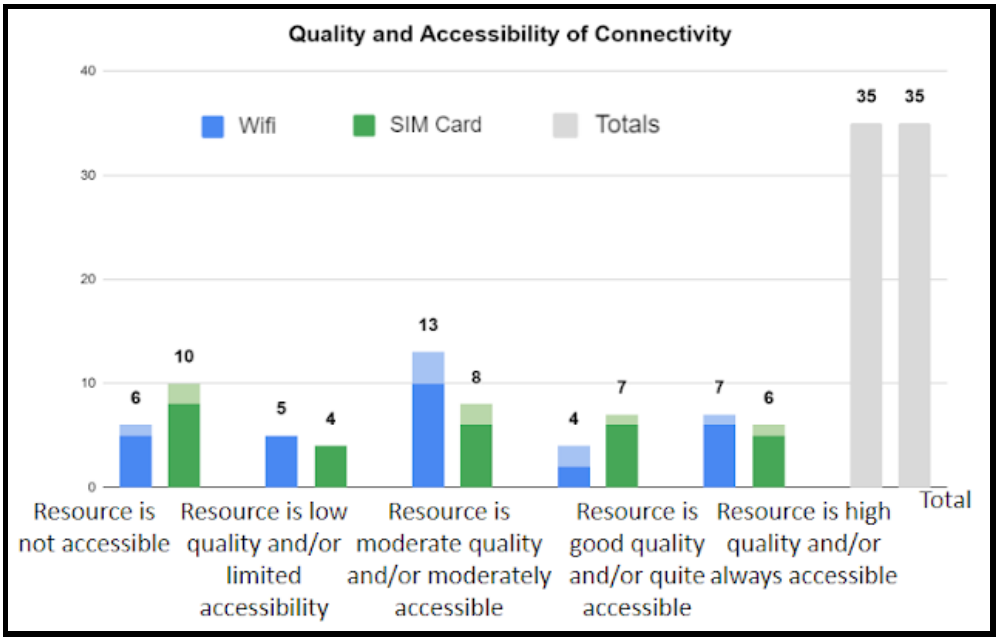


**Figure 4.** A bar graph representing the distribution of responses ranking the quality and accessibility of Wi-Fi and SIM Cards.

Figure 5 underscores the importance of transportation for the residents of the CCAC, as the most frequent response to the question asking participants to list their top 5 most important resources was "transportation." The second most frequent response to this question, as shown in Figure 5, was "food," and the third most frequent response to this question was "interpreters." The fifth question used in the focus group discussions (shown in Figure 2) was designed to allow residents to elaborate on their need for interpreters in the CCAC.

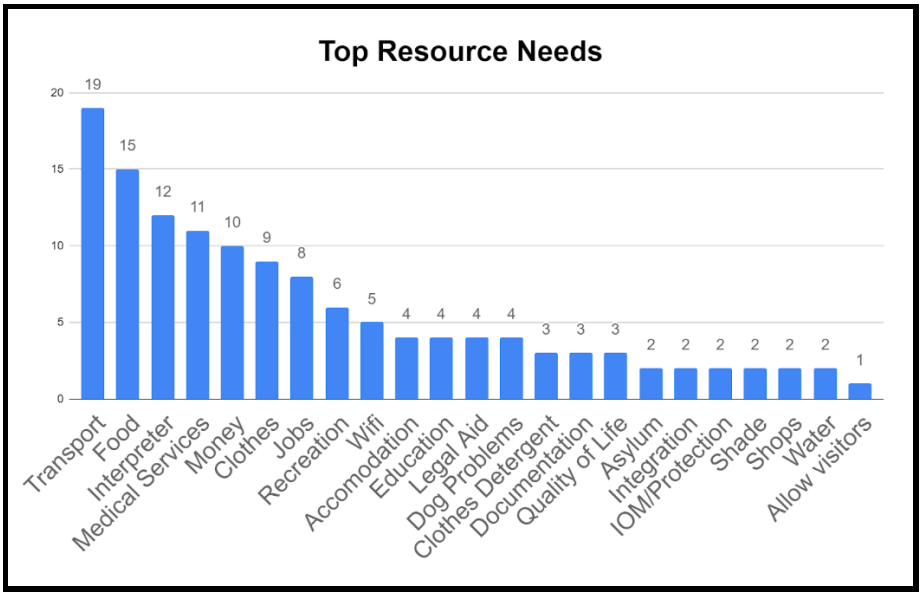


**Figure 5.** A bar graph representing the distribution of responses to the survey question asking respondents to list the 5 resources they considered most important in the CCAC.

### 3.2 Focus Group Discussion Results

In addition to the quantitative data gathered from the paper-based survey, there were a number of quotations from the focus group discussions that expanded the authors' understanding of the three needs analyzed in this paper: access to the public bus system, reliable Wi-Fi connection, and language interpreters. The chart below (Figure 3) displays relevant quotations from the residents regarding these needs.

| Need | Quotation |
|---|---|
| Transportation | "The government is trying to close the camps that are close to cities and take the refugees far away from the cities. And, there were the buses, and they cut the buses. I don't know. Maybe they're planning not for refugees to be able to come to the city. And, being in the camp is kind of like being in the prison. While you have the freedom of movement, you don't have the ability to move. You don't have the transportation and maybe you cannot, you will not be able to afford it. To pay the transportation. And, as my friend here said, it is, you know, one of the most important things… a bird without wings." |
| | "It's very difficult to stay in the camp more than one or two weeks, and even if you go and stay inside the camp for more than two weeks, you are going to be depressed." |
| | "You don't have to pay for the bus when you go to the hospital right? No, no. Only if you want to go just for fun or for food or for anything. You have to pay." |
| | "The people that are staying inside the camp right now… they have depression, and they want to get out. They need to go to the town, for example Thessaloniki. So they can see more things, new people, new buildings. For example, there are no trees inside the camp" |
| Wi-Fi | "Wi-Fi connection is not as strong in all the places in the camp. There are places that it's strong enough. And others it's not. So you have to change, move around. To get the better connection" |
| | "Inside the container, the Wi-Fi malfunctions all the time. So they are getting out of the container so they can have a better signal with the Wi-Fi." |
| Interpreters | "Let's say we have great Wi-Fi and a great translator app. Does the person that we're discussing with, an employee or whoever, accept to use an app to translate and communicate? If something is not very understandable, does he have the patience to go through all this procedure?" |
| | "Example. The container is on fire. Do I have the time to write it? Like, explain what's going on? My wife, my children will all be burned if I have to use technology to translate and communicate what's going on." |

**Figure 6.** A table displaying quotations from focus group participants regarding the need for the public bus system, Wi-Fi, and interpreters.

The survey found that the public bus system was reported to be an "extremely important" resource by over half of respondents. The authors initially defined the need being met by the public bus system as "access to off-site resources such as medical services, diverse nutrition options, language lessons, and jobs." However, the focus group discussions revealed that the need being met by the public bus system was not only access to off-site resources but also the ability to experience different activities, meet different people, and see different places. For the residents, access to the public bus system meant they were able to regain control over a part of their lives. The public bus contributed largely to improving the mental health of residents, and any transportation solution that solely connected residents to off-site resources would have failed to meet another very important need of the community: freedom of movement.

The survey also found that less than one-third of respondents reported that the Wi-Fi in the camp was of "good" or "high" quality/accessibility. From this data, it would be reasonable to consider investing in Wi-Fi with a stronger signal. However, the focus group discussions revealed that residents were mostly having issues with the Wi-Fi not connecting well to devices being used inside the living containers. Further research might be needed to confirm that the material of the living containers is blocking the Wi-Fi signal. If this theory is confirmed, however, a more appropriate solution might be to create an outdoor space for Wi-Fi use.

Finally, the survey found that "interpreters" was the third most frequently identified need by residents. The authors had initially defined this need to be a way to understand and communicate in written and spoken Greek or English without fluency in either language. However, residents in the focus groups discussed how one

important aspect of interpreters is that they act as advocates on their behalf, answering follow-up questions and communicating urgency and meaning more effectively than any app or website. The need was actually an advocate that could understand and communicate their needs. If the authors had suggested using a translator app to meet this need to overcome the language barrier, the real need for an advocate would have gone unmet.

## 4 Conclusion

The initial aim of the quality improvement study that was undertaken at the CCAC in Northern Greece by SolidarityNow and the team from the University of Texas at Austin was to identify areas of improvement in the unmet technology and service needs of the resident population, particularly surrounding connectivity. However, comparison of the authors' understanding of the residents' needs after analysis of the survey to their understanding after analysis of the focus group discussion transcripts provides a number of relevant examples of the importance of qualitative data collection in order to understand the latent technology needs of the CCAC residents. In the case of the three examples of technology and service needs discussed in this paper, there was significant value added by the qualitative portion of the study. The focus group discussions revealed crucial information about why the public bus system and interpreters were important resources to the residents and clarified the existing issue with the W-Fi. Specifically, the qualitative portion of this study changed the authors' perspectives on the importance of the methods by which the residents' needs are met. The authors' engineering backgrounds had not prepared them to assess the social and mental health needs that were met by some solutions and ignored by others. Without the information provided in the focus group discussions, the needs of the residents would not have been identified to their full extent, and attempts to engineer solutions would not have effectively mitigated remaining barriers to resident connectivity.

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# Disaster Management - Multidisciplinary Perspectives

# Field research and natural disasters in Folklore Studies: Issues and considerations

Aikaterini Schoina

PhD Candidate, Department of Philology, School of Philosophy, National and Kapodistrian University of Athens, Greece

katerinasxoina@gmail.com

**Abstract**

A natural disaster due to climate change can be a field of research for the humanities, as it can cause significant changes in the society. What happens after a disaster? What are people's feelings? What will happen to them if something similar happens again? Then fear and uncertainty change the whole structure and function of the community. Floods are the second most common natural disaster after forest fires, and they cause serious effects on the societies that are affected. The Prefecture of Attica in Greece has suffered many disasters from dangerous phenomena in the last twenty years. As an example, the case of the flash floods in Western Attica is used for this research. On the morning of November 15, 2017, the sudden rainfall on Mount Pateras created enormous destruction in the settlements of Mandra and Nea Peramos. The phenomenon was local, and the bulk of the rain fell on the mountain. This is the third-largest flood in Attica, based on the number of dead. The analysis is based on qualitative research, on-site ethnographic research and is theoretically framed with the tools of the Science of Folklore, Anthropology and Ethnography. Narratives from victims who lived through the disaster are used to record their memories, the environmental impact on the areas, as well as their uncertainty about the area's past and future. Finally, special emphasis will be placed on the analysis of the emotions connected to memory.

**Keywords:** Natural Disasters, Climate change, Traumatic Memory, Narratives, Field Research, Orality, Folklore Studies, Emotions

## 1 Introduction

A natural disaster due to the climate crisis can be a field of research for the humanities, as it can cause significant changes in society. The science of Folklore can make a decisive contribution to the research of these changes, with the interdisciplinary contribution of the sciences of Anthropology, Ethnography, and other related sciences. This short article is a small part of some of my first observations, as well as reflections, regarding the conduct of the field research I am carrying out in the Attica region as part of my doctoral thesis entitled "Folkloristic approaches to natural disasters due to the climate change. A case study from Attica (2000-2020). Traumatic memories, narratives and collective representations"[1]. In Greece, as far as the science of Folklore is concerned, although the subject was touched upon for the first time by Nikolaos Politis in his work *Traditions* (*Παραδόσεις*) in 1904 (Indicatively: "Sunken places and towns", "The Weather"), there is no corresponding extensive study on major natural disasters.

My particular interest in natural disasters began with my involvement with the science of Folklore, during my postgraduate studies. Also, my interest in the issue of natural disasters is related to my professional capacity as a journalist. Constantly watching the Greek and international news, on the subject of natural disasters, I realised that

[1] Supervisor: Georgios Kouzas, Assistant Professor of Urban Folklore, Department of Philology - Faculty of Philosophy, NKUA. Advisory Committee: Marianthi Kaplanoglou, Professor of Folklore Studies, Department of Philology - Faculty of Philosophy, NKUA - Vasiliki Chrysanthopoulou, Associate Professor of Folklore Studies, Department of Philology - Faculty of Philosophy, NKUA.

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climate change can substantially change a community, the quality of life, habits, human relationships, the natural environment and create feelings of fear and collective traumatic memories.

The most common way of obtaining primary data is through field research, a scientific tool that aims to collect data and information. Conducting field research is a fundamental way of acquiring knowledge, and more specifically empirical knowledge, with its object at the heart of science which is human beings and their activities. The application of field research must meet two basic conditions: the documentation and defense of the way of collecting the research data, which presupposes that the researcher knows what he is doing, for example that he has the knowledge required to collect primary data, and of course, the data collected do not express or reflect the biases and opinions of the researcher. There are researchers who are collecting answers they want or hope to hear. Of course, it is a fact that every researcher has his own views and beliefs. Therefore, even unwittingly, there can be the corresponding partiality on his part. Of course, the opinion and experiences of the researcher are equally valuable in any field research. The personal characteristics of each researcher play a decisive role in the formation, focus, but also in the overall contribution of the field research.

## 2 Field research and the researcher in the field

I will start with the part of observation through ethnographic walking in the areas where I am conducting the research, mainly in Western Attica and in the field research so far, basically by conducting interviews with people who have experienced catastrophic events, mainly the floods in Mandra and Nea Peramos Attica in 2017, but also earlier or more modern times in the surrounding areas. First, the great difficulty in approaching the subject lies in the contact with the victims, their relatives or people who simply saw such images, without necessarily being hurt themselves (postmemory). Oral testimony is directly linked to memory. So, we cannot analyze testimony without analyzing memory. This fact makes memory present in a large range of studies interwoven with society. The first issue is the contact with the community and how to build relationships of trust with the researcher. For the interview to be successful, it is necessary to create a climate of familiarity and trust between the interviewer and the interviewee. The researcher must always psychologically prepare his narrator and inform him even of the necessity of recording the interview. This process creates anxiety for some narrators, and it is possible to create a negative climate and limit the narrative speech (Kakaboura, 2011: 115 - 116). Unbreakable communication and trust with storytellers must be established. If they feel offended for any reason, the investigation stops there. However, this is a commonplace, I am not referring to something new. However, if they have experienced such a catastrophic event, the issue is that they are not simply sharing a part of their lives, but the feelings of pain and uncertainty, which they are trying to suppress. So that's the issue in a disaster investigation: the feelings they try to forget - or have forgotten - and the researcher rekindles them and brings them to the surface. So far there have been a few cases in my research where people have politely refused to speak to me for this very reason. The questions, of course, despite the difficulty of extracting the data for the research, are never in any way misleading or uncomfortable for the interviewee (Mason, 2011: 104 - 105). In addition, the researcher's goal is to pick up on cues in the conversation and be attuned to the body language of the interviewee and listen carefully with real and not fake interest (Mason, 2011: 89). In this way, the researcher can better understand the researched and see reality as he constructs it (Kyriazi, 2004: 53). In the qualitative methods[2] of analysis, we do not only pay attention to the description of the message, but also to the hidden intentions of the narrator (Lydaki, 2016: 182).

But always, even if they do not accept it themselves, they will try to introduce me to another narrator to speak, because they want their experience to be recorded and they even ask many times specifically to have their truth about the events recorded. That's why if trust is built right from the beginning and real relationships and respect are established with the researcher, victims want to talk in my experience so far. They see it as therapeutic in some cases, perhaps even redemptive "as if they exorcise evil", as one of my narrators has said (see related articles by Carl Lindahl on the therapeutic nature of narrative). The researcher, of course, under no circumstances asks the interviewee to say his point of view and his thoughts "objectively", but listens to him carefully, even if his words do not correspond to the original goal of his research (Lydaki, 2016: 182). In addition, the purposes of the research

[2] The main characteristic of qualitative research, in relation to quantitative research, is that it is based on a smaller number of cases with the aim not of discovering general trends (which necessarily requires many cases), but of forming an overall picture for each case and finding their common elements. Thus, qualitative research, entailed by in-depth analysis, leads to the gathering of detailed data on multiple aspects of the cases under investigation (Kyriazi, 2004: 51 - 52). The term *qualitative interview* usually refers to in-depth interviews, semi-structured or loosely structured, which appear to have an informal style, biographical or narrative approach and interactive data generation (Mason, 2003: 89 - 90).

are always explained in detail to the interviewees, and they are given the necessary guarantee that the interview will not be published in any medium, apart from academic purposes, if they do not wish to do so (Mason, 2011: 105). The same applies to information from third parties during the recording and in cases where the research is carried out in focus groups[3], where their consent for the publication of the personal information they will provide is not a given (Mason, 2003: 127). At the same time, after the end of the research, they will be given full access to the research results (Iosifidis & Spyridakis, 2006: 221).

The researcher, therefore, is called upon in such a condition to distance himself from the facts, although it is not always entirely possible. The issue in such research is that the narrators do not simply share a story of theirs and are not simply called upon to describe an event, to tell a tale, their life story, etc. Even in cases where in other studies, where researchers have been asked to record burial customs and traditions, obituaries, etc. they may not have as much direct contact with human suffering because they are recording an event, even if it is being told to them. However, in the case of a natural disaster, I believe that the handling is completely different. It is not only the event, but also the traumatic memory, the remembrance and how this event is reflected in a second stage collectively within the community.

After all, can the science of Folklore have a relationship in the part of natural disasters? The answer is affirmative. It might be related. A natural disaster not only disrupts society, but also brings about changes in the operation of Cultural Associations (I am referring to the Association of Peramian Cyzikins of Nea Peramos Attica, as evidenced by interviews I have conducted with them), in the realization of cultural events, in human communication, in the economy, in the environment, but also in human relations. This trauma, I would say the "wound" in their soul, follows them, and will follow them. Time freezes and starts from the beginning. It is like an interval in the sequence and cycle of time that simply ceases to exist. Society straightens itself out (or not, depending on its vulnerability and adaptability) and starts over, or better continues on new terms. Moreover, the "traumas" in the physical space remain almost unchanged. Mud marks on shops, streams that were covered but reappeared, since water has a memory, shops that never reopened, Cultural Associations that stopped working. However, there is a bright side. The feelings of fear and terror are replaced by the necessity of survival and the power of life. But the most important thing is the cohesion of the community, where in situations of emergency it finally comes together and forgets its differences. Such examples and references are present in the narratives I have collected so far, although the narrators are concerned, as after the disaster they say people forget this unity until the next crisis comes to the community. Of course, somewhere here I must emphasize that my bibliographic and scientific analysis would not have been sufficient without the tools of Anthropology and Ethnography. I undertake an interdisciplinary approach, as beyond the theoretical analysis from studies of Folklore, the analysis of the material I collect also requires approaches that refer to trauma, memory, and emotions, as they emerge through the narratives. For the same reason, I also use a theoretical framework from the STEM sciences[4], from the fields of Geology and Meteorology and other related sciences that touch on the issues I am examining, as such an analysis would at least be considered insufficient, since I use terms from these fields. Finally, in terms of finding appropriate data from secondary sources it is not always possible. That is, there are many cases where the needs of a research can be met only by collecting primary data, especially in a topic that may not have a corresponding literature. Thus, despite the convenience offered using secondary data, a researcher will at some point, in some of his studies, be obliged to collect the data he needs himself.

The second issue is the anthropo-geography of the place. In the first phase, my plan was to deal with the floods in Mandra and Nea Peramos in Western Attica in 2017 and the deadly fire in Mati in Eastern Attica in 2018. Now having expanded the field research[5] further in Western Attica, as I have included areas such as Megara, Kineta and Magoula, I am deeply concerned about the field of time and space. Anna Lydaki typically states that the original research plan can be reversed and changed. The different elements are not considered a mistake since this would lead to entrapment of research and not to new knowledge (2016: 182 - 183). The differences between the

[3] "Participant observation is the basic method for qualitative research. At the same time, however, in addition to the researcher's observations, the production of data is also required through in-depth interviews, individual and in focus groups" (Varvounis & Sergis, 2012: 449).

[4] At the same time, from November 2022, I am also a postgraduate student at the School of Sciences, Department of Geology and Geoenvironment of the National and Kapodistrian University of Athens in the Program "Environmental, Disaster and Crisis Management Strategies", in order to fill the bibliographic gap I have and to proceed to write an even more in-depth research.

[5] Field research will not be limited to a specific field but will be multi-sited, following the example of internationally followed practices of multi-sited ethnography.

communities in Eastern and Western Attica, even in how they perceive the pain from the disaster - if we make a first comparative approach - is completely different and has to do with many factors, such as the location of the areas, the living conditions, the economy, the distance from the center of Athens, the same people regarding their views, their culture, etc. Of course, at the same time, I am making some contacts with the community in Mati for future research, even if it does not fit into my thesis. Therefore, research even on such a scale may have to be strictly limited, as in this way accounts are lost and aspects of the events unknown, which will not possibly come to light by gathering additional material.

## 3 Discussion and reflective thoughts

Indeed, there are areas within Attica and all over Greece that are vulnerable to floods, fires, and other natural phenomena. This is not related only to climate change, nor of course to any "disaster" we invoke, and which unfortunately constitutes a fatalistic acceptance of our inability to operate in an organized and planned manner against natural phenomena that existed, exist and will exist. While scientists cannot predict the exact rate of increase in these phenomena due to climate change, the prediction of more extreme weather in the future will almost certainly lead to an upward trend in these disasters in the coming decades.

Reflectively, therefore, and not conclusively, since at this stage of the research there can be no conclusive or absolute results, I could only write this with certainty: the field of research on natural disasters is wide with many ramifications. I did not attempt an extensive bibliographical review or approach, as my aim in this article - perhaps not so scientific - was more to state my point of view and my opinion through my so far little experience in the field. In the future I hope to have more results and to list more detailed theories and observations.

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# Citizens' Social Media Engagement in Times of Natural Disasters: Evidence from Greece

Amalia Triantafillidou[1], Prodromos Yannas[2]

[1] Department of Communication and Digital Media, University of Western Macedonia, Kastoria, Fourka Area, PO Box, 30, 52100, Greece
Email: atriantafylidou@uowm.gr
[2] Department of Business Administration, University of West Attica, Athens, Egaleo, 122 44, Athens, Greece
Email: prodyannas@uniwa.gr

**Abstract.** The aim of the present study is to examine how citizens in Greece engage in social media disaster communication during times of natural disasters with emphasis on Facebook. Moreover, through the lens of the social media engagement approach this study proposes a typology of users' disaster-related social media activities. Towards this end, an online quantitative survey was conducted through a self-administered questionnaire using the snowballing sampling method. In total, 1574 citizens responded to the questionnaire. Results indicate that citizens in Greece exhibited low levels of engagement in disaster related communication on Facebook. During times of natural disasters participants seem to perform mainly passive tasks such as receiving information about the event and reading the news from media sources and journalists. More active social media tasks such as creating disaster-related content were observed to an extremely low extent. Through an exploratory factor analysis, three main engagement forms were derived namely: consuming, sharing, and creating. Consuming refers to passive activities such as searching for information and reading posts of others about the disaster. Sharing is about forwarding information produced by other users while creating content reflects more active forms of social media engagement during disasters and is related to activities such as expressing emotions, proposing solutions, announcing, organizing relief efforts, praying for victims, discussing about responsibility, praising, etc. Results of the present study will be of value to disaster managers wishing to take advantage of social media.

**Keywords:** social media engagement; natural disasters; users; citizens; Greece.

## 1 Introduction

Social media can be regarded as important communication tools that can be used by citizens as well as authorities in times of emergencies and disasters. During disasters social media can provide to citizens relevant information in timely manner about the event by official and non-official channels but can also expose citizens to misinformation and false rumors (Simon et al., 2015). Due to the high levels of uncertainty that crises and disasters produce, oftentimes citizens turn to social media to seek as well as provide and spread information (Zander et al., 2022) regarding the event thus can act as "sensors" that identify information as well as journalists that analyze and report 'news' about the crisis (Palen and Hughes, 2018). Despite the various uses of social media by citizens, their actions on social media during emergencies might result in several advantages as well as challenges to emergency authorities (Albris, 2018). For example, emergency services can turn to user-generated content to formulate a clear picture of the crisis, the public sentiment, and public's knowledge about the disaster. This content can provide added value to the decision-making of authorities (Jurgens and Helsloot, 2018). However, citizens can use social media in a chaotic way by spreading false information or organizing rescue initiatives that might impede the work of emergency services (Kaufhold et al., 2019). Thus, it can be argued that understanding how citizens react and behave on social media (Reuter et al., 2019) might yield fruitful insights to disaster managers who try to communicate in an accurate and effective way to related publics as well as harness the user-generated crisis information on social media.

However, until now most research has tried to shed light on the ways authorities are utilizing social media to communicate with relevant public in all phases of a disaster cycle while fewer studies have examined how publics that evolve around a crisis or disaster use social media (Gasco et al., 2017) and engage in participatory behaviors (Guo et al., 2021). In addition, most studies on public's use of social media examine the content of social media posts that are collected about a specific type of crisis or disaster and less is known about users' self-reported social media activities when they encounter emergencies and disasters (e.g., Zander et al., 2022).

The present study contributes to the existing literature on social media engagement and disaster communication and sheds light on how citizens use social media during disasters. Specifically, the aim of the present study is three-fold. First, to identify the most frequent social media behaviors of users during natural disasters. Second to decipher the main dimensions that comprise users' social media engagement when they face emergencies and natural disasters. Third, to test whether social media usage frequency and their perceived reliability affects user social media engagement.

## 2 Related Work

The present study builds on the field of "crisis informatics" that deals with citizens use of communication technologies to react to disasters and to cope with the uncertainty inherited in such events (Palen and Anderson, 2016). Prior research has shown that users enact various roles in social media during times of disasters. According to Fraustino et al. (2017) three types of social media publics emerge during disasters: influential social media creators who engage in online discussions about the event and have more knowledge about the disaster that other publics; followers who receive information from influential creators and social media inactives that do not have social media accounts but are receivers of offline word-of-mouth communication by social media followers and creators. Regarding the content produced, Reuter et al. (2013) found that social media users can act as helpers that coordinate helping activities such as donations, rescue efforts, first aid and supplies provision, and psychological support. Moreover, social media users can become 'reporters' by analyzing, synthesizing, and providing information. Retweeters and repeaters are another type of users that share information and posts produced by others and readers are regarded as the most passive form of social media users that mainly consume disaster related content.

Work on user generated content during natural disasters has revealed several functions that social media serve in emergencies. As Fraustino et al. (2017) note citizens' social media activities span from passive behaviors such as reading, searching, and filtering disaster related information to more active forms of social media usage such as sharing disaster content, organizing volunteer activities, responding to urgent needs, providing emotional support to others as well as expressing opinions and engaging in discussions with other users.

Qu et al. (2011) analyzed the social media posts of citizens in the 2010 Yusun earthquake and found that users tend to publish informational messages about disaster updates and relief efforts; action-related messages that requested help, and coordinated relief efforts and proposed relief actions; opinion-related messages that criticized the government response, evaluated and commented on the situation; and emotion-related messages through which users expressed their personal feelings and provided emotional and social support to the affected citizens. Imran et al. (2013) and Li et al. (2018) argued that during natural disasters such as the 2011 Joplin tornado and the Yiliang earthquake users on social media post mainly informational messages, caution and advice posts, messages about the casualties and extent of damages, as well as messages seeking for help, donations, etc.

Takahashi et al. (2015) examining citizens social media behavior during the Haiyan Typhoon classified users' posts into the following categories: reporting posts were users reported their personal information or shared information from other sources such as news outlets, requesting help, coordinating relief efforts, providing mental counseling and health support, criticizing the government, expressing well wishes and memorializing victims, discussing causes, and reconnecting community members. Al-Saggaf and Simmons (2015) analyzed through a qualitative thematic analysis users social media activity during two natural disasters in Saudi Arabia. Based on the results users through their posts tried to help users communicate the extent of the crisis, engage in discussions about the causes of the disaster, assign responsibility, criticize the government, request help, express emotion and sadness. Albris (2018) investigated the posts published by Facebook groups during the 2013 floods in Dresden, Germany. These posts aimed to enhance the profile's network, to report on the situation, to offer help, to request help as well as to bolster the morale of volunteers, authorities, emergency personnel.

In a recent literature review, Li et al. (2021) social media disasters posts by citizens were classified in two broad categories: (a) situational information messages and (b) non-situational messages. Situational messages were further divided into social-support related posts through which citizens published warnings, advice, calls for help and donations; and non-social support messages that included more disaster-related information about damages. Non-social messages also contained and personal comments about the event. In addition, non-situational posts were messages that were of interest only to the sender.

Based on the preceding analysis it can be argued that most of the studies on disaster-related communication on social media by citizens analyze the content of social media posts for specific types of disasters and do not take into account the perceptions and importance that citizens assign to each type of post. Moreover, the proposed typologies until now do not classify messages based on the intensity of users' engagement. Towards this end, the present study will shed light on the (a) importance assigned by social media users to several types of social media posts that are published during natural disasters and (b) classify users' social media actions based on the intensity of their engagement with disaster related communication. Social media engagement activities can span along a spectrum from passive to active based on the commitment of users (Molina et al., 2023). Passive forms of engagement are related to consuming activities (searching for and reading posts) while more active forms of engagement are sharing (forwarding information) and creating content (expressing opinion, organizing relief activities). Another objective of the study is to test whether social media usage frequency and perceived social media reliability influences the different forms of social media engagement with disaster communication.

## 3 Methodology

To achieve the study's objectives a quantitative online survey was conducted from November 2019 until July 2020. The initial "seed" sampling units comprised of students of a Communication Department at a University in a northwestern city in Greece. The seed students were asked (in class) to forward the online questionnaire to at least 20 Facebook peers, in exchange for extra credit. To ensure that the students had done as asked (i.e., to receive the extra credit), in the online questionnaire, their peers were asked to note the registry number of the student by whom they had been asked to complete the survey. Only if a student registry number appeared in 20 questionnaires would the student receive the extra credit. In total, 1574 questionnaires were completed only with no missing values. The questionnaire was in Greek and was developed in Google Forms.

The questionnaire was comprised of two main sections. The first section contained 28 questions that were derived from an extended literature review of studies related to social media posts of users in natural disasters. Specifically, a group of questions asked the frequency users engaged in searching for information about the crisis event, government response, media reports, instructions on how to handle the crisis, emergency spots and locations (e.g., evacuation shelters, hospitals), relief initiatives, personal stories and testimonials, lost people and victims. Another group of questions collected information about sharing-related activities of users such as sharing information about the disaster event, relief initiatives, missing people and victims, calls for help, guidelines of authorities, critique of the government and response of authorities. In addition, a set of questions asked participants to rate how frequently during a natural disaster did they engage in activities such as expressing negative emotions about a disaster, describing their personal experience, criticizing the government, proposing solutions for future crisis avoidance, suggesting solutions for quick recovery, offering instructions and personal advice, offering support to victims, discussing about the crisis responsibility, praying for victims, praising rescuers, firefighters, volunteers, organizing relief initiatives, report about their safety, offering psychological support, and requesting help. The questionnaire also included a question about the usage frequency of Facebook in general. All the above questions were answered on five-point likert-scales ranging from 1: never to 5: very frequent. Moreover, respondents rated their perceptions about the reliability of Facebook as a communication channel during natural disasters through a five-point scale ranging from (1) strongly disagree to (5) strongly agree. The second section of the questionnaire included questions about the gender and age of the participants.

## 4 Results

The sample consisted of 42.7% males and 57.3% females. 45.4% of participants were aged between 18 to 25 years old; 18.6% between 26 to 35 years old; 18.8% between 36 to 45 years old; 13.3% between 46 to 55 years old; and only 3.9% were above 56 years old.

To examine the dimensionality of users' social media engagement with disaster communication an exploratory factor analysis was performed using principal components and varimax rotation via SPSS 21.0. The 28 questions were initially factor analyzed. However, three items were dropped from further analysis (e.g., request for help, receive information about missing people, share criticism) due to high cross loading between two factors. The remaining 25 questions were again factor analyzed. The analysis revealed three factors with eigenvalues greater than 1.0 that explained the 67.31% of the variance. Moreover, all items had factor loadings that were above 0.50 and the three factors exhibited high internal reliability as Cronbach's alpha values exceeded the 0.70 threshold. Table 1 shows the factor loadings and the descriptive statistics of each item.

**Table 1.** Results of factor analysis

| Factor/Items | Factor Loadings | Mean Scores (Standard Deviation) |
|---|---|---|
| *Consuming (Cronbach's alpha: 0.907, 19.54% of variance)* | | |
| Receive information about the authorities' response | 0.777 | 2.44 (1.10) |
| Receive information about the disaster event | 0.775 | 2.76 (1.08) |
| Receive information about the news and media reports | 0.757 | 2.72 (1.11) |
| Learn about emergency spots and locations (e.g., hospitals) | 0.747 | 2.71 (1.12) |
| Receive information about instructions on how to respond | 0.735 | 2.39 (1.07) |
| Receive information on how to help | 0.724 | 2.65 (1.06) |
| Read personal stories and experiences from affected citizens | 0.682 | 2.63 (1.11) |
| *Sharing (Cronbach's alpha: 0.931, 17.48% of variance)* | | |
| Share support and relief initiatives | 0.827 | 2.47 (1.15) |
| Share calls for help | 0.793 | 2.41 (1.15) |
| Share information about missing people | 0.768 | 2.58 (1.24) |
| Share information and instructions of authorities | 0.766 | 2.41 (1.18) |
| Share information about the disaster event | 0.724 | 2.31 (1.14) |
| *Creating Content (Cronbach's alpha:0.952, 30.29% of variance)* | | |
| Express negative emotions (e.g., worry) | 0.764 | 2.11 (1.08) |
| Describe personal experiences about the disaster | 0.758 | 1.85 (0.98) |
| Propose solutions for future crises and disasters | 0.747 | 2.06 (1.14) |
| Criticize authorities | 0.742 | 1.94 (1.02) |
| Suggest solutions for recovery | 0.736 | 2.05 (1.10) |
| Offer instructions and personal advice | 0.724 | 2.01 (1.02) |
| Offer support to victims | 0.714 | 2.31 (1.14) |
| Pray for victims | 0.691 | 2.12 (1.15) |
| Discuss about responsibility | 0.690 | 1.99 (0.98) |
| Praise rescuers, firefighters, volunteers, etc | 0.685 | 2.31 (1.13) |
| Organize relief initiatives | 0.681 | 2.12 (1.10) |
| Report their safety | 0.653 | 2.08 (1.16) |
| Offer psychological and mental health support | 0.636 | 2.11 (1.09) |

Based on the rotated factor matrix, the first factor was named "consuming" and included seven items that were related to passive forms of social media engagement such as searching for information and reading posts of others about the disaster. The second factor was named "sharing" and was comprised of five items. This factor represented moderate levels of user engagement and included items that were about sharing posts and forwarding information produced by other users. The third item was labeled "creating content" and contained thirteen items that referred to activities such as expressing emotions, proposing solutions, announcing and organizing relief efforts, praying for victims, discussing about responsibility, praising, etc. "Creating content" reflected more active forms of users' disaster-related social media engagement.

Looking at the descriptive statistics of the items it should be noted that respondents do not engage to a high extent in disaster related communication on social media. In fact, we found low levels of engagement with social media during times of disaster and emergencies. Of the 25 social media activities, participants indicated that they mainly utilize social media for passive forms of engagement (consuming activities) such as to learn about the event, reports from media sources, emergency locations, information on how to help, experiences of others, missing people, and government's response. Moreover, they engage in sharing activities such as forwarding

information about missing people, instructions of authorities, and calls for help. To a much lesser extent, respondents reported that they engage in active form of disaster communication.

Next three summative scales were developed for each factor by adding the items of each factor and dividing them with the number of items. Then, we calculated the Pearson's r correlation coefficient to examine whether each summative scale was correlated with Facebook usage frequency and Facebook's perceived reliability. Results indicate that Facebook usage frequency is significantly ($p<0.05$) and positively correlated with consuming ($r=0.224$, $sig=0.000$), sharing ($r=0.144$, $sig=0.000$), and creating ($r=0.167$, $sig=0.000$) activities on social media during disasters. In a similar vein, Facebook's perceived reliability was significantly ($p<0.05$) and positively related to consuming ($r=0.347$, $sig=0.000$), sharing ($r=0.173$, $sig=0.000$), and creating ($r=0.241$, $sig=0.000$) forms of disaster-related social media engagement. Based on the findings consuming activities are influenced the most by Facebook usage frequency and reliability perceptions compared to the other two dimensions (creating and sharing).

## 5 Conclusions

The present study examines how citizens in Greece utilize social media and specifically Facebook during times of natural disasters. Results indicate that respondents exhibited low levels of engagement in disaster related communication on Facebook. During times of emergencies participants seem to perform mainly consuming tasks such as receiving information about the event and reading the news from media sources and journalists. More active forms of engagement such as creating disaster related content were observed to an extremely low extent. Another important contribution of the present study is that it develops a unique typology of users' disaster-related social media activities through the lens of social media engagement approach. The typology classifies social media activities into three dimensions, namely: consuming, sharing, and creating. Each dimension represents different forms of users' engagement with disaster-related information on Facebook. In addition, the present study shed light on the antecedents of the three derived disaster-related social media engagement forms and found that respondents' Facebook usage frequency and Facebook's perceived reliability were positively correlated with all three engagement forms.

Findings of the present study could be of value to disaster managers wishing to harness the power of social media and communicate effectively with citizens during natural disasters and emergencies based on their needs. Future research could validate the dimensionality of the proposed typology based on another sample as well as test other antecedents of users' social media engagement with disaster-related information.

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# Are the September 2023 floods in Thessaly the Greek equivalent of Katrina? A preliminary, comparative analysis.

Dr Eleni Kotsira[1]

[1] Senior Social Researcher & Designated Safeguarding Lead, Alma Economics, 43 Tanner Street, SE1 3PL, London, UK
Email: helena.kotsira@gmail.com

**Abstract.** This paper identifies and discusses a list of early drawn similarities between two otherwise different disasters, namely the flooding of the valley of Thessaly, in Greece, following Mediterranean storm Daniel in September 2023 and the landfall of Hurricane Katrina in New Orleans in August 2005. I argue that while the two hazards are not comparable, the reasons why the two locations flooded are. Likewise, similarities can be found in the ways the people affected experienced these two disasters, which were primarily driven by socioeconomic and not natural factors. Setting off from the position that, given the global attention and amount of scholarly work on disaster management that followed Katrina, the wrongdoings of 2005 should have been avoided 18 years later, and further motivated by the long-lasting impact the floods in Thessaly are expected to have both for their survivors as well as the Greek state more broadly as the climate crisis deepens, this comparative analysis is provided so that any future national disaster risk management plan does, at the very least, make use of lessons already learnt from previous disasters.

**Keywords:** floods; Thessaly; New Orleans; Katrina; disaster preparedness; disaster management; internal displacement.

## Introduction

The flooding of the valley of Thessaly in early September 2023[1], with Greek media broadcasting images of buildings submerged up to their tiles in floodwaters, people finding shelter on rooftops and awaiting to be rescued by boats or helicopters, and stagnant waters covering even the national highway, brought to mind similar images also broadcasted by Greek media 18 years ago, at that time coming from the Katrina hit New Orleans. As more information gradually becomes available about the reasons that led to the flood in Thessaly as well as the (lack of) response to the risk of flooding, the similarities between these two very different disasters increase.

The aftermath of Katrina, with the Hurricane acknowledged as 'the most destructive natural disaster in American history' (Committee on Homeland Security and Governmental Affairs, 2006, p. 2), mobilised such an amount of scholarly work and disaster response reforms (such as the Post-Katrina Emergency Reform Act of Oct. 4, 2006 (FEMA, 2021)), that a reasonable expectation would have been that the wrongdoings which led to the deadly flood of New Orleans in 2005 would have turned into lessons learnt for preparedness actions of global importance. As it appears though that this was not the case for Thessaly, this paper attempts a preliminary[2], comparative analysis of disaster preparedness and early response between 2005 New Orleans and

1 The Region of Thessaly flooded twice in September 2023, first in the week of 4 September 2023 and then the week of 25 September 2023, both times after being hit by storms and both times with destructive consequences. This paper was written in response to the first flood and before the second occurred, therefore it only covers the events of the week of 4 September 2023 and their aftermath. A complete timeline and assessment of that first flood is provided by the Copernicus Emergency Management Service (2023).

2023 Thessaly, focusing on the wrongdoings that were – much unnecessarily and tragically – repeated 18 years later at the other side of the Atlantic.

## Hit by different hazards, yet flooding for similar reasons

While Katrina was a Category 5 Atlantic Hurricane when it made landfall in New Orleans on Monday, 29 August 2005, and the floods in Thessaly were triggered by Mediterranean storm Daniel[3], and thus the intensity of these two different hazards cannot be compared, the reasons that led to the flooding of both New Orleans and Thessaly can. Three of these reasons, as things stand at the moment of writing, are juxtaposed below, without the following list being exhaustive.

### Failing engineered water-control systems and collapsing levees

Both locations flooded not strictly as a result of a natural hazard, but because the local engineered water-control systems proved detrimental for, or simply incompatible with, the surrounding environment when put under severe force of water (Lemann, 2020; News247gr, 2023). Characteristically, during both disasters levees were reported as collapsing one after the other. However, areas across New Orleans as well as across Thessaly were differently impacted by the broken levees. The French Quarter, the highly prosperous neighbourhood and tourist landmark of New Orleans, saw much less destruction due to, in contrast to the majority of other areas in the city, being located above water level and having been built along a natural levee (Landphair, 2007). This alludes to the socioeconomic connotations of Katrina's impact, with the city's less privileged populations already living in 'flood-prone backswamps' (ibid, p. 839). In the case of Thessaly, it has so far been reported that levees were intentionally broken amidst the water rise from surrounding rivers so that areas at immediate risk would be protected from flooding; it turns out that this may have happened at the expense of other areas (News247gr, 2023). It also appears, with greater clarity and more data available, that levees were not maintained and assessed for their effectiveness as they should have, with the required, EU-standardised revisions of national river basin management plans as well as flood risk management plans pending in Greece since 2019 (European Commission, 2023; Rigopoulos, 2023).

### Disregarding weather history and prediction models

Floods are no stranger to the valley of Thessaly, with several of its areas having been destructively flooded before, for example in the passing of the medicane Ianos in 2020 (Kotsira, 2021), or in a deluge that had hit the valley in 1994 (Zafeiropoulos, 2023). Both central and local government had at their disposal meteorological predictive models about the expected magnitude of storm Daniel in the region on Thessaly, but neither this information nor the region's proneness to flooding were acted upon, and no preparedness was planned (To Vima – Podcasts, 2023). Ironically, such were also some of the key factors that had led to Katrina's disastrous impact, as it was concluded by the Committee on Homeland Security and Governmental Affairs (2006, p. 585) in their special report:

> *Four overarching factors contributed to the failures of Hurricane Katrina:*
>
> *(i) long-term warnings went unheeded and government officials neglected their duties to prepare for a forewarned catastrophe;*
>
> *(ii) government officials took insufficient actions or made poor decisions in the days immediately before and after landfall;*

2 While there is a breadth of resources in the bibliography analysing Katrina as a natural as well as socioeconomic disaster, given the proximity of the floods in Thessaly, the majority of information available at the moment for the Greek case come from the media or are findings of investigative journalism.

3 Note that Daniel eventually developed into a 'medicane', but that was only before making landfall in Libya (Earth Observatory – NASA, 2023), thus after passing over Greece.

*(iii) systems on which officials relied to support their response efforts failed, and*

*(iv) government officials at all levels failed to provide effective leadership.*

**Creating, or deepening, vulnerability with unequal evacuations**

The lack of preparedness for storm Daniel mentioned above was exacerbated by delayed or even faulty evacuation alerts sent to residents of the valley surrounding the city of Karditsa, in Thessaly, towns and villages of which flash flooded in the early morning hours of 7 September 2023 (To Vima – Podcasts, 2023). It is telling that while some of those locations had their buildings sunk in floodwaters within 30 minutes, evacuation alerts were sent three hours later (News247gr, 2023). Additionally, while the population requested to evacuate in the valley around Karditsa mainly consisted of elderly people with no means of escape, there was no provision for public means of transport that could facilitate the evacuation (To Vima – Podcasts, 2023). This further intensifies the socioeconomic aspect of the disaster, just like it had happened during Katrina.

The special report on Hurricane Katrina had concluded that while the City of New Orleans was responsible for its citizens evacuating and furthermore 'had language in its plan stating the city's intent to assist those who needed transportation for pre-storm evacuation', nonetheless 'had no actual plan provisions to implement that intent' (Committee on Homeland Security and Governmental Affairs, 2006, p. 585). Katrina made landfall with an estimated number of the city's residents between 100,000 (ibid, p. 588) and 120,000 (Oliver-Smith, 2009, p. 23) not owning a car and not being able to evacuate. Anthropologist Anthony Oliver-Smith (2009, p. 13) discusses the example of residents' inability to evacuate from New Orleans as one of those aspects that can place people in a vulnerable position and thus 'exacerbate the impact of a hazard'. Vulnerability can be traced in 'how social systems generate the conditions that place different kinds of people, often differentiated along axes of class, race, ethnicity, gender, or age, at different levels of risk from the same hazard and suffering from the same event' (ibid, p. 14). Vulnerability can thus lie in a multitude of aspects concerning one's life, including living in flood-prone areas as mentioned earlier, but evacuations during a disaster stand out as perhaps the most evident placement of people in immediate need within a vulnerable context – and constitute a recurring deficiency, or simple neglect, in disaster management.

## Divine excuses for human-driven disasters

Shifting from disaster preparedness to early response, it is currently a surprise seeing the term 'act of god' (in Greek *theominía*) making its way back to Greek public discourse and being repeatedly used to describe the September 2023 floods in Thessaly. While the term used to be undoubtedly popular in the Greek society, in the recent years its use had decreased as the discourse about climate change and the climate crisis had facilitated its replacement with scientific or technical terms.

It should be noted that the use of term 'act of god' should not be seen as implying religiosity. When I was conducting research on the deluge that in September 2017 hit and destructively flooded Samothraki, a small and remote island in NE Greece, the term 'act of god' was the one used the most by the people who had endured the disaster, but research findings suggested that the term was mobilised to emphasise the danger and long-lasting impact of their experience (Kotsira, 2020). Other research also infers similar findings, suggesting that where people attribute the causes of a disaster to a supposed deity, the motive behind this choice is usually for those affected to regain a sense of control and minimise their anxiety in the midst of an uncertain situation by attributing purpose and meaning to the events that have occurred (Stephens *et al.*, 2012).

Returning to the use of 'act of god' to describe extreme weather phenomena in a time of human-induced climate change can be problematic though because the term is essentially an attempt to revoke human liability. The following two examples from the field of Law are particularly interesting given the current degree of post-flood pollution across Thessaly and while waters in many areas remain stagnant. According to Casey Kaplan (2007) describing Hurricane Katrina as an 'act of god' could serve for granting lack of liability for the environmental pollution caused due to oil spills from refineries or tank farms while the Hurricane lasted. The term is improper for the discussion of liability because '[w]hen God came to Noah and told him a great flood

would come and cover the earth, Noah had forewarning. The storm was anticipated' (ibid, p. 181). Anticipated was also Hurricane Katrina and its potential damage given the weather forecasts and the existing vulnerabilities of the Gulf Coast (ibid, p. 156). Therefore Kaplan (ibid, p. 181) concludes that 'if Noah had been an oil producer, he would have been expected to prepare for the impending doom, so as not to damage the environment'. Along the same lines, Myanna Dellinger (2016, p. 1617) suggests that in the face of anthropogenic climate change attributing severe weather events to '"superior forces" or "God" to which we now know that we – mankind – have contributed to a very large extent' is close to irrational, not to mention costly. For parties to no longer be able to avoid liability at court on the grounds of – again – an 'act of god', she suggests that potential climate risks and a series of measures responding to them should constitute mandatory clauses in contracts.

## Conclusion: the necessity of forward planning

The reasons why such obvious and widely reported wrongdoings in managing Hurricane Katrina had to be repeated 18 years later in Thessaly require meticulous research and detailed scrutiny to be identified and analysed – this goes beyond the present time and the objectives of this paper. There is no doubt that the first priority should be that a recovery plan is devised and implemented in the valley, which of course will not be short of challenges or facing further repercussions of unpreparedness; people's physical and mental health, financial insecurity and property loss, business continuity for administrative and professional services, especially where non-digitised archives have been destroyed or equipment lost, and the colossal work of restoring public infrastructure and road networks, to mention only a few.

Yet, the impact of the floods in Thessaly has already shown its teeth, with people reportedly already abandoning their places of residence and seeking to permanently relocate. Of course, there have been in the past internal displacements in the country; for example, 67,000 internal displacements had been recorded during 2021 as a result of the wildfires and subsequent flash floods on the island of Evia as well as the high magnitude earthquakes in Larissa, Thessaly, and the island of Crete, but these appeared to be temporary, with the total number of internally displaced people (IDPs) at the end of the year dropping to 1,600 (IDMC, 2022). However, considering the extent of the disaster on the occasion discussed in this paper and the numbers of the population it affected – the total population of the Region of Thessaly according to the 2021 census is 688,255 people – it is very likely that the country will see its first internal climate migration. A well-informed and easily applicable national disaster risk management plan is then a vital necessity for Greece, especially as it is solid scientific fact that extreme weather will sooner or later become the norm in the country. With reference to the latter, it suffices to note that the Mediterranean Basin is recognised as 'an example of a region with high vulnerability' (IPCC, 2018, p. 200) to climate change and its associated hazards, with drought in particular being seen as an imminent threat due to the increase of the Earth's average temperature between 1.5°C and 2°C in the near future (ibid).

The present comparative analysis is then provided with the hope that any future national disaster risk management plan will, at the very least, make use of lessons already learnt from previous disasters.

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# Disaster Management - Multidisciplinary Perspectives

# Extreme and devastating weather events and related fatalities in Greece

Michalis Sioutas[1,2], Maria Siouta[3]

[1] National Agricultural Insurance Organization (ELGA), Meteorological Applications Center Airport Macedonia, Thermi 57001, Thessaloniki, Greece - Email: sioutasm@gmail.com
[2] Technical Chamber of Greece, Section of Central Macedonia
[3] Aristotle University of Thessaloniki, School of Law, 54124 Thessaloniki, Greece
Email: sioutamariaa@gmail.com

**Abstract.** Extreme or severe weather and climate events occasionally cause devastating impacts to communities, infrastructures, various economic sectors, and natural ecosystems. A disaster related to a weather, climate or water caused every day on average 115 fatalities and 202 million US$ in the last 50 years (1970-2019) according to the World Meteorological Organization (WMO). In this study, the most devastating and extreme weather events resulted to fatalities in various parts of Greece over the last 53 years (1970-Sep 2023) are investigated. Based on ongoing research, a total of 135 devastating weather events resulted to 287 fatalities have been recorded in the 50-year period. Severe weather events include thunderstorms and floods, lightning, strong winds, tornadoes, snowfalls and freeze. Heatwave and wildfire fatalities are not included in the analysis since no consistent detailed data are available. Climate projection models show the Eastern Mediterranean including Greece as a rapid climate change hotspot area. In this perspective, a consequent increase and intensification of extreme weather events is anticipated thereby increasing human loss, larger damages, economic losses, and destroying impacts to various ecosystems.

**Keywords:** Extreme Weather; Severe Weather; Weather Fatalities; Climate Change

## 1 Introduction

Disasters related to weather, climate or water hazards in all over the world caused a daily average of 115 fatalities and US$ 202 million losses in the 50-year period (1970-2019) according to World Meteorological Organization (WMO). In the same period in Europe, a number of 1672 disasters caused 159,438 deaths and US$ 476.5 billion damage in economic losses. Floods with 38% and storms with 32% are the prevalent disasters, however heatwaves accounted for the highest number of deaths (93%) with 148,109 lives lost. The two extreme European heatwaves of 2003 and 2010 accounted for the 80% of deaths over the 50-year period 1970-2019 with 127,946 lives lost in both events. Based on data from two different sources (NatCatSERVICE-Munich Re GmbH and CATDAT-RiskLayer GmbH) from the 32 EAA member countries for the period 1980-2020, economic losses amounted to between 450-520 billion (2020 euros) and fatalities to between 85,000 and 145,000 (Figure 1).

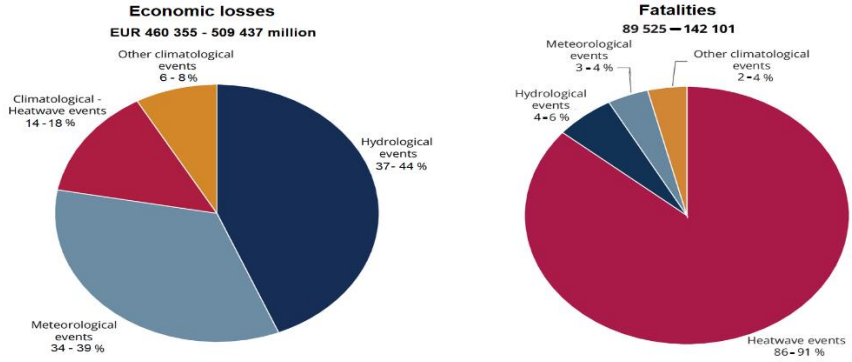


**Figure 1.** Meteorological and hydrological event related economic losses and fatalities in Europe for 40-year period 1980-2020 (European Environment Agency).

# 2 Severe weather events and fatalities in Greece

## 2.1 Greek severe weather database

In Greece, based on ongoing research and a developing database (Sioutas et al., 2022), a total of about 1,050 severe weather events with 135 of those characterized as devastating and killer have been recorded in the last 53-year period (1970-Sep 2023). A total of 287 fatalities occurred by weather floods, windstorms, lightning and cold-frost conditions. In Table 1 a sample of the most severe weather events and related fatalities is presented.

**Table 1.** Devasting weather events and associated fatalities in Greece in the last 53 years (1970-Sep 2023).

| No | Date | Place | Event | Number of fatalities |
|---|---|---|---|---|
| 1 | 21 July 1983 | Thermaikos Gulf, Thessaloniki | Windstorm | 9 |
| 2 | 23 August 1990 | Northern Euboea | Flood and Lightning | 7 |
| 3 | 21 November 1994 | Attica | Flood | 6 |
| 4 | 26 May 2007 | Lousios River, Arcadia | Flood | 6 |
| 5 | 25 March 2009 | Manolada, Ilia | Tornado | 3 |
| 6 | 22 November 2013 | Rhodes Isl. | Flood | 4 |
| 7 | 15 November 2017 | Mandra, Attika | Flood | 23 |
| 8 | 10 July 2019 | Chalkidiki | Windstorm | 7 |
| 9 | 5 December 2019 | Evros | Cold - Frost | 6 |
| 10 | 5-7 September 2023 | Thessaly | Flood | 15 |

## 2.2 Temporal distribution of severe weather-related fatalities

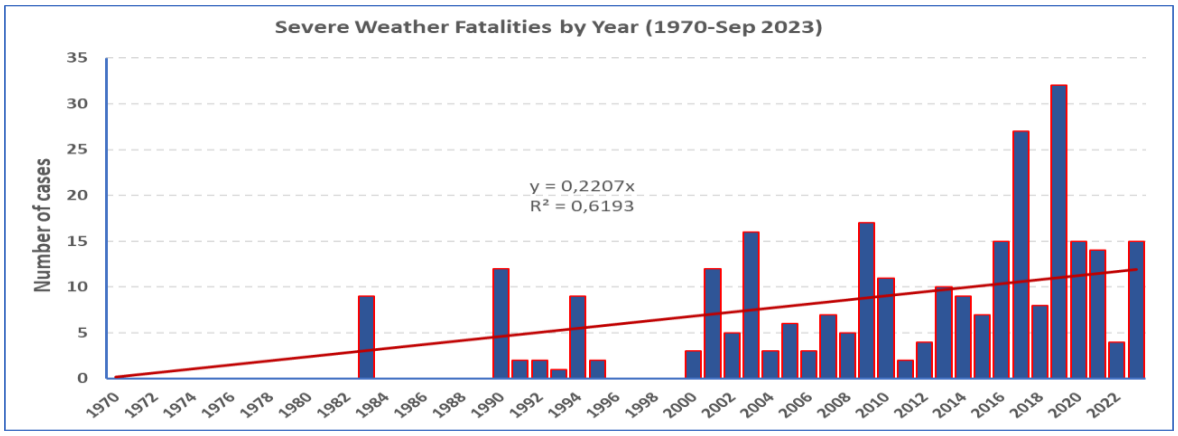


**Figure 2.** Yearly distribution of severe weather event fatalities in Greece for the 53-year period (1970-Sep 2023).

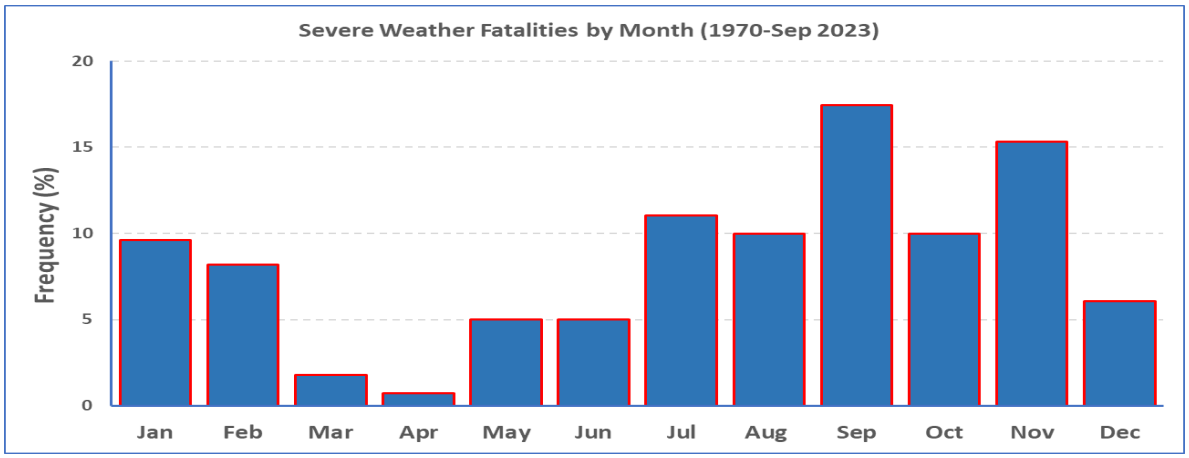


**Figure 3.** Monthly frequency of severe weather event fatalities in Greece for the 53-year period (1970-Sep 2023).

## 3 Summary and Conclusions

Weather and climate related fatalities are examined based on a severe weather database for Greece for the last 53 years (1970-Sep 2023). ). In this study the fatalities caused by the most devastating and extreme weather events in Greece over the last 53 years (1970-Sep 2023) are investigated. Severe weather events include thunderstorms and floods, lightning, strong winds, tornadoes, snowfalls and freeze. Based on ongoing developing database, a total of 135 devastating weather events resulted to 287 fatalities have been recorded in the 50-year period.

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# Natural Disasters impact in Greece the last 10 years as revealed from EM-DAT

Vasiliki Neofotistou
Department of Science and Technology, International Hellenic University,
14 th km Thessaloniki-N. Moudania, 57001, Greece
Email: vicky_neofotistou@hotmail.gr

**Abstract**
Natural disasters exert a profound influence on human lives, resulting in significant economic and environmental repercussions. Effective preparedness is a crucial strategy for mitigating these adverse impacts. This research offers insights into Greek natural disasters documented in the EM-DAT database over the decade spanning from 2014 to 2023. It examines the consequences of these disasters in terms of human fatalities, injuries, the number of affected individuals, and property damages. Furthermore, this study draws a comparative analysis between the initial five years (2014-2018) and the subsequent five years (2019-2023) of the decade. These insights into the impacts of natural disasters serve a dual purpose. On one hand, they furnish essential data for informing future policymaking regarding preparedness, emergency management, and disaster mitigation in Greece. On the other hand, they shed light on the efficacy of preparedness and emergency management measures implemented over the past decade, especially when comparing the first half to the latter half.

**Keywords:** Natural disaster, natural hazard, risk, risk management.

## Introduction

Over the past decade, Greece has experienced a series of natural disasters that have left an indelible mark on both its human and environmental landscapes. This paper delves into the compelling narrative of Greece's encounter with natural disasters during the period from 2014 to 2023, as chronicled by the Emergency Events Database (EM-DAT). The Mediterranean nation's geographic location places it in the crosshairs of various natural phenomena, from earthquakes and wildfires to floods and heat waves. These events have not only posed immediate threats to life and property but have also imparted profound and enduring impacts on Greek society. As we explore the data contained within the EM-DAT database, we gain valuable insights into the frequency, magnitude, and consequences of these natural disasters.

Through this examination, we aim to provide a comprehensive overview of the challenges posed by natural disasters in Greece over the last decade. We will delve into the grim statistics of human fatalities, injuries and property damage. Furthermore, we will draw comparisons between the first

discernible trends or
shifts in the nature and severity of these disasters. In doing so, we seek not only to elucidate the historical record but also to provide a foundation for future policy development and disaster management strategies in Greece. By understanding the evolving dynamics of natural disasters in this region, we hope to contribute to more effective preparedness and mitigation efforts, ultimately striving for a safer and more resilient Greece in the face of an uncertain climatic future. For the accuracy of the research, it should be noted that the latest flood currently ongoing in the Thessaly region has not yet been included in the EM-DAT.

## Natural Disasters Analysis for 2014-2023

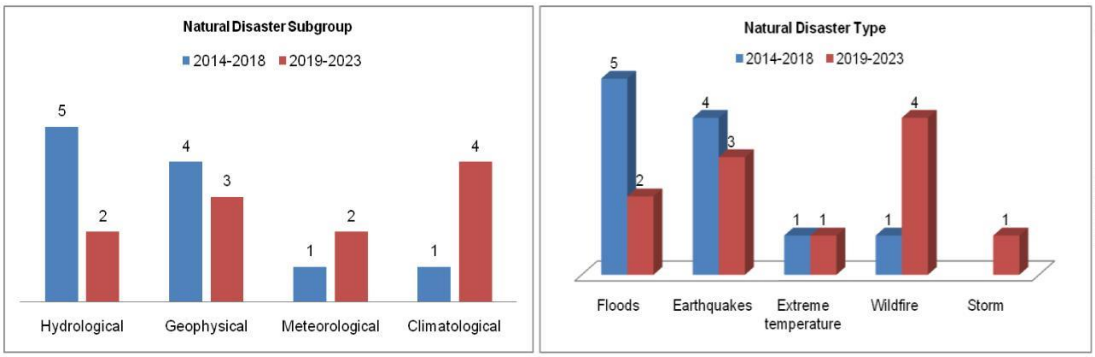


Figure 1 and 2: Comparison of occurrence of Natural Disasters in Greece between the first half and the later half (Public EM-DAT platform, 2023)

As demonstrated in figures 1 and 2, hydrological natural disasters were more frequent during the first half of the decade compared to the second half, with geophysical disasters following a similar trend. Floods and earthquakes emerged as the primary natural disasters affecting Greece from 2014 to 2018. In the latter half of the decade, climatological disasters took the forefront, with geophysical disasters following suit. Wildfires and earthquakes continued to rank as the most prevalent disasters in Greece from 2018 to 2023.

Continuing to examine the occurrences throughout the entire decade, the EM-DAT database revealed, as shown in figure 3, that 2017 had the highest number of natural disasters, while 2016 and 2019 had the lowest occurrences. On Table 1, we can observe the types of disasters that took place in 2017, which had the highest occurrence.

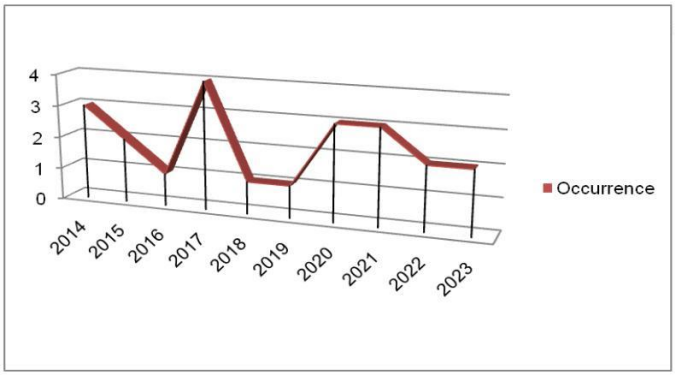


Figure 3: Occurrence of natural disasters in Greece from 2014-2023.(Public EM-DAT platform, 2023)

Tablet 1. Impact high score for Occurrence

| YEAR | TYPE OF DISASTER | IMPACT HIGH SCORE |
|---|---|---|
| 2017 | Geophysical/ Earthquake/ Ground movement Hydrological/ Flood/ Flash Flood<br>Geophysical/ Earthquake/ Ground movement<br>Meteorological/ Extreme temperature/ Severe winter conditions | Occurrence: 4 |

Figure 4 provides a temporal view of fatalities, affected populations, injuries, and damages. As indicated in the Fatality figure for 2022, the second half of the decade witnessed the highest annual report of human fatalities. This aligns with the Affected figure, which also reveals the second-highest number of affected individuals occurring in 2022. The year 2014 stands out as having the highest number of affected populations, attributed to two earthquakes that struck during that year. Additionally, 2014 recorded the most significant damages throughout the entire decade. In contrast, the year 2018 saw the highest number of injuries among the population. Tablet 2 illustrates the types of disasters with the most significant impact.

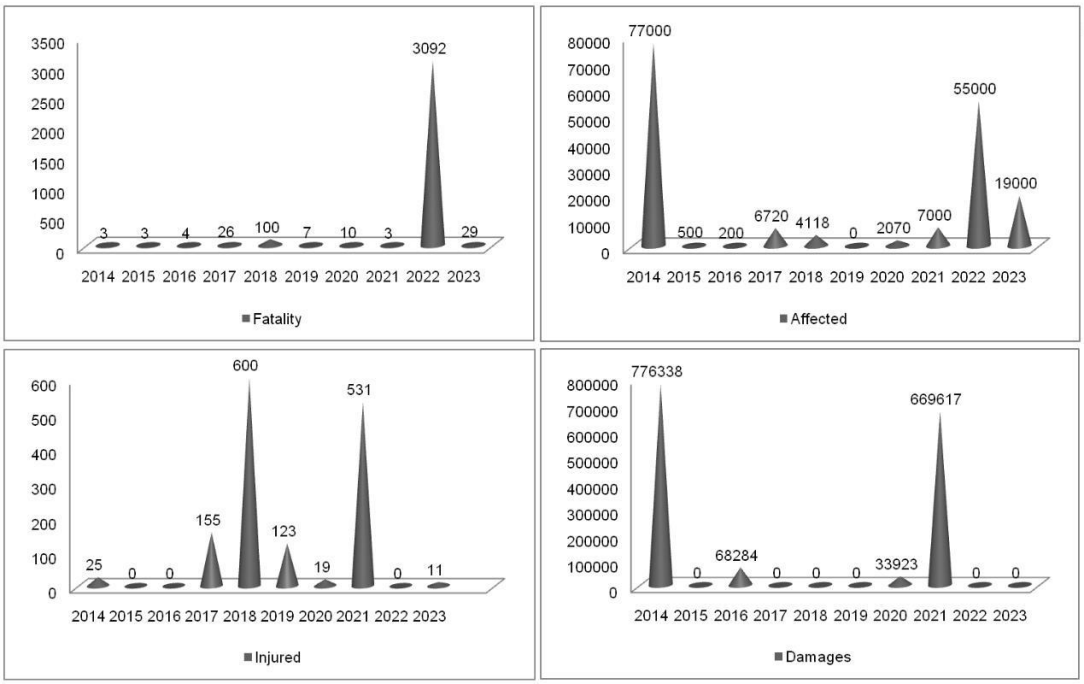


Figure 4: A temporal views of natural disasters in Greece the last 10 years (Public EM-DAT platform, 2023)

Tablet 2. Impact high score and type of disaster

| YEAR | TYPE OF DISASTER | IMPACT HIGH SCORE |
|---|---|---|
| 2014 | Geophysical / Earthquake/ Ground movement<br>Two different earthquake incidents | Affected: 77000<br>Damage: 776338 |
| 2018 | Climatological / Wildfire/ Forest fire | Injured: 600 |
| 2022 | Meteorological / Extreme temperature/ Heat Wave | Fatality: 3092 |

Tablet 3 presents the impacts of natural disasters in Greece for the decade spanning from 2014 to 2023. Notably, one category of natural hazards, specifically biological disasters, is absent from the

dataset, indicating the absence of such incidents during this period. There is a discernible upward trend in annual fatalities in recent years, and a similar pattern emerges for the annual number of injured individuals, affected populations, and the extent of damages. This increase may be attributed to the prevalence of climatological and meteorological disasters during the latter years of the decade, which are often more challenging to predict and prevent. In contrast, the first half of the decade was characterized by a higher occurrence of hydrological disasters, which are generally more amenable to prevention and mitigation efforts. (Shen and Hwang, 2019)

Tablet 3 Natural Disasters impacts by year 2014-2023

| | Occurrence | | | | Fatality | | | | Injured | | | | Affected | | | | Damage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | C | G | H | M | C | G | H | M | C | G | H | M | C | G | H | M | C | G | H | M |
| 2014 | - | 2 | 1 | - | - | 3 | - | - | - | 25 | - | - | - | - | 77.000 | - | - | 776.338 | - | - |
| 2015 | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 500 | - | - | - | - | - |
| 2016 | - | - | 1 | - | - | - | 4 | - | - | - | - | - | - | - | 200 | - | - | 68284 | - | - |
| 2017 | - | 2 | 1 | 1 | - | 3 | 23 | - | - | 131 | 24 | - | - | 720 | 6000 | - | - | - | - | - |
| 2018 | 1 | - | - | - | 100 | - | - | - | 600 | - | - | - | 4118 | - | - | - | - | - | - | - |
| 2019 | - | - | - | 1 | - | - | - | 7 | - | - | - | 123 | - | - | - | - | - | - | - | - |
| 2020 | - | 1 | 2 | - | - | 2 | 8 | - | - | 19 | - | - | - | 900 | 1.170 | - | - | - | 33.923 | - |
| 2021 | 1 | 2 | - | - | 2 | 1 | - | - | 500 | 31 | - | - | 7000 | - | - | - | 626.416 | 43.201 | - | - |
| 2022 | 1 | - | - | 1 | - | - | - | 3.092 | - | - | - | - | 55.000 | - | - | - | - | - | - | - |
| 2023 | 2 | - | - | - | 29 | - | - | - | 11 | - | - | - | 19.000 | - | - | - | - | - | - | - |

C=Climatological, G=Geological, H=Hydrological, M=Meteorological. (Public EM-DAT platform, 2023)

## Conclusion

In conclusion, the analysis of natural disasters in Greece from 2014 to 2023, as revealed by the EM-DAT database, paints a multifaceted picture of the nation's resilience in the face of nature's forces. Notably, the absence of biological disasters during this period stands as a testament to Greece's fortunate escape from such events. The data presented in Tablet 3 provides valuable insights into the evolving landscape of natural disasters in Greece. A clear observation emerges: there has been a consistent increase in annual fatalities, injuries, affected populations, and damages during the latter years of the decade. This trend aligns with the prevalence of climatological and meteorological disasters, which, due to their unpredictable nature, present significant challenges in prediction and prevention. This underscores the importance and impact of climate change, emphasizing the need for adaptable disaster preparedness strategies that account for the evolving hazard landscape. Moreover, efforts should focus on harnessing predictive technologies and strengthening preventative measures, particularly in the context of climatological and meteorological events.(Haggag *et al.*, 2021) All this could offer the opportunity to build more resilient strategies capable of safeguarding lives, minimizing injuries, and preserving the nation's natural and cultural heritage in the face of an ever-changing world.

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