



# Fighting Anthropogenic Forest Fires: Implications from Forest Fires in the Mediterranean Region

## Antropojenik Tehlike Olan Orman Yangınlarıyla Mücadele: Akdeniz Bölgesi Orman Yangınlarından Çıkarımlar

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### ABSTRACT

*This study aims to reveal the variables affecting forest fire response management, identify the difficulties encountered, and develop solutions. In the study, semi-structured interview technique, which is a qualitative research method, was used. The data obtained within the scope of the study were analysed by thematic analysis method. A purposeful sampling method was used within the scope of the study, and in-depth interviews were conducted with eleven firefighters who responded to the Mediterranean region fires in 2021. In the analyses made within the study's scope, four themes were revealed: coordination, source and spread factors, response reactions, and institutional roles. As a result of the study, it was seen that the participants often associated their past forest fire response experiences with the concepts of helplessness and inexperience due to a lack of training, equipment, and personnel. As a result of the analysis showed that the most common cause of forest fires in the region was the human factor, and the most serious problem encountered in the intervention was the lack of coordination. Within the scope of the study, it is recommended that professionals make the coordination the awareness of the local people, which constitutes the majority of the volunteer capacity, about forest fire precautions, and the voluntary firefighting system should be activated and included in the response system, especially in areas with high fire risk.*

**Keywords:** Firefighter, Forest Fire, Mediterranean Region, Response, Qualitative.

### öz

*Bu çalışmanın amacı, orman yangınlarına müdahale yönetimini etkileyen değişkenleri ortaya koyarak karşılaşılan güçlükleri tespit etmek ve çözüm önerileri geliştirmektir. Çalışmada, nitel bir araştırma yöntemi olan yarı yapılandırılmış görüşme tekniği kullanılmıştır. Çalışma kapsamında elde edilen veriler tematik analiz yöntemi ile analiz edilmiştir. Çalışma kapsamında amaçlı örnekleme yöntemi kullanılmış ve 2021 yılında Akdeniz bölgesi yangınlarına müdahale eden on bir itfaiyeci ile derinlemesine görüşmeler yapılmıştır. Çalışma kapsamında yapılan analizlerde koordinasyon, kaynak ve yayılım etmenleri, müdahale tepkileri ve kurumsal rollerden oluşan 4 tema ortaya konulmuştur. Çalışma sonucunda katılımcıların geçmiş orman yangını müdahale deneyimlerini sıklıkla eğitim, ekipman, araç ve personel yetersizliği kaynaklı çaresizlik ve tecrübesizlik kavramları ile ilişkilendirdikleri görülmüştür. Yapılan analizler sonucunda bölgede çıkan orman yangınlarının en yaygın sebebinin insan faktörü olduğu ve müdahalede karşılaşılan en ciddi sorunun koordinasyon eksikliği olduğu görülmüştür. Karşılaşılan sorunların çözümü için koordinasyonun profesyonellerce yapılması, gönüllü kapasitesinin büyük çoğunluğunu oluşturan yerel halkın orman yangını önlemleri ile ilgili bilinçlendirilmesi, özellikle yangın riski yüksek bölgelerde gönüllü itfaiyecilik sisteminin aktive edilmesi önerilmektedir.*

**Anahtar Kelimeler:** İtfaiyeci, Orman Yangını, Akdeniz Bölgesi, Müdahale, Nitel.

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## INTRODUCTION:

Forest fires appear complex and costly events that cause more harm than good for the ecosystem, which is affected by physical, climatic, and social factors (Canton-Thompson et al., 2008; Krah et al., 2020). Despite the developing technology, forest fires are considered a global public problem that are becoming more severe and cause significant increases in burned areas and lost property (Mukhopadhyay, 2007; González and Pukkala, 2007; Alamsyah, 2022). Forest fires not only destroy forests but also bring problems such as endangerment of public health, disruption of socio-economic activities, ecological deterioration, and shaking of political confidence, triggering energy poverty (Krah et al., 2020; Elbaar and Meilantina, 2020; Paudel, 2021). In addition, forest fires can adversely affect sustainable development goals such as poverty, quality education and health, economic growth, industrial innovation and infrastructure, sustainable cities, and responsible consumption and production (Alamsyah, 2022). Fires are considered among the leading causes of forest destruction and have far-reaching adverse effects on forests, such as loss of valuable wood resources, loss of biodiversity, global warming, changes in microclimate, soil erosion, and loss of livelihood (Bahuguna and Upadhyay, 2002). Considering the possible consequences listed above, forest fires can be a disaster due to their impact on many aspects of community life (Fitri and Wibowo, 2012). As a matter of fact, in the International Disaster Database (EM-DAT), forest fires are defined as hazards caused by long-lasting, medium-scale atmospheric processes ranging from inter-seasonal period to ten-year climate variability in the general disaster classification and classified as a climatological disaster type (International Disaster Database [EM-DAT], 2022). Although they are seen as climatic disasters, the vast majority of forest fires occur due to human activities and, to a small extent, are caused by natural ignition sources (Narendran, 2001). The number and complexity of the underlying anthropogenic causes of forest fires may differ between countries and on a regional scale (Tedim et al., 2015). The reasons for its occurrence include, in summary, the availability of abundant fuel, continuous and/or recurrent droughts, climatic conditions, and the presence of ignition sources (Aregai and Neary, 2015; Tian, 2013). Whatever the source or cause of forest fires, their impact is primarily determined by duration and intensity (Krah et al., 2020). Forest fires are classified as hill, cover, and ground fires based on fire density, fuel properties, and weather conditions (Narendran, 2001; Stocks et al., 2002). Considering the extreme fire behavior of forest fires, characterized by high spread rates and energy release under certain conditions, some studies deal with explosive, peak, and point fires (Viegas and Simeoni, 2011). Regardless of the type of fire, extinguishing efforts continue to take priority over prevention and harm reduction efforts in responding to forest fires (Mateus and Fernandes, 2014). The ongoing debate in recent years about how to best protect human populations and property at risk from increased wildfire events is indicative that future fires will require far more significant changes to prevent them from decimating even larger areas in the coming years (Paveglio, 2010; Dauvergne, 1998). Addressing forest fire challenges requires integrating fire science into management decisions (Glenn et al., 2022). Fire management policies and effectiveness require good governance to consider existing risks, create changes in prevention programs, strengthen first responders, and define action programs (Mateus and Fernandes, 2014; Flannigan, 2006). In this context, fire management is defined as the activities carried out by a country, region, or city to prevent and combat forest fires (Trejo, 2008). Integrated approaches that need to be adopted globally to seek long-term sustainable solutions to fire management incorporate five key elements: research, risk reduction, preparedness, response, and rescue (FAO, 2011). Fire management efforts range from community involvement to the planning of critical institutions, from technical elements such as prevention, response, and recovery to more complex frameworks involving social, economic, and political interactions (Hoffmann, 2013).

### 1. Research Methodology

Fire responders' experience and opinions are essential to respond to the problems encountered in the research, risk reduction, preparation, response, and rescue stages of integrated fire management. In this context, the study aims to reveal the variables affecting forest fire response management, identify the difficulties encountered, develop solution proposals, and provide the necessary information to disaster managers and stakeholders. In the study, semi-structured interview technique, which is a

qualitative research method, was used. The data obtained within the scope of the study were analysed by thematic analysis method. A semi-structured interview is a data collection technique shaped in the context of intellectual approaches, covering all dimensions of the researched subject, asking open-ended questions, allowing information collection, and detailing the subjects through face-to-face, one-to-one interviews (Alsaawi, 2014; Tekin, 2006; Polat, 2022). In the study, the phenomenology design, which emphasizes the shared experiences of a group of individuals and provides a theoretical explanation for a process or action, was used (Tekindal and Uğuz Arsu, 2020). This study has two main research questions:

RQ1. What are the factors affecting forest fire response management?

RQ2. What are the disadvantages of firefighters in forest fire management practices?

### 1.1. Study Area

General Directorate of Forestry (2021) reported that 485,305 hectares of land were destroyed as a result of 72,360 forest fires between 1988-2021. In addition, the year 2021, in which 2,793 forest fires occurred in Türkiye, was reported as the year in which the most forestland burned in a year (28.7%, 139,503 hectares) in the history of the country (General Directorate of Forestry, 2022). In this context, the study area of the research has been determined as the Mediterranean region, which is covered with first-degree fire-sensitive forest areas in the south of Türkiye (Güngöroğlu, 2018) and is seriously affected by the forest fires of 2021 (Fig. 1). The area of the region is 2,300,000 km<sup>2</sup>. Its topographic structure is divided by narrow and deep valleys due to its complex geology (Arslantürk and Ketenöğlü, 2008). The 2021 Türkiye Population Map data shows that the total population of the Mediterranean region exceeds 10 million (Ministry of Interior, 2021).

Figure 1: Study Area



Source: General Directorate of Mapping, 2022.

### 1.2. Study Participants

Participants were selected through purposive sampling. Having experience in responding to forest fires, responding to forest fires in the Mediterranean region of 2021 and currently working as a firefighter were determined as inclusion criteria. In addition, the participants were selected in line with the information received from the Bucak Fire Brigade Directorate, which is the closest professional response unit unaffected by the incident, and the Gümüşhane Fire Brigade Directorate, which has forest fire experience and is one of the most remote response units to the region. Fifteen firefighters meeting the inclusion criteria were identified and interviews were conducted with eleven firefighters who volunteered to participate in the study. In the analysis made within the scope of the research, it

was seen that the age distribution of the participants was between 31-48 and their educational status changed from primary school to graduate education. All of the participants are men, and their terms of office vary between 2-18 years. Participants who experienced the fires in the Mediterranean region as responders worked as firefighter directors (n=2), fire chiefs (n=3), firefighters (n=4), and drivers (n=2) within the fire brigades. For the fire that started in the Manavgat district on 28.07.2021, the Gümüşhane team operated on 31.07.2021, and the Bucak team operated on 29.07.2021.

### 1.3. Data Collection

Data collection was carried out by face-to-face interviews with eleven firefighters. The language adopted in the interviews is Turkish. In order to prevent data loss, the interviews were audio recorded with the participants' permission. The interview data of the participants who did not allow audio recording were obtained by taking written notes during the interviews, in line with their permission. In the study, the researchers used an interview form as a data collection tool, whose general parameters were determined through a comprehensive literature review, and which was prepared by evaluating expert opinions. The last semi-structured interview form consists of eighteen questions. Twelve of the questions are open-ended and six of them are demographic questions (gender, age, education level, position, duty and tenure). In some parts of the interview process, spontaneous questions were also asked to the participants in order to provide depth of topic. The interviews were held between 01.05.2022 and 01.07.2022 at the workplaces of the participants. In-depth interviews were conducted with an average of 30 minutes (minimum 15–maximum 45 minutes) per person, considering the confidentiality of individuals' identity information. Afterwards, all interviews were anonymized by coding the participants in the range of P1, P2,...P11. There are limitations such as the fact that the data obtained within the scope of the study is based on the experience and opinions of the participants, covers a certain period and a narrow place, and the results cannot be generalized.

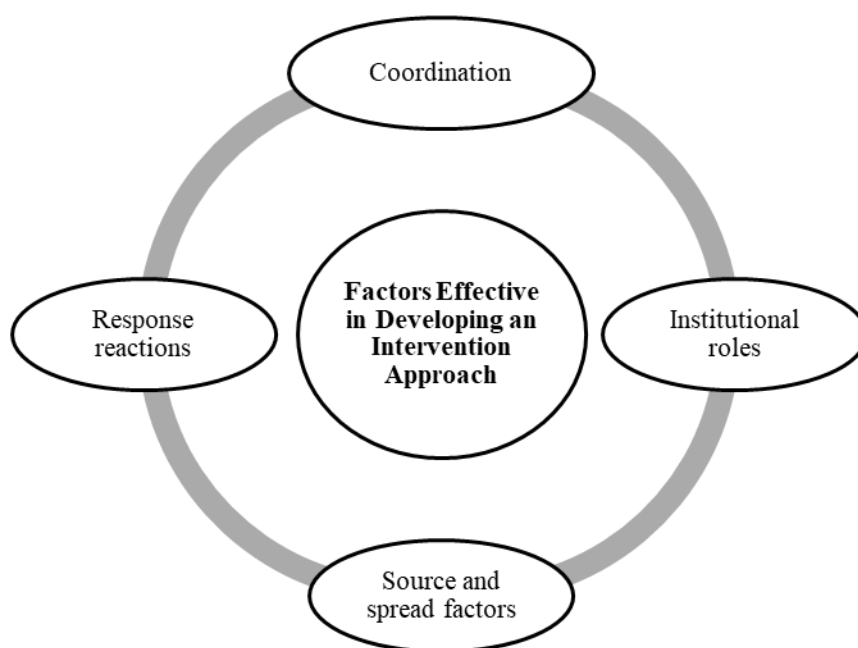
### 1.4. Data Analysis

Audio recordings were transcribed by the researchers using Microsoft Office Word 2016. A twenty four-page data set of eleven firefighters was created, along with the written notes taken. The created data set was analysed using the thematic analysis technique, considered the coding process of qualitative information (Boyatzis, 1998). In the data analysis phase, six-step thematic analysis was carried out: defining data, creating initial codes, identifying themes, examining themes, naming themes, and creating a final report (Braun & Clarke, 2006). In order to become familiar with the data and explore the main ideas of the study participants, the first step was to review and re-read the transcribed text by two researchers independently. In the second step, the authors determined the initial codes by the inductive method. Then, the codes that were similar in concept were placed under potential sub-themes. The codes revealed as a result of this analysis were grouped into seventeen sub-themes. The conflicts in 5 sub-themes were evaluated in a second analysis round and the seventeen sub-themes revealed as a result of the analysis were grouped under twelve sub-themes. In the fourth step of the analysis, the sub-themes were reviewed, and the themes were made more abstract. With the regulations in the fifth step, the influential factors in developing an intervention approach are coordination, source and spread factors, response reactions, and institutional roles. They are grouped under four themes (Tab. 1). In the last stage, the conflict situation in the theme and sub-themes was reviewed, and the results were turned into a table.

## 2. Findings

In the analyses made within the study's scope, four themes were revealed: coordination, source and spread factors, response reactions, and institutional roles (Fig. 2).

Figure 2: Study Themes



Source: The figure was created by the authors.

Table 1: Effective themes, sub-themes and codes in developing a forest fire response approach

Codes	Sub-themes	Themes
Support of public institutions, private sector, and non-governmental organizations (NGO), the presence of unorganized volunteers, stakeholder cooperation protocols, establishing spontaneous collaborations when needed, trust between institutions, the necessity of an organized public scheme, and knowledge of local people.	Collaboration-stakeholder	Coordination
Guide staff, mapping, and orientation, response personnel unfamiliar with the area, the use of up-to-date technologies, the use of local people for orientation, and problems in vehicle shipments.	Routing-workflow	
Telephone, walkie-talkie, megaphone, etc., presence of physical means of communication, determination of communication personnel, media attention, spreading false news, inter-team communication problems, effective team communication.	Communication	
Insufficient information about the incident, unsuitable deployment areas, failure to establish duty and responsibility zones, lack of command, inadequate incident scene security, presence of provocateurs, recording and reporting deficiencies, lack of decision support systems, planning deficiencies, lack of standardized documentation, post-incident evaluation commissions.	Incident management system	
Problems with vehicle water supply, vehicle density, lack of machinery, supply of vehicle fuels, lack of personal protective equipment, supply of surplus material, and storage issues.	Logistics	

Land intervention methods, aerial intervention, use of extinguishing materials such as water, foam, use of manual equipment, use of up-to-date technologies, for hose transport and wind calculation use of local people, cooling operations, dilution of forests, counter fire, road/lane clearing, creation of artificial lakes, placing hydrants, cleaning the ground cover.	Active reactions	Response reactions
National feelings, self-sacrifice, religious beliefs, helplessness, fear, benevolence, solidarity, courage, the low fire resistance of residential and agricultural areas in the region, evacuation, aggression, leave the fire on its natural course, supply of water tankers to villages, legislative regulations and penal sanctions, isolation of unburned areas.	Passive reactions	
Land conditions, tree species, dispersal effect of tree roots and cones, old and dry trees, uncontrolled deforestation, wind factor, humidity, temperatures, day-night temperature differences.	Geographical conditions and climatic features	Source and spread factors
Neglect-carelessness, location, and maintenance of power transmission lines, burning animals carry fire, inadequate preventive activities, economic and agricultural activities, political reasons, terrorist activities, sabotage, and dwellings on the land.	Human factor	
Lack of vehicle equipment suitable for terrain conditions, number of vehicles, towing vehicles, tonnage, lack of vehicle material knowledge, vehicle-equipment safety, hose length and diameters, equipment weights, personal protective equipment, standardization in tool-material nomenclature.	Vehicle-equipment capacity	Institutional roles
The number of staff, delegation of authority-responsibility, conflict between teams, long-term work, the problem of unqualified and unfamiliar personnel, lack of institutional strength, extraterritorial shipments, inability to function as an apolitical professional group, problems in personnel rights, opportunism, firefighting volunteering system.	Team capacity	
The training is focused on responding to urban fires, the lack of drills and applied training, non-standardized training, public training, personnel adequacy, differences in expertise, inexperienced personnel being responsible for coordination, incorrect application of response methods, not determining site responsible, differences in working styles, hazard, and risk analysis, resource and needs analysis.	Training-Experience	

Source: The table was created by the authors.

### Theme 1. Coordination

The theme of "Coordination" is divided into five sub-themes: cooperation-stakeholders, routing-workflow, communication, incident management system, and logistics. Regarding cooperation-stakeholders processes;

P2; *"...There was so much volunteer support...they got to the point of driving the fire truck...we could have said it would not have happened without them..."*

P5; *"...There was no place without the people...we were four people, but the people increased the team...the people of the village we extinguished as well as the nearby villages were always with us...the people should be included and rested in the process...a rescue hierarchy should be made for an organized public scheme, the village mukhtars village committee should be included in this..."*

P6; *"...There were citizens with vests on them...but they were unconsciously trying to help...there were people who tried to extinguish it with a fire extinguisher and were caught in the fire..."*

P3; *"...Since the institutions were already conscious, rather than the agreement, they contacted the fire department and sent equipment such as construction equipment, water tankers, etc., as needed. There are water tankers in our villages..."*

P8; *"...In the first place, chamber of commerce, directorate of agriculture, organized industrial zone, etc. They demand construction equipment from institutions..."*

Regarding routing and workflow processes;

P1; *"...we had problems reaching the fire area; there was a need for a guide who knew the area...In the past fires, signs were placed at the area's entrance to reach the fire area..."*

P2; *"...I do not know the location, there is no guide, they said, continue straight 30-40 km later, I went to the wrong place...then they gave a guide, we went with the guide, we found it in 5 minutes..."*

P4; *"...If we had done what the foresters said, we would have settled on the side of the road and prevented the spread..."*

P6; *"...a map containing the terrain features was not given, no one knew, they did not even explain the extent of the event..."*

P8; *"...we were going towards where the smoke came from...maybe there is a shortcut, but it is a waste of time since we do not know the area..."*

P10; *"...Coordination was achieved on the 3rd day of the fire, the directions started...On the first day, when they said to go to that area, you go to that area and look, 30-40 cars are waiting..."*

Regarding communication processes;

P4; *"...we had seen from the press, that is all we knew...we were given a number we were told to call him...when we arrived, we saw that there was no coordination...we do not know the area, they directed us to a location with locations on our own..."*

P5; *"...we only knew about the event from the media until we left...even when we were leaving from here, there was a communication breakdown, we did not know where or how to go, only a name was given..."*

P6; *"...We were holding evaluation meetings among ourselves...we had no communication with different teams other than our contact..."*

P7; *"...Forest teams had communication among themselves, but we could not get involved...due to the differences in how they work, communication was not established in the same direction..."*

P11; *"...there is a completely burned tree around, there is no place for it to spread, the team is located at another point, to prevent the fire from spreading to the houses, but the citizen says, the tree is on fire, the firefighter is waiting there...the media writes without knowing this..."*

About the incident management system;

P1; *"...You carry twenty tons of water; the vehicle throws 5 tons of it out of the drain...you also disturb the stability of the road..."*

P2; *"...Until the command center was established, we did not have a chance to determine our area of duty..."*

P4; *"...We made the intervention decisions ourselves in the first five days...it was when we worked most efficiently...I saw that the teams were guided by those who did not know the job..."*

P5; *"...Someone was walking around so we could beat the foresters and cause a riot...There were many provocateurs...There was a management race among the personnel...There was no coordination, there was no interlocutor...I have no authority to write a report; no one wanted it anyway...A commission should be established, and lessons should be learned. Resilience is needed, both locally and institutionally..."*

P7; *"... command, the event manager was not clear...4. After the day, the assembly area was created. It was as if we had worked illegally for four days...With competent coordination, so many opportunities could have been organized faster...only our entries and exits were recorded..."*

Regarding logistics processes;

P2; *"...the material tents did not have water resistance...there was no shortage of water, food...the material problem was solved later...gloves, burn cream came..."*

P3; *"...If the logistics were provided in a coordinated way, there would be no problem...They loaded the water back into the vehicles and took them back..."*

P7; *"...There was a tanker for vehicle fuel, we were printing our license, and we were getting our water supply from different teams..."*

P11; *"...people are helping, but it is not functional; it is a serious waste...There were 2-3 water trucks; they gave it to Red Crescent...then they sent a truck for cooling...it would have been more beneficial if it had been thought from the beginning..."*

## **Theme 2. Response Reactions**

The theme of "Response Reactions" is grouped under two sub-themes as active and passive response reactions. About active reactions;

P1; *"...we intervene with water...since the trees are under the rocks...the helicopter worked continuously for one day, stopped advancing but could not extinguish it...The best way to control is to open a safety lane every 5-10 km..."*

P3; *"...The unburned trees were soaked so that the fire would not continue...Roadworks were made...Counterfire varies according to the condition of the land..."*

P4; *"...We did not use anything but water...you can block the fire so that it does not spread...artificial lakes have been created to supply water...clearing vegetation can be effective..."*

P6; *"...The local people helped promote and guide the region...They also attacked us with picks and shovels..."*

P7; *"...local people helped calculate and observe the wind...the forest villager knew the geography, climate, terrain..."*

P9; *"...There are such lands that extinguishing vehicles cannot enter, but you can watch the fire come to you...Dilution studies should be conducted, especially at the points close to the settlements..."*



P10; *"...We did not use any intervention material other than water...Citizens intervened with fire extinguishers...Controlled burning is applied in some areas...They lit a fire in Manavgat, fifty vehicles were waiting, and there was no water sprayer; I said what are we waiting for, I looked at the two drones and ignited the unburned area..."*

About passive reactions;

P1; *"...You go to the place where everyone fled...You work non-stop for 8-10 hours...if the weather conditions are not suitable, one cannot afford it...but think of a unity...we all joined together and left together..."*

P2; *"...All your stress ends when the fire is put out...God gives strength to intervene ..."*

P5; *"...I saw trees burning, which required a lot of effort...people were running away when I turned my back, there was no one left...where there was no experience, we needed courage...we were caught in the flames, and our water ran out, and we survived with a blessing..."*

P6; *"...while trying to intervene, it was said that it will burn...they were waiting for the fire and trying to extinguish it after moving forward..."*

P7; *"...We wanted to intervene in the fire like an ant...we were going to put out that fire for the homeland...There was no question mark in our minds about whether we would return or not..."*

P9; *"...Those who took his valuables fled, they emptied the village...there was even a funeral, they postponed the burial..."*

P10; *"...We saw 6-7 greenhouses burning within minutes...the owner of the greenhouses just had to watch...the villagers attacked our teams to get priority...a woman fell on my feet, but there was no water in the vehicle..."*

### **Theme 3. Source and Spread Factors**

The theme of "source and spread factors" is grouped under two sub-themes: geographical conditions, climatic characteristics, and human factors. About geographical conditions and climatic features;

P2; *"...In general, fires in these areas occur and grow in windy weather. Cones affect the spread...the roots of the trees also contribute to the fire..."*

P4; *"... To prevent forest fires, dry litter must be collected. When the cones burst, we saw that the spread was fast...We saw that the wind changes direction frequently, putting everything in danger at once..."*

P5; *"...There is about 15 cm of dry debris where the cones fall, it burns immediately...there used to be a policy for the villager to collect the debris..."*

P7; *"...high humidity, the low-temperature difference between day and night...In Manavgat, the forest and the air were burning too...There was high temperature...the steepness of the land was forcing..."*

P9; *"...The wind factor is significant. The wind stopped in Manavgat; the fire stopped...humidity is another important factor. In coastal areas, fire moves quickly due to humidity and wind..."*

P11; *"...tree roots continue to burn for 3-4 days because it is kindred..."*

Related to the human factor;

P3; *"...Generally, fires caused by negligence occur...In addition, the presence of residences on the land made it difficult to control..."*

P5; *"...The reason for its formation is people, terrorism, etc. there could be reasons...the main reason was lack of timely action...Protection systems were not in place...debris vegetation needed to be cleared..."*

P8; *"...Fires are inevitable when people and machinery enter the land...on equipment, worn areas can rub off to create sparks...burning animals can carry fire to unburned areas..."*

P10; *"...Fires can be started as a result of political and political activities...to open the area for construction activities or to convert burned trees into products by processing them for profit..."*

#### **Theme 4. Institutional Roles**

The "institutional roles" theme consists of 3 sub-themes: team capacity, vehicle-equipment capacity, and education-experience. About team capacity;

P2; *"...Whoever knows the area and vehicles well should intervene. Forestry teams and we are different units...for example, forestry teams reach the bus fire but do not intervene by saying we are not responsible..."*

P3; *"...fire managers need to be involved in the coordination because they know the area...volunteer firefighting is important to increase team capacity..."*

P9; *"...The person in charge of the coordination does not know the region. The foresters are in the status of workers, but they know the region...In addition, five vehicles out of 10 are in different regions, with vehicle delivery problems. These vehicles will take 8-10 hours to return for the fire in their own region..."*

P10; *"...Since fire brigades are part of municipalities, they cannot function as a professional group regardless of politics..."*

P11; *"...Since firefighting is not seen as a profession in our country, we cannot receive support in case of damage. If there are one-thousand personnel in the region, three hundred will not work. They receive land money, incentives..."*

About vehicle-equipment capacity;

P1; *"...our vehicles are not suitable for the terrain conditions; the forest teams' vehicles, the four-wheel drive vehicle, the risk of staying on the road and overturning is less...we have 85 hoses, both wide and short enough. They have 65 hoses. We flood them a lot during the intervention..."*

P2; *"...The vehicles of the forestry teams are more equipped than ours...our vehicles do not move through the path opened by the bucket...we have 3-5 tons of water in the vehicles of the forest, and we have twelve tons...we have protective clothing...the forest does not have such clothes..."*

P4; *"...The naming of the equipment was different; they called it murç...they did not know how much the hose was; I heard them say bring a small, big hose..."*

About education-experience;

P1; *"...forest crews do not know your vehicles but try to manage your crews..."*

P2; *"...we are the reinforcement team...if there is no one, we intervene according to our knowledge...if we wait for the forest teams, we will burn ourselves...two people are caught in the fire, they could not be saved..."*

P4; *"...we saw that the rulers were inadequate...they misjudged the known tactics and applied them in the wrong place...I have seen that people unrelated to the fire, such as erosion control teams, are assigned. This may be one of the biggest reasons for the high casualties. The forest fire response teams are less equipped and trained than firefighters..."*

P5; *"...drills were not held...the people to coordinate the teams should be more trained...we need to standardize our rescue capability..."*

P7; *"...The equipment and trained forest villagers will be able to respond to the fire...Our training and experience is on residential fires..."*

P10; *"...they attend because the training is compulsory 10 out of 100 seriously want to learn..."*

### 3. Discussion and Recommendation

#### 3.1. Evaluation and Recommendation Regarding the Coordination Theme

Based on the discourses, public institutions, private sector organizations, NGOs, volunteers, etc., are expected to participate in disaster situations. It is understood that cooperation with stakeholders needs to be established more effectively. It is seen that cooperation with the stakeholders develops spontaneously upon request, and instant partnerships are realized with the agitated volunteers that exist for the needs. However, the effective use of voluntary resources in forest fire intervention will contribute to early intervention in order to reduce the time loss between the notification and arrival time in forest fires with intense combustible materials and oxygen. In addition to the participant's satisfaction with their voluntary participation, the fact that they suffer from life-threatening situations due to a lack of knowledge and expertise suggests that it is necessary to improve volunteer capacity in terms of training, equipment, and legal framework. In addition, although they were unfamiliar with community-based intervention strategies, most of the response personnel (n=7) mentioned the importance of community involvement in the intervention systematic. In addition, the instant realization of large-scale local organizations for forest fires has created new uncertainties regarding management and response services and made incident coordination more complex.

Based on the discourses, the ambiguity of the duty-responsibility areas, the lack of guide personnel and guidance, and problems in transportation to the fireplace stand out. In particular, the problems caused by routing were solved with the use of current technologies and the support of the region's people. In addition, it is seen that the response personnel try to overcome the uncertainties regarding their duties and responsibilities with internal decision support systems and spontaneous intervention decisions. As a result of the lack of effective coordination, loss of time and workforce has emerged in the field, and the teams' need to familiarize themselves with each other's vehicle-equipment capacities and working styles has led to team dispatches to inappropriate points and conflicts.

The participants stated that they generally needed more information about the size, spread, environmental conditions, and subsistence of the event and that they obtained information about the event through mass media. In addition, it was observed that they knew that they would communicate with a contact person while being assigned to the scene, but they could not provide rational communication with different teams and the coordination center during the intervention processes. Although it is seen that the teams can actively use the physical communication systems and are familiar with alternative communication systems, it is understood from the discourses that the forest teams,

which are the primary intervention organizations, cannot be included in the internal communication systems. As a result of the differences in expertise between the teams, the need for more organization for stakeholder cooperation before the fire, and the lack of inter-team communication systematics, it became challenging to present an organized scheme in the response processes. This situation has led support response teams to assume the primary interventionist role at many points in the field. In addition, it was seen that the unfounded news in the media caused the team to carry out risky interventions without creating support, security, and reinforcement teams with their scarce resources.

Based on the discourses, it was observed that the information related to the impact area of the event, possible spread, deployment and intervention points, and escape routes needed to be included. It has been concluded that the reporting, analyzing, and evaluating this information during and after the incident needs to be standardized. The lack of sufficient data and information caused the selection of inappropriate areas of responsibility and deployment points, the spread of manipulated news and security problems, and the inability to use the existing intervention force in a timely and effective manner. Factors that prevent the formation of data and information are inexperience, confusion of authority, ignorance, race to manage, ambiguity of command, size of the event, and lack of clarity of roles and responsibilities. The most dramatic inference is that at a point where there is a strong vehicle fleet and facilities, all participants mentioned a severe lack of coordination in the region. Failure to provide effective coordination processes underlying response management has led to severe organizational problems.

It is understood that the firefighters who came to the region to participate in the response work upon request using public and local facilities for the supply of fuel, extinguishing material, and accommodation. In addition, the organization has been achieved very quickly at the point of meeting the basic needs thanks to the high interest and benevolence of the local people, the public, and NGOs. However, it is seen that there are problems in the management of logistics processes such as warehousing, stock management, and distribution as a result of uncontrolled demand, excess material availability, and unsuitability of storage conditions, but this problem is not sustainable.

### 3.2. Evaluation and Recommendation Regarding the Response Reaction Theme

Participants stated that they intervened in fires with water and used alternative materials such as foam and fire extinguishers and simple hand tools such as picks and shovels. Although the participants presented evidence of using thermal cameras and drones at some points, most (n=9) stated that traditional methodology was followed in extinguishing agent selection and response methods. The participants stated that thermal cameras are used for prevention rather than intervention, and drones were used for counterfire. In addition, it was stated that airborne intervention, siege, grapple, counterfire, parallel intervention, dilution, and cooling methods were used in the region for forest fire intervention. However, reasons such as the firefighters, who are the primary responders in urban area fires, are not familiar with forest fire intervention methods, the land characteristics, factors affecting the fire and fire behavior cannot be thoroughly evaluated, and the lack of the number of teams have reduced the response power and increased the rate of fire spread.

Based on the discourses, it is observed that firefighters identify passive response reactions with national feelings, helplessness, self-sacrifice, solidarity, fear, aggression, and belief factors. In particular, the personnel involved in the intervention process with emotional motivation factors such as religious beliefs and self-sacrifice act with a mindset that puts their safety in the background. In addition to the emotional reactions, the participants talked about leaving the fire to its natural course, supplying water tankers to forest villages, increasing the number of artificial ponds in the forest and

installing hydrants, increasing legal sanctions, reducing security gaps, regional evacuation, etc. measures can be evaluated as passive responses.

### **3.3. Evaluation and Recommendation Regarding the Source and Spread Factors Theme**

Based on the discourses, it is understood that climatic features such as temperature, wind, and humidity, as well as terrain conditions such as altitude, ruggedness, uncontrolled forestation, old and dry trees, ground cover, tree roots, and species, make fire intervention difficult and increase the spread of fire. In addition, the participants experienced that the ignition temperature, density, and persistence of the combustible material affect the intensity and direction of fire spread and are important factors when developing response tactics and strategies. It has been observed that firefighters intervene in the fire early, but they have difficulty responding due to terrain and climatic conditions and are even exposed to risks.

All participants identified the cause of forest fires with the human factor, albeit for different reasons. Although it is stated that the fires are caused mainly by negligence-carelessness, it is also thought that deliberate fires were created due to economic and political reasons. In addition, the participants also mentioned the need for measures that can be considered risk management studies, such as deforestation, thinning, planting trees with high fire resistance, and equipment maintenance.

### **3.4. Evaluation and Recommendation Regarding the Institutional Roles Theme**

It was seen that the intervention teams had differences in operation, method, tactics, equipment, and legal framework. It has been concluded that these differences undermine the unity of forces required for the reaction, create conflicts and adversely affect the intervention processes. The authority-responsibility confusion in the field has led to the involvement of teams in response processes without their skills and characteristics being discovered. In addition, the lack of adequate planning processes in dispatching teams to respond to fire incidents at different points has also decreased the team's capacity to respond to fires at points with a high probability of forest fires. The high effort and long-term work of firefighters, who do not know the region and have limited team capacity, led to adopting intervention approaches that are dangerous at some points. In addition, it is seen that the firefighters, who frequently mentioned legal problems, unqualified appointments, and problems related to personal rights in the interviews, complained about not being able to take an active role in forest fire management and coordination, lack of institutional strength, inadequacies in the wage policy and opportunism.

Problems were experienced due to reasons such as the heavy and low traction of the vehicles, the lack of pavement material on the roads, the inadequacy of personal protective equipment and equipment for the intervention, the dense and rapid discharge of the intervention material (water), the remoteness of the supply points, the use of different terminology in the intervention. In addition, since the response planning was carried out without evaluating the incident, region, and team, and information in depth, and the support elements were integrated into the response with instant decisions, it was challenging to adapt the response materials in the fire department inventory to the regional conditions. In this sense, the teams mentioned the necessity of adapting the vehicle-equipment capacity to ambient conditions and carrying out standardization studies for equipment naming.

Based on the discourses, it can be deduced that there are differences in the education levels of the response teams, that standardized training is not organized with all of the response organizations, and that the training is carried out for exceptional responses with a high frequency of encounters, and that the plans for the training are insufficient. As a result of the lack of practical, scenario-based response

training in response organizations, it is seen that a response systematic that needs to be more familiar with rescue terminology and rescue team skills has emerged in incident coordination. In addition, educated people will be very functional for forming the first line of defense in the intervention. The inexperience of the teams and the differences in expertise and working styles made the incident response easier. Although the knowledge, ability, experience, and educational background are not appropriate, the individuals involved in the management processes in the field have damaged the trust in decision support systems by the teams who interrupted the intervention. The unplanned interventions and the incompetence of crisis managers reduced the intervention's success and carried the event's size to frightening points. In addition, it is another inference that the teams in the region as a support team have to assume the primary interventionist role at some points, intervention decisions are taken for protection with the effect of environmental conditions, and intervention methods and techniques are misused in some areas.

## CONCLUSIONS

As a result of the analysis, it was seen that the participants often expressed their past forest fire response experiences with the concepts of helplessness and inexperience due to a lack of training, equipment, tools, and personnel. Participants participated in regional fires as response support teams with a central call. However, it was observed that they moved to the scene without detailed information (spread area, response area, assembly point, logistic scheme, etc.) about the fires in the area. In order to overcome the routing problems and prevent time and labor loss, it is recommended to place the directions describing the fire area on the passage routes, to make the location clear with the support of the guide staff or volunteers, and to develop mobile applications where instant information from the field is delivered to the crisis desks. As a result of the analysis, coordination is one of the most severe problems encountered in crime scene management and fire intervention. It has been determined that the problems experienced in coordination bring additional problems such as communication, logistics, cooperation, and authority-responsibility confusion. It has been concluded that the interventionists, who do not have experience in the crime scene and do not know the region, could not communicate rationally with fearful citizens and different teams because they needed help finding a coordination interlocutor. It is thought that making impact analysis and coordination by professionals, requesting the needs in line with the suggestions of these people, ensuring that the regional teams participate in joint exercises and training, organizing in-service training, establishing inter-institutional cooperation protocols, and constantly informing the public against disinformation with briefings will contribute to overcoming the problems experienced in coordination. In order to avoid problems caused by the incompatibility of equipment and vehicles with the terrain conditions, which are frequently mentioned as a result of the analysis, the use of agricultural equipment belonging to the villagers that do not create additional costs for dispatch, the design of drones to support the extinguishing works, the use of unmanned aerial vehicles (UAV) in extinguishing works, and the use of the responders in high-temperature conditions and the use of robotic technologies is recommended in order to minimize their exposure to flame. In order to reduce the impact of the human factor, which is the most common cause of forest fires in the region, and to get the support of the local people who constitute the majority of the volunteer capacity, it is recommended to raise awareness of individuals about forest fire precautions, to activate the volunteer firefighting system, especially in areas with high fire risk, and to increase their awareness level with the projects and campaigns to be carried out. In addition, as emphasized by the participants, planting trees with low flammability in areas with high fire risk and adding deterrent penalties by arranging legal legislation will contribute to forest fire management.

### **Compliance with Ethical Standards**

**Conflict of interest:** *There is no conflict of interest between the authors or third-party individuals or institutions.*

**Ethics Committee Approval:** *Ethics committee approval for the study was obtained from Gümüşhane University Scientific Research and Publication Ethics Committee with the decision numbered 2021/8 dated 29.12.2021.*

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