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OCCUPATIONAL HEALTH AND SAFETY PRACTICES IN THE FORESTRY SECTOR IN TURKEY: A BRIEF REVIEW

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ABSTRACT

This study provides a comprehensive review of the occupational health and safety (OHS) practices in the forestry sector in Turkey, highlighting the current trends, challenges, and improvements over recent years. Forestry work, known for its high-risk environment, involves various hazards, including machinery use, falling trees, and uneven terrain, which pose significant risks to workers' health and safety. This review synthesizes findings from various studies, reports, and regulations to present an overarching view of the OHS landscape in Turkish forestry. The paper begins by outlining the fundamental characteristics of the forestry sector in Turkey, including the types of forestry activities and the typical working conditions. It then delves into the specific occupational hazards faced by forestry workers and the implications of these risks for their health and safety. The study extensively discusses the legislative framework governing OHS in Turkey, emphasizing the forestry sector's compliance with national and international standards. A significant focus is on the preventive measures and safety protocols implemented to reduce workplace accidents and illnesses. This includes the use of personal protective equipment (PPE), safety training programs, and the adoption of new technologies and ergonomic tools designed to mitigate occupational hazards. The review also examines the role of government agencies, non-governmental organizations (NGOs), and worker unions in promoting and enforcing OHS practices. It highlights successful case studies where collaborative efforts have led to notable improvements in safety outcomes. In conclusion, while there have been substantial advancements in OHS within the Turkish forestry sector, ongoing challenges remain. The study suggests areas for future research and potential strategies to further enhance the health and safety of forestry workers.

Keywords: Occupational health and safety, forestry sector, Turkey, workplace hazards, safety protocols.

INTRODUCTION

Today, one of the most formidable threats to forests is forest fires. Fires of varying intensities can completely remove the dead and living cover on the soil or cause changes in the biological, chemical, and physical properties of the soil, negatively affecting the relationship between soil and vegetation (Korkmaz, 2002).

During fires, when temperatures reach particularly high levels, they cause degradation of soil properties as well as damage to water sources through evaporation and contribute to water loss. Soil and water, as non-renewable resources, carry vital importance for all life, and forests play a critical role in maintaining the stability of these resources. Hence, forest fires not only directly threaten life but also indirectly pose a threat by damaging these essential resources (Ayanoğlu et al., 2017: 33). The damage to renewable resources carries risks for living organisms and also plays a significant role in the ecological cycle. In a study by Değerliyurt (2014), it was found that areas in Hatay affected by fires were subject to approximately 4.5 times more erosion compared to unburned areas. Similarly, a study conducted by Ellwell and Fenton in 1941 in the USA found that over the past nine years, regions where fires occurred experienced 12-31 times more loss of soil and water compared to regions without fires. Similarly, according to a study by Tüfekçioğlu and others (2017), the amount of erosion in fire-affected parcels was determined to be 194 kg/ha, while in unburned parcels, this amount was calculated as 78 kg/ha (Tüfekçioğlu & Tüfekçioğlu, 2021).

Forest fires play an active role in preventing erosion and lead to increased surface runoff by destroying vegetation and causing changes in the vegetation-soil-water balance due to the destruction of plant cover. The accumulation of ash resulting from fires creates a slippery layer on the soil surface, increasing the amount of water that contributes to surface runoff and thus leading to the formation of floods (Küçükosmanoğlu, 1995: 108). As a result of floods, materials with polluting properties fill up dams and other water sources, reducing the quality of water resources and putting aquatic life at risk.

Forest fires affect soil and water resources as well as contribute to air pollution and climate change in two different ways. Fires emit toxic gases during combustion, causing air pollution, and also hinder the role that forests would play in balancing atmospheric CO2 concentrations. In addition, fires lead to mass loss, floods, desertification, and air pollution, causing the extinction of fauna and flora and leading to social, economic, and ecological losses, including damage to ecosystems, recreational areas, and residential areas near forest lands (Ayanoğlu et al., 2017).

The effects of fires on forests can be categorized as direct and indirect. Direct effects include damage to forests, soil, vegetation, the litter layer, seeds, and loss of wildlife, while indirect effects are analyzed under three main headings: biotic, edaphic, and climatic (Bilgili, 2014). Fires directly cause death or injury to wild animals and indirectly lead to the destruction of their habitats, causing migrations, food shortages, invasions of other species' territories, and thus disrupting ecological balance (Özkazanç & Ertuğrul, 2011).

In summary, forests are natural regulators in many aspects such as maintaining natural balance, ecosystem stability, water regime regulation, nutrient cycling, climate moderation, soil stabilization, and carbon sequestration. Moreover, they play an active role in enhancing the economies of various sectors (Bilgili et al., 2021). Forests are as valuable to ecology and organisms as fires are dangerous, and fires pose the greatest threat to forests. These threats, caused by the direct effects of fires, also lead to various environmental changes. These environmental changes vary depending on the frequency of fires, the geographic region where they occur, intensity, duration, size, and shape (Yıldız and Özgüler, 2021: 33).

The aim of this study is to conduct a comprehensive review of Occupational Health and Safety (OHS) practices within the forestry sector in Turkey, focusing on the current trends, challenges, and improvements that have been made in recent years. The significance of this research lies in its potential to enhance our understanding of the specific risks and hazards associated with forestry work, which is recognized as one of the most hazardous sectors due to its dynamic and unpredictable working environment.

Forestry workers are exposed to a range of occupational hazards including the use of heavy machinery, the risk of falling trees, and navigating uneven and potentially treacherous terrain. These risks make the sector a critical area for OHS research and interventions. By analyzing the legislative framework, preventive measures, and the roles of various stakeholders in the sector, this study aims to highlight successful strategies and identify areas where further improvements are needed.

The forestry sector not only plays a crucial role in Turkey's economy but also has significant implications for the environmental and social fabric of the country. Therefore, enhancing OHS practices in this sector is not only about protecting workers but also about sustaining the forestry resources and the communities that depend on them. This research is significant as it seeks to contribute to the development of safer working conditions and the overall enhancement of worker welfare in the forestry sector.

By providing a detailed analysis of the OHS practices and the interplay between various factors influencing these practices, this study aims to offer insights that could guide policy makers, industry leaders, and researchers in their efforts to promote a safer and more sustainable forestry sector in Turkey.

BACKGROUND

Forest Fires as a Global Problem

Forests are of great importance for all life due to their functions such as stabilizing the climate, hosting and preserving biodiversity, storing CO2, and preventing natural disasters like erosion and floods. Forests play a key role in combating the climate change crisis and slowing down the process, and have been valued as areas serving human and economic interests to this day (Akkaş, 2021). However, the point reached shows that humanity does not reciprocate the forests adequately. Today, the world is facing forest fires that are becoming globalized and increasing every year in every region. Each year, millions of hectares of forest land are damaged

or destroyed by fires. The majority of the burned areas are located in Mediterranean countries and their surroundings. Countries like Italy, France, Spain, Portugal, and Greece suffer significant losses of life and property due to forest fires every year (Ayanoğlu et al., 2017).

When considering the frequency and intensity of occurrences and their impacts on health, economy, security, and ecology, forest fires have become an increasingly concerning issue for policymakers, political actors, international organizations, and citizens, especially since the early 20th century. The ability of forest fires to spread without recognizing natural and political boundaries and to persist beyond physical limits, reaching uncontrollable dimensions, necessitates an international scale of combat (Miranda et al., 2009).

While the Mediterranean region has a significant share in forest fires, fires are effective on many continents from Africa to Asia, from the USA to Europe, and are surpassing the averages of previous years each year. Greenpeace placed the fires that broke out in Siberia in 2019 among the largest disasters of the century and reported that the smoke cloud formed as a result was wide enough to correspond to the geographical boundaries of the EU (BBC News, 2019). In Indonesia, over 20,000 fires occurred in the first seven months of the same year, and the toxic gases and air pollution caused by these fires led to the suspension of education in over 1,300 schools (Euronews, 2019a). According to the National Disaster Management Agency (BNPB), 330,000 hectares of forest land had been burned in Indonesia in the first eight months of 2019. In the same year, fires in Indonesia and Malaysia affected 40 million people in various ways; for example, approximately 885,000 people in Indonesia suffered from upper respiratory infections (Yıldız and Atanur, 2019). In Greece, the fires in the Attica region in 2018 affected 4,118 people, and 126 people lost their lives (Yıldırım & Yılmaz, 2019).

The Australian newspaper The Sydney Morning Herald in its article dated December 31, 2019, titled "Extraordinary 2019, ending with the deadliest day of the worst fire season," reported that some towns lost access to drinking water due to the pollution of water sources by the fire, intense smoke hindered the evacuation of burn victims, and people trying to defend their homes against the fire died. According to 2020 estimates, at least 25 people lost their lives in these fires, while 67,000 people were forced to evacuate (Hürriyet, 2020). In Australia alone, the fires of 2019-2020 burned more than 10 million hectares, and 3 billion animals were displaced or died (BBC News, 2020). During the same period, in global-scale climate-regulating regions such as Southeast Asia, the Congo, and the Amazon forests, considered large carbon sinks, 4.2 million hectares were destroyed, and according to the World Resources Institute, these forests had the capacity to clean the annual CO2 emissions of 575 million vehicles (NTV, 2021). According to the Copernicus Emergency Management Service (CEMS), forest fires alone caused the emission of approximately 6.735 million tons of CO2 globally until December 2019. The highest emissions occurred in the Northern Arctic in June-July, releasing 140 million tons of CO2, equivalent to 36 million vehicles, in just two months. Another peak period was in Indonesia from August to November, with 708 million tons of CO2 emissions (Euronews, 2022).

The forest fires emerging in many sensitive regions in recent years are harbingers that more frequent and intense fires will occur. The widespread forest fires occurring around the globe indicate that large forest fires

will pose an even greater threat to natural areas in the coming years. Mega forest fires in countries and regions like the USA, Canada, the Mediterranean Basin (2021), Australia (2020), Indonesia and Siberia (2019), the USA and Greece (2018), Chile and Portugal (2017), show that forests are under threat regardless of the climate zone or region they are in, and this threat is growing day by day. Studies show that due to current weather conditions linked to anthropogenic greenhouse gases, the extreme fire risk has doubled in the Amazon and increased by 50% in the Mediterranean Basin. Additionally, it is estimated that due to anthropogenic greenhouse gas-induced changes in temperature, relative humidity, and wind speed, there will be more than a twofold increase in extreme fires in the Amazon, Northeast America, the Mediterranean, Africa, and Southeast Asia by the end of the century (Touma et al., 2021). According to a study by Jolly and others (2015: 1) covering the years 1979-2013, fire seasons have lengthened in 29.6 million square kilometers of vegetation (25.3%), and the global average fire season length has increased by approximately 19%. Another finding from the study shows that the global burnable area has doubled, showing a 108% increase.

Forest fires are already factors with destructive socio-cultural, economic, and ecological outputs, and combating mega forest fires is both dangerous, difficult, and costly (Bilgili et al., 2021: 6). The direct costs of forest fires, such as losses during the fire, damage to crops, firefighting and prevention costs, damage to infrastructure, and death of animals, as well as indirect costs such as damage to cultural heritage and natural areas, which are hard to quantify due to definitional difficulties or lack of data, also exist (Yanıkkaya and Kaymak, 2021: 327-328). For instance, the total economic cost of the California forest fires in 2020 alone has been stated to be $149 billion, including $28 billion in capital loss, $32 billion in health costs, and $89 billion in other costs (Wang et al., 2021). Economists have estimated that the 2019-2020 Australian forest fires caused approximately 75 billion USD in losses, equivalent to about 6% of the country's GDP (Reed and Denniss, 2020). Additionally, the Center for Research on the Epidemiology of Disasters (CRED) has reported that forest fires worldwide have injured 10,500 people and displaced 175,000 people from their homes since 1990. Forest fires also adversely affect wildlife. For example, the Australian forest fires of 2019-2020 damaged or destroyed more than 30% of the existing habitats of 70 vertebrate species, including 21 species already in significant decline due to climate change over the past decade. The same fires burned 97,000 square kilometers of vegetation, creating habitats for 378 birds, 254 reptiles, 102 frogs, 83 mammals, and 15 freshwater fish (Ward et al., 2020).

In the last five years, despite the situation showing its severity in every region, forest fires in 2021 have reached horrific dimensions. In Canada, 2,800 hectares were burned due to 4,891 recorded fires, and in 2021, both the number of fires and the burned area exceeded the average of the previous ten years (1,736 ha). In the USA, as of August 2021, 97 uncontained forest fires continued, damaging over 1.8 million acres of land (Aytekin, 2021). In 2021, over 4 million hectares burned in a single day in the western parts of the USA and Canada due to extreme heat, and it was announced that 35 new fires broke out in just two days (Euronews, 2021).

On a hot day in the summer of 2021, 58 fires occurred in Greece, while Italy saw over 800 fires in 24 hours. In Italy, 20,000 hectares burned within a week, while in Portugal, fires caused the loss of 2,000 hectares of land during the same period. France lost 22,807 hectares in the first eight months of 2021, while Bosnia-

Herzegovina saw 25,583 hectares of forest land burned to ash. In Russia, fires in July burned 1.3 million hectares (Aytekin, 2021). According to mapping by the European Commission's Joint Research Centre (JRC), 1,113,464 hectares of forest fires occurred in 39 countries in 2021, with Turkey being the most affected with 206,013 hectares. It was followed by Italy with 159,537 ha and Algeria with 134,273 ha, mapped in 1,422 fire records in the European Forest Fire Information System (EFFIS) (European Commission, 2022).

Considering the direct and indirect losses experienced in forest fires, questions arise about what should be done to prevent fires at their source instead of conventional methods like firefighting or fire retardant attempts used in combating global forest fires. Despite all the financial investments and technological advances made in the name of combating forest fires, the fundamental problem of increasing fires each year and the failure to prevent them is due to incorrect policies and management in practice (Özkazanç & Ertuğrul, 2011). Despite decades of effort, neither any country nor any international organization has shown significant success in combating forest fires.

According to daily data published by EFFIS, the fires that broke out in some countries in 2022 (July, 2022) have already exceeded the average of the previous 15 years. In Germany, 3,217 ha burned as of July 2022, while in Romania, 149,362 ha burned, with both countries exceeding the average of previous years. In France, 45,802 ha turned to ash, while in Greece, 17,163 ha, in Italy, 32,216 ha, in Portugal, 53,703 ha, and in Spain, 226,175 ha burned. The situation is different in Northern European countries where forest fires were not previously a source of concern. In the 2022 season, the affected area in Denmark is 6 times, in the Netherlands 1.8 times, in Slovakia 22 times, and in Slovenia approximately 25 times higher than the average of the previous 15 years. Similarly, the number of fires in the first seven months of 2022 is 4 times higher in France, 5 times in Germany, 26 times in Hungary, 7 times in Poland, and about 15 times in Romania compared to the average of 2006-2021. In the EU, the estimated burned area in 2022 is 834,566 ha, while the total burned area in the regions covered by EFFIS is approximately 1,636,160 ha (EFFIS, 2022). Although these data are estimates and subject to processing, the increasing trend of forest fires each year is a constant fact based on previous data, and it is clear when looking at past years.

Causes of Forest Fires

For any fire to occur, three essential elements are necessary: heat, oxygen, and a combustible (ignitable) material. The fires resulting from the combination of these three components generally pose a threat to forests during periods when temperatures increase and humidity decreases. Especially in Mediterranean regions, forested areas face an increasingly intense risk of forest fires each year due to decreased precipitation and drought conditions caused by rising temperatures (Mısır & Mısır, 2021). Today, forest fires occur as a result of many different causes and the combination of numerous parameters. Based on their cause, fires are classified as natural and anthropogenic (human-caused). Factors like lightning strikes, high temperatures, and volcanic eruptions are considered natural causes, while fires caused by human negligence, carelessness, or intent are anthropogenic. The share of natural fires within the total number of forest fires varies between 10-15%, and

today, the vast majority of forest fires are the result of human activities (Mısır and Mısır, 2021). For instance, a study by Mietkiewicz and others (2020) showed that 84% of forest fires in the USA between 1992 and 2012 were anthropogenic and that these fires lasted three times longer compared to those caused naturally. Natural fires, i.e., those caused solely by natural processes, represent only a small percentage of all fires and are mostly explained by lightning. The anthropogenic causes of forest fires, however, are numerous and complex; they vary regionally within the same country and among different countries. For example, in Spain, Italy, and Poland, most fires are attributed to intentional arson, whereas in other European countries, forest fires are thought to be caused by negligence or carelessness without intent to harm (Tedim et al., 2015).

With increasing human population and urbanization, the number of residential areas has also increased. The rise in population density in cities has pushed residential areas into rural regions and caused people to live closer to forests than in the past. This situation has made forests more vulnerable to human threats. For instance, actions such as cigarette butts thrown into the forest, burning crop residues, children playing with fire, burning garbage in or around the forest, electric line failures in the forest, military exercises, and the inability to control fires lit for recreational purposes like picnics or camping can cause hectares of forest to burn. Additionally, people intentionally set forests on fire for various reasons including terrorism, hatred, hostility, commercial interests, competition, and attempts to cover up other activities (Bilgili, 2014). Regardless of how and why they occur, the magnitude and intensity of forest fires vary due to changes in meteorological parameters triggered by climate change (Mısır & Mısır, 2021).

The severity and duration of forest fires are primarily influenced by three fundamental factors: temperature, humidity (dryness or precipitation), and wind (Ruffault et al., 2016). In weather conditions where temperatures are high, humidity (precipitation) is low, and winds are strong, the potential for fire in forested areas is high, and these human or natural causes trigger this potential. High temperatures increase the flammability of materials by lowering the temperature level needed for ignition and by reducing humidity levels. This makes fires easier to start and spread more rapidly.

Precipitation has a dual effect on fires (Dabanlı, 2021). A decrease in precipitation directly affects relative humidity, leading to drought in the region, and when the relative humidity drops below a certain level (30%), the potential for fire increases. Similarly, an increase in relative humidity not only slows down the start and spread of a fire but also increases the moisture on the dead organic matter on the forest floor, reducing the flammability of the materials. Another effect of precipitation is the forest fires caused by lightning strikes when heavy and frequent precipitation occurs. Wind is a strong factor in terms of extending the fire to broader areas and enabling it to spread. The speed and direction of the wind directly affect the spread of the fire beyond its original location.

Forest Fires in Europe and EU Policies

Forest fires represent a serious security threat to Europe. Often perceived as a problem primarily for Southern European countries in the Mediterranean Basin, such as France, Greece, Italy, Portugal, and Spain, fires have now begun to pose a danger affecting most European nations. While southern countries are under a greater threat in terms of fire regime (fire frequency, burned area, fire behavior, and causative factors), the problem is widespread across Europe, and today no country is exempt from this danger (Tedim et al., 2015). Fire regimes are changing as a result of climate change, land cover, and land-use changes. While most of the annual burned areas are concentrated in southern countries, regions like Scandinavia have also experienced significant damage from forest fires over the last decade and continue to do so (Cardoso Castro Rego, 2018).

Due to climate change and socio-economic changes, the risk of forest fires is now a significant concern not only in Mediterranean Europe but also in Central and Northern Europe. Norway experienced its largest forest fire in the last century in the Froland region in 2008, losing 2,600 hectares of forest, which significantly increased concerns; Sweden was shocked by a major forest fire in the Västmanland region in 2014, which burned 15,000 hectares of forest in just 12 days (Tedim et al., 2015: 85). The tragic trend of increasing fire seasons in Europe reflects the limits of current forest fire and forest management strategies in effectively addressing the phenomenon (Cardoso Castro Rego, 2018).

As in other parts of the world, the disappearance of forests over centuries was considered normal in Europe. People often burned forests to make way for alternative economic activities like agriculture and farming (Leone & Lovreglio, 2003). Although this has begun to change as we approach modern times, economic motives such as clear-cutting still occupy a significant place among the causes of forest fires.

To examine and analyze the causes of fires at a national level in Europe, a common fire cause database was established in 2012. This classification identified six general categories of fire causes: unknown, accident, negligence, deliberate, secondary fires, and natural. Unknown fires are the most frequently observed category in many countries including France, Germany, Greece, Hungary, and Portugal (Tedim et al., 2015). Although statistics on the causes of forest fires in Europe are not precise, it is known that most fires are human-caused. The Mediterranean Basin accounts for a larger proportion (95%) of human-caused fires globally (Leone et al., 2009: 149). Only about 5% of all forest fires in Europe are due to natural causes, while the rest involve human fault, negligence, or carelessness (Ganteaume et al., 2012). A significant factor triggering forest fires in Europe is the increase in urban settlements near forested areas or bordering these regions. Particularly in Southern Europe, as a result of socio-economic changes, urban settlements in forested areas have increased, and city dwellers' desire for a better life in less polluted and quieter environments has made forests more vulnerable to threats. A large majority of these urban residents, due to their limited understanding of the role of forests and forest fires in nature, engage in negligent behaviors (parking vehicles in vegetated areas, open barbecues, burning trash, etc.) (Tedim et al., 2015).

With the parallel increase in urban settlements in mountainous areas, the population of rural villages has decreased, creating a gap in fire management. The decrease in the rural population has led to a decline in forestry and logging activities, increasing the accumulation of fuel and combustible materials in forests. Additionally, the spread of urban areas in these regions is generally unplanned and not suitable for the land typology, exacerbating losses above previous levels (Tedim et al., 2015). These and similar causes have prevented a desired decrease in forest fires, and instead, a significant increase has been observed. Record losses each year have opened the way for forest fires to be a risk issue on the EU's agenda, yet despite advanced technology and national or international measures, forest fires have remained a threat since the 1980s.

To understand the seriousness of forest fires in Europe, one need only look at the European Forest Fire Information System (EFFIS) data. EFFIS was established in 1998 by a working group within the European Commission's Joint Research Centre (JRC). EFFIS was established with the aim of mapping fire-prone areas in Europe, evaluating fire dangers, and developing and implementing new management strategies. EFFIS started operations in 2000 (Şahan & Kaya, 2022). The initial EFFIS reports focused on Southern European countries, but from 2004 onwards, the reports were prepared under the title "Forest Fires in Europe," covering all European countries. Over the years, EFFIS expanded its scope and since 2011 has published reports under the title "Forest Fires in Europe, the Middle East, and North Africa," covering annual fire numbers, burned areas, causative factors, and fire maps for a total of 43 countries in the mentioned regions. EFFIS also provides a complete fire cycle by evaluating conditions before, during, and after fires (EFFIS, 2022). EFFIS serves as a platform for sharing practices related to fire prevention, firefighting, restoration practices, and other fire management activities among countries (EFFIS, 2016). EFFIS is connected to the Copernicus Emergency Management Service (CEMS) and provides short-term fire forecasts using the Fire Weather Index (FWI) (Euronews, 2022).

According to EFFIS data, in 2015, fires larger than 30 hectares were observed in 32 of the countries covered by EFFIS, damaging an area of 398,325 hectares, more than double the area burned in 2014, with Spain being the most affected European country (EFFIS, 2015). The burned area in European countries increased by 35% in 2016, covering 542,338 hectares. Thirteen of the EU28 countries faced fires larger than 30 hectares, nearly doubling the recorded amount from 2015 (EFFIS, 2016). The fire threat in European countries has increased each year, and the fires in 2017 doubled the amount recorded in 2016. EFFIS's highest fire data processed since its establishment in 2017 showed that a total of 993,558 hectares succumbed to fires (EFFIS, 2017). According to EFFIS data, while 2018 was a relatively calm year for forest fires, more countries than usual experienced fires (22 in the EU28, 38 in the 42 countries covered by EFFIS), and some regions in Northern Europe had a fire season above the average (EFFIS, 2018). The following year, fires larger than 30 hectares were observed in 40 of the countries covered by EFFIS, damaging approximately four times more area than in 2018, totaling 789,730 hectares. EFFIS authors noted the season's uniqueness, stating, "The season was unusual, with most of the burned areas mapped earlier in the season," highlighting the extended fire season. In 2019, just in Southern

European countries (France, Spain, Italy, Portugal, Greece), the burned area reached 194,710 hectares, nearly double the total of the previous year. In 24 of the EU28 countries, fires larger than 30 hectares were observed, with the total burned area for 2018 reaching about 2.5 times at 333,542 hectares (EFFIS, 2019).

In 2020, fires larger than 30 hectares broke out in 39 of the countries covered by EFFIS, burning 1,075,145 hectares, about 35% more than in 2019. Looking at the EU27, we see a similar increase; fires larger than 30 hectares were observed in 20 countries, covering a total of 339,489 hectares. This amount remained above the 2019 data when considering that the UK's 2020 data were not included in the EU figures (EFFIS, 2020). By 2021, 1,113,464 hectares had burned in the countries covered by EFFIS, with the EU alone accounting for nearly half of this area with fires burning 500,566 hectares (EFFIS, 2021). As of August 2022, with four months still to go in the year, the burned area has surpassed the 2021 figures. EFFIS estimates that in the EU countries alone, 707,446 hectares have burned this year, of which 672,074 are matched fires. The affected area in 2022, including other countries covered by EFFIS, has already exceeded previous years, reaching an estimated 1,404,407 hectares (EFFIS, 2022).

Despite increased preparedness levels in European countries, about 340,000 hectares burned in the EU in 2020, representing an area 30% larger than Luxembourg. The 2021 fire season was even worse than 2020, with an area half the size of all burned areas in the EU geography. It was determined that 61% of the burned areas were forests that would take years to recover. In Italy, France, and Romania, the number of burned areas by August 2021 had surpassed the average for 2008-2020. In Turkey, although not the highest in terms of the number of fires for the last ten years, the area damaged in 2021 surpassed the total of the previous nine years, with 61.5% of the forest loss due to fires in the last decade resulting from these fires. 2021 was recorded as the second worst fire season since EFFIS records began in 2000 in the EU. The losses in the past year (2021) left behind the damages of 2017, when over 1 million hectares burned in the EU (European Commission, 2021b).

According to EFFIS data, in France, forest fires in 2015 affected an abnormally high area of 11,160 hectares, while 2016 surpassed 2015, reaching 16,093 hectares. In 2017, like all of Europe, France experienced a long and intense fire season, affecting a wider area compared to previous years. The burned areas in 2019 reached 4.5 times the previous year and twice the average of the previous decade. In 2020, there was a decrease in burned areas to 17,077 hectares, but this rate was still well above the average of the previous decade. By 2021, the area affected in France was more than double the previous year and 3.5 times the average of the previous decade. In 2022, a new record was set with 48,089 hectares affected by fires in France, and with the fire season not yet over, the area affected was about five times the average of the previous decade.

Greece experienced a relatively normal fire season in 2015, but in 2016 saw a significant increase, with over three times the area burned compared to the previous year. While 2017 was a calm year for Greece, contrary to Europe, there was a noticeable increase in the number of fires. In 2018, the number of fires decreased, but the burned area increased by over 2,000 hectares compared to the previous year. As one of the countries most actively fighting fires, Greece saw a decrease in both the number of fires and the burned area in 2019 and

2020, but in 2021 experienced a massive increase, battling fires that affected 131,254 hectares. This was the highest amount mapped since 2007, approximately three times the average of the previous decade. The island of Evia saw 51,000 hectares burned, making it the second-largest fire in the entire area covered by EFFIS.

Italy, as one of the countries most affected by forest fires, battled fires in 2015 that burned 41,511 hectares. In 2016, this amount exceeded the previous three years, reaching 47,926 hectares. 2017 was a year of intense fires for Italy, with fires affecting 161,987 hectares, making it the worst fire season of the last decade. 2018 was calm in Italy, as in all of Europe, but in 2019 both the burned area and the number of fires exceeded the previous year. Italy saw a significant increase in burned areas the following year, with fires in 2019 burning 36,034 hectares and making a strong comeback in 2020, destroying 55,656 hectares. Last year, Italy experienced losses close to those in 2017, becoming the second most affected country after Turkey, with fires in 2021 damaging 159,537 hectares, three times the average of the previous decade.

In Portugal, the fires in 2015 were below the average of the last decade, but there was a 55% increase compared to 2014, affecting 64,443 hectares. In 2016, this amount saw a significant rise, representing 210% of the previous decade's average, with fires covering 161,522 hectares. Portugal was by far the most affected country by forest fires in 2016, with the total burned area accounting for about a third of all fires recorded that year. In 2017, fires burned 540,630 hectares, representing 498% of the average of the previous decade.

As in the previous year, Portugal was the most affected country by fires in 2017, accounting for 41% of all burned area on its own. Despite a significant drop in 2018, a calm year for forest fires, Portugal remained the country with the most burned area. In 2019, Portugal saw a slight decrease but was the second most affected country by forest fires after Spain. The following year saw a much larger increase than the declines of the last two years, with fires in 2020 burning 67,170 hectares in Portugal. Portugal experienced a decrease in 2021 but could not maintain stability, and with the 2022 fire season not yet over, the area burned has already exceeded the previous year.

Romania had relatively calm years in 2015 and 2016, but in 2017, it burned more area than the previous six years, experiencing one of the worst fire seasons in recent years. There was a drop in 2018, but 2019 and 2020 again showed significant increases. By 2021, Romania had surpassed the average of the previous decade, with the burned area four times the previous year. As of now, with the fire season still ongoing, Romania's burned areas have increased sevenfold compared to the previous year, reaching 149,997 hectares.

Spain was below the long-term average in burned area in 2015 but was the most affected European country by fires. In 2016, it saw a decrease compared to the previous year, but in 2017, more than double the area was devastated compared to the previous year. In 2018, like many European countries, Spain experienced a decrease, but the following year made up for this drop, with nearly 84,000 hectares succumbed to fires. 2021 was the worst fire season for Spain since 2017, with 91,295 hectares burned, 24,330 hectares more than the average of the previous decade. 2022 is shaping up to be an even worse fire season for Spain. In the first seven

months of this year, the area burned has not only exceeded the average of the previous decade but is close to the total of the last three years combined.

Sweden, as a Northern European country, is less affected by forest fires compared to other countries, but has still had to combat significant fires for its context. In 2016, Sweden exceeded the average of the previous ten years, and in 2017, it experienced 8 fires larger than 30 hectares, surpassing the data recorded in the last two years. In 2018, Sweden was the third most affected country by fires after Portugal and Spain, a ranking unusual for a Northern country, as noted by EFFIS authors (EFFIS, 2018).

According to EFFIS data, Turkey, although not an EU member, is included in the European geographical context. In 2015, Turkey experienced its worst fire season of the last decade, with 55,070 hectares damaged. In 2019, the burned area in Turkey doubled from the previous year, reaching 11,332 hectares. In 2020, there was a noticeable increase, with Turkey being the most affected country by fires in 2021, burning an area about 4.5 times the average of the last decade.

Sensitive Forestry Approaches in Forest Fires

Sensitive forestry approaches are implemented using modern techniques and analytical methods. Among these, Geographic Information Systems (GIS) and computer-supported decision support systems are the most commonly used. To be successful in combating forest fires, it is essential to use resources both efficiently and economically, and employing advanced technologies is increasingly important. The use of technology in forest fire management, such as Remote Sensing (RS), GIS, decision support systems, and artificial intelligence, is crucial in today's world, where technology is advancing in every field (Bilgili and Küçük, 2002). These systems enable the most effective firefighting before and during a fire by facilitating the acquisition of data. Efficient use of technology is necessary for gathering, analyzing, and delivering results to users. Using GIS, data can be accessed more quickly, easily, and economically. This provides us with useful information before, during, and after a fire (Küçük & Bilgili, 2006). This information includes fire danger and risk, weather conditions, statistics, settlement locations, roads, travel time to the fire, environmental impacts, firefighting organization, and capacity (Küçük, 2004). GIS allows for the creation of simple as well as complex maps, thereby supporting decision-makers. Within the scope of combating forest fires, GIS and Remote Sensing techniques are used to predict and detect fires before they occur, model them, understand fire formation, organize efforts, and identify the damage caused by fires (Erten et al., 2005).

The use of decision support systems like GIS in forest fires is a significant factor that influences the success and economy of fire management planning, management, and decision-making processes (Bilgili et al., 2001). To fight forest fires more effectively, the General Directorate of Forestry (OGM) has developed the Forest Fire Information System (FFIS). This GIS-based system allows all vehicles involved in a fire to be tracked in real-time based on their locations. Using Network Analysis methods in a GIS environment, the quickest routes for the first-response teams to reach the fire area can be determined and directed (Ün, 2009). In the FFIS

environment, GIS data is used to develop fire models aimed at predicting fire behavior (Ün, 2009). Additionally, fire risk maps are produced to understand the probability of fires in forest areas. Furthermore, visibility analyses of fire watchtowers are conducted to ensure they are optimally positioned.

Causes of Occupational Accidents in the Forestry Sector and Measures to be Taken

Just like any other industry, the forestry sector has its own unique culture and displays various attitudes and behaviors due to its workers and administrative staff. While some characteristics of the operations can be seen positively, the opposite may be true for others. The forestry sector is exposed to external conditions, and administrative measures, engineering interventions, changes in machinery and equipment, among other measures, are not always sufficient to prevent occupational accidents and other issues. This is because the soil, being a living entity by nature, is subject to change at any moment and is an essential part of our lives. Especially in situations like forest fires, the differences between the environment's previous state and its current state can lead to difficulties in intervention and increase life-threatening risks for workers. As a result, forestry work is challenging due to natural conditions like harsh weather and terrain. Additionally, the lack of protective clothing and equipment for workers, along with food and water shortages, further complicates the situation (Menevşe, 2006).

Compared to other sectors, the object of forestry work is nature itself, and operations are under the influence of open-air conditions. The uniqueness of the forestry workforce requires workers to travel to their work sites, making it part of the heavy and hazardous labor group like logging. Moreover, a significant portion of forestry operations cannot be done with the aid of machines, forcing forest workers to perform various tasks at different times. The continuous complexity of technology and increased production figures have made it harder to maintain human health and occupational safety, also increasing natural resource consumption and various environmental risks (Acar and Şentürk, 1997).

Among the measures that can be taken to ensure Occupational Health and Safety (OHS) is the training of forest workers. Approximately half a million workers are employed in forest areas each year. Training these workers and providing them with information on self-protection, and ensuring the use of Personal Protective Equipment (PPE), can help prevent losses. Even a 1% improvement in preventing occupational accidents can lead to thousands of dollars in value increase each year (Engür, 2014).

When referred to as "gradient" in the field, it means "land with many ups and downs, soil" in the context of the angle of the land. Working in areas with such elevation changes always requires more attention and planned work compared to flat areas. Operations like cutting and transporting trees are among the most hazardous tasks. The use of machinery in forestry activities has been observed to reduce the incidence of accidents and injuries by nearly 70% (Menevşe, 2012).

Different types of forests form at different elevations. The interventions to be made in each type and the machinery and equipment to be used accordingly vary. The gradient also poses challenges to mechanized

operations because, beyond a certain steepness, modern technology does not allow for mechanized work. This necessitates manual labor, increasing the risk of accidents. In forestry, "texture" refers to the structure of the soil. The handling of fine-textured soils, coarse-textured soils, or sandy soils involves differences in fieldwork (Başkan, 2004). Therefore, fieldwork conducted without considering these differences during operations necessitates that workers operate with additional precautions and technical knowledge.

OCCUPATIONAL HEALTH AND SAFETY IN COMBATING FOREST FIRES

One of the greatest dangers causing the depletion of forest resources is fires. On average, two million hectares of forest area are destroyed by fires worldwide each year. In 2022, 2,167 forest fires damaged 5,644 hectares of forest area, with an average of 2.6 hectares per fire (OGM, 2023). According to these figures, there has been a 10.12% decrease in the number of forest fires compared to the previous year, and a 53% decrease in the area damaged by fires. Research and statistics on forest fires indicate that the majority of fires in our forests are caused by humans. In 2022, the causes of 45% of forest fires were identified. Of these, 32% were due to individual negligence and accidents, 19% were natural causes, and 4% were intentional actions (OGM, 2023).

Due to its Mediterranean climate, Turkey faces a significant risk of frequent forest fires. According to EFFIS data, between 2007-2022, the average area burned per fire in European countries located in the Mediterranean climate zone was 2.65 ha in France, 3.73 ha in Turkey, 4.6 ha in Portugal, 6.83 ha in Spain, 12.72 ha in Italy, and 41.98 ha in Greece (OGM, 2023). In 2022, a total of 137,539 hectares of forest area burned in the EU-28 (JRC, 2023). This situation, when compared with the forest area and annual forest fires in countries around the Mediterranean, shows that our country is more successful in combating forest fires. Turkey's success, compared to countries around the Mediterranean, can be attributed to the firefighting methods used as well as the efficient use of physical and mental labor. However, while labor is fundamentally utilized, occupational health and safety aspects are often overlooked. This is mainly due to the primary focus on extinguishing fires and being successful in fire suppression. According to Articles 169 and 170 of the Turkish Constitution, Laws No. 3234 and No. 6831 (Articles 68, 69, and 76), and Regulation No. 285 within Law No. 6831, the responsibilities and duties of the OGM regarding forest fires are defined. OGM has adopted a managerial structure for combating forest fires, with the establishment of a Directorate of Firefighting in the central office and firefighting branch directorates in regional forestry directorates, as well as forest management directorates and subordinate chiefdoms. OGM also operates in areas where there is no fire brigade or where it is insufficient.

During the "New Approaches in Combating Forest Fires" workshop held online on 24-25 December 2020 due to pandemic measures, the issue of forest fires was thoroughly discussed, and short, medium, and long-term goal-oriented approaches were developed. The Minister of Agriculture and Forestry, in his speech at the workshop, mentioned the use of unmanned aerial vehicles for the first time this year to detect and fight fires, noting their significant benefits in directing and managing teams. With a UAV, an area of 600-800 thousand hectares can be scanned instantly, and about 3-3.5 million hectares can be scanned within a minute, allowing for rapid

detection of fires and swift mobilization to the region. In 2021, the strengthening of aerial capabilities with 5 amphibious planes, 4 drones, and 30 helicopters was aimed, and with the introduction of the Fire-Cell system, communication problems in fires were expected to be resolved, emphasizing the importance of technology in combating forest fires. The interventions in fighting forest fires, traditionally focusing only on combustible materials, have recently expanded to targeting the heat source with water and oxygen with chemical agents. The increase in vehicle and equipment use in firefighting has also led to a rise in potential hazards. As the potential sources of danger increase, so do the risks. Looking back at the history of occupational health and safety in Turkey, the first legal regulations date back to the 1865 Dilaver Pasha Regulation, followed by the Mining Regulation of 1869. The laws of the Republican era related to occupational safety and worker health began with the laws of the Amel-i Menafi-i and Ereğli Havza-i Fahmiyesi in 1921. Subsequent significant legislations include the Obligations Law of 1926, the Public Health Law of 1930, the Labor Law No. 3008 of 1936, and the Workers' Insurance Institution Law No. 4792 of 1945. The Social Insurance Law No. 506 of 1964 came into effect, providing workers with protections against various risks. This law was replaced by Law No. 4958 in 2003, followed by the Social Insurance and General Health Insurance Law No. 5510 on 16.06.2006, and the Labor Law No. 1475 of 1967 and No. 4857 of 2003. The basis for these laws is derived from certain articles in our constitution relevant to these issues. Article 50 of the Constitution states, "No one can be employed in jobs that do not suit their age, gender, and strength. Children and women, as well as those who are physically and mentally disabled, are specially protected in terms of working conditions. Resting is the right of the employees. The rights and conditions of paid weekly and public holidays and paid annual leave are regulated by law." Moreover, Article 56 states, "Everyone has the right to live in a healthy and balanced environment. It is the duty of the State and citizens to improve the environment, to protect environmental health, and to prevent pollution. The State organizes health services to ensure that everyone can live their life in physical and mental health, increasing savings and efficiency in human and material power, and facilitating cooperation. The State uses public and private health and social institutions to fulfill this duty, improving these institutions to provide widespread health services. General health insurance can be established by law to ensure the provision of health services extensively." (TBMM,2018).

In Turkey, the absence of a specific law on occupational health and safety has been continuously highlighted in ILO conferences and EU reports. Turkey became a member of the International Labour Organization in 1932. The ILO's Conventions No. 155 and 161 and the EU Directive 89/391 mandated Turkey to enact an independent OHS law. Consequently, the Occupational Health and Safety Law No. 6331 was enacted, replacing the OHS-related articles of the Labor Law No. 4857, and was published in the Official Gazette No. 28339 on 30 June 2012. This law introduced several changes, including bringing public institutions within its scope and eliminating distinctions between worker titles among employees, emphasizing the term 'employee.' Although the provisions of Law No. 4857 remain in effect in forestry operations with more than 50 personnel, public institutions do not apply certain obligations related to occupational health and safety. This non-application increases the risks for employees and employers. Reviewing scientific studies on working conditions and occupational health and safety in forestry activities, several studies stand out: "A Study on Working Conditions

and Occupational Accidents in Forestry Production Operations" by Menevşe in 2006, "An Analysis of Health and Occupational Safety Issues of Workers Engaged in Combating Forest Fires" by Akay and colleagues in 2008, "Evaluation of Anthropometric Data and Working Postures as Accident Risk Factors in Forestry Production Labor" by Inez in 2008, "An Analysis of the Social Situations and Working Conditions of Aerial Support First Intervention Teams Operating in Fire Helicopters" by Akay and colleagues in 2009, and "A Case Study Analysis Related to Health Examinations of Forest Workers in Forestry Production Operations" by Melendez and colleagues in 2012. Generally, most of these studies focus on forestry production operations, with only a few concerning workers involved in fire operations. These studies have not aimed at preventing hazards and risks for personnel engaged in firefighting. This indicates that the research conducted is insufficient. Therefore, priority should be given to studies related to forest fires.

RISKS ARISING FROM FOREST FIRES IN TURKEY AND MEASURES TO ADDRESS THEM

After prevention and containment of the fire, another crucial aspect is to prevent it from turning into a larger-scale disaster through effective organization before it spreads further. It is essential that individuals involved in firefighting are well-informed about occupational health and safety (OHS) measures and proficient in their implementation, as this not only contributes significantly to human health but also to the country's economy. Given the potential for disability, injury, and death in firefighting activities, occupational health and safety are paramount. Some factors that need attention in forest fire control and which complicate firefighting efforts include:

- Excessive heat generated by the fire
- Reduced visibility due to smoke and dust
- Terrain obstacles
- Difficulties encountered by firefighting personnel in accessing equipment and tools
- Mandatory night shifts
- Difficulty in predicting the direction of fire spread due to sudden changes in wind direction
- Stress and tension, among other factors.

Reducing the number of accidents and occupational diseases is a fundamental goal of occupational health and safety. One of the scientific methods used to achieve this goal is risk assessment. Risks encountered in forestry activities can be categorized into four main types: physical, chemical, biological, and psychological risks. Additionally, besides the mentioned dangers and risks, many other unforeseen hazards and risks can occur in fire situations. Minimizing these risks involves eliminating the contact between the hazard and the worker. The most effective way to deal with risks is to address their source directly. A preventive culture provides the best solution for real protection. It's more appropriate to establish an effective prevention policy rather than merely attempting to eliminate the consequences of potential hazards. Incompatibility between the job and the worker increases the risks. Therefore, selecting suitable employees for the job is an important approach to risk reduction. Problems arising from the lack of adaptation during technical developments also contribute to

increased risks. Hence, adapting to technical advancements is the most effective way to mitigate risks. Work equipment and production methods also contain elements of danger. The key action is to replace hazardous elements with non-hazardous ones to reduce risks. Occupational health and safety measures are not limited to individuals; collective protection measures are more effective in reducing risks and hazards. Collective protection measures take precedence. Finally, providing instructions tailored to the workers' conditions is crucial. Instructions that do not match the workers' conditions can lead to an unhealthy and unsafe work environment. It is necessary to avoid this (Çentel, 2013).

CONCLUSIONS

There are many factors in workplaces that jeopardize the health of workers. As a result of these adversities, employees may be prone to occupational accidents and diseases. According to the International Labour Organization (ILO), every 15 seconds, 160 workers worldwide experience a work-related accident. Approximately 6,400 people lose their lives every day due to occupational accidents or diseases. Approximately 270 million occupational accidents occur each year, with over 313 million workers suffering non-fatal but debilitating accidents, and around 160 million workers contracting occupational diseases. It is worth noting that the lack of reporting and registration systems in place may mean these figures could be even higher. Asbestos alone is estimated to cause the loss of around 100,000 lives annually. Despite a decrease in asbestos production globally since the 1970s, the risk persists for those exposed to existing asbestos. Silicosis, a fatal lung disease caused by silica dust, affects millions worldwide, with approximately 37% of construction workers in Latin America and significant percentages in other industries affected. The construction sector, where employment rates are high, records the highest incidence of occupational accidents according to the ILO. In Turkey, the mortality rate of construction workers is approximately 4.5 times higher than the European average.

Despite increasing mechanization, manual labor remains prevalent, particularly in developing countries. According to the ILO, the construction sector worldwide experiences around 60,000 fatal accidents annually, with a worker losing their life to an occupational accident every 10 minutes. Daily worldwide statistics indicate approximately 1 million occupational accidents, over 4,932 cases of occupational diseases, and 1,096 fatalities due to occupational accidents. In Turkey, approximately 172 occupational accidents occur daily, leading to 5 fatalities, with 6 workers permanently disabled. The economic loss resulting from these incidents ranges between 3% to 5% of the Gross Domestic Product (GDP). This financial loss amounted to 44 billion TL in Turkey in 2010 according to the Turkish Statistical Institute (TSI).

One of the primary goals of economic enterprises is to generate profit sustainably. However, substantial costs are incurred due to occupational accidents. Minor accidents may seem insignificant initially but, considering factors like the mandatory notification to the Social Security Institution (SSI) within three workdays, the morale of workers, etc., they can result in an eight-hour loss of productivity per worker. Despite advancements in

Occupational Health and Safety (OHS) in recent years, inadequate implementation of necessary precautions leads to losses for both workers and employers.

The forestry sector, being inherently exposed to natural elements, presents numerous hazards. Despite efforts to mitigate them, complete prevention is often impossible. However, during natural disasters like storms, proper safety measures should be established in workplaces to ensure workers' safety. Failure to do so may result in significant financial and psychological losses.

Ethics Statement

"This article complies with the journal's writing rules, publication principles, research and publication ethics rules, and journal ethics rules. The author bears responsibility for any violations related to the article." Since this article was conducted through review article, one of the qualitative research methods, it does not require ethical board approval.

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