

# Environmental Sustainability Implications of Forest Fires: Evidence From Turkey

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## Research Article

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# Abstract

This study aimed to identify research seeking to answer the fundamental research question: What are the effects of forest fires on environmental sustainability? This research employed a qualitative research method using document and archive analysis. Existing documents, reports, diaries, letters, photographs, and digital content were initially examined. Areas of study were identified to classify the effects of forest fires on ecology and environmental sustainability. The first step of the study was a literature review. Data was collected from relevant literature to achieve the objectives. As part of the initial study, the General Directorate of Forestry's past fire data, including Fire Assessment Reports and Fire Action Plans, were examined in detail. Document and archive analysis is the process of systematically collecting and extracting meaning from existing documents in qualitative research. This method uses written, visual, or digital sources related to the research question, instead of direct data collection methods such as observation or interviews. The documents obtained as a result of the research were classified and systematically organized. The obtained documents were linked to the research question. It is clear that the damage and negative impacts caused by forest fires will be similar to their effects on the environment on a broader scale. Forest fires do have some beneficial effects, but these are insignificant compared to the environmental damage. The revelation that the vast majority of forest fires are caused by human activity is expected to encourage authorities to take preventative measures.

## 1. INTRODUCTION

The importance of forests to life cannot be overstated. They prevent erosion, clean the air we breathe, purify the water we drink, and serve as a significant barrier against climate change (WWF, 2022). However, due to the increasing number of forest fires worldwide, these natural resources are being rapidly lost. According to the European Space Agency's estimate, approximately four million square kilometers (1.5 million square miles) of land are affected by fire each year. It should be noted that this area is larger than India and almost four times the size of Nigeria (Hussein, 2021). More than 12 million hectares of tropical forest cover were lost in 2020 alone; this loss equates to approximately 30 football fields of trees every minute (WWF, 2022).

Inger Andersen, Executive Director of the United Nations Environment Programme (UNEP), emphasized in the foreword of a report that rising atmospheric greenhouse gas concentrations and associated wildfire risk factors are exacerbating dangerous fire weather conditions. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), wildfire-prone weather conditions (dry, hot, and windy) have become more common in some regions and are expected to become even more widespread with increasing global warming. This poses a serious threat that could lead to deforestation. Indeed, 13 of California's 20 most destructive wildfires occurred in the last five years, and in September 2021 alone, these fires destroyed 40,000 homes, businesses, and other infrastructure (Pandey, 2022). Forest fires not only threaten forest survival but also disrupt biodiversity, ecological balance, and environmental sustainability. In recent years, forest fires have been frequent in the Himalayas, particularly

the Garhwal Himalayas. India's total tree and forest cover is 80.9 million hectares, representing 24.62% of the country's total area.

(FSI, 2022). Between November 2020 and June 2021, 52,785 forest fires were detected by the MODIS (Moderate Resolution Imaging Spectro-Radiometer) sensor and 345,989 by the SNPP-VIIRS (Suomi National Polar Orbiting Partnership – Visible Infrared Imaging Radiometer Suite). While dry deciduous forests are particularly vulnerable to severe fires, evergreen, semi-evergreen, and highland temperate forests are relatively less vulnerable. It is estimated that more than 36% of the country's forested area is at risk of regular forest fires.

The research strategy was established to identify studies that address the following fundamental research question: What are the effects of forest fires on environmental sustainability?

The most important step in this direction is to investigate the impact of differences between different fire intensity groups. Then, data from various stands must be collected and analyzed. This limited research aims to reveal the effects of different fire intensity groups on regeneration.

The research consists of five sections. The introduction section provides information on the necessity of forests for our planet and the research problem. The second section provides a conceptual framework regarding the impact of forest fires on environmental sustainability. The third section provides information on the methodology used in the research. The fourth section provides conclusions regarding the environmental impacts of forest fires in Turkey. The fifth section includes the results and discussions.

## **2. CONCEPTUAL FRAMEWORK**

### **2.1. Forest Fires and Their Types**

To improve sustainable forest management, an integrated understanding of natural degradation processes and their effects is crucial (Hunter, 1999). Fire degradation has increased worldwide in recent years, primarily due to climate change and human activities (Chen, 2009). Forest fire is the largest type of degradation in many natural landscapes; in addition to shaping the structure and function of ecosystems, it can also cause significant timber loss and land burning (Greene and Johnson, 1999).

Wildfire can affect ecological factors, particularly physical, chemical, and microbial processes above and below ground, which can alter succession and mineralization rates. These changes influence the spatial and temporal dynamics of land cover, leading to indirect effects on degradation processes such as soil erosion, precipitation, and runoff (Bowman et al., 2011). Furthermore, the effects of the greenhouse gas CO<sub>2</sub> can cause extreme climate change and increase the frequency of fire outbreaks, increasing susceptibility to wildfires (Ackerly, 2004). According to Dickmann and Lee, wildfire during the 20th century may have affected forest regeneration and suppressed fire-dominated forest management. Traditionally, boreal forests have been able to successfully regenerate naturally after fire (CCFM, 2005). The ecosystem's response to fire outbreaks forms the basis of fire ecology, particularly for post-fire

regeneration. The early stages of post-fire regeneration can be influenced by various factors, including microclimate, depth of organic matter, soil vegetation, and soil texture availability (Chen, 2009). For example, wildfire damage can reduce the stand canopy, leading to regeneration failure; it can also destroy roots and stems, all of which have significant effects on regeneration. A 1996 study showed that regeneration in a given physiographic area is influenced by three ecological factors: seed supply, environment, and seedbed.

- Environmental factors: Sunlight, moisture, frost, temperature, and wind.
- Seedbed: Soil type, microclimate, depth of organic matter, soil vegetation, soil texture, and erosion accumulation.
- Seed supply: Seed source, type, production, quality, and damage status. These three factors collectively influence regeneration.

## 2.1.1. Fire Intensity and Regeneration

Post-fire regeneration functional groups (obligate pollinators and resprouts) can be stimulated and increase in numbers at moderate and high burn severity. Annual species, especially grasses, colonize burned areas after moderate-severity fires (Cristina, 2017).

Low-intensity fire: Affects herbaceous plants, does not significantly alter ecological factors (temperature, pH, organic matter), and promotes regeneration by increasing seed and soil contact opportunities (Sun, 2011).

Medium-intensity fire: Herbaceous plants are completely burned; few seeds remain on the ground, and the canopy is severely reduced. Regeneration is largely dependent on herbaceous plants. In boreal forests, pioneer species such as larch, poplar, and aspen initiate succession and become dominant species in the future (Heather, 2018).

High-intensity fire: Soil organic matter is significantly reduced; the litter layer is completely burned, leaving no seeds. Fast-growing species (poplar, white birch) quickly become dominant; coniferous species take a long time to regenerate (Grau-Andrés, 2018).

Natural fires develop depending on the moisture content of the burned material (Stanimir, 2015). Forest fire behavior can influence microclimate changes in forested areas in many ways (Thomas et al. 2021). Fire is likely to increase temperature and decrease moisture, increasing fire risk. Furthermore, the impact of fire may become more severe in the coming years due to the frequency of extreme disturbances and climate change (Bartkowiak and Lemanowicz, 2017).

Air temperature and precipitation trends can affect the condition of the burned material; high temperatures can create fire-prone ecosystems. Changes in microclimate increase drought susceptibility, reduce water absorption, and alter nutrient cycling, negatively impacting regeneration (Refsland, 2018). Drought can further intensify the impact of regeneration by increasing fire intensity. In summary, wildfire

affects environmental factors (temperature, humidity, etc.); high temperature and low humidity increase fire severity and alter the regeneration process.

## **2.2. Impacts of wildfires on Environmental Sustainability**

### **2.2.1. Effects of Fire on Soil Organic Matter**

Forest fire, in particular, alters the chemical and physical properties of soil organic matter and nutrients; it can facilitate or hinder tree regeneration in boreal forests (Bigelow, 2012). Fire has short-term effects on soil composition and nutrients (Heydari, 2014); post-fire mulching, in particular, can have significant consequences for soil organic matter. Soil organic matter plays a critical role in ecosystem dynamics through ion exchange, interaction with clay minerals, formation of soil aggregates, the ability to absorb and release plant nutrients, and the ability to retain water (Huang, 2018). Therefore, the indirect impact of wildfire on regeneration is largely dependent on soil quality.

Experiments by Shakesby et al. (2013) showed significant losses in soil organic matter following low-intensity fires in Central Portugal. Sun (2011) reported that slight increases in organic matter were observed after low-intensity fires, and that flame temperature varied with intensity.

Fire accelerates mineralization in moisture-limited ecosystems, but it depletes soil organic matter and reduces microbial processes, reducing long-term nutrient availability (Neary, 2005). Severe fires alter soil structure, porosity, and water-holding capacity, affecting erosion potential and regeneration. While organic matter and soil exoenzyme activities are generally negatively affected (9%), some enzymes may also show positive responses (Bowman, 2011).

### **2.2.2. Effects of Forest Fire on Temperature**

Forest fires can burn most of the dead branches and leaves on the ground, reducing ground reflectivity. Therefore, wildfires can affect the ground reflectance and radiation balance, and ground temperature can fluctuate. According to three studies conducted by Bai in 2012, Davis in 2017, and Kasischke in 2005, the peak temperature in burned areas after a fire is higher than that in unburned areas. Therefore, the temperature range after a wildfire is expected to increase, as evidenced by the maximum post-fire temperature.

### **2.2.3. Effects of Wildfires on Air Humidity**

Humidity in a forested area can be divided into atmospheric humidity and soil moisture. Atmospheric relative humidity refers to the actual vapor pressure of the air and the percentage of saturation vapor pressure at the same temperature (Refsland, 2018). Furthermore, changes in atmospheric moisture content affect the germination and growth of plants in the surface layer and can also displace water in the soil, which is one of the factors affecting surface temperature.

Soil moisture is important in determining potential yield. It refers to the water content of the soil, which is a significant factor. Soil water content is an important indicator of soil fertility and a key factor in forest

development. Soil moisture content directly affects the amount and rate of soil heat transfer (Bai, 2012). The higher the soil moisture content, the stronger the soil's ability to retain moisture, absorbing more heat and preventing soil overheating by transferring surface heat to the soil in a timely manner. As previously mentioned, forestland temperature will increase significantly after a fire. Therefore, the implication regarding moisture is that water in the atmosphere or soil will decrease as the forest fire occurs.

Consequently, moisture loss has negative effects on regeneration because water is fundamental to the physiological activities of trees (Heather, 2018). Plants must obtain water through stem runoff, which combines and transfers precipitation and solutes within the plant body (Holden, 2015). Moisture loss will lead to a decrease in available water for trees. Therefore, forest fires are increasing as a result of soil moisture loss.

## **2.2.4. Effects of Forest Fire on the Seedbed**

The seedbed represents the environmental conditions necessary for seed germination. During forest fires, the burning of surface litter and changes in soil structure directly affect the seedbed. Heather (2018) states that fire disrupts soil structure, reducing favorable conditions in the seedbed. Furthermore, high temperatures can reduce or completely destroy seed viability. In some species, fire can provide the necessary conditions for cracking seed coats and breaking dormancy (Thomas et al. 2021). In this context, the effects of fire may vary by species. However, in general, the negative effects of intense and prolonged fires on the seedbed are more dominant.

## **2.2.5. Effects of Forest Fire on pH**

Soil pH is a critical factor that directly affects plants' ability to absorb nutrients. The ash layer formed on the soil surface after a fire can cause pH levels to rise (Bai, 2012). Because ash generally contains basic elements such as calcium, potassium, and magnesium, it reduces soil acidity and increases alkalinity. However, this change is not permanent. Over time, as the ash layer is removed by precipitation and surface runoff, the pH value may decrease again. Therefore, the post-fire pH increase is considered a short-term effect (Kasischke, 2005).

## **2.2.6. Effects of Forest Fire on Organic Matter**

Organic matter in the soil is the primary source of nutrients necessary for plant growth. Forest fires lead to the burning and depletion of organic matter. Bai (2012) emphasizes that the organic matter content in the soil decreases significantly after a fire. High temperatures, in particular, destroy a large portion of organic carbon, reducing soil fertility. However, some low-intensity fires do not completely destroy organic matter; they may allow surface plant residues to decompose and contribute to humus formation (Smith, 2005). Therefore, the intensity and duration of the fire determine the degree of impact on organic matter.

## **2.2.7. Effects of Forest Fire on Micronutrients**

Forest fires significantly affect the cycling of essential nutrients such as nitrogen, phosphorus, and potassium in the soil. High temperatures, in particular, cause nitrogen to be lost through gasification

(Heather, 2018). As a result, nitrogen levels in the soil can decrease significantly after a fire. Conversely, some elements, such as phosphorus and potassium, are released during a fire and can contribute to plant growth in the short term (Kasischke, 2005). However, in the long term, these nutrients can be washed away by rainfall, negatively impacting soil fertility.

## **2.2.8. Effects of Forest Fire on Seed Supply and Germination**

Fires directly affect seed supply in forest ecosystems. While the high temperature of a fire can destroy the viability of seeds on the surface, some seeds deep underground may remain unharmed (Thomas et al. 2021). In some plant species, fire plays a necessary role in cracking the seed coat and breaking dormancy. For example, in conifers, high temperatures melt the resin, releasing the seeds (Thomas et al. 2021). Therefore, the impact of fire varies depending on the species and the intensity of the fire.

## **2.2.9. Effects of Forest Fire on Vegetation**

Forest fires cause significant losses in vegetation and alter species composition. While low-intensity fires can support the resprouting of some plant species, high-intensity fires can cause complete vegetation loss (Heather, 2018). Although vegetation may decrease in the short term after a fire, long-term Some species may become dominant and new plant communities may form. This demonstrates that fire can have both decreasing and increasing effects on species diversity in ecosystems.

## **2.2.10. Effects of Forest Fire on Animals**

For animals, fires directly lead to death, injury, migration, and habitat loss. High temperatures and dense smoke threaten the survival of many species during fires (Smith, 2005). Furthermore, changes occur in the food chain after a fire. While a decrease in vegetation makes it difficult for herbivorous species to find food, an increase in insect species can increase the feeding opportunities of some birds and reptiles. Therefore, the effects of fires on animal populations can be both negative and transformative in terms of ecological balance.

## **2.2.11. Forest Fire Effects on the Atmosphere**

Forest fires accelerate global warming by releasing large amounts of carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), methane (CH<sub>4</sub>), and other greenhouse gases into the atmosphere (Bai, 2012). Furthermore, the smoke and particulate matter released during fires reduce air quality and have adverse effects on human health. These gases released into the atmosphere degrade regional air quality in the short term and accelerate climate change in the long term. Particle counts in the atmosphere increase, particularly after intense fires, and this can lead to changes in precipitation patterns (Kasischke, 2005).

## **2.2.12. Forest Fire Effects on Water**

Forest fires directly and indirectly impact water resources. Ash and burned organic matter accumulated on the surface after fires are carried by precipitation into streams and lakes, reducing water quality (Heather, 2018). Furthermore, soil erosion caused by fires leads to the turbidity of water resources and an

increase in sediment load. This negatively impacts both drinking water resources and the organisms living in aquatic ecosystems. When the hydrological balance is disrupted, the capacity of water to infiltrate into the ground decreases, increasing the risk of flooding (Smith, 2005).

Literature demonstrates that forest fires not only have short-term ecological consequences but also lead to changes in long-term environmental sustainability. The effects on temperature, humidity, pH, organic matter, micronutrients, seedbeds, vegetation, animals, the atmosphere, and water vary depending on the severity and duration of the fire (Smith, 2005). Therefore, a conceptual understanding of the multidimensional impacts of forest fires on the ecosystem is critical for sustainable forest management and the development of environmentally sustainable policies.

### **3. METHODOLOGY**

This study utilized a qualitative research methodology using document and archive analysis. In recent years, qualitative research methods have been increasingly used in scientific research (Çelik et al. 2020; Ertugay, 2019; Güneş and Erdem, 2022; Pathak et al., 2013). Interest in qualitative research and respect for the qualitative paradigm continue to grow, and more qualitative research is being featured in professional journals and conferences (Probst, 2015). Qualitative research is a natural process that requires exploring people's perceptions of their social world through in-depth, long-term interaction with them (Glesne, 2020a). The qualitative research process, which attempts to understand and explain human experiences through a humanistic, interpretive approach (Jackson et al. 2007), depends on a number of factors, including the nature of the social world and knowledge, the aims and target audience of the research, the characteristics of the participants, and the researcher's position (Ormston et al. 2014).

Qualitative research, shaped by a fundamental phenomenon to be explored, has some unique characteristics (Creswell, 2017b). Qualitative research reflects participants' perspectives on the phenomenon being investigated (Allan and Skinner, 2020; Creswell, 2017b; Flynn and Korcuska, 2018; Merriam and Grenier, 2019). Furthermore, when collecting data, it conducts direct field observations in natural and real-world settings (Cypress, 2015; Patton, 2005) and attempts to understand how the environment or the social environment in which people interact shapes their experiences (Creswell, 2017b). Qualitative research is crucial for discovering the unknown (Creswell, 2017a) (Data richness in qualitative research).

In this study, existing documents, reports, diaries, letters, photographs, and digital content were first examined using the document and archive analysis method of qualitative research, a scientific research method. Study areas were identified to classify the impacts of forest fires on ecology and environmental sustainability. The first step of the study was a literature review. To achieve the objectives, data were collected from relevant literature. Within the scope of the first study, Oman Gen Fire data from the Directorate of Fire and Fire Assessment Reports and Fire Action Plan Reports from previous years were examined in detail. Document and archive analysis is the process of systematically collecting data and

extracting meaning from existing documents in qualitative research. This method utilizes written, visual, or digital sources relevant to the research question, rather than direct data collection methods such as observation or interviews. The documents obtained as a result of the research were classified and systematically organized. The resulting documents were linked to the research question.

## 3.1. Reliability and Validity

In the research, triangulation was performed between documents collected from different sources. Triangulation is the method of using multiple data sources, methods, or perspectives to increase the validity and reliability of data in qualitative research. The basic idea is to avoid relying on a single source or method, thus ensuring more robust and reliable findings.

Triangulation Types: Data Triangulation: Collecting data from different sources or at different times. For example, examining the same event across different employees, different departments, or different time periods. Researcher Triangulation: When multiple researchers analyze the same data. For example, when two researchers separately code an interview transcript and compare the results.

Method Triangulation: When different data collection methods are used together. For example, when interviews, observations, and document analysis are used to examine the same topic.

Theoretical Triangulation: When the same data set is interpreted from different theoretical perspectives. For example, when an organization's internal communication is evaluated using both motivation theory and organizational culture theory. This research used Data Triangulation, a type of triangulation.

## 4. FINDINGS

Turkey's forest assets cover approximately 30% of the country's surface area, with 23,363,084 hectares. Within this area, normal closed forest area, at 13,813,598 hectares, constitutes 59% of the total forest area, while open forest area, at 9,549,486 hectares, constitutes 41% (OGM, 2024).

Turkey, geographically located in the Mediterranean climate zone, is subject to a large portion of the country's forests, which are under fire threat. 64% of the total forest area consists of areas susceptible to first- and second-degree fires. Therefore, forest fires are among the priority issues for the country's forestry sector (OGM, 2024). Turkey's forest fire toll for 2025 was announced by the General Directorate of Forestry. In 2025, 4,426 forest fires broke out in 75 provinces, damaging 49,769 hectares. The most fires occurred in Çanakkale, while the greatest area loss occurred in Izmir. According to experts, 90% of forest fires are human-caused. This rate clearly demonstrates that the vast majority of fires are preventable (OGM, 2025).

According to Zafer Derince, Istanbul Regional Director of Forestry, the most common causes of fires are: cigarette butts thrown in forested areas, uncontrolled picnic fires, stubble burning, sparks from welding

machines and similar equipment, and objects such as glass bottles igniting by concentrating sunlight (worldofturkiye, 2025).

According to 2025 data from the General Directorate of Forestry, 4,426 forest fires broke out in 75 provinces in the first seven months (January 1-July 22), damaging 49,769 hectares. According to experts, 90% of forest fires were human-caused. The distribution of forest fires by number over the last five years and seven months is detailed in Table 1.

Table 1  
Numerical Distribution of Forest Fire Causes, 2020–2024

| Fire Causes Unit Number                     | Adet | 2020  | 2021  | 2022  | 2023  | 2024  | 2025 (first 7 months) |
|---------------------------------------------|------|-------|-------|-------|-------|-------|-----------------------|
| Natural Number                              | Adet | 312   | 353   | 358   | 399   | 730   | 400                   |
| Intentional Number                          | Adet | 72    | 110   | 86    | 92    | 117   | 4.026                 |
| Negligence/Carelessness/<br>Accident Number | Adet | 1156  | 1001  | 830   | 1.133 | 1.839 |                       |
| Undetermined Cause<br>Number                | Adet | 1.859 | 1.329 | 886   | 955   | 1.111 |                       |
| Total Number                                | Adet | 3,399 | 2,793 | 2,160 | 2,579 | 3,797 | 4.426                 |

Source: General Directorate of Forestry 2024 Activity Report

As seen in Table 1, the rate of naturally occurring forest fires has been steadily increasing between 2020 and 2025. However, their proportion among other causes of outbreaks is 10%. Human-caused causes (intention, negligence/carelessness/accident, and undetermined causes) account for 90% of forest fires. This demonstrates that forest fires can be reduced and prevented with care and sensitivity. Similarly, the spatial distribution of the causes of forest fires for the relevant six years is presented in Table 2.

Table 2  
Spatial Distribution of Forest Fire Causes, 2020–2024

| Fire Causes Unit Number                     | Hektar | 2020   | 2021    | 2022   | 2023   | 2024   | 2025<br>(first 7 months) |
|---------------------------------------------|--------|--------|---------|--------|--------|--------|--------------------------|
| Natural Number                              | Hektar | 197    | 208     | 517    | 365    | 736    | 5000                     |
| Intentional Number                          | Hektar | 718    | 46,148  | 4,722  | 662    | 218    | 44.769                   |
| Negligence/Carelessness/<br>Accident Number | Hektar | 8.285  | 46.878  | 5.428  | 11.260 | 19.959 |                          |
| Undetermined Cause<br>Number                | Hektar | 11.771 | 46.269  | 2.132  | 3.233  | 6.572  |                          |
| Total Number                                | Hektar | 20.971 | 139.503 | 12.799 | 15.520 | 27.485 | 49.769                   |

Source: General Directorate of Forestry 2024 Activity Report

As shown in Table 2, the rate of naturally occurring forest fires has been steadily increasing between 2020 and 2025. However, the number of outbreaks is 10% compared to other causes. Compared to the last five years, 2021 is seen to be higher than other years. Among the reasons for this is the increase in the rate of deliberately started forest fires. For example, the number of deliberately started forest fires reached 46,131 hectares in 2021. This is due to the fact that the Manavgat fire was started intentionally. Because the Manavgat fire was started by a child angry with his relatives, it was classified as a fire not caused by terrorism, arson, or other causes, and was placed in the "other" category. This is the first time this category has reached such a large scale (Kavgacı and Başaran, 2023). The possibility that the person or persons deliberately setting the fires may have acted with the appropriate conditions in mind may have influenced these rates. However, contrary to popular belief and some political circles, the number and proportion of forest fires identified as terrorist-driven in recent years has been negligibly low. For example, none of the fires that occurred in 2021, which damaged approximately 140,000 hectares of forest, were determined to have been started for terrorist purposes. Conversely, even family disputes can sometimes be a reason for deliberate forest burning. For example, it was reported in the press that the fire that caused damage to approximately 4,392 hectares of forest in Marmaris Bördübet in June 2022 was started by a person who was having family problems and was angry that his father sold the family's land without asking them Habertürk, 2022).

## 5. CONCLUSION AND DISCUSSION

Our article investigated the effects and consequences of forest fires on forest ecosystems and environmental elements. It was determined that the destroyed vegetation and rare animal species will cause a collapse in the microenvironmental balance and food chain. Fire will hinder and delay

regeneration processes. The balancing, life-giving, and biotope-protecting role of the forest will be eliminated, and losses due to the destruction of biotopes will be serious.

It is clear that the damage and negative effects of forest fires will be similar to those of the entire environment on a broader scale. Forest fires also have some beneficial effects, but these are insignificant compared to the environmental damage.

There is a direct relationship between the increased intensity of meteorological extremes in the last 10 years, decreased precipitation, rising average temperatures, and snowless winters, and the increase in the number of forest fires in Turkey. While 80–90% of these fires are caused by human activities, a smaller portion is caused by extreme weather events, mostly lightning strikes. As with other forest protection problems, the cheapest and most effective solution to forest fires is to take precautions; however, it is also necessary to be prepared for effective firefighting and appropriately addressing the resulting environmental damage. Most consequences of forest fires will only become apparent after a longer period of time, and in many cases, burned areas can only be partially regenerated, or the damage may become permanent.

All segments of society must understand that we need forests in the future, and therefore, the ecological and other damage caused by forest fires should not be ignored. Protecting our forests is crucial, so we must act quickly and effectively to defend them, especially against those who wish to harm them.

This research, based on data from the General Directorate of Forestry, conducted a literature review on forest fires and their causes over the last five years. The research found that 90 percent of forest fires are caused by humans. Furthermore, the decrease in precipitation as a result of global climate change is causing a decrease in the moisture content in forests. This decrease in moisture will reduce the water available for trees. Therefore, it has been determined that the number of forest fires will increase as a result of the decrease in soil moisture caused by forest fires. According to data from the General Directorate of Forestry, forest fires have consistently increased over the last five years. However, 2021 appears to be higher than previous years. This is due to the increased rate of deliberately set forest fires. For example, the total number of deliberately set forest fires reached 46,131 hectares in 2021. This is due to the Manavgat fire being deliberately set. Because the Manavgat fire was started by a child angry at his relatives, it was classified as a fire not caused by terrorism, arson, or open-fire activities, and was placed in the "other" category. This is the first time this large a fire has reached such a large scale (Kavgacı and Başaran, 2023).

This research concluded that forest fires have negative effects on forest seedbeds, organic matter, and soil pH, reducing the pH of the soil. Furthermore, forest fires release large amounts of carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), methane (CH<sub>4</sub>), and other greenhouse gases into the atmosphere, accelerating global warming. It has been concluded that forest fires directly and indirectly affect water resources, reducing water quality by transporting ash and burned organic matter accumulated on the surface after fires into streams and lakes with precipitation.

However, this study found that while low-intensity fires can promote the resprouting of some plant species, high-intensity fires can completely destroy vegetation. A decrease in vegetation makes it difficult for herbivorous species to find food, while an increase in insect species can increase feeding opportunities for some birds and reptiles (Heather, 2018). Furthermore, soil erosion caused by fires leads to the turbidity of water resources and increased sediment load.

This research is expected to contribute to the literature by identifying the positive effects of low-level forest fires on vegetation, in addition to the negative effects of forest fires. It is expected to contribute to the determination that the vast majority of forest fires are caused by human activity and to encourage authorities to take measures in this regard. This research investigated the causes and consequences of forest fires occurring over the last five years (2020–2025). Future studies investigating forest fires and their causes spanning longer periods of time could be conducted.

## Declarations

### Ethics approval and consent to participate

This study was designed using a qualitative research design. Therefore, since the study does not contain any opinions or data regarding living beings, there is no need to obtain ethical approval.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that there are no competing interests.

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## Author Contribution

tüm katkılar AHMET FİDANOĞLU aittir.

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## Data availability

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