

## **NEGATIVE IMPACTS OF FOREST FIRES ON ECOLOGICAL BALANCE AND ENVIRONMENTAL SUSTAINABILITY: CASE OF TURKEY**

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### **Abstract**

#### **Negative Impacts of Forest Fires on Ecological Balance and Environmental Sustainability: Case of Turkey**

Forests are a vital element in the Earth's ecological balance, economy, biodiversity, water resources and air purity. On the other hand, forests are confronted with various threats – one of them being fires. Its distinctive geographical features provide Turkey with rich plant diversity along with an imbalance in the dispersion of forested land. 27% of Turkey's surface area is covered by forests, most of which are concentrated on the coastal lands and their hinterlands. 2.135 forest fires were recorded in Turkey in 2008, resulting in a loss of 29.749 ha of forest. Although this figure translates into a decrease of 25% in the number of fires, the amount of destroyed forestland increased by 155% with respect to the previous year. This paper questions the incendiary causes and negative effects of fires in the case of Turkey.

#### **Key Words**

ecological balance, environmental sustainability, forest fires, Turkey

## **1. Introduction**

As is known well, forests, as a result of their multiple functions, are one of the most efficient natural resources contributing to the continuity of ecological balance on the face of the earth. They also ensure environmental sustainability. With these attributes, forests are natural resources that have vital importance for not only humans, but all other living creatures as well.

Degenerations in the natural environment caused by the demolition of forests as well as forest loss as a result of uncontrolled use for centuries, especially by human beings, bring forward the issue of protection and sustainable management of forests.

Forested areas, which directly affect the ecosystem in full, as in other resources, are accepted to be not just the possession of a single country but also the common heritage of mankind. Within this framework, international initiatives and efforts for the preserving and sustaining of the mentioned resources are intensified more and more each day. That's because the negative conditions arising as a result of the demolition of these resources for various reasons are experienced globally along with the positive conditions gained as a result of restoring the natural balance. Especially in recent years, new threats that have emerged as a result of changes in the climate require accelerating the efforts for preserving forests.

Fires are a major threat to forests that are vital for the survival of ecological balance and environmental sustainability. Each year, fires, which are caused by a variety of circumstances, cause millions of hectares of forest to be destroyed, a large amount of forest fire fighting expenses, and loss of recreational value and lives. This paper questions the incendiary causes and negative effects of fires in Turkey.

### **1.1. Methodology**

The methodology of this study includes a survey of the literature on the issue of forest fires, collection of up-to-date data from relevant public institutions, administration of field observations over the ecological damages caused by forest fires, analysis and synthesis of data with the observational findings, and mapping of the assessments made upon questioning of the cause and effect relationships.

## **2. The functions of forests**

Besides being an essential part of ecological balance, forests also have many economic and social benefits. Within this scope, we can discuss the functions of forests under the following main topics: ecological functions, economic functions and social functions. "Ecological functions" covers hydrological, erosion prevention, climate protection, biological diversity and preserving of wildlife functions. On the other hand, the forestry products function, including construction materials and fuel wood, can be evaluated under the "economic functions." Social health, ecotourism and recreational functions, employment and aesthetic functions constitute the "social functions" of forests.

### **2.1. Ecological functions**

The most important sub function of forests in terms of ecologic functions is

undoubtedly that they are an oxygen source. Forests make the world more livable for other creatures as a result of the photosynthetic properties of the plants, which take in CO<sub>2</sub> and release O<sub>2</sub>. They also play an important role in cleaning the air with positive contributions such as absorption of dust formed in a variety of ways, reduction of noise pollution and elimination of harmful gasses. Within this context, it is accepted that forests clean 50% of the pollution formed in the air and that one hectare of Beech trees cleans more than 68 tons of dust per year. Also, according to the conducted research, plants contribute approximately 140 billion tons of oxygen to the world, of which forests contribute 66 percent (Konukcu 2001, 12 and 13).

Besides having a great capacity for storing carbon, forests may turn into carbon sources when certain interventions are made (fires, overuse, illegal cutting, desire to obtain agricultural land) and may become harmful to nature rather than beneficial (DPT 2000, 10).

Another sub function of forests within their ecological function is their hydrologic function. Forest flora enables rainwater to travel through the leaves, body and roots of the trees and to slowly reach the earth, and this way, by aiding the formation of underground water sources, contributes to the arrangement of the water regime and consistent and regular provision of water from these sources throughout the year. Forests play an important part regarding the provision of not only drinking water but also water for agricultural irrigation and urban use.

Another main function of forests that can be evaluated under the ecological function is the preservation and regulation of the climate. In this sense, forested areas, which constitute floras spread over large territories, have a positive effect on the shaping of climate properties and also offer contributions such as water evaporating and turning into rain and limitation of the effects of storms. Forests also act as a heat buffer and play an important role in the balancing of temperatures, causing humid local and regional climate properties by decreasing the temperature differences between night and day and between the different seasons.

The land protection and erosion prevention function may be considered to be another sub-function that is among the ecological functions of forests. The tree formations composing forest flora limit the intensity of the rains with their leaves and branches as well as through holding together the soil with their roots and therefore preventing the groundcover from being carried away by external factors such as water and wind. Forests not only protect the soil zones but also prevent or reduce the loss of lives and goods in settlements, other facilities and roads on the foothills by preventing floods, avalanches and landslips.

Preserving the biological diversity and wildlife is another one of the ecological functions of forests. Forests, which are natural shelters for wildlife, provide an opportunity to preserve the biological diversity on earth with the many endemic plants and wild animals they host. The fact that 50% of the existing species on the face of the earth lives in forest ecosystem (Konukcu 2001, 10) proves the effect of forests on biological diversity.

## 2.2. Economic functions

Forests are important not only for ecological purposes but also as an economic asset for the world economy. Since there are many useful products provided by forests,

they are also considered to be raw material depots. The raw materials mentioned can be classified as primary and secondary resources. Primary raw materials consist of construction (building materials) and fuel (wood) materials whereas secondary raw materials consist of plant (seeds, flowers, leaves, roots, crusts, fruits, resin, etc.), animal (hunting, fishing) and mineral (mines, mineral water, etc.) products. Cellulose, which is the raw material paper is made of, is also an important product acquired from forests.

Besides the raw materials provided by wood products, forests play an important part in improving society and forest villages, by meeting the needs for the food, medicine, chemistry, alcoholic beverages, leather and cosmetic industries. The fact that forests provide the materials used in medicine production, meaning that an important part of medicines are produced from plants, along with the fact that a major part of lesser developed countries use the plants directly as medicine, displays another great contribution of forests to the health of people.

### 2.3. Social functions

Forests, besides their ecological and economic functions, also have various social functions that directly affect social life. We can state these as community health, ecotourism, employment and aesthetic functions.

The community health function concerns the part played by forests in CO<sub>2</sub> - O<sub>2</sub> exchange and their role as a filter for the cleaning of the air. This function is key for human beings and all other creatures to continue their presence on earth.

The tourism functions of forests have begun to be more and more evident as a result of people desiring to spend more time in natural environments, starting from the acceleration of urbanization. Within this context, daily or long term tourism activities such as long hikes, camping and safaris represent an appropriate basis for the development of ecotourism, which draws more attention each day.

Forests have an important place in the lives of societies, not only by being the source of raw materials indicated above, but also by providing employment to many people who help convert these products into consumable products. Forests provide many employment opportunities ranging from growth of seedlings to afforestation, from maintenance efforts to fire fighting. These employment opportunities are taken advantage of by many people in many countries, and large masses of populations earn their livings from forested areas. Economic activities such as freshwater fishing in the water resources that emerge within the borders of forests, and beekeeping for which the plant flora provides an appropriate ground, may be evaluated in the sense of the contributions they make to employment. Forests, with the many different kinds of plant types they have, also display an aesthetic look on the fields they inhabit. This situation has positive effects for societies in terms of environmental beauties, tourism and general living.

### **3. Damaging elements on forests and forest fires**

Forests, which fulfil multiple and diverse functions and are a key element of ecological balance, are also under intense threat by various factors. Forest fires, biotic factors (pests and diseases), uncontrolled human interventions (overuse, illegal cutting, grazing, desire to obtain agricultural land, road construction and

establishment of settlements), abiotic factors (air pollution, various gasses and acid rains) and other harmful environmental factors such as extreme weather conditions (long term heat waves, overtimes and gales) are the main harmful factors that cripple and sometimes totally rule out the beneficial functions of forests.

A Forest fire, one element that harms forests, is one of the most important natural disasters directly concerning all countries with its effects and results. Fires, caused by various reasons, are the most important environmental threat that causes millions of hectares of forest land to be destroyed each year, a large amount of forest fire fighting expenses and loss of recreational value and lives.

Large scale fires in forests not only cause the floras to be destroyed but also, as a result of depriving the land of floras, a chain reaction occurs, which causes water resources to be spoiled, air pollution, desertification, and natural disasters such as flood, avalanche and landslip to be experienced more frequently. Also, the large scale fires that take place in different areas of the world including the Mediterranean basin may continue for many days and may even threaten agricultural and settlement areas.

The CO<sub>2</sub> and other greenhouse gas accumulations that emerged as a result of the rapid growth following the industrial revolution also caused an evident temperature increase in average global surface temperatures. Climate changes caused in connection with this temperature increase are anticipated to have significant results that may directly or indirectly effect human life and health, socio-economic sectors and ecological systems. These changes may include melting of the glaciers, increase of altitude above sea level, severe weather conditions, overflows and floods taking place more frequently and strongly, drought, erosion, desertification, epidemics and agricultural pests (Ministry of Environment and Forestry 2008, 3).

The change that may take place in the climate is anticipated to cause problems that may be effective on all living spaces present on the earth in different scales. Within this framework, Turkey is one of the countries at risk that shall be affected by global climate change causing the diminishing of water resources, forest fires, drought, desertification, increase of harmful creatures in the ecosystem and the ecological corrosions caused in connection with these.

In this sense, global climate changes, which have started to become more and more of a current issue, including above average temperatures, cause forest fires to take place more frequently and more destructively over large areas and the carbon release that takes place as a result of forest fires causes negative changes in the climate. The extremely high temperatures caused by carbon release result in a decrease of relative humidity and cause forest fires to spread further by gales, leading to disasters. Therefore, these fires result not only in the destruction of forests, which are considered to be the common heritage of the world, but also in the formation of new conditions that emerge as a result of this threat and affect the lives of human beings and other creatures in a negative manner.

Consequently, global warming, depending on the increase of the term and intensity of the drought period, may have an effect on the increase of frequency, impact area and duration of forest fires and may cause changes in the CO<sub>2</sub> retaining and releasing capacities of forests.

#### 4. General geographical properties of Turkey and the present situation of forests

Turkey has rich natural resource diversity as a result of the mathematical and distinctive location it possesses. The country, which resides at the intersection of the Asian and European continents, contains the properties of Asia and Europe as well as the Black Sea and Mediterranean basins in terms of geographical properties. The existing topographical properties and climate fractionations play an important role in the distribution of the flora (especially forests) and the various climate types that emerge in the country and allow a very rich natural life to exist in this location.

The land use characteristic in Turkey has shaped parallel to the fairly uneven topography and climate conditions showing alterations in short distances. The 77,846,000 ha total land it has shows many different utilization characteristics such as agricultural lands, forests, grasslands, pastures, lakes, settlements, roads and other facilities (Fig. 1). In the scope of this general land use, forested land consists of 21,188,747 ha (27%).

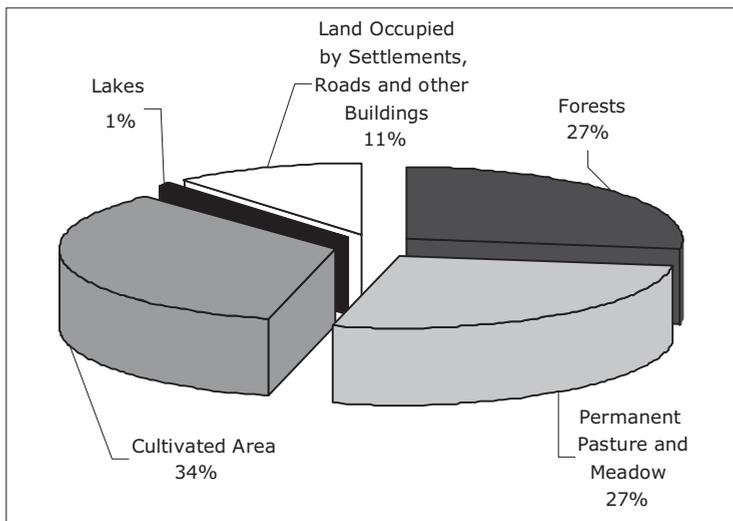


Fig. 1: Land Use in Turkey.

Source: OGM 2006.

The forests of Turkey, which are within the earth's north zone forest system, are at the south of the Cold-Temperate and Cool-Temperate forest zones consisting of Russia, Siberia, Middle and Northern Europe, Canada and the North of USA, and at the north of tropical and hot-temperate subtropical forest zones (Fig. 2). The ambivalent physiological structure that can be seen in the country and the habitat properties, which change at short intervals, has allowed thousands of simple structured and hundreds of developed plant taxons to grow and, as a result, has formed the basis for a rich diversity not only in the number of species but also in the number of inter-species elements.

Almost all forest land in Turkey belongs to the state. After the adoption of the principle that forestry activities shall be completed by the state, following the establishing of the Republic (1920), almost all forests have been nationalized with

the 4785 numbered act accepted in 1945. 99% of forest in Turkey is still under the control of the state. 50% of these forests are productive forests and the other half are low yield forests.

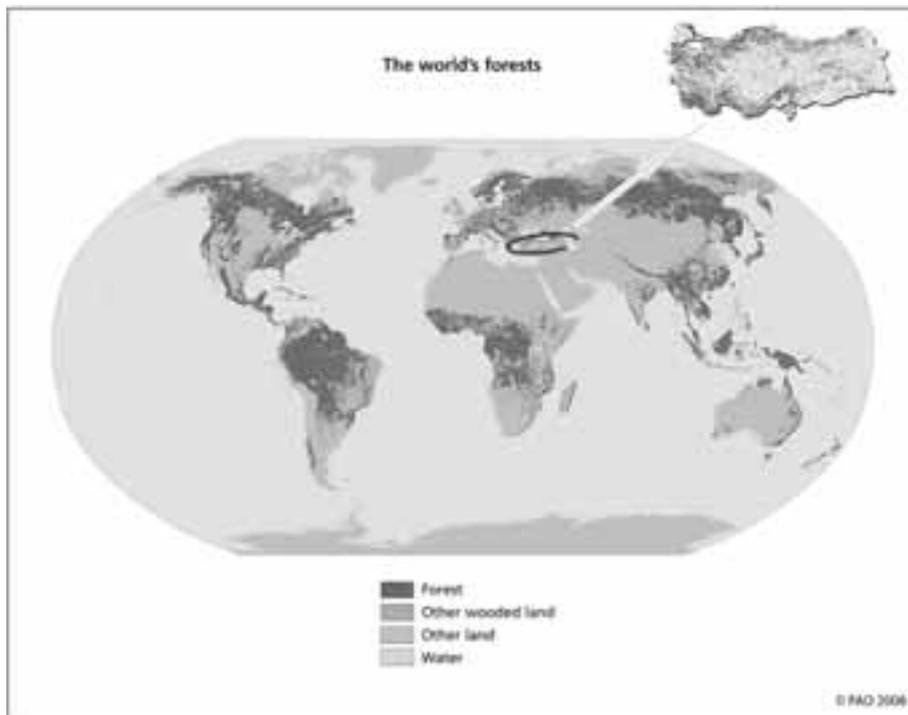


Fig. 2: Distribution of Forest Land on the Earth.  
Source: FAO 2006.

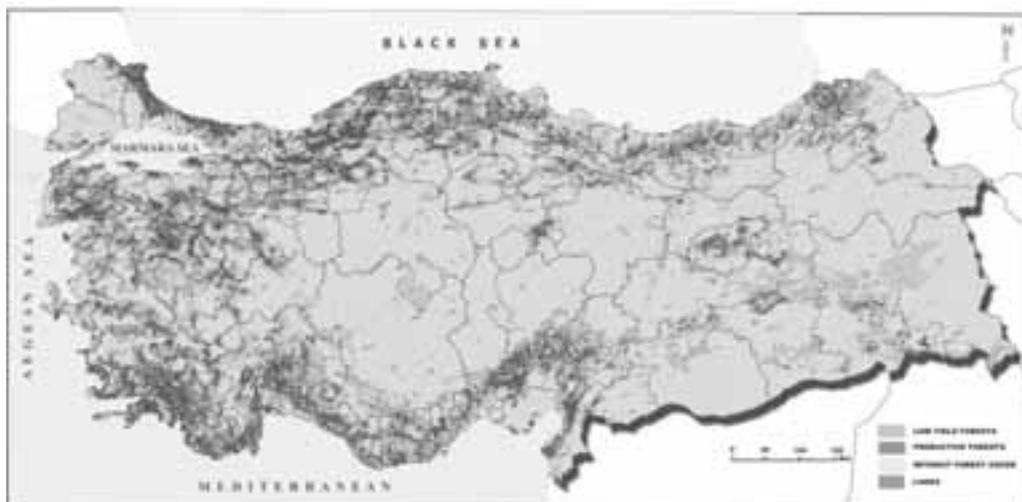


Fig. 3: Distribution of Forests in Turkey.  
Source: OGM 2007.

As a result of various environmental conditions experienced, including climatic disparities, forests do not display a balanced distribution in the country. In this sense, while the geographical regions that consist of the coastal regions that are open to the effects of the sea contain a richer potential in terms of forest flora, Central, East and Southeast Anatolian regions have a weaker forest flora (Fig. 3).

When we look at how the approximately 21.2 million ha of forest in Turkey is distributed in terms of different regions, we can see that most forests are present in the Black Sea Region (23.7%). While the mentioned region is followed by the Mediterranean Region covering the south coastal areas of the country (19.4%), the Aegean Region concerning the western coasts (17.7%) and the Marmara Region (14.3%) also has important shares (Fig. 4).

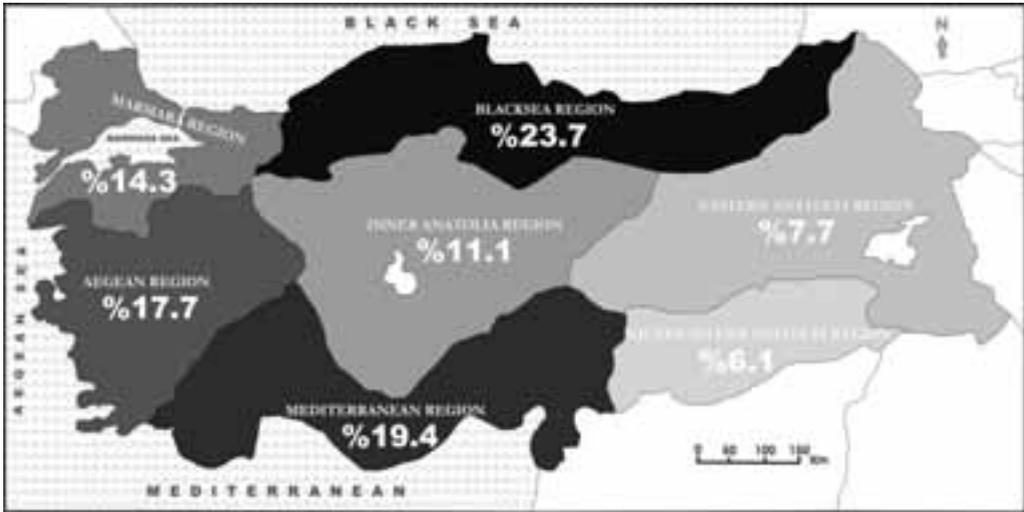


Fig. 4: Proportional View of Forests in Turkey In Respect of Geographical Regions.

As can be seen, Turkey's coastal regions, which are open to the effects of the sea and have a relatively wet climate, display similar values, while the Central Anatolian (11.1%), Eastern Anatolian (7.7%) and South-eastern Anatolian Regions (6.1%), which have arid climatic properties, have a small share of the country's forest assets. Consecutively, it can be seen that 75.1% of forests in Turkey can be found in coastal regions or regions close to shores.

Undoubtedly, as a result of its geographical location and the present data concerning the distribution of Turkey's forestry assets, evaluations also need to be made concerning the properties of the present forest flora. Within this scope, the first thing that can be argued about forests in Turkey is that the Anatolian peninsula has a floral diversity that only few regions in the world have. There are still 11,000 plant types present in Turkey, of which 3,150 are endemic species (Ministry of Environment and Forestry 2007a, 27).

Also, parallel to the general rural settlement order of Turkey, there are many rural settlements and populations in connection with forests. According to the 2007 data, there are 21,218 villages in Turkey with 7,096,136 people residing in these settlements (OGM 2009, 1).

#### 4.1. Forest fires in Turkey

Standing amongst the most significant elements damaging forests and vegetation, forest fires are one of the top agents that endanger the sustainability of forests in Turkey. Every year, a great number of forest fires occur in the country. Only a small percentage of these occur from natural causes; while many of them are caused by human interaction and are effective on wide vegetation areas. Having the most suitable conditions for a wildfire to spread, regions under the strong affect of a Mediterranean Climate (namely most of Turkey) are initially amongst the constant victims of this kind of natural disaster. Roughly corresponding to the 51.4% of Turkish forest areas overall, 12.9 million hectares are located in the regions with a "very high risk" rate. Within the country, a high percentage of wildfires occur in areas across the Mediterranean and Aegean shores, which bear a "very high risk" rate (Fig. 5). Within the top regions suffering from the wildfires most, there reigns a drought effect at almost full scale during the wildfire seasons; this causes great risk of forest fires. Forest fires become intense in the June-October period, when the average temperatures are above 30 °C; however, the wildfires can occasionally occur during other months as well.

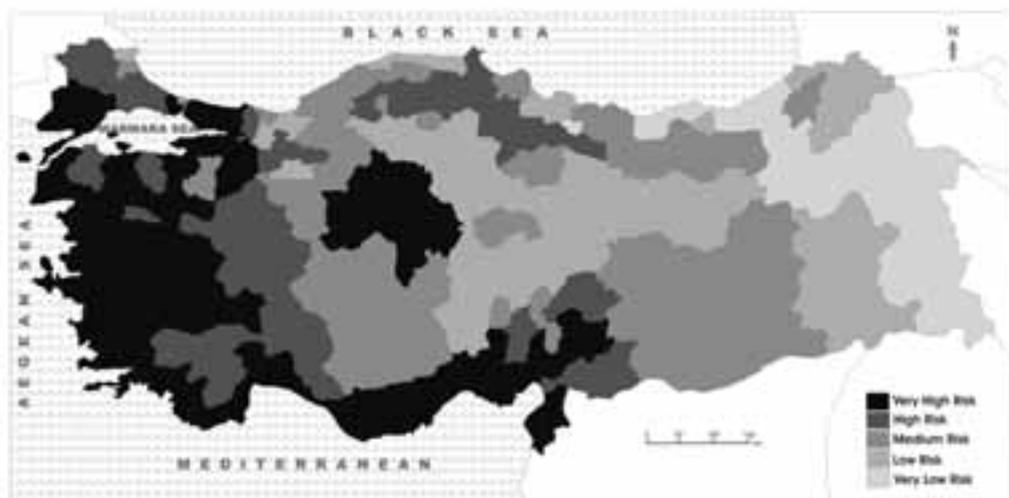


Fig. 5: Forest Fires Risk Map of Turkey.

Source: OGM 2008a.

It would be appropriate to classify wildfire causes in Turkey as carelessness, negligence, accidental, intentional, natural causes and unknown causes. Within those classifications, carelessness, negligence and accidental causes include throwing un-stubbed cigars or matchsticks in the woods, lighting an uncontrolled fire without taking the necessary precautions, burning undesired bushes in the agricultural areas in the woods or by the side of the woods, bushes kindled by sunlight reflecting from glass shards left in the woods, burning trash in or around the woods in order to dispose of the waste, leaving a picnic fire as it is without putting it out completely, electrical wires snapping off, cars burning in traffic accidents and shepherds or hunters leaving a campfire burning. The class of intentional causes includes burning the woods in order to open up new settlements, agricultural fields and pastures or to expand the existing ones, trying to cover up

illegal deeds or traces leading to criminal acts in the woods, setting a fire to leave the owner of an agricultural field in a difficult position and trying to banish wild animals. Leaving those out, some wildfires in the country are caused by natural causes such as lightning strikes, while the remaining percentage of wildfire causes are not exactly known.

In Turkey, approximately 2,000 to 2,500 wildfires occur per year on average, and approximately 10,000 to 15,000 ha of forests have been incinerated by those fires per year. As far as the official recordings go, throughout the period from 1937 to 2008, there have been 84,976 wildfire occurrences recorded, and 1,613,022 hectares of vegetation have been incinerated (Tab. 1). Although fire extinguishing processes are accelerated and wildfire occurrences are somewhat better controlled with each passing day, it is observed that as far as the official records go, overall wildfire occurrences in each decade have climbed incrementally, excluding the decade between 1946-1955.

Tab. 1: The Number of Wildfires and the Amount of Forest Spaces Affected in Turkey per Decade.

Period	Number of Fires	Incinerated Forest Areas (ha)
1937-1945	5 943	417 086
1946-1955	9 014	485 251
1956-1965	6 537	152 765
1966-1975	6 676	117 723
1976-1985	11 957	152 270
1986-1995	18 743	148 344
1996-2005	18 915	90 408
2006-2008 (3 years)	7 191	49 175
Total	84 976	1 613 022

Source: OGM 2009a.

When we carefully scrutinize the last three years for forest fire occurrences in Turkey, we see that the wildfire occurrences for the last 3 years encompass 38% of forest fires experienced through the period of 1996-2005 overall. This incremental leap regarding forest fire occurrence rates is reflected more significantly when we see the amplitude of the incinerated vegetation areas. Throughout the past ten years, more than half of the incinerated forest spaces (54%) have seemingly occurred within the previous three years.

When we examine the causes behind wildfire occurrences for the last 10 years, we see that the causes can be classified by the following percentages: 58% through accident, negligence and carelessness, 19% with unknown causes, 13% through intentional actions, and 10% by natural causes. In light of those findings, we can observe that 71% of wildfire occurrences are based on human actions. When it is considered that some percentage of unknown causes are probably based on human actions, we can easily state that forest fire occurrences are caused by human actions at a rate almost above 80%.

Throughout the last 3 years, we can observe that more than 2,000 wildfires have occurred in Turkey. In alignment with this, it can be observed that the amount of incinerated forest areas has been on an incremental rise. Through that point of view, the number of wildfire occurrences as well as the amount incinerated forest

areas has increased significantly. Although there has been a slight decrease in the number of wildfire occurrences in 2008 compared to 2007, the amount of incinerated forest areas has been multiplied by almost 3 (Tab. 2, Fig. 6).

Tab. 2: The Causes of Wildfire Occurrences and the Amount of Forest Spaces Affected in Turkey for the Last 3 Years.

Source: OGM 2009b.

Year	Amount of Incinerated Forest Areas (ha)	Number of Wildfire Occurred	Wildfire Occurrence Causes							
			Intentional Actions		Carelessness-Negligence-Accident		Natural Causes		Unknown Causes	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
2006	7 762	2 227	166	206	1 315	5 873	330	543	416	1 139
2007	11 664	2 829	292	1 705	1 642	7 994	407	243	488	1 722
2008	29 749	2 135	377	797	1 018	26 283	330	699	410	1970

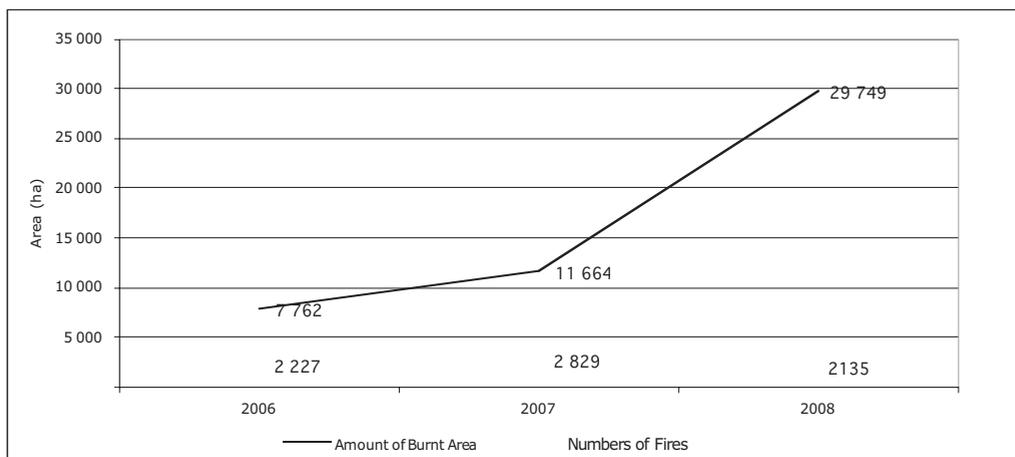


Fig. 6: The Number of Wildfire Occurrences and the Amount of Forest Areas Affected in Turkey for the Last 3 Years.

Source: OGM 2009b.

When data from 2008 is carefully inspected, it can be observed that in 2008, there was a respective decrease regarding the number of wildfire occurrences; but it can easily be seen that there was also a significant increase regarding the amount of incinerated area per each wildfire occurrence. In 2007, the amount of incinerated area per wildfire occurrence was 4 ha, while in 2008, this amount climbed to 14 ha. When we consider the causes of wildfire occurrences, we see that carelessness, negligence and accidents stand out in the foreground with a steep climb to 48%. Representing almost half of the wildfire occurrences overall, this 48% is followed by unknown causes with 19%, and intentional actions with a rate of 18%.

Considering the aforementioned causes, when we inspect the number of wildfire occurrences and general dispersion of the incinerated vegetation for the year of

2008 in Turkey, we see that 52% of the 2.135 forest fires have occurred within the region of the south western and western shoreline. Again considering the aforementioned causes, it can be observed that 91% of the incinerated 29,749 hectares of forest areas bears a "very high" risk rate for fires (Fig. 7, Fig. 8).



Fig. 7: The Dispersion of the Number of Wildfire Occurrences by Regional Forest Directorates in Turkey for the Year 2008 after they start.



Fig. 8: The Dispersion of the Amount of Incinerated Forest Areas by Regional Forest Directorates in Turkey for the Year 2008.

When we consider the number of wildfire occurrences in accordance with regional directorate boundaries, we can see that three regional directorates within the southwest of the country (Antalya, Mugla and Izmir) are significantly prominent. Considering the dispersion rate for wildfire occurrences in 2008 among those three, Mugla Regional Directorate has a share of 16%, Antalya Regional Directorate of 10%, and Izmir Regional Directorate of 7%. Considering all those rates, wildfire

occurrences within the boundaries of those three regions altogether constitute more than 33% of the total forest fire occurrences across the country.

The status we currently hold regarding the number of wildfire occurrences bears a great resemblance to the status of the amount of incinerated forest areas. Within that perspective, in 2008, 57% of the total incinerated forest areas were located within the boundaries of the Antalya Regional Directorate, 6% were located within Izmir Regional Directorate boundaries, and 2% were located within the boundaries of Mugla Regional Directorate. Considering all those rates, forest areas incinerated within the boundaries of those three regions altogether constitute more than 65% of the total damaged forest areas across the country.

Here, the point to be underlined is that although Mugla Regional Directorate takes first place with the highest rate of wildfire occurrences, the region is respectively at the back of the line with its low rate of incinerated forest areas. Unlike Mugla however, Antalya Regional Directorate has experienced a respectively lower rate of wildfire occurrences, while the rate of incinerated forest areas there reaches up to much higher levels. Within that scope, while the amount of incinerated area per wildfire occurrence is about 80 ha for Antalya Regional Directorate, that amount is approximately 2 ha per occurrence for Mugla Regional Directorate. Regarding that frame, another Regional Directorate to be highlighted is Mersin Regional Directorate, which is located due south, along the Mediterranean shore of the country. In this region, 93 wildfire occurrences were recorded in 2008, with the amount of incinerated forest areas reaching up to 5080 ha. This means that the amount of destroyed forest areas per occurrence is approximately 55 ha regarding the aforementioned region.

The fact that there will always be some natural causes behind wildfire occurrences proves that it will not be possible to stop those occurrences completely. However, the point to be highlighted here is that it is mainly human actions causing wildfire occurrences, rather than natural ones. Therefore, although it is not possible to prevent wildfire occurrences entirely, it is possible to prevent the wildfires, or to minimize the damage caused by human carelessness, negligence or intentional acts. Consequently, within contemporary silvicultural approaches, it is important to take preventive and precautionary measures in order to hinder wildfire occurrences, and it is critical to conduct all necessary practices to extinguish fires as quickly as possible.

In Turkey, several strategic plans and programs are carried out to the implementation phase including conducting silviculture activities more actively, ensuring sustainable utilization of natural resources, preventing wildfire occurrences and devising more efficient response methods. Within that framework, the "fire fighting strategy" has been implemented for a more efficient response rate against forest fires. That strategy consists of three basic phases: the first step is "preventing the fire where it may begin". Within that scope, as most wildfire occurrences have emerged due to the human element, education and informative activities for natural disasters should be implemented initially. Then, within the scope of this determined purpose, a variety of introductory short movies should be displayed, fliers distributed and campaigns supporting forest love and protection should be initiated; these are the frequently applied methods of preventing fire.

The second phase of the fire fighting strategy is "extinguishing activities". In this

phase, if a fire has started in spite of all precautions taken, the most rapid and efficient response should be provided against it. In order to do so, certain devices should be implemented and utilized, including a toll-free phone line, remote sensors and geographical information systems, early alert systems and rapid management methods (fire fighting planes).

The third phase that the Turkey fire fighting strategy is built upon is rehabilitation. The main purpose of that phase is to rapidly replant forests destroyed by wildfire occurrences. Within that scope, various replanting campaigns are implemented in cooperation between government agencies, the public sector and voluntary organizations in order to accelerate the silviculture process of the burnt forest areas.

## **5. Conclusion**

In consequence of land misuse due to rapid population increase, economical development and especially industrialization, forest and vegetation areas are diminishing, or their overall nature is deteriorating. Moreover, the damaged forest areas fail to conduct their functions exactly as expected. In consequence of those negative impacts, there are various problems arising or intensifying, such as pollution, erosion risk and many other environmental problems. This status brings a vicious cycle along with it. All these negative impacts only indicate how much "sustainable utilization" is required for forest areas. Moreover, this concept has now begun to take shape in the world agenda more than ever. Standing as one of the most significant natural resources, forests encompass many ecological, economical and social functions. As such, it is of utmost importance to protect these resources, enabling their continuity and growth in accordance with the sustainable utilization principle.

As approximately 13 million hectares of forests are destroyed each year all over the world, this causes serious problems in ensuring the ecological balance and environmental sustainability. Various perils create negative effects on forest areas, triggering one another. Those perils include greenhouse gases (carbon emission), which has emerged from rapid industrialization and urbanization and has caused global warming, along with drought and desertification. These threats also endanger biological diversification significantly, which may occasionally create disastrous environmental issues in turn.

Regarding the aforementioned issues, forest fires are one of the most essential topics that have effect on and are affected by environmental sustainability as both reason and consequence. The increasing rate of wildfire occurrences along with global warming now constitutes a higher amount of risk. Moreover, CO<sub>2</sub> and other gases emitted from fires also contribute partially to global warming.

Having a vast coverage of forests with 27%, Turkey encompasses rich flora diversity, containing a wide array of plant species, as well as a high rate of plants with endemic qualities. However, forests in Turkey face various dangers, as do most other regions in the world. The most prominent of these threats is forest fire. Being under the effect of a Mediterranean climate, the western and south western regions of the country are especially vulnerable to wildfire occurrences. Moreover, vast vegetation areas are devastated every year with a high rate of forest fires in the aforementioned regions.

Although many improvements are achieved each passing day regarding fire prevention and extinguishing strategies, the number of wildfire occurrences still reaches very high levels sometimes. This proves that fires will continue to constitute a threat to the natural environment and environmental sustainability and will continue to have a serious impact. However, the point to be underlined here is the fact that fires generally emerge from human actions in Turkey. This status proves that, although it is not possible to change the amount of fires started by natural causes, the rate of fires caused by human actions can be averted or diminished.

Consequently, uncontrolled human actions cause a specific range of disruptions that cause devastation for the natural environment. In turn, disruptions experienced in the ecological balance bring forth natural disasters. Consequently, the natural balance disrupted by humans should also be rebalanced by humans. In that respect, it is not possible to entirely hinder wildfire occurrences, which threaten the natural environment. However, it is in our hands to minimize the impact of those fires before it's too late.

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## **NEGATIVE IMPACTS OF FOREST FIRES ON ECOLOGICAL BALANCE AND ENVIRONMENTAL SUSTAINABILITY: CASE OF TURKEY**

### **Summary**

With their multiple functions, forests are one of the most efficient natural resources contributing to the continuity of ecological balance and the ensuring of environmental sustainability. On the other hand, forest fires are not new, but will always be one of the most damaging factors for forests.

Besides being an essential part of ecological balance, forests also have many economic and social benefits. "Ecological functions" cover the hydrological functions, erosion prevention, climate protection, biological diversity and preserving of wildlife functions. Forests are important not only for ecological purposes but also as an economic asset for the world economy. Since there are many products provided by forests, they are also considered to be raw material depots. Besides their ecological and economic functions, forests also have various social functions that directly affect social life. We can state these as community health, ecotourism, employment and aesthetic functions.

Forests, which fulfil multiple and diverse functions and are a key element of ecological balance, are also under intense threat by various factors. Forest fires, biotic factors, uncontrolled human interferences, abiotic factors and other harmful environmental factors, such as extreme weather conditions, are the main harmful factors that cripple and sometimes totally rule out the beneficial functions of forests.

A forest fire is one of the most important natural disasters directly concerning all countries with its effects and results. Fires, which are caused by various reasons, cause millions of hectares of forest to be destroyed each year, a large amount of forest fire fighting expenses, loss of recreational value and lives. Large scale forest fires not only cause the plant flora to be destroyed but also, as a result of depriving the land of flora, cause a serial reaction causing water resources to be spoiled, air pollution, desertification, and more frequent natural disasters such as flood, avalanche and landslide.

Turkey has rich natural resource diversity as a result of its mathematical and distinctive location. The country, which resides at the intersection of Asia and Europe, contains the specialties of Asia and Europe as well as the Black Sea and Mediterranean Basins in terms of geographical properties. The existing topographical characteristics and climate fractionations play an important role in the distribution of forests, and the various climate types that emerge in the country allow a very rich natural life to exist there.

The land use characteristics in Turkey have shaped parallel to the fairly uneven topography and climate conditions, showing alterations in short distances. The total land area shows many different utilization characteristics such as agricultural land, forest, grasslands, pastures, lakes, settlements, roads and other facilities. In the scope of this general land use, forests consist of 27%.

As a result of various environmental conditions experienced in Turkey, forestland does not display an equally distribution in the country. In this sense, while the geographical regions that consist of coastal regions contain a richer potential in terms of forest flora, the Central, East and Southeast Anatolian regions have a

weaker forest flora.

When we look at the distribution of the Turkey's forests (that means nearly 21 million hectares) in terms of different geographical regions, we can see that most forestland is present in the Black Sea Region (23.7%). That region is followed by the Mediterranean Region (19.4%), the Aegean Region concerning the western coasts (17.7%) and the Marmara Region (14.3%), which also has important shares. It can be seen that 75% of forestland in Turkey can be seen in coastal regions or regions close to shores.

Almost all forestland in Turkey belongs to the state; 99% is still under control of the state. 50% of this land is productive forest and the other half is low yield forest. Besides forestry assets, the Anatolian peninsula has a floral diversity shared by only a few regions in the world. There are still 11,000 plant types present in Turkey, of which more than 3,000 are endemic species. Also, parallel to the general rural settlement order of Turkey, there are more than 20,000 villages in connection with forests with about 7 million people residing in these settlements.

Having the most optimal conditions for a wildfire to spread, the regions under the strong affect of the Mediterranean Climate are initially amongst the constant victims of this natural disaster. Roughly 50% of Turkish forests are located in regions with a "very high risk" rate. Within the country, a high percentage of wildfires occur in areas across the Mediterranean and Aegean shores. The fires become intense between June and October, when average temperatures are above 30 °C.

When we examine the causes behind forest fire occurrences for the last 10 years, we see that the causes could be classified as 58% for carelessness and negligence, 19% for unknown causes, 13% for intentional actions, and 10% for natural causes. In light of these findings, we can observe that 71% of wildfire occurrences are based on human actions.

During the last 3 years, more than 2,000 wildfires have occurred in Turkey. In alignment with this, it could be observed that the amount of burnt forest areas has been on an incremental rise. From this point of view, the number of wildfire occurrences as well as the amount of burnt forest areas has increased significantly. Although there has been a slight decrease in the number of wildfire occurrences in 2008 compared to 2007, the amount of burnt forest areas has multiplied by almost 3.

Considering the aforesaid causes, when we inspect the number of wildfire occurrences and general dispersion of burnt vegetation in 2008 in Turkey, we see that 52% of the total forest fires have occurred within the region of the south western and western shorelines. Considering the number of wildfire occurrences in accordance with regional directorate boundaries, it can be seen that three regional directorates within the southwest of the country (Antalya, Mugla and Izmir), are significantly prominent. Wildfire occurrences within the boundaries of these three regions altogether constitute more than 33% of the total forest fire occurrences across the country.

Resembling the number of wildfire occurrences, of the burnt forest areas in 2008, 57% of the total burnt forest areas were located within the boundaries of Antalya Regional Directorate, 6% were located within Izmir Regional Directorate, and 2% were located within Mugla Regional Directorate boundaries. Considering all those

rates, forest areas burnt within the boundaries of these three regions altogether constitute more than 65% of the total damaged forest areas across the country.

The "fire fighting strategy" of Turkey has been implemented for more efficient responses against forest fires. The strategy consists of three basic phases; the first step is "preventing the fire where it may begin". Within that scope, as most wildfires emerge due to human actions, education and informative activities for natural disasters should be implemented to start. The second phase of the fire fighting strategy is "extinguishing activities". In this phase, if a fire has started in spite of all precautions taken, the most rapid and efficient response should be provided against it. The third phase that the Turkey fire fighting strategy is built upon is rehabilitation. The main purpose of this phase is to rapidly replant forests destroyed by the occurrence of wildfire.

Consequently, the natural stability disrupted by humans should also be rebalanced by humans. In that respect, it will never be possible to entirely stop wildfire occurrences. However, it is in our hands to minimize the impact those fires cause.