Forest Fire Risk Management at the Country Scale: The Case of Turkey

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Abstract Forest fires cause hazards and damage to both ecosystems and humans increasing attention in the globalizing world. Forest fire risk analysis and management issues cover the prevention of forest fires, response to forest fires and what to do after the forest fires. This chapter is focused on the evaluation of forest fire risk management from socio-economic, landscape planning and risk management perspectives at the country scale. In this context, national policies, strategies, documents and practices are scrutinized in terms of forest fire mitigation acts in Turkey. As a result of the examination policy makers and decision-makers should increase pay attention to their primary stakeholders for better engagement in forest fires. There is an urgent need to obtain an annual forest fire risk assessment report from public institutions. Participatory approaches need to be applied through good governance to mitigate forest fires and decrease forest fire risks in Turkey.

Keywords Participation · Stakeholder engagement · Good governance · Turkey

1 Introduction

Wildfires are widespread in many regions over the world due to several causes such as urban sprawl, the extensive land abandonment in the late twentieth century or mismanagement of natural areas that led to increased frequency and severity of wildfire risk (Moreno et al., 2021; Fernandez-Anez et al., 2021). This has increased the risk of human and economic losses, changes in vegetation cover, surface runoff, soil degradation and contamination of the water bodies of streams, and reservoirs with toxic compounds in ashes (Terêncio et al., 2020). Fire is a natural phenomenon that affects Earth's ecosystems and which needs better research networking to face the

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challenges of scientific development and fire risk management (Stoof & Kettridge, 2022). Fire dynamics and behavior are essential to understand fire prevention and predicting the environmental impacts of fires (Mueller et al., 2020). Building an understanding of the types of fire behavior (energy release, spread rates and conditions of extinction) that occur in our changing landscapes such as abandoned agricultural sites and across newly connected ecosystems is substantive if we are to effectively manage fire prevention and emergency responses to fires in these areas (Samuela Bassi, 2008).

The risk concept widely defines the possibility of something bad happening. Risk refers to uncertainty about the effects/implications of an activity concerning something that humans value (such as health, well-being, wealth, property or the environment), often focusing on negative, undesirable consequences (Hardy, 2005). Accordingly, forest fire risks can be defined by the possibility of various criteria coming together in an area to cause a forest fire (Baltaci, 2021). To manage forest fire risks sustainably, it is key to define potential risks, and then, analyze and evaluate them according to scientific criteria (Çoban & Erdin, 2020). Moreover, under climate change and shifting biogeographic vegetation patterns, novel fire behavior begins to affect regions that have not previously had a significant fire history or fire management infrastructure (Elvan et al., 2021). On the other hand, increasing the living standards of local people dramatically reduce fire risk (Samuela Bassi, 2008).

According to the assessments regarding the climate crisis, it is predicted that the frequency of forest fires will increase in the future all over the world due to extreme heat and drought (IPCC, 2021). Therefore, an understanding of fire dynamics in Europe's climate and ecosystems is required as well as coupled research on emergency response (onsite and offsite) and monitoring, mapping, and adoption of new firefighting strategies and decision-making strategies to manage, prevent, combat and fight forest fires that might display a range of fire behaviors. All these issues require a holistic approach to sustainable fire management (Abreu, 2022).

Turkey has been struggling with forest fires, especially in the Mediterranean regions of the country. It has been deeply affected by mega-forest fires in 2021 and raises awareness of forest fire risks and mitigation strategies in scientific and socio-political areas. Mega-forest fires have been recently defined by United Nations Environmental Program (UNEP) as "an unusual or extraordinary free-burning vegetation fire which may be started maliciously, accidentally or through natural means, that negatively influences social, economic or environmental values" (UNEP, 2021). This situation shows that we are facing some different challenges. Financial investment and human and organizational resources are required to minimize the negative impacts of forest fires (Mavsar et al., 2012). However, new approaches and perspectives are needed for forest fire risk assessment and management.

In this book chapter, we present as a main aim, an example of research to show how to evaluate damages caused by forest fires, costs and their reasons from socio-economic, landscape planning and risk management perspectives at the country scale using Turkey. Policy implementations were also presented to evaluate the fire risk management practices in this country. The political framework, socio-economic constraints, ownership and legal issues will be evaluated to assess the forest fire

risk management issues and how local features can be overcome, and transferability allowed among different EU contexts.

2 Forest Fire Risk Analysis in Turkey

The fire risk concept is still under investigation by some researchers but some key variables can explain the underlying factors of forest fires (Çoban & Erdin, 2020; Çolak & Sunar, 2020; Daşdemir et al., 2021; Hardy, 2005). Forest fires may be the result of natural phenomena, human negligence, accidents and human intentional behavior. There are two main causes of forest fires in Turkey: "thunderbolt" and "human" (GDF, 2022). Although the number of these two reasons varies per country, in Turkey, 1% of forest fires are caused by thunderbolts. Thunderbolt apart from fires with few numbers, the main cause of fires is human "human factor" which is always the main problem in fire protection (FAO, 2007; Samuela Bassi, 2008). According to studies on forest fire risk resources, tourists and local people living in or adjacent to forests cause forest fires due to socio-economic reasons, low level of education, stubble burning, agricultural activities, tourism and recreational activities, illegal utilization, intentional, negligence, lack of knowledge and awareness, etc., in Turkey (Çolak & Sunar, 2020; Gültekin & Baysal, 2020; Sezgin & Gültekin, 2022; Yakupoğlu et al., 2022; GDF, 2022).

After analyzing scientific papers, there are major motivation types such as agricultural burning, rangeland intentional burning, pyromania, hunting, vandalism, getting salaries, non-planned land use changes, revenge, dispute against punishments, resentment against reforestation, grazing, watching forest fire fighting, distract the police, rituals, cancelations contracts with administration or resentment against subsidies (GDF, 2022; Sezgin & Gültekin, 2022; Yakupoğlu et al., 2022). Despite all the opportunities provided by ecosystem services, it can be said that the desire of human beings to make excessive use of forest resources constitutes the basis of forest fire risk resources (Samuela Bassi, 2008). In order to reveal the social and economic consequences of forest fires, it is necessary to focus on the economic benefits of forests, in other words, the functions of forests. Contemporary studies mentioned that ecosystem services are a key issue to understand and manage forest ecosystems (Başak et al., 2022; Gültekin, 2022).

Forest fire statistics (General Directorate of Forest, GDF) have been regularly collected and degrees of fire risks mapped to combat and monitor the forest fires in Turkey. Damages caused by forest fires and their reasons should be evaluated according to burnt areas from the forest fire risk management perspective (Fig. 1).

Forest fire risk factors that can be considered are topography, wind speed, high temperature, low level of humidity, accelerators (i.e., low moisture content of combustible material, especially coniferous species), the existence of large and uniform areas, where the accumulation of fine combustible material is very high (Çolak & Sunar, 2020). According to forest fire statistics, total burnt forest areas explicitly increased in recent years (Fig. 2). Unfortunately, there is still not enough
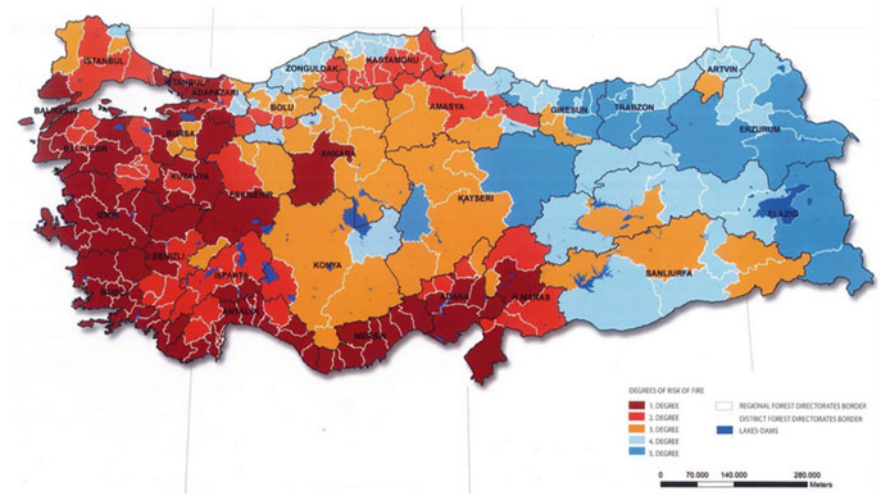
Fig. 1 Forest fire risk map of Turkey. (Risk ranges from "1°" = Highest to "5°" = Lowest. Graphic: GDF, 2022)

scientific evidence to understand forest fires and their underlying risks in Turkey (Fig. 3). It is hard to decrease the forest fire risk because of causing forest fires 48% "unknown" according to statistics of GDF (GDF, 2022). Although the annual number of fires does not change much over the years, the increase in the total burnt area is remarkable.
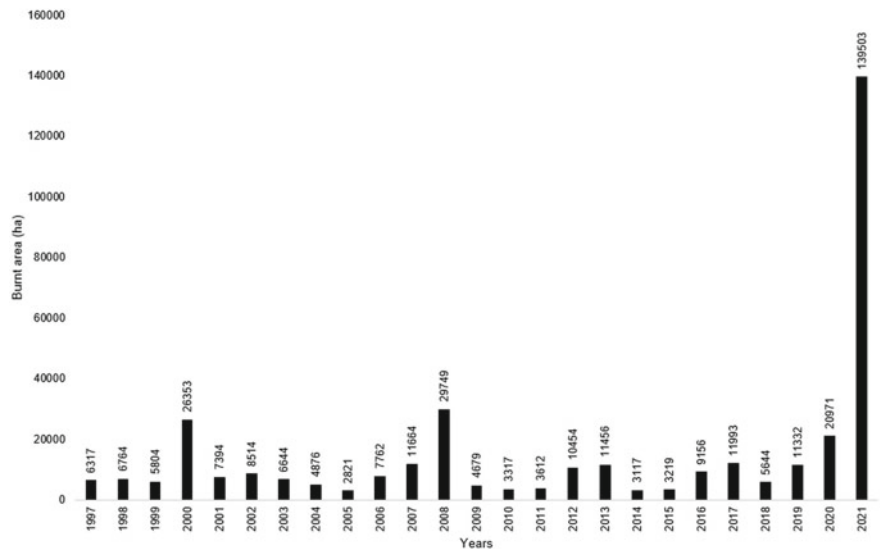

Fig. 2 Forest fire statistics according to burnt areas between 1997 and 2021 in Turkey (GDF, 2022)
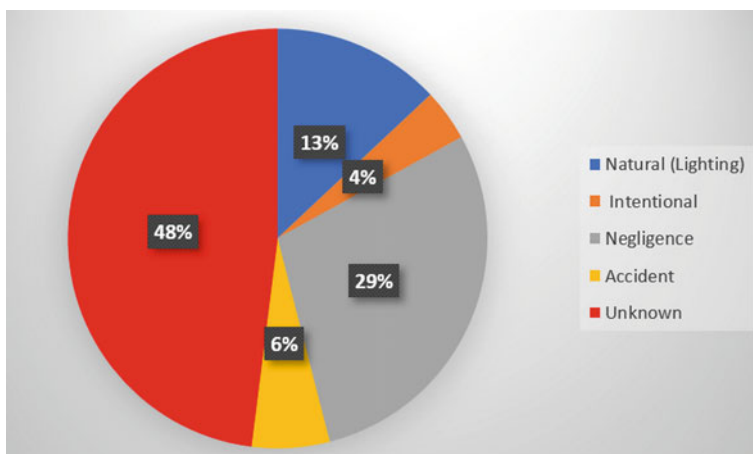
Fig. 3 Causes of forest fire in Turkey (GDF, 2022)

3   Forest Fire Risk Management in Turkey

According to the Turkish constitution (article no. 169) and law (article no. 6831), all forest areas are managed and controlled by the government via the Ministry of Agriculture and Forestry. GDF follows sustainable forest management principles according to the national forestry program (2004–2023) and GDF strategic plan (2019–2023) as a public institution affiliated with the Ministry of Agriculture and Forestry. GDF applies "Forest Fire Prevention and Combat Acts" including fire risk maps, forest fires early warning systems, forest fire towers, and fire pools (GDF, 2022). In this regard, the "Fire Management System" has been used by GDF since 2007 (Fig. 4).

Fire prevention facilities are being built within the scope of Fire-Resistant Forest Projects (YARDOP) projects started in Turkey. Neyişçi (2011) mentioned the use of some species in forest areas such as *Cuppressus spp.* can be effective to mitigate forest fires in the Mediterranean region of Turkey. The use of fire-resistant species in forest areas can decrease the risk of forest fires of severity and sprawling. As of the end of 2020, a total of 8358 km of fire prevention facilities (i.e., fire breaks, plantations
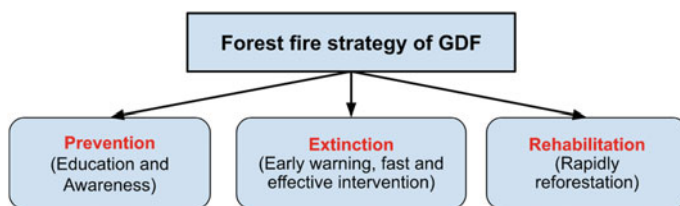

Fig. 4 Forest fire strategy of general directorate of forestry (GDF, 2022)

Table 1 Forest fire extinction activities of GDF in Türkiye

Forest fire extinction activity	Amount	Forest fire extinction activity	Amount
Forest fire rangers	20,500	Drone	10
Forest fire towers	776	Dozer	181
Fire extinguisher equipments: water-tender	1010	First responder team	1167
First responder vehicle	2270	Firefighting aircrafts	3
First responder team	1167	Other vehicles	501
Helicopters	39	Water tender	281
Forest fire volunteers	13,400		

of fire-resistant species, pruning of trees near the roads, etc.) have been applied. YARDOP application was made in 292,719 ha forested areas in Turkey (GDF, 2022). Forest fire costs (direct costs) are explained as 45 million Euros according to the GDF budget report in 2020. There also 8 people died because of these forest fires in Turkey (GDF, 2022). Unfortunately, there are no indirect cost calculations such as biodiversity and tourism losses, injuries, non-wood products loss and wildlife loss after forest fires in Turkey. According to the legislation of GDF, circular cleaning and harvesting activities are mandatory after forest fires in Turkey (GDF, 2022) (Table 1).

Disaster and Emergency Management Presidency (AFAD), affiliated with the Ministry of Interior, appears as the highest level and sole authority in terms of disaster preparedness and response in Turkey. AFAD prepared disaster prevention, coordination and response plans for the first time in 2014 within the scope of the "Turkish Disaster Response Plan" (TAMP, 2014). However, due to the mega-forest fires in recent years, it has been observed that there are major problems in coordination between institutions and in the fire response process. For this reason, it is necessary to review fire risk management at the national, regional and local levels in Turkey.

4   Discussion and Final Remarks

In Turkey, many citizens cause forest fires by having recreational activities in the forest areas because of their carelessness and neglect. Participation of citizens is a crucial issue in terms of motivation factors to prevent forest fires (Land-Zandstra et al., 2021). Citizen science approaches can be used to decrease forest fire risk and combat forest fires. Forest villagers can be included as volunteers to contact GDF in the early warning system. Local people can be involved in communication platforms or networks (Mavsar et al., 2012). This approach can be decreased the involvement duration of forest fires in shorter minutes.

However, there are forest fires because pedestrians and transportation roads pass through the forests. Some forest fires can cause thousands of hectares of forest area to burn as a result of a spark from just one train (Niklasson et al., 2010). The presence

of 21 thousand of villages in and adjacent to forests in Turkey and the fact that approximately 7 million people live in these forests increases the risk of forest fires. As a result of the Antalya-Manavgat fire, which was recorded as the largest forest fire in Turkey in the recent past (in 2020), nearly 59.000 hectares of total forest areas have been burnt (GDF, 2022). Lack of coordination and cooperation between stakeholders increases the forest fire risk. Stakeholder engagement and participation need to be provided through good governance (Gültekin, 2022). Forest fire action plans need to be improved and up to date in terms of sustainable forest fire management (Daşdemir et al., 2021).

There is a need to improve prescribed forest fire risk management, more critically, "local people" acceptance and participation as a strategy for future land management (Francos & Úbeda, 2021). The fact that the local people do not have enough knowledge about firefighting also makes it difficult to fight forest fires. For instance, it has been observed that forest engineers who tried to intervene in forest fires that took place in recent years were physically attacked while using firefighting techniques. There is also an important key issue increasing forest villagers' quality of life that needs to be considered in risky regions (Daşdemir et al., 2021). It is clear that decision-makers need to be focused on intensive forest fire prevention studies (Taylor et al., 2019). These studies are described as less dangerous, easier, more valuable and cost-effective activities. It is a new initiative defined as the «Public Education through Mobile Education Teams» project which can be a good practice in Turkey (GDF, 2022). Especially GDF need to find and apply smart, effective and practical solutions for the pre-fire activities in Turkey (Çolak & Sunar, 2020).

Intensive education programs on fires are required (Charnnarong, 2021). For example, it was determined that some of the people living in the forest lost their lives in the Antalya-Manavgat fire because they did not want to leave their homes (GDF, 2022). This shows that there is a need for more effective information and awareness-raising studies and projects about the extent of the danger, especially wildfires.

It is necessary and should be possible to inform forest villagers and farmers through documentaries, TV programs, education and training activities, social media activities, etc., about the necessity and benefits of forest assets and to make them more familiar with forest goods and services. In addition, how the villagers can obtain more income from forest resources can be explained with this approach as well. These activities are very effective but mostly invisible and hard to measure the total effect. Lack of coordination and cooperation between stakeholders should be fulfilled in Turkey. There is a new establishment and initiative necessary covering national, regional and local stakeholders leading AFAD. Crucial stakeholders include the Ministry of Interior, Ministry of Agriculture and Forestry, General Directorate of Forestry (GDF), public institutions (Universities, Municipalities, etc.), Private sector related to forest fires, NGOs, and the public (forest villagers, farmers, civil society) must gather participatory approaches (Hesseln, 2018).

To reduce the risk of forest fires, it should be ensured that species are resistant to fires to the extent permitted by ecological conditions in afforestation. It is stated that planting species such as *Cupressus sempervirens* in forest areas with fire risk not

only makes the forest resistant to fires but also contributes 10–15% to the increase in volume (Coşgun & Çobanoğlu, 2009). Especially in areas where the Mediterranean climate prevails mixed with red pine in the afforestation works to be made, therefore more fire-resistant establishing forests is a highly convenient practice. In literature, especially fire-resistant species such as "*Cupressus sempervirens*" can be used for fire prevention. It is stated that Cupressus proved their resistance to flames in the Gallipoli Fire in Turkey. From this perspective, Fire-Resistant Forest Projects (YARDOP) should be enhanced in Turkey (Neyişçi, 2011; Yılmaz, 2016). The utilization of various fruit tree species such as olive, almond and walnut as buffer zones for the protection of citizens and forests from forest fires in the settlement areas will also serve the sheltering, feeding, breeding and protection from the enemies of the hunting animals in these areas. This issue must be supported and prioritized by policymakers and decision-makers in Turkey.

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