

AGROSYM

BOOK OF PROCEEDINGS



*XV International Scientific Agriculture Symposium
"Agrosym 2024"
Jahorina, October 10-13, 2024*

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“AGROSYM 2024”**



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PREFACE

Dear colleagues,

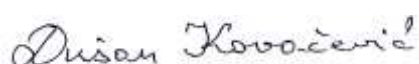
It is with great pleasure that I introduce the *Book of Proceedings* for the 15th International Scientific Agricultural Symposium “AGROSYM 2024.” I trust that you will find it a valuable resource in your work. This year, around 800 contributions have been accepted for inclusion in the *Book of Abstracts*. The themes of AGROSYM 2024 span the full spectrum of agricultural sciences, divided into seven key sessions: 1) Plant Production, 2) Plant Protection and Food Safety, 3) Organic Agriculture, 4) Environmental Protection and Natural Resource Management, 5) Animal Husbandry, 6) Rural Development and Agro-Economy, and 7) Forestry and Agroforestry.

There is growing consensus among scholars and practitioners that technological innovations have the potential to boost agricultural production, enhance supply stability, and reduce the environmental impact of farming. Technology has been especially pivotal in increasing the productivity of annual crops such as maize, rice, soybeans, wheat, and cotton. However, with trees having longer growth cycles, breeding programs for these crops require more time. New plant breeding techniques promise improvements in productivity, but they have sparked an ongoing academic debate regarding their advantages and drawbacks.

While much of the focus in the past has been on the production side of agriculture (e.g., productivity and efficiency), there is an increasing emphasis today on the consumption side and the intermediate stages of the food chain, such as processing and distribution. This shift is driving the transition toward a “farm-to-fork” approach. Globally, consumers are sending clearer signals about their preferences for higher quality, healthier, safer, and more flavorful products. In response, many agri-food companies are exploring innovative ways to gain greater control over production processes and ensure the quality and safety of final products. Furthermore, changes in investment strategies hold the potential to reduce the environmental and social costs of agriculture. It has become increasingly clear to investors that companies that prioritize sustainability and social responsibility tend to yield better long-term returns.

Agri-food systems are at the heart of global discussions surrounding sustainable development and the achievement of the United Nations Sustainable Development Goals (SDGs) by 2030. These systems are deeply connected to numerous global challenges, including climate change, poverty, food insecurity, biodiversity loss, resource depletion, and ecosystem degradation. A key goal of the sustainable agriculture movement is to create farming systems that mitigate or eliminate the environmental harms associated with industrial agriculture. Additionally, it is critical to improve the resilience of food systems to crises, shocks, and pandemics.

I would like to extend my heartfelt thanks to all the authors, reviewers, and colleagues who contributed to the editing of the *Book of Abstracts*. Special thanks are due to our co-organizers and partners for their unwavering collaboration and comprehensive support throughout this endeavor.



East Sarajevo, 10 October 2024

Prof. Dušan Kovačević, PhD

Editor in Chief, President of the Scientific Committee of AGROSYM 2024

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FORESTRY AND AGRO- FORESTRY

ANALYSIS OF FOREST DAMAGE: 20-YEAR STUDY IN SERBIA

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Abstract

Forest damage causes an alarming volume of affected trees. In this article we analyze the forest damage in the first 20 years of the XXI century on the territory of Serbia. The data are taken from the Statistical Yearbook. The results are presented according to the volume of damaged trees in five categories based on the main cause: by humans, by insects, weather disturbance, by plant diseases and forest fires. The results show that 1,8 million m³ were damaged in the period under observation. The lowest volume of damage was recorded in 2006 with a total of 29.505 m³ and the highest in 2016 with a total of 223.469 m³. The most common cause of damage was weather disturbance (39%), followed by man-made damage (22%) and insects, plant diseases and fire (13% each). A trend towards an increase in the volume of damage can be observed for all types of damage, with the exception of fire damage. The largest volume of damage caused by humans was recorded in 2011 (28.285 m³), by insects and plant diseases in 2016 (40.520; 37.249 m³), by weather disturbance in 2015 (116.431 m³), and by forest fires in 2012 (63.118 m³). Forest damage is a complex phenomenon in which natural and anthropogenic factors play a role and lead to a loss of forest trees of up to 0,08% of the total volume and up to 3,4% of the total volume increment. This conclusion must be taken into account in future forest management plans.

Keywords: *natural disturbance, climate change, biotic, abiotic.*

Introduction

Forest damages are inherent part of natural ecosystems. Forest damage is defined as: “a disturbance to the forest which may be caused by biotic or abiotic agents, resulting in the death, or significant loss of vitality, productivity or value of trees and other components of the forest ecosystem” (TBFRA, 2000). Abiotic factors are weather conditions such as ice break, wind break, snow break, storms, droughts and human activities as well as fire. Biotic factors are insects and plant diseases. The frequency and intensity of extreme weather conditions and the occurrence of insects leads to an alarming volume of affected trees (Köhl, et al., 2024).

In a 50-year period from 1950 to 2000, an average of 35 million m³ of damaged trees per year was observed (Schelhaas, et. al, 2003). The chronology of forest damage illustrates the vulnerability of forests. In the 1980s, large-scale forest damage occurred as a result of transboundary air pollution (Kandler, Innes, 1995) with significant science policy consequences (Poduška, 2018). In the 1990s, severe storms damaged up to 180 million m³ of wood in Central Europe and boreal forests (Lassig, Mocalov, 2000). In the last few decades, we have seen a new combination of storms and resulting insect outbreaks. According to the FAO report, storms, insects and diseases damaged around 40 million ha of forest in 2015 (FAO, 2020).

The problem with the analysis of forest damage is the lack of a historical overview of disturbances in European forests, which is somewhat fulfilled by a comprehensive analysis of forest damage and disturbances since 1950 (Schelhaas, et al., 2003); Patacca, et al., 2023) and the Database on Forest Disturbances in Europe (Patacca et al., 2021). In Serbia, the analysis of the development of the extent of damage caused by natural hazards in the forests of Serbia and the influence of temperature and precipitation showed that the extent of damage caused by natural hazards decreases with increasing temperature (Ranković, et al., 2016). Other different causes of damage such as radiation, war and tree competition can be found in the literature. Analysis of forest damage caused by radiation (Witherspoon, 1965) and war (Westing, 1975) and damage caused by competition between trees (300.000 ha), which was observed in Finland (UNECE/FAO, 2000) is the least represented in the scientific literature and was not considered in this study.

Materials and methods

The data from monitoring of forest damages caused by natural disturbances can be found in several data bases: Database of European Forest Insect and Disease Disturbances, Database on Forest Disturbances in Europe, European Forest Fire Information System, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests. In this study as relevant source of data on forest damages we used National data base derived from Statistical Office of Republic of Serbia. The data was collected from Statistical Yearbooks in 20-years period (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020). The data in Statistical Yearbooks was submitted by public forest enterprises: “Srbijasume” and “Vojvodinasume”, and public enterprises for management national parks and units that are parts of other enterprises and cooperatives engaged in forestry. Data on damages to forests are collected by causes of damages and are expressed in m3.

Results and discussion

The results are presented for forest damages according to the causative agent, i.e. human caused, insects, natural inclemency - which represents damages from weather events, followed by damages caused by plant diseases, and fire. The volumes of damaged trees are present in two categories. abiotic and biotic, as well. Damage from human caused and damage from fire combined in the category of abiotic damage. Biotic damage is caused by insects and plant diseases.

Table 1. shows volume of damages per causative agent and total damages in 20-years period.

Table 11. Forest tree damages (m3)

m3 Year	Human caused damages	insects	natural inclemency	plant diseases	Fire ha	TOTAL
2000	11.792	5.966	35.684	3.900	7.944	63.223
2001	14.590	6.738	19.064	9.519	459	52.890
2002	12.158	5.796	5.280	7.033	969	43.052
2003	19.634	10.384	8.812	5.690	1.402	82.041
2004	15.212	1.043	9.544	11.857	202	39.158
2005	12.220	3.302	20.090	2.741	52	38.881
2006	9.918	1.402	9.172	7.933	494	29.505
2007	17.046	2.160	10.549	5.003	22.161	40.576

m3 Year	Humam caused damages	insects	natural inclemency	plant diseases	Fire ha	TOTAL
2008	22.229	3.877	15.706	4.611	575	53.572
2009	14.090	3.021	19.937	8.313	1.210	47.293
2010	13.881	4.070	14.902	5.093	503	38.003
2011	28.285	3.281	8.141	3.358	2.036	67.635
2012	27.590	2.583	18.619	5.765	7.460	117.675
2013	17.859	13.056	29.960	17.556	561	85.774
2014	26.524	29.861	41.107	14.769	284	122.517
2015	24.393	32.680	116.431	13.218	827	191.781
2016	21.760	40.520	86.826	37.249	296	223.469
2017	26.327	27.303	44.074	17.504	1.050	126.623
2018	24.685	16.506	74.495	16.798	303	133.191
2019	27.378	11.765	58.028	13.876	1.079	114.444
2020	25.723	11.886	75.396	26.477	3.635	141.640
TOTAL	413.294	237.200	721.817	238.263	53.502	1.852.943

Table 1 shows the volume of damage per causative agent and the total damage over a period of 20 years. In the 20-year period observed, the total forest damage amounted to 1.852.943 m³. This corresponds to an average volume of 88.235 m³ of damaged trees per year. Over a 20-year period, state forests lose 2 m³ per hectare. The average annual damage in Serbia is 0,09 m³/ha, while the damage in Europe is significantly higher and amounts to 0,21 m³/ha) (Schelhaas, *et. al.*, 2003). Forest damage caused by severe weather condition here called Natural inclemency caused 39 % of the total damage (721.817 m³) over the 20-year period, followed by damage caused by humans (22 %) and damage caused by insects, plant diseases and fire (13 % each). The results are presented for forest damage according to the causative factors, i.e. damage caused by humans, insects, natural inclemency - which stands for damage caused by weather events, followed by damage caused by plant diseases and fire. The volume of damaged trees is divided into two categories: abiotic and biotic damage. Man-made damage and fire damage are summarised in the category of abiotic damage. Biotic damage is caused by insects and plant diseases.

Human-caused damage ranged from 9,918 m³ in 2006 to 28,285 m³ in 2011. The average human-caused damage was 19,681 m³ per year. Total man-made damage in the last 20 – years amounted to 413,294 m³, which corresponds to 22% of all damage in this period. The man-made damage mostly occurs in the form of illegal shelters, due to economic instability and the impossibility of guarding and protecting the forest in certain places, such as the security zone with Kosovo. The administrative authorities of the public forestry company Srbijašume state that the value of illegal timber over a 20-year period amounts to 22 million euros (CINS, 2019).

The damage caused by insects was highest in 2016 with 40,520 m³ and lowest in 2004 with 1,043 m³. The average damage caused by insects amounted to 11,295 m³ over the 20-year reporting period. The total damage caused by insects amounted to 237,200 m³, which corresponds to 13% of the total damage over the 20-year reporting period. The tree species most frequently attacked by insects were spruce, Austrian pine, oak and beach (Češljär, *et al.*, 2014). The most common insect damage is caused by bark beetles attacking the most valuable spruce trees. Bark beetle outbreaks occur after wind breakage, when remedial measures such as the removal of uprooted trees come too late (Marković, 2012).

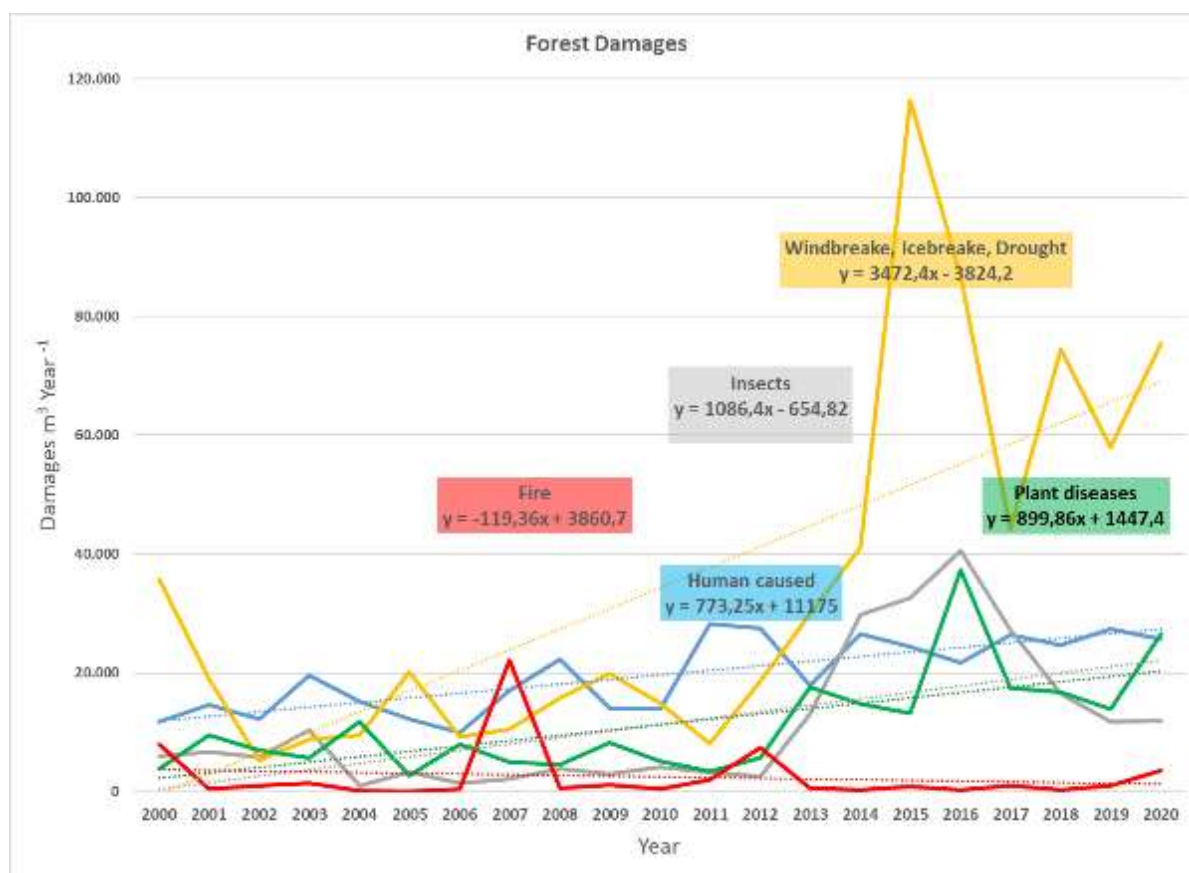


Figure 5. Forest damages

The extreme weather conditions referred to here as natural inclemency caused the most forest damage in 2015 with 116.431 m^3 and the least damage was observed in 2002 with $5,280 \text{ m}^3$. The main cause was the ice breakage in the winter of 2014/2015, which according to the reports of Public Forest Enterprise “Srbijašume” caused 456.326 m^3 of damage, which for some reason is not visible in the Statistical Yearbook report. The average damage caused by natural inclemency were 34.372 m^3 in the reporting period. In Europe, storms are the main cause of damage and are responsible for around 51% of all damage recorded in the period 1950 – 2000 (Schuck, Schelhaas, 2013). After the wind simulation, it was pointed out that this extent of damage due to weather phenomena (ice, wind) could also be a consequence of novel silvicultural regimes leading to a relatively low tree height to stem diameter ratio (h/d) (Schelhaas, *et.al.*, 2007). In even-aged stands, a low h/d ratio could have a direct effect on stand stability due to the low stand density. Low stand stability in uneven-aged stands depends on thinning, which favors taller trees with relatively small diameters.

The lowest fire damage was observed in 2010 with 57 m^3 and the highest in 2012 with 63.118 m^3 . The average damage caused by fire amounted to 11541 m^3 . The total damage in the observed period amounted to $242,369 \text{ m}^3$. Such large discrepancy in forest fire damage can be explained by the fact that forest fires are considered both a damaging event (Sil, *et al.*, 2019) and a beneficial event (Pausas, Keeley, 2019). The cause of forest fires is mostly human activity, with some benefiting from the fire, but there are also situations where the fire leads to significant losses (Poduška, Stajić, 2024). The global estimate of fire damage from the decade of 1960 is up to \$7.06 billion (Ritchie *et al.*, 2022). The greatest damage to trees in the state forests is in the region of southern and eastern Serbia. (Marčeta, Milanović, 2018).

The forests were damaged the most in 2016 with $223,469 \text{ m}^3$, and the least damage was observed in 2006 with $29,505 \text{ m}^3$. To gain a better insight into the causes of the damage, we have depicted abiotic and biotic damage in Figure 2.

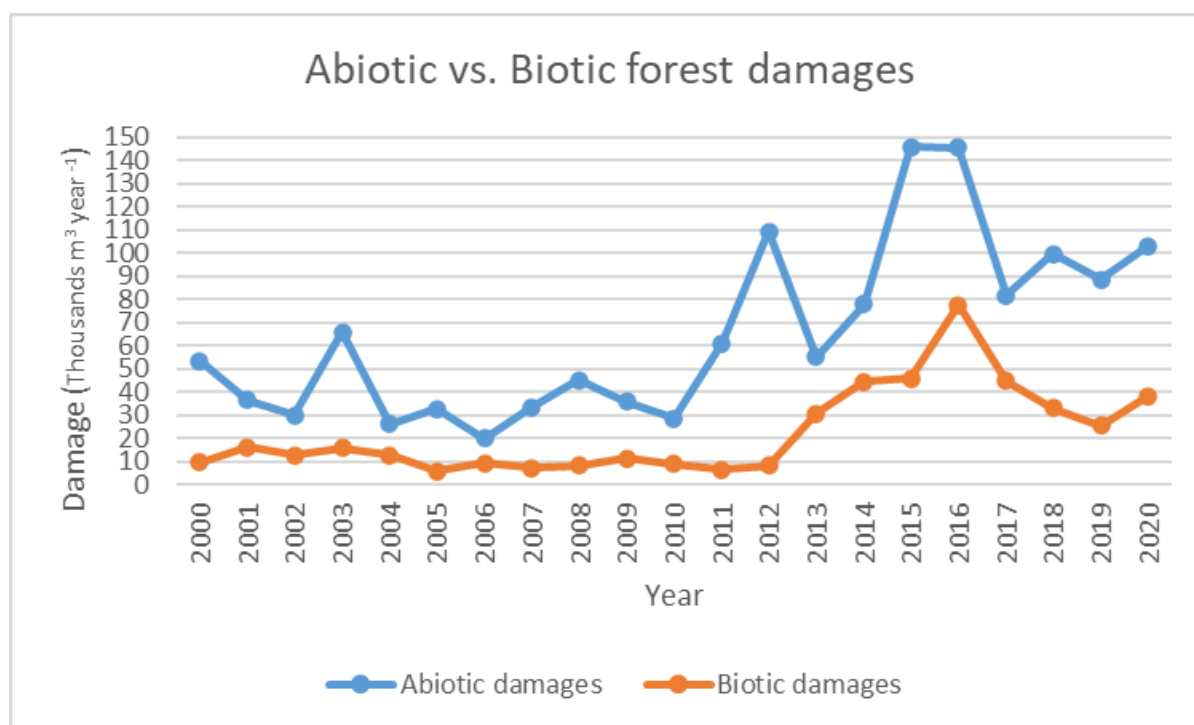


Figure 6. Abiotic vs. biotic forest damages

Forest damage caused by abiotic factors was observed to a greater extent than biological damage. The ratio between abiotic and biotic damage is 13 times higher in 2012, which is mainly due to natural inclemencies. The year 2012 was one of the driest years on record, which led to forest trees drying out (Radulović, *et al.*, 2014).

Conclusion

In the assessed 20-year period from 2010 to 2020, the total damage to the trees in state owned forest in Serbia amounted to 1.852.943 m³.

- Abiotic damage, which is caused by the influence of humans, fire and weather, accounts for the largest share of damage, accounting for 65% of all damage in the period from 2000 to 2020.
- Damage caused by natural disasters accounted for 39% of total forest tree losses.
- Human damage accounted for 22% of total tree losses.
- Fire damage accounted for 13% of total tree losses.
- Plant diseases caused 13% of total tree losses.
- Insects caused 13% of the total tree losses.

The patterns of damage in forests can be linked not only to the negative effects of climate change, but also to forest management and planning practices associated with silvicultural measures that have a significant impact on stand instability, as one of the objectives of such measures is to reduce the h/d ratio.

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