

Forests in Kazakhstan: issues of conservation and environmental safety

*Albina Zhanbossinova*¹, *Zhanna Mazhitova*^{2*}, *Zauresh Saktaganova*³, *Bakyt Atantayeva*⁴, *Arman Kulshanova*⁵, and *Raushan Akhmetova*⁴

¹L.N. Gumilyov Eurasian National University, 2, Satpayev str, Astana, 010008, Kazakhstan

²Astana Medical University, 49a, Beybitshilik str, Astana, 010000, Kazakhstan

³Buketov Karaganda University, 28, University str, Karaganda, 100024, Kazakhstan

⁴Shakarim University, 20a, Glinki str, Semey, 071412, Kazakhstan

⁵T. Zhurgenov Kazakh National Academy of Arts, 127, Panfilov str, Almaty, 050000, Kazakhstan

Abstract. The article discusses issues of forest preservation and environmental safety in Kazakhstan. The authors conduct a comparative analysis of forest cover across regions of Kazakhstan, revealing its low percentage in the Western regions and high in the eastern and southern regions. The article highlights both man-made and natural risks to the forest fund of Kazakhstan. The authors argue that fires, caused by both human activities and natural factors, pose a particular danger to Kazakhstan. Analysis indicates that the dynamics of fires have been intensifying since 2018, which naturally disrupts the structure of the area's biocenosis. Based on the results of the study, conclusions were drawn and recommendations were made for the conservation of biological diversity.

1 Introduction

Modern society, accustomed to comfortable living conditions, often overlooks the potential for catastrophic loss not just from nuclear explosions, but also from large-scale environmental disasters. Few people consider that water sources, forests, and mountains may vanish, partly due to natural processes but predominantly due to human actions, accounting for 90% of environmental degradation. Much of the global population lacks access to clean water, leading to fatalities. Meanwhile, industrial activities continue to contaminate groundwater unabated. Protecting and preserving the world's forests is paramount. Occupying a crucial role in the global ecosystem, forests serve as natural air filters, protect against geological hazards, and provide essential resources and sustenance. Any disruption to this delicate balance risks triggering irreparable global catastrophes.

The current state of affairs on our planet serves as evidence of society's gradual self-destruction, with the consequences of forest destruction proving irreversible. According to statistical data from the UN's interactive report, "Global Forest Resources Assessment 2020 (FRA 2020)", in 2020, Earth's forests covered approximately one-third of the planet's surface, totaling about 4.06 billion hectares, equivalent to 31% of the land [1]. For

*Corresponding author: mazhitova_69@mail.ru

perspective, 10,000 years ago, forests covered 71% of the Earth's surface, highlighting the significant decline in global forest reserves over time. Between 2002 and 2020 alone, approximately 12% of the world's natural forests were lost, equivalent to an area roughly the size of three Spains [2].

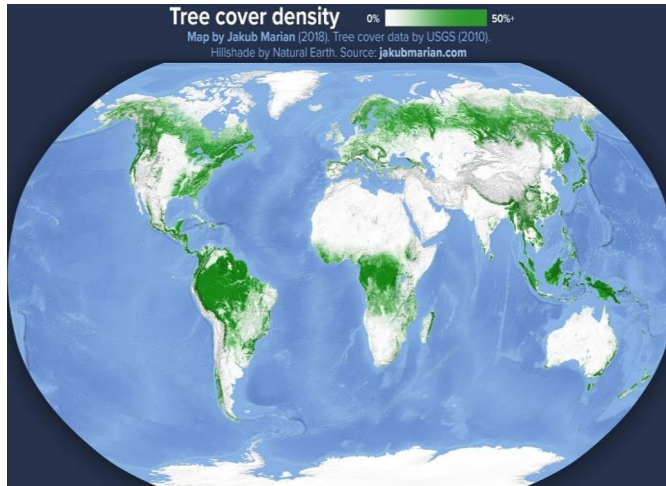


Fig. 1. World Forest Map.

By the onset of the 21st century, humanity had already obliterated approximately 50% of the world's forested areas, thereby highlighting the pressing issue of deforestation spurred by both anthropogenic and climatic factors. Scientists studying this issue warn of an impending environmental catastrophe [3]. Last March, the sixth One Planet Summit convened, representing perhaps the sole non-politicized platform addressing the intricate challenges of Earth's biodiversity. Amidst various topics previously discussed such as "Desert Containment" and "100 Water and Climate Projects in Africa," the sixth summit in Libreville, Gabon, focused on African forests, consequently shedding light on global forest-related concerns.

It is indisputable that each country contributes its share to the dwindling global forest cover. On one hand, man-made disasters exacerbate the problem, while on the other, the incessant demand for wood to fulfill daily needs perpetuates irreparable environmental damage. The Government of Kazakhstan has initiated measures to preserve its natural forest wealth and address afforestation concerns. Nonetheless, Kazakhstan faces its own environmental challenges, including water resource management, raw material extraction technologies, and energy production. It's imperative to evaluate the effectiveness of governmental measures aimed at addressing these pressing environmental issues. The author's focus revolves around forest conservation, using the Republic of Kazakhstan as a case study, with particular emphasis on the environmental challenges associated with Kazakhstani forests. The research object pertains to forests within Kazakhstan's ecosystem, while the subject of the research involves analyzing the environmental policies of the Kazakhstani government

2 Materials and methods

Our research methodology was grounded in established scientific principles, which delineated the object and subject of our investigation within the framework of structural and

functional relationships. In our study, we relied on commonly accepted systemic scientific principles and approaches aimed at objectively identifying reliable knowledge. This involved analyzing statistical parameters, comprehending the problem through an analytical review of pertinent materials, and synthesizing and structuring them for visual representation, enabling comparison across chronological and numerical dynamics.

Throughout the article, we employed a systemic approach at the intersection of ecology, biology, history, and geography to gain a comprehensive understanding of the issue under investigation. This interdisciplinary approach facilitated the incorporation of methodologies from related fields, enhancing the efficiency of our research process.

3 Results and Discussion

The issues surrounding deforestation and its environmental consequences represent an urgent and interdisciplinary topic. Forests constantly face the potential threat of fires, which have multifaceted impacts on the surrounding environment. Researchers addressing fire safety and its consequences identify various direct and tangential issues related to our investigation. Due to the limited scope of this article, we couldn't provide a comprehensive historiographical overview of the topic. Instead, we opted to focus on publications directly or indirectly related to our research.

For instance, F. Seijo examined the phenomenon of fires deliberately ignited by peasants in Spain as a form of political protest, demonstrating the intricate socio-political dimensions of fire-related issues [4]. Additionally, the authors of the article "A review of forest fire and policy response for resilient adaptation under changing climate in the Eastern Himalayan region" delved into the spontaneity of fires, particularly within protected areas and standard forest zones. They presented the scale of forest fires in the Himalayas, analyzed their potential consequences for the ecosystem, and proposed policy measures and financial support for scientific research on forest fires in the region [5].

Given that fires have become a recurrent aspect of ecosystems, the authors developed a 'Fire Zone Simulator' to simulate spatial fire modeling and assess its consequences, aiding in damage evaluation and prevention strategies. We believe such an invention holds significant potential for widespread adoption, enabling the assessment of fire threats, providing an objective overview of potential damage, and facilitating the development of preventative measures [6].

The scientific world was particularly concerned about the consequences of afforestation and destruction of forests, both with the participation of humans and natural elements. The impending catastrophe and the fate of the earth from a scientific perspective with visual evidence has become a trending topic in many publications and monographs. Back in 1992, an initiative group of 1,700 scientists published a letter addressed to the citizens of the earth. The author's message, the published manifesto warned of a looming catastrophe for the entire planet, "They expressed concern about current, impending, or potential damage on planet Earth involving ozone depletion, freshwater availability, marine life depletion, ocean dead zones, forest loss, biodiversity destruction, climate change, and continued human population growth." On the 25th anniversary of this manifesto, i.e. in 2017, the authors of the article "World Scientists' Warning to Humanity: A Second Notice" visually showed by publishing graphs and diagrams what was before 1992 and the result of the disaster by 2017 [7].

It should be noted that there are in-depth scientific studies in many countries of the world by experts of the United Nations on the problem of forests, their analytical reviews have a tremendous effect and serve as the methodological basis for such publications. There are also many interesting investigative journalisms, but due to the fact that they sometimes

have a populist connotation, we did not include them in the analytical review in the discussion section.

Thus, summarizing only a small fraction of the publications we've referenced, we observe that the issue chosen by the author team for research is widely discussed and actively studied. It is approached from an interdisciplinary perspective, involving experts ranging from ecologists to IT technology specialists

3.1 Assessment of the forests of the Republic of Kazakhstan

Kazakhstan has the most diverse types of natural landscape, steppe spaces (26%) are replaced by mountain ranges (10%), forests grow behind desert and semi-desert lands (55%), water sources (2.8%). Each region has unique, inimitable natural designs created without human intervention, and at the same time the uneven distribution of these types of landscape. Water sources hold particular significance for any nation. Central Asia, including Kazakhstan, faces a unique challenge due to its lack of access to the sea. The observed water shortage stems from reduced inflows from neighboring territories. Kazakhstan has explored 1,552 groundwater deposits, with a total volume of 42.2 million cubic meters per day. However, only 13.7 million cubic meters are allocated for household and drinking water supply, with 2.1 million cubic meters designated for industrial and technical purposes, and 18 million cubic meters for land irrigation.

In terms of water supply across the republic, Almaty ranks highest, followed by East Kazakhstan, Pavlodar, and South Kazakhstan regions. Conversely, Akmola, West Kazakhstan, Atyrau, and Mangystau regions face water scarcity issues [8]. Water sources significantly shape the country's landscape, thus regions across Kazakhstan exhibit distinct natural features, including varying forest coverage. The nature of Kazakhstan is beautiful and unique in its own way, there are Martian species somewhere, such as the Kiin-Kerish tract, a paleontological monument in the complete absence of tree growing, the Charyn Canyon in the Alma-Ata region. Water scarcity in Kazakhstan has led to the prevalence of deserts across most of the territory, covering 164 million hectares (44%), along with semi-deserts (14%). Steppe territories account for only 26% of the land, while forest zones, comprising coniferous and softwood trees, shrubs, and saxaul, occupy a mere 5.5% (13.6 million hectares) of the country's area.

All matters pertaining to forests are overseen by the Committee of Forestry and Wildlife, previously part of the Ministry of Agriculture, but now reorganized under the Ministry of Ecology, Geology, and Natural Resources. This reorganization signifies a significant political decision, reflecting the ministry's commitment to align with global trends aimed at environmental preservation.

The majority of the state forest fund, comprising 74.9%, falls under the jurisdiction of the regional akimats, while 24.4% is managed by the Committee. The Committee places particular emphasis on areas with dual status as both specially protected natural sites and legal entities, ensuring the protection of national natural parks, reserves, and nature reserves.

According to the World Bank's rankings, Kazakhstan held the 84th position in terms of forest area in 2020, and the 85th position in 2016, out of 200 countries worldwide. Coniferous plantations are primarily located in the northern, eastern, central, and partially southern regions of Kazakhstan, spanning Akmola, Kostanay, Semipalatinsk, East Kazakhstan, Pavlodar, and Alma-Ata regions.

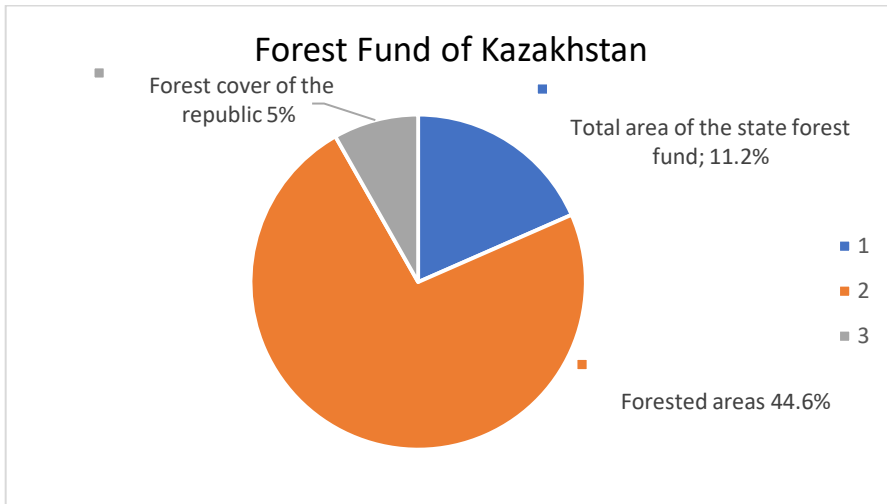


Fig. 2. Forest Fund of Kazakhstan.

The management of Kazakhstan's forest fund is overseen by two entities responsible for its preservation: 24.4% falls under the jurisdiction of the Committee for Forestry and Wildlife, while 74.9% is under the control of local regional authorities, led by regional akims. Additionally, in 2020-2021, unaccounted forest lands were discovered by the IT company Bitfury during project implementation, totaling 67 and 47 thousand hectares in the East Kazakhstan and Pavlodar regions, respectively [9].

Kazakhstan hosts seven state natural reserves: "Irgiz-Turgai State Natural Reserve" in Aktobe region, "Akzhayyk" in Atyrau region, "Altyn-Dala" in Kostanay region, "Ile-Balkhash" in Almaty region, and "Yertys Ormany" in Pavlodar region. Among these, only the latter is dedicated to protecting a unique ribbon forest along the Irtysh River, extending up to and including the Abai region.

Among the ten state reserves, only three focus on conserving and expanding forest lands. The West Altai State Nature Reserve, situated at the junction of mountains, taiga, and tundra on the border between East Kazakhstan and Russia, stands out as the most ambitious and distinctive in our view. It hosts valuable birch, cedar, pine, and poplar trees within its territory. In the South Kazakhstan region, the Aksu-Zhabagly State Nature Reserve, nestled in the valleys of the Bala-Baldybrek and Baldybrek rivers, boasts unique juniper forests. The Alma-Ata Nature Reserve, featuring coniferous forests, is noteworthy for being the exclusive habitat of the Shrenka spruce, named after the explorer who first discovered and described this unique tree.

There are 14 national natural parks in Kazakhstan. Katon-Karagai National Park, located on the borders of East Kazakhstan, Russia, Mongolia, and China, is renowned for its cedar forests and cones. Burabai, Kokshetau, and Bayanaul National Parks showcase diverse natural landscapes, including forest-steppe, steppe, mountains, and forests. All these parks, reserves, and sanctuaries are state-owned, with their protection and development entrusted to the Committee for Forestry and Wildlife.

Based on the author's research on the forest cover of Kazakhstan's territory, we present the data from Diagram 2, which illustrate the comparative ratio of forest cover across the regions of Kazakhstan. The obtained indicators are quite interesting, revealing that two regions with large areas (Karaganda – 428 thousand square kilometers and Aktobe – 300.6 thousand square kilometers) have the lowest percentage of forest cover (land covered with forest) – 0.2%, with an area of 118.6 thousand square kilometers. The Atyrau region has a forest cover of 0.1%. In contrast, Zhambyl region has the highest forest cover at 16%,

followed by Kyzylorda at 13.6% and South Kazakhstan at 13.7%. Alma-Ata follows with 8.2%, and East Kazakhstan with 6.2%, the latter being the third-largest region by area, with Kyzylorda ranking fourth. The high forest cover in the Kyzylorda region is primarily due to the presence of saxaul, which occupies extensive areas, including in the Zhambyl region. The most sought-after wood for industrial production in Kazakhstan and beyond, such as larch, cedar, spruce, and fir, are predominantly found in the Alma-Ata, East Kazakhstan, and Abai regions (separated from East Kazakhstan region in 2022).

The data presented in the diagram correlate with the overall estimated indicators of natural parks and reserves. Regions hosting national parks, sanctuaries, and reserves tend to have a higher percentage of forest cover compared to those without such protected areas. However, this observation applies solely to the issue of forest funds and volumes in the Republic of Kazakhstan. Overall, the situation is concerning, as Kazakhstan faces challenges related to the expansion and restoration of the state's forest fund to restore ecological balance.

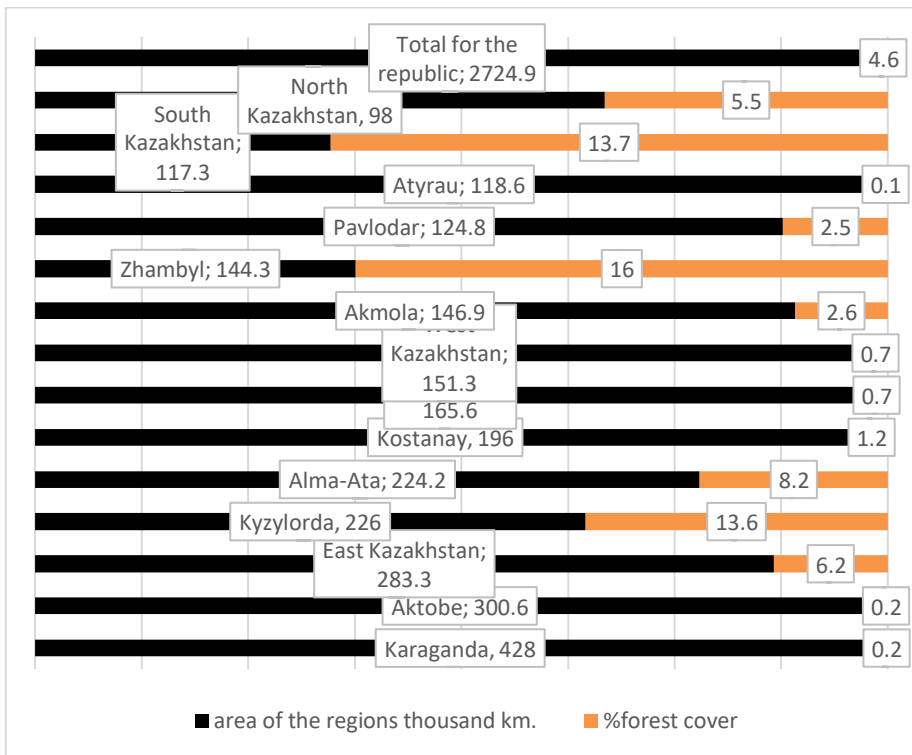


Fig. 3. The ratio of the area of the regions of Kazakhstan to the percentage of forest cover of the territory.

We cannot assert that these issues are being neglected. The primary concern regarding the forest cover of Kazakhstan's territory has been addressed at various levels, ranging from local regional governance to the Cabinet of Ministers. President K. Tokayev himself underscored the urgency by emphasizing the necessity to plant 2 billion trees in the forest fund and fifteen million trees in populated areas within five years in one of his presidential messages. Additionally, in the reports of committee chairpersons and the Minister of Ecology, Geology, and Natural Resources in 2020, statistics were cited, including the mention of the forest fund encompassing 30 million hectares, constituting merely 11% of

the total area of Kazakhstan [10]. This proportion is notably small. However, we harbor some reservations regarding the realization of the Minister's outlined prospects for increasing forest cover, primarily due to the presence of numerous other challenges in forestry. The situation is exemplified by Astana city in Kazakhstan, where the greening process faces hindrances not only from natural and climatic factors but also from an irrational approach and the capital's greening program.

3.2 Threats and risks to the forest fund of Kazakhstan

The forest is a guarantee of ecological balance in nature. According to the UN, every year humanity loses about ten million hectares of forest, at such a gigantic rate we will soon remain on earth, where there will not be a single tree. Of course, there are forests that naturally regenerate themselves, but there are those categories of forests that do not have the opportunity to reproduce themselves.

Let us highlight the man-made and natural risks of the forest fund of Kazakhstan.

Man-made damage to forest plantations is caused by the daily socio-medical needs of mankind and industrial demands, where we include all its areas where wood is in demand. Man-made damage occurs both within the legal and criminal framework, we are talking about smuggling and shadow timber business.

Natural risks include anthropogenic and human factors, various adverse climatic conditions such as drought, floods, fires, and the spread of pathogenic microbes that adversely affect forests. We cannot say which of the risks causes more damage, there are probably fragmentary indicators that will be partially shown, but in general this issue is voiced in various journalistic public investigations.

Let us focus first on man-made damage. Of course, governments of all world countries are forming a legislative algorithm and taking many measures to protect forests, in addition to legal issues, problems with the forest reproduction program are being solved by mass planting of fast-growing seedlings, special cultivation of so-called commercial forests for production needs, replacement of valuable wood with new technological solutions. Kazakhstan is no exception, the state takes legislative and economic security measures to protect forest plantations, creates obstacles to the criminal element. In particular, the Kazakhstani government, concerned about the catastrophic decrease in the area of forest territories, as well as fulfilling its obligations under the UN Paris Agreements, has intensified the planting of young tree seedlings. Starting from 2019, Kazakhstan has been extending the ban on the export of certain types of timber every six months. It's an important step, but it is difficult to control. The largest neighboring countries, like Russia and China, also took the same measures by banning the export of wood, but at the same time the needs of Chinese industry have increased dramatically. It is assumed that "by 2025, the shortage of wood in China will amount to 200 million m³ per year, with an increase in new jobs of 2 million people" [11]. According to the logic of the ban, wood exports should decrease, however, according to the Bureau of National Statistics and Eurostat, "...in the first 9 months of 2022, the republic increased exports of wood, timber and pulp and paper products to Western and other countries by \$14.8 million. At the same time, the largest volume of supplies (\$8.6 million) fell on the EU countries" [12]. In the 90s of the twentieth century, the society of Kazakhstan sounded the alarm that despite the ban, the predatory felling of relict pine forests continued, the illegal business of sawmills flourished and led to the destruction of forests in protected areas, which were mentioned above.

Similar actions continue in the 21st century. Photo 1. With the latest technologies and capabilities of Google Maps, it was possible to detect illegal logging of more than 200 trees from an area of 1.7 hectares [13]. The new legislative norms of Kazakhstan contain norms

of penalties for illegal felling, ranking the list, for any felled tree. The rules also clearly prescribe the punishment for illegal felling of trees. For one felled tree, a fine and compensation are threatened by planting new seedlings, in the case of cutting down a perennial tree, the fine is doubled, and there is also criminal liability for damage caused on a large scale.

A serious dangerous problem for forests is fires, which are based on various causes, ranging from natural disasters, ending with ordinary human negligence.

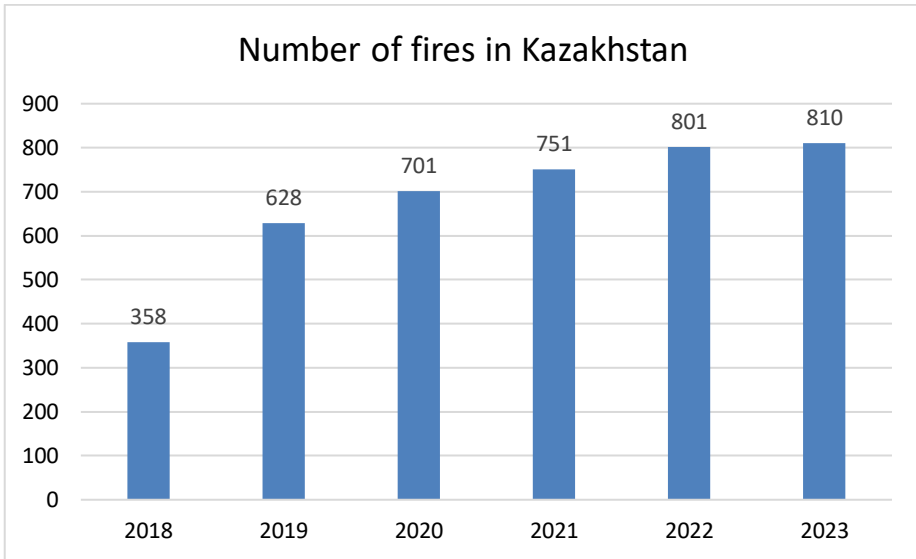


Fig. 4. The number of fires in Kazakhstan from 2021-2023.

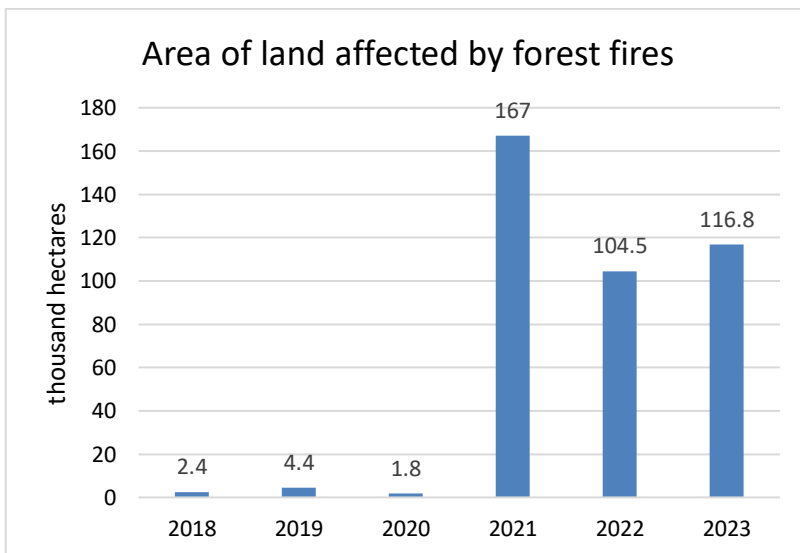


Fig. 5. The area of land affected by forest fires.

Since 2018, there has been a dramatic increase in the frequency and scale of fires in Kazakhstan. The highest number of fires over the past three years has been recorded in East

Kazakhstan, Pavlodar, and Abai regions, which are home to the Yertys Ormany Nature Reserve and the West Altai State Nature Reserve, harboring some of the most valuable wood species. The “Yertys Ormany” is a ribbon forest stretching along the Irtysh River in these regions. Only three similar ribbon forests exist worldwide, found in Canada, Kazakhstan, and Russia, with the latter’s stretch continuing from three Kazakh regions along the Irtysh River. In June 2023, a fire broke out in the Yertys Ormany branch of the Semey Ormany, covering an area of 60,000 square kilometers in the Abai region. This fire engulfed up to 250 hectares of relict forest, remnants from the Ice Age, within the reserve, leading to tragic consequences with 15 fatalities and the declaration of national mourning [14].

Will the national program “Green Kazakhstan” be able to solve issues with the reproduction of lost forests outside and inside the urban infrastructure. On behalf of the President of Kazakhstan K. Tokayev 2 billion trees should be planted by 2025, of which 244 in 2022, 411 in 2023, 573 in 2024, and 643 in 2025.

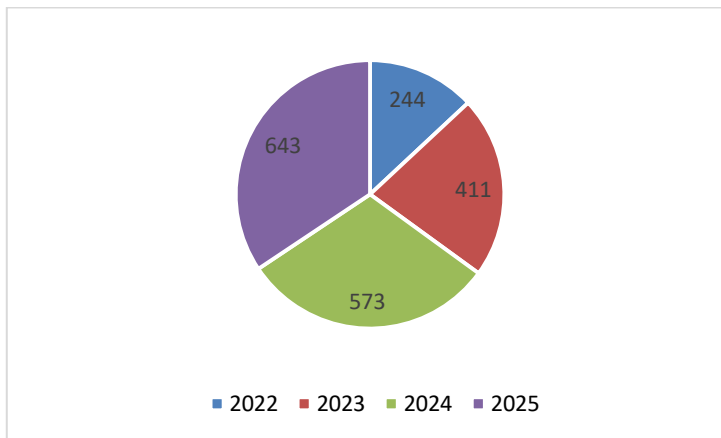


Fig. 6. The Green Kazakhstan Program.

The varieties of the selected planting material, of course, are impressive, trees are planted en masse in the spring and autumn period, they mostly die without careful care. Unfortunately, we do not have the data on the geography of planting, we hope that they are selected ecologically correctly. We cannot provide information about the survival rate of the planting material, as we did not find it on the website of the Forestry and Wildlife Committee. As the little Prince of Antoine De Saint-Exupery said, “We are responsible for those who have been tamed,” there is hope that those who plant will bear moral responsibility for the small tree planted by him.

According to experts, it will take almost half a century to restore the forest area. The consequences of the fire will naturally affect the ecological climate and biodiversity of the natural reserve. The composition of air and water has changed, given that, the pine forest had an impact on nearby reservoirs, then if the root system is disturbed, drying begins, the volume of the sand cover on which the pines grew increases, which means that sandstorms will result. It should be noted that the ribbon forest affected by fires runs through the territory where the nuclear test site was once located, and where the explosions ended only in August 1991 with the adoption of a special presidential decree. The consequences of the explosions still affect the ecology of the region, in addition to them, the consequences of fires worsen the situation, cumulatively a large-scale environmental disaster may break out in the future.

4 Conclusion

In conclusion, our research underscores a global problem that demands the attention of the entire international community. Forest fires pose a destabilizing threat, disrupting ecosystems, causing extensive damage to flora, fauna, infrastructure, and human-inhabited areas. The aftermath of fires, including atmospheric emissions, deterioration of air quality, afforestation, desertification, and sandstorms, often presents irreversible and challenging issues.

Since the publication of the 1992 Manifesto and the subsequent “World Scientists’ Warning to Humanity: A Second Notice,” which garnered support from over 15,000 scientists worldwide, Kazakhstan has made strides in establishing and maintaining nature reserves, national parks, and reserves. Legal and economic frameworks have been developed to preserve forests, enhance biodiversity within Kazakhstan’s ecosystems, and protect endangered wildlife species, such as the snow leopard.

However, while many programs and governmental decisions have been declared, some are still in the decision-making phase or face questions regarding their effectiveness and implementation quality. Challenges persist in environmental education and renewable energy sources in Kazakhstan. Yet, the urgent need remains for concerted efforts towards afforestation and forest conservation, echoing the concerns raised by scientists in 1992 – a concern that persists today, as evidenced by statistical indicators presented in our visual representations. Addressing these challenges necessitates a radical shift in public consciousness and the adoption of concrete measures yielding tangible results to reduce fire statistics and ensure the successful reproduction and survival of trees.

References

1. UN News, <https://news.un.org/ru/story/2010/04/1162211>
2. Forests are being mercilessly destroyed all over the world. What does this mean for the planet? <https://lenta.ru/articles/2023/02/08/deforestation>
3. N. Litvinenko, *IACJ*, **6**, 509-523 (2021)
4. F. Seijo, *Journal of Environmental Policy & Planning*, **11**, **2**, 103-128 (2009) DOI: 10.1080/15239080902732570
5. W.W. Sonam, Ch.-H. Lim, W.-K. Lee, *Forest Science and Technology*, **17**, **4**, 180-188, (2021) DOI: 10.1080/21580103.2021.1979108
6. H. Lee, S. Lim, H. Paik, *Journal of Spatial Science*, **55**, **2**, 289-301 (2010) DOI: 10.1080/14498596.2010.524144
7. J. William, *BioScience*, **67**(12), 1026–1028 (2017)
8. Yu. Zhikhar, New generation http://www.np.kz/last/12626-vodovoroty_geopolitiki.html
9. Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan, <https://www.gov.kz/memleket/entities/forest/about?lang=ru>
10. M. Mirzagaliyev, “By 2030, the forest cover of the republic will increase from 4.8% to 5%”, <https://primeminister.kz/ru/news/k-2030-godu-lesistost-respubliki-uvelichitsya-s-48-do-5-m-mirzagaliyev-10112455>
11. E. Bessonov, “Open letter. The Forest Code does not solve the problems of the industry, but creates new ones”, https://online.zakon.kz/Document/?doc_id=30065986&pos=5;-105#pos=5;-105

12. S. Cherniauskas, “Forest powers of Central Asia”, <https://vlast.kz/jekonomika/53118-lesnye-derzavy-centralnoj-azii.html>
13. Radionov V. “Trees are cut down - “greenery” flies”, <https://dzhk.kz/ekologiya/derevyat-rubyat-zelen-letit>
14. “Ecology and statistics”, https://stat.gov.kz/ru/news/ekologiya-i-statistika/?sphrase_id=286546