

Features of Forest Conservation in Azerbaijan: Management, monitoring and prevention

Aydin Yakhyaev¹  , and Meryem Aliyeva¹  

¹School of Advanced Technologies and Innovation Engineering, Department of Ecology and Environmental Sciences, Western Caspian University, Baku, AZ1072, Azerbaijan.

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Abstract

This article examines the specific features of the implementation of forestry measures carried out in Azerbaijan. In this context, the general characteristics of the forest resources were highlighted, including issues relating to the cultivation, use, and protection of forest resources. The structure of the Republic's land holdings, together with the corresponding percentage breakdown, was presented here. In this context, particular attention was paid to the structure of forestry management in the Republic and to the specific features of the measures implemented to protect and ensure the sustainable development of forest stands. In addition, the study also carries out a comparative analysis of forest conservation in Azerbaijan and the Republic of Georgia, which is reflected in the relevant trends.

Keywords: forestry management, forest resources, protection of forest stands, sustainable development, comparative analysis

1. Introduction

Forests are one of the planet's most important natural resources and play a key role in maintaining ecological balance. They perform a lot of functions: they regulate the climate, play a role in the water cycle, protect the soil from erosion, preserve biodiversity, and serve as a source of raw materials for various sectors of the economy. In addition, forests have a significant impact on people's quality of life by providing recreational areas and helping to improve environmental conditions.

2. Forest Resources

The overall area of Azerbaijan's forests is 1,213.7 thousand hectares. Forest area per capita is approximately 0.12 ha, which is four times (0.48 ha) less than the corresponding international average (Azərbaycan Respublikası Ekologiya və Təbii Sərvətlər Nazirliyi, 2017).

Azerbaijan's forests are classified as Group I in terms of importance and are found in different forms throughout the country's regions. One of the distinctive features of these regions is the presence of various natural resources – minerals, energy, water, and land. Among these, forest resources fulfill functions that are not typical of other natural resources. Forests are considered the only natural ecosystem that provides the conditions necessary to stabilize components as vital to the biosphere as water, air, and soil.

Most of the republic's forest areas (85%) are located in the Greater and Lesser Caucasus and in the Talysh Mountain Region. Most of the forests consist of valuable tree species (oak, beech, hornbeam, linden, maple, etc.). The diversity of the republic's forests depends on the climate, soil, and varying altitudes.

In today's world, the importance of forests is growing significantly due to global environmental issues such as climate change, land degradation, and the loss of biodiversity. In this regard, effective management of forest resources and the development of clear legal regulations in this area have become particularly important. Forest legislation is the primary tool for ensuring the sustainable use, protection, and restoration of forests (Dolxanov et al., 2012).

For Azerbaijan, forests are of particular importance, even though the country's forested area covers a relatively small territory. The republic's forests have a vital role in protecting the soil, preventing desertification, regulating water resources, and preserving unique ecosystems. Government policy in this area is based on the provisions of the Forest Code of the Republic of Azerbaijan, which regulates the most important aspects of the use and protection of forest resources.

Forest legislation consists of a set of legal provisions governing relations related to the ownership, use, protection, and regeneration of forests. It defines the rights and obligations of the state, legal entities, and individuals, and establishes penalties for violations of the established rules. Effective forest management is impossible without a clear legal framework that strikes a balance between economic interests and the need to protect the environment (Balakışiyeva, 2011).

This means that studying the characteristics of forest protection and management in Azerbaijan is an important step toward understanding the mechanisms of conservation, sustainable development, and the use of natural resources.

The purpose of this study is to examine the fundamentals of forestry legislation and the forest resource management system, as well as to analyze the specific features of forestry in Azerbaijan. To achieve this goal, it is necessary to:

1. To examine the characteristics of the concepts used and the structure of forestry management in the Republic;
2. Identify the key features of the measures implemented to protect and ensure the sustainable development of forest stands;

To compare the measures being taken to protect and ensure the sustainable development of Azerbaijan's forests with those of the Republic of Georgia.

3. Discussion

Forest management in the country is carried out by government agencies, specifically the Ministry of Ecology and Natural Resources of Azerbaijan, which ensures compliance with legislation, organizes measures to protect and restore forests, and develops programs for the sustainable development of forestry.

Management Structure: Since the Ministry was established in May 2001, the scope of work related to forest restoration, tree planting, the cultivation of planting stock, seed collection, and other activities has expanded significantly throughout the republic.

By decree of G. A. Aliyev, the national leader of the Azerbaijani people, dated December 26, 2001, the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan was instructed to submit for consideration by the Cabinet of Ministers of the Republic of Azerbaijan a National Program for the Restoration and Expansion of Forests, developed in collaboration with state and local government bodies (UNECE/FAO Forestry and Timber Section, 2019).

The Forest Development Department oversees 34 regional forest conservation and restoration enterprises, 3 tree-planting enterprises, and 3 regional forest seedling enterprises (the Center for Pest and Disease Control and the Forestry Research Institute). In accordance with the Presidential Decree, the draft National Program "On the Restoration and Expansion of Forests," developed by the Ministry of Ecology and Natural Resources, was approved by Presidential Order No. 1152 of April 18, 2003, with the relevant

amendments and additions. Currently, the Ministry of Ecology and Natural Resources implements its forestry policy through the Forest Development Service.

The Forest Development Service (FDS) ensures the protection of forests within the forest fund, carries out forest restoration and planting activities, cultivates planting stock, and collects seeds from forest trees and shrubs, maintaining state records of the forest fund and the forest cadastre, carrying out forest maintenance and other silvicultural activities, managing the supplementary use of forests, and conducting targeted, effective work on auxiliary agricultural plots. The FDS ensures that the following work is carried out to enhance the functions of forest management activities: land conservation, water conservation, climate conservation, sanitary and hygienic functions, and other beneficial functions. In addition, the Service carries out measures to preserve natural complexes and sites of scientific, cultural, and recreational significance to the environment; to protect biological diversity; to safeguard the fauna species found in forest lands; and to preserve the gene pool during forest seed collection operations.

In conjunction with this, instructions have been given to develop and submit to the relevant organizations coherent and environmentally sustainable national programs related to socioeconomic development, the development of livestock farming and agriculture, national programs on the use of summer and winter pastures and hayfields, the prevention of soil erosion in mountainous areas, gorges, and ravines, as well as at river mouths, and the prevention of soil salinization in mountainous and lowland regions (Məmmədov & Əsədov, 2010).

Forest Code of the Republic of Azerbaijan: Forest management is carried out in accordance with the Forest Code and the Environmental Protection Law. The Forest Code of the Republic of Azerbaijan was adopted on December 30, 1997 (Law No. 424-IQ). It took effect following its official publication on March 3, 1998. This Forestry handbook primarily covers the following topics: basic forestry concepts; forestry legislation of the Republic of Azerbaijan; the forest fund, forest lands, and forest areas, etc.

Within the territory of the Republic of Azerbaijan, all forests, as well as lands within the forest fund that are not covered by forest vegetation (both forested and non-forested lands), constitute the forest fund of the Republic of Azerbaijan. The boundaries of the forest reserve are defined by the lines separating forest reserve lands from other lands. The inclusion of land in the forest fund and its removal from it are carried out in accordance with the procedures established by the forestry and land laws of the Republic of Azerbaijan. Forest lands include lands covered with forest vegetation and lands not covered by such vegetation but designated for forest regeneration (unregenerated logging sites, burned areas, thinned areas, clearings, dead stands, nursery areas, forest plantations with an open canopy, etc.). Non-forest lands include lands designated for forestry purposes (agricultural land, forest clearings, land under roads, etc.), as well as other lands located within the boundaries of the forest fund (marshy, stony, rocky, and other land parcels unsuitable for use). Forest fund areas include forested areas, as well as forested and non-forested land areas not covered by forest vegetation (Azərbaycan Respublikası Prezidentinin İşlər İdarəsinin Prezident Kitabxanası, 2019).

Ground-based monitoring in forests: The purpose of these inspections is to regularly monitor, on-site, the activities of forest rangers in protecting forests from illegal logging and other violations (grazing of livestock, unauthorized mowing of grass, land encroachment, etc.). Inspections are conducted at least once every two months, with a thorough survey of the entire area covered by each inspection route. This is carried out directly by the assistant forester or the forest supervisor.

During an inspection, the assistant forester or forest supervisor first reviews the reports and records prepared by the forest ranger regarding cases of illegal logging, whether the perpetrators have been identified or not. At the same time, the tree species, their sizes, and their numbers are cross-checked on site against the data specified in the reports or protocols, after which the stumps of these trees are marked with the illegal logging stamp ("QQ").

If, during an operational inspection, a forest ranger's assistant or a forest supervisor discovers illegal logging that was not previously detected or documented by a forest guard, they shall draw up a corresponding report, mark the stumps with an "illegal logging" stamp, and record the report in the forest guard's logbook.

During the inspection, reports or records are also drawn up regarding other violations of forestry laws that were not documented by the forest ranger, including: grazing of livestock; illegal grass cutting; unauthorized occupation of forest land; forest fires; and others (President of the Republic of Azerbaijan, 1999)

Forest Monitoring: This involves observing, recording, and analysing changes taking place in the environment, as well as identifying changes in nature resulting from human activity. In this area, the 'ICP-Forests Programme' is primarily used – this is the largest international forest monitoring system, established in 1985 under the auspices of the United Nations Economic Commission for Europe. This programme is used in more than 41 countries. Its key objectives are: monitoring the condition of forests, studying the impact of climate change, and ensuring sustainable forest management (UNECE/FAO, 2020).

In accordance with Article 40 of the Forest Code of the Republic of Azerbaijan, forest monitoring is carried out. The main areas of monitoring carried out by the Ministry of Ecology and Natural Resources of Azerbaijan are: studying the ecological functions of forests; monitoring the sustainable use of forests; using aerospace and remote sensing methods; assessing forest regeneration; preventing forest fires; phytosanitary measures against pests; and monitoring sanitary felling (Мамедов, 2012).

Phytosanitary measures for forest protection: These phytosanitary regulations govern the procedures for protecting forest stands from pests and diseases. The main aim of such measures is to protect forests, prevent the widespread spread of pests and diseases, identify outbreaks in good time, and implement preventative and sanitary measures to contain and eradicate them.

The protection of forest resources is ensured through systematic monitoring of the condition of forests, identifying the sources of the spread of pests and diseases, carrying out preventative, sanitary, and phytosanitary measures in affected areas, preventing the further spread of infestation, and mitigating its consequences.

Preventative and phytosanitary measures to protect the forest resources are carried out by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, as well as by the relevant organisations within the scope of their remit

The range of measures for the protection of forest resources includes routine, field, aerial visual and other forest pathology surveys; general and initial surveys of outbreaks of pests and diseases, as well as detailed studies of these; the preparation of measures to combat pests and diseases using aerial and ground-based resources; the organisation of preventative measures against forest diseases and the eradication of pest and disease outbreaks; and monitoring the implementation of these measures.

In order to prevent the spread of pests and diseases and to improve the resilience of forest stands, compliance with phytosanitary, silvicultural and agronomic requirements is monitored. Both aerial and ground-based methods are used to carry out pest control measures. Special work plans are drawn up, technical supervision of such activities is carried out, and compliance with the regulations governing the transport and use of toxic chemicals is ensured.

Comprehensive monitoring involves determining trends in pest insect populations, identifying the causes of changes in their numbers, and developing short-term and long-term forecasts of mass pest outbreaks based on the data obtained. To this end, forestry enterprises select several plots for each type of pest and carry out inspections twice a year, taking into account the biological characteristics of the pests. If a mass outbreak of a particular pest is forecast, the list of areas subject to integrated pest management is

also extended to include forest areas where that pest is likely to spread, and detailed surveys are carried out there (UNECE, 2017).

An inventory is carried out every autumn to record active outbreaks of forest pests and diseases, and to ensure that eradicated outbreaks are promptly removed from the records. The procedure for carrying out the inventory is determined by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan. The inventory draws on data regarding the number of pest and disease outbreaks identified in previous years, as well as the results of forest pathology monitoring and observations. It is also important to note the specific characteristics of the spread of certain fungal diseases commonly found on oak trees.

Oaken polypore (*Inonotus dryophilus*, Berk., Murr) causes variegated heart rot in oak trees. This fungus is found sporadically throughout the area and infects only living oak trunks. Infection occurs via basidiospores through broken branches that already contain heartwood (Figure. 1).



Figure 1. Oaken polypore (*Inonotus dryophilus*, Berk., Murr)
on the trunk of an oak tree

In the first stage of decay, the wood turns brown. In the second stage, light-yellow areas of bleached cellulose of varying lengths appear against a brown background. In the third stage, cavities form in the wood, i.e., mottled, pitted rot develops. Yellowish clusters of mycelium form in the affected wood. The rot has a pitted, fibrous structure. The rot is spreading rapidly through the middle of the trunk. The extent of the damage reaches 6-8 m and accounts for 40% of the trunk's volume. The fruiting bodies grow on the middle section of the trunk and resemble those of the *Inonotus dryophilus* fungus. This fungus is found sporadically in the oak forests of the Greater Caucasus and therefore causes little damage.

Chicken of the Woods (*Laetiporus sulphureus*, Bull.) causes red-brown prismatic heart rot in the trunk. The fungus most commonly affects the base of the trunks of oak, ash, beech, willow, white acacia, maple, sweet cherry, walnut, and other species. The prevalence of tinder fungus in oak stands reaches 20–50%. The trunks are infected by basidiospores in the lower part of the trunk, entering through wounds and frost cracks. (Fig. 2).

Destructive type of rot. In the first stage of decay, the wood is pink in colour with white streaks. In the second stage, it turns brown, and cracks appear, in which a whitish mycelium accumulates. In the third stage, the wood is brown, and the cracks contain thick, whitish or yellowish, suede-like films of mycelium, which can easily be rubbed into a powder between the fingers. Most often, rot is found in the lower part of the tree up to a height of 2–3 m, but sometimes as high as 6–12 m, leading to the tree becoming top-dead. It is not uncommon for affected trees to be blown down by the wind.

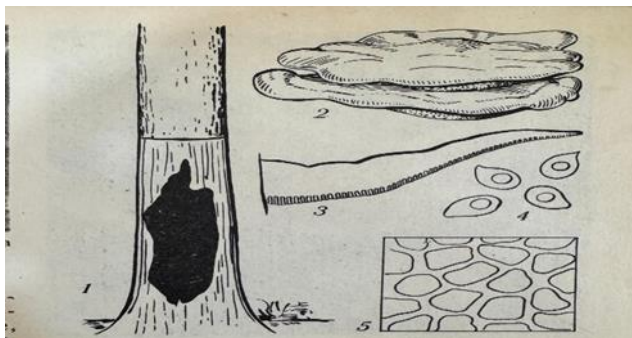


Figure 2. Chicken of the Woods (*Laetiporus sulphureus*): 1 – diagram showing the distribution of rot within the trunk; 2 – external appearance of the fruiting body; 3 – cross-section of the fruiting body; 4 – basidiospores; 5 – rounded pores

The *Laetiporus sulphureus* is found everywhere. As well as on living trees, it also grows on felled timber, products, and structures, causing considerable damage to the forestry industry. Fruiting bodies do not appear every year, so the rot often goes undetected.

To summarise the issue of protecting forest stands from pests and insects, it is worth noting that a range of sanitary and restoration measures must be carried out in forest stands. In young stands, maintenance felling should be carried out in a timely and professional manner with the aim of establishing healthy, biologically sustainable stands with an optimal species composition. In middle-aged, mature and overmature stands, selective sanitary felling should be carried out regularly, with the mandatory removal of deadwood, wind-damaged trees, as well as conifers that are dying back, weakened, wind-felled or damaged by storm, as these trees rapidly become host to large numbers of fruiting bodies of polypore fungi – the causative agents of rot, whose spores continue to infect the wood for many years. When the density is 0.3–0.4, it is advisable to carry out a clear-cutting sanitary felling. To minimise the spread of infection, it is essential to remove infected timber from the stands as quickly as possible. To prevent trunk-dwelling pests from infesting timber, it is necessary to debark it or treat it with chemicals, and to ensure that stands are not left cluttered with felling residues, windfall and storm-damaged timber, which must be removed or destroyed in a timely manner.

The fight against forest diseases and the key challenges involved in preventing their spread should be viewed not as a temporary campaign, but as a comprehensive set of measures aimed at enhancing the resilience of the forest. In the fight against forest diseases, the key factors are boosting plants' natural immunity to infections, establishing resilient plant communities, reducing the virulence of the pathogen, and eradicating the pathogen. In this regard, the main focus should be on various approaches to managing the environment, taking into account the specific ecological characteristics of the forest's growth.

General preventive measures: The development of forest management measures to combat forest diseases has so far received insufficient attention; individual studies by S. V. Shevchenko (1989), A. I. Akhundov (2005) and others provide examples of forest protection systems for specific regions and particular groups of stands.

In forest protection programmes, nationwide monitoring, forest pathology surveys, the mapping of existing and potential foci of infection, and the study and forecasting of the patterns of epiphytotic outbreaks should play a significant role. These measures should be implemented on the basis of forest typology, taking into account natural regions, on a zonal basis.

However, the primary role in combating forest diseases should be played by silvicultural measures covering the entire life cycle of the stands – from seed collection to final felling. In doing so, it is necessary to take into account the stages of disease development, linking them to specific forest protection measures, primarily biological control methods. Such a system should be introduced first and foremost in potential disease hotspots, as it is not always possible to cover all forests.

In forestry, it is essential to use planting stock of high quality in both sanitary and genetic terms when establishing forest stands. To this end, seeds must be collected from healthy, high-yielding crops, and when growing planting material, all agronomic guidelines must be followed, including disease control measures, in particular seed treatment, the implementation of a range of preventative measures in nurseries, and the protection of seedlings from adverse non-parasitic damage (frost cracks, sunscald, etc.).

Fire Prevention and Control. Fire prevention includes preventive, monitoring and suppression measures aimed at reducing wildfire risk and minimizing ecological damage. As a preventative measure, firebreaks are created, deadwood is cleared from forests, access to forests is restricted during the fire-risk period, and public awareness campaigns on safety rules are organised. Early detection of fires is carried out using satellites, drones, surveillance cameras, and ground patrols. Water, earth, backfiring, specialised equipment, and aircraft are used to extinguish the fire. Fire services, forestry organisations, and rescue services are involved in tackling large-scale fires. An important objective is to preserve ecosystems and protect animals, soil, and water resources from damage.

Following the fires, work is carried out to restore the forests, plant trees, and monitor the state of the natural environment. Modern methods of combating wildfires are aimed not only at extinguishing the fire, but also at preventing it from breaking out and preserving the ecological balance.

Between 25 April 2026 and 25 May 2026, a total of 61 VIIRS fire alerts were recorded in Azerbaijan; only alerts with a high confidence level were taken into account (Fig. 3).



Figure 3. Number of fire alerts in Azerbaijan

Between 2001 and 2025, Azerbaijan lost 1.3 thousand hectares of forest cover as a result of fires and 7.2 thousand hectares due to all other causes of loss. The greatest loss of forest cover due to fires during this period was recorded in 2014: that year, 200 hectares were lost to fires, accounting for 61 per cent of all forest cover losses that year (Figs. 4 and 5).

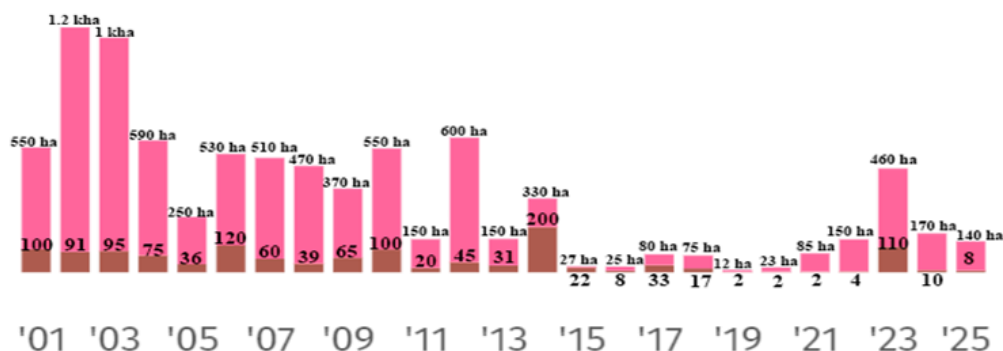


Figure 4. Loss of tree cover due to fires in 2001–2025.

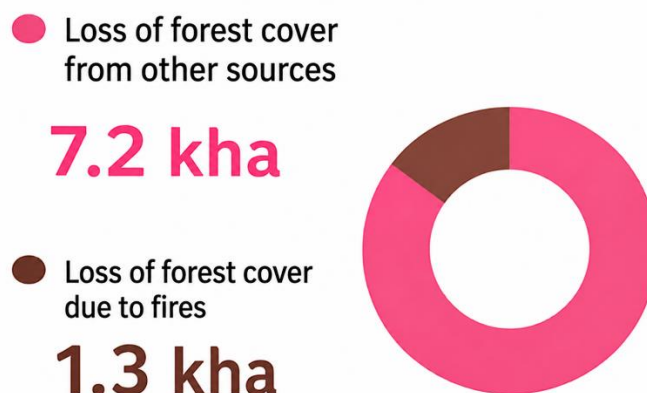


Figure 5. Forest cover loss in Azerbaijan by cause (2001–2025). Fires accounted for 15% of total forest cover loss. [17].

International practice. To examine the tasks set, a comparative analysis was carried out of Azerbaijan's forestry sector and the corresponding sectors in the Republic of Georgia.

Azerbaijan and Georgia are both located in the Caucasus region, but there is a huge difference between their forests – in terms of area, climate, biodiversity and the role forests play in the life of each country. If one were to compare the two countries specifically in terms of their natural forest resources, Georgia has a substantially higher proportion of forest cover than Azerbaijan. The main difference is the level of forest cover. In Azerbaijan, forests cover approximately 11–14% of the country's territory, whereas in Georgia the figure is around 40–41%. Historically, Azerbaijan has lost a significant proportion of its forests. According to some sources, several centuries ago, around 35% of the country's territory was covered by forests, but due to deforestation, agriculture and the expansion of pastureland, this area has more than halved. Logging also took place in Georgia, but thanks to the humid climate and lower levels of aridity, the forests were better preserved and recovered more quickly.

In terms of biodiversity, both countries are of great interest because they form part of the Caucasus biodiversity hotspot – one of the world's most biologically diverse regions. However, Georgian forests are generally considered to be richer in terms of total vegetation mass and the number of forest ecosystems. There are vast beech forests, chestnut groves, spruce forests, fir stands, and the humid subtropical jungles of Colchis. In Azerbaijan, however, the landscape is more varied: there are many steppes and arid areas, so the forests look like isolated green islands amidst the drier landscape.

Another important difference is water balance. Forests are closely linked to rainfall and water resources. Georgia has far more rivers and rainfall thanks to the mountains and the Black Sea. Azerbaijan suffers from a water shortage compared with its neighbours. This has a direct impact on forest growth and density.

From an environmental perspective, Georgia's forests play a vital role in protecting the slopes of the Caucasus from erosion, landslides and floods. Forests are also extremely important in Azerbaijan, but there they primarily serve to protect the soil from desertification and to conserve moisture in mountainous areas (Figure 6).

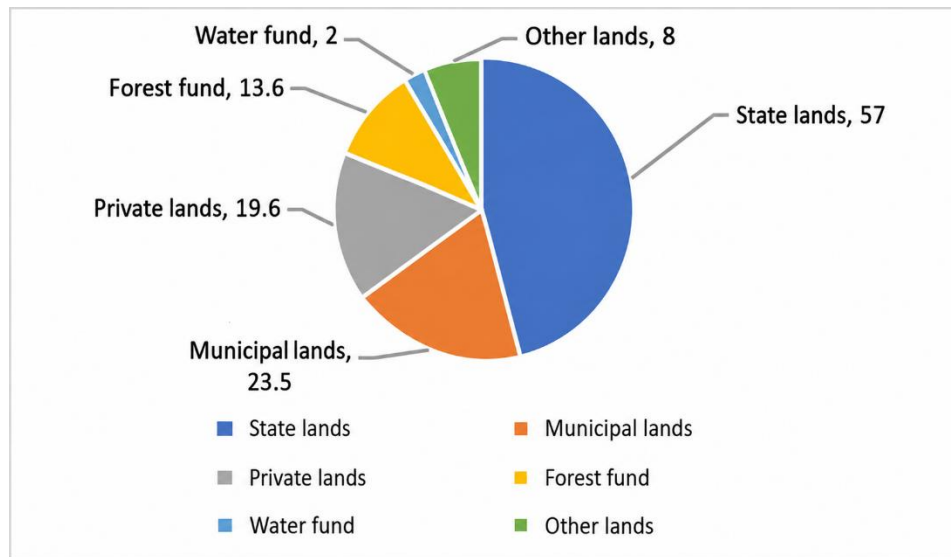


Figure 6. Land use in Azerbaijan

Economically speaking, forestry is not a major industry in any country; however, in Georgia, the potential for forestry and ecotourism in the form of national parks and mountain forests is considerably greater. Nature reserves and national parks are also being actively developed in Azerbaijan, particularly in the Hyrcanian region and the Caucasus, but the overall extent of its forest resources is smaller.

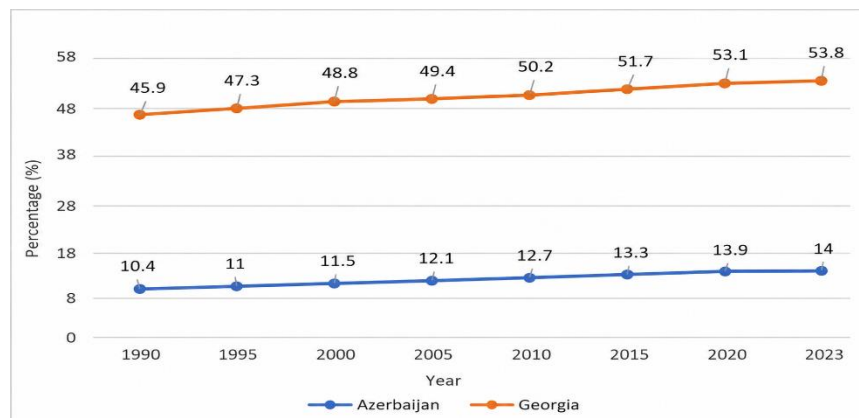


Figure 7. Comparison of forest cover in Azerbaijan and Georgia, %

In summary, the comparison can be summarised as follows: Azerbaijan is a country with limited but highly unique and rare forests, particularly relict forests; Georgia is one of the most forested countries in the Caucasus, with vast wet mountain forests and a significantly richer forest cover. In terms of volume, density and total forest area, Georgia clearly surpasses Azerbaijan; however, Azerbaijan's forests are valued for their uniqueness and rare ecosystems (Fig. 7).

For Azerbaijan to come closer to Georgia's level of forest cover, or at least to significantly improve the condition of its forests, long-term and comprehensive measures are needed. Azerbaijan's main problem is not just deforestation, but a combination of an arid climate, water scarcity, soil erosion and the historical decline in forest cover. To tackle these problems, strict controls on illegal logging must be put in place. Even small-scale illegal logging in arid regions causes enormous damage because forests take a long time to recover. Satellite monitoring, drones, digital forest inventories, and hefty fines all play a part here.

Another important area is firefighting. Due to climate change, the Caucasus is becoming drier and hotter. We need early fire detection systems, forest patrols, firebreaks, and public education. A single major fire can wipe out decades of restoration work.

In addressing these issues, the expansion of national parks and nature reserves is of great importance. The particularly valuable forests of the Hyrcanian and Caucasus regions require strict protection. Azerbaijan's relict forests are of international natural importance, as some species have survived since the Ice Age.

Another important area is the development of ecotourism as an alternative to the exploitation of forests. When a forest generates income through tourism, walking routes, hotels, and national parks, it becomes more profitable to preserve it than to cut it down.

In the long term, it is entirely feasible for Azerbaijan to increase its forest cover from its current level to approximately 18–20% over the course of several decades. This can be achieved through effective government regulation, sustainable water management, and the protection of existing forests. There is particularly great potential in the restoration of mountainous areas and the creation of green belts to combat drought.

4. Conclusion

Based on the work carried out, the following conclusions can be drawn:

1. This paper examines the specific characteristics of the meaning of forestry terminology relating to the protection and use of forest resources
2. The characteristics of the management structure and the forestry sector have been identified. This paper examines the specific features of the implementation of the Forest Code in Azerbaijan.
3. The potential applications of forest monitoring have been identified. The characteristics of monitoring methods – ground-based and remote sensing – have been identified.
4. This paper analyses phytosanitary measures to protect forests from fungal diseases affecting forest trees. It also outlines preventative measures for fire safety.
5. A comparative analysis was carried out of measures for the protection and sustainable development of Azerbaijan's forests in comparison with those of the Republic of Georgia.

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