ABS ACTA BIOLOGICA SIBIRICA
A journal on the biodiversity of Siberia and the adjacent lands

Acta Biologica Sibirica 9: 1125–1140 (2023)
doi: 10.5281/zenodo.10297250
http://journal.asu.ru

RESEARCH ARTICLE

Anthropogenic impacts on Ajinohur arid forests of Azerbaijan

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Academic editor: R. Yakovlev | Received 1 May 2023 | Accepted 29 November 2023 | Published 10 December 2023

http://zoobank.org/AC109D05-1EDA-47F7-BD52-BECDF7C155BC

Citation: Togola A, Yusifova MM, Sadigova NA, Akhundova AA, Karimova LR, Nuriyeva KG, Sariyeva GR, Agayeva ZT, Jafarzadeh SA, Aghayeva SA (2023) Anthropogenic impacts on Ajinohur arid forests of Azerbaijan. Acta Biologica Sibirica 9: 1125–1140. https://doi.org/10.5281/zenodo.10297250

Abstract
Degradation of forest resources and deforestation, insufficient satisfaction of society's needs and demands for environmental, social and economic goods and services, insufficient participation of stakeholders and cross-sector collaboration in forestry practices are the main challenges of forest management in Azerbaijan. One of the main factors influencing and changing arid ecosystems is human economic activity. Ajinohur arid forests are located in the southern part of the Ajinohur foothills of Azerbaijan between the Alijanchay and Goychay rivers. The total area of the Ajinohur foothills is 152544.53 ha, where arid forests are 9379.61 ha (6.14%), and lowland forests are 5182.14 ha (3.4%), mainly mountain-steppe landscape prevails here (81.6%). The arid forests of the Ajinohur foothills are intensively used for agriculture, and therefore, are subject to strong anthropogenic impact. In this regard, in 2021–2022, we conducted research on the study of the current ecological state of arid forests, compiled maps using GIS technologies. It was established that, according to the degree of anthropogenic impact and the level of transformation, the landscapes of the Ajinohur arid forests are divided

into the following groups: unaltered (7.2% of the total area), slightly modified (83.34%) and intensively modified (9.42%) landscapes. The ecological state of lowland forests is more unsatisfied compared to dry woodlands, where landscapes with a critical ecological state account for 57.31%.

Keywords
Anthropogenic pressure, transformation, Ajinohur, lowland forests, dry woodlands

Introduction

The history of the development of mankind over the centuries shows that, starting from the period of the appearance of agriculture and cattle breeding, as a result of the expansion of agricultural areas, there was a massive destruction of forests. The total area of the green cover of the planet has significantly decreased, climate change, soil erosion, desertification, depletion of forest resources, weakening of biological functions and the protective role of forests have occurred. Almost every year, FAO presents the state of the world's forests. In 2015, world leaders approved the United Nations 2030 Agenda for Sustainable Development SDGs and its 17 goals, which would become the central framework for guiding development policies around the world (Sustainable Forest Management Strategy 2015). The 2017 edition aims to make us understand how forests and their sustainable management contribute to the achievement of several of these SDGs. It will soon be too late for the world's forests: we must now work across sectors, bring together the various stakeholders and act quickly.

State of the World's Forests (2018) envisions actions that could be taken to improve the contribution of forests and trees, and without which it is difficult to accelerate progress towards the SDGs. It has become essential to act to establish collaboration with more economic, social and environmental benefits that it provides.

In order to better protect forests from natural and anthropogenic phenomena of their degradation, numerous research works have been carried out among scientists involved in the problems of forest management.

The relationships between rainforest, distribution and soils on different types of Mother Rocks in the Republic of Congo have been researched by (Felix et al. 2019). According to them, the factors influencing the distribution of forests and their development are important to better understand the bio-functioning of tropical forest systems ecosystems. With a significant forest area of 23.5 million hectares subdivided into three large massifs with different forest units from the north to the south of the country, the Republic of the Congo is the second largest biodiversity reserve in the world after the Amazon. Finally, they focused their studies on shedding light on the relationship between edaphic and pedagogical factors and the distribution of plant species in certain tropical forests in the Congo. The analysis of the main components carried out showed that the distribution of plant species in the forests studied is determined by edaphic factors.

Shwe and Mitlöhner (2020) point us to the tropical rainforests in the southernmost part of Myanmar. The main objective of this study according to the authors is to highlight the diversity of tree species, species composition and stand structure of tropical rainforests that support sustainable forest management in Myanmar.

As a result of (Jomaa and Khater 2019) research, the 2002 and 2010 land cover maps of Lebanon are the most detailed spatial distribution that spatially shows forests. The mapping of juniper forests showed a high degree of complexity, especially because of their low density and mixed nature. The spatial representation of juniper forests was compared between the 1965 forest map and the 2002 and 2010 land cover maps. A GIS environment was used to extract juniper forests from all maps. The degree of coincidence of juniper forests in terms of total area and spatial overlap was studied. Juniper forests were examined for their spatial position by comparing three maps. Spatial changes and anthropogenic effect were obtained using Google Earth tools.

According to (de Lima et al. 2020) tropical forests are being deforested worldwide, and the remaining fragments are suffering from biomass and biodiversity erosion. Authors use an unprecedented dataset of 1819 field surveys covering the entire Atlantic Forest biodiversity hotspot. They show that 83–85% of the surveys presented losses in forest biomass and tree species richness, functional traits, and conservation value. On average, forest fragments have 25–32% less biomass, 23–31% fewer species, and 33, 36, and 42% fewer individuals of late-successional, large-seeded, and endemic species, respectively. Biodiversity and biomass erosion are lower inside strictly protected conservation units, particularly in large ones. They estimate that biomass erosion across the Atlantic Forest remnants is equivalent to the loss of 55–70 thousand km^2 of forests or US$2.3–2.6 billion in carbon credits. These figures have direct implications on mechanisms of climate change mitigation.

According to (Chaplin-Kramer et al. 2015), carbon stock estimates based on land cover type are critical for informing climate change assessment and landscape management, but field and theoretical evidence indicates that forest fragmentation reduces the amount of carbon stored at forest edges. Here, using remotely sensed pantropical biomass and land cover data sets, they estimate that biomass within the first 500 m of the forest edge is on average 25% lower than in forest interiors and that reductions of 10% extend to 1.5 km from the forest edge. These findings suggest that IPCC Tier 1 methods overestimate carbon stocks in tropical forests by nearly 10%. Proper accounting for degradation at forest edges will inform better landscape and forest management and policies, as well as the assessment of carbon stocks at landscape and national levels.

(Haddad et al. 2015) conducted an analysis of global forest cover to reveal that 70% of remaining forest is within 1 km of the forest's edge, subject to the degrading effects of fragmentation. A synthesis of fragmentation experiments spanning multiple biomes and scales, five continents, and 35 years demonstrates that habitat fragmentation reduces biodiversity by 13 to 75% and impairs key ecosystem functions by decreasing biomass and altering nutrient cycles. Effects are greatest in the smallest and most isolated fragments, and they magnify with the passage of time. These findings indicate an urgent need for conservation and restoration measures to improve landscape connectivity, which will reduce extinction rates and help maintain ecosystem services.

Protected areas are a key tool in the conservation of global biodiversity and carbon stores. (Wolf et al. 2021) conducted a global test of the degree to which more than 18,000 terrestrial protected areas (totalling 5,293,217 km^2) reduce deforestation in relation to unprotected areas. They also derived indices that quantify how well countries' forests are protected, both in terms of forested area protected and effectiveness of protected areas at reducing deforestation, in relation to vertebrate species richness, aboveground forest carbon biomass and background deforestation rates. Overall, protected areas did not eliminate deforestation, but reduced deforestation rates by 41%. Protected area deforestation rates were lowest in small reserves with low background deforestation rates. Critically, they found that after adjusting for effectiveness, only 6.5% – rather than 15.7% – of the world's forests are protected, well below the Aichi Convention on Biological Diversity's 2020 Target of 17%. They propose that global targets for protected areas should include quantitative goals for effectiveness in addition to spatial extent.

U.S. temperate and boreal forests remove sufficient atmospheric CO2 to reduce national annual net emissions by 11%. U.S. forests have the potential for much more rapid atmospheric CO_2 removal rates and biological carbon sequestration by intact and/or older forests. According to investigation of (Moomaw et al. 2019), growing existing forests intact to their ecological potential – termed proforestation – is a more effective, immediate, and low-cost approach that could be mobilized across suitable forests of all types. Proforestation serves the greatest public good by maximizing co-benefits such as nature-based biological carbon sequestration and unparalleled ecosystem services such as biodiversity enhancement, water and air quality, flood and erosion control, public health benefits, low impact recreation, and scenic beauty.

In this compelling book, biologist (Askins 2014) examines the history and ecology of Northern Hemisphere deciduous forest ecosystems in East Asia, North America, and Europe. These forests have a common ancient origin but have evolved in now widely separated regions for millions of years. Askins writes clearly on the similarities among and differences between the forests, including the threats to the plants and animals they contain and the challenge of developing effective conservation methods for these unique ecosystems.

One of the main factors affecting ecosystems and changing them is the economic activity of people. The Ajinohur foothills, which is our study area, is intensively used for agriculture and pastoralism and settlement and is subject to anthropogenic impact throughout the year, has suffered greatly from anthropogenic transformation. The purpose of our research was to identify the level of anthropogenic pressure on Ajinohur arid forests and develop a system for sustainable management of forest resources in this area.

Materials and methods

The general scheme of research on the Ajinohur arid forests of Azerbaijan is based on methodological approaches proposed by scientists such as (Mammadov 2012; Khalilov 2013) and others (Mammadov 2009; Garibov 2014). The studies were conducted in 4 stages: desk-preparatory, field, laboratory and generalizing-final.

At the desk-preparatory stage, information was collected on the vegetation and soil cover, topography and climatic conditions of the studied territories, the causes of deforestation in the objects of research were identified; fund cartographic materials and taxation indicators of forest of the studied territories were studied (forest composition, its age, completeness, bonitet, wood stock); and a brief review of the research of world scientists on forest management was conducted.

Field studies were carried out in 2021–2022, in the Ajinohur arid forests of Azerbaijan, the total area of which is 152 544.53 ha. Initially, the selected route was used to study the species composition of trees, forest taxation indicators (average diameter of trees, their height, age) and noted anthropogenic changes, where they were observed, as well as 5 soil profiles were set at characteristic points of soil types and subtypes distributed in the study area. On-site, their morphological features were described by genetic horizons and soil samples were taken for laboratory analysis. To monitor the state of forest ecosystems, electronic maps were prepared, based on the processing of remote GIS data, reflecting the level of anthropogenic impact on forest ecosystems of the study area in both countries. At the final and generalizing stage, the forests of the studied territories were monitored, maps of forest resources were compiled based on GIS technologies, and the main directions for the restoration and protection of the Ajinohur arid forests of Azerbaijan were developed.

Result

The Ajinohur arid forests are located in the southern part of the Ajinohur foothills between the Alijanchay and Goychay rivers. Its territory begins in the west from the Alijanchay River and extends in a narrow strip (5–6 km) to the east (45–50 km) to the Goychay River (National Atlas of the Republic of Azerbaijan 2014) (Fig. 1). In the narrowest part of the area, its width is a little more than 2 km, in the widest part – almost 10 km. This forest does not escape the misdeeds of anthropogenic and natural activities which increase its destruction. Forest areas have suffered severe deforestation, which has led to the disruption of the natural balance and internal structure of the landscape. Thus, the vast forests of arid woodlands have been significantly exterminated to this day, their area has been significantly reduced compared to the historical past. The absence of trees from many mountainous regions of the republic, where climatic conditions are favorable for deciduous and arid forests, should be considered as the result of human activity.

The territory of the Ajinohur arid forests lies within the height range of 100-650 m above sea level. The territory is a relatively young geological formation and is composed of Tertiary and Quaternary continental deposits (alluvial-proluvial, deluvial, proluvial, deluvial-proluvial) (Rustamov 2007).

Three large rivers flow on the territory of Ajinour arid forests: Alijanchay, Turianchay and Goychay, which originate from the high peaks of the Greater Caucasus. The climate of moderately warm semi-deserts and dry steppes with dry summers and winters and the climate is moderately warm with dry winters prevail in the research area.

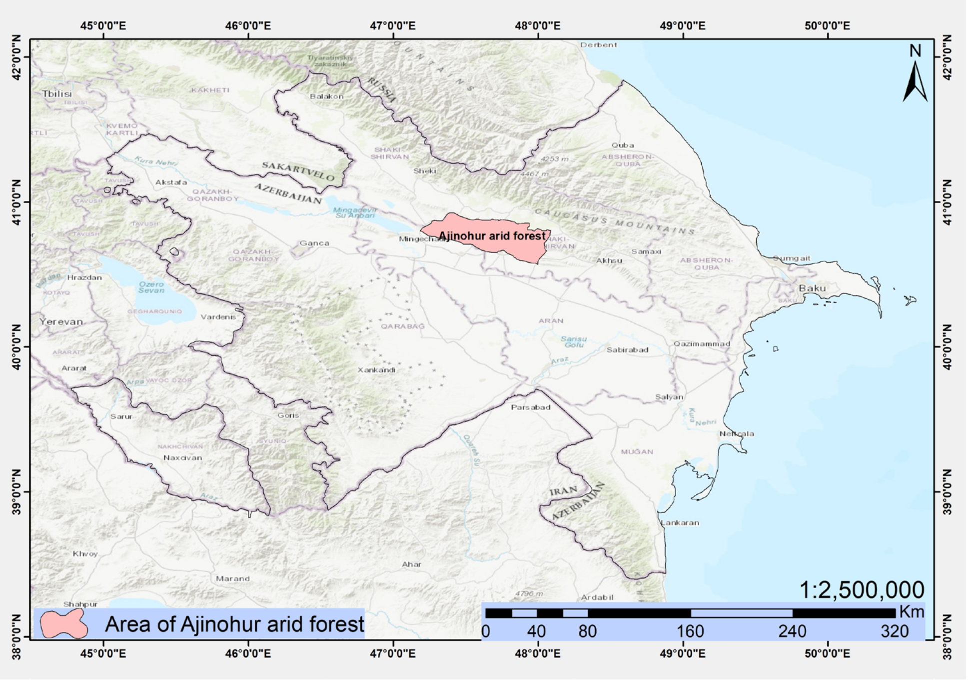

Figure 1. Map of Azerbaijan with Ajinohur arid forests.

On the territory of the Ajinohur arid forests, elements of several landscapes are combined, mainly forest, steppe, semi-steppe and semi-desert types of vegetation. The vegetation cover of the slopes of the mountain ranges is a combination of groupings belonging to different types of vegetation. As (Amanova 2015) notes, these combinations are directly related to the dissection of the relief, the nature of the soil cover, erosion phenomena, the impact of livestock grazing, clearings, etc. Arid forests and shrubs are distributed mainly on the Steppe Plateau (Fig. 2). These plants are derivatives. Since ancient times, these lands have been used for agriculture and cattle breeding. In the past, these areas were covered with arid forests. Associations of arid woodlands located along the slopes of Bozdag, when joined with groups of other habitats, form mixed combinations on the border with them.

Figure 2. Landscapes of pistachio-juniper woodlands in Ajinohur.

On the southern side of the research area, woodland is in contact with semi-desert and semi-steppe vegetation, along the northern edge of the massif there are small areas of xerophytic variant of the feather grass steppe. Thus, the open woodlands is wedged between the semi-steppe and steppe vegetation in the area confined to the eroded slopes of the Bozdag.

Impact of the anthropogenic factors

One of the main factors affecting ecosystems and changing them is the economic activity of people. The eastern part of the Ajinohur foothills, which is our study area, is intensively used for agriculture and settlement and is subject to anthropogenic impact throughout the year, has suffered greatly from anthropogenic transformation compared to the western part, which is used mainly as pastures and where seasonal anthropogenic impacts are observed.

Arid ecosystems of mountain regions are characterized by low resistance to anthropogenic impacts. The large vertical and horizontal dissection of the relief, rather steep (35° or more) slopes, the widespread occurrence of rapidly washing clayey, clayey-sandy marine and continental deposits increase the anthropogenic load of mountain semi-deserts, intensify soil degradation and create conditions for the formation of badlands.

The role of (Khalilov 2013; Garibov 2014; Suleymanov 2005; Dolkhanov 2012) and others is great in the study of anthropogenic landscapes on the territory of Azerbaijan.

Favorable hydrothermal conditions, fertile lands, diversity of flora and fauna determined the early and rapid development of the research area by people.

We prepared the map "Anthropogenic landscapes of the Ajinohur foothills" in the ArcGis program, using natural landscapes in the main plan and anthropogenic modifications and directions of changes in natural landscapes in the background. According to the map, 5 types out of 14 types of anthropogenic landscape are distributed in the territory (Fig. 3, Table 1).

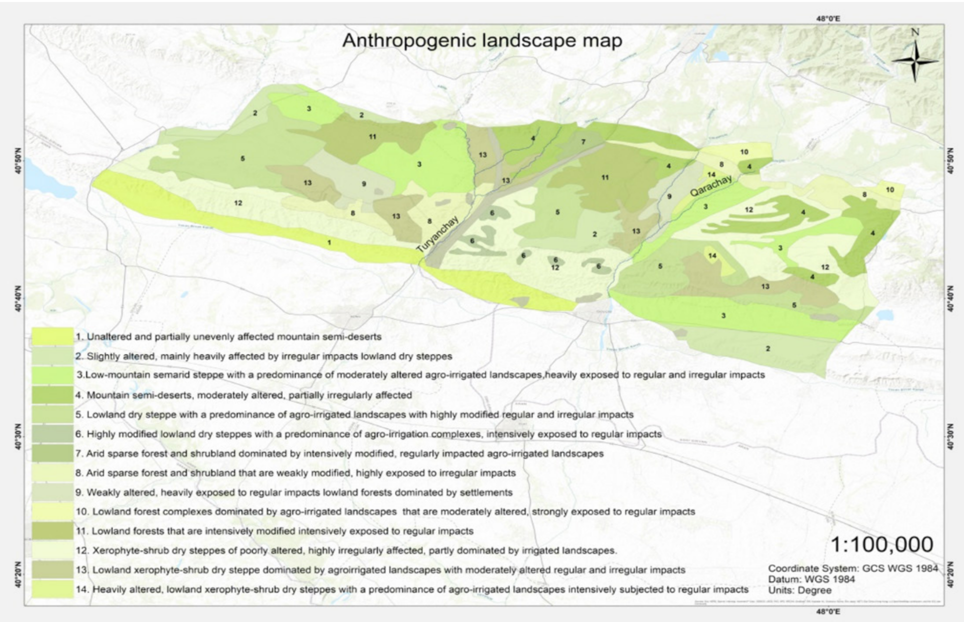

Figure 3. Anthropogenic landscape map of the Ajinohur foothills.

Table 1. Legend of the anthropogenic landscape map of the Ajinohur foothills

No	Landscapes	Area ha	%
1	Unaltered and partially unevenly affected mountain semi-deserts	11260.6	7.38
2	Slightly altered, mainly heavily affected by irregular impacts lowland dry steppes	12911.7	8.46
3	Low-mountain semiarid steppe with a predominance of moderately altered agro-irrigated landscapes, heavily exposed to regular and irregular impacts	22130.6	14.51
4	Mountain semi-deserts, moderately altered, partially irregularly affected	12997.6	8.52
5	Lowland dry steppe with a predominance of agro-irrigated landscapes with highly modified regular and irregular impacts	19621.1	12.86

No	Landscapes	Area	
		ha	%
6	Highly modified lowland dry steppes with a predominance of agro-irrigation complexes, intensively exposed to regular impacts	1870.9	1.23
7	Arid sparse forest and shrubland dominated by intensively modified, regularly impacted agro-irrigated landscapes	971.04	0.63
8	Arid sparse forest and shrubland that are weakly modified, highly exposed to irregular impacts	9332.9 90.58	6.12
9	Weakly altered, heavily exposed to regular impacts lowland forests dominated by settlements	5845.8	3.83
10	Lowland forest complexes dominated by agro-irrigated landscapes that are moderately altered, strongly exposed to regular impacts	1852.1	1.21
11	Lowland forests that are intensively modified intensively exposed to regular impacts	10337.2	6.78
12	Xerophyte-shrub dry steppes of poorly altered, highly irregularly affected, partly dominated by irrigated landscapes	29943.8	19.63
13	Lowland xerophyte-shrub dry steppe dominated by agroirrigated landscapes with moderately altered regular and irregular impacts	12332.3	8.08
14	Heavily altered, lowland xerophyte-shrub dry steppes with a predominance of agro-irrigated landscapes intensively subjected to regular impacts	1165.8	0.76
	Total	152544.53	100.0

Within each anthropogenic landscape, settlements, roads, crops, pastures, nature reserves, as well as the share of the forest were analyzed. Let's get acquainted with a brief description of anthropogenic landscapes in the study area. Depending on the degree of transformation, duration and direction of anthropogenic impact on the study area, the following anthropogenic landscapes are distinguished.

As can be seen from the legend of the map, the most common in the study area Xerophyte-shrub dry steppes of poorly altered, highly irregularly affected, partly dominated by irrigated landscapes account for 19.63%. Unaltered, partially unevenly affected area is found only in mountain semi-deserts, the total area is 11260.6 ha (7.38%). The rest of the mountain semi-deserts, as moderately altered, partially irregularly affected landscapes accounted for 8.52% of the total area.

90.58% of arid light forests and shrubs are slightly modified, highly subject to irregular impacts, 9.42% are subject to intense systematic impacts. In arid sparse forest and shrubland that are weakly modified, highly exposed to irregular impacts, 40% of the area is occupied by pastures, 15% by crops. Half of the weakly altered, heavily exposed to regular impacts lowland forests dominated by settlements are cultivated lands. 60% of the lands of the arid sparse forest and shrubland dominated by intensively modified, regularly impacted agro-irrigated landscapes complex are cultivated.

Lowland forests are highly exposed to regular impacts, both weak (3.83%), moderate (1.21%) and intense (6.78%). In weakly altered, heavily exposed to regular impacts lowland forests dominated by settlements more than 55% of the area is covered with forests.

Lowland forest complexes dominated by agro-irrigated landscapes that are moderately altered, strongly exposed to regular impacts have more sown areas (30%) than forest ones. The main anthropogenic impact on lowland forests that are intensively modified intensively exposed to regular impacts is the cutting down of these forests, 70% of the area of which is occupied by settlements, and more than 20% by culture.

28.09% of the lowland xerophyte-shrub dry steppes, which occupy the largest area in the study area, were subjected to regular and irregular impacts to a weak degree, 22.59% to an average degree, and 14.85% to an intense degree. Xerophyte-shrub dry steppes of poorly altered, highly irregularly affected, partly dominated by irrigated landscapes are mainly included in protected areas, some of which are pastures. In the low-mountain semiarid steppe with a predominance of moderately altered agro-irrigated landscapes, heavily exposed to regular and irregular impacts, crops account for 42%, and pastures – 58%.

Lowland dry steppe with a predominance of agro-irrigated landscapes with highly modified regular and irregular impacts are mostly plowed up (more than 50%), part is used for pastures (30%). 90% of highly modified lowland dry steppes with a predominance of agro-irrigation complexes, intensively exposed to regular impacts are under cultivation (Amanova 2017).

If we look at intensively exploited areas, we will see that settlements dominate in lowland forests, while crops and pastures dominate in steppe landscapes.

It should be noted that the newly created anthropogenic landscapes have poor ecological stability compared to natural landscapes. Compared to other landscapes, pasture landscapes are able to retain their previous ecological structure.

When analyzing the anthropogenic impact on the Ajinohur arid forests, the data created in the geographic database were analyzed. To determine the level of anthropogenic changes in the study area, we compiled a map "Anthropogenic transformation of the landscapes of Ajinohur foothills " (Fig. 4).

When compiling this map, we analyzed the statistical indicators of natural landscape types and, based on the results obtained, assessed the degree of landscape transformation. When assessing the degree of anthropogenic transformation of the Ajinohur foothills and adjacent territories, the authors took into account such factors as the degree of land development, the degree of change in the amount of humus in the soil, plant productivity, NDVI index, slope exposure, hypsometric conditions, slope steepness, the degree of horizontal and vertical fragmentation and their influence for landscape transformation.

We have determined the level of anthropogenic influence on the research area based on the "Map of anthropogenic transformation of the landscapes of Ajinohur foothills" (Table 2).

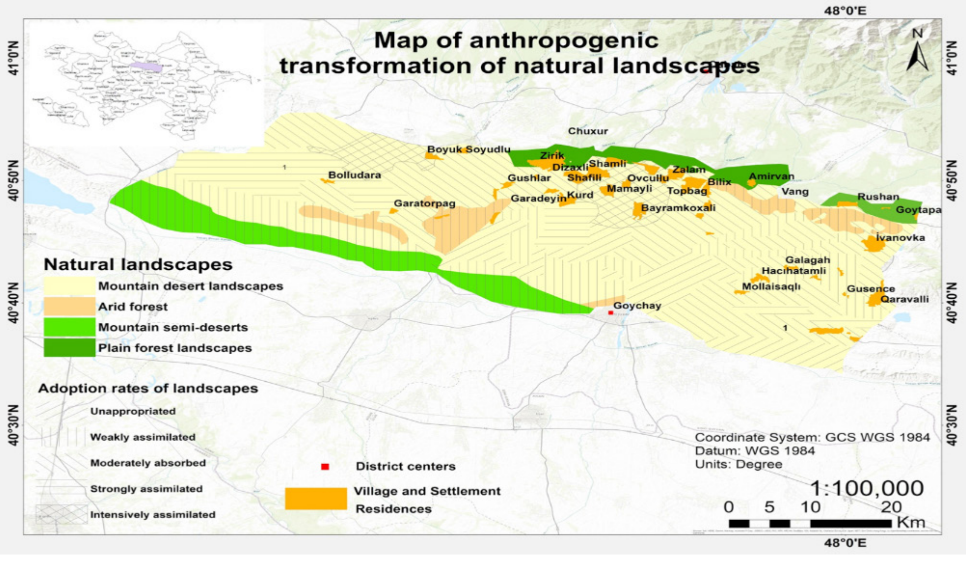

Figure 4. Map of Anthropogenic transformation of the landscapes of Ajinohur foothills.

Table 2. Anthropogenic impact on the areas of the Ajinohur foothills

Change rate	Area	
	ha	%
Unappropriated	17327.87	11.36
Weakly altered	50524.23	33.12
Strongly altered	24247.44	15.90
Moderately altered	50364.2	33.02
Intensively altered	10080.79	6.60
Total	152544.53	100.00

Relatively unchanged landscapes occupy 11.36% (17327.87 ha) of the study area. These landscapes include Mount Chokhkar (735 m), Ohandag (701 m), Sarchalidag (754 m), Sichandag region and the coastal regions of the Garamaryam River. On 33.12% (50524.23 ha) of the study area, the degree of anthropogenic transformation is weak (Turyanchay Reserve, Gedekdara, Khojashen, Surkhaykhan, Dashuz Ranges, Shorusar District). 14% of these landscapes are covered with forests, and 25% belong to specially protected natural areas. According to Amanova, the productivity of pastures in these areas is 6.5 centners per hectare, and crops up to 28 centners per hectare. 92% of these areas are poorly covered with vegetation. Horizontal fragmentation in most areas is 0.6–1.2 km/km^2, vertical – 100–400 m. In most cases, the slopes have a slope of up to 20°.

Moderately transformed landscapes surrounding the villages of Ivanovka, Uzumlukand, Galagah, Goshakand, Gubahalilli occupy 33.02% (50364.2 ha) of the foothills. 60% of the landscape has been developed, especially for pastures and settlements. Productivity is 6.5-20 c/ha. As a result of anthropogenic impact, the amount of humus in the soil decreased to 0.2–0.5%.

Strongly altered landscapes covering Mount Alasagyzly (131 m), the southeastern tip of the Saryja plain, Gozludag (639 m), a narrow section along the left bank of the Eyrichay, a large section along the Guzeyyatag, Ajidara, Deymadarachay, the channel of Nazarchay, Ekakhan, Shahsoltanly, etc. settlements make up 15.9% (24247.44 ha) of the study area. These strongly altered landscapes are dominated by crop (54%) and pasture complexes (26%). Due to strong assimilation, the amount of humus in the soil was 0.25–0.6% less than the norm. These landscapes cover absolute heights of 400–900 m.

Intensively altered landscapes are distributed by 6.6% (10 080.79 ha) in the areas of the Gobuchay valley, the settlements of Mamayli, Bayramkokhali, part of the Sheki low-mountain plateau, and the Kychych Turut valley. Crops and settlements predominate. As a result of human activities, the amount of humus has decreased to 0.6%. These landscapes almost completely cover the absolute heights of 100–680 m, with a slope of 0–20°.

Anthropogenic impact causes changes in the amount of humus in the negative direction (0.6–1.6%). In 2008, it was found that the amount of humus in these soils is 5.4–6.4%. The amount of humus in arid forests on the coast of Turyanchay is 2–3.1%, which is 0.1–1% less than the norm. The yield in these areas is 20 c/ha. Productivity in arid forests along the banks of Alijanchay and Ayrichay is 6.5 c/ha.

Table 3. Anthropogenic impact on the Ajinohur arid forests

Change rate	**Area**	
	ha	**%**
Relatively unaltered anthropogenic landscapes	648.65	7.2
Weakly altered, irregularly impacted landscapes	7508.15	83.34
Intensively altered, irregularly impacted landscapes	852.26	9.46
Total	9009.06	100.00

7.2% of arid sparse forest and shrub landscapes are relatively unchanged, 83.34% slightly modified and 9.46% intensively modified anthropogenic landscapes. (Table 3, Fig. 5).

The natural landscapes of the foothills and adjacent territories have undergone drastic changes as a result of human economic activity, an intensive anthropogenic transformation is observed. In this type of landscape, natural processes that create ecological risk are at a low level compared to other landscapes. An increase in warm runoff towards river valleys causes a change in the plant composition of the forest.

As an indicator of anthropogenic impact in the forests of the Ajinohur lowland, one can show the work of dairy farms, sheep farms and poultry farms. Typical soils of the soil fund of lowland forests are leached brown mountain forest, typical and carbonate meadow-brown, alluvial-meadow forest soils. The amount of humus in these soils decreased by 0.1–1%. The yield is 27 c/ha.

32.41% of the lowland forest landscape are slightly altered, 10.27% are moderately altered, 57.31% belong to intensively altered anthropogenic landscapes (Fig. 6).

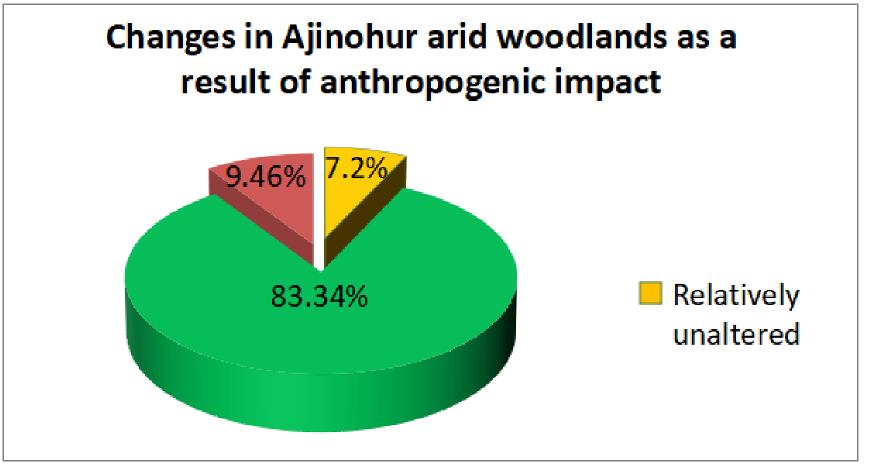

Figure 5. Anthropogenic transformation of the Ajinohur arid forests.

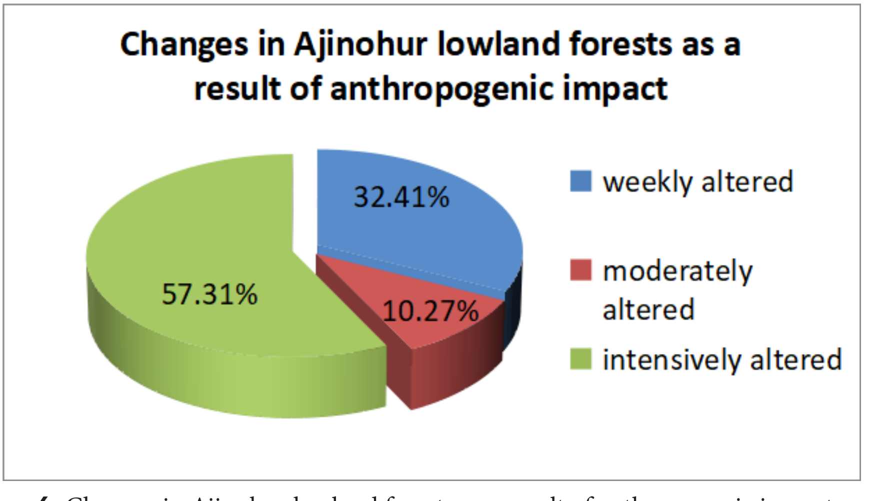

Figure 6. Changes in Ajinohur lowland forests as a result of anthropogenic impact.

Thus, landscapes with a higher degree of anthropogenic transformation in the study area than others are dry steppes and lowland forests. Dry steppes are strongly transformed as a result of winter pasture complexes, and lowland forests are strongly transformed as a result of irrigation and agro-irrigation complexes. The degree of transformation is weak in rocky and rocky areas with a high absolute height.

As a result of the research, it was found that the degree of anthropogenic transformation of natural landscapes changes due to the intensification of arid processes in the foothills of Ajinohur from west to east. In the west of the foothills, arid woodlands and shrubs, dry steppes, and steppes with xerophytic shrubs have been transformed into pastures and meadows, and in the east, arid woodland landscapes and lowland forests have been transformed into fields and garden plantations.

Based on our research, we can conclude that the forests of the Ajinohur foothills (with the exception of protected areas) have been subjected to a large anthropogenic pressure. Unsystematic logging, failure to plant new forests have led to a significant reduction in forest areas and created favorable conditions for the development of the erosion process. It has been established that the following degradation processes occur in the forest ecosystems of the research area as a result of anthropogenic impact: reduction of forest area; degradation of the species composition of forests; decrease in the productivity of forest ecosystems; replacement of forest ecosystems with steppe ones; loss of valuable plant species; adverse changes in flora and fauna within the forest ecosystem; deterioration of the sanitary condition of forests; reduction in wood stocks, etc.

Conclusion

On the basis of research, it has been established that the nature of the anthropogenic transformation of the natural landscapes of Ajinohur in Azerbaijan changes as aridity changes from west to east. In the western part of the territory, arid forests and shrubs, xerophyte-shrub steppes have been transformed mainly into pasture, partly arable agrolandscapes, and in the eastern part into fields, garden plantations and partly pasture agrolandscapes.

It has been determined that the ecological state of landscapes, depending on the structural and functional features of natural landscapes, the nature, intensity and direction of anthropogenic impacts, manifests itself in various forms and levels. Accordingly, the Ajinohur arid forests are grouped according to their ecological state into the following levels: landscapes with a stable (7.2% of the total area), sufficient (83.34%) and critical (9.42%) ecological state. The ecological state of lowland forests is more terrifying compared to arid woodlands, where landscapes with a critical ecological state account for 57.31%.

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