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ANTHROPOGENIC TRANSFORMATION OF FOREST ECOSYSTEMS IN THE MOUNTAINOUS AREA OF AGSUCHAY

Aim: The purpose of the research is to determine the transformation characteristics of the forest ecosystems of the Agsuchay basin of the Greater Caucasus and to analyze the results of anthropogenic effects.

The methodological basis For the study of anthropogenic effects in forests there were used satellite images, scientific literature and the results of observations in experimental areas.

Results: The article analyzes the initial state of forest ecosystems in the upper reaches of the Agsuchay and the subsequent anthropogenic transformation. The causes, directions and consequences of anthropogenic transformation of forest ecosystems in the research areas are shown. Due to the mountainous nature of the study area (750-2200 m a.s.l.), the trees formed here have very important tree species in terms of composition. As a result of anthropogenic transformation, the formation, development and gradual expansion of landslides on bare slopes as a result of deforestation and destruction.

Scientific novelty: The obtained scientific results can be used to prevent the transformation of forests and restore the forest cover in the study area.

As a result of anthropogenic transformation, deforestation and deforestation, landslides were formed, developed and gradually spread on bare slopes. At the same time, the directions and dynamics of anthropogenic transformation are reflected in the altitudinal belts. On the plains of the Agsuchay basin, forests are cut down mainly for the construction of farms and public catering establishments, and in mountainous areas, forests are cut down for firewood. Grazing in forests also leads to the drying up and destruction of forests. At the same time, this area has been inhabited since ancient times due to its geographical location, climate, water and land resources. Over time, large cities were formed here. As the population grew, the economy expanded, the number of livestock increased, and the anthropogenic impact also increased. People who thought about increasing their income by increasing the amount of arable land and pastures and increasing the number of livestock did not take into account the natural landscape of the area. They began to use it blindly, unplanned and intensively.

Keywords: forest, planting, shibliak, forest ecosystems, transformation, completeness.

Introduction. Forests are one of the irreplaceable resources of any country. When we say forest, clean air, water, balance of the ecosystem, etc. come to mind. Therefore, forests are called “lungs” of mankind. 1 ha of forest absorbs 8 kg of carbon dioxide per hour, which is equal to the volume of carbon dioxide emitted by 200 people per hour. Although 35% of the territory of our country was covered with forests two centuries ago, now it has a total cover of 1213.7 thousand hectares, which is about 11.8% of the territory of the country. 93-95% of our forests are spread in mountainous and sub-mountainous areas, the remaining 5-7% in plain and river valleys. 49% of the forest cover is in the Greater Caucasus region, 34% in the Lesser Caucasus region, 15% in the Talish zone and 2% in the Aran zone (Nakhchivan Autonomous Republic). At the same time, forests are divided according to age classes. 11.2% of the area covered with the forest is young forests, middle-aged trees -63.3%, growing trees - 13.4%, ripe and old forests-12.1%. In our republic there is 0.12 hectares of forest area per person, which is 4 (0.48) times less than the world indicator. 261,000 hectares of forest in Karabakh have been cut down and looted by Armenia. It should be noted that in the first years of independence, our forests began to be cut down intensively like firewood during difficult times when there was no fuel, then it continues with the development of the construction and furniture industry. In recent times, rare trees such as beech, walnut, oak, chestnut, etc. are mostly destroyed.

The research area has been attracting people since ancient times due to its geographical location. Favorable relief, climate and forests have been started being destroyed over time. As the population grows, the agriculture grows, and the number of cattle increases, anthropogenic influences developed. People who thought about increasing their income by increasing the number of arable lands and pastures and increasing the number of livestock did not take into account the natural landscape of the area. They began to use it blindly, unplanned and intensively. For this reason, the modern forest ecosystem of Agsuchay has undergone anthropogenic transformation. Some areas were completely deforested and landslide hotbeds appeared in their places [1,6,9].

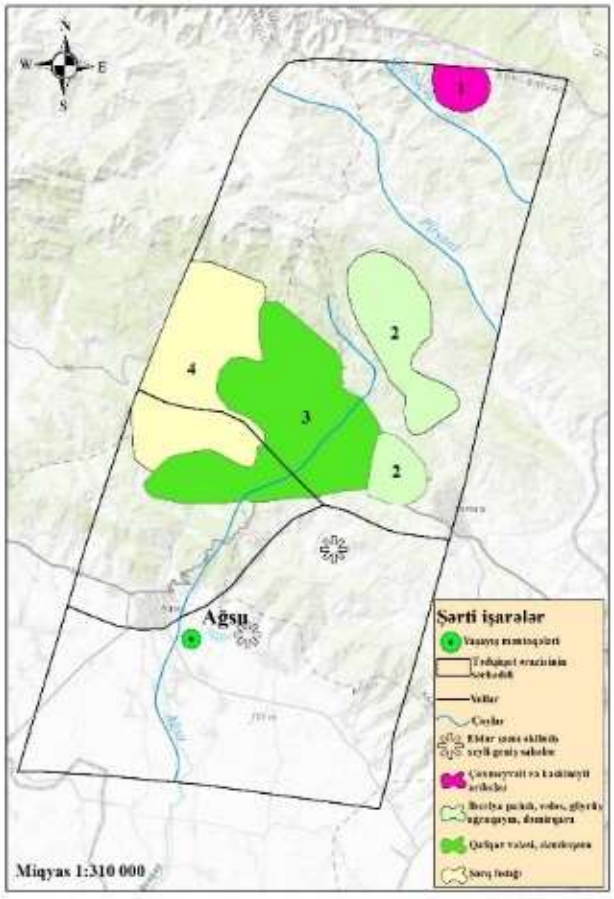

Figure 1. Distributed forest ecosystems in the research area

Figure 2. Landslide hotbed on the upper slope of the Agsuchay basin

In some areas of the study area, the liberated areas were replaced by shrubs and shibliak groupings. Most of the forest massifs have changed in terms of species and genus, and in some places, in the place of felled forests, there are various hornbeams, beech and oak trees of different ages.

The forest vegetation in the mountainous part of the Agsuchay, which originates from the Greater Caucasus Range (2260 m) and flows into the Kura, is characterized by an elevation belt. Although there is

an upper boundary of the forest in the mountainous part of the Agsuchay, it is sometimes impossible to determine the lower distribution boundary.

Material and method. Forests have been a shelter and a source of food for people to live in from time immemorial. In particular, the settlements are so ancient that the forests of Azerbaijan are rich and diverse in terms of plant composition. Various literature materials, maps and mathematical calculations were used in the study of the research area. The forest ecosystem of the area has been studied by the route system and stop points. At the same time, taking into account the relief and vegetation of the study area, experimental areas from topo-ecological profiles were set. The relief of the area, the exposition of the slopes, the name of the area, the composition of forest ecosystems, the passages on the height are shown. The impact of human economic activity on forest ecosystems in the research area was determined by B.D.Alexandrov method [2,3,7,9].

Analysis and discussion. The forest cover of the mountainous area of the Greater Caucasus was studied by L.I.Prilipko, H.A.Aliyev, M.Y.Khalilov, G.S.Mammadov, M.H.Zangiyev and other researchers. In 2017, it became clear from field research in the areas we studied that the anthropogenic transformation of forest ecosystems in the mountainous basin of the Agsuchay has undergone more anthropogenic transformation than in other areas. Even in some areas, mainly in the middle and lower mountainous, forest ecosystems have been completely destroyed.

Iberian oak (Quercus iberica Stev) forests, which are characteristic of the middle mountain-forest belt of the Agsuchay, rarely exist in the form of small belts. The main forest mass of the basin has been cut down unplanned and continues to be cut down.

The dense and full forest massif of the basin has undergone an almost anthropogenic transformation. The oak forest, which is typical for the area, has been replaced by various shibliak groupings, hawthorn (crataegus), wild service tree (Sorbus torminalis), Caucasian medlar (Mespilus germanica), Jerusalem thorn (Paliurus spina christi), scalloped spirea (Spiraea crenata).

Figure 3. Shrubs formed in the forest along the slope

Mountain forest zone. On the left bank of the Agsuchay, at the **T-2** research area, located at an altitude of 750 m above sea level, in place of the Iberian oak forests, a mixed hornbeam forest has been formed. Oak trees are 120-180 years old, 15-22 m tall, with very random diameters of 50-75 cm. Different types of shrubs, cornel (Cornus mas), cherry-plum types (Prunus caspica, P.divaricata), Caucasian medlar (Mespilus germanica) have been formed on the site of the felled forest.

On the south-western slope of Mount Pirgulu, near the village of Sis, at an altitude of 1,470 m above sea level, the **T-4** research area was densely populated with trees, relative to the middle and lower mountain forests. In general, young peanuts reach 15% and have a single linden (Tilia cordata Mill) in their composition. The fact that the T-4 research area is close to the residential area causes it to break down in forest ecosystems. The mass grazing of large horned cattle as a pasture area in intensive forests mainly leads to the destruction of young forests. At the same time it is carried by horses, cutting like firewood. For this reason, some of the slopes in the experimental area have been completely cleared of forest and replaced by thorny bushes (table 1).

The species and genus composition of forest plants have also changed as a result of anthropogenic transformation of the forest ecosystem in the **T-3** research area at a depth of 1,300 m near the village of Galeybugurd, where a checkpoint of the Shahdag National Park was built on the right bank of the Agsuchay. In the early days of independence, the forest was subject to mass deforestation and used as fuel. After the establishment of Shahdag National Park, the forest ecosystem began to be protected. The T-3 research area consists mainly of Iberian oak, hornbeam, beech and poplar trees. Old oak trees are also found here. In the forest, grows large oak trees with a height of 24-28 m and a height of 150-250 cm along the chest. The

results of our research are given in the **table**. Derived type of oak and hornbeam trees are spread in this area instead of felled trees. In the deforested areas on the steep slopes of the experimental field, shrubs were covered with cornel (Cornus mas), European guelder rose (Evonumus), hawthorn (Crataegus), privet willow leaf pear (Pyrus caspica, P. divaricata). At the same time, the ground for landslides has been created in deforested areas. Landslides occur even in small areas.

Table 1

Anthropogenic transformation of forest ecosystems in the upper basin of Agsuchay

Research area	*Type of vegetation*	*Location*	*Trees and shrubs*	*Grass cover*	*Probable primary wooded*
T-2	Sea buckthorn bush in the place of an oak forest	The left bank of Agsuchay ASL-750m, N-18^0	Rarity 6H2B (13-15) d=5-10cm	absent	Iberian oak forest
T-6	Derivative type hornbeamed oak trees	The left bank of Agsuchay ASL-890m between two tributaries	10O(10-20) fullness-0.2 single oak h=20-25m, d-20-30cm	Various grain herbs	Oak forest
T-3	Hornbeam trees of different ages, born from a stalk	The right bank of Agsuchay ASL - 1300m S-28^0	8O 2H, h=3-5m fullness 0,6 height-10-15m	Sparse grass	Beech hornbeam forest
T-4	Beech and hornbeam forests of different ages derived from a stalk	The left bank of Agsuchay ASL - 1470m N-30^0	6B 4H, fullness 05-07. Rose hips, juniper	Sparse grain grasses oregano	Beech forest with hornbeam
T-5	Oak forest with hornbeam of different ages	Right bank of Agsuchay ASL - 1600M S-25^0	8H 2O, h=21, d=50-70cm fullness 0,5	Very sparse woodruff, oregano	Oak forest with hornbeam

As it rises along the Agsuchay basin, the forest massif changes according to the altitude zone. In the **T-5** research area, at the site of felled forests at 1,600 m, various shibliak groups are found in small areas and steep slopes against the background of meadows. In the field of practice, beech, beech-hornbeam, hornbeam forests have been spread in accordance with the middle mountain-forest. The Caucasus hornbeam (C.Caucasica) trees here are 22-28 cm tall, the bark is smooth, light grey, sometimes whitish, the leaves are 7-12 cm long, 2.5-6 cm wide, ovate-oblong or ovate, the tips are sharp, the edges are double-toothed, sparsely hairy at the bottom. Cones 5-8 mm long, 3.5-5 mm wide, oval, 6-10 tils. Covering a small area, Iberian oak is 28-33 m tall, the shoots are reddish-brown and hairless. The leaves are 5-18 cm long, 3-7 cm wide, oblong, oval, shiny green, 120-280 cm in circumference along the stem [3,5].

The **T-**6 research area, Kalva village (Picture 4), located at an altitude of 890 m between the two main tributaries of the Agsuchay, attracted people with its relief, climate and numerous springs. Due to the fact that the T-6 research area is located mainly in the depression, there are many springs and groundwater, so that is sometimes called "springs village". In the south and south – east of this research area, forest areas have undergone anthropogenic transformation, as there are a lot of densely populated areas, economic areas, and the main employment is livestock and crafts. The species and genus composition of forests has been changed. Intensive grazing of cattle does not allow the development of these young shoots. Even in some areas, instead of the original trees, shrubs such as cornel (Cornus mas), forest grape (Vitis), privet (Ligutrum), cherry plum species (Prunus caspica, P. Divaricata), Caucasian medlar (Mespilus germanica). Some areas are completely deforested and even landslide areas developed. Part of the plains has been completely cleared of forests and turned into arable lands, and most of them into pastures. The northern part of the study area is not heartwarming, and these areas have been deforested. The main reason for deforestation in the north is the provision of land for new housing. The forest massif to the west and southwest of the **T-6** research area has retained some species and genus composition. Trees are spread in the territory of Mountainous Shirvan of the Greater Caucasus [3,4,8].

As it rises along the Agsuchay basin, there are no forest massifs on the slopes facing the river along the right bank. As a result of anthropogenic transformation in the area, the forest ecosystem has been almost completely destroyed. The number of landslide areas has increased on the slopes. Some areas are completely bare. The main reason for this is deforestation in the upper parts of the slope and intensive

grazing of livestock. Recently, these areas have become real landslide zones. In the plains near the river basin, forests have been destroyed for the construction of new plantations and the construction of various facilities and catering facilities.

Figure 4. Agsu district Kalva village

Figure 5. Areas freed from forest close to residential areas along the river bank

As we move up along the right bank of the basin, the steep slopes facing the basin are mainly covered with thorny bushes and shibliak groupings. In the upper part of the slope there is a hornbeam grove with birch made of young shoots. As you go deep into the forest, one by one large oak trees are found. It grows mainly oak trees with a height of 25-30 m and a circumference of 160-240 cm around the chest.

In the **T-7** research area, in the mountainous areas mentioned by Aliyev H.A (1964), broad-leaved forests are spread at an altitude of 600-1800 m above sea level**.** The species that make up these forests include Georgian and Iberian oak, Eastern beech, and Eastern oak in the upper mountain ranges, as well as multi-component mixed forests. In addition to beech and oak, linden, hornbeam, 5-6 species of

maple, especially trautfetter maple, grow in these forests together with Eastern oak. In very dense beech forests, there is no grass cover, but in sparse beech forests, along with shrub species, grass cover also develops. Beneath the forest, there are yellow rhododedrons, blackberries, guelder rose, elder-berry, many species of male ferns and dozens of different grain grasses. Georgian oak, currant and mountain ash are very common on the slopes of the mountains. In the high mountain zones (1800-2000 m) there are park-type forests. It was noted that park-type forests, along with subalpine meadows and highlands, created subalpine sparse forests. Our research in 2017 showed that the forest ecosystems of the areas have been completely transformed. In forest-inaccessible parts of the area, small forest areas have been able to partially retain their original composition. Forests in the middle mountainous and partially flat parts of the mountainous areas have undergone an anthropogenic transformation. Shrubs were formed on the site of the original forest, and pastures were formed on the plains.

In areas more than 2200 m above the sea surface, subalpine and alpine meadows, steppe and meadow plants of various compositions prevail. True subalpine meadows create different formations, spreading in dozens of variants, depending on the relief and character of the high mountains. In the subalpine zone, thickening also forms a special formation; the composition is quite diverse. Most of the subterranean and subalpine plants are that grow under the forest. High grass is rich in hogweed, comfrey, yarrows, capsella, dropwort, types of soft brooms, sorrel, cruciferous, nettle, khashambul, various representatives of the rosales family. In the subalpine zone, meadows of different composition, low-moisture and mesophilic meadows, dry xerophytes, steppe meadows are widespread. The basis of the subalpine meadow consists of white matgrass, brome, purple barley, alpine tooth, many species of lame and three-leaf clover, geranium, lady's mantle, inula; pyrethrum, speedwell, cephalaria, bedstraw, goatsbeard, betonica, primula, scabious, plantains, senecio and dozens of other plants are typical for here. Up to 1,000 plant species are found in the subalpine meadow.

Table 2

Characteristics of derivative type shibliak in deforested areas in the mountain-forest belt of Agsuchay basin

Research area	Type of vegetation	Location	Trees and shrubs	Grass cover	Probable primary wooded
T-2	Bushes in liberated areas from forests	The steep slope of the left bank of Agsuchay	Cherry plum (2), hawthorn apple(3)	30-50% alfalfa species, yarrows	Iberian oak
T-6	Thorny bushes in deforested areas	The left bank of the basin close to Sis village ASL-890m	Rose hips (5), barberry(5), milkvetch (4)	20-70% grain herbs	Oak forest
T-3	Derivative typed juniper in deforested area	The right bank of Agsuchay ASL - 1300m	50% of juniper bushes, milkvetch, rose hips, barberry	15-20% of sedges, thyme	Beech – hornbeam
T-4	Different juniper bushes	The left bank of Agsuchay ASL-1470m	Lancet leaf plantain, yarrows, thyme	40-50% grain herbs, thyme, perforate St John's-wort, chicory	Beech with hornbeam
T5	Sea buckthorn bushes around the river	The right bank of Agsuchay ASL-1600m	Sea buckthorn (2), rose hips (3), cherry-plum, hawthorn cotoneaster	70-80% grain herbs, sage chicory	Oak with hornbeam

T-7	Different thorny bushes	The right bank of Agsuchay ASL-1800m	Rarely rose hips, sea buckthorn in the pit	Birch bush, rose hips, barberry	Caucasian oak

Although meadows are widespread on high mountain tops, steep slopes, and mountain passes, their diversity is less than that of subalpine meadows, but small plant species are very diverse and of great importance. Alpine carpets consist of two groups of formations: real alpine carpet in small northern lands (carum, plantain, lady's mantle, dandelion) and alpine carpet in rocky places (sibbaldia, macrotomy).

At an altitude of 1600-2200 m above sea level, in the liberated areas, shibliaks were formed against the background of meadows and steppes. Groups of sea buckthorn bushes are found in these areas.

Our research showed that deforestation, which is the biggest problem of the whole country, is typical for this area. In the upper mountain-forest zone of the Agsuchay (750-2200 m), most of the forest ecosystems have been transformed, some areas have been completely freed from forests. Landslides areas have formed on deforested slopes and are expanding. Very small areas in the upper mountain remained in its original condition. At most height forests were replaced with shrubs [3,7].

Conclusion and suggestions

1. In the upper mountainous part of the Aghsuchay basin of mountainous Shirvan, forests were transformed in large areas of forest massifs and kept their initial state in small areas.

2. The middle mountain-forest belt of the Agsuchay basin has been completely transformed and replaced by young hornbeam with beech trees, mainly of the stem. The slopes of the area are covered with shrubs.

3. Iberian oak is rarely found in the low-mountain forest zone, and has been replaced by mostly unproductive hornbeam trees. Most of the area is covered with shrubs.

4. In the areas liberated from forests, the process of erosion has intensified, ravines and gullies have formed. This has led to the emergence and growth of landslide hotbeds.

As the forests of mountainous areas have undergone drastic changes in quantity and quality, comprehensive measures must be taken.

1. To restore the initial state in the areas where it is possible (with little transformation), taking into account the biological and other characteristics of forests

2. Facilitate the natural regeneration of young shoots from new shoots by preventing livestock from entering forest areas

3. To implement various measures to prevent illegal logging of forests

4. In the areas liberated from forests, shrubs and sparse trees of insignificant importance should be removed and new forest plantations should be planted in their place.

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