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ALGORITHMS OF NAKHCHIVAN (AZERBAIJAN) GRASSLANDS AND THEIR ECONOMIC-GEOGRAPHICAL ASSESSMENT, BASED ON LANDSCAPE PLANNING

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АЛГОРИТМЫ ПАСТБИЩ НАХИЧЕВАНИ (АЗЕРБАЙДЖАН) И ИХ ЭКОНОМИКО-ГЕОГРАФИЧЕСКАЯ ОЦЕНКА НА ОСНОВЕ ЛАНДШАФТНОГО ПЛАНИРОВАНИЯ

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Abstract. According to the article, grasslands amount for 103,816 hectares out of 5,502.78 km^2 total area of Nakhchivan AR. The grasslands play a vital role in the development of livestock, especially rearing of bovine animals, small-horned livestock and beekeeping. Descriptive research work has been conducted in the field, in order to determine the role of grasslands in the development of livestock farming. There is a strong need for conducting study of the area on the basis of landscape planning. As a consequence of a series of natural and anthropogenic factors, a number of environmental issues have arisen on grasslands, and as a result, some areas have become unusable. 58,020 hectares or more than 50% of grasslands became unusable. On the other hand, 45,796 hectares are in good condition. It should be outlined that since destructive factors outpower restorative factors, there is a risk of losing grasslands in the future. It is about time to seriously engage in the solution of environmental problems related to grasslands. Otherwise, we will face bitter consequences. Therefore, landscape planning should be applied in every research work. Hierarchical landscape composition of the area and the problems in each composition should be clearly defined, and the solutions should be developed accordingly. Research work is notably topical in this context.

Аннотация. Из 5 502,78 км^2 общей площади Нахичеванской АР, пастбища составляют 103 816 га. Пастбища играют жизненно важную роль в развитии животноводства, особенно крупного рогатого скота, мелкого рогатого скота и пчеловодства. Были проведены описательные исследования с целью определения роли пастбищ в развитии животноводства. Существует острая необходимость в проведении исследования местности на основе ландшафтной планировки. В результате действия ряда природных и антропогенных факторов на пастбищах возник ряд экологических проблем, в результате чего некоторые территории стали непригодными для использования. 58 020 га или более 50% пастбищ пришли в негодность. С другой стороны, 45 796 га находятся в хорошем состоянии. Следует отметить, что, поскольку деструктивные факторы превосходят восстановительные,

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существует риск потери пастбищ в будущем. Пора серьезно заняться решением экологических проблем, связанных с пастбищами. В противном случае мы столкнемся с горькими последствиями. Поэтому ландшафтное планирование следует применять в каждой исследовательской работе. Иерархическая ландшафтная композиция территории и проблемы в каждой композиции должны быть четко определены, и решения должны быть соответственно разработаны. В этом контексте особенно актуальны исследовательские работы.

Keywords: summer grasslands, winter grasslands, rural grazing, algorithm, landscape planning, economic-geographical assessment.

Ключевые слова: летние луга, зимние луга, сельский выпас, алгоритм, ландшафтное планирование, экономико-географическая оценка.

Topicality. Taking into account the escalation of the ecological situation in the grasslands, field research work has been conducted according to data acquired from a number of various sources, with the view of identifying the factors contributing to the development of ecological problems and their elimination methods. In the Autonomous Republic, 70,674 ha area account for rural pastures, 15,325 ha for summer grasslands, and 14,638 ha account for winter grasslands. 5,541 ha of rural pastures are utilized for other purposes [2–3].

As a part of land reforms, 45,037 ha grassland area was allocated to municipalities, and the rest were kept remained in state ownership. During the study of grasslands, it was concluded that they can be classified into 3 main groups, depending on their use — Summer grasslands, winter grasslands, and rural pastures. In this regard, it is quite topical to include grasslands in scientific research work.

Analysis. It can be solidly stated that the majority of grasslands are rural pastures. Vegetation of winter grasslands in the area does not produce sufficient food for animals. Therefore, they should be fed additionally in the evenings. Notably, winter grasslands are not used for rearing bovine livestock. The reason lies in severe cold, which can lead to the death of livestock.

During Soviet times, it was impossible to rear 15,000–20,000 livestock belonging to collective and state farms near residential areas, and therefore, special stalls named gashes had been built 15–20 km away from the residential settlements. They were intended for the protection of livestock overnight from frosty weather conditions. As the weather set in, livestock was directed to these stalls. Livestock was reared for several hours a day on the grasslands and was fed in the evenings in those gashes.

It should be pinpointed that winter grasslands also fall under the classification of rural pastures. Based on landscape planning grassland algorithms have been developed for the study of grasslands. Since there is a certain hierarchy in grasslands, the algorithms were defined according to the system below [1, p. 135]:

Hierarchical landscape — high level (grassland), Composition-lower (main foundation) level [8, p. 57–62].

Grasslands

2.Summer pastures

2.1. Forestry meadows and shrublands

2.1.1. Mesophilous forest meadows rich with legumes

2.1.2. Meadows rich in shrubs

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2.1.3. Xerophytic forest meadows
2.2. Subalpine meadows
2.2.1 Prairies containing Festuca pratensis
2.2.2. Prairies containing thymes, astragalus, meadow fescue
2.2.3. Meadow prairie transitions
2.3. Montane grasslands
2.3.1. Alpine heaths
3. Winter grasslands
3.1. Wormwood rich semi-deserts
4. Rural pastures
4.1. Wormwood rich semi-deserts
4.2. Xerophytic montane prairies and shrublands

The grasslands in the area are spread to the height up to 3000 meters, starting from Araz river banks. The majority of the area is used intensively, excluding the areas suitable for cultivation. It should be underlined that after the harvest season, those areas are also used for grazing. Summer grasslands are located at an altitude of 1800–2000 meters [4, p. 138]. According to Shelepnev's altitude classification scheme of the area, summer grasslands account for 35.6% of the total lands [1, p. 23]. The area is abundant with rocks, boulders, various cliffs, etc. and therefore, its use as grazing grasslands is limited. Summer grasslands are of utmost importance in terms of the protection of human health, the development of livestock farming, and beekeeping.

The total area of summer grasslands in the Autonomous Republic is 55,032 ha, which accounts for 10% of the total area of the republic [5, p. 113].

36,071 ha of these grasslands are in active use, whereas the remaining 18,961 ha are unfit for use [1, p. 154]. The role of summer pastures in the development of livestock farming is indispensable.

The aforementioned grasslands are home to plants, containing all-important nutrients vital for livestock. Besides the grasslands are also rich in ultraviolet rays, which positively impact the growth and rearing of animals, improvement of livestock metabolism, and strengthening of their bones.

As a result of conducted observations, it was identified that livestock reared on summer grasslands become more developed, sturdier, healthier, and have approximately 1.5–2.0 times more weight compared to livestock reared on lower prairies [4, p. 139].

Summer grasslands in Nakhchivan AR start from 1700–1800 m from sea level and continue up to 2900–3000 m. For about 6–7 months of the year, summer grasslands remain covered with snow. Starting from April, the thawing starts, and the area clears from snow. On the northern slopes, snow can remain until August. Precipitation in the area falls mainly in spring and early summer. Summer grasslands are rich in rivers, lakes, and natural springs. This adds to the significance of pastures. Notably, the Batabat zone is quite rich with such bodies of water. Water from the springs poses an advantage for livestock and people. Yet, it should be outlined that locals warn against using water from a number of springs.

The lands containing summer grasslands are mainly montane meadows, and partly forests. More than 20% of the vegetation here is valuable as fodder plants [4, p. 139]. Remaining vegetation consists of low-quality fodder plants, and a number of harmful weeds.

Seasonality is observed in the use of summer grasslands. The grazing process starts from the mid-level montane area and transitions to subalpine and alpine meadows. With a good grazing

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organization, the same meadow can be used 3 or 4 times. Bovine livestock is grazed in forested and subalpine meadows, whereas small-horned livestock is grazed in alpine meadows.

Due to the unsystematic grazing in summer grasslands around 18,961 ha of the area have become totally unfit [1, p. 154]. Currently, too much livestock is grazed on those grasslands. The 2018 summer studies showed that 120 camps were created in just Batabat pastures. Such crass overloading of pastures results in the trampling of the area and contributes to the erosion process. This leads to dire changes in vegetation types. Valuable fodder plants are replaced with low-quality fodder vegetation and thorny plants [7–9].

In past, more systematic grazing was applied in summer grasslands. At the first stage, the grasslands were divided into certain parts and shifted grazing was applied. Besides, a pasture area named “untilled/Kham” was left around the camps, and these zones were used for grazing sick and lank animals. At the moment, such aspects are totally disregarded. Therefore, the depletion process of grasslands can be observed with a naked eye.

For a more thorough study of summer pastures, it is expedient to conduct study based on landscape planning. Along with identifying the reasons behind emerging ecological problems, this method also clearly shows the solutions. Since the vegetation varies significantly, they can be grouped in separate formations. The summer grasslands can be classified in 3 groups: (1) Forestry meadows and shrublands, (2) subalpine and (3) alpine grasslands [4, p. 140].

1. Forestry meadows and shrublands at one time, this division covered the areas between 1700–1800 m and 2100 m altitudes. However, it should be pinpointed due to the climate changes, the new classification contains the areas between 1900–2000 m and 2100–2200 m altitudes. This grouping can be further divided into three formations.

1.1. Mesophilous forest meadows rich with legumes. Bichanak forest displays characteristic examples of such grasslands. The soil belonging to these meadows are fertile and have higher relative humidity. This in turn, leads to rich vegetation life. The average height of plants is around 50–60 cm, in some species reaching as high as 100 cm. Mesophilous forest meadows are home to approximately 60 plant species [4, p. 140]. Chamomiles, clover, Boehmer's cattail, couch grass, yarrow, moss, chive, wild onion, mountain garlic, various shrubs, including rosehip, hawthorn, viburnum, wild plums etc. are abundant.

L. I. Prilipko noted that humid areas have various vegetation ranging from swamp plants to hydrophylous legumes: coltsfoots, sagebrush, orchids etc. High altitude arid areas are home to xerophytic plants.

2. Meadows rich in shrubs. Shrublands and shrubby meadows are located in the zone stretching from Kukuchay basin to Yalinjachay basin, valleys and watersheds, situated 1900–2200 m from the sea level. The shrublands are common on rocky foundations. Although the top of the plants may seem dense, they are sparse at the ground level. The shrubs are the second formation vegetation, which replaced forests. The precipitation in the area amounts to 600 mm. Drought season kicks off from July, and in August succulent meadows are replaced with dry grass. However, perennial xerophytic plants, such as horsetails, echinops, cotton thistle continue their vegetation cycle. Viburnum, honeysuckle, maples, plums, hawthorne, spiraea, sorbus, buckthorn are common in this zone. Shrubs have spread on montane slopes, and meadows in valleys.

Various leguminous plants, including clover, lucerne, coronilla grow in shrubs, and wild peas, larch, lathyrus, yarrow, thymes create a dense cover around them. These areas are mainly used as leasows. These areas are extensively used in May-June and September-October.

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3. Xerophytic forest meadows. Xerophytization is more common in dry forest meadows, and grass cover is rare in such places. Milkvetches, couches, circisum etc. are quite common in this zone.

2. Subalpine meadows. The zone features 3 distinct vegetation formations [5, p. 113].

2.1. Prairies containing Festuca pratensis. This formation is stretched over montane slopes around Batabat lake, in Salvarty, Kukudagh, Qazanchy pastures, Gomur mountain and other areas. The plants here are mainly two-tiered, prior to summer they are 3-tiered. Around 55% of plants are embryophytes [5, p. 115]. Couchgrass prairies are rich in leguminous plants, onobrychis, bell-flowers, clustered gentian, knapweeds, masterwort, aniseed etc. They are mainly used as summer pastures. Due to the dry summers, soil vegetation dries early. Grainy plants are also observed in this zone.

2.2. Prairies containing thymes, astragalus, meadow fescue. the formation is widespread at high altitude montane areas. Usually common in rocky slopes, rocky areas and underdeveloped slopes. Dense milkvetch plants can be predominant in some parts. Leguminous plants, bulbous meadow-grass, meadow foxtail, prarie junegrass, strawflowers, ragworts, groundsels, cephalaria, figworts etc. are widespread here.

2.3. Meadow prairie transitions. The formation has stretched in the western slopes of mountains and in low-lying parts. Various legumes, rhinopetalum, catnips etc. are common. Transition area is home to junipers, cotoneaster, hawthorns and other shrubs. The vegetation dries early, so grazing period covers early summer.

3. Montane grasslands. These grasslands include the areas of the Autonomous Republic, situated at 2350–3000 m above the sea level. The meadows are rich in vegetation. The meadows feature distinctive high-altitude supalpine and alpine plants. High grassland formations are observed in transitional areas. Alpine vegetation are located among alpine meadows, remote rock foundations. Up to 25 species of plants are common in high montane meadows. Some plants can grow as high as 150–180 cm [4, p. 140]. Primroses, bluebells, asters, bulrushes, foxtails, scorpion grasses, erigeron, bulbous bluegrass, cinquefoils, mouse-ear chickweeds, gypsyweeds, cumin, etc. are widespread in this zone.

Alpine covers are stretched in Salvarty, Aghdaban, Gapyjyk, Kechaldagh and Kukudagh regions in isolated formations. The vegetation is very dense.

Chives, dandelions, chicpeas, butterworts, erigeron etc. are predominant in the area. These pastures are mainly used in grazing of small-horned livestock. Due to excess grazing, valuable fodder plants face the danger of depletion, with low-quality meadow plants replacing them [4, p. 140].

The largest pasture camps in the Nakhchivan Autonomous Republic are situated in the Batabat zone. Batabat, Guluyurdu, Kelekli, Ahmedbey yurdu, Kechaldagh and others can be named in this regard. It is safe to say that livestock are reared here from May through late September. On average, around 80–100 camps are installed in Batabat pastures annually. It noteworthy that the number of livestock sent to montane pastures exceed the norm by 10–15 factor, which in turn leads to depletion of pastures.

Kishlaks. The kishlaks of Nakhchivan AR are located in semi-arid areas. Pasture zones around the villages can also be attributed to this classification. Major kishlaks are situated in areas adjacent to Araz river, Boyukduz, Tenenem sloping plain, Duzdah plain, southern of Jahri gorge, Lizbirt etc.

The total area of kishlaks amount to 48,784 hectares. 39,059 ha of this area in unfit condition. The suitable kishlak area is 9725 ha, which is too low figure to meet the demand for livestock feed,

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contrary to yaylaks/summer pastures. The grasslands are used from October through April [1, p. 154].

Since the fodder reserves of winter pastures is weak, livestock should be provided with additional succulent fodder. The vegetation is poor in both winter and rural pastures, due to the natural conditions. During the annual rainy season, the productivity of semi-arid areas amounts for 11–15 hundredweight per hectare [6, p. 102–106]. More than 150 species of forage plants are found in semi-arid zone. The biological productivity in semi-arid zones increases in spring and fall. The plants which starts flourishing during autumn, are the main source of fodder for winter grazing. Various plant formations exist in semi-arid zones. Calligonum is predominant in slopes of Velidagh and yarrows are predominant in the area between Julfa and Ordubad. It is noteworthy that generally, mogwarts, salsola dendroides, salsola nodulosa, ephemeral plants, milkvetch-mogwart-salsola, mogwart-phrygana etc. formations are also spread over the area in the Autonomous Republic. Tamarix formations should also be mentioned in this regard, which started to spread lately, much due to the climate changes. Tamarix are spread along the floodplains, around Araz river basin, on the wide areas between Duzdagh and Chalkhangala village roads. The vegetation formations below are typical to winter grasslands.

1. Semi-deserts rich in mugworts. This formation is spread in Sadarak valley, Sharur valley, west side of Tananam sloped valley, area stretching from Diza village up to Kivrag village, Kengerli slopped valley, Julfa and Yayji valleys, lower bank of Vanandchay etc. These formations developed on the gray and gray-brown soils. Mugworts and other *Artemisia* plants are predominant here. Along mugworts, various salsolas, poisonous and harmful plants are observed in the area. Acantholimon karelinii, cousinia, figworts, wild rue, bermuda grass (cynodon), field bindweed, native liquorice, Tribulus terrestris, puncture vines, cockleburs, Russian knapweed, nightshare, malva etc. are among commonly spread plants. The areas predominantly to such formations are usually used for grain and tobacco farming. However, land reclamation processes and severe drought lead to mass inclusion of these areas to agriculture. Remaining areas became predominant with thorny vegetation.

2. Semi-deserts rich in salsola dendroides. This vegetation formation is observed between the western end of Sadarak valley and Araz river-bed, on the alluvial sediments drawn from Jahannam valley. During the spring floods, various ponds are created here and this leads to flourishing of cynodon meadows, salsola rich formations, various bulrushes and reed-rich lands. Wild licorice and camelthorns are found here in dense bushes. It is noteworthy that some salsola species are spread especially in this area of Nakhchivan AR. Along salsola dendroides, grain and ephemeral plants are spread here too. In the lands, close to Araz river, tamarix is widespread. All these areas are utilised as pastures.

3. Salsola nodulosa and mugwort rich areas. Widespread at the 1000-1300 m altitude from the sea level, on Sust slopped valley. Floods from Анабад and Gapagysh mountains draw in high amount of alluvial sediments. Main vegetation here consists of salsola nobulosa and mugworts. Ephemeral plants can also be found among salsolas. Geomorphological structure and physical-chemical composition of the soil greatly impacts the vegetation. So that, Salsolas mainly distributed in valley zones are tend to be taller and denser. Xerophylic legumes and arid-climate plants are predominant in the area. The area is not suitable for livestock grazing [5, p. 118].

Over the Autonomous Republic, these areas are distributed at the south and south-west of Duzdagh, steppes around the Garaultepe, between Shahtakhty village and Taziuchan. Milkvetch and mugwort formation are widespread in the mid-montane parts of Autonomous Republic. In addition to abovementioned, ephemeral plants are also vital for livestock grazing. Since fodder reserve is

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scarce in plains and mid-montane area, additional fodder should be preserved in advance for livestock.

According to the local population, ephemeral plants dry out in May, and summer plants replace them. These start to grow from June and remain as the main source for grazing for winter grasslands. This idea was confirmed by our scientific studies.

Outcome and recommendations. In order to prevent the depletion of grasslands in Nakhchivan Autonomous Republic, certain measures should be implemented, steps should be taken to reclaim unfit pastures. Survey works on the pastures should be carried out on the basis of landscape planning. In order to achieve this, grassland algorithms have to be defined on hierarchical basis. Another advantage of landscape planning is that it also identifies the factors leading to ecological problems and related conflicts, and provides solutions to these issues. It is of utmost importance to implement the following measures in this regard.

1. Irrigation means should be created in the areas intensively used as pastures, and which are short in water.

2. Due to excessive grazing over long period of time, a number of valuable fodder vegetation is replaced by harmful plants. Poisonous and harmful vegetations should be eradicated and valuable fodder plant seed should be sowed in the grasslands.

3. The number of livestock sent to grasslands should be closely monitored. Excessive livestock grazing can result in serious drop in productivity, reduction in valuable fodder plants and can facilitate erosion. In other words, the use of grasslands should be optimized.

4. Systematic grazing should be introduced in pastures; frequent shifted grazing should be observed. This point is not strictly adhered in the private property period. This system was applied in common property period and yielded good results.

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