Environmental Pollution Journal
ISSN (Online): 2776-5296

Volume 5 Nomor 2 Juli 2025
https://doi.org/10.58954/epj.v5i2.310
Page:185-192

Study of Modern Pasture Landscapes in Subtropical Zones of the Azerbaijan Republic

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ABSTRACT

The article shows climate data, soil moisture, humus and nitrogen content and other key indicators of the area (2022-2024). Abandoned agriculture and reforestation that have taken place in Azerbaijan in recent decades have led to accelerated transformation of the pasture landscape. It was found that all soils subject to grazing (regulated and unsystematic) have an average and low humus content (no more than 2.1%) compared to soils of the reserve regime, which are characterized by a high humus content (11.4%). Grazing leads to the dispersion of the structure of the upper (0-10 cm) sod horizon. In the grazing variant 3/15 the content of the megastructure decreased by 10.6 times, and dust increased by 2.26 times. The bulk density of the soil increased from 1.26 to 1.50 g/cm^3, the volume of the solid phase - by 16.48%, non-capillary porosity decreased by 8.44%, capillary - by 8.05% with a decrease in the water resistance of aggregates - by 7.9% and water permeability by 2.15 times. A large amount of nutrients was lost with erosion products. With normal erosion - in the absence of grazing, the total losses of nitrogen, phosphorus and potassium amounted to - 7.86 kg / ha, with intensive (3/15) - 297.57 kg / ha, or 37.7 times higher. Overgrazing and exploitation of forest stands in natural forests, as well as the replacement of forests with cultivated lands, have significantly increased the density of sand (by 10.3-60.5%) and bulk density (4.1-7.16%), and have also significantly reduced the content of silt (2.34-8.56%), clay (2.36-10.5%), K (35.68-49.63%), P (15.58-29.38%), N (23.2-55.6%), and C (23.3-52.6%). There is little and rather contradictory information on the impact of grazing on soil properties. Research aimed at improving the use of pastures for grazing livestock in subtropical regions. No reliable changes in yield were found either at low grazing intensity (1/5, 1/10, 2/5) or at acceptable load levels (1/15, 2/10, 3/5) (13.7-14.6 t/ha). Grazing options 2/15, 3/10, 3/15 are excessive, leading to a decrease in yielding by 0.43-3.07 t/ha, or 3.26-23.66%.

Keywords: Humidity; Bioreserves; Productivity; Soil erosion; Physical properties; Biomass

PENDAHULUAN

The problem of desertification and the decline in land productivity is one of the main problems of our time today. The loss of rich vegetation exposes the soil, changing its temperature regime. Established parameters of the soil climate change depending on the methods of influence on vegetation cover, determined by the density of grazing livestock (Ngobi et al., 2022; Sawadago, 2011).

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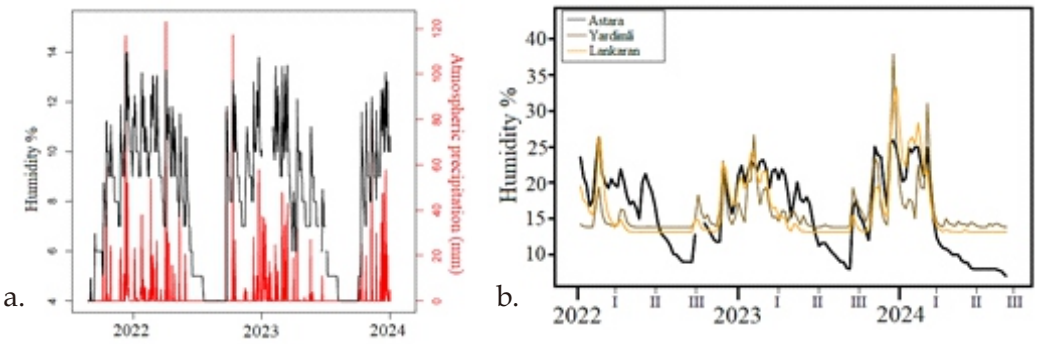
The processes of overheating of the soil surface under the influence of solar radiation, penetrating into the soil mass, have a significant impact on the transformation of the organic and mineral parts of the soil (Baude et al., 2019). Currently, population growth and demand for agricultural products have led to significant destruction of natural ecosystems, including forests and pastures, and converted them into farmland (FAO, 2020; İsmayilov et al., 2020). Land use can cause changes in the chemical and physical properties of soils, which in turn can ultimately lead to degradation. Domestic animals consume the main part of the above-ground phytomass in pastures and, at the same time, the largest part of the phytomass consumed by vertebrates in general (Hasanova & Asgarova, 2024). Various aspects of the activities of domestic animals act as significant ecological and cenotic factors in their consequences, exerting a multifaceted and profound influence on the components of pasture ecosystems. They especially strongly influence vegetation and soils, edifying the specific pasture environment (Hasanova et al., 2021; Hasanova & Asgarova, 2024). Therefore, in this study we compare recent changes in the physicochemical properties of soils, the erosion factor, and humus and nitrogen reserves in natural ecosystems. Unsystematic use of pastures contributed to the destruction and removal of upper soil horizons and the emergence of lower carbonate horizons on the soil surface. Regulation of grazing led to an improvement in the coverage of the soil surface, and, consequently, to a decrease in the erosion and blowing away of soil material (Ikhtiyar et al., 2022). Pasture use, especially unsystematic and intensive, significantly changes the humus state of the studied soils. In areas with unsystematic grazing, there is a significant decrease in the content of nutrients compared to the soils of the protected area and with regulated grazing (Sadigov et al., 2024; Sudhakaran et al., 2018). Pasture use, especially unsystematic and intensive, significantly changes the humus state of the studied soils. In areas with unsystematic grazing, there is a significant decrease in the content of nutrients compared to the soils of the protected area and with regulated grazing (Sadigov et al., 2024; Sudhakaran et al., 2018). The projective soil cover and sod cover, which play an important role in protecting soils from erosion, have decreased. The territories of the subtropical regions of the Republic of Azerbaijan are experiencing intensive pasture pressure (Novruz et al., 2025).

Perennial weeds have the greatest species diversity, the most common weeds being *Krasheninnikovia ceratoides, Artemisia arenaria, Artemisia vulgaris L., Artemisia lerchiana, Agropyron fragile, Stipa sareptana, Stipa lessingiana, Poa bulbosa, Leymus racemosus, Carex stenophylla, Gypsophila paniculata, Falcaria vulgaris, Anisantha tectorum, Alyssum desertorum, Ceratocarpus arenarius, Lagoseris sancta, Salsola tragus, Galium aparine, Phlomis pungens, Bromus squarrosus, Alhagi pseudalhagi, Kochia prostrata, Salsola tragus, Tulipa biebersteiniana, Tanacetum achilleifolium, Descurainia sophia, Sisymbrium loeselii*, *Centaurea jacea* L., *Plantago major* L., *Tanacetum vulgare* L. and others whide spread in Lankaran lowland natural biotopes.

The aim of the study is to obtain data to stop the degradation process and for future work to improve the condition of forest pasture soils. The data obtained were presented to the state and received approval for further study. The data obtained were presented to the state and received approval for further research.

RESEARCH METHODS

The work was carried out according to the experimental scheme: 1. reserve regime, 2. regulated grazing, 3. unsystematic grazing. Analyses to establish the physical and chemical properties of gray-brown soils were carried out using traditional



Source: Primary Data Processed (2024)

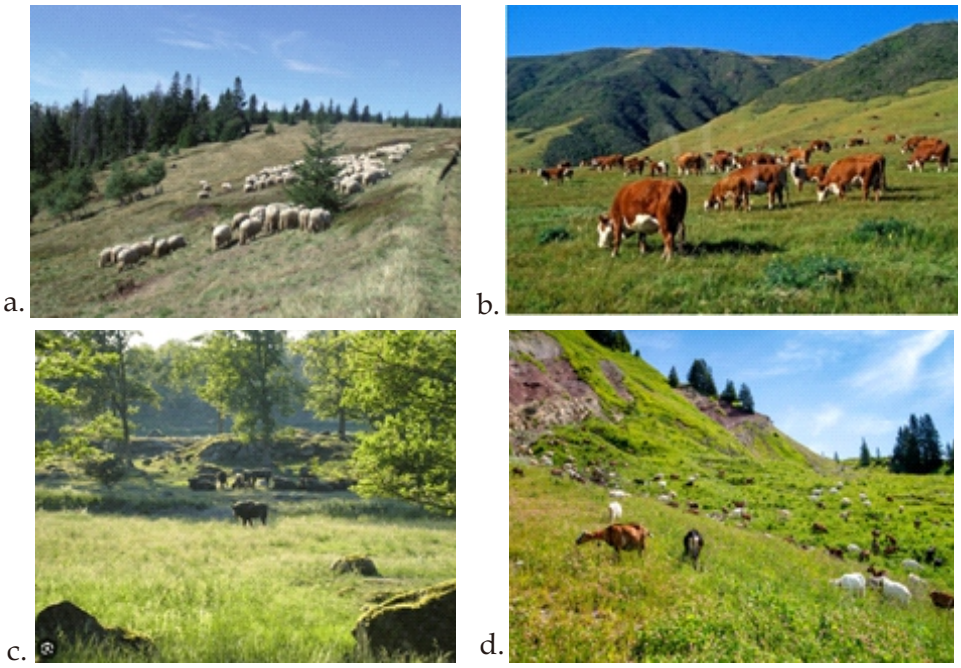
Figure 1
Soil humidity in 2022-2024 years (Lankaran-Astara economic region); b. Soil humidity in Astara, Yardimli, Lankaran (I – March, II – May, III – September)

methods. To study the quantitative characteristics of woody plants, we selected 50 random plots of 1000 m^2. At each site, we counted the trees, determined their quantitative characteristics, and randomly selected 4 soil samples at a depth of 0-50 cm, and then mixed them into one for soil analysis (Astara (38°28′23″ N 48°50′20″ E), Lankaran (38°42′54″N 48°49′53″E), Lerik (38°50′25″N 48°20′05″E), Yardimli (39°03′ N 48°21′ E)). The areas selected for the research reflect all the ecological problems of the local pastures. The selected key areas have been subject to anthropogenic impact for many years. Soil studies play a crucial role in the environmental assessment of an area.

To assess some physical and chemical properties, such as texture, organic carbon, total nitrogen (N), bulk density, available phosphorus (P) and other parameters, the samples were air-dried for 2-3 days and then sieved through a 2 mm sieve to remove large roots and stones (Didehban et al., 2025). To study erosion processes, artificial rain was supplied to the trays. The variable squares method was used to conduct vegetation census studies. In the study areas, 10x10 m (100 m^2) test plots were laid out to study the phytocenoses, and 25 x 25 cm counting plots were determined within this area. The total census area is at least 1 m^2. The selection of counting plots was carried out using the random numbers method (Chaves et al., 2020; Rowell, 1999).

RESULT AND DISCUSSION

These pastures are ancient and support the local population of 100,000 people mainly through livestock farming, which accounts for 70% of agricultural income. Current land management practices are leading to increasing land degradation due to overgrazing, the spread of non-food grasses, and an annual loss of productivity of 2.5%. The issue of land degradation and desertification in the Lankaran lowland is a pressing issue that poses a threat not only to the ecosystem, but also has a negative impact on the living standards of the population and economic development, such as tourism. At present, people do not pay attention to this for their own benefit. At this rate, in 5 years the situation of the residents of this area will be grave. Positive changes in the management of pastures near the lakes will bring, according to researchers, $ 19.6 million over 10 years. And vice versa, Azerbaijan will lose the same number of millions of dollars in the next decade if it does not start saving the pasture now. The main reason for the acute environmental situation in Azerbaijan is overgrazing, which consists not only in the large number of grazing livestock, but also in the change in the system of pasture use, which have become year-round. And as a result, degradation of pastures is observed, the processes of



Source: Primary Data Processed, (2024)

Figure 2

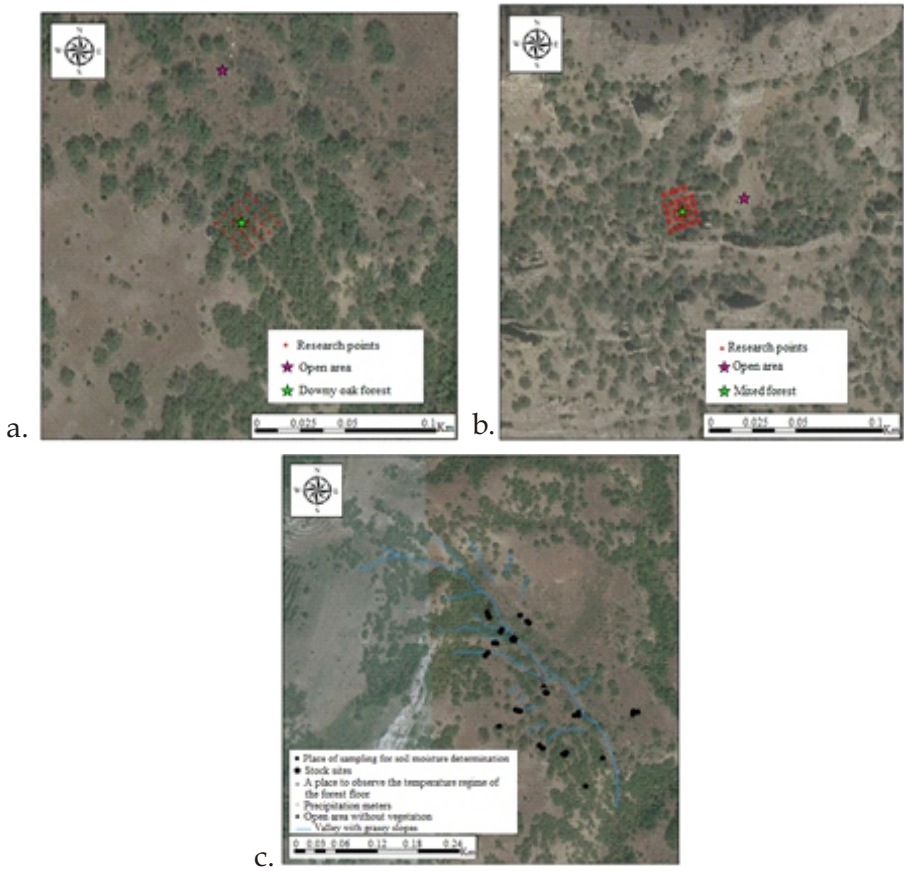
Important Pastures of the Lankaran Lowland

Note: A. Astara region Artupa village (38°28′23″ N 48°50′20″ E); B. Lankaran region Garmatuk village (38°42′54″N 48°49′53″E); C. Lerik region Bilavar village (38°50′25″N 48°20′05″E); D. Yardimli region Gendere village (39°03′ N 48°21′ E)

replacing annual forage grasses with weeds are intensifying. The negative consequences of overgrazing include desertification, soil erosion, deforestation, degradation of the wealth of flora and fauna, a decrease in the productivity of the livestock itself and, ultimately, a decrease in the level of food security for humans.

Pasture rotation, i.e. change of pastures, is almost not carried out in the country. The authors propose such measures as compliance with the pasture rotation system, seasonality of migrations; regulation of livestock numbers taking into account pasture resources; growing annual and perennial grasses in order to improve the forage base, reduce livestock mortality due to lack of feed; introduction of irrigation systems for watering hayfields, pastures, watering places. Also, reducing the livestock population by introducing more productive breeds of livestock, orients shepherds to other areas of earnings-ecotourism, rural tourism, provides an opportunity to process livestock products and organizes a sales market for cattle breeders who get the opportunity to reduce the number of livestock due to earnings from side activities.

In most cases, precipitation falls in the form of downpours, which contributes to the intensive development of erosion processes. Pasture soils are very diverse, due to differences in their origin and the nature of human impact (Ikhtiyar et al., 2022; Sylia et al., 2025). All natural pastures of the Lankaran lowland are characterized by the impact of mesophilic perennial herbaceous plants on the soil, expressed in the formation of turf (the upper soil horizon, densely intertwined with grass roots) and the accumulation of humified organic matter. Groundwater is deep and inaccessible to grasses (Nazim & Oqtay, 2024). The climate is moderately warm, subtropical with dry hot summers, the average annual air temperature fluctuates between +14 and +16°C, the temperature of the cold month (January) is 0-5°C, the soil does not freeze (Fig.1). Overgrazing and exploitation of forest stands in natural



Source: Secondary Data Processed

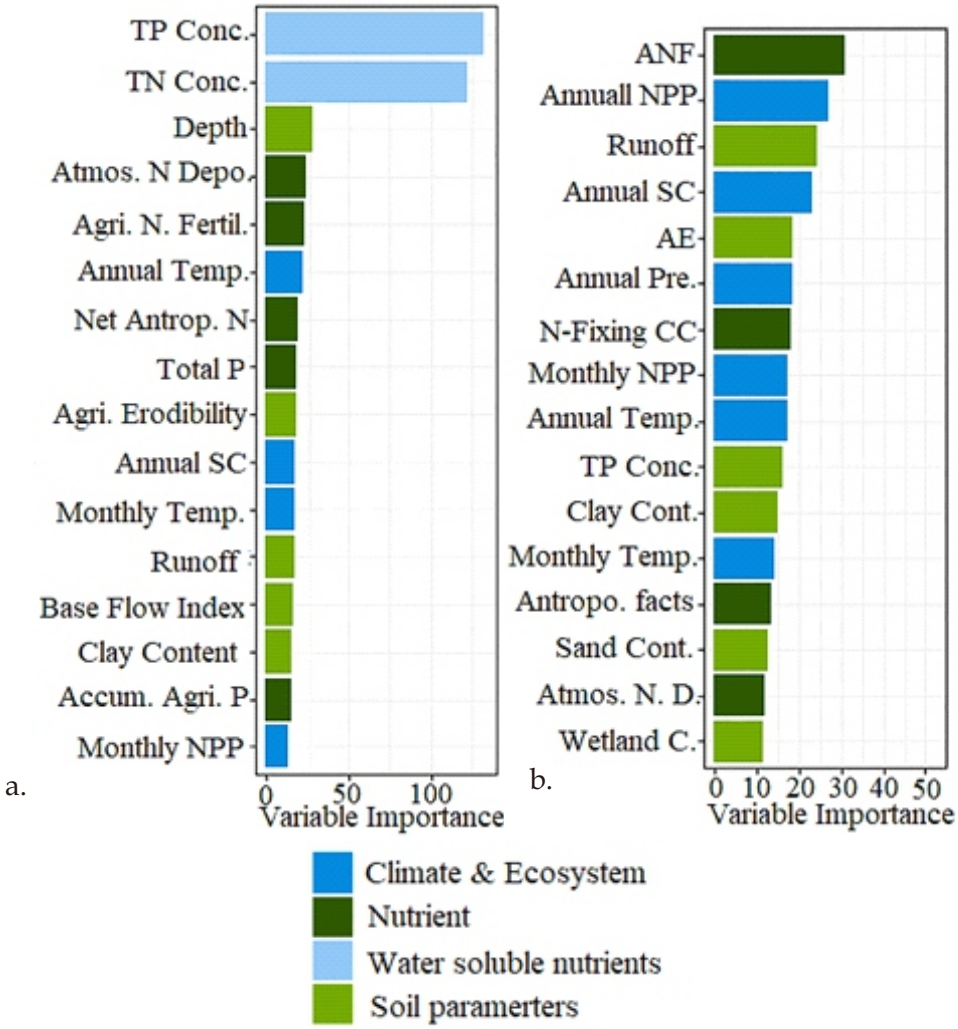
Figure 3

a. Location of the key area of downy oak forest; b. Research site on the southern slope; c. Sampling places (Lerik region)

forests, as well as the replacement of forests with cultivated lands, have significantly increased the density of sand (by 10.3-60.5%) and bulk density (4.1-7.16%), and have also significantly reduced the content of silt (2.34-8.56%), clay (2.36-10.5%), K (35.68-49.63%), P (15.58-29.38%), N (23.2-55.6%), and C (23.3-52.6%).

The content of organic matter and mobile forms of phosphorus, exchangeable potassium and nitrogen in the soil was directly dependent on the mass of applied manure, straw, green manure crops, cultivated in fallows, after stubble and after mowing, both separately and together with mineral fertilizers (Macnunlu et al., 2025). Thus, in the soil layer 0-10 cm over three years in variant 3/15 the content of megastructure decreased by 10.5 times, and the proportion of dust increased by 2.4 times. In 3/15 the bulk density increased from 1.27 to 1.51 g/cm^3 over the study period (Fig.4). In variant 3/15, the volume of the solid phase increased by 16.48%, non-capillary porosity decreased by 8.44, and capillary porosity by 8.05%. The water resistance of the aggregates decreased by 1.8-7.8% depending on the grazing intensity, and the water permeability in the 3/15 variant decreased by 12.13 times. An increase in slope steepness by 1° within the studied range contributed to an increase in runoff by an average of 0.17 m^3/ha, and an increase in precipitation by 1 mm–by 0.76 m^3/ha, and runoff, respectively, by 3.6 and 4.1 kg/ha.

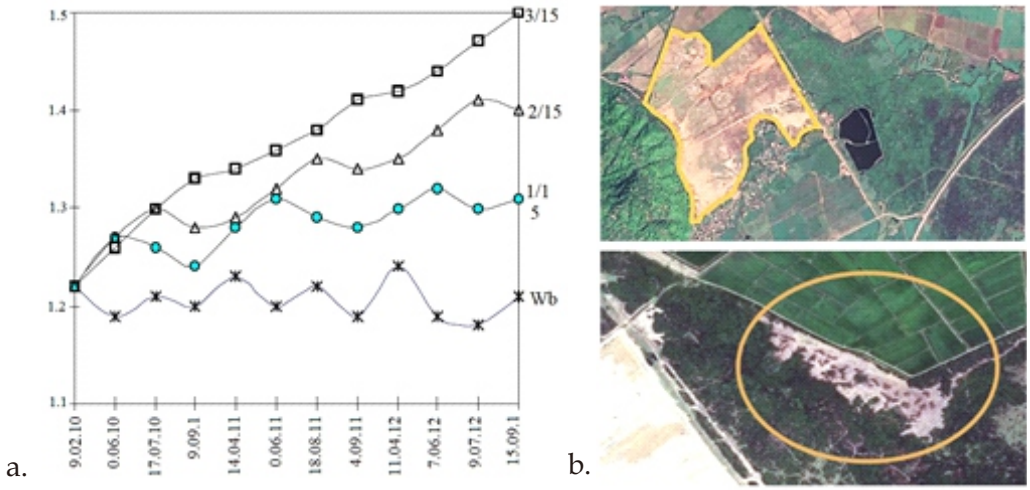
From the presented data, it can be concluded that with low grazing intensity (options 1/5, 1/10, 2/5) the yield fluctuated between 13.7-14.4 t/ha. At acceptable load levels (options 1/15, 2/10, 3/5) no reliable changes in yield were found. Grazing options 2/15, 3/10, 3/15 are excessive and lead to a decrease in yield (on average over 3 years) by 0.5-3.2 t/ha, or by 3.26-23.64%.



Source: Primary Data Processed (2024)

Figure 4

a. Total parameters Lankaran forest soils; b. Total parameters Lerik forest soils



Source: Primary Data Processed (2024)

Figure 5

a. Dynamics of soil volume biomass (0-20 cm, slope 14^0) under different grazing regimes. b. Vegetation biomass cause of grazing over the past few years in Lankaran (Garmatuk village 38°42′54″N 48°49′53″E); b. Lerik (Bilavar village 38°50′25″N 48°20′05″E) regions.

Note: For comparison, a control was included - without bleeding (Wb).

CONCLUSION

The mountainous regions of Azerbaijan are one of the key regions for traditional livestock farming, providing livelihoods for a large part of the population. However, intensive use of natural resources without considering environmental consequences leads to several serious problems, including water pollution, pasture degradation and loss of biodiversity. The main reason for the acute environmental situation in the Lankaran region is overgrazing, which consists not only in the large number of grazing livestock, but also in the change in the pasture use system, which has become year-round. And as a result, degradation of pastures is observed, the processes of replacing annual forage grasses with weeds are intensifying. The negative consequences of overgrazing include desertification, soil erosion, deforestation, and degradation of wealth. Based on archival and modern materials, the trajectories of pasture landscape change were established, and the sustainability of the pasture landscape was assessed. Factors threatening and supporting traditional pasture use were studied. In this study we compare changes in the physicochemical properties of soils, the erosion factor, and humus and nitrogen reserves in natural biotopes. The study of the variable importance of some soil parameters of forest ecosystems is considered relevant for Azerbaijani scientists. The highest erosion index was found in cultivated lands (0.270) and the lowest in protected forests (0.210). The results of this study showed that firewood cutting in natural forests, together with overgrazing, and forests to convert land conversion have caused significant soil degradation in the semi-arid region of Lerik. Overseeding of perennial legumes and cereal grasses on pastures helps improve land cover, increase biomass and biodiversity, and improve soil structure.

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