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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

SOIL TRANSFORMATION ON THE SHORES OF THE CASPIAN SEA AND STUDY OF THEIR DEVELOPMENT PROSPECTS (USING THE EXAMPLE OF THE SHABRAN-KHIZI DISTRICTS)

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GENERAL CHARACTERİSTİCS OF THE WORK

The actuality of the topic and level of research on the subject. As a result of man's incorrect economy which has been increasing year by year for many years, not only the destruction of the nature of separate countries, but also the loss of the civilizations they have gained from time to time has been occurred. It is possible to meet the negative cases in this direction of the modern practice. Beginning from the second half of the XX century, the transformation, degradation and desertification of the soils are given wide attention in individual countries and regions, but also in the international world, including the UN Environment Program (UNEP). It is noted that the anthropogenic deserts occupy 9.1 million km^2 of zone of the total soil fund on the earth, but a velocity of the desertification is equal to 50 000 km^2.[1] At present approximately 150 million hectares of the sown area of the arid zones are irrigated and 145 million hectares are dry-farming land, 3.6 milliard hectares form pasture areas.[2]

In addition to more than 70% of the total territory of the Republic of Azerbaijan being characterized by arid and semi-arid landscapes, over 85% of the country's population resides within these landscapes. As a result, the intensity of human economic activity in these areas has led to the rapid transformation of soil cover and caused significant negative changes within various ecosystems.

The research area, located along Caspian Sea coast, encompasses arid and semi-arid landscapes of the region and represents a geographically extreme environment. The soil cover of the area has been subjected to intensive exposure to both natural and antropogenic influences. Due to the significant transformation of the soils in the Siyazan-Sumgait massif and the Bogaz plain, these lands have been weakly involved in agricultural cultivation. They have primarily been used as winter pastures for livestock farming.

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[1] Zonn İ.S., Orlovsky N.S. Desertification: strategy // Ashgabat: Ilim, —1984, pp. 253-268

[2] Rozanov B.G., Zonn I.S. Action plan to address the challenges of dessert devolopment // Problems of desert development —1981, —No 6, —pp. 22-30

The transformation of soils under the influence of natural and anthropogenic factors and, from this perspective, the ecological assessment of soils under the conditions of Azerbaijan have been studied by V.R. Volobuyev, G.Sh. Mammadov, M.P. Babayev, V.H. Hasanov, B.N. Ismayilov, K.A. Alakbarov, H.A. Aliyev, S.H. Khalilov, and R.M. Abduyev.

The location of area in close proximity to the Baku-Sumgayit agglomeration enhances the importance of protecting and efficiently utilizing these soils. The study of this issue in the given context is not only of scientific-theoretical and scientific-practical relevance, but also holds significant importance in terms of initiating new research efforts in this direction whitin the Republic.

Research object and subject. The study encompasses the lowland area of the northeastern part of the Greater Caucasus. The western boundary is conditionally defined by the 200-meter elevation above sea level, while the eastern boundary extends to the wave-washed shores of the Caspian Sea. From an administrative perspective, the research area includes the coastal regions of Shabran, Siyazan, and Khizi districts.

The objective is to assess the current state of the soil cover in the coastal region of the Greater Caucasus in terms of exodynamic and anthropogenic impacts, and to develop comprehensive mitigation measures aimed at reducing the effects of soil transformation processes.

Objectives and tasks of the research. The primary of this investigate the transformation of soils along the Caspian Sea coast against the backdrop of the current desertification process, to assess their state of degradation, and to develop comprehensive measure for the effective utilization and management of these soils. To achieve this goal, the following tasks have been set:

- Assessment of the physical – geographic conditions of the study area in terms of natural and anthropogenic soil transformation;
- Development of criteria adapted to local conditions for various types of soil transformation, as well as the assessment and mapping of soil transformation factors;
- Generalization of long-term soil research results and

identification of dynamic based on subsurface processes and parameter indicators;

- Forecasting of soil transformation processes for the near future;

- Development of scientifically grounded mitigation measures related to soil transformation.

Research Methods. In the course of the research, both modern and traditional methods were employed. The study was carried out under field, laboratory, and office conditions. Geographic Information Systems (GIS) technologies were used alongside historical-geograpical, statistical, comparative, and systematic analysis methods, among others.

The laboratory analysis of soil and water samples involved the following methods: humus content was determined using the I.V.Ivanov, pH was measured in aqueous solution using a potentiometerin, carbonate content (CO_2) was assessed using the Scheibler method with a calcimeter, easily soluble salts in soil were analyzed according to E.V.Arinushkina's metod, hydroscopic moisture was determined by drying the samples in a drying oven at 105^{o}C for 6 hours using gravimetric method, granulomtric composition wasdetermined by the Kachinisky method using sodium pyrophosphate ($Na_2P_2O_7$) treatment.

Key provisions for defense:

1. Assessment of the physical-geographical conditions characteristic of the area in the context of global desertification processes, with regard to soil transformation.

2. Evaluation of the role of antropogenic factors in soil transformation.

3. Modern state and prognosis of the soil transformation.

4. Development and effective implementation of comprehensive mitigation measures to prevent the degradation of soils from original condition.

Scientific novelty of the research:

- For the first time, the degree of anthropogenic pressure on the soil zone has been assessed, taking into account natural exodynamic processes, and the level soil transformation has been determined.

- Based on the continuity of long-term soil investigations, internal soil processes and changes occuuing in the area have been identified using a number of essential parameters.

- Considering both quantitative and qualitative indicators, soil have been classified and mapped according to the types and classes of anthropogenic transformation.

- In the context of ongoing global desertification, a short-term forecast of antropogenic soil transformation in the study area has been developed.

- Based on the result of the research, a set of integrated mitigation measure has been developed to ensure the rational and efficient use of soil resources.

Theoretical and practical significance of the research. The methodology for assessing the transformation of soils within various ecosystems along the Caspian Sea coastal zone, in the context of the intection between natural and anthropogenic factors, holds significant scientific-theoretical and practical importance. The antropogenic soil transformation map, developed at a scale of 1:100 000, not only provides a quantitative and qualitative evaluation of regional soils, but can also serve as a reference for the assessment of soils in other comparable areas.

The land-use efficiency map, created based on the transformation map, is important from the standpoint of implementing ameliorative and preventive measure, as well as ensuring the sustainable and efficient use of soil resources in the region.

In addition to the rich empirical data, the consistent analysis of long-term research and the observed trends in anthropogenic pressure make it possible to forecast soil transformation processes in the near future.

Approval and application of the research. The propositions and various sections of the dissertation have been approved and presented at both national and international scientific conferences held in Azerbaijan and abroad, including: the republican scientific – practical conference “Global trends and modern Azerbaijan”, (Mingachevir, 2018), the republican scientific – practical conference

“100th anniversary of the Azerbaijan People’s Republic” (Sumqayit, 2018), International conference on “Mountains: cultures, landscapes and biodiversity (Baku. 2019), the republican scientific conference “Modern problems of Science and Education” (Sumqayit, 2022), ınternational scientific and practical conference "Geographical aspects of sustainable development of regions" (Gomel, 2023), etc.

The name of the organization where the dissertation work was implemented. The dissertation was carried out at the “Geography of soil resources of Azerbaijan” department of the İnstitute of Geography named after academician Hasan Aliyev of the Ministry of Science and Education of the Republic of Azerbaijan.

The volume, structure, and primary content of the dissertation. The dissertation consists of an introduction, 4 chapters, a conclusion, reference lists and additions. The volume of the work is 162 pages. The work consists of 27 tables, 16 figures, 7 graphs, 5 maps-schemes and a list of 169 references. Introduction — 5 pages, Chapter I — 13 pages, Chapter II — 62 pages, Chapter III — 38 pages, Chapter IV — 17 pages, conclusion — 2 pages, list of references — 15 pages. The dissertation, excluding tables, graphs, illustrations, and the list of references, consists of 182008 characters.

A BRİEF SUMMARY OF THE DİSSERTATİON

The **introduction** outlines the relevance of the topic, the degree of its study, the aim and objectives of the research, its theoretical and methodological foundations, as well as the scientific novelty and practical significance of the study.

The first chapter of the dissertation is titled **“Scientific-theoretical and methodological problems of the modern transformation characters of soils in arid and semiarid regions”.** The **chapter explores the** scientific-theoretical aspects and methodological challenges of the issue. It examines the transformation of soil cover in arid and semiarid regions under the influence of natural antropogenic factors, focusing on the development of internal soil prosesses and their negative

consequences.These processes are characteristic of soils along the Caspian Sea coastal zona. The observed changes include the deterioration of physical and physical-mechanical properties – such as compaction of the subsurface layer, crust formation, development of wide cracks, and the emergence of sticky textures in both the topsoil and deeper horizons. These are indicative of transformation of soil quality. In arid and semiarid bio-climatic zones, such transformations are largely driven by unsustainable human agricultural practice.The primary reason lies in the neglect of the natural properties of soils, including elementary soil-forming processes and genetic characteristics that define their natural fertility. As a result, approximately 6 million hectares of the 1.5 billion hectares of arable land globally are being removed from agricultural use every year.

When evaluating the impact of natural and antropogenic factors on the soil cover separately, it was revealed that there are anthropogenic factors in the study area that accelerate natural transformation processes. Anthropogenic – particularly technogenic-impacts cause severe, and sometimes catastrophic, disruptions to the ecological balance, which can ultimately lead to the complete loss of the A+B soil horizons. It has been noted that all these processes are characteristic of the study area.

Another characteristic process analyzed in the study shows that the plowing of virgin lands often results in a significant decrease in the amount and reserves of humus. The main reasons for this are the acceleration of mineralization and the reduction in the amount of plant residues returned to the soil.

The problem discussed in this chater is briefly analyzed from a theoretical perspective at the global, regional, national, and study area levels. It is noted that the main cause of fertile soil loss in the republic, including the study area, is the inefficient use of soils. Within the Quba-Khacmaz economic region, the population has migrated at an increasing rate since the 1950s, moving northward from the Samur River to the coastal plains extending southward to Absheron.

The population of the economic geographical region of Guba-

Khachmaz were migrated from Samurchay in the north to the seashore plains of Absheron in the south after the 50th years of the XX century. The bioclimatic zones in Azerbaijan, including in the research zone were analyzed and its soil and landscape areas were determined on the basis of aridity index adopted in the international world. Investigation of the anthropogenic transformation of soil cover of the arid zones in the context of the desertification process and assessment were grouped and analyzed on separate stages.

The second chapter of the dissertation is called "**Natural factors of transformation**". The first subsection of this chapte covers the orographic characteristics, geological, and geomorphological structure of the study area. The geological structure, relief, and geomorphology of the region are closely related to the issues addressed in the research, including the formation and transformation of soil cover. Tectonic uplifts occurring in the western parts of the Samur-Davachi, Siyazan-Sumqayit and Bogaz plains have led to the deepening of the erosion base level and, consequently, to changes in the location of alluvial fans.

During the fourth period, intensive tectonic movements in the area caused marine regressions, Which resulted in the rivers flowing from the northeastern slopes of the Greater Caucasus depositing their transported materials and extending the alluvial fans into the Caspian Sea. Currently, alluvial-meadow, meadow-brown, and meadow-grey soils have formed on these deposits. In the southern parts of the study area, the areal extent of contemporary accumulative processesis narrowing, occurring on the basis of the alternation between continental and marine deposits.

The stripe along the seashore possesses a sunken form. A main reason is that the beach sand is subjected to aeolian process. Exogenous micro-relief forms by accumulating mobile sand on young soils – dashes, dunes, sand hills.

Increase of the relief inclination from Siyazan-Sumqayit massive to the west direction caused good development of the ravine and valley. Density of the ravine and valley net rises in the river vales. This depends on relief character and lithological composition of the rocks.

The climate factor was interpreted under the second subheading. It has been shown to have a major effect in transformation and degradation process of soils in addition to its soil-forming function.

Though an amount of the sunny hours, annual quantity of the sun radiation in the research zone are good for development of soil-forming process and an area of the plant-growing of agriculture, lack of precipitation, majority of evaporation deficit is considered inconvenient and there is a serious need for soil irrigation in the massive.

An amount of the rainfall strongly decreases from north to south at a distance of 150-200 km. A high temperature begins from May and continues to September. In this period an average temperature doesn't fall below + 16.4 ^{0}C for months. An annual quantity of the rainfall (moderate perennial) is 227 mm in the Absheron peninsula. In the south this indicator slightly reduces. The most part of the rain (approximately 60-70 %) falls in autumn and winter.

The high temperature and low rainfall in summer months in the Siyazan-Sumgayit massive, ncluding Boghaz plain caused formation of the semi-desert landscape. So, weak leaching on the upper part of the soil led to gathering of easily soluble salts, especially calcium carbonate ($CaCO_3$).

While the fluctuations in the level of the Caspian Sea have a negative impact on the transformation of coastal plain soils, they, conversely, have a moderating effect on the dry air masses originating from Central Asia. If the Caspian Sea did not exist in spatial terms, the study area would be considerably drier and more continental in nature.

One of the exodynamical processes which transform the soils in the research region is a wind. An average velocity of the wind in the zone is 6-7 m/sec. Sometimes a maximal velocity of the wind reaches 20-40 m/sec. An average yearly velocity is equal to 8.6-9.4 m/sec. on the shore zone. The north and south winds prevail on rhumb. These winds spread mineral particles and dust-sand grains around and seriously damage the soil cover, social and industrial infrastructure.

On the basis of the obtained climate data, the following conclusion can be reached: it is known from the last centenary temperature data of the meteorological stations which reflect the research region that the temperature rose 0.7-0,9 ^{0} C in the last century; it is known that an annual quantity of the rainfall reduced 30-40 mm according to the comparison of the data of 1933-1934, 1960s with modern data in Khachmaz, Shabran, Baku meteorological stations; the observation winds on rhumb dominate according to the number and velocity of observation. The south winds take the second place, the north- north-west winds take the third place. The north-north-west and north-west wind prevails in the winter and autumn seasons.

Under the third subheading of the second season an impact of the rivers of the north-east slope in the Great Caucasus on the environment and soil cover of the research zone was given. We can come to such a conclusion that the mineralization degree of the river waters rises from north to south, from west to east. The influences of the positive and negative directions of the large rivers on soil irrigation in the zone have been shown on the basis of the perennial researches.

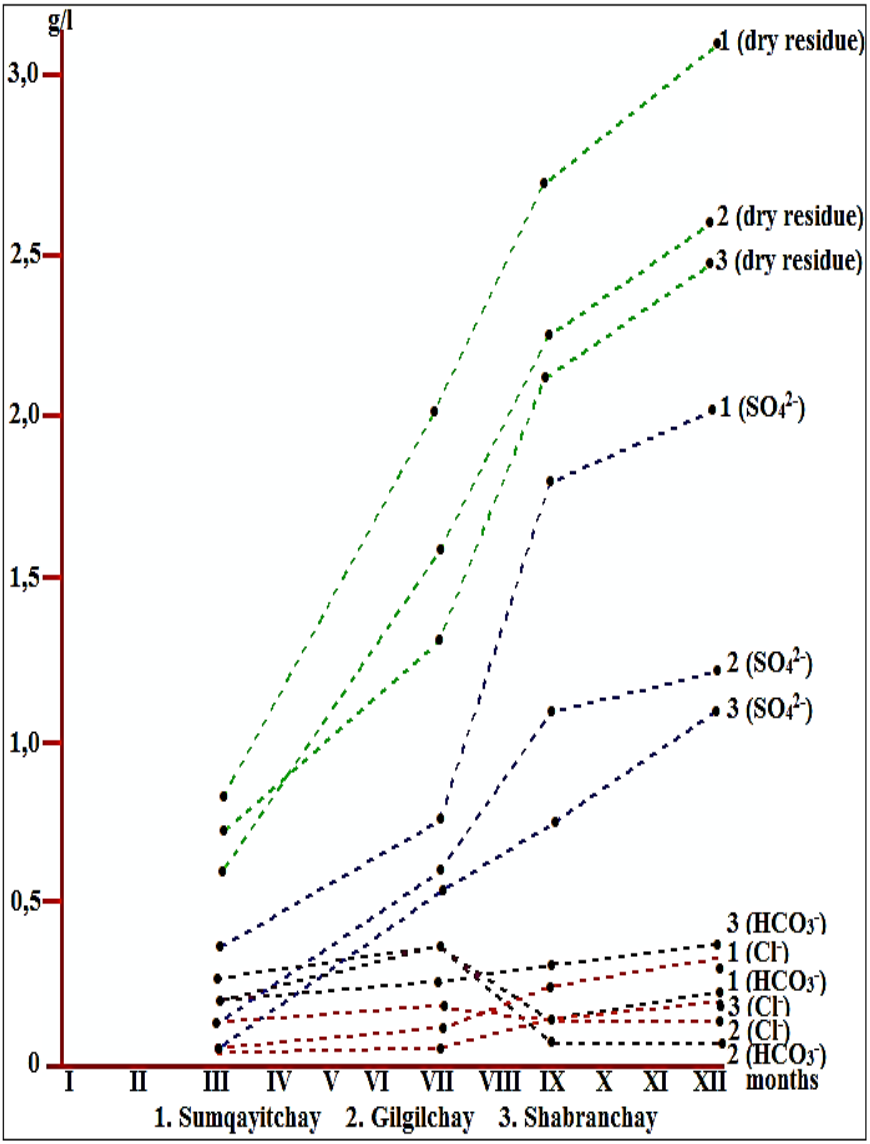
In this section the positive effects of the zone soils in the Takhtakorpu-Jeyranbatan and rebuilt Samur-Absheron canals have been noted.

One of the important approaches is a dynamical investigation of mineralization of the Davachi, Shabran, Giligil and Sumgayit rivers flowing from the research zone. The mineralization degree of the rivers within the study area increases from north to south. Mineralization also increases from west to east. The waters of the rivers mentioned belong to the carbonate class, and in the lower reaches of these rivers, the mineralization exceeds 1000 mg/L. Moving south, the rivers of the Siyazan-Sumgait massif belong to the sulfate class and are highly mineralized.

The rivers in the study area have a significant impact on the formation of the region's soil cover. Therefore, analyzing the chemical composition of these river waters is very important. Water samples were collected seasonally (in March, July, September and

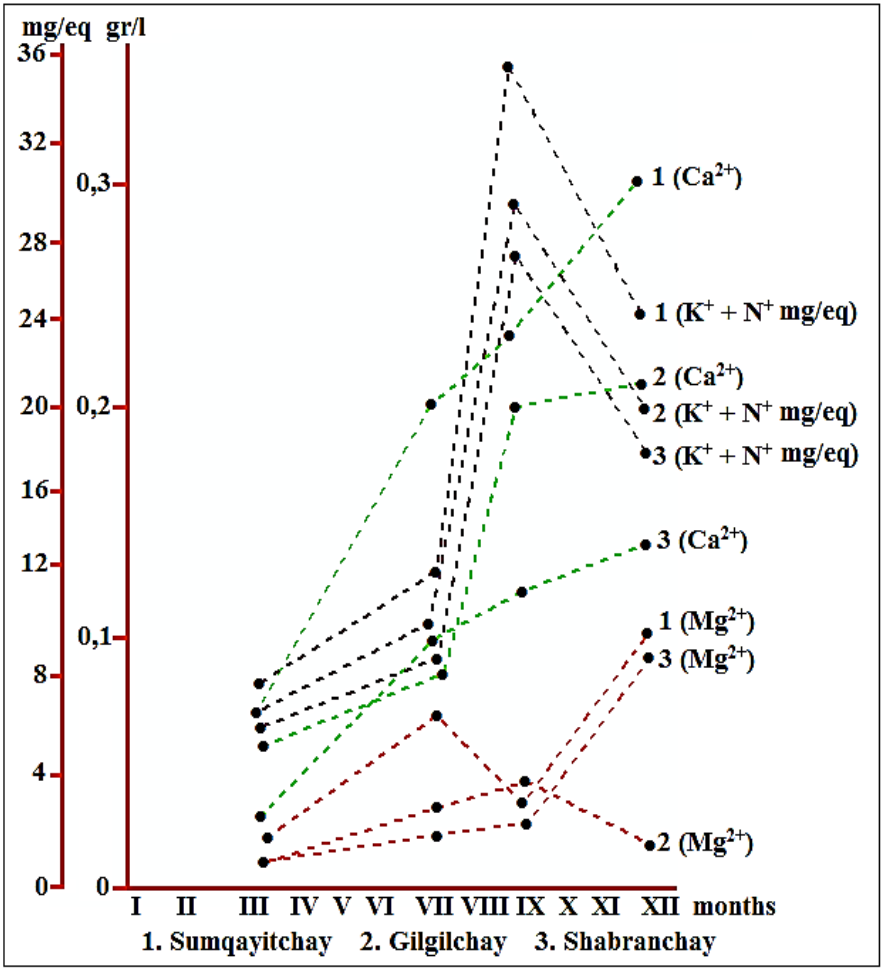
December) for analysis. The ion composition, including anions and cations, was determined in the collected samples.

It is seen from the analysis consequences that mostly mineralized river is Sumqayitchay among these rivers. This index is higher compared to other rivers of Azerbaijan (Graph 1, 2).



Source: *The graph was constructed by the claimant based on the analysis results of water samples taken from the rivers*

Graph 1. Chemical composition on river anions



Source: *The graph was constructed by the claimant based on the analysis results of water samples taken from the rivers*

Graph 2. Chemical composition of the rivers on cations

It is known from the conducted geo-botanical that a clear appearance of the plant-growing in the Caspian region due to frequent changes of the micro-meso relief in the area. Two semi-desert subtypes are separated by taking into account of geographical factors in the Siyazan – Sumqayit massive: the first, saline-solonchak semi-

desert, the second, perennial wormwood and ephemeras semi-deserts. Both subtypes are separately explained and it is shown on which soils the common plants are formed. Under the other subheadings the geo-botanical features of the natural pastures and pastures, including a modern state, internal differences, the anthropogenic effect degree have been evaluated. It was known from the research that poverty of phytocenoses depends on soil-climate condition.

It was clearly observed that the formation and grouping of plants in the area in an associative manner took place in the conditions of adaptive compatibility with the soil cover under the influence of numerous elements of the climate.

It should be noted that the anthropogenic loading of the XX century and continuing today has led to the expansion of the human's farming activity. As a result, the agro-phytocenological vegetation was formed in place of natural fodder areas. The other change is related to technogenic destruction. So, the swamping process happened around many different lakes and ponds and moisture-loving vegetation was formed in the nettogen zones.

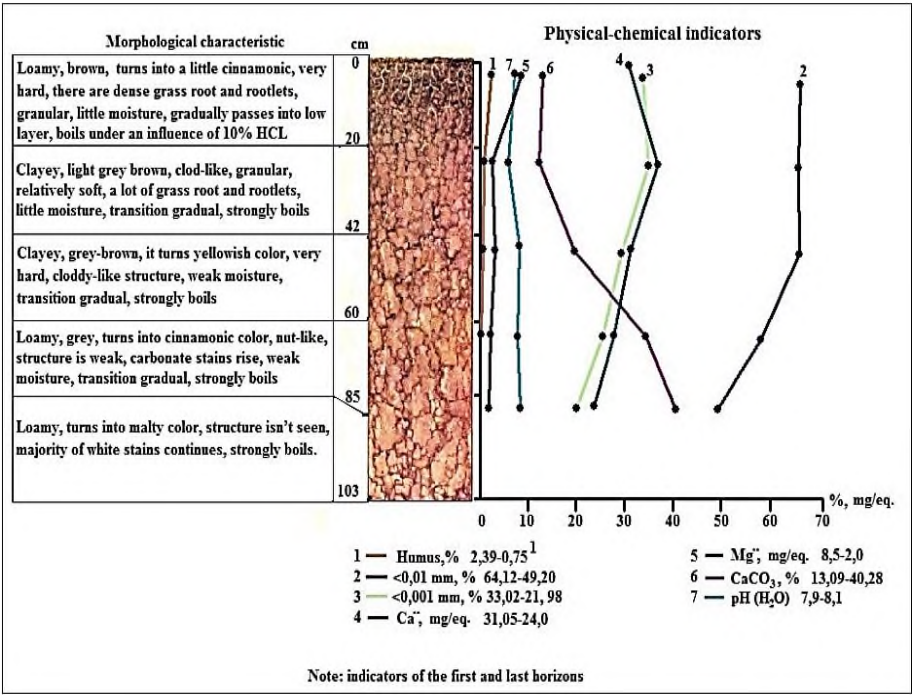
The fourth subhead of the second chapter was written on the basis of the results of fund, map materials, cosmic pictures, field expeditions and laboratorial analyses. Though the zone relief is simpler, covering a long distance from north to south, a mutual complex effect of the natural and anthropogenic factors caused formation of some soils from taxonomic point of view. The great and little taxonomic units of the grey-brown (chestnut), meadow-grey, grey, grey-cinnamonic, alluvial-meadow soils are characteristic for the zone.

One of the widespread soils in the research regions is a light grey-brown (chestnut) subtype of the grey-brown (chestnut) soil. Use of these soils under the grain and grape plant for a long time led to decrease of the nutrients. During the field research the results of the physico-chemical analysis of the character soil have been given on coordinates of N $41^0$06'65.5" , E $49^0$05'445".As it is seen that a quantity of physical clay is 60-65%, calcareous is 12.8-40.28%. The exchangeable bases are as the followings: $Ca^{++}>Mg^{++}>Na^{+}$. The absorption capacity in the rotten accumulative horizon of the soil

changes from 29.45 mg/eq to 33.52 mg/eq in 100g of absolute arid soil (Graph 3).

The salt quantity widely changes according to the results of the total water weight in these soils. An amount of dry residue is 0.430, the salt sum is 0.427 on the upper horizon of the soil, but these indicators decrease in the middle horizon. At last it rises again in the last "C" layer.

The meadow-grey soils environ the seaside regions of Shabran and Siyazan. The researches performed in these soils before us give a chance to monitor changes that have taken place over the past century.

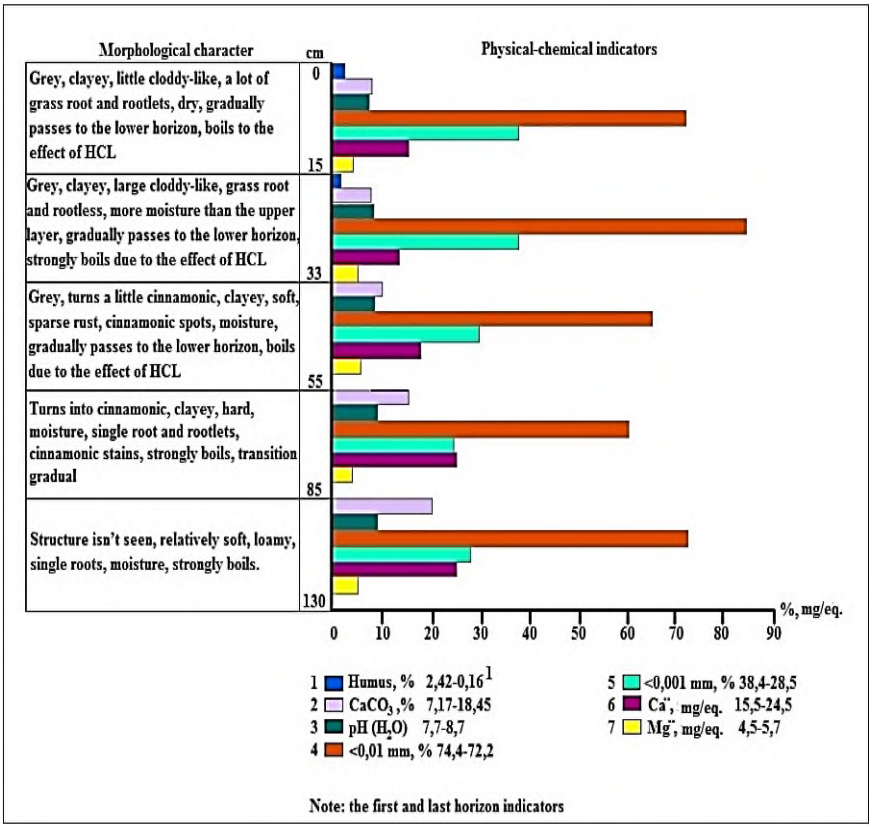


Graph 3. Physical-chemical indicator of light grey-brown (chestnut) soil

M.E Salayev shows a change of total humus averagely 2.0-3.5 % in these soils during his research. This index changes by 1.5-2.6 according to our research results. The graphic that reflects morphological and physical indicators of the section I applied in the

zone of the Gulami village has been given (Graph 4). Calcareous gets increased towards depth in these soils. An absorption capacity is 20.5-22.7 mg/eq in absolute dry soil of 100 g. Saturation with bases reaches 96-98 %.

[3]One of the main signs which the meadow-grey soils acquire under irrigation conditions is acceleration of solonetzicity and salinization process towards depth and sharp increase of the quantity of dry residue at a depth of 1 meter.



Graph 4. Morphological and physical-chemical indicators of the meadow-grey soils

[3] Salaev M.E. Soils of the zone of the Samur-Devechi canal named after Stalin / M.E.Salaev, -Baku, -1945, pp. 7-10

The grey, grey-cinnamonic soil types that reflects total natural regulation have been formed in addition to the formed meadow-boggy, alluvial meadow, takyr-like intrazonal soils in the research zone. It was possible to determine dynamics of the process, by comparing analytical consequences of our modern researches with the analysis results of other researches in the last 100 years. The progress of the process showers that a quantity of cations and anions was mostly observed on the maternal rock in the last 100 years, but these indicators occurred in the direction of decrease on the upper horizon.

"Anthropogenic factors of transformation, assessment and forecast of the current situation" is analyzed in the third chapter. Here, the field researches, fund and map materials, analysis of LANDSAT 8 satellite images, separate ecosystems farming areas, anthropogenic loading level of the zone were analyzed and evaluated on the basis of the statistic data.

Firstly, the soils have been subjected to transformation in the research zone and a modern state of transformed degree was evaluated taking into account many indicators and their norms. The transformation degree of the soil was: 0- untransformed (standard), 1- weakly transformed, 2 - average) transformed, 3 - severe, 4 - very severe.

The assessment is based on data of the field researches, results of the laboratorial analyses, processing of satellite images, many different thematic maps and large scaled tablets.

The social-economical indicators are also taken into account while evaluating the modern state. Both the population number and a degree of loading with the agricultural animals have been included in here. Much normative was taken according to the normative adopted by the FAO, YUNEP and YUNESKO programs of UN.

Dynamics of the perennial social-economical progress and changes happened during the field research have been determined while defining a transformation velocity.

The processes with the transformation type have been worked out on the different aspects. They are: Modern state (MS), transformation velocity (TV), transformation internal riskiness

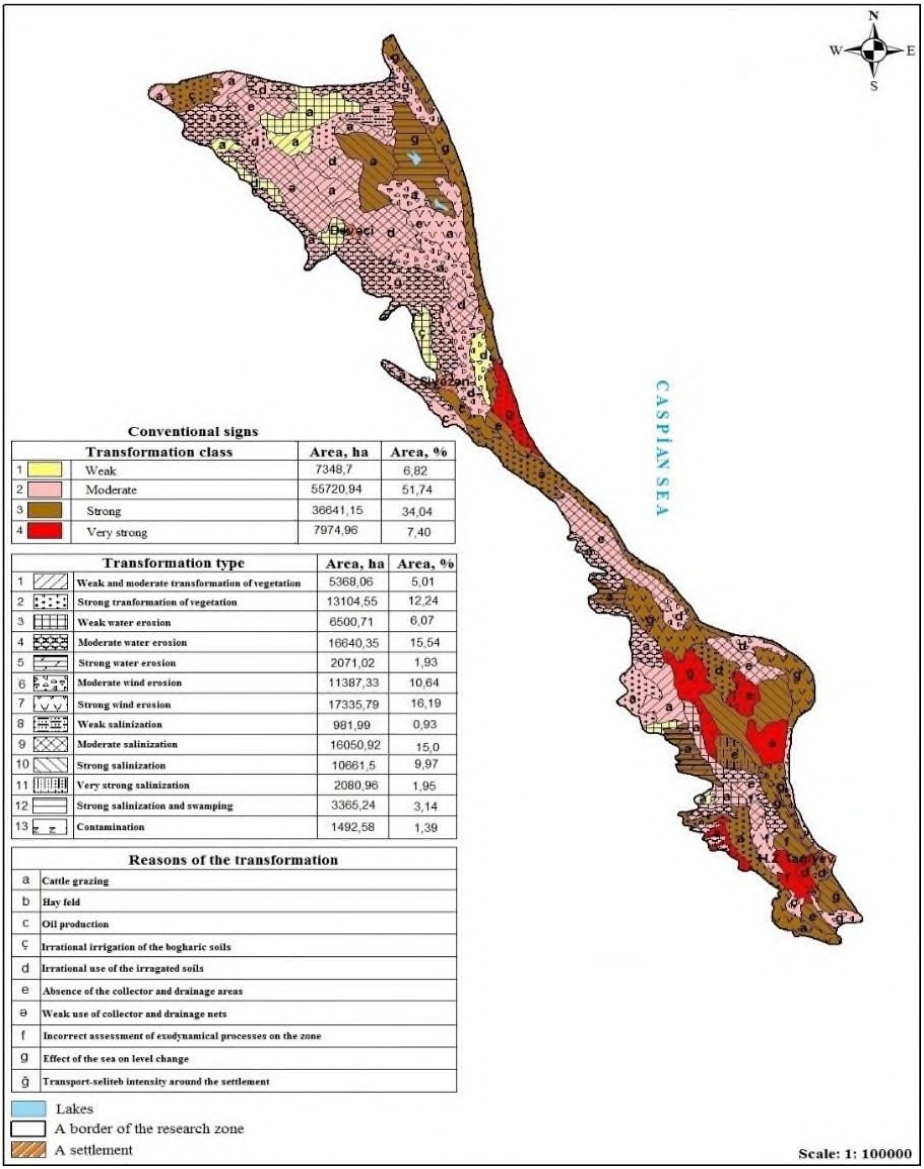
(TIR), effect of the domestic animals on the environment (EDE), anthropogenic effect degree (AED) and background level (BL).

The feed stocks, potential capacity, factual loading level of the pasture areas were defined on the research zone of the Khizi, Siyazan and Shabran districts. It is known from the results that the factual loading is minimum 0.5 times, maximum 3 times higher than the norm on separate farming areas. Increase of the anthropogenic loading in the zone caused formation of the desertification places and increase of impact of the exodynamical processes on soil cover.

The fodder resources deteriorate in the pastures year after year as a result of increase of the anthropogenic loading in the arid climatic conditions.

One of these is keeping the flock of sheep in the pastures for the whole time or not taking them out to the summer pastures. We can show the followings as a generalized final reason of the deterioration of the pastures in the zone: the number of livestock falling on a single area is several times higher than the norm; replacement of the pastures by the sowing areas; movement of the animals in the same way every day; cutting the forests and bushes for fuel and burning; little water of the water sources for animals' watering; unregulating of the cattle; burning of the plants in the summer.

Increase and density of the population in the research zone year after year was given on separate settlements. Perennial increase tendency of the population informs increase of the anthropogenic loading in this geographical zone year after year. A zone of the research region is under an influence of the great Baku-Sumgayit agglomeration. The flat, building, social and industrial infrastructure is quickly broadening from south to north. So, the zones of the administrative districts belonging to the Caspian coastal region increase at the expense of mountainous zones every day; as a result, the fertile soil areas decrease and the anthropogenic loading develops on positive dynamics. The transformation map of the plain soils on the Caspian shore was composed on a scale of 1:100000 (Picture 1).



Source: *Compiled by the claimant through the use of ArcGIS software*

Picture 1. Anthropogenic transformation map-scheme of Caspian coastal lowland soils (Shabrançay–Sumqayıtçay section)

Both intensity of transformation on classes and reasons of the transformation occurrence have been shown on the map. As it is seen from the map , Change of the bioclimate zone from north to south according to the circumstances in the research region accelerated natural exodynamical processes and negative effect of anthropopgenic process on soil cover. The soil transformation process in the research zone occurs in a negative direction, it passed to the stage and the desertification hearths are being observed in the Siyazan-Sumgait massive at present. Formation of the desertification hearths happened under the negative influence of different processes in nthe zone. For example, four characteristic processes rise as a result of the human' s incorrect farming activity in the Samur-Davachi, Siyazan-Sumgayit and Boghazplains. An effect of wind erosion and secondary salinization,solonetzification process strongly occurs. So, more than 17 % of the area has been transformed by vegetation, 23.5% of the water**,** 27 % by wind erosion , 28% by salinization, 1.4 by pollution.

The transformation level of soil cover in the separate municipial regions of the research zone was studied. It was known that the weak and mild transformation mostly surrounds Shabran region, Strong and very strong transformation is in the soil cover of Siyazan and Khizi.

The transformation of the vegetation was evaluated on the basis of separate transformation rates considering the background level in the zone. It was evaluated by considering the percentage rate of phytomass, project cover and ruderal plants.

The anthropogenic transformation of vegetation corresponds to the following serquence :the number of sheep per unit area is many times higher than the norm, replacement of pastures with sowing area as a result of the population increase; technogenic impact, unregulated grazing; irrigation of soils with mineralized waters; burning of plants. Development of water erosion in the zone related to the natural-geographical condition of the research region, including climate, vegetation, length, inclination and form of the slope . The weak, mild and severe classes of water erosion have

been determined according to the generalized results of the performed research.

The criterion for weak surface and linear erosion is defined by the presence of fewer than 5 gullies per kilometer. The number of dry, small, temporary watercourses is considered to be less than 10 per kilometer. Soils affected by weak water erosion have a high degree of vegetation cover. Rainfed agricultural lands occupy less than 10% of the total area. These areas, located on gently sloping north-facing hillsides of the study region, are characteristic of the dry steppes situated between forest and semi-desert zones in the Khizi, Shabran, and Siyazan districts.

The surface of soils subjected to moderate erosion transformation is covered with stones at a rate of 10–25%. The number of gullies ranges from 5 to 8 per square kilometer, while the number of dry, small, temporary watercourses varies between 10 and 20 per square kilometer. Under rainfed conditions, ploughed land accounts for 25% of the total surveyed area. The projected vegetation cover composed of herbaceous plants varies between 10% and 20%.

The number of the precipitations and grass-covered gorges is 7-10, a quantity of the small dry ditches and water flows is 20-25 at a distance of per kilometer. 50-60 % of the total zone was ploughed in the bogharic conditions. The vegetation has undergone transformation because the soils have been seriously transformed.

Wind erosion in the study area increases regularly from north to south and from west to east, in accordance with the region's natural and ecological conditions.

A negative effect of the deflation process was on grey, grey-cinnamonic and takyr-like soils. The wind erosion exposed to 10.6% of the territory to a moderate degree, and more than 16% to a severe degree of deflation. More windy days mostly accelerate this process while performing plowing operations during early spring. The mobile sand creates sand storm, 3-5 times a year the coastal zones and surrounding soil are covered with 2-3 cm thick sand.

The dust particles with the little fraction moving as a result of the deflation process were retained on the basis of the specially prepared method and a total water weight was analyzed. It was known that a quantity of Cl^- and SO^{2-}_4 anions is superior compared to other indicators. We can come to such a conclusion that the wind erosion plays an important role in salinity of soils.

The deflation process that has continued in the zone for a long time negatively affects soilforming process. Weak provision of soils with nutrient in the upper accumulative horizons and lower percentage of the silt fractions (<0.001mm) in mechanical composition are related to the impact of this process.

All the types of the saline transformation are found in grey, grey-cinnamonic, meadow-grey, grey-brown (chestnut) and takyr-like soils of the research zone.

Productivity of agricultural plants decreases as a result of occurrence of the soil transformation process in connection with the salinization and solonetzification of the arable soils (structure, deterioration of water-air regime, weakening of microbiological process, increase of concentration of soil solution , strongly deterioration of efficiency of the organic-mineral fertilizers.

The weak salinization transformation of the zone covers the regions with a height of 0-200 m. These soils are formed in the automorph conditions. Salinization to a mild degree happened in horizons of “B”,”C”.Mineralized groundwaters are located at a depth of 3-5 m.

The soils exposed to strong and the strongest saline transformation cover coastal plains of the Siyazan-Sumgayit massive. The depth of subsoil waters in these soils changes from 1.5 to 2.0-3.0. The groundwaters are mineralized at a high degree and heavy mechanical component. Degree of intrinsic hazard included in this class is rather great.

The changes which will be occured for the near future,in addition to evaluation of the available state in the research zone. The model experimental areas have been selected and a velocity and direction of the anthropogenic influence have been determined.

Acceleration of the transformation is observed on all types compared to the previous years.

An analysis of the statistical data of the last 15-20 years shows that the anthropogenic effect rises in the zone from year to year, and this informs about acceleration of the soil transformation in the future.

The IV capter is called "The complex fight and rational use measures against the soil transformation".

The scientific-theoretical issues in connection with the complex protection and restoration of the soils exposed to the beginning transformation and complex fight measures in this direction have been mentioned.

The soils are used in different directions of agriculture in the research zone and differently transformed under a mutual influence of the natural and anthropogenic factors. These are weakly, moderately, strongly and very strongly transformed as seen in the transformation map. Scientifically and practically weak and moderate transformed component can be quickly restored as a result of the complex fight measures. But severely and very severely transformed soil of the zone, restoration of the vegetation becomes difficult and requires a lot of resources.

A main direction of the fight measures in the research zone is secondary salinization of the rocks, soils; negative transformation of vegetation, water and wind erosion and technogen transformation.

Construction of forest stripes in a direction of improvement of the winter pastures under subheading of the complex fight measures against vegetation transformation and considering the local natural process have been shown. At the same time the trees and bushes which are used according to the separate soil-ecological condition have been indicated. It is more appropriate to plant forest strips every 100-150 m in the grey, grey-cinnamonic soils, if forest stripes are planted every 200-300 m in the grey-brown (chestnut) soils taking into account the change of the soil-climate condition, intensity of the deflation process. The tree and bush species should be selected according to the zone taking account the local condition

while planting the forest strips in the mobile and in semi-hardened sandy areas. The width of the forest strips is 15-30 m, the distance between the trees along the row length is 0.7-1.5 m, and the width distance is 3-5 m.

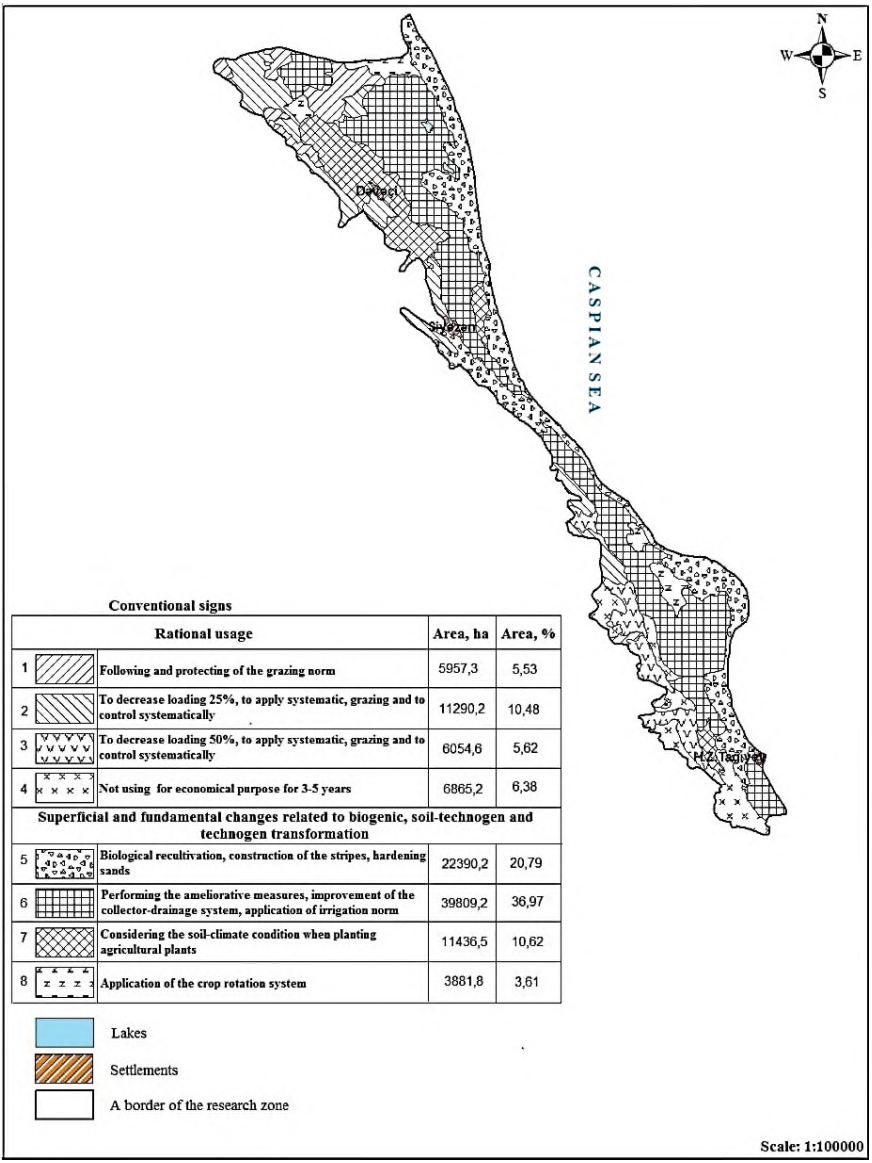
The implementation of measures such as cleaning from dashes, regulation of water regimes of the slopes, prevention of water erosion,planting of fodder grass and application of mineral fertilizers are indicated, taking into account the local conditions.

The fight measures were performed taking into consideration the local natural-ecological conditions besides benefiting from world experience in complex fight measures aganst wind erosion.

These measures include construction of forest stripes, in the degree of perennial grass cover, mulching of coastal sands, etc. First of all, the soil-ecological conditions of the area and the ways of using the farm of the zone in the complex fight against water erosion. The complex fight measures include farm-organizational, forest-meliorative, agrotechnical and hydromeliorative measures. The suggestions have been put forward , taking into account the inclination rate of the zone. So, preservation of the bush and slope plants, planting of the perennial grass in the soils with the inclination more than 5^0 is considered important. Considering the mechanical composition of soils in addition to the slope inclination and exposition is indicated during the complex fight measures. .

The complex ameliorative measures, including crop rotation system should be followed, planting of regionalized productive and durable varieties, agrotechnical measures should be in a high level in parallel with the introduction of the irrigation system in the meadow-grey, grey-cinnamonic, grey, takyr-like soilks formed in the semi-desert conditions should be fulfilled. At the same time application of the automatized irrigation system, prevention of irrigation erosion for protection of the accumulative horizon is indicated.

The rational map-scheme was compiled on a scale of 1:100 000 in the research zone taking into account the complex fight measures (Picture 2).



Source: *Compiled by the claimant through the use of ArcGIS software*

Picture 2. Schematic map of the efficient utilization of Caspian Coastal lowland soils (Shabrançay–Sumqayıtçay Section)

Conclusion

1. The negative transformation of the land cover in the research area has occurred against the background of the interaction of the following natural-geographical and anthropogenic factors: extreme climatic conditions consisting of high summer temperatures, high evaporation capacity, and frequent strong winds; fluctuations in the Caspian Sea level; highly mineralized groundwater; soil salinization and solonetz formation; overgrazing of pastures and meadows; a steadily increasing population dynamic; fires occurring in virgin and cultivated lands; secondary soil salinization; pollution by petroleum products; weak implementation of comprehensive measures to combat soil degradation; and increasing technogenic impact in the area[1;3;5;17].

2**.** A comparative analysis of large-scale soil studies conducted over the past century on the grey, grey-brown, and takyr-like soils of the research area shows that from the 1930s to the 1960s, the amount of toxic salts in these soils — including chloride and sulfate anions — exceeded acceptable levels by several times. However, as a result of subsequent ameliorative (reclamation) measures, these indicators decreased on average by 2.5 to 3 times. In contrast, in soils where no ameliorative measures were implemented, these values have increased [7;8;13].

3. Based on the level of mineralization, the rivers flowing through the research area are considered highly mineralized. As the ecological conditions change from north to south, the degree of river mineralization also varies. This dynamic also changes by month. For example, in the Sumgayitchay River, the dry residue ranges from 0.658 g/l (March) to 3.065 g/l (December); in the Gilgilchay River, from 0.502 g/l (March) to 2.175 g/l (December); and in the Shabranchay River, from 0.605 g/l (March) to 2.075 g/l (December). Among the anions and cations, the sulfate ion (SO_4^{2-}) is dominant. Overall, these indicators show that the amount of dissolved salts in the irrigation water exceeds the permissible limits for soil and vegetation, leading to the conclusion that these waters have contributed to the salinization of soils [3; 14].

4. A comparative analysis of long-term soil studies conducted in the area shows that the transformation of soils through salinization leads to the loss of valuable agronomic structure, deterioration of granulometric properties, increased alkalinity, accumulation of toxic salts along the soil profile, dehumification, and a decline in biological productivity [15;16;18].

5. An analysis of long-term socio-economic statistical data shows that, as a result of increasing anthropogenic pressure in various settlements of the Caspian coastal plain, the grazing load on pasture and rangeland areas has, over the past 25–30 years, exceeded the recommended norms by an average of 0.5 to 3.4 times. It has been proven that anthropogenic impact has been increasing year by year across all directions in the area.

6. For the first time, an anthropogenic transformation map at a scale of 1:100,000 was developed, taking into account the natural factors that accelerate the desertification process in the area. According to the results, 6.82% of the total area is subject to low, 51.74% to moderate, 34.0% to severe, and 7.44% to very severe levels of transformation. Among the types of transformation, 17.34% is attributed to vegetation degradation, 23.54% to water erosion, 26.83% to wind erosion, 30.14% to salinization, and 1.3% to technogenic pollution.

7. The degree of anthropogenic transformation of the land fund in the administrative districts of Shabran, Siyazan, and Khizi, as well as the city of Sumgayit, which are part of the research area, varies depending on their geographical location. Specifically, while the soils in the Shabran – Siyazan – Khizi – Sumgayit direction are subject to slight and moderate transformation in the northern parts, the degree of transformation gradually shifts to severe and very severe toward the south.

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