

REPUBLIC OF AZERBAIJAN

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SYNOPSIS OF THE THESIS

submitted for obtaining the degree of Doctor of Philosophy

**ECOLOGICAL-GEOGRAPHICAL PROBLEMS CAUSED BY
THE USE OF NATURE IN LANKARAN PHYSICAL-
GEOGRAPHICAL PROVINCE AND THEIR SOLUTIONS**

Profession: 2508.01 – Geoecology

Science: Geography

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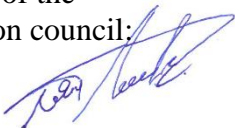
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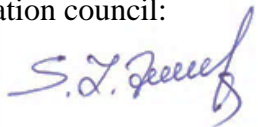
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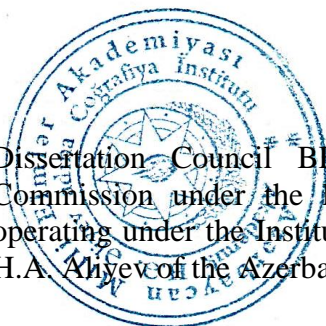
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GENERAL CHARACTERISTICS OF THE WORK

Actuality and level of research on the topic. One of humanity's most important problems in our modern era is the correct and efficient use of nature. The rapid growth of the population on earth has led to the intensification of the use of natural resources. Although scientific and technical progress reduces people's dependence on nature, the ecogeographical problems caused by the use of nature have become complex and dangerous. All this has connected the efficient use of natural resources and the organization of nature protection work with sustainable socio-economic and ecological development. From this point of view, the ecogeographic evaluation of the air, soil, water, as well as the natural conditions of the flora and fauna during the settlement of the population, the activities of the farms, the problems caused by the use of nature and the research of their solutions attract attention with their relevance.

Studying nature allows people to improve their way of life, correctly analyze their position in nature, and discover ways to make its activity more efficient. However, the interaction between man and nature, that is, man's use of nature, the expansion of his settlement areas, the intensification of economic activity, etc., harms nature. As a result, the air is polluted, soils are degraded, water resources become unusable, and the area of greenery decreases. These events lead to the creation of ecogeographical problems and the observation of conflicts in certain areas and have a negative impact on nature.

After gaining independence, the Republic of Azerbaijan entered new economic relations. These relations aim to improve people's living conditions, establish production relations, and lay internationally important transport lines, as a result of which a number of new problems of nature use have appeared. The conflicting character of the problems occurred in the conditions of differentiation of socio-economic systems, and was related to the population settlement and the rapid development of the use of nature as means of production. Thus, the production relations in our country, characterized by a market economy and based on the

efficient use of nature, have negatively impacted the surrounding areas' ecogeographical situation. In the regions of our republic, this factor has shown itself more prominently. One of such regions is Lankaran physical-geographic region.

In recent years, several eco-geographical problems have arisen in Lankaran physical-geographical region related to people's life and economic activity. Thus, natural ecosystems have been seriously damaged, including atmospheric air, soil and vegetation, and surface and underground water resources. All this, in turn, had a negative impact on people's health and their work activities. In this regard, the use of nature should be studied together with the development laws of life.

Some scientists and specialists have studied the scientific basis of ecological-geographical problems caused by the use of nature in our republic. However, the research works conducted in this direction were mainly dedicated to separate areas of the ecosystem, and complex researches were hardly carried out. Therefore, we believe that the scientific importance of using nature should be studied with the approach of understanding natural phenomena, ways of making people's life and economic activities more efficient should be discovered, and special attention should be paid to environmental protection.

The geological-geomorphological structure, landscape features, climatic conditions, soil-vegetation cover, hydrological resources and tourism-recreation resources of Lankaran physical-geographic region have been investigated by various researchers in the ecogeographical direction. Physical-geographical zoning of the province, orography, landscape zones, harmful substances released into the atmosphere, types of soil-vegetation cover, nutrition of plants with mineral elements, ecological assessment of soils, forest ecosystem, water resources of rivers, their biogenic elements and multi-year changes in the flow of organic matter, river the average annual mineralization and chemical composition of its waters, the ecological condition of the population's settlement areas, the sources of pollution of the city atmosphere, the ecogeographical situation caused by the socio-

economic problems of the region and other issues have been conducted. However, since these cases are small, there is a need to conduct complex studies. In the dissertation, we tried to comprehensively study the ecogeographical problems caused by the use of nature in the Lankaran physical-geographical region. At the same time, nature-society relations, anthropogenic effects on the environment, ecological stress zones caused by production areas, damage to soil and water resources, atmospheric air pollution along road transport routes and other-oriented ecogeographic studies were conducted.

Research goals and objectives. The main goal is to study the current ecogeographical conditions of the Lankaran physical-geographical region and to discover and solve the existing problems on a scientific-practical basis. In order to achieve this goal, the solution to the following tasks is planned:

- to assess the natural-geographical conditions and analyze them in the GIS environment to determine the degree of appropriation of the territory;

- to study the settlement of the population and the territorial organization of economic areas from a historical-geographic point of view and to determine the ecogeographical problems caused by them;

- to study the number of harmful substances released into the atmosphere from industrial enterprises and motor vehicles and noise pollution;

- to determine the degree of appropriation of water, soil and plant resources during the use of nature and to group ecologically tense zones, to determine areas of pollution;

- to make proposals on ways to improve the ecological situation of the province.

Research methods. Historical-geographical approach, mathematical-statistical, comparison, systematic analysis, field observations, etc. methods were used as well as physical, chemical and biological monitoring were carried out.

The main provisions of the defense:

1. To analyze the degree of population settlement and the territorial organization of farm areas in Lankaran physical-geographical region in the GIS environment.

2. Ecogeographically assess the components of natural conditions in the Lankaran physical-geographic region.

3. To study the ecogeographical problems arising during the use of nature in the Lankaran physical-geographical region, to group the ecological stress zones of the area and determine the areas of pollution.

The scientific novelty of the study:

- ecogeographical problems have been identified, which are caused by population settlement areas and density indicators, as well as the territorial organization of farm areas;

- the amount of polluting substances released into the atmosphere and the areas creating the noise effect were studied, and their norms were theoretically and practically analyzed;

- land resources and ecogeographical problems arising during land use were investigated, and ways of their improvement were indicated;

- researches were conducted on water resources, water use, polluting water sources and their protection, and water quality indicators were given;

- damage to the environment during the use of nature was studied, ecological stress zones were grouped, and pollution areas were determined.

Theoretical and practical significance of research. The theoretical bases of the research are the scientific works of scientists who have conducted research in this field, methodical instructions, and the author's scientific-research works.

The obtained scientific results can solve the studied area's ecogeographical problems, optimise people's life and economic activities, efficiently use water and land resources, ensure sustainable socio-economic development, and prepare state programs.

Approval and application. Republican scientific-practical conference on "Global economic conditions and the economic-geographical position of Azerbaijan" (Baku, 2017); Republican scientific conference on "Problems of the development of natural and humanitarian sciences" (Lankaran, 2017); I International scientific conference of young researchers, (Baku, 2017); "Modernizing Azerbaijan: A new stage of progress" Republican scientific conference of young researchers, (Baku, 2017); III International Scientific Conference on "Ecology: Nature and Society Problems", (Baku, 2017); Republican scientific-practical conference on "The unity of science, education and production at the stage of modern development" (Lankaran, 2018); Republican scientific-practical conference on "Ways of applying scientific innovations in the educational process" (Lankaran, 2019); Scientific-practical conference "The role of tourism in ensuring sustainable development", (Baku, 2019); II International scientific-practical conference "Influence of climatic changes on spatial development of Earth's territories: consequences and solutions" (Kherson, 2019); XXIII Republican scientific conference of doctoral students and young researchers (Baku, 2019); Republican scientific-practical conference of young researchers on "Impact of the application of modern training technologies on the quality of education" (Lankaran, 2019); Republican scientific conference of doctoral students and young researchers on "Information, science, technology and University perspectives" (Lankaran, 2020).

14 scientific articles and 7 theses were published on the topic of the dissertation work.

The recommendations, suggestions and maps made in the thesis work can be used to improve the ecological situation of the province, protect the environment and forest ecosystem, territorial organization of farms, sustainable socio-economic development of the region, Ministry of Transport, Communications and High Technologies, Ministry of Labor and Population In the Ministry of Social Protection, Ministry of Youth and Sports, Tourism Agency, as well as scientific research institutions.

The name of the organization where the dissertation was carried out. Dissertation work was carried out at Lankaran State University "Biology and Ecology" department.

The volume, structure and main content of the dissertation. The dissertation consists of an introduction, 3 chapters, a conclusion and a list of references. The volume of the work is 161 pages. The work consists of 2 pictures, 7 maps, 19 tables, 20 graphs, a bibliography with 153 titles. Introduction - 6 pages, Chapter I - 48 pages, Chapter II - 45 pages, Chapter III - 44 pages, conclusion - 2 pages, bibliography - 14 pages. It consists of 258096 characters without tables, graphs, pictures and bibliography.

THE MAIN CONTENT OF THE RESEARCH

The relevance and degree of development of the topic, goals and tasks, methods, main propositions defended, scientific innovations, theoretical and practical significance, approval and application of the research are given in the introduction.

The first chapter of the dissertation work is dedicated to the **"Scientific-methodological basis of the study of the eco-geographical situation of Lankaran physical-geographical region"**. In this chapter, the relationship to ecogeographical researches is first reported, and the scientific-methodical bases of these researches are explained because the intensive use of natural resources in modern times has caused several eco-geographical problems.

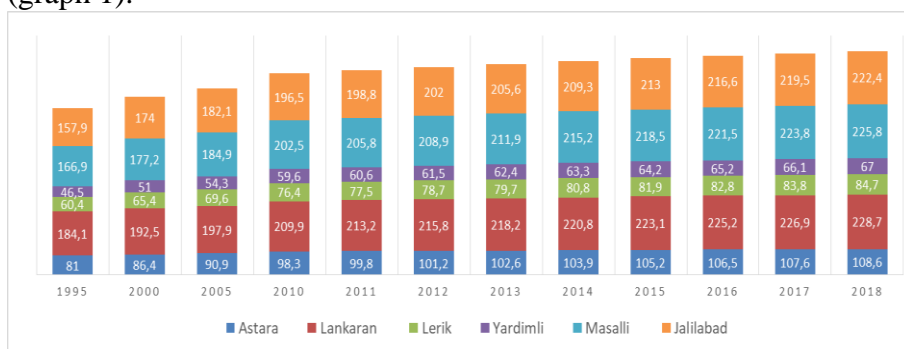
Ecogeographic studies are mainly focused on the study of nature-society relations, the study of anthropogenic effects on the environment, the characteristics of the creation of territorial-production complexes, the optimization of ways of practical use and protection of mineral resources, the study of the physical and chemical properties of soils, the organization of land cadastral work, the determination of ecogeographical problems making, conducting ecogeographic assessment and so on.

H.A.Aliyev, who led the first work in the field of environmental protection and ecogeographic research in Azerbaijan, stated the advantages of using a scientifically based planning method depending on the ecological conditions of each region. Sh.Y. Goychayl, who studied the multi-faceted relationship and mutual effects between nature-population-production processes, explained the essence and advantages of geographic ecology, considering the integration of nature-society relations and classifying them the assessment of natural conditions and natural resources, assessed their ecological efficiency and stability calculated the rates. G.Sh.Mammadov and M.Y.Khalilov gave extensive information about ecological balance, characterization of ecological factors, classification of natural ecosystems, protected areas, socio-ecological problems and so on. T.B.Huseynov and V.Z.Mehdiyeva studied ecological regionalization from the point of view of socio-economic aspects. They studied the geological structure of the area, physical-geographical features and economic activities of people using different approaches, and they stated that the causes of the occurrence of ecogeographical problems are formed under the influence of endogenous and exogenous processes. A.A.Gurbanzade justified the evolution of the geographical-ecological space and forms of sustainable resource environment. S.Z.Mammadova worked out a new ecological evaluation of soils in the Lankaran physical-geographical region based on a new approach to evaluating soils on an agroecological basis and developed an agroecological model of soils used under crops. Sh.I.Mammadova studied the economy of large and medium-sized cities of Azerbaijan and determined the amount and composition of pollutants released into the atmosphere and water bodies by industrial enterprises, vehicles, household services, etc.

In addition to ecogeographical studies, this chapter also deals with issues of population settlement, growth dynamics, and territorial organization of farms.

Suppose we conduct a statistical analysis of the years 1995-2018. In that case, we will see that an annual growth trend has been

recorded in the population dynamics in Lankaran physical-geographical region. This growth trend was also observed in cities and regions. During the last 2010-2018 years, the population growth in the province was 111.2%, which is higher than the average national indicator (109.6%). Even though the main part of the population, i.e. 72.2%, is concentrated in Lankaran, Jalilabad and Masalli districts, there are differences in the dynamics of population growth by city and district. Thus, the highest dynamics of population growth was recorded in Jalilabad (113.2%) and Yardimli (112.4%), and the lowest growth was recorded in Lankaran region with 108.9% (graph 1).



Source: Demographic indicators of Azerbaijan. - Baku, 2019. p. 80

Graph 1. Number dynamics of the population in Lankaran physical-geographic region, thousand people

Due to the influence of natural and socio-economic factors, there are serious differences in the settlement of plains and mountainous areas. The settlement system formed as a result of the factors that create these differences, in turn, affects the development of the region. The main part of the population in the province is settled in plain areas.

Territorial organization of the farm requires the establishment of a close connection between the fields. In the Lankaran physical-geographic region, a number of fields of agriculture were developed even in the former Soviet era. However, the collapse of the Soviet

power disrupted economic relations in the Lankaran province as well as in the entire republic, inter-sectoral economic relations declined, and the economic development indicators of the region decreased. Nevertheless, in the last 20 years, certain progress has been achieved with the establishment of economic relations. New industrial areas were created, agriculture was developed, modern and world-standard transport roads were built.

In terms of industry, Lankaran physical-geographic region is distinguished mainly by the development of agro-industrial complexes. The development of industry here is based on the production of local agricultural products. These include enterprises that produce tea, canning, milk and dairy products. However, the province produces only 0.3% of the total industrial product produced in the republic¹.

As we know, most of the waste that pollutes the atmosphere from stationary sources is the waste of industrial enterprises. The largest amount of these emissions is accounted for by the fuel and electricity industry. Considering the small number of industrial enterprises (96 enterprises) and the fact that they are equipped with modern equipment in the Lankaran physical-geographical region, we can see that they do not contribute much to atmospheric pollution. In 2018, the amount of pollutants released into the atmosphere from industrial enterprises was 1.45 thousand tons. In 2005, this indicator was lower and 0.5 thousand tons of pollutants were released into the atmosphere². This indicator is quite low compared to other regions of the republic.

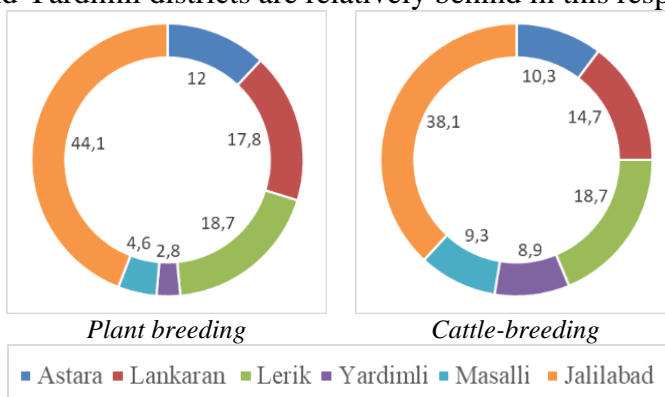
Lankaran physical-geographic region has favorable natural conditions and economic potential to develop agriculture at a higher level. Agriculture in the area is mainly developed more intensively in the foothills and the coastal zone of the Caspian Sea. Here,

¹ Regions of Azerbaijan: (statistical collection) / compiled by T.Budagov - Baku: SSCRA (State Statistical Committee of the Republic of Azerbaijan), - 2019. - 788 p.

² Environment in Azerbaijan: (statistical collection) / compiled by T.Budagov - Baku: SSCRA, - 2019. - 140 p.

subtropical fruit growing, tea growing, vegetable growing, grain growing and meat and dairy farming are considered the leading areas of agriculture. Currently, 9.3% of the agricultural products produced in the republic fall on the share of our research region, of which 46.4% is crop production and 53.6% is the share of animal husbandry products³.

Jalilabad region takes the main place in the production of agricultural products in Lankaran physical-geographical region. Jalilabad provides 44.1% of the total crop products produced in the province, and 38.1% of livestock products (graph 2). In addition to Jalilabad, Lankaran, Astara and Masalli are considered to be moderately supplied regions with both plant and livestock products. Lerik and Yardimli districts are relatively behind in this respect.



Source: Regions of Azerbaijan. - Baku, 2019.

Graph. 2. Volume of agricultural products produced by regions of Lankaran physical-geographic province, in %

In Lankaran physico-geographical region, severe erosion of the soil surface is observed in the upper highlands, moderate erosion in the foothills and middle highlands, weak erosion and irrigation

³ Agriculture of Azerbaijan: (statistical collection) / compiled by T.Budagov - Baku: SSCRA, - 2018. - 612 p.

*erosion in Lankaran lowland areas with low surface inclination*⁴. In addition, in order to obtain a high crop yield in the province, excessive and dangerous chemical substances are applied to the soil. As a result, the area of lands suitable for agriculture is decreasing, and the process of their degradation is taking place.

Experience proves that one of the main sources of atmospheric air pollution is motor vehicles. The amount of toxic waste from combustion engines of cars is 0.5-10% carbon oxide, 0.8-25% nitrogen oxides, 3% carbohydrates, 0.2% aldehydes, which has a dangerous effect on the human body and has high toxic properties. The location of the Lankaran physical-geographic region on the North-South transport corridor, the increase in the number of cars in the region and their intensive use have caused ecogeographical problems in the region: air and soil pollution, noise.

As a result of our research and statistical analysis, it was determined that the amount of pollutants released into the atmosphere from road transport in the Republic of Azerbaijan increased to 950.2 thousand tons in 2018 compared to 2005. Although this indicator has increased over the years, a partial decrease has been observed in the last two years. Carbon oxides are the main part of air pollutants. Carbon oxides make up 72.3% of total waste. Hydrocarbons are 16.5%, nitrogen oxides are 9.2%, and other gases are 2.1%. In the Lankaran physical-geographic region, the amount of waste has increased over the years due to the increase in the number of cars, and currently in 2018, 2.9% (28.0 thousand tons) of the pollutants released into the atmosphere from motor vehicles throughout the republic belong to this region. Carbon oxides account for 22.2% of pollutants, hydrocarbons for 3.8%, nitrogen oxides for 1.8%, and other gases for 0.2%. If we look at the amount of polluting substances released into the atmosphere from motor vehicles in the regions included in the province, we will see that Lankaran (8.0

⁴ Бабаева, U.A. Efficient use of soils in the Lankaran-Astara economic-geographical region // The impact of climate change on spatial development of Earth's territories: implications and solutions. - Kherson: DVNZ KhDAU, - 13-14 June, - 2019. - p. 95

thousand tons), Masalli (7.7 thousand tons) and Jalilabad (6.6 thousand tons) exceed the other three regions. The reason for this is that all three districts are located on the highway. Heavy tonnage trucks passing through the area pollute the air more. Astara region takes the next place with 2.9%. 1.7 thousand tons of harmful gases were released into the atmosphere in Lerik, which are mountainous regions, and 1.1 thousand tons in Yardimli⁵.

In recent years, the tourism industry in the Republic of Azerbaijan has attracted more attention with its development dynamics. Lankaran physical-geographic region has its own exotic landscape and natural monuments. Hirkan and Kyzylagac national parks, Zuvand and Rvarud reserves, Khanbulanachay and Lovani reservoirs, sandy beaches of the Caspian coast, balneological healing thermal and mineral springs, Gyzyurdu cave, Babek tower, etc. are located in the area. It is considered one of the objects that attract the attention of tourists more. However, a number of ecogeographical problems related to the development of the tourism economy are observed in the province, which leads to the pollution of running water, the creation of garbage dumps in the surrounding areas, and the land becoming unusable. For example, the treatment and recreation centers established on the banks of Vilashchay also play a big role in the pollution of the river. One of such centers is "Fatimeyi-Zahra" Healing Sanatorium located on the right bank of the river. Sewage generated in the sanatorium is discharged directly to Vilashcha without treatment. As a result, Vilashchay, polluted with sewage and solid domestic waste, enters the reservoir of the same name, straining its ecogeographical situation. In addition to the Vilashchay, various wastes (food scraps, plastic water containers, etc.) formed in the "Absheron" Family Recreation Center and the Siyaku Recreation Center organized on the banks of the Tangaruchay are also thrown on the banks of the river and pollute the surrounding areas.

⁵ Regions of Azerbaijan, statistical collection / compiled by T. Budagov - Baku: SSCRA, - 2019. - 788 p.

The second chapter of the dissertation work is dedicated to **"Natural conditions of Lankaran physical-geographic region and ecogeographical problems caused by the use of nature"**. The geological-geomorphological features and landscapes of the province, climatic resources, soil-vegetation cover and hydrological resources were analyzed in the chapter.

Lankaran physical-geographic region is divided into two physical-geographical regions: Talysh mountain and Lankaran lowland due to its natural conditions.

Relief plays a key role in the formation of ecogeomorphological conditions in the Talysh mountainous physical-geographical region in the complex of natural and anthropogenic factors. The relief is distinguished by the influence of static and dynamic factors, as well as morphostructure and morphosculptures on environmental conditions. According to geomorphological zoning, Talish geomorphological region includes Buravar, Yardimli, Peshtasar, Zuvand and Talish geomorphological regions. According to the tectonic zoning scheme of the area, the Talish tectonic megazone is located in the Astara, Burovar uplift and Lerik-Yardimli, Jalilabad flexural tectonic zones⁶.

The absence of a high mountain belt in the territory of Talysh mountainous physical-geographical region, lack of observation of glacial relief, the intensity of volcanism and the widespread distribution of its products, the relatively young history of the geological development of the area, and other factors are manifested. In this regard, the geological-geomorphological characteristics of the area played an important role in the formation of its ecogeographical conditions. Because endogenous and exogenous factors have a sufficient influence on the ecogeographical situation of the area and cause ecogeomorphological diversity. For example, the violation of zonal regularities in the high parts of Talysh and Peshtasar ranges and in the inner mountain depressions of Yardimli, Diman, Lerik, as

⁶ Geology of Azerbaijan / pod ed. A. Alizadeh. – 4 volumes, Tectonics. - Baku: Nafta-Press, - 2005. - p. 41

a result of which the occurrence of drought (intrazonality) leads to relatively tense ecogeomorphological conditions.

The Lankaran lowland physical-geographical region is located between the coast of the Caspian Sea and the foothills of Talysh mountains, it stretches up to 100 km from Bolgarchay in the north to Astaracha in the south, and covers altitudes of -27-200 m⁷.

Lankaran lowland physical-geographical region is distinguished by favorable economic-geographical position and natural conditions. Although the lowland is poorly provided with natural resources, as agriculture is developed here at a high pace, land appropriation and population settlement have become more intensive compared to other regions. The concentration of most of the population living in the region in the Lankaran plain, the high natural growth of the population, good supply of labor resources, etc., had a positive effect on its socio-economic situation. Since agriculture plays an important role in the employment structure of the population, most of the population is settled in the villages. The growth rate of the rural population has the highest indicators in the republic. However, as a result of the development of agriculture, plain forests have been destroyed, cultivated areas have been exposed to chemical pollution, the soil layer has been eroded, and frequent natural disasters have caused serious ecogeographical problems in the area.

The climate of the province is characterized by dry and mild-humid summers, very mild and mild winters. Above 2,000 m above sea level, the semi-desert and dry desert climate prevails, with slightly mild winters and dry-hot summers, which is the result of the unique distribution characteristics of temperature and precipitation observed in the area. In this chapter, we used meteorological observations to estimate climate parameters. The number of sunshine hours, solar radiation, effective radiation, possible evaporation, average daily, monthly and annual temperature, effective and active temperature, amount of precipitation, humidity conditions, wind

⁷ Constructive geography of the Republic of Azerbaijan / Chairman of the editorial board B.A. Budagov. - Baku: Science, - v. 1: - 1996. - p. 9

speed and direction were studied from an ecogeographic point of view.

Lankaran physical-geographic region is considered one of the rare areas of Europe. These areas are very rich in relict plants of the Tertiary period and periods close to us. These relict plants are well preserved in their habitats and have survived to our modern times. This region is rich in unique endemic plant areas that are not found in the Caucasus, as well as in other flora regions of the world. Both paleoendemism and neoendemism are found in the area.

It is clear from the historical data that the forest landscape of the Talysh Mountains had a larger area in the recent past, but in a short period of time this area has shrunk further due to anthropogenic influence. According to N.G. Akhundov, in 1897 the total area of forests in Lankaran district was 207 thousand desyatins (225.6 thousand ha)⁸. I.S. Safarov notes that in 1914 this indicator decreased to 167.7 thousand ha⁹. Therefore, during 75 years (1897-1972), the forest area decreased by 59.9 thousand ha.

The area where the soil-vegetation cover of Lankaran physical-geographical region is subjected to the most anthropogenic transformation is the Lankaran lowland and the coastal areas of the Caspian Sea. Construction of settlements, economic activity of people, expansion of road and transport infrastructure, etc. in these areas. has increased the degree of environmental tension of the area. The reduction of forest areas and their use for agricultural purposes have generally had a negative impact on the ecogeographical conditions of the area.

In Lankaran physical-geographic region, as in the whole republic, the main water sources are rivers, and the secondary water sources are underground waters, lakes and marshes. The region is

⁸ Akhundov, N.G. The state of the disordered forests of Talysh and the ways of their restoration // "Mountain forest lands and protection of forests" Proceedings of the Institute of Geography, XIX volume. - Baku: Science, - 1979. - 168 p.

⁹Safarov, I.S. Subtropical forests of Talysh / I.S.Safarov. - Baku: Science, - 1979. - 146 p.

distinguished by the spread of yellow soils, humid subtropical climate, presence of azonality and dense hydrographic network.

Water resources of Lankaran physical-geographic region have been evaluated by a number of researchers. Thus, according to S.H. Rustamov and R.M. Gashgai (1978), the water reserves of the region are 1,229 km³, according to H.Y. Fatullayev (2002), 1.0 km³, according to F.A. Imanov (2012), 1.42 km³. According to the research conducted in recent years, due to anthropogenic activity and climate changes, the water resources of the province have decreased by 19.3% (0.237 km³) and are currently 0.992 km³ ¹⁰. On average, 97.6 million m³ of water is taken from natural sources in the province during the year, but 100.45 million m³ of water was used. This has increased due to the water supplied by the irrigation system. The development of the irrigation system has given impetus to the development of the agricultural industry in the area. In 2018, the amount of water taken from natural sources varies between 0.2-51.5 million m³ on average. The least amount of water is Yardimli (0.2 million m³, 0.2%) and Jalilabad (0.2 million m³, 0.2%), and the most is Lankaran (51.5 million m³, 46.8%) and Masalli (43.9 million m³, 39.9%) is taken from the natural sources of the regions. The taken water reserve is used for various purposes. There is inconsistency in the indicators for the regions where water use is also mentioned. Thus, although the total indicator of water resources taken from natural sources in Jalilabad region is 0.2%, the use of water is 24.9%. Lankaran (30.9%) and Masalli (30.3%) districts use the most water. During the irrigation system and the transportation of water taken from natural sources, water loss is allowed, and this indicator varies from 10.0 million m³ (year 2000) to 39.1 million m³ (year 2018). The increase in water loss over the years causes a number of environmental problems in the area¹¹.

¹⁰ Imanov, F.A. Water resources and their use in the transboundary basin of the river. Chickens / F.A. Imanov. - St. Petersburg: Own publishing house, - 2016. - 163 p.

¹¹ Environment in Azerbaijan: (statistical collection) / compiled by T. Budagov - Baku: SSCRA, - 2019. - 140 p.

As a result of man-made activities in Lankaran physical-geographic region, the most ecogeographical problems are observed in Vilashchay, Lankaranchay and Tangeruchay, whose deposits are exploited as clay and sand quarries. The Vilashchay basin, which is exploited as a sand-gravel quarry, has been more exposed to human economic activity than other river basins. As a result of excessive digging of the river bed, the water level in the backyard wells of the coastal villages drops sharply, and drinking water problems arise in those villages in the summer months. The most ecologically tense situation arose in the territory of the village of Kosakul. Thus, two asphalt (Road Construction Department No. 47 and asphalt plant of "Raqif" Road Construction Company) and two brick factories ("Masalli-Karpic" and "Kenan" brick enterprises) operating in the area, as well as a sand-gravel quarry ("Farahim" Construction Production Company) as a result of the production process carried out in the bed of Vilashchay, the bed of the river has been lowered by about 10 m. In addition, the waste water generated in these enterprises is discharged directly into the river. Ammonium ions were 3.8, and BDO (biochemical demand for oxygen) 83.3 times higher than the norm in the water sample taken from the stream of industrial wastewater of the "Raqif" Road Construction Company.

Sewage and waste from other facilities located along the banks of the Vilashchay are also directly dumped into the river or riverside areas. Due to the lack of treatment facilities, domestic, farm and industrial effluents formed in the area are discharged into rivers and canals, and partly into reservoirs.

The evaluation of the ecogeographical situation was carried out not only due to anthropogenic and man-made effects, but also based on the analysis of water samples taken from the rivers. For this purpose, the information of the water samples taken from the place where the river flows into the Vilashchay reservoir of the Regional Ecology and Natural Resources Department No. 1 was used. The value of Cl, Na+K and Ca ions in the water of Vilashchay, as well as mineralization, is much higher than the permissible hardness limit.

According to M.A.Abduev's research, Vilashchay and Istisuchay, a tributary of Astarachay, have highly mineralized waters and belong to chloride waters¹².

Our research confirms these ideas once again. Thus, the analysis of the results of the water samples taken from the Vilashchay before entering the Vilashchay reservoir confirms once again that the water of the river is polluted (table 1).

Table 1.

Results of water samples taken from Vilashchay before entering
Vilashchay reservoir

№	Indicators	Unit of measurement	Actual	Permissible Hardness Limit
1	pH	-	8,00	6,50-8,50
2	SSAM	mq/l	0,60	0,50
3	OKT	mq/l	5,0	10,00
4	OBT5	mq/l	36	3,00
5	NO2	mq/l	0,35	0,08
6	NH4	mq/l	1,2	0,50
7	Dependent substances	mq/l	14,00	0,25
8	Oil products	mq/l	1,9	0,05
9	Zn	mkq/l	277	10,00
10	Ni	mkq/l	44	10,00
11	Pb	mkq/l	18	30,00
12	Mn	mkq/l	3,5	10,00
13	Ag	mkq/l	2	50,00
14	Cd	mkq/l	0,25	5,00
15	Cr	mkq/l	4	50,00
16	Co	mkq/l	60	10,00
17	Fe	mkq/l	145	50,00

¹² Abduev, M.A. Average annual mineralization and chemical composition of river waters of the Republic of Azerbaijan // - Baku: News of the Azerbaijan National Academy of Sciences, Earth sciences, - 2011. No. 2, - p. 36-41.

As can be seen from the data in the table, the amount of most substances (OBT5, NO₂, NH₄, suspended substances and oil products) is many times higher than the permissible concentration limits. However, there is a significant advantage in the amount of heavy metals such as Zn, Ni, Co and Fe in river waters.

In addition to Vilashchay, in this chapter, water samples were taken from other rivers and reservoirs of the province, and their permissible concentration limits were determined.

In general, the main ecogeographical problems that arise during the use of hydrological resources in the Lankaran physical-geographical region are the pollution of rivers, the direct discharge of waste and collector waters into water basins without treatment, the creation of fertile conditions for the occurrence of floods and floods with deforestation in the basins, as well as the supply of clean water to the population. that it is not performed at an adequate level and that water is not used efficiently.

The third chapter of the dissertation work is dedicated to **"Solutions of ecogeographical problems and grouping of ecologically tense zones in Lankaran physical-geographic province"**. In this chapter, one of the main factors that ensure the restoration and protection of human health, the resort and treatment properties of climatic resources have been studied, the possibilities of its use have been determined, the problems that arise during the use of land and hydrological resources and their solutions have been investigated, and the ecological stress zones of the province have been grouped.

*Climate is the main criterion that creates favorable conditions for the development of tourism types. From this point of view, regions with favorable natural and climatic conditions for the treatment and health of tourists are of special interest*¹³. Because the climate of the area has great advantages for the organization of tourist-recreational places, the creation of tourist centers, the organization of routes to tourist zones, and so on.

¹³ Mammadov, C.A. Geography of international tourism / C.A. Mammadov. - Baku: Mutarcim, - 2002. - p. 32

As a result of our climate analysis, it was determined that April-September is the most favorable period for the use of climatic resources for resort and treatment purposes for the Lankaran-Astara physical-geographic region. If we add to this the rich subtropical vegetation and the mysterious beaches, we can see that the province has a greater resort and treatment potential.

At a time when the population's demand for natural resources is growing rapidly, the impact of people on the environment and its components is constantly increasing. Among them, the soil layer is more affected by negative effects, degrades and loses its productivity. *Pesticides applied against agricultural pests also lead to the worsening of the ecological situation in most cases, including soil pollution, which is one of the main components of the landscape.*¹⁴. One of the main conditions for the efficient use of land and increasing its productivity is to preserve the fertility of the land ecologically. At this time, it is necessary to enrich the soil with humus. Crises in agriculture are always accompanied by worsening environmental problems¹⁵.

All soil types of the yellow soil and brown soil zones of humid subtropical forests formed in the territory of Lankaran physical-geographical region have lost their characteristic morphogenetic properties and fertility indicators have changed for the worse as a result of the long-term impact of human economic activity. As a way out, it is necessary to properly direct the economic activities of people in the area and develop traditional plant cultivation typical of subtropics. The main anthropogenic impacts on surface water are determined by mixing irrigation water from irrigated agricultural areas and wastewater discharged from settlements and enterprises. In

¹⁴ Salayeva, U.A. Contamination of the soils of the humid subtropical zone with pesticides and other toxic substances // Republican scientific conference on "Problems of the development of the fields of natural and humanitarian sciences". - Lankaran: - May 5-6, - 2017. - p. 18-19.

¹⁵ Goychaylı, Sh.Y., Khalilov, T.A. Analysis of the technology of using mineral resources in the protection of ecological productivity in the soil // "Problems of applied ecology" scientific-methodological conference. - Baku: Baku University, - October 14 - 2002, - p. 78-81

Lankaran physical-geographic region, water is polluted mainly due to industrial facilities, settlements, livestock complexes and collector-drainage waters.

River waters of the Lankaran physical-geographic region are widely used for irrigation, especially in the hot months of the year. At this time, due to the increased demand for water in the area, the anthropogenic effects on the rivers are also increasing. As a result of improper adherence to irrigation norms or improper drainage, the soil becomes salty, swampy, and gradually deteriorates. One of the ecogeographical problems in the province is the destruction of forest strips along the riverbeds. Forest strips prevent river waters from washing the banks, widening of the bed, floods and the materials brought by them from spreading around and flooding the farms. Therefore, trees and shrubs growing along river beds should not only be protected, but also strips of trees with large trunks and dense root systems should be planted in such areas.

In order to analyze the ecogeographical conditions of the Lankaran physical-geographic region, we first of all consider the settlements in the region, their population density (50 people and less per ha, 50-100 people, 100-200 people and more), land fund - village we have transferred agricultural crops, pastures (winter and summer pastures), unused and unusable areas, forested, marshy and rocky areas to the map. Then we mentioned the economic areas - light industry, food industry, agricultural areas, areas used for fishing and areas where the tourism sector is developed. By summarizing all these factors, development trends of farm areas were determined. As a result, the ecogeographically stressed zones of the province are defined and marked on the map in 3 categories - areas with low, medium and high degree of ecological damage (figure 1).

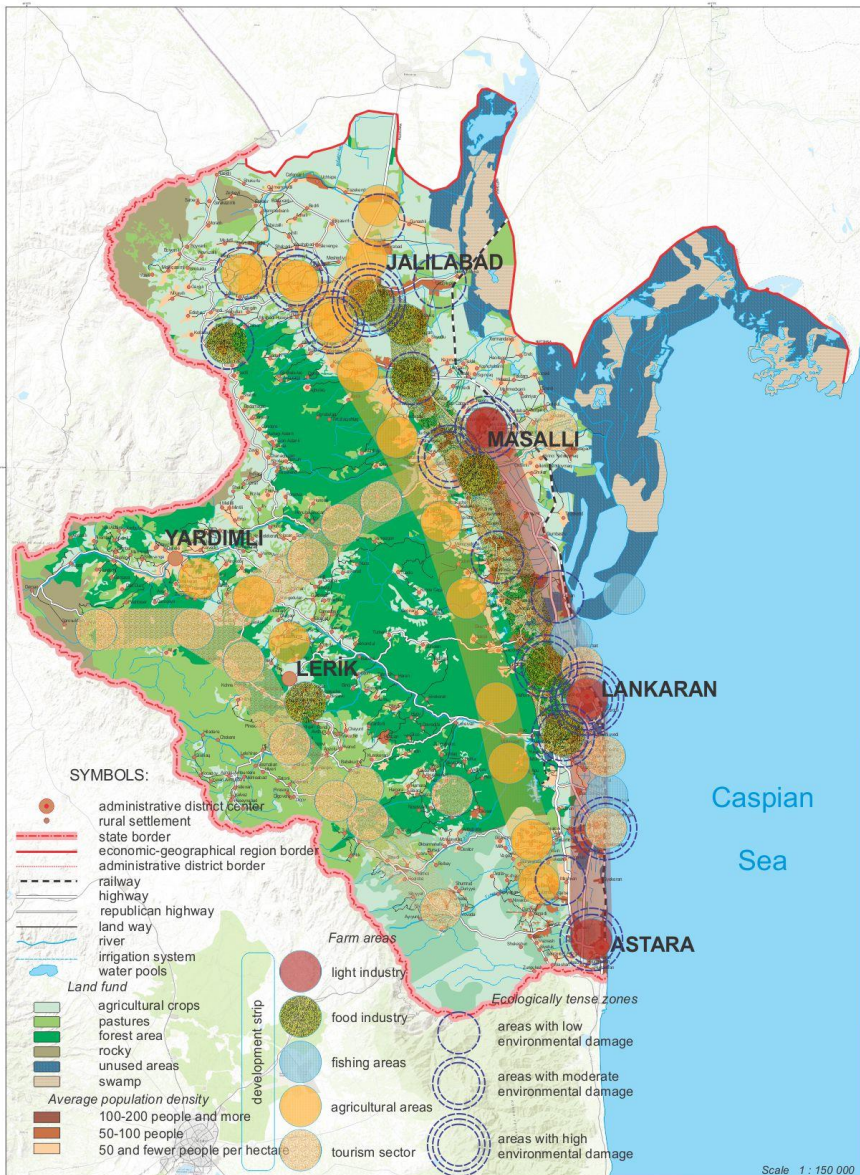


Figure 1. Development of farms in Lankaran physico-geographical region and map of ecological stress zones

In addition to the ecogeographical map of the Lankaran physical-geographical region, we have drawn up a new map of the research region with the help of aerospace images and GIS technology for a more accurate study of the territory and to determine the areas of ecologically stressed zones using the formula $(A_3 = \frac{\sum al}{\sum TL})$; A_3 - anthropogenic factor; $\sum al$ - sum of anthropogenic complexes; $\sum TL$ - field of natural geosystems) proposed by Y.A.Garibov¹⁶.

By applying the anthropogenic factor, the appropriated areas of each geosystem (residential areas, agricultural areas, roads and railways, industrial enterprises, etc.) were calculated. When determining the areas of ecological stress zones, they were divided into 4 groups, taking into account the anthropogenic factor, soil fertility, vegetation density, and anthropogenic loading of water basins (pollution with domestic water) (table 2, figure 2).

1. Very good - areas with well-preserved ecological condition, practically unchanged territory, low (0.1) anthropogenic factor. These areas cover 24.8% (147006.73 ha) of the research region. These include border mountainous and rocky areas that have preserved their natural structure, as well as Hirkan and Kyzylagac national parks. There is great potential for organizing tourism and recreation here.

2. Good - areas with relatively disturbed ecological condition, anthropogenic factor of 0.2, in some places 0.3. These areas cover 47.5% (289240.07 ha) of the research region. Within this group, which is characterized by forests and agricultural lands, the anthropogenic loading of rivers is almost not noticeable in the upper reaches, while in the middle reaches they are relatively polluted, and the natural structure is almost preserved. It is possible to develop tourism-recreation and agriculture here.

3. Average - the ecological condition is slightly disturbed, the anthropogenic factor varies between 0.4-0.5, it mainly covers settlements and their surrounding areas. These areas cover 23.4%

¹⁶ Garibov, Y.E. Anthropogenic transformation of modern landscapes of the Republic of Azerbaijan / Y.E.Garibov. - Baku: Nafta-Press, - 2011. - 298 p.

(142178.77 ha) of the research region. The rivers passing through the areas included in this group, as well as the soil, are subject to strong anthropogenic loading. The natural structure has changed, settlements have expanded, previously unused land areas have been cultivated, the intensity of cars has increased with the construction of roads, etc. is a clear example of them. Agricultural industries are being developed, new agricultural farms are being built.

4. Crisis - the ecological situation is severely disturbed, the anthropogenic factor varies between 0.6-0.8, the anthropogenic load of rivers is high, it covers large settlements, highways and rural agglomerations. These areas cover 4.1% (25031.85 ha) of the study region. Within this group, where various economic fields are developed, pollution is more caused by the expansion of residential areas, the emission of carbon dioxide into the atmosphere by the burning of fuel from vehicles (trucks stopping at the border crossing point), the pollution of water by industrial (agricultural industry and furniture industry) production waste, agriculture The process of soil poisoning is caused by the use of fertilizers in agricultural fields. At this time, the collapse of the ecosystem, the degradation of natural landscapes and soils, and the expansion of agricultural areas are observed.

Table 2.
Environmental stress zones of Lankaran physical-geographic region

Ecologically stressed zones	Area, with ha	Area, with %
Very Good	147006,73	24,2
Good	289240,07	47,5
Medium	142178,77	23,4
Crisis	25031,85	4,1
Water areas	4638,39	0,8
Total:	608095,81	100



Figure 2. Map of ecological stress zones of Lankaran physical-geographic region

Based on our research, monitoring results, literature materials, mathematical-statistical analysis and field research observations, we can say that Lankaran physical-geographical region is more sustainable from an ecogeographic point of view compared to other regions of our republic. As the region is developed much less than its potential in industry and agriculture, the environmental effects are not so significant here. The expansion of residential areas is mainly along highways, and these roads almost determine the dynamics of agricultural development. Various types of tourism are developed in the mountainous areas of the province, which are cleaner and purer economic areas from the point of view of ecogeography. Since this development is related to agriculture in some places, fields such as rural tourism and agro-tourism, alpinism in mountainous areas, sports, hiking, and ecological tourism are being developed.

CONCLUSION

1. In recent years, in the Lankaran physical-geographic region, the population's settlement areas have expanded mainly along highways, the development trend of production areas is poorly developed compared to other regions of the republic, and the territorial organization of social infrastructure has been improved. However, the rapid appropriation of territories has led to the creation of new pollution areas, emissions into the atmosphere increase in the number of pollutants, pollution of water resources (mainly rivers and coastal areas of the Caspian Sea), an increase in diseases, etc. caused such ecological-geographical problems to arise and manifest itself more prominently.

2. In the mountain-forest yellow soils spread in the Lankaran physical-geographical region, the moisture reserve runs out in the summer months, and the productivity of plants decreases; aeration is disturbed in soil-ecological conditions in pseudopodzolized mountain-yellow soils, the normal nutrition of the root system of plants is inadequate; clayey-yellow soils have insufficient physical properties, the process of swamping accelerates, and microbiological activity decreases; mountain-forest brown soils are most degraded, forests are intensively cut down, the erosion process accelerates;

grass-brown soils are prone to siltation, siltation and swamping, the environmental reaction is weakly acidic and neutral in water solution; mountain gray-brown soils are subjected to dehumification, the soils should be rested, organic and mineral fertilizers should be applied; the degree of mineralization of groundwater in meadow-swamp lands increases, the salt content is dominated by sulfate-chloride-sodium; wetlands lose their functions and become degraded; mountain-forest brown soils are more subject to erosion in deforested areas, this process mainly occurs around settlements.

3. The pH value in the studied waters in the Lankaran physical-geographical region varies between 3-5 mg.eq/l. These waters have a relatively very acidic reaction and relatively little mineralization due to intense leaching of soil-rock and a more significant role of organic matter than essential ions. The zinc price varies between 0.003-0.004 mg/l and is lower than the permissible concentration limit (0.005 mg/l). The value of aluminum concentration ranges from 0.007 to 0.055 mg/l, below the permissible concentration limit. In order to protect water resources in the province, it is necessary to prevent the discharge of sewage and domestic waste into rivers, and for irrigation, purified wastewater should be used.

4. Recently, the amount of pollutants released into the atmosphere from industrial enterprises and vehicles in Lankaran physical-geographic region is 1.45 and 28.0 thousand tons, respectively. Lankaran, Masalli and Jalilabad regions account for the majority of pollutants released into the atmosphere in the province. Although the primary industry in the region is the production of food products, there are also brick, electricity, gas and steam production areas. The cause of atmospheric air pollution by motor vehicles is more intensive traffic areas, which has a negative impact on the health of the population living in the villages along the North-South highway corridor.

5. In the Lankaran physical-geographic region, the ecogeographical problems and their causes that arise during the life and economic activities of people have been investigated; the ecogeographical stress zones are the boundaries of settlements,

population density, land fund, forest, swamp, as well as the development of the industrial, agricultural, transport and tourism sectors. Within the built areas, the areas are grouped into three categories (areas with low, moderate and high environmental damage), and areas of ecological stress zones are divided into four groups: very good, good, medium and critical.

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