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## Statistical Assessment of the Ecological Situation: The Case of the Republic of Azerbaijan

*The economic development in a country depends on the continuous development of its regions. This issue can be effectively addressed by statistical assessment of the real situation in economic regions of a country by use of key sustainable development indicators. Development factors at regional level (ecological, economic, and social) are not studied as a complex, which raises the need for and importance of comprehensive statistical analyses of the data on environmental performance at region and country level. The article contains a statistical analysis of these indicators for the Republic of Azerbaijan. The period from early 2000s till 2017 is covered. The analysis is made on the official statistics of the Republic of Azerbaijan. The indicators under study include: distribution of land by purpose, specially protected areas, state nature reserves, air temperature, air temperature in Baku city, average annual precipitation, average annual precipitation in Baku city, amount of pollutants emitted in the air, domestic wastes generation etc. The analysis also demonstrates the need to improve the quality of the primary statistical data. Conclusions and recommendations provided in the article are formulated from the results of the statistical analysis.*

**Keywords:** Environmental protection, ecological areas, ecological agriculture production, specially protected areas, economic efficiency.

One of the issues of dynamic development of the country's economy is the continuous development of economic regions (urban and rural settlements). In order to address this issue, first of all, the key indicators of sustainable development should be clarified and the real situation of the economic regions should be analyzed. It should be noted that currently the information on the complex analysis and future state of the ecological, economic, social situation of the region is not sufficient. Development factors at regional level (ecological, economic, and social) are not studied as a complex. The analyses cover mostly economic and social issues. The complex analysis of ecological, economic and social spheres remains a scientific-methodological problem. Environmental agricultural policy is an important component of the general agricultural policy in European countries and research into this area is included in the political programs of these countries. Preparation of action programs is essential to create new sources of income due the development of exported certified organic food products.

It should be noted that the issue of ensuring the ecological condition of the ecosystems, biological durability, as well as the pollution of air and water areas, various water bodies, soil structure, plant biodiversity (including forests), biological sources of water and fauna's habitat [1; 2].

At present, the warm weather of the planet, the increasing degradation process, the sharp decline in biodiversity, the spread of various diseases associated with environmental pollution, are among the most global environmental problems of concern to the population. Implementation of urgent measures to solve these problems is even more urgent. The problems that have not been resolved in a timely manner, and are described as a small nature phenomenon, have now become a process that can end up with global and irreversible disasters.

55% of the world's declining environment is in the energy sector. The following negative effects of the energy economy are available [5]:

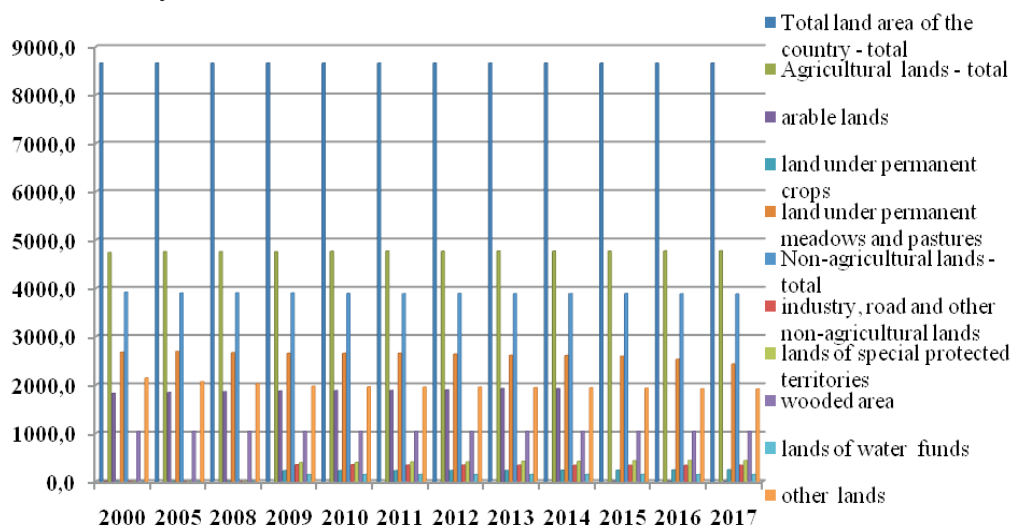
- economic efficiency is low compared to other sectors;
- underground resources run out;
- the amount of oxygen in the air decreases;
- heat wastes;
- the ecological balance in the biosphere is violated;
- biosphere fertility decreases.

As we know, soil is considered to be one of the most important indicators for studying the linkage of agricultural economics with environmental factors [5; 12]. It is important to take into account a number of factors to assist in the increase of production in the field of ecological agriculture and development. The following can be noted for this [4; 11].

1. Creation of ecological agricultural production associations.
2. The political recognition of the ecological agricultural production and the use of identical production standards.
3. Financial assistance to environmental farms.
4. Establishing a certain level of cooperation with the farmers' network.
5. Development of appropriate markets.

From this point of view, we have identified the dynamics of the overall land area designation in the country. The dynamics of the indicators obtained during the survey are illustrated in Figure 1.

As can be seen from the dynamics, the main parameters in the interval from 2000 to 2017 are analyzed.



**Fig. 1. Distribution of the Total Land Area in the Republic of Azerbaijan, thou. ha**

Source: <https://www.stat.gov.az>

There is not a sharp difference in the country's agricultural land. In comparison with the plowed areas it can be noted that in 2000 it was 1825 thousand hectares, in 2015 it increased to 1924.5 thousand hectares. In other areas and indicators, dynamics are also observed in the decade. This also allows us to note that, the country's agricultural development has given a great boost to economic growth. It is known that ecology plays an important role in the dynamics of agriculture employment and growth. In the course of the research, it is envisaged to use appropriate methods of economic and human potential management to improve the quality of the environment [3; 13].

From this point of view, the dynamics of specially protected areas in the country have been identified during the survey and are illustrated in detail in Figure 2. As can be seen from the data, the dynamics of the protected areas in the country have been increasing in the years since. If the total area of specially protected soils was 4298.6 km<sup>2</sup> in 2000, it increased

sharply in 2005 to 6038.2 km<sup>2</sup>, in 2010 it increased to 8807.7 km<sup>2</sup>, and without a sharp increase in 8925.5 km<sup>2</sup>.

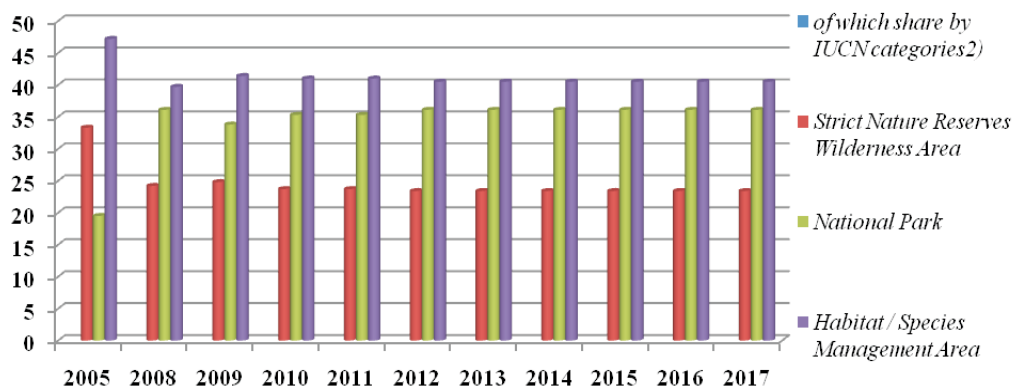


Fig. 2. Specially Protected Areas in the Republic of Azerbaijan, km<sup>2</sup>

Source: <https://www.stat.gov.az>

On the other hand, the dynamics of the state nature reserves in different years shows that there is a slight increase in the year 2000 to 2015, which is also unimportant. The highest increase in these ecological areas is observed in the number of national parks [11; 13]. Note that national parks have been created in accordance with the President’s decree since 2003. In this case, as the diagram shows, dynamics of national parks, unlike other surveyed areas, since the beginning of the year. So, if it was 1177.5 km<sup>2</sup> in 2005, it increased to 3105.3 km<sup>2</sup> in 2010, and finally, last year, there was more increase in 2015, covering 3223.1 km<sup>2</sup>. This is due to the fact that the country’s renovation works are being carried out more rapidly and the creation of various green areas indicates that other environmental measures are being developed.

It is known that the main principle in the development of cities, the establishment of regional markets and the development of strategic (50–100 years) policy of economic regions should be a sustainable development model [2; 13].

Conflict between economy and ecology is one of the major environmental problems. The economic mechanism for the use of natural resources and environmental protection is the broad use of economic entities in the use of natural resources. It is known that the regulation of ecosystems is governed by the use of nature, which is closely related to environmental protection [6; 8].

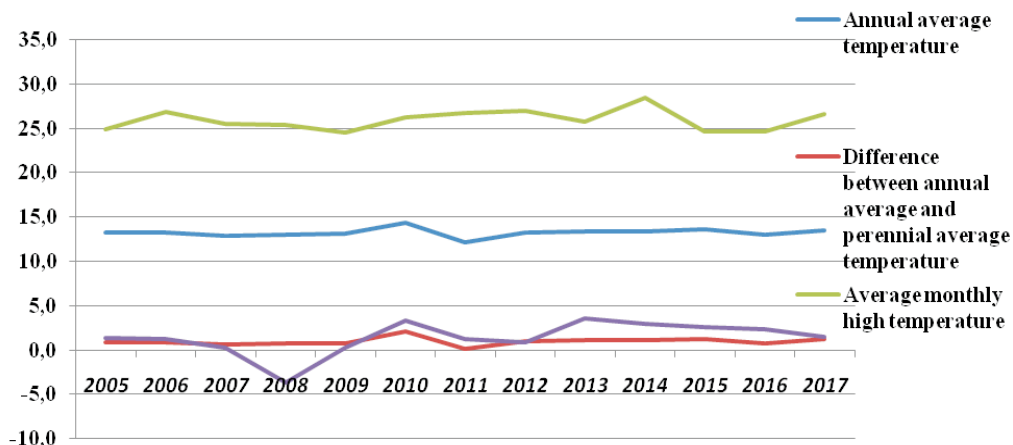


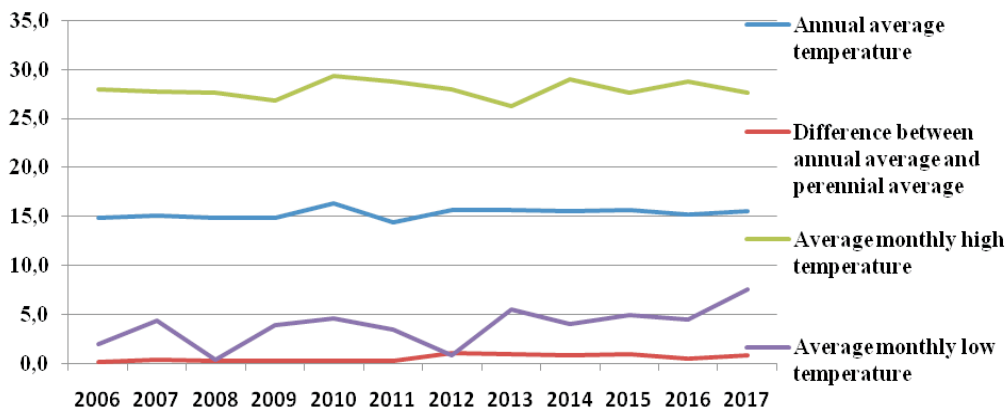
Fig. 3. Dynamics of Air Temperature in the Republic of Azerbaijan, °C

Source: <https://www.stat.gov.az>

The protection of the environment, living in a healthy natural environment and the efficient use of natural resources for the wellbeing of our people play an important role in the ongoing socio-economic reforms [7].

Ecology learning the interaction of living systems with their environment, the interaction of organisms, biosystems and the environment, which synthesizes the factors of natural and social science interaction with nature and society.

It should be noted that average annual temperatures were 0.2–1.30C above the climate norm in accordance with the global warming trend in the country in 2005–2015. Dynamics is given below in the pictures.

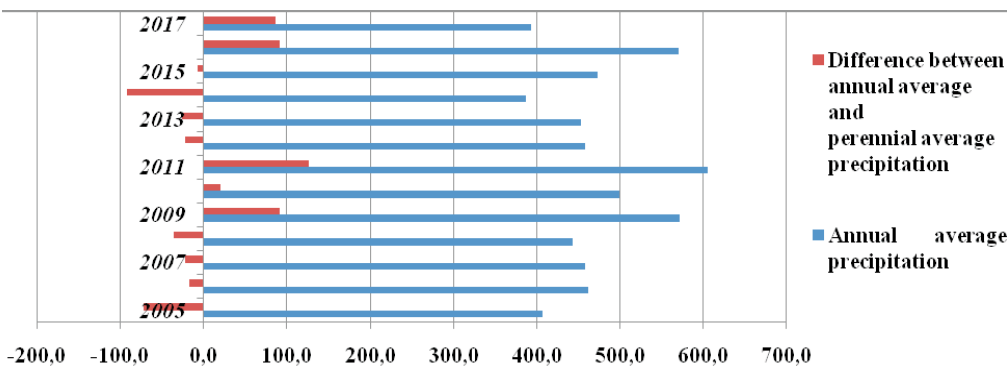


**Fig. 4. Dynamics of Air Temperature in Baku City, 0C**

Source: <https://www.stat.gov.az>

As can be seen from the picture, the year 2011 was the coldest year with 0.20C positive anomaly and the hottest years with positive anomaly of 1.30C in 2010 and 2012.

As can be seen from the dynamics, the air temperature in 2012 was cold at normal temperatures, and temperatures were below 2.30C and 1.30C. In January, July, and December the temperatures were close to the norm with a smaller percentage. In other months temperatures were significantly above the norm (2.0–3.8°C) and average temperatures were above 1.30C above normal.

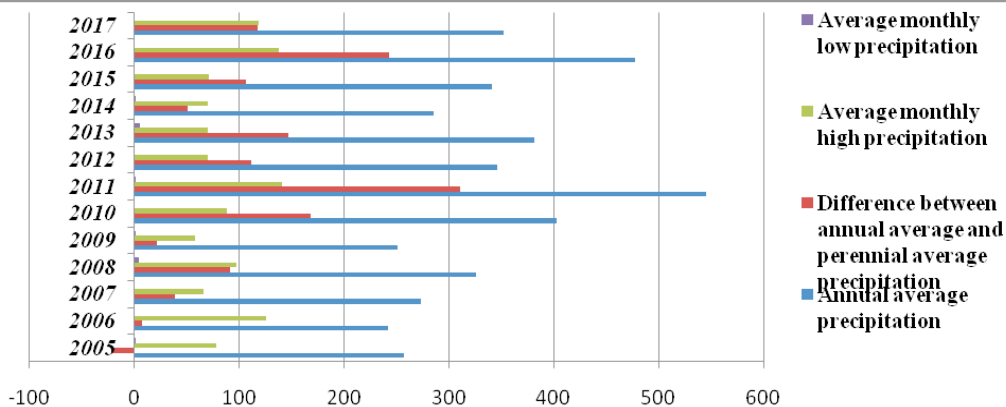


**Fig. 5. Dynamics of Average Annual Precipitation in the Republic of Azerbaijan, mm**

Source: <https://www.stat.gov.az>

As for the precipitation, both positive and negative anomalies were observed in 2005–2015.

In addition to the average annual dynamics of rainfall (mm), the annual average annual rainfall indicators in Baku (mm) are given in detail in Figure 5 and 6.

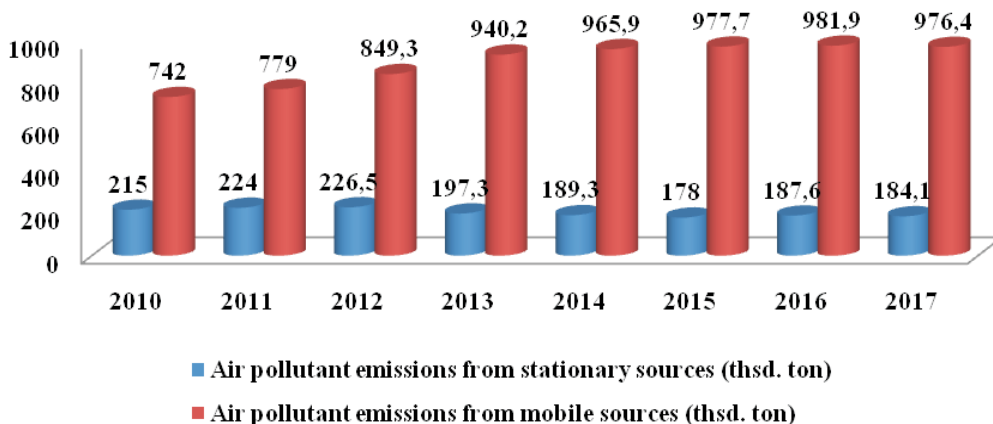


**Fig. 6. Dynamics of Average Annual Precipitation in Baku City, mm**

Source: <https://www.stat.gov.az>

The maximum rainfall is in line with 2011, when the country’s rainfall in the same year was 21% higher than the climate norm. The precipitation anomaly was 10.6% in 2010 when large-scale floods were observed. In 2008 and 2012, precipitation was anomalous, with an average of -6.6% and -6% respectively.

In 2012, rainfall was generally below 6% of the climate norm. In the winter and in March, in the summer months in June and July, and in the autumn in September and November, precipitation was relatively close to norm and norm. However, in summer and partly in autumn, the annual rainfall was less than normal, as the falling precipitation in the maximum period of rainfall was much lower than the norm. Although precipitation in July was an average of 2 times the norm, it did not affect the annual total precipitation [10].



**Fig. 7. Amount of Pollutants Emitted into the Air in the Republic of Azerbaijan, thou. ton**

Source: <https://www.stat.gov.az>

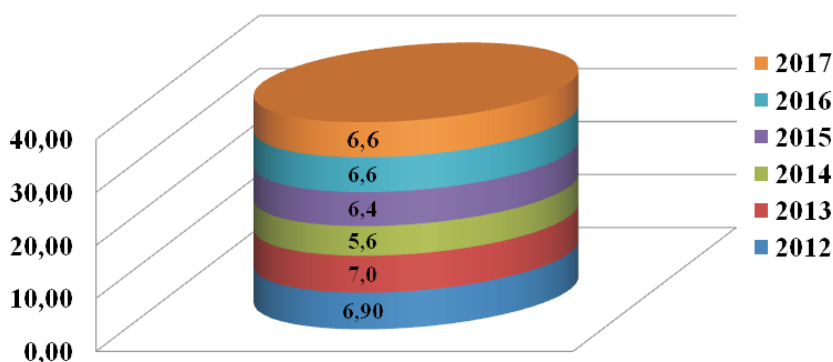
The amount of contaminants emitted into atmospheric air (thousand tons) is given in Figure 7. In the next dynamics, pollutants thrown into atmospheric air. There are 2 main sources out there. First, the amount of pollutants emitted into the atmosphere from stationary sources and the amount of pollutants emitted from the vehicles to the atmosphere was given [1; 9].

The source of air pollution is the system, manufacturing, technological processes or operations that are involved in the production of harmful substances and which are separated into the atmospheric air. As we know, sources polluting the atmosphere are mainly from sources derived from harmful substances (technological equipment, mechanisms, apparatus,

raw materials and storage warehouses, raw materials and waste disposal sites, fuel tanks, etc.) and sources from the atmosphere (pipe, ventilation mines, etc.).

In recent years, automotive engines, which play a key role in polluting atmospheric air, are harmful gases in the domestic combustion products. According to statistical data, in 2012, harmful substances emitted from the motor vehicles into the atmospheric air accounted for 79% of total waste. Intensified traffic increase and traffic jams, particularly in major cities, the excessive pollution and physical exposure of atmospheric air to the hazardous wastes exported by cars have made the problem more difficult. Has increased the amount of harmful gases emitted by the mobile sources in Baku.

Dynamics has increased over many years from the amount of transport that has been thrown over many years. This is due to the fact that the number of vehicles imported to the country is excessive and has more circulation capacity. On the other hand, the dynamics on stationary sources shows a slight decline over the years.



**Fig. 8. Indicators of Domestic Wastes Generation  
in the Republic of Azerbaijan, million m3**

Source: <https://www.stat.gov.az>

Dynamics, as seen in 2010, was 215,000 tones, in 2015 it dropped to 178,000 tones. The presence of such a dynamics characterizes the reduction of environmental pollution. At the same time, further increase of ecological awareness in the country can lead to the reduction of other pollutants.

It is known that during the economic activity of people (as a result of technological processes) a product (goods and services) and useless waste are formed. Although the economic (institutional) unit is interested in the organization of quantities and quantities of products useful for use, it is not interested in the organization of waste accounting. As a result, the environment (soil, water, air, etc.) is constantly degraded (quantitatively and qualitatively), exposed to physical, chemical and biological effects. Because the correctness of the damage to the environment is beyond the scope of the enterprise, there is a need to regulate this field by the relevant authorities. According to statistical data, 6.7 million cubic meters in 2010, 6.9 million cubic meters in 2011, 6.9 million cubic meters in 2012, 7.0 million cubic meters in 2013, 5.6 million cubic meters in 2014 and finally 2015 6.4 million cubic meters of household waste per year.

As it is known, in recent years, due to the construction and installation works that have been widespread, various wastes have been formed as a result of construction and demolition, so that waste is disposed of in the surrounding areas and transported together with domestic waste.

Waste impacts on the environment and the health of the population. According to which deposition of heavy metals and toxic substances into deep soils of the soil and their incorporation into groundwater as a result of placement of wastes without isolation, the presence of volatile substances around the pits, including contamination of smoke from uncontrolled waste burning, and so on.

The protection of existing environmental systems, economic potential and the rational use of natural resources are among the most important environmental issues. In order to

achieve this, the ways to use natural resources should be studied and implemented on the basis of sustainability principles. As a result, it is possible to achieve the formation of the economic base by increasing the variety of potential. At the same time it is planned to use economic potentials and natural resources to develop various sectors of the economy and create new jobs [6; 12].

Intermediate quantities coincide with individual displacements in the coincidence of coincidences, and give a general characteristic, typical level characteristic. This feature of moderate quantities further favors it as an important generalizing indicator in statistical science. As you can see, the average number of soil structures varies considerably in different years.

At the same time, the standard error of the average quantity is also different. In this case, the variation of the average quantity based on the table indicators varies in different ways according to the last.

Given that the average quantitative index is defective, other descriptive statistical indicators are calculated. For this purpose, the standard error of the average quantity was calculated and other parameters were also analyzed accordingly.

The mathematical-statistical characteristics of the given data show that the average percentage deficiency was 2.98% for agricultural land, 11.08% on the humus land, 1.53% for permanent plantations, 1.53% for permanent pastures and landfills 10.04%, non-agricultural land 2.98%, 5.42% on industrial, road and other non-agricultural lands, 23.81% on specially protected lands, 0.39% on forest areas, 0.61% on water fund lands and finally 21.62% on other lands. As can be seen from the data, the land with the highest standard errors was 23.81% on the lands of specially protected areas and 21.62% on other lands. The standard fault of the average quantity was minimally observed in the lands occupied by the forest area (0.39%).

It should be noted that in addition to the above-mentioned average and its statistical error, in order to study the structure of socio-economic events, it is commonly used in the statistics to describe the variation division in the statistics, as well as the modal and median indices of the medium meanings. The most commonly encountered version or high-frequency variant is called fashion. Here are some of the fashionable figures as seen here.

Additionally, it is possible to note the median of the indicators related to statistical characteristics. The division of the ordered variation sequence into two equal parts is called median. Apparently, the different types of land use indicators have been set at the same or very close interval according to the median mean value of the categories.

The variation coefficient is almost the same as in some land structures (0.11, 0.74, 0.26, 0.36%, etc.), 13.81% on permanent plantations, and on lands of specially protected areas 21.40%, and on the other hand, 46.50% on other lands. More than 33% of variation coefficients indicate the re-grouping of the data.

Asymmetric ratios were found to be 1.601% for agricultural land, -0.275% for plowed soils, 0.076% for permanent plantations, -0.326% for permanent pastures and mowers, 1.601 for non-agricultural lands, industry, road and 2,116% on other non-agricultural lands, 1.78% on the lands of special protected areas, -1.095% for forest areas, 0.61% on the lands of water fund and finally -1.109% on other lands. It has been proved that distribution of numbers is close to normal distribution, where this ratio varies between -2 and +2. Hence, the conditions for asymmetry are paid in our researches. To put it more precisely, it fully meets the normality requirements.

As we know, the medium-sized self-esteem also depends on the nature of the hesitation of its individual variants. Therefore, it is necessary to measure the variation of the sign. Variation width, mean linear displacement, dispersion, mean square rotation and variation coefficients are used to measure the variation of the sign. The width of the variation is determined by the difference between the maximum and minimum values of the variant. In addition, the width of the width indicates the highest limit for the rate of hesitation.

The main purpose of the analysis of statistical characteristics is to determine the legitimacy of data distribution. If the distribution is not normal, then it should be normalized. This is done through data compilation. The average error calculated on the basis of non-normalized data is large and the final figures calculated for that mean value are distorted.

The result of the study shows that there is a need for econometric analysis of micro-data to improve the quality of statistical data. Before analyzing micro-data, their editing, statistical characteristics of the indicators should be analyzed [11].

Table

**Statistical Characteristics of Categories of Capacity Use on Mass Loops in the Country**

	Total land area of the country – total	Agri-cultural lands – total	Land under permanent crops	Land under permanent crops	Land under permanent meadows and pastures	Non-ag-ricultural lands – total	Industry, road and other non-agricul-tural lands	Lands of special protected territories	Wooded area	Lands of water funds	Other lands
Mean	8660	4762,5	1884,59	229,91	2646,79	3897,5	351,85	369,26	1039,7	147,01	1989,68
Standard Error	0	2,983	11,084	1,529	10,037	2,983	5,422	23,809	0,396	0,605	21,616
Median	8660	4767,55	1884,9	228,9	2655,55	3892,45	346,15	400,3	1040,25	147	1958,25
Mode	8660						342,2	407,1	1040,8	146,9	
Standard deviation	0	9,432	35,051	4,835	31,739	9,432	17,146	75,289	1,253	1,914	68,354
Sample Variance	0	88,971	1228,565	23,379	1007,385	88,971	293,987	5668,472	1,571	3,663	4672,315
Kurtosis		2,574	-0,898	-0,287	-0,846	2,574	4,764	2,803	-0,279	4,154	2,009
Skewness		-1,601	-0,275	0,076	-0,326	1,601	2,116	-1,780	-1,095	-1,109	1,615
Range	0	29,4	100,9	15,5	98,7	29,4	55,6	237,5	3,4	7,7	211,5
Minimum	8660	4740,4	1825,6	221,5	2595,2	3890,2	339,5	192,4	1037,4	142,5	1933
Maksimum	8660	4769,8	1926,5	237	2693,9	3919,6	395,1	429,9	1040,8	150,2	2144,5
Sum	86600	47625	18845,9	2299,1	26467,9	38975	3518,5	3692,6	10397	1470,1	19896,8
Variation	–	0,11	0,74	0,26	13,81	0,36	0,44	21,40	0,34	0,18	46,50



Finally, we have a number of conclusions and recommendations on the results of the research conducted on the basis of statistical evaluation of ecology and nature protection for various parameters.

### **Conclusions and recommendations**

1. It should be noted that currently the information about the complex analysis and future state of the ecological, economic, social status of different regions of the country is insufficient. Developmental factors of economic regions (ecological, economic, social) are not studied complex. The analyzes cover mostly economic and social issues. Complex analysis of ecological, economic, social spheres can give a great boost to the economic development.

2. It is important to prepare a plan of action for establishing a diversity of stable, balanced agro-ecosystems in the country that will protect human health, heritage, natural resources, and the environment;

3. As a result of carried out studies, the causes of danger to life and health of people have been identified as a result of pollution of atmospheric air. In order to eliminate it, it is important that preventive measures should be taken regularly in terms of population protection in an emergency.

4. The need for the conservation and enhancement of biodiversity through the cultivation of plant species and varieties, as well as the selection of effective methods of animal breeding and nutrition, which contribute to the harmony of the ecological agriculture with the natural resources of the soil;

5. Creation of efficient technologies to control the source of pollution of water bodies and atmospheric pollutants, stimulating the natural restoration and demilitarization of the lands used, limiting the collection of pollutants in the soil and preventing them from passing through the vegetation;

6. Ensure environmental safety, environmental protection and effective use of natural resources;

7. Ecological norms and standards should be defined in the field of nature protection and nature use, and regular measures should be taken to control the pollution of natural environment.

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### **Статистичне оцінювання екологічної ситуації в країні на прикладі Республіки Азербайджан**

*Статистичне оцінювання показників стану навколишнього середовища на прикладі Республіки Азербайджан проведено за період з початку 2000-х років ХХІ століття по 2017 рік з використанням даних державної статистики. Аналізовані показники включають розподіл земель за призначенням, території під спеціально охороною, температуру повітря, середню кількість опадів, викиди забруднювачів у атмосферне повітря, створення побутових відходів та інші. Також продемонстровано необхідність покращення якості первинних статистичних даних. На підставі отриманих результатів сформульовано висновки та рекомендації.*

**Ключові слова:** *Захист навколишнього середовища, екологічні зони, екологічне сільськогосподарське виробництво, спеціально захищені території, економічна ефективність.*

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### **Статистическое оценивание экологической ситуации в стране на примере Республики Азербайджан**

*Статистическое оценивание показателей состояния окружающей среды на примере Республики Азербайджан проведено за период с начала 2000-х годов ХХІ века по 2017 год с использованием данных государственной статистики. Анализируемые показатели включают распределение земель по назначению, специально охраняемые территории, температуру воздуха, среднее количество осадков, выбросы загрязняющих веществ в атмосферу, создание бытовых отходов и другие. Также продемонстрирована необходимость улучшения качества первичных статистических данных. На основании полученных результатов сформулированы выводы и рекомендации.*

**Ключевые слова:** *охрана окружающей среды, экологические области, экологическое сельское хозяйство, особо охраняемые территории, экономическая эффективность.*

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