The Importance of Anthropogenic Influence in Assessing the Ecological Condition of Cities in Uzbekistan (in the Case of Navoi)

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Abstract

Creating a series of maps, grouping ecological indicators, and assessing cities' environmental status are considered very relevant research tasks. A growing population in cities, the establishment of various industrial and production enterprises, and the use of vehicles all contribute to the degradation of the environment. Navoi region is a young administrative unit located in central Uzbekistan. Regarding industrial development, it ranks first among administrative units in the republic. Production in its cities, especially the high productivity of heavy industrial enterprises, ecological problems in various forms due to human pressure on the natural environment, and the health of the population - mothers and children, and the elderly - pose a serious threat. As a result of high anthropogenic pressure, ecologically clean green areas are decreasing. It occupies a very small share compared to the total area. This, in turn, can cause environmental stress in regional cities located in arid regions, and cause the loss of greenery. Anticipating such consequences and combating them is particularly important today. This article analyzes environmental conditions in the Navoi region and its cities, as well as the most significant factor affecting them, the anthropogenic effects. The land classification was made for the city area, as well as suggestions and recommendations. For this, we analyzed and grouped the structural classification of the area of regional cities. As a result of our research, we can see that environmental risk is high. In this article, the main parameters of the study are covered with accurate calculations.

Keywords: Absolute ecological stress coefficient (K_a), Anthropogenic load (AL), cities ecology, Coefficient of area protection (K_{ez}), land resources, Relative environmental stress coefficient (K_o), urban indicators.

Introduction

Analyzing the correlation between the anthropogenic load and the ecological condition of cities in the Navoi region is the focus of this article. It shows the coefficient of natural protection of the area, calculating the absolute ecological and relative ecological intensity indicators of cities such as Navoi, Zarafshan, Ghazgan, Kyziltepa, Nurota, Uchkuduq, Yangirabot[1-4].

Land use types and the characteristics of settlements in different regions affect the landscape's anthropogenic load (AL) (density of rural and urban population). Environmental assessment includes the identification of various anthropogenic (technical) impacts on landscapes, including in the impact zones (outside the area of direct impact). Several indicators are used to assess the ecological-economic balance of an area: the distribution of land types and categories, the area of nature protection areas, and indicators by types and levels. Anthropogenic load, the intensity of the ecological and economic condition of the area, the intensity of the integrated anthropogenic load, the state of natural protection of the area, the state ecological fund in the area, etc. In addition, the analysis of land use composition considers expert scores for certain types of land based on the land cadastre classification units Table 1[2].

Materials and Methods

This study studied seven different-sized cities of the Navoi region: Navoi, Zarafshan, Gozgon, Qiziltepa, Nurota, Uchkuduq, and Yangirabot Fig. 1. A total of 111,000 km[2] are covered by the Navoi region, which ranks second among administrative units in the republic after the Republic of Karakalpakstan, and first among 12 regions. A desert zone characterizes the main part of the territory. The total area of the seven cities taken as a research object is 55,481 km[2] or 49.9% of the entire Navoi region. 1.44% of this area is arable land, 0.26% is transport roads, 6.05% is industrial and service areas, 11.6% is forested, and the remaining 80% is pastures, Fig. 2.

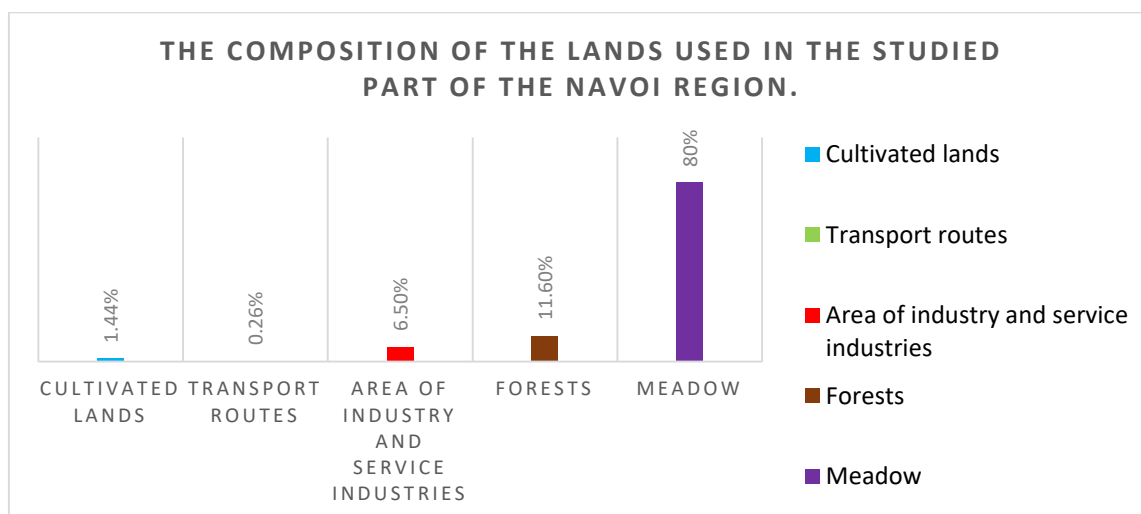**Figure 1. 3D map of the research area.**

Figure 2. Table of land resources in the section of administrative units of Navoi region

According to the level of anthropogenic influence in the territory of the region, the lands were classified as follows:

Table 1. Land classification according to the level of anthropogenic influence

Anthropogenic load level	Grade	Types and categories of lands
The highest	6	Industry, transport, cities, villages, infrastructure land, degraded land
Very high	5	Cultivated lands
High	4	Fodder lands, dry lands, etc.
Average	3	Meadows
Low	2	Forests and wetlands, water bodies
Very low	1	Lands of specially protected natural areas

Research Methods and Necessary Materials

At the next stage of the research, the assessment of the intensity of the ecological and economic condition of the area is carried out, including the analysis of the absolute ecological stress level in the form of the Ka coefficient, based on the mutual ratio of the land area with high anthropogenic load and low anthropogenic load[1].

The values of the absolute ecological stress level coefficient (Ka) allow for an objective assessment of the degree of compatibility of the intensity of anthropogenic effects[5] with the restoration potential of natural landscapes and justify the need to create

specially protected natural areas in the region and mean that their area should be increased[6-7].

When calculating the coefficient of the relative environmental stress level (Ko), all types of land use in the considered area are considered, and the total environmental burden in the area is evaluated. If the value of the Ko coefficient approaches 1, then there is a balance in the area regarding the level of anthropogenic load[1-8].

As a rule, the diversity of natural or natural-anthropogenic landscape shows its resistance to anthropogenic influences. The limit of such stability is determined by the sufficient availability of

natural biogeocenoses, nature protection zones and specially protected natural areas that comprise the ecological fund (EF) of the area's ecological fund (EF). The higher its value, the greater its natural protection level (NP) and, consequently, the landscape's stability[9]. Land distribution according to anthropogenic load also affects the natural protection of an area. The natural protection of areas with high anthropogenic loads is low. For example, if we consider the lands with the least anthropogenic burden (AB) on the ecological fund

as P1, then 0.8 P2, 0.6 P3, and 0.4 P4 (where there are) are the lands with conditional values of AB levels 2, 3, and 4[10].

Thus, it will be possible to obtain the average and total land area with environmental and resource stabilizing functions (R_{ef}). If we connect the land area R_{ef} with the total area of the study area (R_o), we get the coefficient of natural protection of the area (K_{ez}). A general ecological and economic balance assessment can be made using the proposed coefficients Table 2.

Table 2. Coefficients for assessing the ecological and economic balance of the region[1]

The name of the coefficient	Formula	Utilized information	Identifying value changes and characterizing them
Absolute ecological stress coefficient	$K_a = AL_6 / AL_1$	Areas with high anthropogenic load – AL_6. Areas with minimal anthropogenic influence (usually protected areas) – AL_1	$K_a \uparrow$ - increase in tension.
Relative environmental stress coefficient	$K_o = AL_4 + AL_5 + AL_6 / AL_1 + AL_2 + AL_3$	The total area of used land that has changed to different degrees	$K_o \rightarrow 1$- the tension between the ecological and economic situation of the region is balanced; $K_o \uparrow 1$ - increase in tension
Coefficient of area protection	$K_{ez} = R_{ef} / P_O$	obtaining the average and total area of the land with the functions of stabilizing the environment and resources $R_{ef} = P1 + 0.8 P2 + 0.6 P3 + 0.4 P4$; P_o- the area of the study area	$K_{ez} \uparrow$ — increase in natural protection of the area; $K_{ez} < 0.5$- the significant level of need to protect the area

Results and Discussion

To determine the absolute environmental stress coefficient, we need to do the following, that is, we need to understand the ratio of areas with the highest level of anthropogenic load (AL_6) to areas with very low anthropogenic load (AL_1). We can see the following result:

$$K_a = AL_6 / AL_1 \qquad 1$$

$$K_a = 3133,93 / 5782,12 = 0,54200;$$

The ability of natural complexes to self-restore is lower than that of anthropogenic burdens, which requires expanding protected areas.

Next, it is necessary to determine the coefficient of relative environmental stress (K_o). For this, we use the following formula:[10]

$$K_o = AL_4 + AL_5 + AL_6 / AL_1 + AL_2 + AL_3 \qquad 2$$

$$K_o = 51009,401/48000,61 = 1,062$$

This result shows relative ecological tension in the region because the industrial enterprises are specialized in heavy industry, and their negative impact on the natural environment and the level of anthropogenic load is very high.

To determine the area protection coefficient, the following sequence was performed:

$$K_{ez} = R_{ef} / P_O \qquad 3$$

$$K_{ez} = 2,8/55,481 = 0,05$$

where R_{ef} takes the lands with the lowest anthropogenic load (AL) as 1 P1, the areas of the lands with the conditional value of AL level 2, 3, 4 points are 0.8 P2, 0.6 P3, 0.4 It is found through P4 (where it is) and it is equal to 2.8. P_o is equal to the area of the studied area.

This calculation clearly shows that the area needs protection. If the processes continue like this analysis, negative consequences can be observed for the region's ecological condition and the population's health.

Conclusion

The results of this research show that if we do not improve the ecological environment not only in the administrative units of Navoi region but also in our republic or the entire planet, first of all, the ecological environment and then various negative changes in the health of the population, mothers and children. Important indicators such as life expectancy may decrease due to death, increase in the level of disability and a sharp decrease in the proportion of the elderly. Therefore, reducing the anthropogenic burden and impact, increasing the "greenness index" in the regions, or carrying out the work of "ecological gentrification" should be considered the most important issue.

Acknowledgment

Authors' Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for re-publication, which is attached to the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in University of National University of Uzbekistan named after Mirzo Ulugbek.

Authors' Contribution Statement

N. K. carried out data collection and worked with them, on theoretical ideas. N.L. worked on statistical numbers and their grouping, tables and 3D models.

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أهمية التأثير البشري في تقييم الحالة البيئية للمدن في أوزبكستان (منطقة نافوي كحالة للدراسة)

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الخلاصة

يعتبر إنشاء سلسلة من الخرائط ، وتجميع المؤشرات البيئية ، وتقييم الحالة البيئية للمدن من المهام البحثية وثيقة الصلة بالموضوع. إن تزايد عدد السكان في المدن ، وإنشاء العديد من المؤسسات الصناعية والإنتاجية ، واستخدام المركبات ، كلها عوامل تساهم في تدهور البيئة. منطقة نافوي هي وحدة إدارية شابة تقع في وسط أوزبكستان. أما فيما يتعلق بالتنمية الصناعية فمنطقة نافوي هي الأولى بين الوحدات الإدارية في الجمهورية. يشكل الإنتاج في مدنها ، وخاصة الإنتاجية العالية للمؤسسات الصناعية الثقيلة ، والمشاكل البيئية بأشكال مختلفة بسبب الضغط البشري على البيئة الطبيعية ، وصحة السكان - الأمهات والأطفال وكبار السن - تهديدًا خطيرًا. نتيجة للضغط البشري المرتفع، تتناقص المساحات الخضراء النظيفة بيئيًا. تحتل حصة صغيرة جدًا مقارنة بالمساحة الإجمالية. وهذا بدوره يمكن أن يسبب ضغوطًا بيئية في المدن الإقليمية الواقعة في المناطق القاحلة ، ويسبب فقدان المساحات الخضراء. إن توقع مثل هذه العواقب ومكافحتها أمر مهم بشكل خاص اليوم. تحلل هذه المقالة الظروف البيئية في منطقة نافوي ومدنها ، بالإضافة إلى العامل الأكثر أهمية الذي يؤثر عليها ، التأثيرات البشرية. تم تصنيف الأراضي لمنطقة المدينة بالإضافة إلى الاقتراحات والتوصيات. لهذا ، قمنا بتحليل وتجميع التصنيف الهيكلي لمنطقة المدن الإقليمية. نتيجة لأبحاثنا ، يمكننا أن نرى أن المخاطر البيئية عالية. في هذه المقالة ، تتم تغطية المعلمات الرئيسية للدراسة بحسابات دقيقة.

الكلمات المفتاحية: معامل الإجهاد البيئي المطلق Ka، الحمل البشري AL، بيئة المدن ، معامل حماية المنطقة Kez، موارد الأراضي ، معامل الإجهاد البيئي النسبي Ko، المؤشرات الحضرية.