Effects of physical characteristics of landscapes of Uzun District on population density

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Abstract: This article covers the issues of determining the boundaries of landscapes, their classification, determining the population density in landscapes, and analyzing the effects of physical characteristics of landscapes on population density. Historical-evolutionary, genetic and structural criteria have been used to determine the boundaries of landscapes in Uzun district. Based on the theory proposed by V.A. Nikolayev, Uzun district landscapes are classified and 13 landscape species are distinguished in this area. The area of landscapes and their population, as well as population density, have been determined. The impact of physical features of landscapes on population density has been comprehensively analysed. A landscape map and population density map of Uzun district have been created.
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1. Introduction

Throughout the history of human society, human influence on nature has increased and this process continues. Natural resources are used more and more as a result of population growth, especially as people's wants and needs increase. Sometimes the laws of nature are not taken into account during the use of natural resources, as a result of which there will be cases where nature have a negative effect on people.

The physical conditions of the area directly affect the population density. In Uzbekistan, where the amount of precipitation is low and the area is mainly in the arid zone, people have been living in areas close to rivers since ancient times. Since ancient times, people had been using river water for drinking water, irrigating land, and driving mills. Rivers flow from the eastern and western parts of the territory of Uzun district, and the central part is occupied by a mountain range stretching from north to south. The diverse physical conditions of the district have an impact on the population density.

The consideration of population density by landscapes provides an opportunity to clearly understand the influence of the physical features of the territory on the distribution of the population. Landscape (German: "Land" – land, area, shaft-relationship, connectedness) is an area that generalizing concept of typological physical complexes: geological structure of land, relief, climate, soil, flora, fauna, hydrological regime, characterized by uniformity and having a natural border. In determining the borders of Uzun district landscapes and classifying landscapes, it is based on the theory developed by V.A.Nikolayev. His theory can be fully applied to the territory of Uzun district.

2. Materials and Methods

Study area. Uzun district is located in the eastern part of Surkhandarya region where the most southern region of the Republic of Uzbekistan. Uzun district borders with the Republic of Tajikistan to the north, east and southeast, Sariosia district to the northwest, Kumkurgan district to the south, Shorchi district to the southwest, and Denov district to the west. The area of district is 1.63 thousand square km. The territory of the district is 78.2 km from north to south, 42.1 km from east to west. The total length of its borders is 373.9 km. The population is 185,510 people (In 2024 y.). The eastern and western borders of Uzun district pass through natural objects. In the east, the border with Tajikistan passes through the Kafirnikhan River. In the west, it is separated from Denov district by the Surkhandarya river. The eastern and western borders of Uzun district correspond to natural objects. In the east, the border with Tajikistan corresponds to the Kafirnihan river. In the west, it is separated from Denov district by the Surkhandarya river.

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The following **methods** have been used in this research: remote sensing, field research methods, cartographic and aerospace methods.

This research work has been carried out in the following stages: 1) The borders of the landscapes in Uzun district have been determined and the landscapes have been classified; 2) The area of landscapes and their

population have been determined; 3) Population density in landscapes has been calculated; 4) A map of population density by landscape has been created; 5) The impact of natural features of landscapes on population density has been analysed.

In the literature devoted to landscape science, it is mentioned that historical-evolutionary criteria, genetic criteria and structural criteria are used to distinguish landscape types and define their borders. Classification based on only one of them is not always accurate and precise. Therefore, it is better to follow one or more of these criteria.

The historical-evolutionary criteria reflect the historical sequence and inheritance in the formation and development of landscapes. Their emergence and development takes place in a certain historical period of the Earth's development. On the basis of this criteria, the species of landscape formed on the river terraces of the Surkhandarya river and its tributaries and the Kafirnihan river in Uzun district are distinguished. River terraces are formed in different historical periods. Therefore, they differ from each other in terms of geomorphological structure of rocks, soils, vegetation cover. In most cases, the boundaries of landscape species coincide with the boundaries of terraces.

The genetic criteria are to determine the factors that caused the landscapes to appear, to what extent their internal genetic commonality, integrity or diversity is. The genesis and evolution of landscapes ensures that their internal structure is unique. Therefore, the structural criteria allow determining the main signs of succession in the genesis of landscapes and the sequence of its formation.

The theory developed by V. A. Nikolayev has been used as a basis for the classification of Uzun district landscapes. Below are the taxonomic entities recommended by this scientist and their separation criteria (Table 1).

Table 1. Classificatory Landscape Categories and their Criteria by V.A.Nikolayev[5] and examples of them from the Uzun district

Taxons	Classification Criteria	Examples from the Uzun district
Division	Type of contact and interaction between geospheres in the structure of the earth's landscape envelope	Terrestrial landscapes
System	Energetic basis of landscapes: zonal differences in the water and heat balance	Subtropical landscapes
Subsystem	Sectoral climatic differences, continentality of climate	Highly continental landscapes
Class	Higher-order morphostructures (elements of the megarelief); types of natural zonality (horizontal or vertical).	Mountains landscapes
Subclass	Second-order morphostructures (morphogenetic subdivisions of the macrorelief).	Low mountains landscapes
Group	Type of geochemical and water regime, determined by the relation· ship between atmospheric, surface and subsurface moisture, and drainage conditions.	Semihydromorphic
Type	Bioclimatic and soils criteria at the level of soil types and classes of vegetation formations (zonal in the case of the eluvial group of landscapes).	Forest-meadow-steppe (lower mountain) landscapes
Subtype	Bioclimatic and soils criteria at the level of soil subtypes and subclasses of vegetation formations (sub zonal in the case of the eluvial group of landscapes).	-
Genus	Genetic landform types	Erosional-accumulative terraces formed in the Syrdarya complex, where accumulative landforms are widespread
Subgenus	Genetic types and lithology of sur· face rocks.	-
Species	Similarity of dominant urochisltche (units) in the landscape.	Sand-gravel floodplains, islands and riverbeds with river forest plants on thin alluvial-sandy soils

After defining the boundaries of the landscape, the population density in them is calculated. In order to determine the population density, the area of landscapes and population data are needed. The area of the landscapes is calculated using ArcGIS 10.8 software with an accuracy of 0.001. In the calculation of the population in the landscapes, the information about neighbourhoods in Uzun district (map of neighbourhoods, number of residents in neighbourhoods, number of households in neighbourhoods) obtained from the authorities of Uzun district is used. The boundaries of the neighbourhoods within the landscape are determined. If one neighbourhood is located in two landscapes, the proportion of its population that corresponds to a certain landscape is divided according to the number of households in the neighbourhoods For example, the total population of the Serharakat neighbourhood, which is located in the 3rd and 7th landscape, is 3830 people, the number of households is 690, and each household in this neighbourhood has an average of 3830:690=5.5 people. From the image map from Google earth.com, it is found that 48 houses are located in landscape 7, 48*5.5=264 people in this neighbourhood live in this landscape, and 3830-264=3566 people live in landscape 3.

To determine population density, the population of landscapes is divided by their area. For example, the population of the 3rd landscape species is 57,657 people, the area is equal to 60.45 sq.km. The population density is equal to 57,657 people/60.45 sq.km.=953.8 people/ sq.km.

3. Results

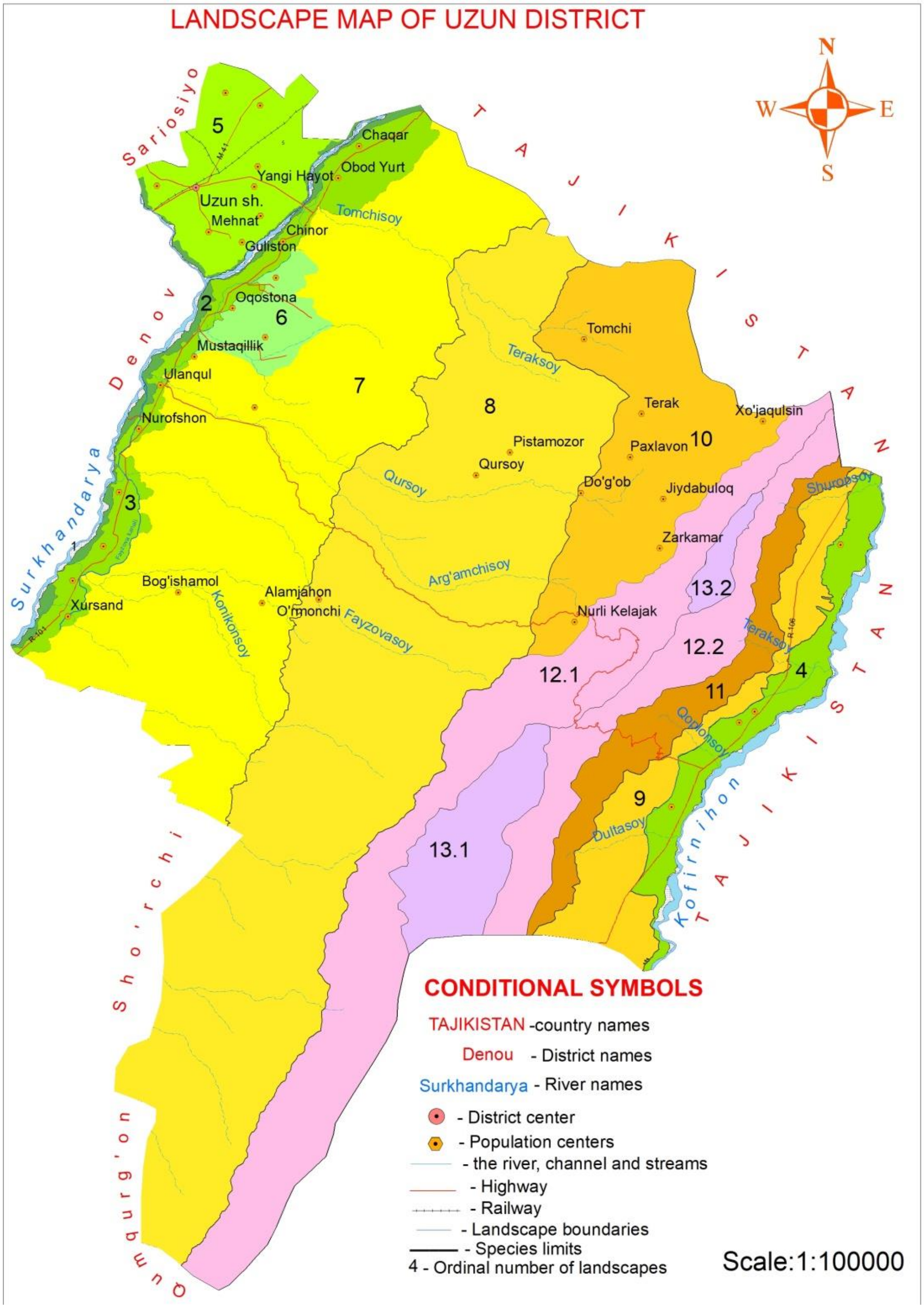
The landscapes of Uzun district are classified and it is determined that there are 1 landscape class, 3 landscape types, 6 landscape genuses, and 13 landscape species in this area (Table 2).

Table 2. Classification of landscapes of Uzun district

Division		Terrestrial landscapes
System		Subtropical landscapes
Subsystem		Highly continental landscapes
Class		Mountains landscapes
Subclass		Low mountains landscapes
Type	Genus	Species
A type. Ephemeral and ephemeroid desert-steppe (lower adir*) landscapes	I Genus. Erosion-accumulative floodplains and riverbeds	1-species. Sand-gravel floodplains, islands and riverbeds with river forest plants on thin alluvial-sandy soils
	II Genus. Erosional-accumulative terraces formed in the Syrdarya complex, where accumulative landforms are widespread	2-species. Flat terraces of Surkhandarya with clay-sand-gravel (alluvial) deposits with grasses and irrigated cultivated plants on alluvial-meadow soils
		3-species. Flat terraces of Surkhandarya with clay-sand-gravel (alluvial)deposits with irrigated cultivated plants on sierozem-meadow soils
		4-species. Flat terraces of Kafirnihan river with clay-sand-gravel (alluvial-proluvial) deposits with irrigated cultivated plants on sierozem-meadow soils
	III Genus. Terraces formed in the Mirzachol complex consisting of accumulative relief forms	5-species. Flat terraces of Karatog river with clay-sand-gravel (alluvial) deposits with irrigated cultivated plants on sierozem-meadow soils

	IV Genus. Wave-shaped erosional accumulative terraces formed in the Tashkent complex consisting of erosional relief forms	6-species. Slightly wave plains with weakly dissected sloping consisted of loess deposits with irrigated cultivated plants on typical sierozem soils
		7-species. Undulating surfaces, hills consisted with loess deposits with dry cultivated vegetation, different grasses and sedges on typical sierozem soils
B type. Dry steppe (high adir) landscapes	V Genus. Slopes of low mountains consisting of erosional-accumulative-denutative landforms	8-species. Strong and deeply fragmented gentle slopes with loess with mixed herbaceous-sedge-pistachio and in some places dry cultivated vegetation on dark sierozem soils
		9-species. Moderately and strong fragmented proluvial conical surfaces with wild wheat-betaga-cultivated dry vegetation on typical sierozem soils
	VI Genus. Slopes of medium-height mountains with tectonic-erosion-denutation, weakly fragmented, erosion-denutation landforms	10-species. The north-western, weak and moderately fragmented slopes of Bobotog mountain with sands, gravels, small-stone rocks with dry cultivated plants-wheat-shrubs on dark sierozem soils
		11-species. The eastern steep slopes of Bobotog with erosion landforms with various bush-wild wheat-betaga-sagebrush-various grass on dark sierozem soils
D type. Forest-meadow-steppe (lower mountain) landscapes	VII Genus. Watersheds in medium-height mountains with tectonic-erosion-denutational landforms and steep slopes adjacent to them.	12-species. Watersheds and steep slopes adjacent to them with jagged-large stones, bedrocks with pistachio-various bush-wheat on strongly washed talc particle-skeletal light brown soils
		13-species. Mountain peaks and watersheds with bedrocks (sandstone, limestone) with juniper-various bushes-various grasses on stony-coarse skeletal brown, high mountain soils

Adir*- In the territory of Central Asia, the foothill zone occupies heights from 400-500 m to 1000-1200 m


LANDSCAPE MAP OF UZUN DISTRICT
N
W
E
S
Sariosiyo
T A J I K I S T A N
Denov
Surkhandarya
Sho'rchi
Qumqo'rg'on
Kofirnihon
Chaqar
Obod Yurt
Yangi Hayot
Uzun sh.
Mehnat
Chinor
Guliston
Tomchisoy
Oqostona
Mustaqillik
Ulanqul
Nurofshon
Bog'ishamol
Xursand
Konikonsoy
Alamjahon
O'rmonchi
Fayzovasoy
Tomchi
Teraksoy
Terak
Xo'jaqulsin
Pistamozor
Qursoy
Paxlavon
Do'g'ob
Jiydabuloq
Zarkamar
Arg'amchisoy
Nurli Kelajak
Shuropsoy
Qoplonsoy
Dultasoy
1
2
3
4
5
6
7
8
9
10
11
12.1
12.2
13.1
13.2
CONDITIONAL SYMBOLS
TAJIKISTAN -country names
Denou - District names
Surkhandarya - River names
- District center
- Population centers
- the river, channel and streams
- Highway
- Railway
- Landscape boundaries
- Species limits
4 - Ordinal number of landscapes
Scale:1:100000

a)

1-species. Sand-gravel floodplains, islands and riverbeds with river forest plants on thin alluvial-sandy soils

2-species. Flat terraces of Surkhandarya with clay-sand-gravel (alluvial) deposits with grasses and irrigated cultivated plants on alluvial-meadow soils

3-species. Flat terraces of Surkhandarya with clay-sand-gravel (alluvial)deposits with irrigated cultivated plants on sierozem-meadow soils

4-species. Flat terraces of Kafirnihan river with clay-sand-gravel (alluvial-proluvial) deposits with irrigated cultivated plants on sierozem-meadow soils

5-species. Flat terraces of Karatog river with clay-sand-gravel (alluvial) deposits with irrigated cultivated plants on sierozem-meadow soils

6-species. Slightly wave plains with weakly dissected sloping consisted of loess deposits with irrigated cultivated plants on typical sierozem soils

7-species. Undulating surfaces, hills consisted with loess deposits with dry cultivated vegetation, different grasses and sedges on typical sierozem soils

8-species. Strong and deeply fragmented gentle slopes with loess with mixed herbaceous-sedge-pistachio and in some places dry cultivated vegetation on dark sierozem soils

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10-species. The north-western, weak and moderately fragmented slopes of Bobotog mountain with sands, gravels, small-stone rocks with dry cultivated plants-wheat-shrubs on dark sierozem soils

11-species. The eastern steep slopes of Bobotog with erosion landforms with various bush-wild wheat-betaga-sagebrush-various grass on dark sierozem soils

12-species. Watersheds and steep slopes adjacent to them with jagged-large stones, bedrocks with pistachio-various bush-wheat on strongly washed talc particle-skeletal light brown soils

13-species. Mountain peaks and watersheds with bedrocks (sandstone, limestone) with juniper-various bushes-various grasses on stony-coarse skeletal brown, high mountain soils

b)

Figure 1. a) Map of lanscape species of Uzun district; b) Description of lanscape species

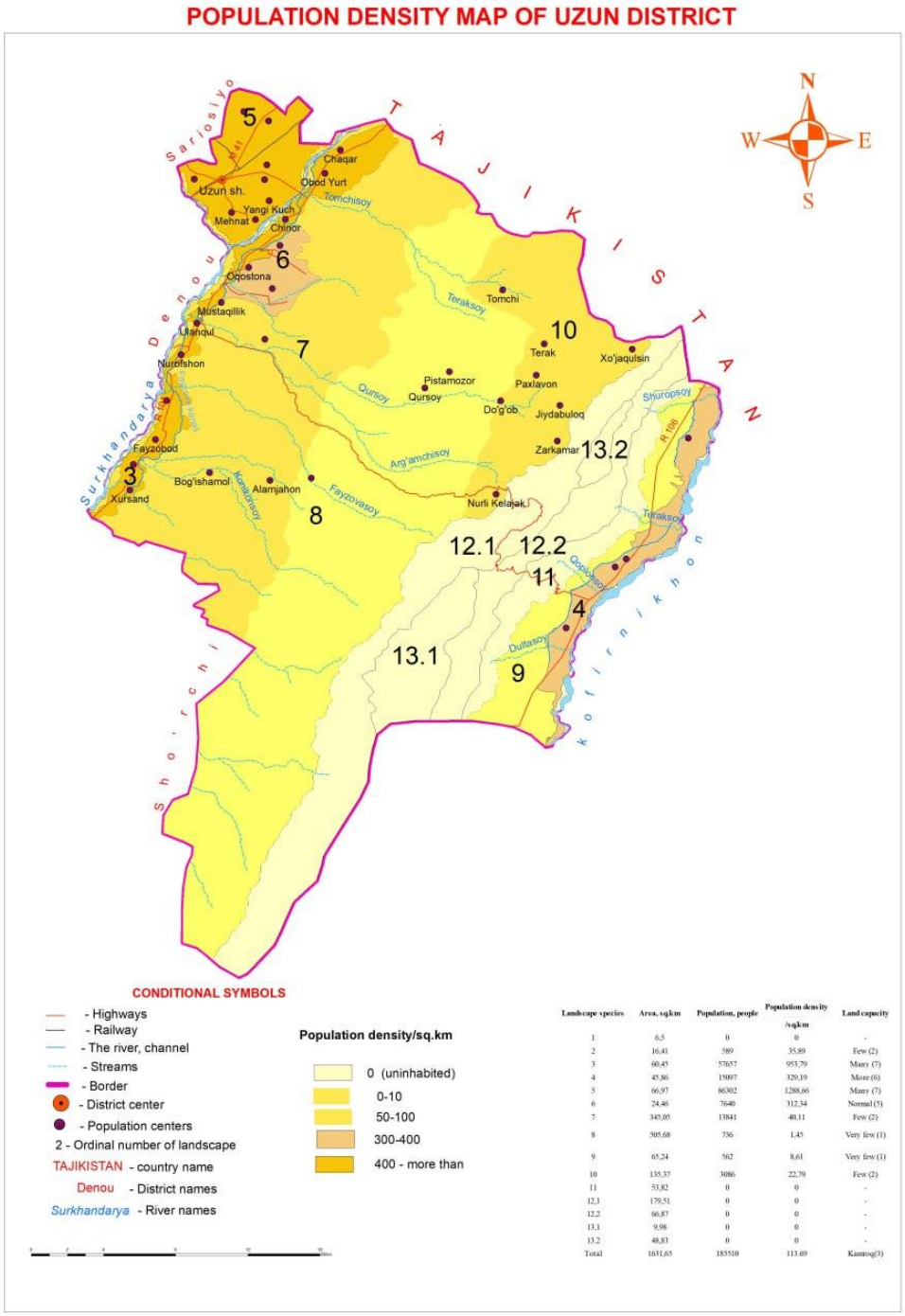
To calculate population density in landscapes, the number of people in them is divided by the area of the landscape. Based on the population density in the landscapes, the level of their land capacity has been estimated (Table 3).

In determining the "land capacity", 7 criteria by Sh.Sharipov and A.Rakhmatullayev are used: 1) 0-10 people/sq.km- very few; 2) 10-50 people/sq.km-few; 3) 50-100 people/sq.km-slightly few; 4) 100-200 people/ sq.km- a few; 5) 200-300 people/sq.km-normal; 6) 300-400 people/sq.km-more; 7) more than 400 people/sq.km -many.

In Uzun district, "Earth capacity" (anthropogenic load) in the 3rd and 5th landscape species is "Many", in the 4th landscape species "More", in the 6th landscape species "Normal", in the 2nd, 7th, 10th landscape species " Few", it was found to be "Very few" in the 8th and 9th landscape species (Table 3).

Table 3. Population density and land capacity in the landscapes of Uzun district

Landscape species	Area, sq.km	Population, people	Population density kishi/sq.km	Land capacity
1	6,5	0	0	-
2	16,41	589	35,89	Few (2)
3	60,45	57657	953,79	Many (7)
4	45,86	15097	329,19	More (6)
5	66,97	86302	1288,66	Many (7)
6	24,46	7640	312,34	Normal (5)
7	345,05	13841	40,11	Few (2)
8	505,68	736	1,45	Very few (1)
9	65,24	562	8,61	Very few (1)
10	135,37	3086	22,79	Few (2)
11	53,82	0	0	-
12,1	179,51	0	0	-
12,2	66,87	0	0	-
13,1	9,98	0	0	-
13.2	48,83	0	0	-
Jami	1631,65	185510	113.69	Slightly few (3)



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12,2	66,87	0	0	-
13,1	9,98	0	0	-
13,2	48,83	0	0	-
Total	1631,65	185510	113,69	Kamroq(3)

Figure 2. Population density in landscape species of Uzun district

4. Discussion

The most densely populated landscapes correspond to the II-III terraces of the Surkhandarya River. Because of the flatness of the relief, thick and fertile soil layer, ease of irrigation and availability of water. Terraces II-III of Surkhandarya correspond to landscape species 3, 5, and terrace II of the Kafirnihan river has landscape species 4. Since water is the main problem in arid regions, in landscape species 3, 4, 5, people have long brought water in canals and cultivated the land. Landscapes species 8, 9, 11, 12, 13 are difficult for people to live in. Due to the fact that these landscapes are located in Bobotog, there are no permanent streams and potable water, so they are almost uninhabited.

Population density in landscapes is one of the main indicators in determining the amount of anthropogenic load and determining the "Earth capacity" criterion. There is no single opinion about the

anthropogenic load in the literature. Below are the opinions and comments of several scientists in this regard.

There are many opinions on the concept of anthropogenic load. Y.A. Izrail defines the concept of anthropogenic load as follows: "Anthropogenic load may not change the quality of the environment surrounding organisms or may change it only at the level of the permissible norm. These changes should not disturb the current state of balance in ecosystems and should not cause adverse consequences in populations. If the anthropogenic load exceeds the norm, the balance in the ecosystem will be disturbed and it will suffer great damage" [1].

A.G. Isachenko [2] understands the stability of geosystems against external influences by the anthropogenic load on geosystems. In his opinion, the excessive anthropogenic load disrupts the balance in geosystems.

S.Y. Mirskhulova [3] explains that the anthropogenic load is the sum of all types of anthropogenic effects on geosystems. Emphasizes that the amount of anthropogenic load should not exceed the permissible level (REM), otherwise various negative natural geographical processes (slippage, erosion, desertification, soil degradation, etc.) may develop in geosystems.

Y. Odum calls the antropogenic load in ecosystems anthropogenic stress and divides it into 2 groups: severe stress and chronic stress. Severe stress occurs in a short time, in this case, the process of restoring the previous state of landscapes is faster. For example, the cutting of forests on the Surkhandarya and Kafirnihan rivers in Uzun district is an example of severe stress, and if such an impact is stopped, the forests will return to their original state. Chronic stress takes its toll slowly over a long period of time. For example, the irrigation canals flowing from the Surkhondarya and Karatog rivers (Atan, Astan-1, Fayzova, etc.) deposit various muddy deposits in the Uzun district, evaluating their impact on the landscapes of the Uzun district, their participation in the exchange of matter and energy in the landscapes is a rather complicated matter.

5. Conclusion

Land capacity is considered as one of the indicators in anthropogenic load assessment. If the land capacity exceeds the norm, negative situations such as a decrease in the stability and resource potential of landscapes, a destruction of the ecological situation that has been formed for a long time, and a violation of substance and energy exchange in landscapes occur.

The purpose of creating a population density map of Uzun district is to determine which landscapes have land capacity at the "normal" level, and which landscapes are higher or lower. Because population density is one of the indicators that affects the stability of landscapes, especially its ecological potential. In order to keep the ecological balance in geosystems at a certain level, and to prevent it from being damaged, it is necessary to develop specific standards for the impact of economic activities on landscapes.

Population density is important in determining the anthropogenic load and assessing the "Land capacity". The higher the population density, the stronger the anthropogenic impact on landscapes.

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