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DEVELOPMENT OF NOSOGEOGRAPHIC MAPS OF THE REPUBLIC OF KARAKALPAKSTAN USING GIS TECHNOLOGIES

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ABSTRACT: This article addresses the methodological issues of using GIS technology in the development of nosogeographic maps that reflect the medical and geographical position of the Republic of Karakalpakstan. In the process of doing research, the territorial differentiation of morbidity of the population of the Republic of Karakalpakstan was identified and the geographical features of their distribution were highlighted. Differences in the northern and southern regions of the Republic of Karakalpakstan are mentioned, and the reasons for this discrepancy are given. All data had been collected from the Ministry of Health care and Department of Statistics of the Republic of Karakalpakstan. The infant mortality rates and population are calculated separately by districts, and these data are compared across the country. A series of nosogeographic maps, showing the medical and geographic situation in the administrative districts of the Republic of Karakalpakstan, was developed in ArcGIS 10.1. Statistical, cartographic, comparative geography, extrapolation, epidemiological and other research methods were used in scientific and applied research. As a result of the research, a number of nosogeographic maps were created. Proposals and recommendations for improving the creation of nosogeographic maps were made using GIS technologies. We believe that these maps will help governments and medical authorities more effectively implement medical and other ecological activities and plan their future work.

KEYWORDS: GIS technology, Infant mortality, Geographical features.

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I. INTRODUCTION

In recent years, a great deal of work is being done in our country to modernize the economy, radically improve the welfare of the population and develop the healthcare system. In particular, the problem of the Aral Sea was reliably presented by the President of the Republic of Uzbekistan Sh.Mirziyoyev at the UN General Assembly. Within the framework of the Conception of Sustainable Development in the Republic of Karakalpakstan, where the ecological situation is severe, it is mentioned that there is a strong need in scientific implementation of new ecological policy, solution to social problems related to migration processes and employment of rural population, financial support of the private sector, creation of the investment basis, and it is necessary to create additional workplaces by establishing joint ventures in the northern districts of the country.

It is known that in recent years, environmental pollution, ecological safety of the population and territories have become one of the most important problems in the world. According to the World Health Organization (WHO), about 24% of the world's population and 23% of deaths are caused by the detrimental effects of preventable ecological factors [14]. Therefore, the scientific study of the territorial differences in the morbidity rate of the population of the Republic of Karakalpakstan and its geographical features is one of the most important issues at present. Moreover, the connection between population morbidity and harmful ecological factors in the region

should be determined from the medical and geographic perspective. It is preferable to use Geographic Information Systems (GIS) software for the development of serial nosogeographic maps reflecting the medical and geographical situation in the administrative units of the Republic.

The main purpose of the research is the development of demographic, medical-geographical and nosoecological situation maps of the Republic of Karakalpakstan, identifying the connection of population health with harmful ecological factors, as well as development of scientifically based proposals and recommendations for the sustainable development of the Republic of Karakalpakstan.

II. MATERIALS AND METHODS

2.1 Study area

The Republic of Karakalpakstan is located in the northwest of Uzbekistan, relatively far from its industrial centers, with an area of 166,600 square km and a population of 1942,400 people (01.01.2020). Administrative and territorial structure of the Republic with the creation of Bozatau district in 2019 with the aim of developing animal breeding in the country, it consists of 16 districts and 1 center - Nukus. The Republic borders on Kazakhstan, Turkmenistan, as well as with Bukhara, Navoi and Khorezm regions. Location of the study area map is given in Fig.1

Despite the fact that Karakalpakstan accounts for 37.1% of Uzbekistan's territory and 5.6% of the population, GDP accounts for 3.3%, including industry - 3.9% and agricultural products - 2.9% (2016). In 2011, this figure was 2.4%, 1.6% and 2.7% respectively. As it is known, in recent years, despite the growth in industrial production in the Republic of Karakalpakstan we can see that its economic development rate is much lower than the country's average economic indicators. Consequently, increasing the volume of gross regional product delivering to the level of the population gives the opportunity to eliminate not only economic problems but also social issues in Karakalpakstan.

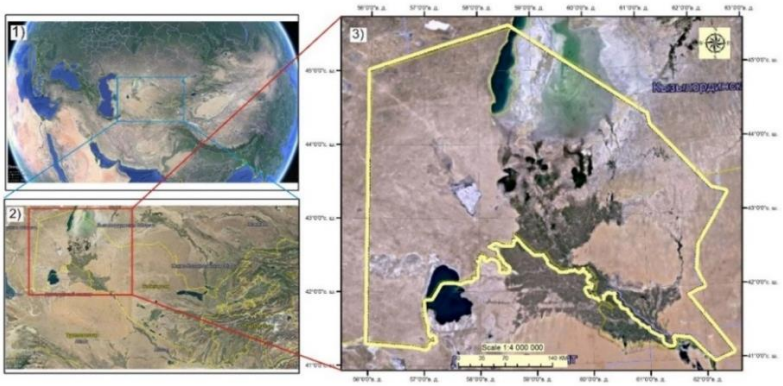

Fig. 1: Study Area Map Shows Republic of Karakalpakstan. 1) Central Asia 2) Uzbekistan 3) Karakalpakstan. (Source: Google Earth)

2.2 Data collection

We have collected all data from the Ministry of Health care and Department of Statistics of the Republic of Karakalpakstan. The infant mortality rates and population are calculated separately by districts, and these data are compared across the country. The lowest infant mortality rate from 2007 to 2018 was recorded in 2011, with the highest reported in 2018 (Fig. 2).

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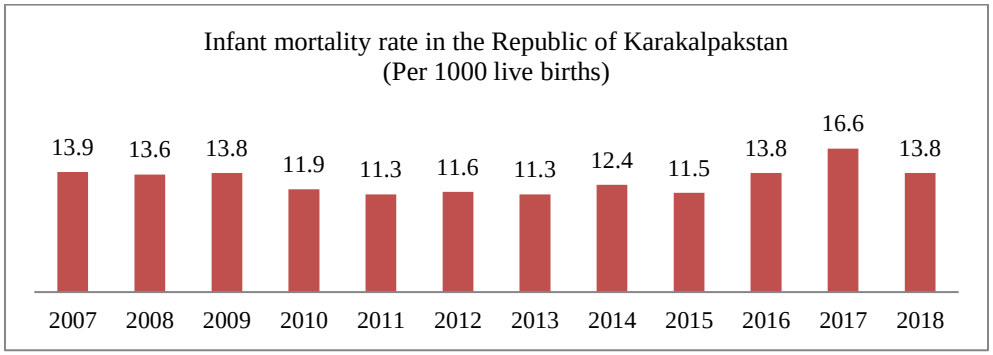

Fig. 2: Infant Mortality Rate

Respiratory diseases have increased in several districts in 2018 except Beruni, Amudarya, Kanlikul, Karauzak and Nukus districts. Especially in Nukus city, Turtkul and Ellikkala districts this indicator is higher than in other districts. Various factors may have contributed to this. In the Amudarya district, in 2018, the number of people with respiratory infections is slightly lower than in 2017. In Takhiatash and Moynak, few people have this disease. The reason for such low rates in Takhiatash and Moynak is that live fewer population in the districts (Fig. 3).

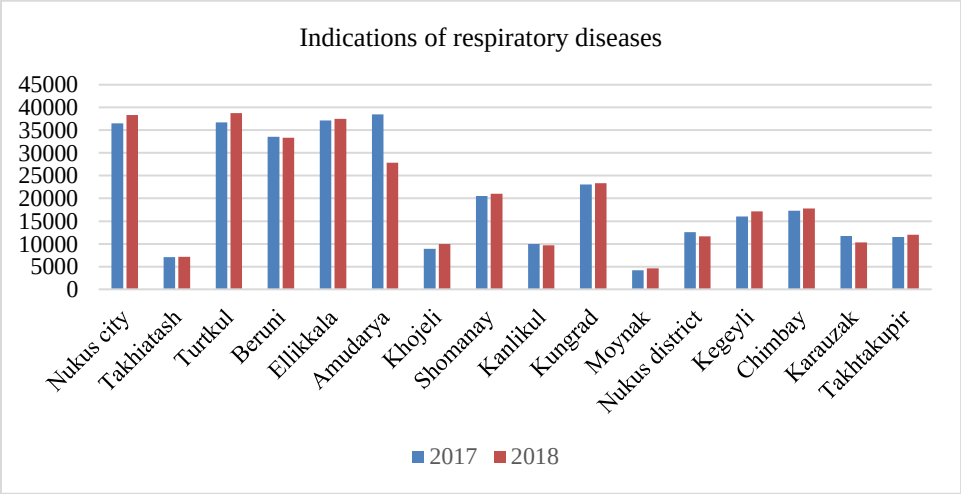

Fig. 3: Respiratory Diseases

According to the department of Statistics of the Republic of Karakalpakstan, in 2018, the population of Moynak district is seven times less than in Turtkul district. By diseases of dangerous tumors in the intensive index, the Moynak district population is more than Turtkul in 2018. This is because of the environmental damage to the people living in Moynak district and it also depends on the geographical location of Moynak. Because of the drying of the seabed here, salty dust from the seabed is raised under the influence of strong winds and penetrates the Moynak area, and has an impact on the population. This salty sandstorm also contains other chemical compounds such as herbicide and pesticide. This means that more nosogeographical research needs to be done for the population of the Republic of Karakalpakstan. From 2013 to 2016, Takhiatash district was administratively part of Khojeli district, and because of this, the table below shows indicators for these years have been added to the Khojeli district (Table 1).

Table 1: Diseases of Dangerous Tumors (per 100 000 people)

№	City/district	Patients first identified													
		Absolute number							Intensive index						
		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1	Nukus city	172	235	223	247	204	250	221	59,7	80,4	74,9	81,7	67,2	80,9	70,6
2	Takhiatash	37	-	-	-	-	57	45	78,2	-	-	-	-	79,7	62,2
3	Turtkul	86	163	148	128	171	173	124	45,9	85,4	76,1	64,7	85,6	84,5	59,5

4	Beruni	104	106	100	112	113	111	126	62,6	62,8	58,1	63,8	63,8	60,9	67,8
5	Ellikkala	29	86	65	97	77	112	88	21,2	61,8	45,8	66,9	52,5	74,0	57,0
6	Amudarya	97	112	74	86	100	107	131	55,3	62,9	41	46,7	53,9	56,3	67,7
7	Khojeli	94	125	140	157	110	119	76	69,9	68,4	75,9	84,3	58,7	100,0	63,1
8	Shomanay	26	22	22	39	31	29	31	49,6	41,6	41,2	72,4	57,2	52,8	56,0
9	Kanlikul	49	30	27	24	42	48	37	106,5	64,4	57,2	50,1	87,0	97,2	74,0
10	Kungrad	76	76	72	81	81	84	71	64,4	63,7	59,6	66	65,5	66,7	55,6
11	Moynak	23	27	26	25	20	24	23	79	92,1	87,8	83,3	66,2	78,2	74,0
12	Nukus district	37	33	37	32	42	47	31	83,7	74,3	82,8	70,3	91,1	98,5	63,8
13	Kegeyli	59	66	52	54	62	62	70	70,7	78,2	61	62,5	71,3	70,1	78,5
14	Chimbay	75	71	73	91	104	105	85	70,3	65,9	67	82,5	93,5	92,7	74,2
15	Karauzak	32	28	27	38	30	41	38	65,4	56,7	54	75,1	59,1	79,3	72,8
16	Takhtakupir	23	25	26	26	28	24	50	59,4	64,6	67	66,7	71,6	60,6	125,6
Total of Rep. of KK:		**1019**	**1205**	**1112**	**1237**	**1215**	**1393**	**1247**	**59,8**	**69,9**	**63,6**	**69,6**	**67,8**	**76,1**	**67,2**

2.3 Methodology

Statistical, cartographic, comparative geography, extrapolation, epidemiological and other research methods were used in scientific and applied research. Zoning methods and typologies of the phenomena processes under investigation were also applied. The study utilizes systematic, program-targeted and situational approaches for the organizing of environmental monitoring of the situation of the environment by State, scientific and public organizations, and ensures the integration of the environment and health care sectors into addressing ecological and health care issues [10].

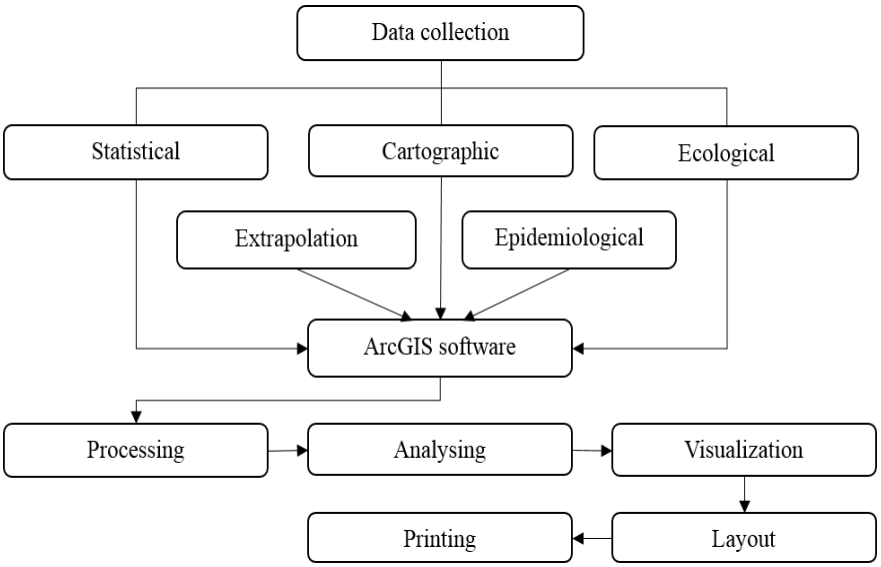

Fig. 4: The Methodology of Creating a Map

The process of creating nosogeographic maps involves several steps. In the first step, the data collection process is carried out, which collects mostly statistical, cartographic, environmental, extrapolation and epidemiological data. In the second step, the data is loaded into ArcGIS and the data is processed as well as the data is analyzed for years. In the third step, the data is visualized, where cartographic imaging methods are selected for imaging and the corresponding mapping method is used. In the next step, the data is visualized, where cartographic imaging methods are selected for imaging and a suitable cartographic imaging method is used. Then the layout process is done, and in the final step, the map is prepared for publication and published.

III.RESULTS

As a result of the research, a number of nosogeographic maps were created using the above methodology. Figure 5 below shows a map of the infant mortality rate of the Republic of Karakalpakstan. On these maps, the data for 2007, 2012, 2017, and 2018 are illustrated by the cartogram method. On the map, Infant mortality rates are divided into four classes and illustrated in separate colors. Per 1,000 live births in the first class 7.1-10.5 children, in the second class 10.6-14.8 children, in the third class 14,9-18,6 children and in the fourth class -

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18.7-25.2 children died. Basically, in the 4th class were the districts of Kungrad, Beruni, Nukus and Shomanay in 2007 and in 2012 were the districts of Moynak and Nukus. We also see that in 2017, in the fourth class were Kegeyli and Nukus districts and by 2018 were the Moynak, Kegeyli and Nukus districts.

Figure 6 below shows a map of the population of the Republic of Karakalpakstan as of 2018 for the number of patients with respiratory diseases and dangerous tumors. Cartographic imaging of the data for these diseases was mainly used by the point symbols method. Classification of respiratory tract diseases is divided into 5 classes: 7386.2-9741.7 in the first class, 9741.8-15108.3 in the second class, 15108.4-19894.0 in the third class, 19894.1-28939.7 in the fourth class and 28939.8-37088.4 people in the fifth class. On this map, we can see that the Shomanay district is included in the fifth class. It is also divided into 5 classes to describe dangerous tumors patients. The number of patients per 1000 population is shown 23-38 in class 1, 38.1-50 in class 2, 50.1-88 in class 3, 88.1-131 in class 4, and 131.1-221 in class 5. The map shows that Khojeli district is predominantly in the fifth class, and the lowest one is in Shomanay, Kanlikul, Nukus and Karauzak districts.

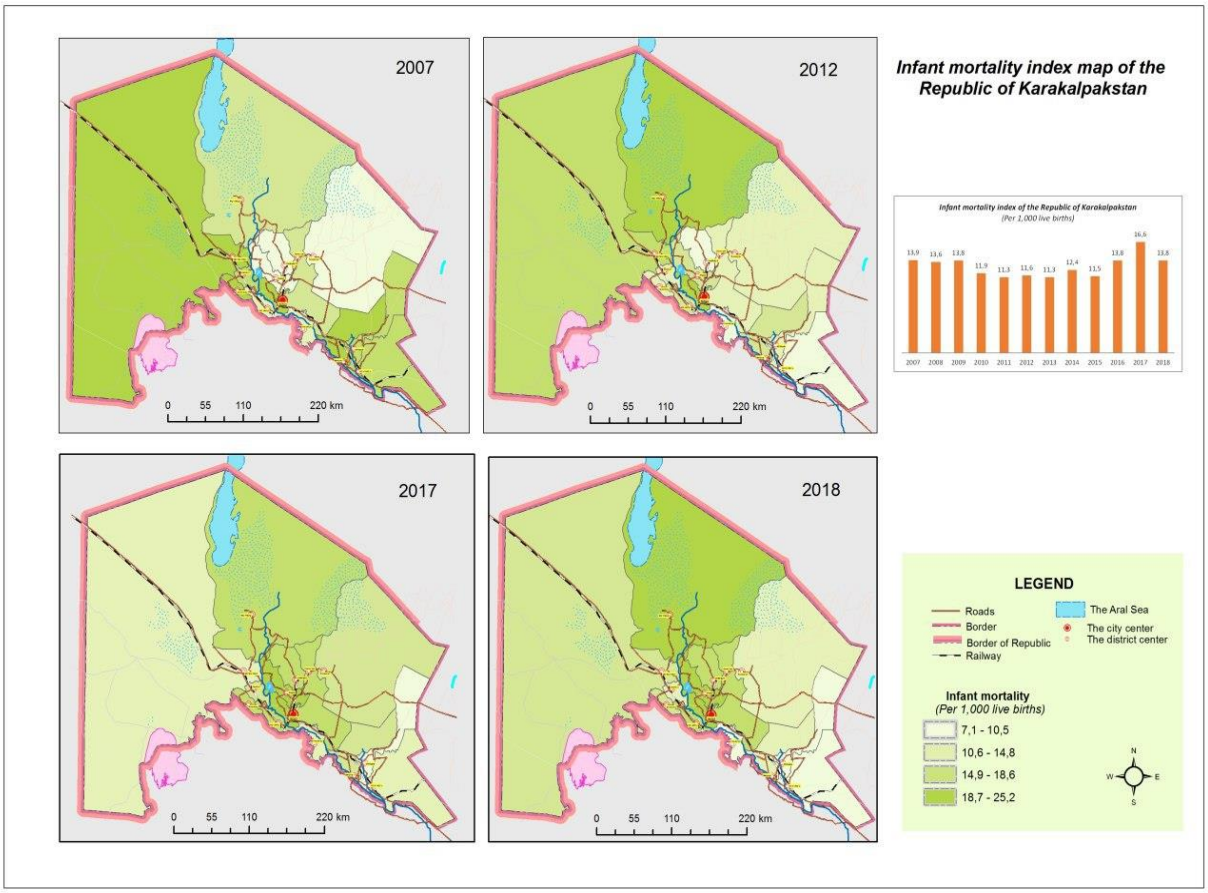

Fig. 5: Infant Mortality Index Map of the Republic of Karakalpakstan

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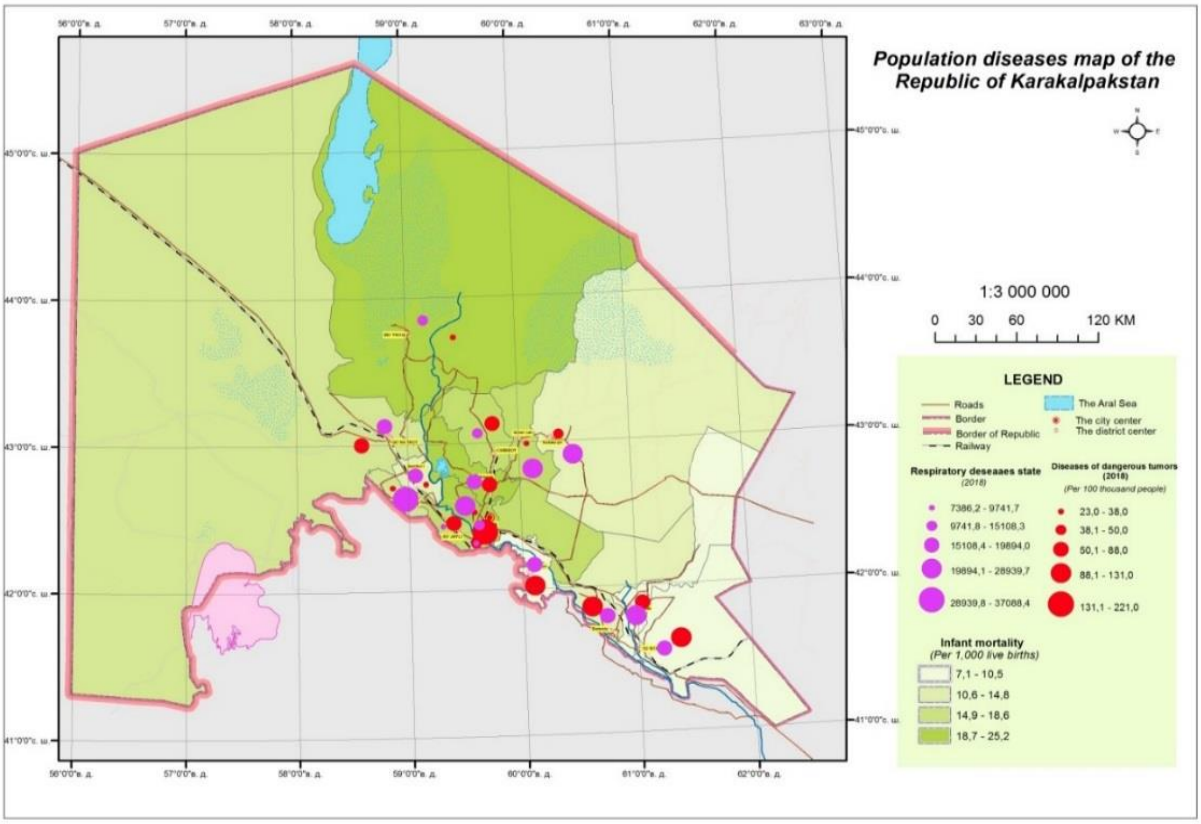

Fig. 6: Population Diseases Map of the Republic of Karakalpakstan

IV. DISCUSSION

Problems of environmental impact on population health in the world and in Uzbekistan are widely covered in the scientific literature. Most publications are concerned with the state of the environment and the problems of environmental pollution [3, 5, 6, 9, 13].

Many works on medical geography are known, and are widely used not only descriptive but also by statistical, cartographic, and historical methods [2, 16].

Some authors connect medical geography to the development of new territories, migration of large groups to new areas, and migration [18].

Other scientists connect medical geography to the level of economic development and economic growth rates of the country [17, 8, 12].

Some researchers say the essence of the disease is not an external factor but also that the body, which is the basis of the mechanism of the disease, lies in its reaction to its emergence [7].

V.V.Davdovski believes that it is impossible to study human biology without considering the social conditions in which he lives and works [19].

Uzbek geographers, ecologists, doctors and hygienists confirm the homogeneity of Uzbekistan's natural environment, this entails comprehensive research, which is based on point of view and opens the way to a new industry – nosoecology [1, 4, 11, 15].

In our opinion, when conducting medical and geographical studies, it is important to take into account that nosogeography and nosoecology, the variability of space and time, environmental factors that cause health hazards and diseases, can be affected in different combinations.

V. CONCLUSION

In conclusion, we can say that during the research, in the Republic of Karakalpakstan increased the number of various diseases as well as infant mortality caused by the severe impact of the Aral ecological problem. Reducing

and preventing these negative consequences is one of the most important processes. The most efficient way to implement these processes is GIS technologies. It is necessary to create nosogeographic database for the region using GIS technologies. It is also necessary to regularly update nosogeographic information and on this basis, we consider it necessary to create nosogeographic maps. We believe that these maps will help governments and medical authorities more effectively implement medical and other ecological activities and plan their future work. It also contributes to the preliminary study, analysis and elimination of ecological impacts on the environment and public health through GIS technologies.

VI. ACKNOWLEDGEMENT

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