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Research Article

COMPLEX ESTIMATION OF THE ENVIRONMENTAL STATE IN THE REPUBLIC OF UZBEKISTAN FROM THE POSITION OF FAVORABILITY FOR THE QUALITY OF LIFE

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ABSTRACT
The article presents the results of studies on the impact of climate resources, soil resources and desertification processes on the living conditions of the population. The results of the development of an estimated synthetic map of zoning of the territory are presented through a comprehensive analysis of the maps of the desertification processes effects, soil and climatic resources on public health, taking into account their importance. The studies were carried out on the basis of the methods of mathematical modeling and GIS technologies.

***Keywords*:** *environment, quality of life and human health, soil and climatic resources, ecosystem desertification, mathematical modeling, GIS technology.*

INTRODUCTION
The Charter of the World Health Organization refers to the highest level of health as one of the fundamental human rights. The leading countries of the world consider the health of the population the highest priority of the state. By definition, WHO health is a state of complete socio-biological and mental well-being, when the functions of all organs and systems of the human body are balanced with nature and the social environment and there are no diseases, illnesses or physical defects. About 85% of all diseases of modern humans are associated with adverse environmental conditions, the cause of which is largely anthropogenic. As a result, previously unknown diseases have appeared, the causes of which are very difficult to establish and they are more difficult to cure.
The living conditions and the health of the population, along with the way of life, the state of development of medicine, biological factors, etc., are greatly influenced by the state of the environment (Bolshakov *et al.,* 1999). Information on this issue from literary sources shows that among the main factors affecting the health of the population, 19.9% is the state of the environment. These data are consistent with the data of the World Health Organization (WHO), where it is noted that the state of public health is determined by 20% of the state of the habitat (atmospheric air, water quality, soil, desertification processes, food products, etc.) (Sanjeev *et al.,* 2012). Active human activity becomes source of environmental pollution. Environmental pollution leads to degradation and desertification of land, reduced soil fertility, aggravation of climatic conditions, loss of flora and fauna, deterioration of surface and groundwater quality, atmospheric air, etc. In aggregate, these processes lead to the extinction of entire ecosystems and biological species, deterioration living conditions and public health.
In the Republic of Uzbekistan, there is a steady increase in the average life duratiom of people, which indicates an active work to improve the quality of life and health of the population. Amendments have been made to a number of legislative acts aimed at improving the quality of life and increasing the level of welfare of the population. Uzbekistan ranks first in Central Asia in life duration. According to the World Bank, in 2013 this figure was 68 years. In 2015, the average life expectancy in Uzbekistan for men was 73.5 years, for women - 75.8 years. These figures are higher than the world average. At the beginning of 2018, the average (expected) life duration in the world was at about 71 years (according to the population department of the UN Department of Economic and Social Affairs)

Urgency of the problem.

At the same time, desertification, land salinization, degradation of soil and vegetation cover, surface water pollution, etc. continue to develop in the country. All these negative processes resulted from the use of inefficient irrigation and water management systems, irrational land use methods, etc. Aral crisis is the largest ecological and humanitarian catastrophe in the modern history of mankind, which broke out during 50 years only. Over 60 million people living in the Aral Sea basin were affected by it. The process of desertification encompassed vast territories. Aralkum, the sand and salt desert with an area of more than 5.7 million hectares appeared on the dried bottom of the sea, which served as the climatic regulator of the Aral Sea region. The entire region of Central Asia finds itself in a zone of permanent environmental risk that adversely affects the quality of life, health, and the gene pool of the population. These processes adversely affect the quality of life and health of the population (Rafikov 2018).

All the above indicates the relevance of research on the analysis and assessment of the environment state and on their results of developing maps of a comprehensive assessment of the territory of the republic from the standpoint of the impact on the life quality and its main component - public health.

This paper is devoted to the development of technology for the integrated assessment of the environment state and their impact on living conditions and public health. At this stage of work, the processes of desertification, soil-ecological and climatic resources act as components of the environment. According to the results of the analysis of the state of these environmental components, an integrated, synthetic map of zoning of the territory of the Republic of Uzbekistan was developed according to the degree of influence on the life quality of the population.

Purpose and objectives of the study

The main goal of the research is to develop a comprehensive analysis of the environment state based on the use of modern information technologies. In the process of research based on thematic zoning maps of climatic and soil resources, as well as desertification of ecosystems, an integrated synthetic map of zoning of the Republic of Uzbekistan is being developed according to the degree of influence on living conditions and public health. During the project implementation the following geomatic tasks were solved:

- analysis and updating of stock mapping material from the point of view of its use for the development of evaluation zoning maps and synthetic integrated maps;
- logical-mathematical processing of used cartographic material, where an important place is occupied by mathematical cartographic modeling;
- development of assessment zoning maps of the territory of Uzbekistan according to the degree of influence of climatic, soil resources and desertification processes on the quality of life and its main component - public health;
- development of a comprehensive environmental analysis technology based on the aforementioned thematic areas based on the use of modern information technologies;
- development on the basis of assessment maps for the above thematic areas of an integrated, synthetic regionalization map according to the degree of their impact on living conditions and public health.

The studies were conducted on the basis of integrated GIS technologies using mathematical modeling methods.

MATERIALS AND METHODS

Ecological research is being developed on the basis of an intensive and versatile application of the cartographic method. In turn, the modern cartographic method is based on the use of mathematical modeling methods, computer aids and GIS technologies.

Studies have shown that when developing evaluation zoning maps, the use of scoring allows a more objective and quick comparison of the objects or phenomena assessed. When conducting a comprehensive analysis of the environmental situation based on the processing of materials of various thematic areas, it becomes possible to obtain integral assessments taking into account the degree of importance both

between individual phenomena and objects within a particular thematic area and between these areas, which is difficult to make when assessing the verbal form. Logical and mathematical processing of the used cartographic material was carried out using the methods of the new direction of modern mathematics, known as "mathematics of fuzziness". In this case, the theoretical views of the founder of this direction, Lotfi A. Zadeh, were widely used (Zadeh L.A., 1965).

In the process of assessing and zoning territories, it is often necessary to operate with concepts that are fuzzy and vague (favorable, satisfactory, crisis, etc.). It is advisable to use the mathematical apparatus of the theory of fuzzy sets, developed by Lotfi A. Zadeh. The main idea of Zadeh was that the human way of reasoning, based on natural language, cannot be described within the framework of traditional mathematical formalisms (Abutaliev F.B. *et al.*, 2000). These formalisms are characterized by a strict unambiguity of interpretation, and everything connected with the use of a natural language has a many-valued interpretation. According to Zadeh, consistently pursuing the idea of fuzziness, one can construct fuzzy analogs of all the basic mathematical concepts and create the necessary formal apparatus for modeling human reasoning and the human way of solving problems (Kurbanov B.T., 2000).

Zadeh's main pragmatic goal is to create an apparatus capable of simulating human reasoning and explaining human decision-making techniques in solving various problems of environmental management.

The method based on Zadeh's research implies the rejection of the main statement of the classical theory of sets that some element can either belong or not belong to a set. This introduces a special set function, so-called membership function, which takes values from the interval [0,1]. The degree of ownership is expressed by number

$\mu_A(x), 0 \le \mu \le 1$

here A is a fuzzy set.

Under $\mu_A(x) = 0$ *x* does not belong to this set.

Under $\mu_A(x) = 1$ the element *x* completely belongs to the given set.

Under $0 < \mu_A(x) < 1$ the element *x* belongs to the set with the appropriate degree of confidence.

This method leads to continuum logic. Mathematics Lotfi A. Zadeh formalizes the expert's presentation of the features of the objects under study. The researcher gets into the hands of a certain mathematical apparatus, allowing to build estimates for difficultly formalized expert solutions. At the same time, the experts in this project were highly qualified specialists who know the analyzed subject area, who have experience in this subject, who know its features. These approaches are used for scoring in the development of assessment maps of regionalization of climatic, soil resources and the impact of desertification processes on the living conditions and health of the population of the Republic of Uzbekistan.

In the process of work, the project used the INTERGRAPH and ArcGIS software and hardware systems, the technologies of which provide a solution in the unified information environment of the whole range of complex tasks of environmental monitoring, spatial planning and management. In particular, when developing thematic maps in order to clarify the boundaries of areas with varying degrees of favorableness for the living conditions and health of the population, in necessary cases (Magdiev H.N., 2016). Earth remote sensing materials were used and three-dimensional terrain models were developed.

Assessment of climatic resources of the Republic of Uzbekistan.

Currently, the analysis of the influence of the environment on the living conditions of the population and their health is of particular relevance. Among the main factors that have a great impact on the living conditions of the population and its health, a significant role is played by climatic factors (solar radiation, average annual temperature in the territory of residence, etc.).

This unit of research is devoted to the results of assessing the impact of climate resources on the living conditions of the population. The assessment of climate resources is based on the selection and ranking of

the parameters of the main meteorological characteristics. A method of integral quantitative evaluation (in points) of the influence of climatic characteristics on different aspects of the population's life is proposed. Based on the results of the assessment based on long-term meteorological data, the stations developed a map of the climatic zoning of the territory according to the degree of favorableness to the living conditions of the population.

At the first stage, the assessment of the influence of climatic characteristics on the living conditions of the population was made on the basis of average annual values of meteorological parameters, taking into account the degree of their influence. For calculations and zoning, data from meteorological stations placed in the Climate Handbook, Vol. 19, having an observation period of at least 20 years, etc., were used.

It should be noted that the average or extreme values of individual climatic parameters can only serve as a rough estimate of the impact of climate on the state of human life. The main impact of climate in our opinion is manifested in the duration of an adverse weather phenomenon. Therefore, the influence of each meteorological characteristic was assessed mainly by its repeatability. For the overall identity of the use of characteristics, a 5-point grade of impact was introduced.

For annual values:

<60 days - 1 most favorable;
60-120 days - 2 points - favorable;
121-180 days - 3 points - average favorable;
181-240 days - 4 points - scarcely favourable;
> 240 days - 5 points - unfavorable.

Estimation by the value of the meteorological parameter was also carried out on a five-point scale. The list of meteorological parameters used is presented in Table 1.

Table 1 Criteria for meteorological point scores (by annual values)

Meteorological Characteristic	Influence degree of the factor				
	Most favorable	Favorable	Medium favorable	Scarcely favourable	Unfavorable
	1 point	2 points	3 points	4 points	5 points
Average minimum air temperature	<60	60-120	121-180	181-240	>240
Average maximum air temperature	<60	60-120	121-180	181-240	>240
Relative humidity 30%	<60	60-120	121-180	181-240	>240
Relative humidity 80%	<60	60-120	121-180	181-240	>240
Snow cover	≤20	21-60	61-100	101-140	141-180
Fog	≤20	21-60	61-100	101-140	141-180
Precipitations 10mm / day	≤20	21-60	61-100	101-140	141-180
Frost-free period	>240	181-240	121-180	61-120	≤60
Dust storms	≤80	81-120	121-160	161-200	201-240
Strong wind at a speed of ≥8m/s	≤80	81-120	121-160	161-200	201-240
Clear and cloudy days	≤80	81-120	121-160	161-200	201-240
By value					
Amplitude of air temperature, o C	1-5	6-10	11-15	16-20	>20
Place height, m	500-400	400-750	751-1100	1101-1450	>1450
Heat loads (evaporation of sweat, g/h), July, 13 h.	≤700	701-750	751-800	801-850	>850

Note:

- dust storms - for the criterion, a period of III-X is considered = 240 days;
- snow cover - the period when snow cover X-III is observed = 180 days;
- average minimum air temperature - temperature repeatability ≤ -10 °C; -20 °C, -25 °C;
- average maximum air temperature - temperature repeatability ≥30 °C, 35 °C, 40 °C;
- heat loads per person - the maximum values for the year were chosen (Aizenshtat B.A., 1973).

The score was made for each climatic characteristic indicated in Table 1. To obtain more reliable data on the complex climatic conditions determining the comfort of the environment, significance coefficients were established for each indicator. The significance of each parameter that affects in one way or another on the human condition and comfort (weighting factor P). When scaling climatic parameters used mathematical apparatus of fuzzy sets. These approaches are used for scoring when solving the tasks.

The weights of each used parameter were also determined using the methods of fuzzy sets. At the same time, large values of the coefficient indicate a high significance of one or another meteorological parameter and vice versa, the smaller values of the coefficient indicate its low significance. For each climatic factor, all aspects of human activity were assessed according to the method described by E. B. Lopatina and O.R. Nazarevsky (1972). Table 2 presents the values of the coefficient of significance for each of the used meteorological parameters.

Table 2: Significance coefficients P in points

Climatic factor	Significance coefficient P
Heat loads (evaporation of sweat, g/h)	1,0
Average maximum air temperature	1,0
Temperature amplitude	1,0
Area height	1,0
Relative humidity ≤30%	0,72
Dust storms	0,67
Strong wind at a speed of ≥8 m/s	0,67
Fog	0,61
Precipitation	0,61
Relative humidity 80%	0,55
Average minimum air temperature	0,55
Snow cover	0,5
Clear days	0,28
Frost-free period	0,22
Cloudy days	0,16

These coefficients made it possible to reflect the relative role of each element of the environment in shaping the living conditions of the population. The relative comparison of the scoring scale in combination with the significance coefficient is expressed by a single evaluation formula, which essentially represents the weighted arithmetic average:

$$K = \frac{C_1P_1 + C_2P_2 + C_3P_3 + \cdots + C_nP_n}{P_1 + P_2 + P_3 + \cdots + P_n}$$

where K is the overall assessment of the degree of impact of climate resources on public health and comfort, C is the score in points of the i-th element of the assessment, P is the coefficient of significance of the i-th element of the assessment.

As a result, the integral estimated climate coefficient K was determined taking into account the introduction of the significance coefficient P for each parameter at each meteorological station. The weighted average score gives an idea of the overall and relative degree of auspiciousness to the health and living comfort of each item of the evaluated territory.

The values of the integral estimated coefficient K for the selected meteorological stations were plotted on a working sparse topographic base, on which the contours of the same K values were plotted. As a result of the analysis, it was possible to identify individual fields with maximum and minimum values of the coefficient K and to identify 5 climatic regions with varying degrees of comfort for human life and his health: comfortable (favorable), moderately comfortable (moderately favorable), poorly comfortable (unsatisfactory), sub-discomfortable (unfavorable) and uncomfortable (very unfavorable) areas (Fig. 1.).

Fig.1. Assessment of climatic resources of the territory of the Republic of Uzbekistan from the standpoint of the impact on the living conditions of the population

Attention should be paid to the fact that the coefficients were calculated according to the data of meteorological stations, which are located mainly in oases, and therefore conditions outside of them were not taken into account. For this reason, it should be assumed that outside the location of the meteorological station (especially in flat areas) the tension of living conditions for the population is slightly higher.

RESULTS AND DISCUSSION

The developed zoning map of the territory according to the degree of influence of climatic characteristics on the living conditions of the population can be used as primary information for assessing the climatic resources of Uzbekistan associated with varying degrees of comfort for human life.

According to the results of the map analysis on the territory of the republic, severe climatic conditions are typical for the Navoi region, the northwestern part of Kashkadarya, and some regions of the Surkhandarya region. In general, most of the flat and desert territory of the republic can be attributed to the conditions of sub-discomfort and discomfort.

The coast of the Aral Sea, the foothills of the Fergana Valley, and certain areas of the Syrdarya, Samarkand and Kashkadarya regions are distinguished by moderate comfort.

The foothill areas bordering the Central Asian mountain range can be attributed to the zone of moderately comfortable.

Comfortable conditions in Uzbekistan can occur in separate spots in the foothill areas of the territory, as well as in oases along the rivers.

The developed scale for the conditions of vital activity of the population is conditional, it was developed for the territory of Uzbekistan and is applicable for this territory. For other territories (Turkmenistan or

Kazakhstan), the values of the coefficients may be different, although the technique is generally applicable to the zoning of other territories.

Developing an Evaluation Map of Zoning "Desertification of Ecosystems" from the standpoint of the effects of desertification processes on public health

Currently, given the global nature of the processes of desertification and aridization, one of the main aspects of assessing the impact of the environment on humans is to assess the effects of desertification processes on their health. The desiccation of the Aral Sea led to the formation of the man-made Aralkum desert, which is a source of salt and dust removal. Periodically strong dust storms cover the entire South Aral Sea. An example is the dust storm that passed through this region on June 14, 2019. (Fig.2). The wind speed reached 23 m/s. The visibility dropped to almost zero (Fig. 2a). The wind tore off the roofs of houses (Fig. 2b), which fell on the roads and parked cars (Fig. 2c). The streets were covered with a layer of sand and salt (Fig. 2d).

Fig.2. Dust storm in the city of Nukus 14.06.2019.

An increase in the area of deserts and changes occurring in ecosystems directly affect living conditions of people, worsening them and leading to a decrease in food production, drying up of water sources and deterioration of water quality, migration of people to areas with more favorable living conditions.

One of the most important factors affecting human health is the reduction in the quantity and change in the quality of water used for drinking water supply, household needs, and watering of livestock. The lack of water forces the population to limit the size of the herd, to reduce water consumption for hygienic needs, which leads to a decrease in household income and an increase in the incidence of diseases of the digestive organs, the spread of infectious diseases.

For the convenience of assessing environmental phenomena and the impact on health of processes in the environment associated with desertification, the legend of the Desertification of Ecosystems map has been divided into four blocks:

I- Endogenous factors affecting desertification;
II- Desertification territorial complexes;
III- Anthropogenic factors of desertification;
IV- Natural and anthropogenic factors of desertification.

Due to the insignificant influence of endogenous factors such as

a) intensive uplift of geological structures;
b) variable (active and passive) uplifting of ecological structures;
c) desertification of geological structures

their degree of impact on desertification was not assessed.

Deserted territorial complexes, anthropogenic factors and natural-anthropogenic factors of desertification were evaluated from the standpoint of the impact on public health by technology, using the methods of mathematical modeling and the theory of fuzzy sets. Based on the results of the assessment, an evaluation map of zoning "Desertification of ecosystems" was developed from the standpoint of the impact of desertification processes on the health of the population. The fig. 3 presents this map.

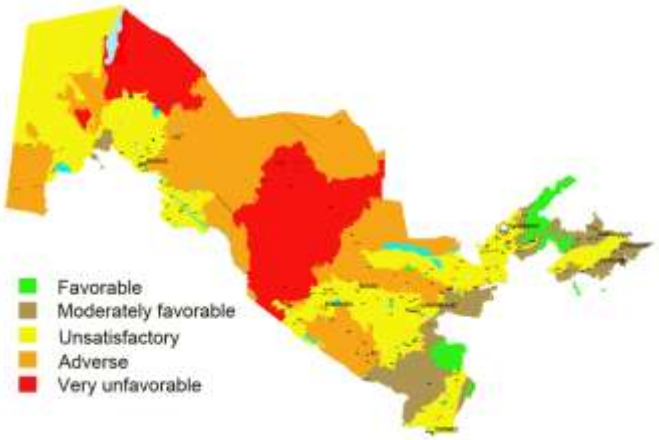

Fig.3. Evaluation map of zoning "Desertification of ecosystems" from the standpoint of the effects of desertification processes on public health.

The analysis showed that the main factors causing the intensification of the desertification process are:

• reduction of biological diversity, degradation of flora and fauna;
• changing of the climate;
• reduction or destruction of vegetation cover due to overgrazing of livestock, irrational use of pastures;
• depletion, salinization and pollution of local water lenses and draining of water sources;
• increased erosion of drylands with their intensive use under agriculture without taking into account the peculiarities of the soil cover;
• destruction of vegetation and soil cover due to unsystematic driving of motor vehicles during road and industrial construction, geological exploration, development of mineral resources, and construction of human settlements and irrigation facilities;
• unsystematic deforestation;
• secondary salinization, leaching of soils and flooding of irrigated lands, etc.

In general, desertification processes increase their negative impact on the environment and public health in those areas where there is a shortage of water resources for drinking water and for household needs. The low quality of water and the large amount of salt and dust removed (over 75 million tons per year) from the bottom of the dried sea contribute to the growth of a number of somatic diseases among the population of the Aral Sea region, including anemia, kidney, blood diseases, gastrointestinal, respiratory, cardiovascular, gallstone and other diseases. The children are particularly affected. The content of dioxin in the blood of pregnant women and in the milk of nursing mothers in Karakalpakstan is 5 times higher than in Europe.

As a result of these factors action, the processes of desertification began to acquire rampant proportions, vast territories are experiencing the influence of these processes, many of which are the result of anthropogenic environmental impact. In regions prone to desertification, there is the highest infant mortality rate.

An analysis of this assessment zoning map indicates that the processes of desertification to a lesser extent affect the health of the population in the mountainous and foothill regions of the Tashkent region, the Fergana valley and the south of the republic. The maximum negative impact on public health is observed in the dried bottom of the Aral Sea and adjacent territories, as well as the central part of the republic.

In order to minimize damage from the negative impact of desertification processes on the environment and public health, it is necessary to conduct scientifically based measures to solve the above problems. At the same time, special attention should be paid to providing high-quality drinking water and water for the economic needs of the population of the republic, and first of all the population of the Aral Sea region. It is necessary to continue forest planting in the Aral Sea region and directly on the dried seabed. Currently, planted forests on the area of 740 thousand hectares, including the dried sea bottom on the area of 310 thousand hectares, were carried out in the Aral Sea region. During 2019, protective forest stands will be created on an area of 500 thousand hectares on the dried bottom of the Aral Sea. Forest plantations contribute to the consolidation of mobile sands and reduce the removal of toxic salts.

Development of a soil-ecological assessment zoning map in terms of the impact on public health.

There is growing tension in the world with the food program realization. The main reason is the gap between the rapid growth rates of the Earth's population and the limited possibilities for growth in the production of food products. In agriculture, mineral fertilizers and pesticides are widely used to increase crop yields, protect plants from pests, diseases, and weeds, as well as to stimulate the development of grains, fruits, etc. Their use must be scientifically based. Unlimited intensive use of chemicals, fertilizers and pesticides aggravates environmental degradation of land.

Use of pesticides allows to obtain large yields. However, the increasing concentration of pesticides in nature poses a real threat to public health. Only 10% of the 35,000 pesticides used since 1945 have been tested for harmful effects on the human body. Approximately 0.5 million people are exposed to pesticides annually, and there are about 10,000 deaths worldwide.

After processing of cultivated plants, pesticides are stored on their surface and in the soil. In this case, the half-life of some pesticides containing arsenic, lead, or mercury can be delayed up to 20 years, since they are very stable and almost do not collapse under the action of the sun, microorganisms, and exoenzymes. These substances include DDT. DDT affects the human genome, causing genetic changes in the body.

At the same time, pesticide components such as arsenic and mercury are never completely destroyed. They constantly circulate in the ecosystem or are deposited in the soil, accumulating there in high concentrations. Such herbicides as simazine and otrazin do not completely decompose during the growing season and as a result, they can be in the soil for several years. Environmental studies have shown that environmental pollution significantly exceeds the pollution of cultivated plants. The concentration of pesticides in the soil is several times higher than the permissible concentration. This is due to the fact that pesticides are very resistant and all subsequent ones are superimposed on the primary pollution.

The consequence of this accumulation of pesticides in the soil is that the products that have not been treated with pesticides in their composition detect these substances. Then with these products pesticides enter the human body. When certain pesticides repeatedly affect a population, this leads to the destruction of normal, susceptible individuals and the survival of resistant forms that become dominant in a given population. Objects, against which pesticides were applied, become more harmful and numerous (for example, because of pesticides, the number of the Colorado potato beetle increased 5 times; fruit ticks - 11 times, and cotton moth - 3 times).

The agricultural sector is one of the important sectors in the economy of the republic. Uzbekistan ranks third in the world in exports and sixth in cotton production. The share of agriculture in the country's GDP in 2017 was 17.6%. In addition to cotton, the most important agricultural products of Uzbekistan are fruits, vegetables and grain (wheat, rice and corn). Employment in agriculture is 44%. All of the above indicates the enormous importance of the agricultural sector in the country's economy.

Residual amounts of persistent organochlorine pesticides are of great importance for the ecological state of soils. On irrigated arable land, there is a presence of areas with a high content of heavy metals in the soil (cadmium, chromium, nickel), radionuclides (cesium and strontium), and others that adversely affect public health. Soil deterioration continues. The productivity of irrigated lands of the republic in recent years has decreased by an average of 3 points (Kuziev, 2007,a). The area of the most valuable lands of the fourth and fifth cadastral zones with a number of points more than 60 decreased by 10.4% (Kuziev,

2007,b). One of the main factors causing the deterioration of soil quality and a decrease in their productivity are the processes of salinization and secondary salinization. Figure 4 presents the space image, which revealed areas with strong secondary salinization. Field surveys of these areas, conducted by us, showed that the cotton yield in such areas is only 3 centners/ha. (Fig.4)

Fig.4. Areas subject to strong secondary salinization. Cotton yield is reduced to almost zero.

The desire to increase productivity in the agricultural sector requires the development of mineral fertilizer production. The mineral fertilizer industry in Uzbekistan is one of the most developed industries. The main producers are "Navoiazot" (phosphatized ammonium nitrate, carbamide-ammonium nitrate, nitrogen-phosphorus fertilizer, liquid suspended phosphorus-containing nitrate, potassium nitrate, etc.), "FerganaAzot" (ammonium nitrate, defoliant "UZDEF", etc.), and "Maxam-Chirchik OJSC (carbamide-ammonium nitrate, which contains 28-30 percent nitrogen and can be successfully used as a fertilizer)
Most of the mineral fertilizers produced are used in the agrarian sector of the republic.
Many fertilizers, especially chlorine-containing ones (ammonium chloride, potassium chloride), have a negative effect on animals and humans mainly through water, where the released chlorine enters. Nitrogen fertilizers with high doses or late application methods lead to accumulation in the form of nitrates (especially in vegetables), violent growth at the expense of sustainability, increased morbidity, especially fungal diseases. Nitrates (MPC for water 10 mg / l, for food - 500 mg / day per person) are reduced in the body to nitrites, causing metabolic disturbances, poisoning, deterioration of the immunological status, methemoglobinia (tissue starvation). When interacting with amines (in the stomach) they form nitrosamines - the most dangerous carcinogens. In children, they can cause tachycardia, cyanosis, loss of eyelashes, rupture of the alveoli. In animal husbandry: avitaminosis reduced productivity, the accumulation of urea in milk, increased morbidity, reduced fertility. Ammonium chloride contributes to the accumulation of chlorine. The negative effect of phosphate fertilizers is mainly due to the fluorine, heavy metals and radioactive elements contained in them. Fluorine with its concentration in water of more than 2 mg / l can contribute to the destruction of tooth enamel.
All the above indicates the impact of soil resources on public health, especially on irrigated arable land, where the use of chemical fertilizers and pesticides is significant. These circumstances make it relevant to

solve the problem of assessing soil-ecological resources from the standpoint of the impact on public health. We have developed a soil-ecological map. On this map, we identified 14 major soil-ecological groups, including:

• Gray-brown soil:
• Gray-brown soils in combination with takyr and takyr;
• Gray-brown soils in combination with various salt marshes;
• Takyr soil and takyrs;
• Takyr soil in combination with various salt marshes;
• Desert - sandy soils and sands;
• Meadow and marsh soils;
• Alkaline soils and their complexes;
• Light gray soils;
• Typical gray earth;
• Dark gray earth;
• Brown and brown mountain forest soils;
• Non-soil formations (chinks, bozigens, bedrock outcrops, etc.);
• Irrigated soil.

According to the technology described in detail on the basis of a soil-ecological map using fuzzy sets, a digital assessment soil-ecological map of zoning was developed from the standpoint of the impact on public health. Fig. 5 presents this map.

Studies have shown that the most ecologically disturbed under the influence of anthropogenic factors are irrigated soils that have been exploited by humans in some regions of Uzbekistan for a very long time. In the Khorezm and Nizhneseravshansky oases, the period of their exploitation reaches 4000 years. Strong environmental degradation is also observed in the Amudarya delta, where meadow and marsh soils were developed.

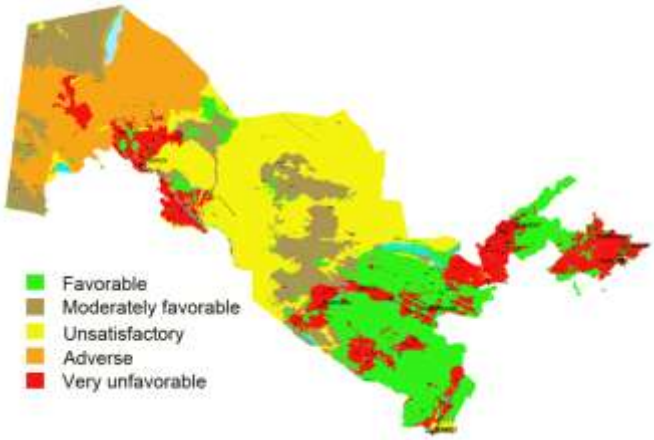

Fig.5. Estimated soil-ecological map of zoning in terms of the impact on public health.

Analysis of the assessment map shows that the most negative impact on the health of the population is observed on irrigated lands where chemical fertilizers and pesticides are most actively used, as well as on the dried bottom of the Aral Sea and adjacent territories. In these areas, the salt that rises with the winds from the bottom of the dried sea influences the population's health most of all. A very weak and weak negative impact is observed in the mountainous and foothill areas, as well as in the central and south-eastern regions of the republic, where the negative impact of chemical fertilizers and pesticides is small.

Findings

The use of chemistry in the agricultural sector is the only reliable way to increase crop yields and preserve soil fertility. With the existing growth of the population of the Earth and the amount of arable land, the

soil would have lost its fertility by the mid-20th century, and the planet would begin to have huge problems with food supply. The invention of chemical fertilizers made it possible to avoid these unpleasant prospects. Worldwide, there has been a steady increase in the production and use of mineral complexes. Japan, Britain, Holland, France and South Korea are leaders in their use. The amount of mineral supplements per hectare of land and yield are closely related. The largest dosages are used in France, England and Holland. For grains, France each year achieves a yield of 74 centners per hectare, the Netherlands - 83 c/ha, and Britain - 70 c/ha. These are the largest yields ever harvested per hectare of arable land in the world.

Following the example of the activities of the countries listed above, the high efficiency of using chemical fertilizers and pesticides in our republic will be achieved solely thanks to an integrated science-based approach, strict dosage of fertilizers and the use of plant protection products against pests and diseases (pesticides), the application of modern irrigation methods, high overall farming culture. Only in this way can we gradually restore the fertility of our soils and get high yields with minimal negative impact of chemical fertilizers and pesticides on public health.

Development of an assessment synthetic zoning map of the territory through a comprehensive analysis of maps of desertification processes and soil and climatic resources effects on public health, taking into account their importance.

It is known that various components of the natural environment have different resistance to anthropogenic factors that disturb them. It means that the responses of the diverse natural and natural-technical elements of the environment to the anthropogenic press vary considerably: the most stable systems are characterized by its conservatism, the least stable are characterized by increased dynamism in terms of changing their structures. Thematic environmental maps highlighting various aspects of the environment make an unequal contribution to reflecting the overall picture of the ecological status of a particular region. In other words, when creating a synthetic assessment map of regionalization according to the degree of environmental impact on the living conditions of the population, each thematic map-layer, which is one of its components, should have significance (or weight) in accordance with the degree of its impact.

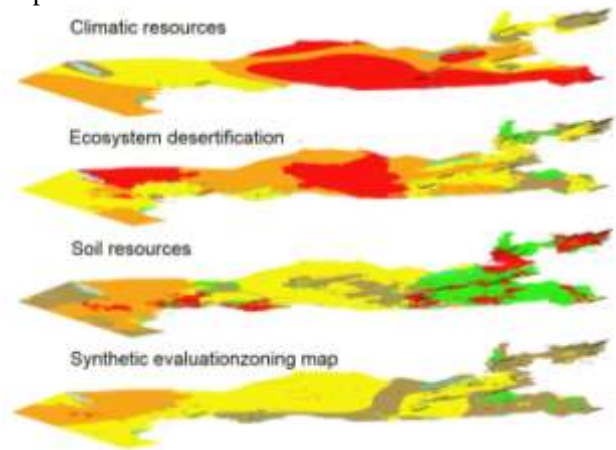

Fig.6. Technology application of OVERLAY procedure

The obtained coefficients of significance were taken into account when computer processing the thematic layers - maps in the process of creating a synthetic map of zoning of the territory according to the degree of their impact on the living conditions of the population. The synthetic map was created by joint processing of maps assessing the impact of desertification processes, soil and climate resources on public health, taking into account their importance. When creating an integrated map for assessing the ecological status of geosystems and its zoning, the OVERLAY procedure was applied. Overlay is the operation of superimposing two or more layers on each other, which results in a single derived layer containing the

composition of spatial objects of the original layers, the topology of this composition, and attributes arithmetically or logically derived from the values of the attributes of the original objects. This procedure allows you to perform a joint analysis of objects displayed on two or more thematic layers and, based on the results of this analysis, create a synthetic map on a separate layer. When creating a synthetic map, the significance (weight) of each of the analyzed thematic layers is taken into account. Figure 6 presents the technology for performing the OVERLAY procedure. The developed system is open and allows you to include for analysis new thematic maps. All the procedures described in this section are performed on the basis of GIS technologies using modern computing facilities and peripheral equipment.

The fig. 7 shows the result of adding the above maps obtained by using the OVERLAY procedure. At the same time, the estimated maps of desertification of ecosystems, soil-ecological zoning and climatic resources were put together with weights of 0.18, 0.20 and 0.62, respectively. These weights are obtained by brainstorming with the involvement of specialists in this field.

As the analysis of the map has shown, the adverse territories are the dried bottom of the Aral Sea and the adjacent areas. Favorable areas are separate areas of the Tashkent region, southern areas of the Samarkand region, certain areas of the Kashkadarya and Surkhandarya regions, as well as in oases along the rivers.

All the above allows us to hope for further development of environmental studies based on the use of wide opportunities and favorable areas - GIS technologies and obtaining new synthetic assessment maps for solving a wide range of tasks.

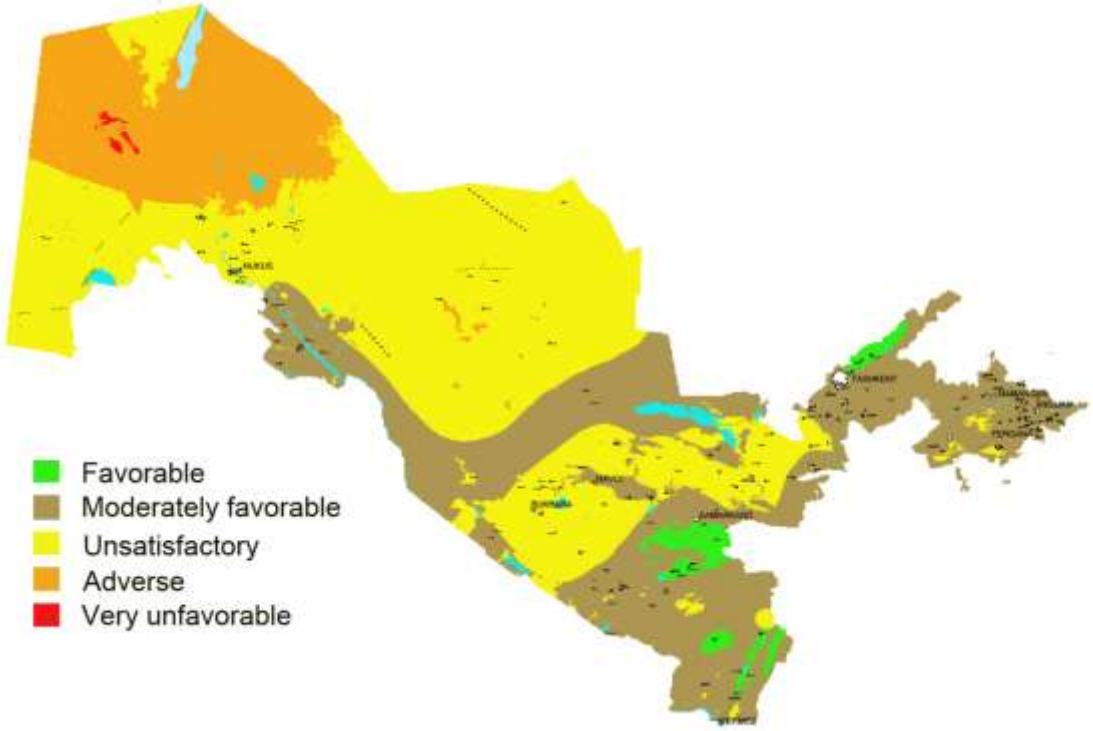

Fig.7. Synthetic assessment zoning map of the territory according to the degree of favorableness for the health and vital activity of the population

Findings

In the process of researching the state of the environment from the point of view of its favorableness to the health and livelihoods of the population, the tasks of developing the assessment zoning maps of the territory for a number of thematic areas have been solved. Based on the assessment maps obtained, regional zoning maps were developed according to the degree of favorableness for the health and

livelihoods of the population by synthesizing previously obtained zoning maps for various subject areas, taking into account their contribution to the solution of the problem.

Studies have shown that the use of scoring allows to more objectively and quickly compare the evaluated objects or phenomena. When conducting a comprehensive analysis of the environmental situation based on the processing of materials of various thematic areas, it becomes possible to obtain integral assessments taking into account the degree of importance of both individual phenomena and objects within a particular thematic area and between these areas, which is difficult to make when assessing the verbal form.

When conducting research, a mathematical apparatus was used, which can be oriented toward obtaining a result from materials presented in both qualitative and quantitative forms. On the one hand, this device allowed to take into account the experience and intuition of the researcher, on the other hand, to find the optimal compromise between the increasing complexity of the analyzed processes and the requirements for the accuracy of the research result.

The overlay of evaluation maps of different thematic focus on each other and their comprehensive analysis allows us to obtain higher-level information. The results obtained allow to select the areas most in need of improvement of living conditions and public health with a view to attracting investment to these territories as a matter of priority. In the future, the developed technologies will expand the range of tasks by including in the analysis of both new thematic areas (water quality, air pollution, geobotanical, etc.), and expanding the objectives of the analysis.

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