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Research Article

MODERN TOPOGRAPHY OF THE USE OF ALTERNATIVE ENERGY RESOURCES IN UZBEKISTAN

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ABSTRACT

This article analyzes the cartographic methodology of using alternative energy resources, the technology of developing maps of alternative energy resources based on the geoinformation system, the issues of developing a visualization system of the location of alternative energy objects based on the geodatabase.

KEYWORDS

Alternative energy, general geographic, natural and ecological, strategic planning, ArcGIS, WinGIS, Pakhtachi, Narpay, Nurabad, Kattakurgan, Ishtikhon, Koshrabad, Akhdaryo, Payariq, Bekobod, Boka, Akhkurgan, Piskent, Kuyichirchik, Ortachirchik, Chinaz, Yangiyol, Zangiota, metrological station.

INTRODUCTION

Methodological and theoretical bases of the research are the principle of systematic approach, methodological developments of local and foreign authors and published information on the studied problem. Cartographic, geo-informational, mathematical-cartographic modeling to achieve the goal; as general scientific methods: logical, statistical, comparative analysis; qualitative and quantitative analysis, graphic interpolation methods were used in the processing of the obtained data.

The use of cards in strategic planning (cartographic planning method) requires special attention. This is one of the strategic methods, a method of analysis and visual representation of the strategic development plans of the region. Regional strategies usually involve different groups of cards. The following group of cards is proposed for the purpose of planning MERs in dissertation research and further development of regions based on them:

1. General geographic maps and aerospace orthophotos – they give general spatial ideas about the region (or region). These maps are the basic geographical information of GAT technologies.
2. Thematic cards of natural and ecological, population and economy, general economic zoning. These are “foundation cards” of strategic plans or cards of objective scientific knowledge of the region - diagnosis of problems, assessment of the main internal and external factors, identification and assessment of the development potential of economic sectors, human and social potential, as well as competition assessment cards.
3. Strategic planning special cards industry sectors, describes regional plans for economic development in general, forecasts and plans (clusters, zones and regions) for spatial population distribution models. Regional strategies project block recommendation cards - show schemes (planned activities, projects) of major investment projects.

Theme cards and special planning cards often have the same theme and can be industry-specific or general, but the main characteristic of planning cards is that the card provides “forward-looking” information for a certain period (for example, up to 2030). Cards can be divided into two functional groups according to the stages of development: strategic analysis and planning cards. In addition, in the process of creating a map, it is necessary to consider the creation of maps for monitoring and making changes to regional strategies.

Cartographic support of regional strategic planning includes the development of a system of interconnected maps that sequentially provide individual stages of regional strategy development. The strategy includes assessment and recommendation cards developed through various sources, applying the cartographic method (creation and analysis of maps) to the practice of socio-economic strategic development of the state regions and cartographic provision of strategic plans - this is the development of the cartographic method of strategic planning and perspective special mapping that is relevant.

Studies. Alternative energy is characterized by its versatility, its characteristic criteria and components. When designing and building MERs, it is important to assess their potential and their effective use.

Therefore, first of all, it is necessary to take into account the characteristics of the region's natural resources, regional infrastructure, energy balance, existing industrial and agricultural enterprises. Secondly, it is required to collect a lot of information and enter it into the database, analyze and evaluate it. In addition, it is necessary to study the data of renewable (solar, wind and biogas, inland waters-hydro) sources of energy. In the regions of the Republic of Uzbekistan, the application of MERs may not always be effective, for example, in regions with hydroelectric power plants and thermal power plants.

The use of GAT technologies in the implementation of these works has been considered abroad, for example in the Netherlands. It is possible to cite a number of indicators included in the GAT for the construction of MERs and the assessment of the state of operation:

1. MER resource assessment data (meteorological, hydrogeological, geodetic, etc.).

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2. Technical characteristics of MERs.
3. Energy indicators (cost of electricity from conventional and non-conventional sources, energy resources of the area, accounts, wages of workers, etc.).
4. Social indicators (employment of the population, creation of new jobs, negative effects on the health of the population, etc.)
5. Nature conservation activities, etc.

The above information was entered into the GAT technologies and the "Alternative Energy" database was created, which allowed to determine the technological process of creating the database cards. In the dissertation work, the integration of information of various characteristics was carried out, and as a result, a technological scheme for creating serial cards according to MER was developed.

MER card acquisition was carried out in 4 stages:

1) data acquisition, systematization (description of geographical features of MERs);

2) data processing (field geodetic survey work, decoding of aerospace materials);

3) preparation of cartographic products, collection and analysis of statistical materials of MERs, selection of GAT programs, creation of MB;

4) geoinformation modeling and MER mapping.

Geographical, fieldwork and statistical materials serve as the source of information for dissertation research. In addition, aerospace materials are involved in the work, they are used to coordinate the geographic basis of the maps being produced, to obtain information on modern changes in the area, etc.

As part of the study, thematic cards were also involved in the work:

1) duration of sunlight during the year,

2) index cards for days with wind speed greater than 15 m/c per year, etc.

Datum - Pulkovo, ellipsoid - Krassovsky, 1942 coordinate system was used in the processing of cartographic projections of remote sensing materials.

As a result of carrying out topographic survey works in the field, digital information about the spatial data of the area was obtained, measurements were carried out based on the GPS device, electronic tachyometers, and as a result, a geodetic database was created. Based on vector models of the area, various digital models are created and used, including the results of spatial analysis or spatial solutions, in most cases they are given in the form of vector models.

Evaluation and modeling of alternative energy resources based on GAT technologies were carried out in the dissertation research. Currently, there are various methods of modeling, semantic, heuristic, informational, etc. Conventional formats as modeling software (ArcGIS, WinGIS, etc.); projection transformations - transition from one cartographic projection to another or from a spatial system to a cartographic projection; geometric analysis (determining the lengths of lines, operations for finding intersection points, etc.); such as overlay and functional modeling operations (buffer zones, network analysis, numerical modeling) are distinguished.

Conversion, overlay and functional modeling were carried out in the dissertation research. Below we present information on modeling work.

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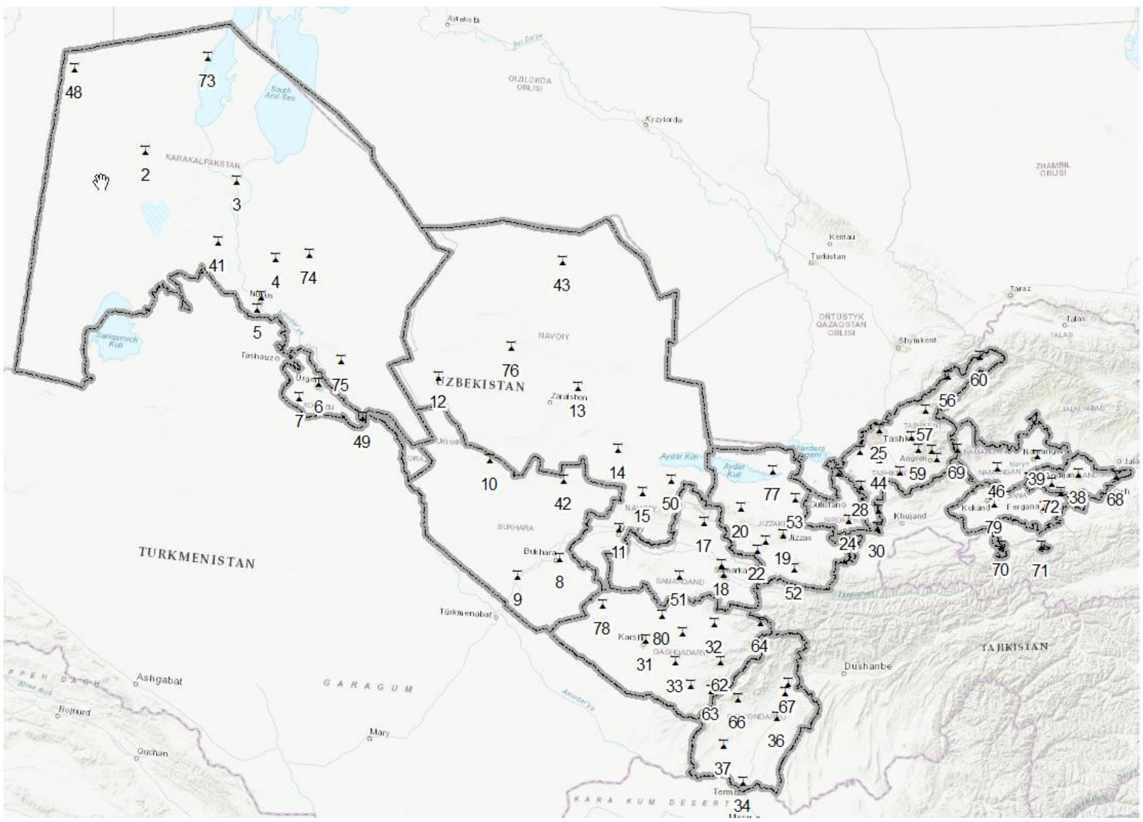
Based on the results of researches on the mapping of objects based on the software belonging to the family of the geoinformation system, and according to foreign and national experiences, the republic made it possible to synthesize the collected data and make management decisions by developing innovative technologies in the use of MER.=.

RESULTS

Data such as surface temperature, temperature at 2 meters above the surface, wind direction, wind speed at 10 meters above the surface, and wind speed at 50 meters above the surface were entered into attributive tables of hydrometrological stations created in ArcGIS software and geovisualized (Figure 1).



Picture 1. Actual location of existing weather stations in the Republic of Uzbekistan

Based on the data obtained as a result of the field work, by interpolating the information using the ArcGIS program, the weights of the temperature indicators related to the surface of the earth were analyzed using the reverse distance method (IVR-inversely weighted distances), and the temperature indicator maps of Samarkand and Tashkent regions were geovisualized (Figure 2).

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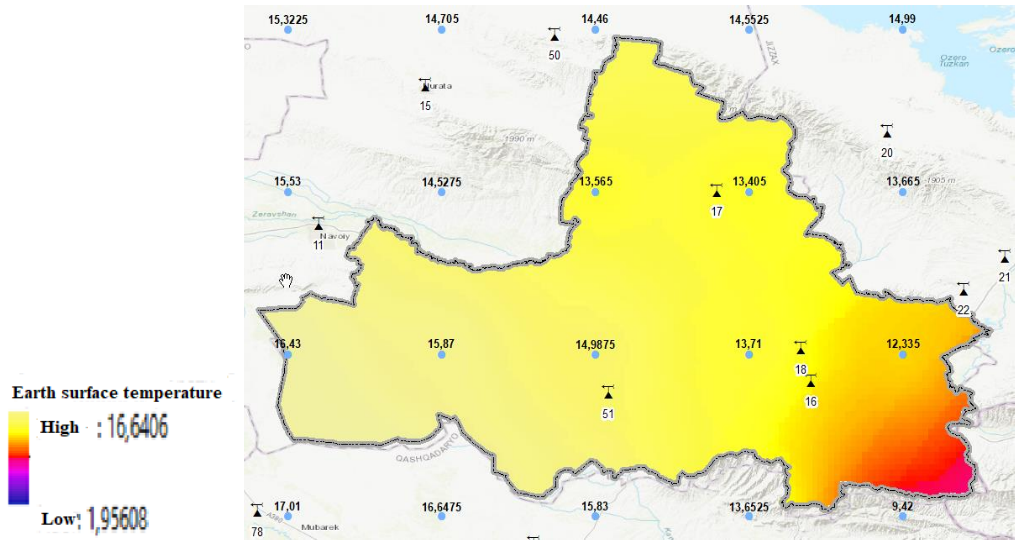

Picture 2. Temperature indicator card of the surface of the earth in Samarkand region

The analyzes during the research were also analyzed according to the temperature indicators at a height of 2 meters above the ground (Appendix 5), by creating an electronic digital map of the regions of Samarkand and Tashkent regions according to air temperature, a cartographic basis was created for determining the areas where solar panels can be installed.

In the final research, it was recommended to install solar panels in the districts of Samarkand region from the west to the east (Pakhtachi, Narpay, Nurabad, Kattakurgan, Ishtikhon, Koshrabad, Aqdarya and Payariq districts) due to the fact that the annual average temperature is higher than 13 degrees Celsius.

As for the districts in the southwestern part of the Tashkent region (Bekabad, Boka, Aqqorgan, Piskent, Kuyichirchik, Ortachirchik, Chinoz, Yangiyol and Zangiota districts), the annual average air temperature is higher than 12 So, it was recommended to install solar panels in these districts (pictures 3)..

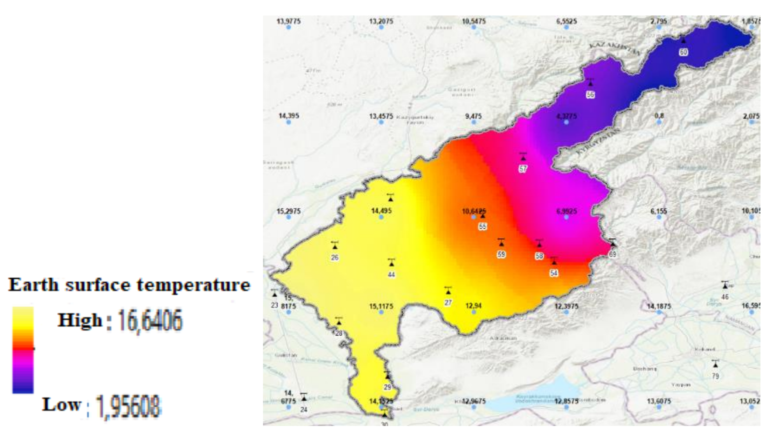

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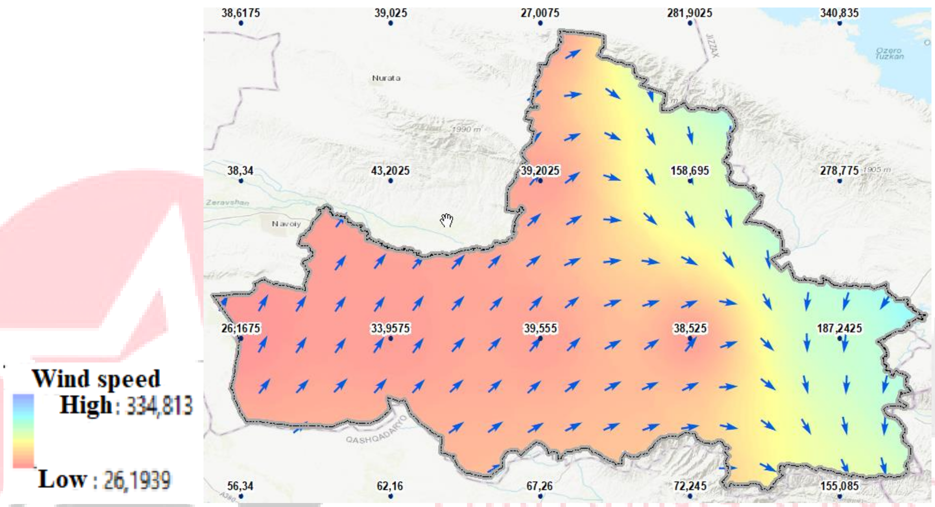
Figure 3. Temperature index card of the surface of the earth in Tashkent region

Using the results of the research, it was possible to determine the zones that are acceptable (convenient) for installing solar panels in any region of our republic through an automated geo-information system and to increase work efficiency. At the same time, the volume of field research work was reduced by 50%.

In order to improve the system of determining areas suitable for installing wind generators using ArcGIS software, OVR (OVR-obratno vzveshennyx rasstoyaniy) analysis was conducted based on the data on wind directions obtained from independently monitored regional metrological stations, and the wind directions were mapped in the section of Samarkand and Tashkent regions by the method of linear symbols in motion (Fig. 4).



Picture 4. A map showing the direction of the wind in the Samarkand region using moving linear symbols

According to the analysis, it is recommended to install wind generators in Payariq, Bulung'ur, Jomboy, Toyloq and Urgut districts of Samarkand region.

It is recommended to install wind generators in the districts of Bostonliq, Ohangaron, Piskent, Bekobad, Boka, Ortachirchik, Koyichirchik, Chinoz and Yangiyol in the districts of Tashkent region, taking into account that the wind directions come from the south-east to the north-west and form a wind path (Fig. 5).

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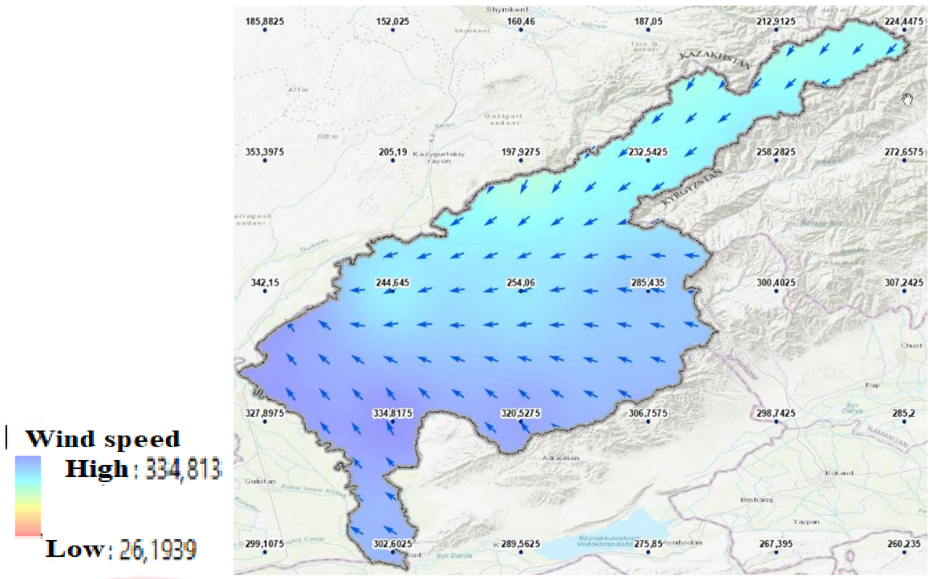
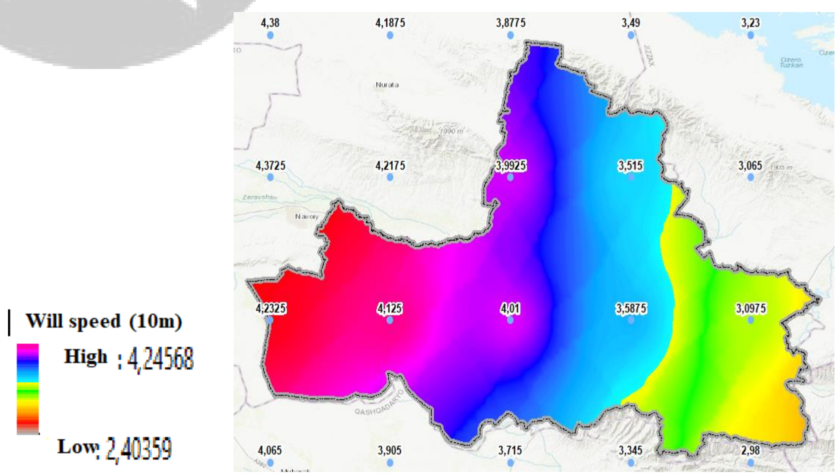


Picture 5. A map showing the direction of the wind in the Tashkent region using moving linear symbols

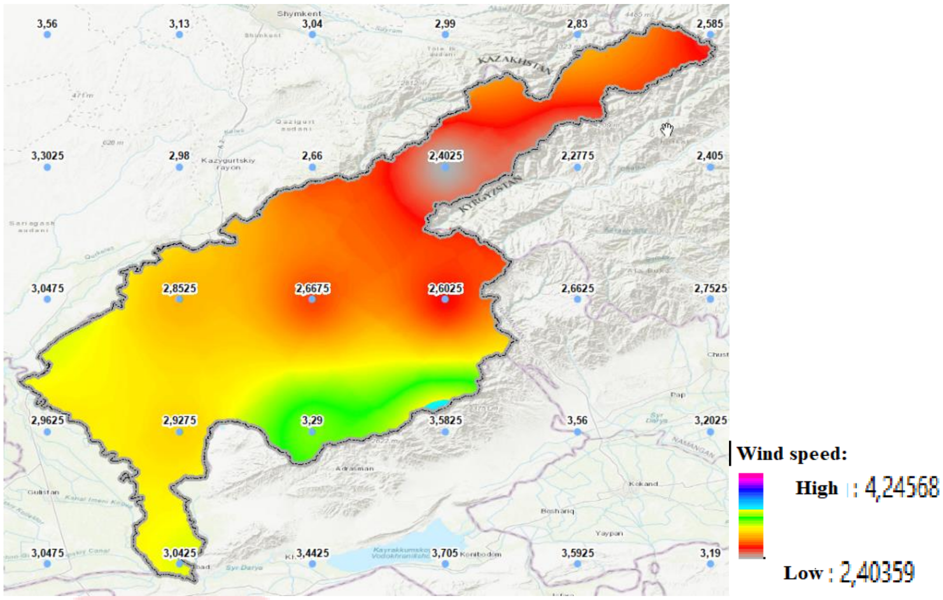
Based on the data of metrological stations, the wind speed in Samarkand and Tashkent regions was studied in order to increase the quality and efficiency of the research conducted in the research work according to the wind directions. Statistical indicators of wind speed were geovisualized based on vector layers.

The analyzes carried out for the Samarkand region show that the wind speed in the western part of the region is higher than 4 m/s per hour per year, so it was determined that it is appropriate to place and use wind generators in the western part of Pakhtachi, Narpay and Nurabad districts of the region (Figures 6).



Picture 6. Geovisualization map of wind speed in Samarkand region (10 m)

According to the analyzes carried out in the Tashkent region, it was determined that it is appropriate to place and use wind generators in the southern part of Bekobad, Boka, Piskent and Ohangaron districts of the region, since the average wind speed in the southern region is higher than 3 m/s per year (Figures 7).



Picture 7. Geovisualization map of wind speed in Tashkent region (10 m)

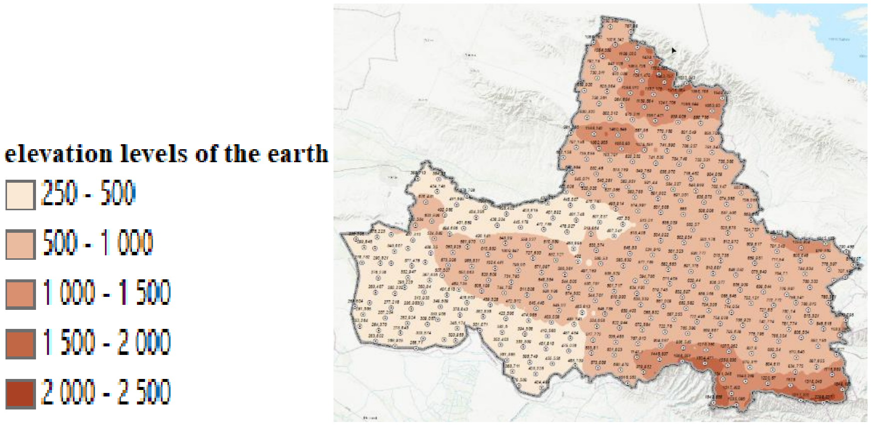
The research was conducted on the wind speed at a height of 10 meters above the ground. The wind speed at a height of 50 meters above the ground was also analyzed in the form of a vector layer in the geodatabase.

In order to further increase the accuracy of the scientific research conducted for the use of alternative energy resources, it was analyzed by linking the research to the terrain. Taking into account the topography of the research area, the areas with higher absolute altitude compared to the Baltic Sea were selected and the areas with wind speed and high temperature (+So) were calculated using the ArcGIS program to determine (select, separate) the most optimal areas for installing wind generators and solar panels.

Point view vector layers with elevation values were exported to the Shape format unit of ArcGIS. Exported layers were downloaded into ArcGIS software and points were generalized according to the working scale. Generalization of points is considered necessary for the creation of medium-scale maps. The working scale of the research work is to create electronic digital maps on a scale of 1:100,000 to 1:450,000.

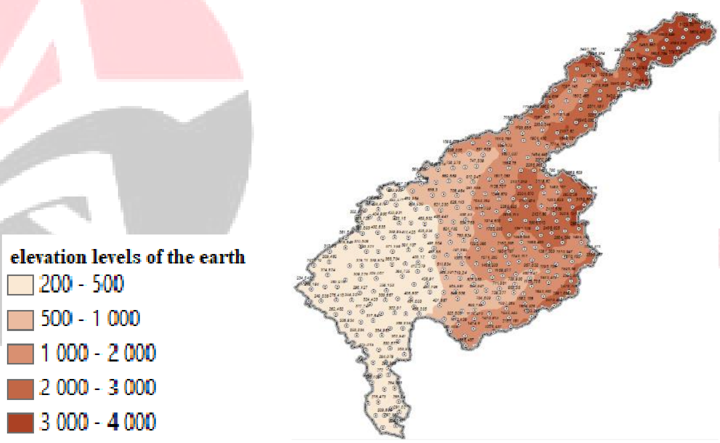
In the altitude attribute of the points, it was taken into account that the absolute height values of each point relative to the level of the Baltic Sea are automatically downloaded from the Global Mapper program. Based on these elevation points, the elevation levels of the land were geovisualized in the form of a field layer by interpolation using the OVR analysis command in the ArcGIS program.

A total of 354 reference points were created for the Samarkand region, and it was observed that the ground level was located in relation to the Baltic Sea in the range of values from 250 meters to 2298 meters (Fig. 8).



Picture 8. Map of elevation values of land levels in Samarkand region

A total of 335 reference points were created for the Tashkent region, and it was observed that the ground level was located in relation to the Baltic Sea in the range of values from 229 meters to 3797 meters (Fig. 9).



Picture 9. Map of elevation values of land levels in Tashkent region

The map data was categorized by height after being created in vector format. Classification works were included in the program based on the height value interval of the regions. 5 classes for Samarkand region, i.e. 250 m. from 2500 m. if intermediate values up to 200 m are obtained, 5 classes for Tashkent region. from 4000 m. values ranging from.

Classification for Samarkand region was carried out in the following order:

1st class = 250 -500

2nd class = 500 -1000

3rd class = 1000 -1500

4th class = 1500 -2000

5th class = 2000 -2500

Classification for Tashkent region was carried out in the following order:

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1st class = 200 -500

2nd class = 500 -1000

3rd class = 1000 -2000

4th class = 2000 -3000

5th class= 3000-4000

Based on the results of the classification, an algorithm was developed using ArcGIS software, and suggestions and recommendations were given for choosing or specifying the optimal location for solar panels and wind generators (Table 1)..

Table 1

Algorithm for determining optimal location using ArcGIS software

O/n	Acceptance levels	surface temperature, ºC	Wind speed, m/s	The height of the ground level, m
	for Samarkand region			
1	Level 1	13<	4,0<	2500<
2	Level 2	10-13	3,5-4,0	1500 -2500
3	Level 3	6-10	2,5-3,5	250 -1500
	for Tashkent region			
	Level 1	10<	3,5<	3000<
	Level 2	5-10	2,5<3,5	2000 -3000
	Level 3	1-5	1,5<2,5	200 -2000

Acceptance levels were divided into 4 types as shown in Table 1. According to it, areas with high acceptability level 1, areas with level 2 medium acceptability and areas with low acceptability level 3 were divided. Level 4 areas include mountainous areas with steep slopes.

ArcGis software belonging to the GAT family was used to solve the problems set before us in the research work. Above, in the second section of the first chapter of the research paper, in the creation of electronic digital cards, work was carried out to create cards describing alternative energy resources based on the systematic structure of GISAE.

In particular, taking into account the levels of acceptability in the installation of alternative energy resources, the result of the above work was connected to the mathematical framework developed during the research, i.e. the resulting data of the research collected in the central database using the geolocation method. Then a map of the areas suitable for the installation of alternative energy resources was created using cartographic imaging methods (Figures 10 and 11).

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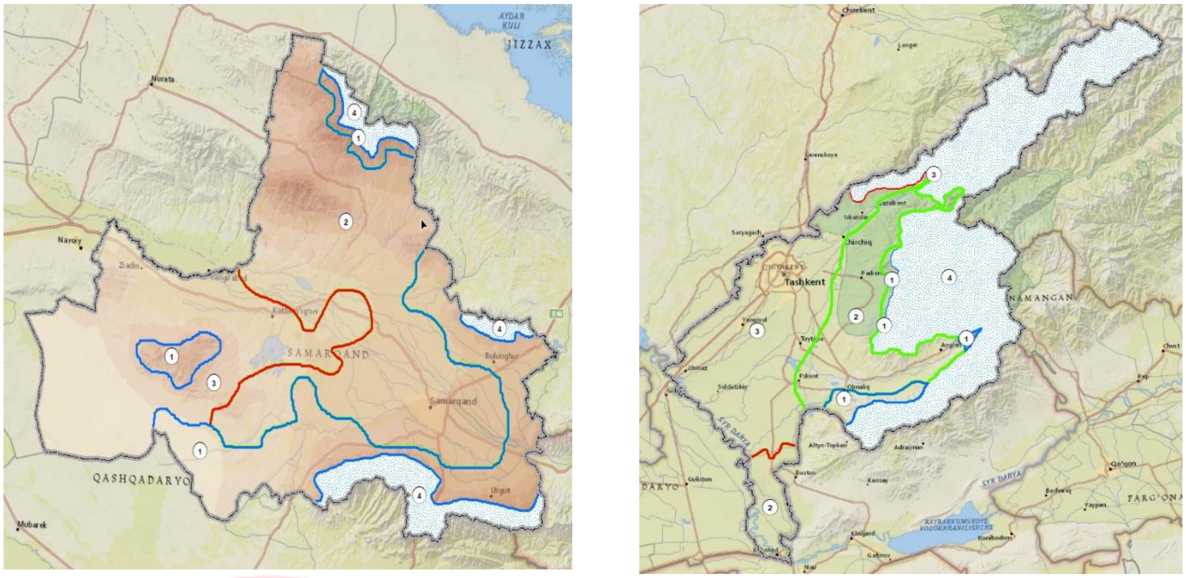
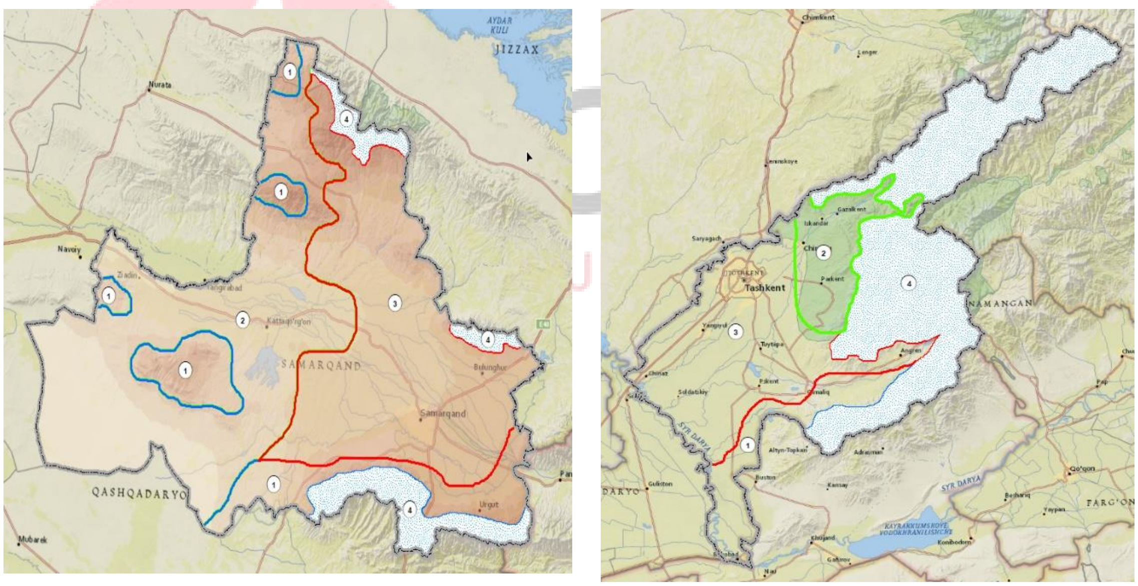


Picture 10. Map of areas most suitable for installing solar panels in Samarkand and Tashkent regions



Picture 11. Map of areas most suitable for installing wind generators in Samarkand and Tashkent regions

Today, the existing versions of GAT technologies fully cover the previous ones and are certainly improved. Current software has made it possible to effectively use digital cards created in previous electronic versions.

Creation of alternative energy maps of regions, creation of databases of different topics, including alternative energy in regions, and their visualization were all carried out using modern software tools.

The creation of maps and plans, their processing, database formation, integration and visualization within the framework of the research topic were considered as one of the main objectives of the GAT technology.

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Based on the command of ArcGIS program to perform analyzes based on algorithms, the most optimal regions were identified and introduced to production organizations by placing them on the elevation points of the land relief in relation to the wind and temperature indicators of Samarkand and Tashkent regions.

CONCLUSION

The most important factor in the development of alternative energy is the prospective deployment of MERs. GAT technologies were used to place MERs in a convenient and visual analysis. Based on the methodological and theoretical foundations of the research, a system of serial cards of alternative energy resources was developed using cartographic, geo-informational, mathematical-cartographic modeling, logical, statistical, comparative analysis, qualitative and quantitative analysis, graphic interpolation methods in the processing of the received data.

Geographical, fieldwork and statistical and aerospace data were used as a source of information. They were used to coordinate the geographic basis of the maps being produced, to obtain information on modern changes in the area, and so on. As a result of carrying out topographic survey work in the field, digital information about the spatial information of the area was obtained. Measurements were carried out on modern geodetic instruments, as a result of which a geodetic database was created. Based on the vector models of the area, various numerical models were created. As a result, evaluation and modeling of alternative energy resources was carried out based on GAT technologies.

The resulting data of the research collected in the central database by the geolocation method were linked to the mathematical framework developed taking into account the levels of acceptability in the installation of alternative energy resources, and serial maps of the areas acceptable for the installation of alternative energy resources were created.

REFERENCES

1. Ibragimov O.A, Nigmatov A.N. The subject of modern cartography and its scientific research methodology: problems and solutions. EPRA International Journal of Environmental Economics, Commerce and Educational Management Journal DOI: 10.36713/epra0414|ISI I.F Value: 0.815|SJIF Impact Factor (2020): 7.572.
2. Ibragimov O.A. The mechanism of creation and use of the geographic information system database of alternative energy resources. "NEWSLETTER" #4 (265) of the Karakalpakstan branch of the Academy of Sciences of the Republic of Uzbekistan – "Science"– 2021.
3. Ibragimov O.A., Abdurashidov Z.A. Future prospects of alternative energy resources in the Fergana Valley: use of solar energy (in the case of the Republic of Uzbekistan). Natural resources of Uzbekistan and their use for the purposes of public welfare. Proceedings of the republican scientific-practical conference. UzNU.-T. 2018. P. 13-15.
4. Ibragimov O.A., Safarov E.Yu. Improving the methodology for determining suitable areas for the placement of alternative energy facilities. "Economy and Society" No. 4 (95) - Saratov - 2022. (11.00.00; № 11).
5. Ibragimov O.A. Technology of development of maps of alternative energy resources based on geoinformation system. Information of the Geographical Society of Uzbekistan, volume 60. - Tashkent,– 2022. P. 300-308.

6. Ibragimov O.A., Khikmatov F.Kh., Magdeev K.N., Rakhmanov K.R., Khakimova Z.F., Ziyaev R.R., Erlapasov N.B. Contents of the "Surface Waters" section of the "National Atlas of Uzbekistan". Geographical problems and opportunities of tourism and recreation development in Uzbekistan. Republican scientific and practical conference. - Against, 2021, 4-8 p.
7. Ibragimov O.A., Nigmatov A.N. Modern science of cartography and its scientific research methodology. Information of the Geographical Society of Uzbekistan, volume 58. - Tashkent, - 2020. P. 283-294.
8. Ibragimov O.A., Safarov E.Yu. Developing wind and sunlight distribution maps for installation of opposite energy sources in the conditions of the Republic of Uzbekistan. International Conference. Europe, science and we, Praha, Czech Republic. 2022 p. 20-25.
9. Abdurakhmanov S.N. Boykulov J., Avilova N. Technologies and programs used in creating an electronic card // Journal of Agriculture of Uzbekistan. No. 10, 2017, p. 42.
10. Abdurakhmanov S.N. Inamov A. Improving the methods of creating objects in the geodatabase // "Agroilm" scientific application of the agricultural journal of Uzbekistan. 5(49) - number Tashkent,2017., 76-77 б.
11. Abdurakhmanov S.N. Inamov A. Digitization of state geodetic points and connection of objects to these points // Bulletin of the State Committee "Ergeodezkadastr" of the Republic of Uzbekistan. Number 2. - Tashkent., 2013. - 14 p.
12. Dobbelsteen A., Broersma S., Stremke S. Energy potential mapping for energy-producing neighborhoods. Int. J. Sustain. Build. Technol. Urban Dev. 2011, pp.170–176.
13. Huisman O, Rolf A. de By, "Principles of Geographic Information Systems". The Netherlands-2009. - 453 p.
14. Jeffrey H, Stuart K. Card, James A. Landay, "A toolkit for interactive information visualization". USA-2006. 2 p., - 267 p.
15. Kang-tsung Chang. Introduction to Geographic Information Systems. Fourth edition. - McGraw Hill Edication (India) 2008. - 450 p.
16. Renewables Global Status Report 2016. REN21 Secretariat. UNEP. -Paris: — Renewable Energy Policy Network REN21 Secretariat for the 21st Century, 2016. — 28 p.
17. World Energy Focus.World Energy Concil. - London:WEC,2016.- 8 p.
18. Yasobant S, Vora K, Hughes H, Upadhyay A, "A Newer GIS Technology for Implementation Research in Health" India-2005. 428 p.
19. Zakhidov, R.A., Kremkov, M.V., The wind power potential of Uzbekistan, Appl. Solar Energy, 2015, vol. 51, no. 4, pp. 336–337
20. Zehner, Ozzie (2012). Green Illusions. Lincoln and London: University of Nebraska Press. pp. 1–169, 331–42