Modernization of telecommunication networks on the basis of studying demographic processes using GIS

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Abstract. The article studies and analyzes the geographical position of households, educational institutions, enterprises and organizations in settlements of the southern region of the Republic of Uzbekistan and their exact number in order to provide the population with telecommunication networks and Internet systems in the republic, as well as to improve the efficiency of fiber-optic cables. We have developed a special methodology for the analysis and study of demographic processes, consisting of six stages, based on cartographic methods. On their basis, a large-scale digital electronic sitemap was created using data from the State Statistics Committee.

1 Introduction

The development of modern methods of mapping that characterize the demographic processes in the world, the creation, visualization, and integration of interactive dynamic maps based on geographic information systems and technologies are of great importance. In particular, the study of the impact of local demographic processes in the dynamics of urbanization is one of the most important issues in the field of cartography. In this regard, special attention is paid to the study of all situations related to the population, including the population of the USA, China, Germany, South Korea, Russia, and other economically developed countries, as well as the creation of population maps and their reliability.

Currently, the main tasks of our country are to implement comprehensive measures to improve computer and information technologies, telecommunications networks, data transmission, and Internet services, including the construction of new telecommunications facilities, the use of modern technologies to improve the existing infrastructure. Thus, these studies correspond to the tasks set out in the regulatory documents related to the activities

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of the industry, in order to ensure the implementation of Decree No.UP-5349 of February 19, 2018 "On measures to further improve information technology and communications" [1].

The aim of the work is to study the demographic processes of the southern region of the Republic of Uzbekistan based on geoinformation technologies and cartographic methods, create and map geolocation databases, model and integrating spatial data, improving the visualization of processes, and creating a series of maps using the above methods to provide the population with high-quality networks and Internet systems in the republic, as well as for the optimization of fiber-optic cables.

2 Methods and material

Cartographic, aerospace, statistical, GIS technologies - ArcGIS, QGIS, Mapinfo, GIS Panorama, PhotoMOD and others, questionnaires, regional analysis, geolocation methods.

2.1. Theory/computation

Geographic information systems technologies are used in various fields, including all cadastral work in the State Committee for Land Resources, Geodesy, Cartography and Cadastre of the Republic of Uzbekistan: architectural design, three-dimensional modeling of buildings, remote astronomical observations, remote design and engineering design, work, etc.

Technologies "Geoinformation systems" are used not only in the state cadastral research, but also in the creation of digital maps and databases, and in general, in carrying out numerous studies on the creation of "Geoinformation systems" in each area.

Currently, there are many software tools for the use and creation of "Geographic Information Systems" in all areas. When choosing software products for developing an organization's long-term plan, the following factors should be taken into account:

- the popularity and availability of the program;
- practical experience in similar projects;
- ease of installation and use;
- the need to take into account the possibility of exporting other data to GIS programs.

To provide the population with high-quality networks and Internet systems in the republic, as well as to optimize fiber-optic cables, it is necessary to study the geographic position of the existing location and analyze the exact number of households, educational institutions, enterprises and organizations in settlements.

To implement the above ideas, it was necessary to create a large-scale digital electronic sitemap using data from Goskomstat. Purposeful systematic research to define the digital mapping methodology showed that this methodology is fundamentally different from the flowchart used to create large-scale maps, and has developed a system consisting of five stages (Figure 1).

At the first stage, large-scale topographic maps at a scale of 1: 10,000 for the regions under study and a collection of digital images from unmanned aerial vehicles (UAVs) are collected, as well as the collection of text and tabular data on telecommunications [2,3].

In the second phase, topographic maps at a scale of 1: 10,000 will be scanned, and topographic images in Adobe Photoshop will be prepared for geographic information systems. Digital images (remote sensing images) will be linked to the compiled topobases and saved in the computer memory using Adobe Photoshop. Text collections of telecommunication resources will be systematized and stored in the computer memory in Microsoft Word. Specific task tables are also organized and loaded into computer memory based on Microsoft Excel.

At the third stage, the topographic materials prepared for Geographic Information Systems in Adobe Photoshop are processed in Mapinfo and ArcGIS. Digital remote sensing images are descriptive using GIS Panorama and PhotoMOD software and are associated with topographic data. The texts collected on this topic are replenished on the basis of processed topographic images and digital images (remote sensing materials), as well as newly revealed materials. The filled-in text information is systematically converted into computer memory as a new option based on Microsoft Excel.

The final stage, which is to create a digital map of the main issue of advanced telecommunications to create a database based on the theme of digital maps (Figure 1).
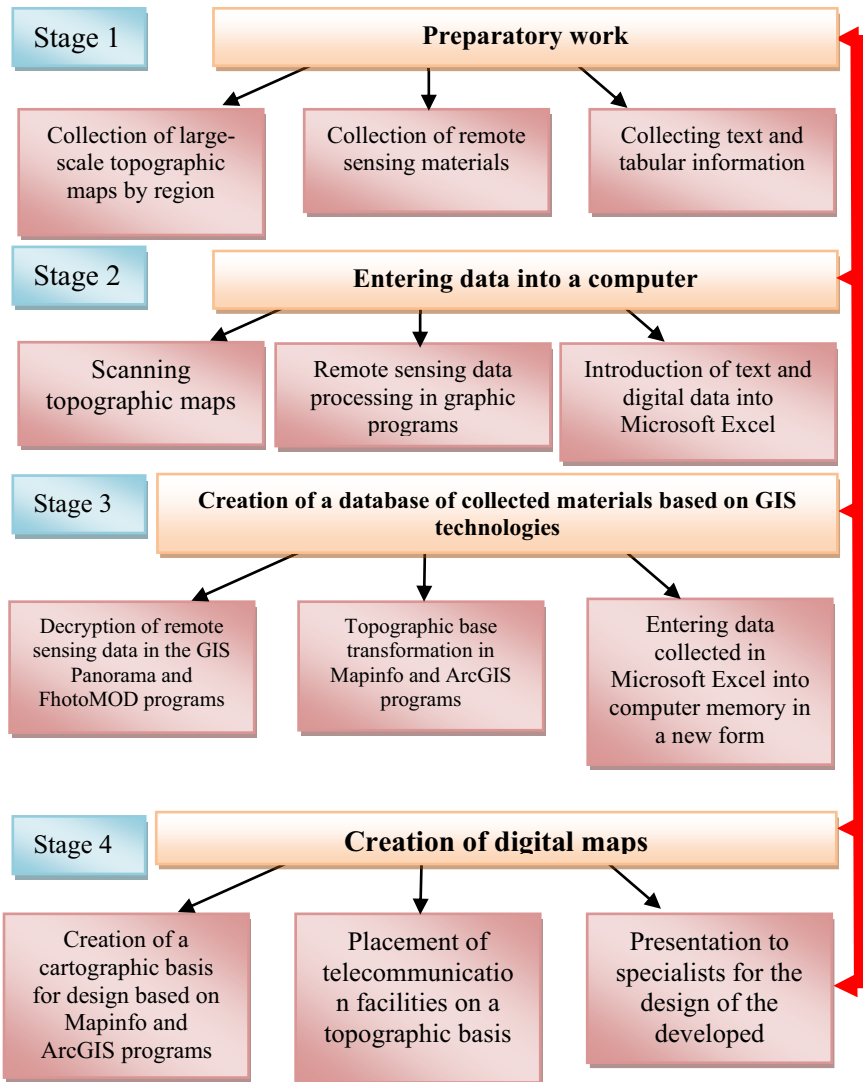
When designing key elements of a map, it is often assumed that it contains information about the map itself. One of the main goals of the work is to provide users with a clear and understandable map for creating planned work.

Thus, telecommunication cards are a component of communication cards, which include an updated system of information and documentation about geographic location, legal status, quantity, quality data and value of a particular type of business or other object. Using the given technological scheme, symbols and general geographic elements of maps were developed in accordance with the requirements of government services and taking into account the capabilities of map users.

When laying fiber-optic cables, special attention should be paid to demographic processes, which were originally associated with the population in villages. A special place is occupied by the implementation of such demographic and economic reforms.

As a result of the study, a special methodology for the analysis of demographic processes was developed, consisting of the following stages, which do not differ from the methods used to study demographic processes based on cartographic methods [4].

This methodology was developed for mapping fiber-optic cables in the Mirishkor region of the southern demographic region (Kashkadarya region) for the purpose of mapping demographic processes. The methodological foundations of the study and study of demographic processes in the region are based on the methods of cartographic research. By analyzing regional demographic data using mapping techniques, the problem can be clearly identified.

| Stage 1 | **Preparatory work** |
| | |

| Collection of large-scale topographic maps by region | Collection of remote sensing materials | Collecting text and tabular information |

| Stage 2 | **Entering data into a computer** |

| Scanning topographic maps | Remote sensing data processing in graphic programs | Introduction of text and digital data into Microsoft Excel |

| Stage 3 | **Creation of a database of collected materials based on GIS technologies** |

| Decryption of remote sensing data in the GIS Panorama and FhotoMOD programs | Topographic base transformation in Mapinfo and ArcGIS programs | Entering data collected in Microsoft Excel into computer memory in a new form |

| Stage 4 | **Creation of digital maps** |

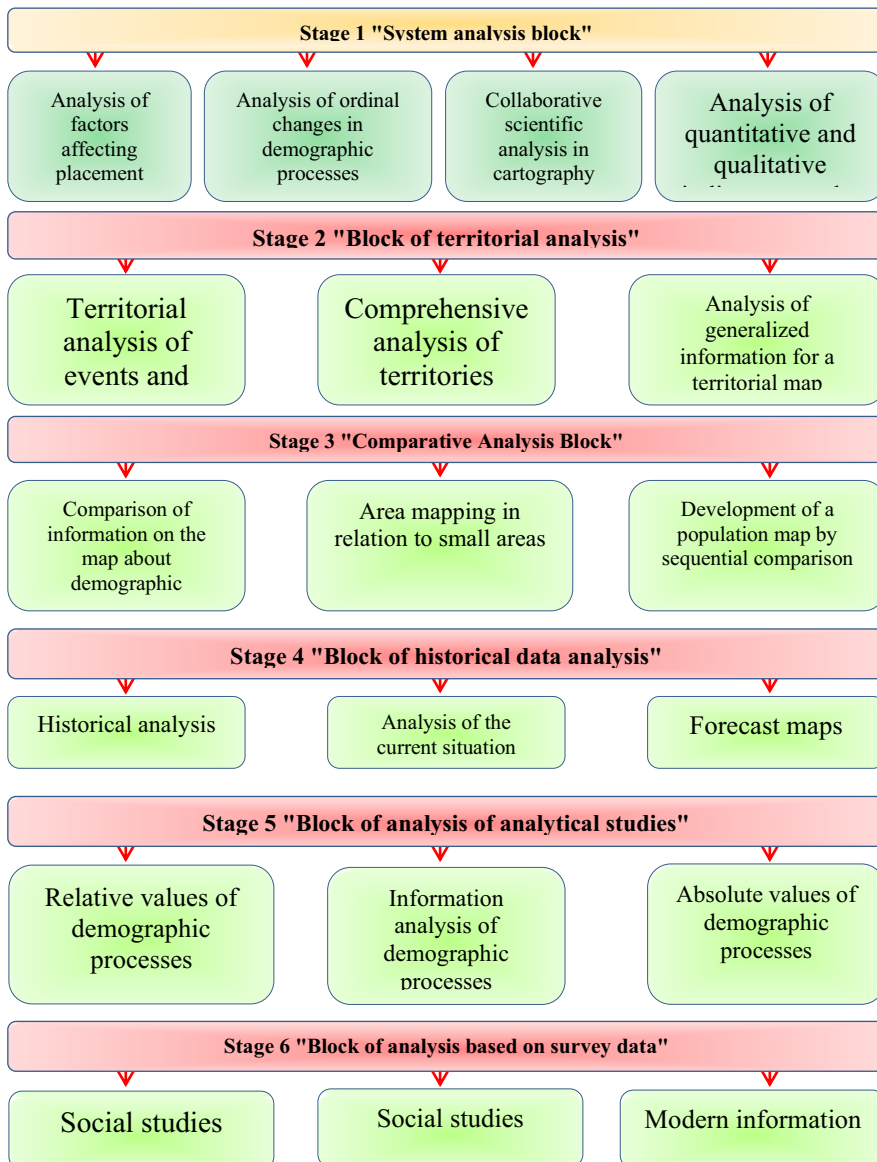| Creation of a cartographic basis for design based on Mapinfo and ArcGIS programs | Placement of telecommunication facilities on a topographic basis | Presentation to specialists for the design of the developed |

Fig. 2. Methodology of analysis of demographic processes

Specific demographic characteristics of the region were determined on the basis of population maps. Maps account for changes in population, density, number of farms, school and preschool education centers, and government agencies.

When developing a demographic map, statistical information is obtained from the relevant industry organizations, depending on the theme of the map being designed. All segments of the population play an enormous role, as these maps will serve the development of other areas and the creation of local programs. When compiling maps, cartographic and graphic materials, including sections, diagrams, tables, figures, text, remote sensing materials are used as the main sources.

When creating population maps, first of all, reliable data are collected and their database is created, and on the basis of these data it is necessary to develop an electronic digital cartographic database of the region (Figure 3).
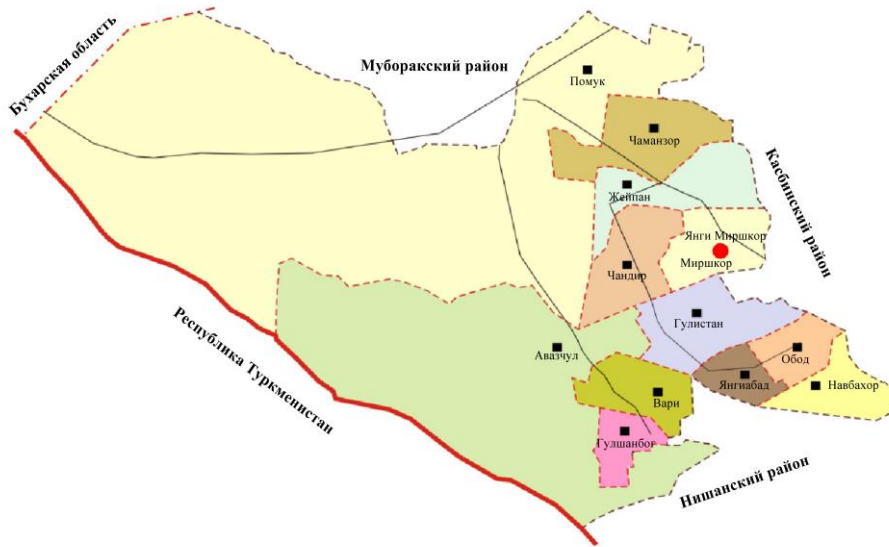
Stage 1 "System analysis block"			
Analysis of factors affecting placement	Analysis of ordinal changes in demographic processes	Collaborative scientific analysis in cartography	Analysis of quantitative and qualitative

Stage 2 "Block of territorial analysis"		
Territorial analysis of events and	Comprehensive analysis of territories	Analysis of generalized information for a territorial map

Stage 3 "Comparative Analysis Block"		
Comparison of information on the map about demographic	Area mapping in relation to small areas	Development of a population map by sequential comparison

Stage 4 "Block of historical data analysis"		
Historical analysis	Analysis of the current situation	Forecast maps

Stage 5 "Block of analysis of analytical studies"		
Relative values of demographic processes	Information analysis of demographic processes	Absolute values of demographic processes

Stage 6 "Block of analysis based on survey data"		
Social studies	Social studies	Modern information

**Fig. 3.** Map of the rural district of Mirishkor district

3 Results

Thus, as a result of targeted studies of demographic processes in the southern region using GIS technology in mapping in different directions, it became necessary to quickly collect data and create databases using new cost-effective methods.

As an example, there is a database where the average number of households was 5-6 people per family. As a result, the total capacity of the cables was determined, which was calculated by connecting to government bodies (table 1).

Table 1. Information about the population in Mirishkor region

№	Village name	Population 2019	Population 2018	Difference
1	Mirishkor	3121	3058	63
2	Yangi Mirishkor	3798	3791	7
3	Okmachit	1938	1894	44
4	Uzbekiston	2546	2496	50
5	Obodon	3780	3780	0
6	Kumbangi	2780	2773	7
7	Kalta	3796	3743	53
8	Yangi Zheinov	4980	4800	180
9	Avvona	3624	4186	-562
10	Kattapoy	3901	3841	60
11	Yangi arik	5710	7273	-1563
12	Isabod	49715	4931	40
13	Oltin bosho	2210	2200	10
14	Chamanzor	4450	4400	50
15	Shirin	38655	3655	210
16	Guliston	2320	2320	0
17	Pomuk	2975	2975	0
18	Bahoriston	2338	2338	0

19	Ignachi	3375	3375	0
20	Malla	2360	2370	-10
21	Yangi kishlok	2880	2855	25
22	Gulobod	2700	2680	20
23	Chandir	1802	2235	-433
24	Madaniyat	3021	3121	-100
25	Yangi hayot	3650	3815	-165
26	Istiklol	4460	4460	0
27	Shodlik	1840	1795	45
28	Zafar	2780	2730	50
29	Guliston	4610	4583	27
30	Rim	4281	4200	81
31	Navbahor	4384	4340	44
32	Yangiobod	1150	1295	-145
33	Buston	1930	1920	10
34	Bori	2083	2184	-101
35	Gulshanbog	2415	2350	65
	Total	**112824**	**114762**	**-1938**
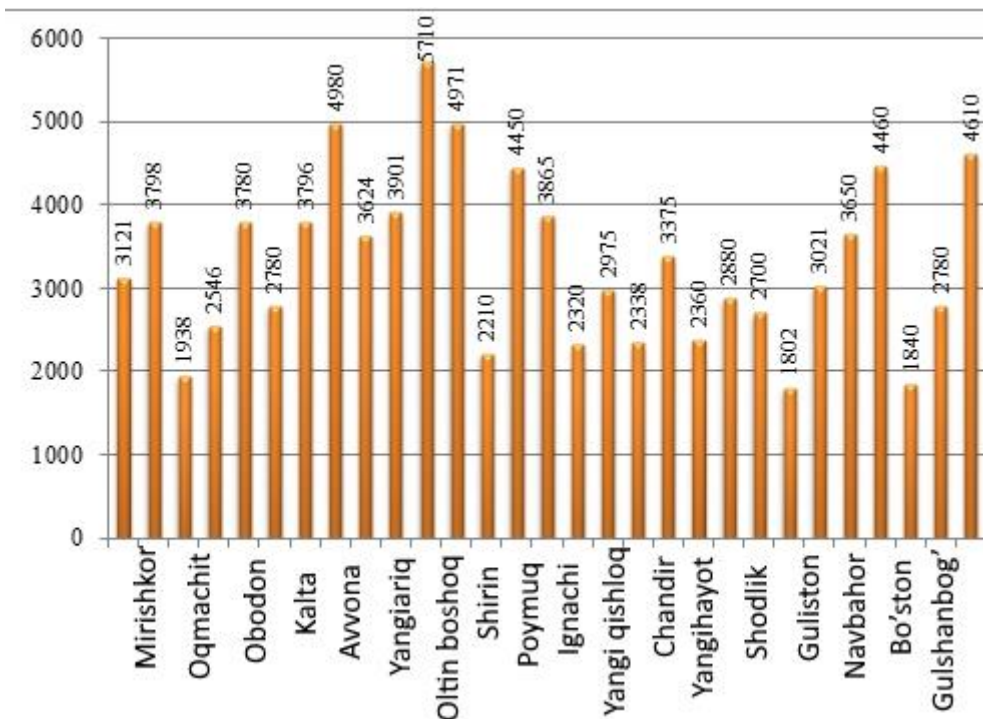
Fig. 4. Shows a diagram of the population size, taking into account which the need for a particular settlement for cable laying can be identified.

The highest population is observed in the village of Yangi Arik (5710), and the lowest is 1150 in the village of Yangiabad. It follows from the diagram that for each family of 5-6 people in the village of Yangi arik (5710: 5.5 = 1038.18), on average, 1040 households

need to be organized, in the village of Yangiabad (1150: 5.5 = 209) the average number of households is 210. As a result of this analysis will be carried out design work.

In addition, cards allow cables to be routed along the shortest and least expensive routes. For example, if you need to mark the route from the district center to the village, where the necessary directions are indicated.

4 Conclusions

The work considered the work on the creation of maps and plans, their processing, and data integration in GIS technologies. GIS-based demographic maps have become an indispensable tool for a number of practical tasks and research related to population. Creation of electronic digital maps of the population on computer programs using special methods of cartographic research, provides the speed of analysis, processing, and forecasting of the development of population maps in one system. A special methodology for the analysis of demographic processes was developed, consisting of six stages, based on cartographic methods. Analytical work has been done to quickly identify data based on spatial data modeling using GIS technologies. A structure has been developed for direct data integration into the geoinformation base when compiling digital maps and visualizing demographic processes, as well as conducting automatic analytical work together with updating remote sensing data and based on this analysis of spatial data in all possible ways.

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