

Application of GIS technologies for improving the content of the tourist map of Fergana province, Uzbekistan

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Abstract. This article contains proposals and recommendations for the creation and future development of interactive-dynamic maps of the Fergana province of the Republic of Uzbekistan through ArcGIS online software and cloud technologies. The experience of tourism geography and cartography, as well as the methodology of creating tourist maps, for creating interactive-dynamic maps, are explained. Selection of software tools for creating an interactive-dynamic tourist map using modern geographic information systems, mapping, creation of digital cartographic bases, and vectorization of the Raster MAR image with the help of manual placement of the map is shown through the MapInfo map system. A 1:750000 scale tourist map of the province was created based on the scientific results obtained on the economic and geographical features of tourism development in Fergana province. On the basis of the map, the possibility of determining the specialization of tourist regions in Fergana province and effectively using the potential of the regions has been revealed. Also, the system of marking objects displayed in the technology of creating maps, which is closely related to their content, and the principle of consistency have been preserved.

1 Introduction

According to the data of the World Tourism Organization (UNWTO), tourism occupies the fourth place in the export of world goods and services and is one of the leading and rapidly developing industries in the current conditions of world economic development. In the report of this organization, the tasks of "paying special attention to issues of consistent development of such types of tourism as ecotourism, pilgrimage, gastronomic tourism" are defined [1]. These tasks have a high population density, a unique agricultural culture, and national craft traditions. It is necessary to carry out studies aimed at the development of complex types of routes and their regional organization in areas rich in tourist resources.

In the world, research in this direction, especially in recent years, is given priority to determine the tourist potential of the regions, diversify their types, and develop and develop new tourist routes. Also, there is a need to create tourist-recreational clusters in tourist

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zones with high tourist potential, to evaluate the tourist potential of the regions, increase the types of tourist services, and improve the territorial organization. One of the important tasks is the development of special programs for creating inventory maps that fully reflect these details [2].

Uzbekistan has a huge historical and cultural heritage, the total number of which is 8208. 4,778 of these tourist objects are archaeological, 2,246 are architectural, 688 are monumental, and 502 are attractions. Currently, more than 500 of these monuments are included in the program of tourist routes. It is planned to increase its number to 800 this year and 2.5 thousand by 2025 [3].

The market of tourism services in the Fergana province is mainly filled at the expense of domestic consumers. The peripheral location of the province, the scattered location of tourist attractions, and the incomplete preservation of ancient architectural monuments are the weak points of the province, while the large and dense population is the strong point. In 2015, 140,000 tourists were registered in the province, and in 2019, this figure was 300,000. Domestic tourism increased by 57% compared to last year.

In Uzbekistan, a number of reforms are being implemented to develop the tourism sector, expand the tourist and related infrastructure in the regions, diversify tourist products and create new tourism facilities, and significant positive results are being achieved. Appendix 1 to the Decree of the President of the Republic of Uzbekistan dated January 5, 2019 #DP-5611 "On additional measures for the rapid development of tourism in the Republic of Uzbekistan" "Tourism in the Republic of Uzbekistan in 2019-2025 "Concept for the development of tourism" defines the important tasks aimed at the development of tourism in the country [4]. In this regard, it is necessary to determine the natural, socio-economic factors and objects that are the basis for the development of tourism in regions with a high population density, where agriculture, industry, and national handicrafts are developed, to evaluate the tourist potential of the area, to study the seasonality of tourism and to make them interactive. scientific research aimed at creating dynamic maps, i.e. cartographic resources, is of great importance.

Currently, geospatial information is being used more and more, and the system of developing tourist information and creating sites around the world is being modernized. In this direction, it is important to use the opportunities of information and communication technology, which is rapidly developing day by day, and to quickly and easily obtain information, process and distribute it by taking open information posted on the Internet into an interactive-dynamic map [5].

Theoretical issues of the tourism sector, its sustainable development, and regional features have been studied by geographers and economists from abroad and in Uzbekistan. [6], [7], [8], and [9].

There are very few cartographic works reflecting the complex development of the tourism industry in the regions of Uzbekistan. Currently, the development of cartographic projects, specialized maps, and atlases, which comprehensively describe tourism in Uzbekistan and in the context of individual regions, has become one of the urgent issues. Therefore, in order to rationally use the natural and cultural heritage of the Fergana province, increase the employment and income of the population, increase the flow of investments, and ensure the development of tourism, the task of creating interactive-dynamic maps aimed at assessing the tourist potential of the region and studying the peculiarities of tourism seasonality was determined.

Therefore, the purpose of this scientific research was to develop proposals and recommendations for the creation and future development of interactive-dynamic maps of the Fergana province of the Republic of Uzbekistan using ArcGIS online software and cloud technologies. In this, the experience of tourism geography and cartography and the methodology of creating tourist maps were studied to create interactive-dynamic maps:

- by studying the foreign experience of creating interactive-dynamic maps, recommendations were developed for its use in the conditions of Uzbekistan;
- a model was developed that includes the stages of creating interactive-dynamic maps when creating tourist maps;
- using the theoretical and practical issues of the research, the methodology of creating touristic interactive-dynamic maps of the Fergana province of the Republic of Uzbekistan was created.

2 Materials and methods

2.1 Research area

Fergana province is one of the provinces of Uzbekistan, located in the southern part of the Fergana Valley in the far east of the country. It borders the Namangan and Andijan Regions of Uzbekistan, as well as Kyrgyzstan (Batken and Osh Regions) and Tajikistan (Sughd Region). Its capital is the city of Fergana. It covers an area of 6,760 km². The population is approximately 3,896,395 as of 2022, with 44% of the population living in rural areas (Figure 1.)



Fig. 1. Map of the study area, Fergana province.

The history and development of the tourist destinations of the Republic of Uzbekistan were briefly studied, and the ongoing reforms related to tourism, including one of the most important political events, a plan of measures for the development of domestic and foreign tourism in Uzbekistan, which will be held in 2022, was developed. As a basis for the creation of tourist interactive-dynamic maps, tourism geography, and cartography were studied from a theoretical and practical point of view, and information on tourism and ways of creating maps of traditional tourist routes were studied.

The foreign experience of creating interactive-dynamic maps, that is, their achievements and shortcomings were studied, and recommendations for its use in the conditions of Uzbekistan were highlighted. The types of interactive services provided through the Internet in Uzbekistan were compared and the main groups were described, and the possibilities of creating interactive-dynamic maps were determined [10].

2.2 Methods

Prospects for the establishment of tourist routes in the province and their geographical characteristics, relief, geographical location, mutual proximity, the convenience of transport routes, population, specialization, and similar aspects of tourist resources were taken into account. On this basis, it is divided into tourist provinces and put on the map.

Development of cartographic bases, design, and methodology of tourism management in the province for the development and regional organization of tourism in the region, based on the identification and assessment of opportunities for the use of tourist facilities in Fergana province.

Such:

- Analysis and generalization of local and foreign experience in the creation of tourist and road maps (atlases), and topographic maps;
- Development of conceptual approaches to the description of the road network and road service facilities;
- Development of information symbols on natural, historical, and cultural attractions of the region, and tourist facilities;
- Development of recommendations on mapping methodology and technology based on geoinformation system programs;
- Test the scientific basis of the content, method, and composition of mapping on experimental samples.

The purpose of the work is to assess the tourist potential of the Fergana province, which is the basis for the development of tourism, and to develop the content of the tourist map, aimed at studying the characteristics of seasonality.

In doing so, we have identified the following tasks:

- Generalization, comparative analysis, and systematization of modern methods of mapping in the field of tourism;
- Classification of maps according to visualization and functionality methods;
- Development of a cartographic concept and structure of the Atlas Information System (AIS) "Tourism in the Fergana province" aimed at supporting decision-making in the management of resorts and tourist complexes in the region;
- Development of content elements by means of cartographic representations and placement on the basis of symbols in the creation of thematic maps on the basis of the created AIS;
- Identify the main directions of further development of tourism in Fergana province, highlight the problems and prospects using research materials;
- On the basis of cartography, it is necessary to indicate the topography, geographical location, specialization of the Fergana province, the convenience of transport routes, as well as the boundaries of tourist areas on the basis of assessment of the potential of tourist resources (high, medium, low);
- Development of content elements of the "Tourist Map of Fergana province" based on the creation, grouping, and classification of databases of tourist facilities and resources in the program ArcGIS;
- Mapping of these routes on the basis of new tourist routes of complex types (eco, agro, business, pilgrimage, historical, archaeological, extreme, recreational, gastronomic, industrial) in the region and their standard programs;

Evaluation of the tourist conditions of the region (plains, mountains, and foothills) on the level of bioclimatic comfort (relative comfort, comfort, warmth, extreme heat) and the development of proposals and recommendations for the diversification of tourism [11].

It is possible to design tourist maps of the remaining regions of the Republic of Uzbekistan on the basis of the model of assessing the tourist potential of the regions of the Republic of Uzbekistan and forecasting domestic tourism in Fergana province. With the

help of this map, the assessment of the tourist conditions of the region (plains, mountains, and foothills) on the level of bioclimatic comfort and the rational use of natural, social, and economic factors will reveal the economic and geographical basis of tourism development in the region. the exit can serve to attract an influx of tourists to these facilities.

Common software changes: ESRI (development of "Marobjects" "GisData" servers for ARS/INFO and AGSView), INTERGRAPH ("GyeoMediaa We Mar 1.0"), MaPInfo, AtlasGIS, and others play an important role [4]. A GIS package can be customized for a specific job using built-in or add-on tools. The raster data model represents the world as a space where the spatial distribution of certain events changes. A pixel is used as a unit of raster data. The difference between raster data and vector data is that only one corner of the raster must be associated with an absolute system (for example, coordinates such as latitude and longitude or other coordinate systems); the location of all other pixels can be calculated relative to the associated pixel [11].

An image (Photo) for the tourist map of the Fergana province was registered in the ArcGIS program according to the coordinates.

1. ArcMap is launched.
2. Fergana province was linked using known coordinates of the .jpg raster map (Table 1).

Table 1. Corner coordinates for the Fergana province map.

	X	Y
North West	70,793	40,726
North	71,468	40,738
North East	72,181	40,537
South East	71,744	39,91
South	71,123	39,863
South West	70,626	40,168

3 Results and discussion

Based on the scientific results obtained on the economic and geographical features of tourism development in Fergana province, taking into account the similarities of the tourist resources of Fergana province at a scale of 1: 750,000, it was divided into tourist areas and mapped.

The map allows for determining the specialization of tourist areas in Fergana province and on this basis effectively uses the potential of the regions.

The process of creating this map takes into account the topography, geographical location, interdependence of the districts of the region, the convenience of transport routes in the creation of tourist routes, population, specialization, and similar aspects of tourist resources.

The principle of consistency, as well as the system of object identification, which is reflected in the technology of creating maps, which is closely related to their content, is preserved.

Such:

- Facilitate the establishment of home museums and themed travel itineraries for poets and writers, sportsmen, artists, and religious scholars who have lived in Fergana to promote educational tourism;
- Establishment of "craft centers" in the city of Kakand and Rishtan district, along with employment, will create opportunities for the production and export of souvenirs for tourism;

- It is advisable to turn the Karkidon Reservoir, located 45 km from Fergana, into an open water recreation area for the city's residents, studying its suitability for students of ecology, irrigation, land reclamation, sanitation, and hygiene;
- The opening of border checkpoints in the Shahimardon and Sokh districts for tourism purposes will increase the number of tourists from the Kyrgyz Republic and the development of international tourism.

A conceptual framework for map content has been developed, which includes two large and equivalent blocks of data:

- about roads and road service facilities;
- about the attractions and tourist facilities of the area.

The content of the map is based on the principles of a systematic approach. The classification of the described objects and the corresponding complete writing systems are developed. The results of the assessment show that Fergana province ranks 7th in the country's tourism potential. The potential of the region was overestimated and compared to natural, social, economic, and demographic factors, it was found that the potential was not used enough (Figure 2).

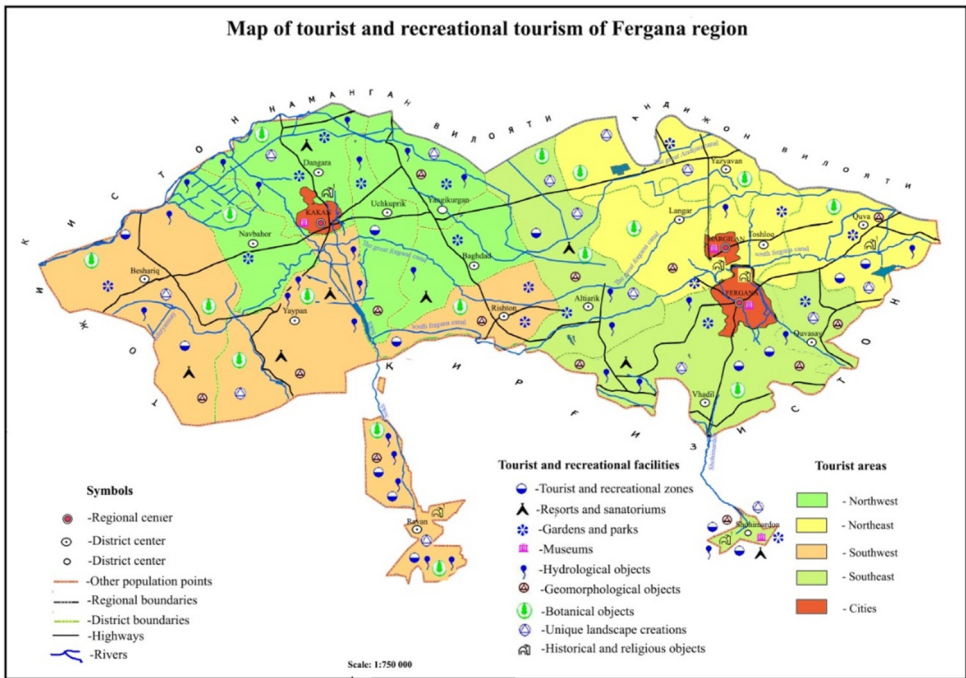


Fig. 2. Map of tourist zoning of Fergana province.

The experiences gained in the use of open data and resources were checked, the compatibility with the conditions of the Republic of Uzbekistan was determined, the scientific research area of the research was developed, and the general methodology of interactive-dynamic mapping was created in connection with it. As a result of the analysis and processing of the digital and textual data collected from the open data of the country about the population, an interactive - dynamic map system of the Fergana province of the Republic of Uzbekistan was created based on the OpenStreetMap database of the ArcGIS online complex.

Through the developed interactive-dynamic maps, it was possible to obtain quick and accurate information about tourist places, as well as perform actions such as calculating areas, measuring distances, and determining location coordinates.

The analysis shows that domestic tourism is a priority in Fergana province. The location of the Fergana province on the periphery, far from major historical tourist centers, makes the population travel mainly within the region and along the Fergana Valley. The map develops a model program for the development of mixed (complex) tourism, aimed at the efficient use of natural, cultural and historical, industrial, business, handicraft, agricultural and other resources to create a complex tourist product based on the division of the region into tourist areas. At the same time, regional levels of information provision are also highlighted. The high number of short-term trips within the region is also due to the natural conditions of the region, the climate, and the number of resorts in the mountains, rivers, and streams. Fergana province is the leader among other regions of the country in terms of population activity and high flow of tourists in domestic tourism.

4 Conclusions

The concept of the specialized "Tourist zoning map of Fergana province" is aimed at supporting decision-making in the management of a complex descriptive, recreational, and tourist complex of the region. The map was developed for the staff of the Department of Resorts and Tourism of Fergana province, as well as for district administrations, which comprehensively reflects the current state and problems of the country's resort and tourist complex. Data were presented at different time intervals and at different regional levels. The main purpose of the map is a scientifically based, systematic database of domestic and international tourism organizations. An analysis of domestic and foreign tourist maps (atlases) was conducted, three descriptive conclusions based on the cartographic results were summarized, and the content of the maps was approached in the design. The original type of map was proposed, taking into account the trends in the development of ecotourism aimed at preserving the natural, historical and cultural environment. The map design methodology was defined (source materials, mathematical and general geographical bases, mapping levels). Relief imaging methods, their advantages, disadvantages, and recommendations for optimal use in the preparation of the proposed maps were considered. The technology of creating maps in digital and electronic form has been developed, including the creation of a bank of symbols corresponding to the system by means of cartographic mapping.

The potential of the region was highly assessed and compared to natural, social, economic, and demographic factors; it was found that the potential is not being used sufficiently (Figure 2). According to the analysis, internal tourism in the Fergana province is a priority. The peripheral location of the Fergana province and its remoteness from major historical tourist centres cause the population to travel mostly within the region and across the Fergana valley. Conditional signs of a mixed (complex) touristic interactive-dynamic map designed for the effective use of natural, cultural-historical, industrial, business, handicraft, agricultural, and other resources to create a complex tourist product based on the division of the region into tourist regions have been developed on the map. At the same time, regional levels of information provision are also distinguished. The high number of short-term trips within the region is also related to the region's natural conditions, climate, and a large number of recreation centres on the banks of mountains, rivers, and streams. It was determined that the Fergana province is the leader in terms of the activity of the population and the high flow of tourists in domestic tourism compared to other regions of our republic.

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