

# ANALYTICAL TOOL FOR RETRIVING GEOSPATIAL INFORMATION FROM OPEN SOURCE DATA IN UZBEKISTAN

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***Abstract.*** This paper covers issues related to using Open Data for retrieving geospatial information about population in Uzbekistan. The methods are described from the perspective of their relevance to the technical and conceptual development of interactive dynamic maps. Several peculiarities of development of Open Data in this country are analyzed with the purpose of applying geoinformation technologies for capturing geospatial information. Some analytical tools are suggested to bring together Open Data of different official sources by means of Geographical Information Systems. ArcGIS Online and other software are applied for interactive mapping.

***Keywords:*** geospatial information, Open Data, interactive mapping, population, Uzbekistan

## **Introduction**

Today, rapidly developing Information and Communication Technologies (ICT) support development of Open sources that are maintained by state agencies, committees, private companies and other institutions in this country. These resources are expanding as the result of state policy on increasing transparency and providing an access to official data. Open data catalogues include the government portal site <[data.gov.uz](http://data.gov.uz)> (Fig.1). According to the national Law "On the Openness of the Activities of State Authorities and Management" Resolution No. 232 adopted by the Cabinet Ministers on August 7, 2015 "On measures to further improve the Governmental portal of the Republic of Uzbekistan in the Internet with the provision of open data", it is this concept that created foundation of the Open Government

and open state management. This online services for citizens and businesses provide access, give an opportunity for using them as data sources, and for public control. Formats of data are in machine readable form, the public datasets can legally be shared and republished.

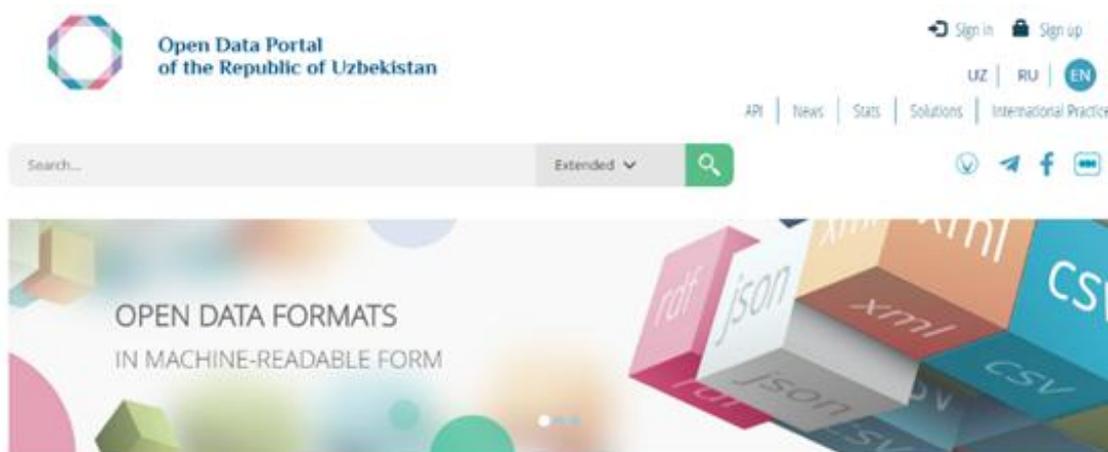


Figure 1. The Open Government open data portal site <https://data.gov.uz/en>

According to official data posted on this Portal it “hosts more than **7,700** sets of public data, which are represented by more than **140** organizations. The users of the Portal have downloaded data sets over **6,600,000** times”.

The Portal provides with a single point of access to posted, as well as for publishing new public data. This State information resource on the Internet consists of a set of software and hardware and is designed to accommodate a public government information and provides with interactive services.

Because of the strong control of the government the administrative data is developing according to standardized rules which provide uniform availability to open sources of different agencies and institutions over the country. This creates more opportunities of developing an analytical tool for the retrieving geospatial information (GI) in a form of interactive maps. This also helps matching of datasets with geospatial geometry data, principally administrative zone boundaries, which is crucial requirement of the mapping of socio-economic open data. The “considerable varying in regard to the availability and legal status of administrative spatial data” (Smith 2016, p.108) is frequently the main challenge for the online socio-economic mapping. From this point of view, resources of Uzbekistan is more suitable for retrieving GI.

However, some obstacles exist for performing this task. One of the reasons it is not well developed National Geospatial Information Infrastructure. And another one is an absence of a simple tool for visualizing and analysis. This paper discusses several ways for combining Open Data and linking the different data to each other for capturing and extracting the GI.

The wide range of potential users of GI includes decision makers of national governance agencies, researchers of universities and scientific organizations, national statistic bodies. Their interest for GI is growing with wide spread of ICT capabilities but this is a challenging task to develop mapping and analytical tool for both specialist researchers and more general audiences. This study is aiming to develop a simple tool for the broad audience of various actors as well as decision-makers and ordinary citizens with different demand and requirements to GI.

Another important subject for discussion is the content of data on different hierarchical levels of collecting, storing, updating and distributing for the purpose of retrieving GI.

### Methodology

In this study the subject of scientific interest is an interactive mapping as a tool to retrieve geospatial information from the open datasets of population. It is suggested to use web mapping tools for combining ICT, GIS, interactive cartography and socio-economic data for retrieving GI from existing open resources.

Using web mapping tools has advantages to integrate socio-economic data into national platforms to be substantial in terms of facilitating research and allowing the public to compare and contrast locations across the country using a range of indicators. Based on the definition of an interactive mapping by Roth (2013) as “a cartography where users can change aspects of the map representation” this study is aiming to establish a two-way friendly-use relationship between the map and the map user.

From the point of view that an interactive cartography (MacEachren & Monmonier, 1992) is more closely related to the research stages of scientific analysis, this study considers interactive mapping as an iterative process of hypothesis formulation and related tasks to retrieve GI.

It is a common practice when the exploratory tasks are typically undertaken using desktop GIS and geo visualization software which offer comprehensive tool suites of cartographic and spatial analysis functions. These tools allow non-technical multidisciplinary and policy audiences to ask questions of data and understand trends.

The domain of study comprises access to datasets for interactive mapping, geospatial analysis, and update techniques (Fig.2). Interactive mapping is a tool not only for visualizing demography but for conducting geospatial analysis (Gulyamova, 2018).

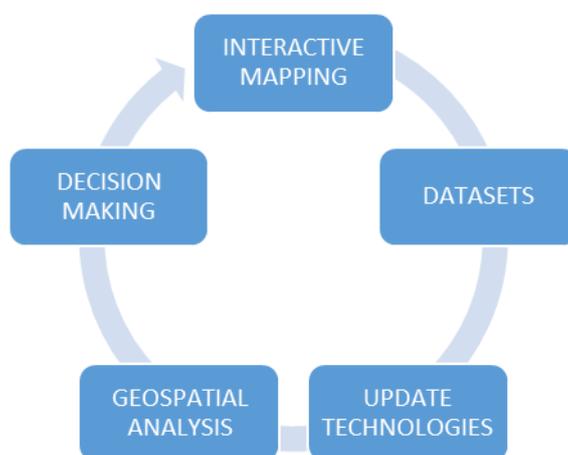


Figure 2. The area of scientific study

The cloud-service model is the most suitable option in a rapidly changing environment of socio-economic datasets. Zastrow (2015) points to such its advantages as reducing the technical skill demands and need for server access. This model is used in this study for uploading map data to a cloud account, while cloud service handles all server-side (Fig.3). Using this model gives more options for interactive web mapping and enlarge the audience of on-line users and developers.

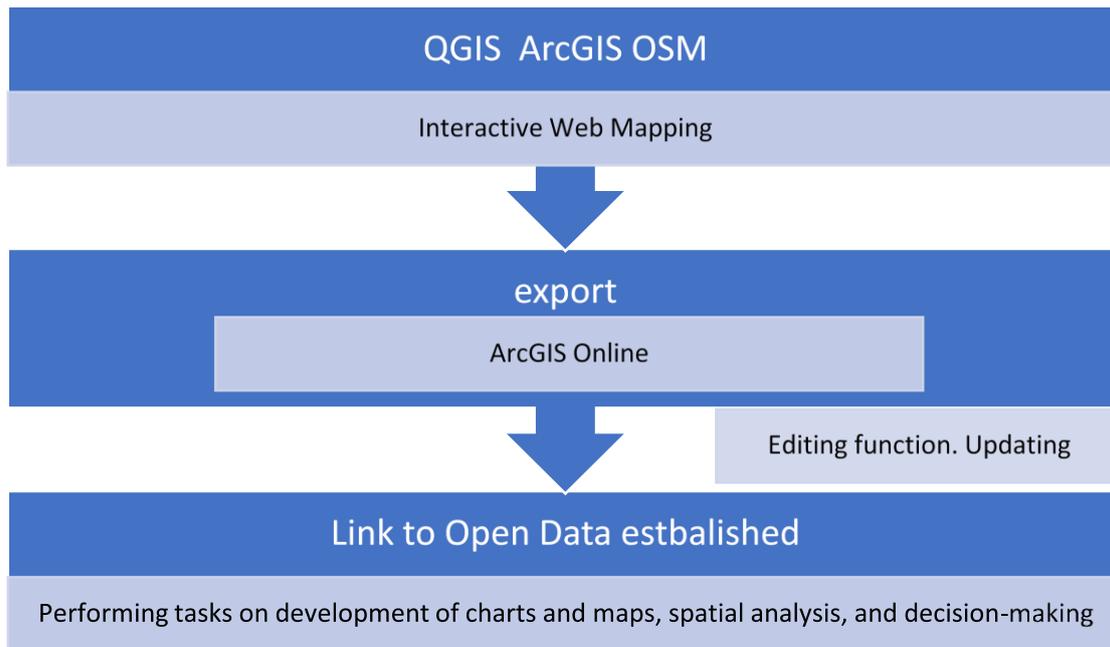


Figure 3. The cloud-service model as part of interactive web mapping process

#### *Online mapping software.*

The interaction with datasets for online mapping and spatial analysis is performed with the help of the ArcGIS Online. ArcGIS Online cloud service helps easily upload data. The advantages of this software are JavaScript API and many spatial analysis functions.

OpenStreetMap (OSM) serves as the additional tool. This a street-level spatial database is constantly being updated and includes all necessary features for mapping of population, i.e. administrative boundaries and major settlements. OSM maps are used to integrate datasets on demography with geospatial geometry data. This Open source software provides flexibility for producing various interactive maps, too.

The next question is how to perform such tasks as to ask questions of data, query statistics, highlight outliers and similar tasks. The focus is made on particular functions for retrieving GI about population data for online mapping. The main goal is to provide users with a simple tool for displaying map indicator values when the user's cursor moves over a polygon, or integrating maps with charts to enhance data insights.

This study considers the feasibility of data interactivity by involving of analytical functions in web and enriching mapping libraries. The integration analytics/infographics libraries with web mapping libraries is selected as the most preferable option. Vector map data is beneficial from the perspective of providing the spatial geometry and feature ID information to enable analytical queries.

#### **Results**

While looking for open resources at the different level of request and retrieving of GI it becomes clear that gaps exist on the lower level of hierarchy of interactive mapping (Fig.4).

Open Data is well represented on the national and regional<sup>1</sup> (Hokimiyat) levels, and <no data> on community levels. At the same time, the geospatial geometry data at all spatial level is available from different open sources, including OSM, GoogleMap.

<sup>1</sup> URL of the Khorezm Hokimiyat Portal is an example of open data source at the regional level

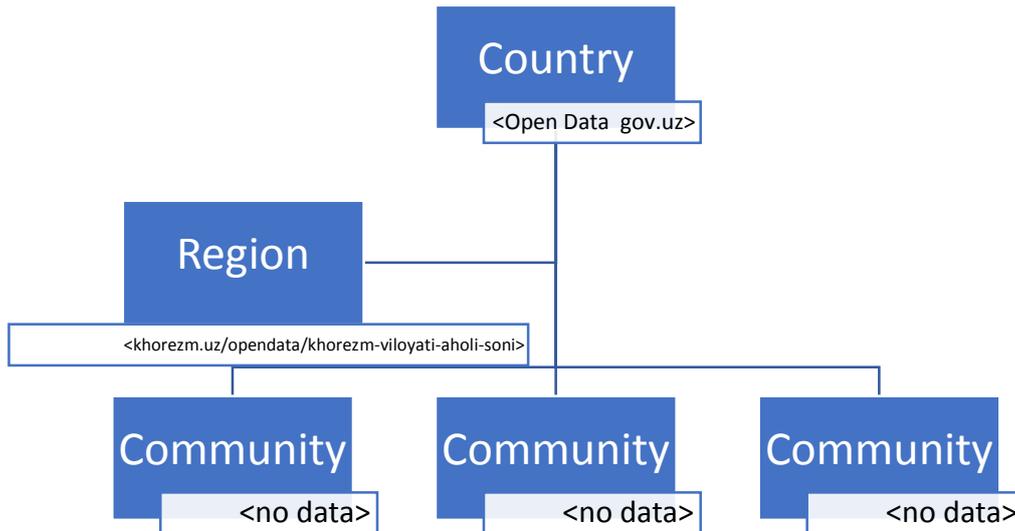


Figure 4. Hierarchy of geospatial information search options

OSM (Fig.5) maps are well suited to integrate datasets on demography with geospatial geometry data on national, regional, local levels of interactive mapping. When compared OSM and digitized maps for the testing of coincidence of geometry data it is confirmed that OSM map is accurate.

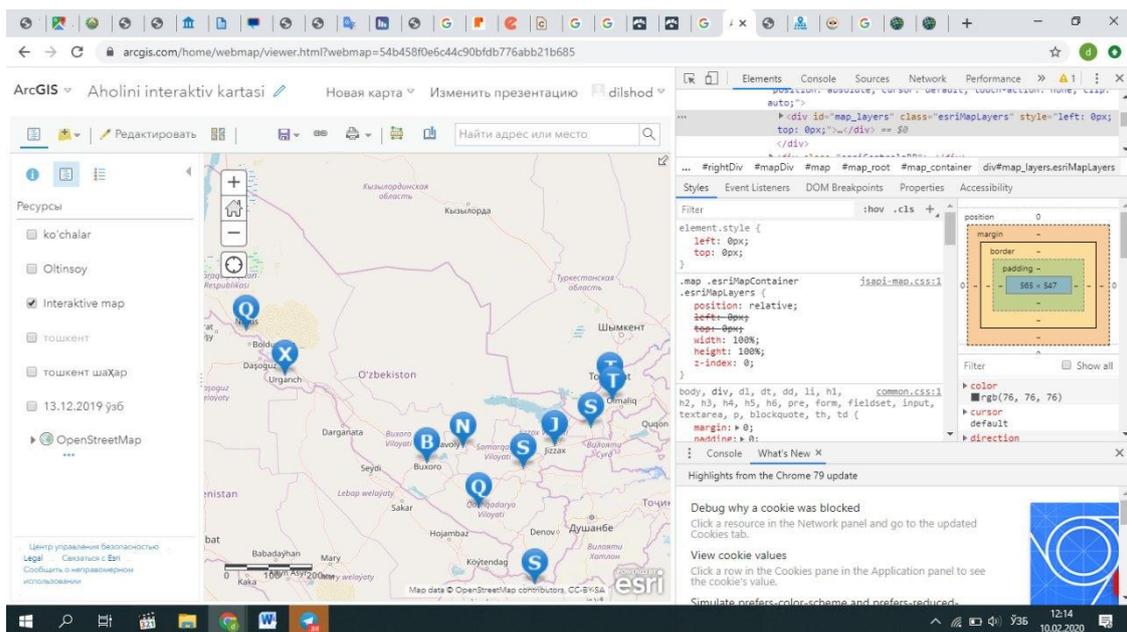


Figure 5. Map of Uzbekistan is retrieved from the OSM and processed in ArcGIS Online. Major urban centers are marked with symbols. Each of them is linked to the relevant Open Data source at the <https://data.gov.uz> The dataset is developed and posted on cloud at <https://www.arcgis.com/apps/View/index.html?appid=ea5d5997ff6f4bfc7b14d237052cfc7>

The development and integration datasets on regional population by establishment links to the portal of regions is represented in Fig.6.

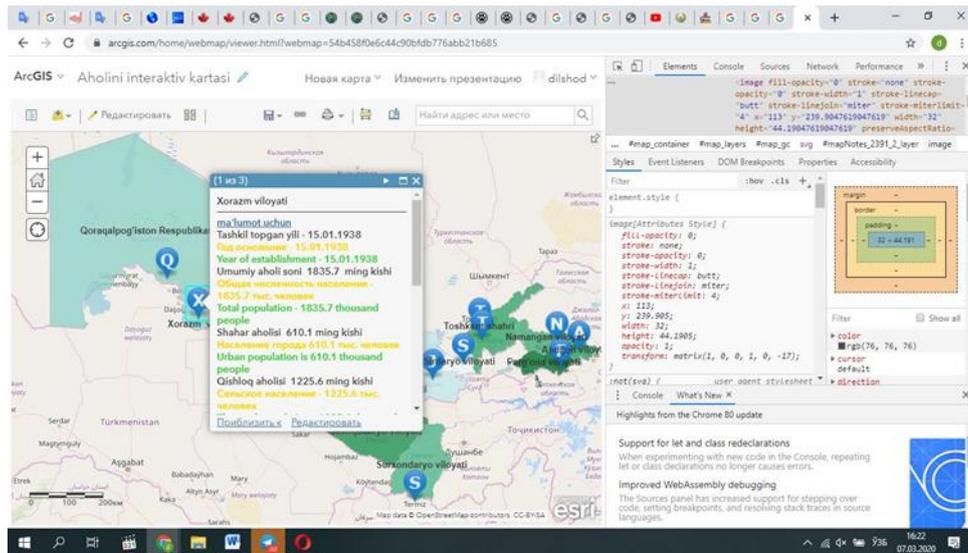


Figure 6. Interactive map of Khorezm region with links to the portal of open data of Khokimiyat of the region at the <https://khorezm.uz/opendata/khorezm-viloyati-aholi-soni>. The dataset is developed and posted on cloud at URL: <https://www.arcgis.com/home/webmap/viewer.html?webmap=54b458f0e6c44c90bfdb776abb21b685>

In a <nodata> case datasets are developed and integrated with the help of ArcGIS Online. This is proved to be the best software for this task. The solutions for mapping the population of the city of Tashkent and of the “Oltinsoy” community are represented in the Fig.7 and Fig.8 respectively.

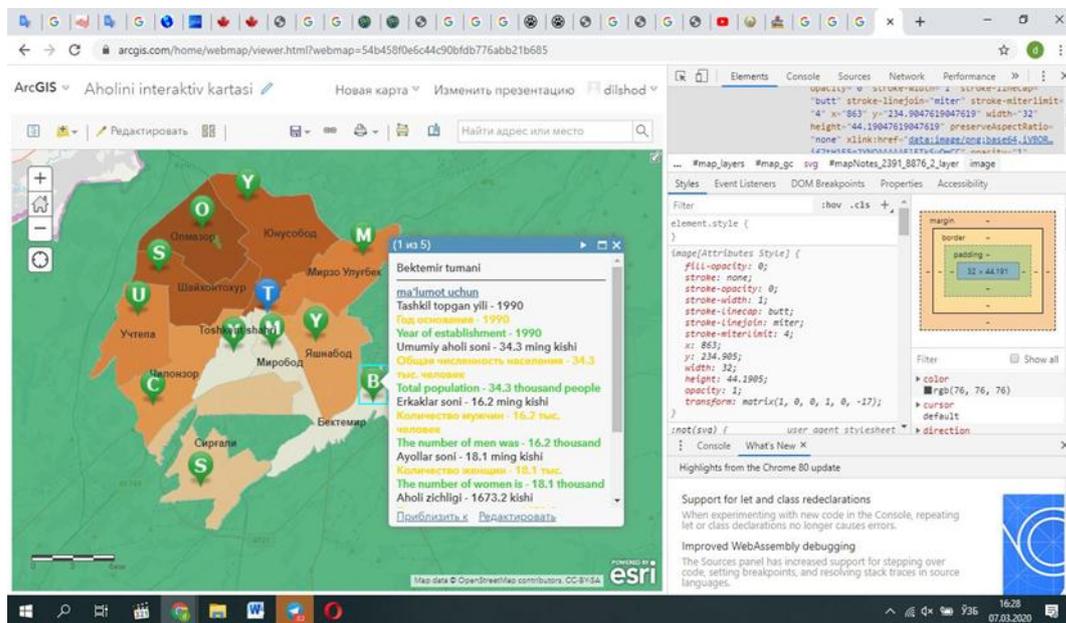


Figure 7. Interactive map of City of Tashkent with links to the portal of open data of respective districts. The dataset is developed and posted on cloud at <https://geoplaza.maps.arcgis.com/home/webmap/viewer.html?webmap=54b458f0e6c44c90bfdb776abb21b685>

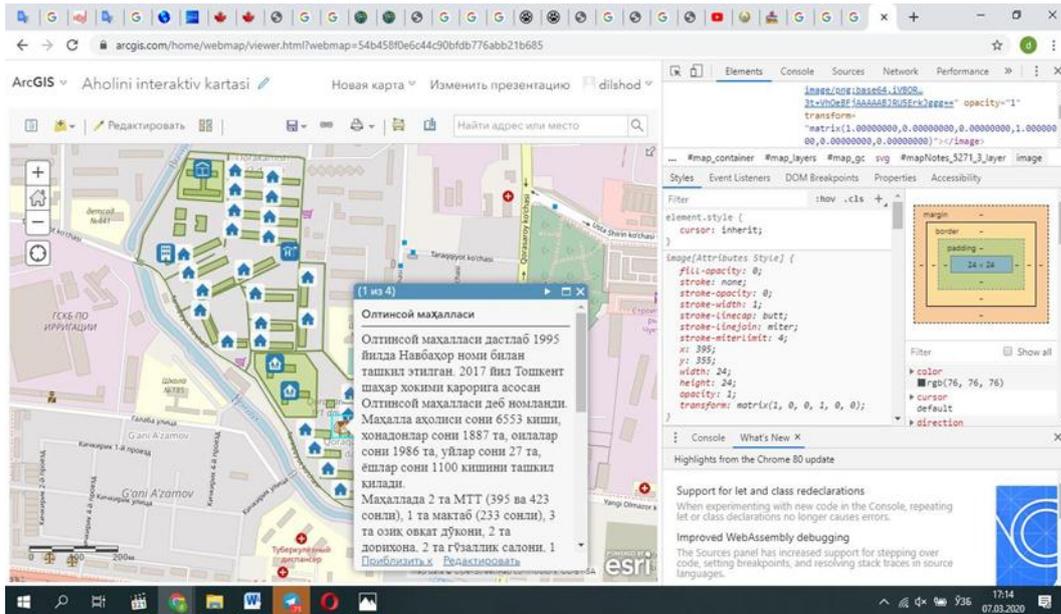


Figure 8. Interactive map of “Oltinsoy” community of Olmazor district of the city of Tashkent. The dataset is developed and posted on cloud at <https://geoplaza.maps.arcgis.com/home/webmap/viewer.html?webmap=54b458f0e6c44c90bfdb776abb21b685>

More options exist for retrieving the GI from the Portal of the State Committee of the Republic of Uzbekistan on Statistics at URL: <https://stat.uz/en/open-data> which publishes quarterly and annually data about population. They are in formats that suitable for integration and interactive mapping. This source of information is valuable for development of various social-economic maps. It includes data that gives an opportunity for efficiently retrieving GI by means of interactive mapping. The mapping of the dynamic of population growth is the only example to get the picture of change of the spatial distribution of population. The series of interactive maps of population are compiled with the ArcGIS Online and established links to Portal <https://stat.uz/en/open-data>. Such kind of maps may be compiled according to data as of any date that exists in a dataset.

Several examples of mapping of the change of population are given in Fig.9 (as of 1991), Fig.10 (as of 2015).

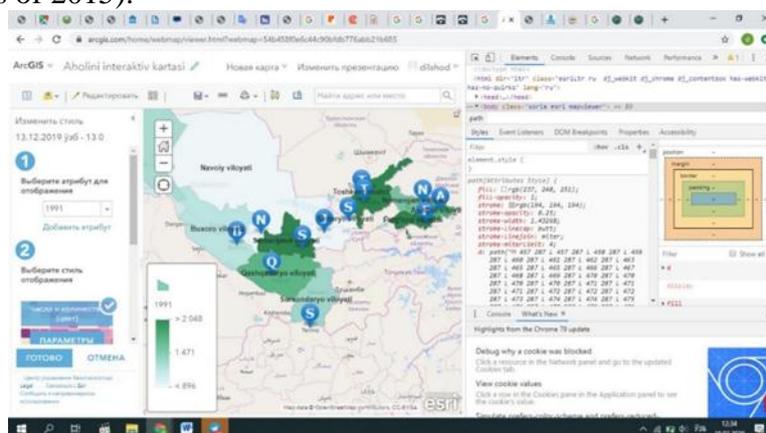


Figure 9. Interactive map of population as of 1991

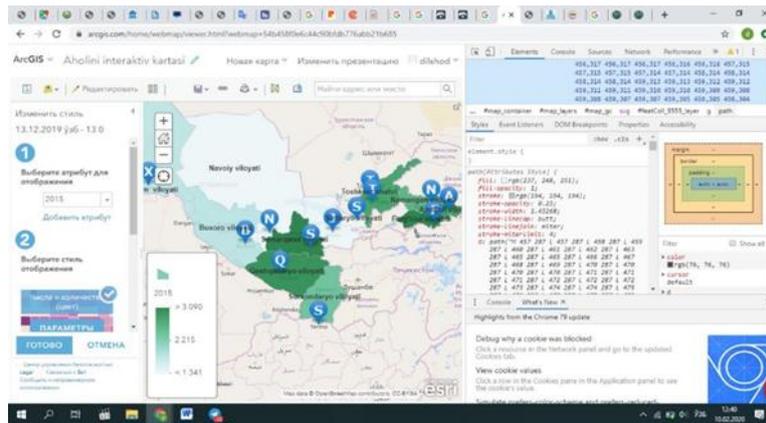


Figure 10. Interactive map of population as of 2015

ArcGIS Online is helpful for performing very simple operations like distance and square measurement (Fig.11). This is very popular request when searching for GI by different users.

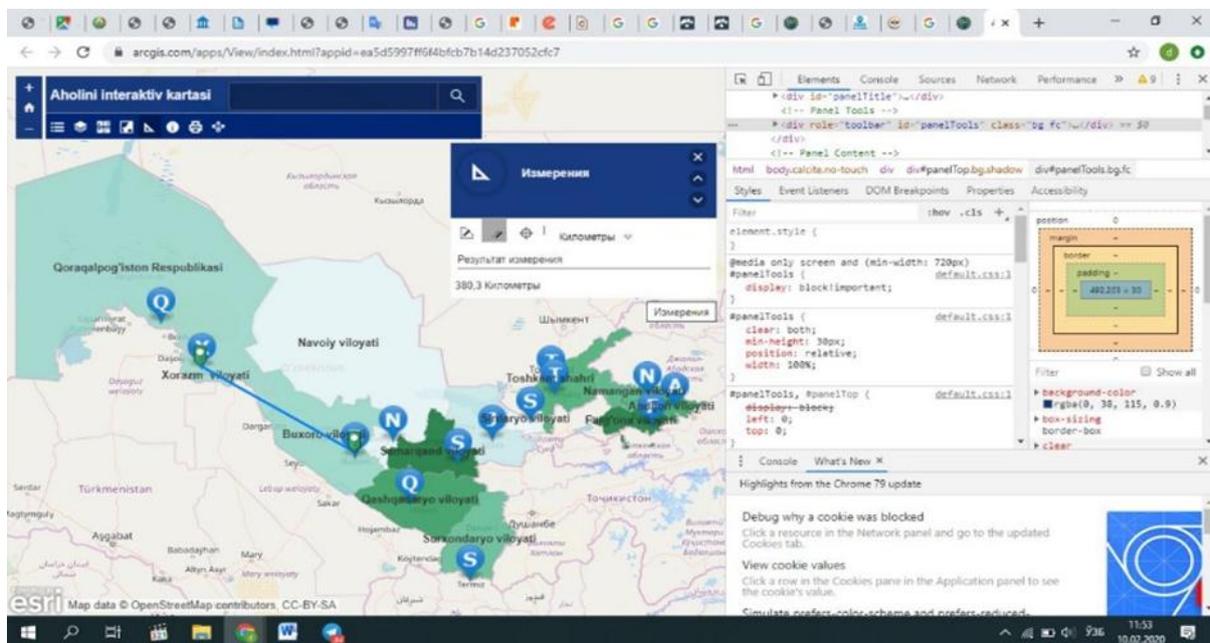


Figure 11. Interactive map of population is linked to Open Data at the Portal of the State Committee of the Republic of Uzbekistan on Statistics at <https://stat.uz/en/open-data>. The simple operation to measure distance between two points is performed by ArcGIS Online

## Conclusion

Open resources provide with many options for interactive mapping. This study focuses only on some of them and the main goal is to look for proper analytical tool for retrieving GI about population from Open Data Portal of the Republic of Uzbekistan. From the technical point of view with the consideration of current state of ICT and GIS development the interactive mapping is the best way to establish relationship between the map and the map user as well as to develop and update datasets. In some cases, when datasets are not posted on the Portal the flexibility of this technology helps to integrate available data with geometry data.

The future prospects for study are in a field of further integration of existing open sources. Today, many datasets are not connected to each other while they are good source for

retrieving GI. This study shows advantages of existing software in a form of open resource for improvement of interactive cartography and interactive mapping of social and economic processes.

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