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Innovations in dissemination and communication throughout the census life cycle

Geostatistics - an innovative tool in the dissemination of official statistics

Note by Belarus*

Summary

The application of geoinformation technologies permits a deeper and more comprehensive analysis of data, and, as a result, permits informed and high-quality decisions in various areas of activity.

In particular, they improve statistical activities by providing tools for spatial data visualization, spatial analysis, integration of different information sources, spatial process modelling, and optimization of resource management.

This note presents the experience of the Republic of Belarus in using geo-information technologies to improve the dissemination and visualization of official statistical information, the calculation of Sustainable Development Goal indicators and the prospects for their further application in statistical activities.

*Prepared by Irina Bichan, National Statistical Committee of the Republic of Belarus, demzdrav@belstat.gov.by

I. Introduction

1. In order to improve the quality and accessibility of official statistical information it is necessary to improve the existing tools and introduce new tools for dissemination. GIS-technologies are one of them.
2. In recent years the National Statistical Committee of the Republic of Belarus (Belstat) has been actively using Geographic Information System (GIS) technologies in statistical activities. Initially their use was aimed at modernization of the preparation and conduct of the census. Integration of GIS technologies by creating web-mapping services, using geodatabases and positioning systems, has significantly improved the quality of the census and provided an opportunity to expand the information services provided by Belstat - in particular the creation of the information and analytical system 'Geostatistics' (IAS 'Geostatistics').

II. GIS for the census

3. IAS 'Geostatistics' is a spatial data dissemination platform created using ArcGIS products. Initially ArcGIS was used to visualize the results of the 2009 population census, and on its basis in 2011 the statistical databook 'Spatial representation of the results of the 2009 population census of the Republic of Belarus' was created.
4. The next step was the development in 2016 of the technology of automated construction of the plan of enumerators, census and enumeration areas on the basis of data from administrative sources: the population register and address register. This made it possible to ensure the construction of subordinate statistical areas in settlements, taking into account the barriers in the form of water bodies and railroads. In large settlements, statistical areas were built from parts of city quarters (neighbourhoods) in cases where the number of population exceeded the limit size of one area. Sub-areas were also formed for buildings, taking into account the location of paths within the blocks.
5. The digital cartographic material for the temporary census staff was generated using the geographic information system 'Population Census' (GIS 'Population Census'). Its use made it possible to obtain data that were geo-referenced and could be aggregated in any territorial section. Spatial datasets were represented in the WGS-84 coordinate system. The complex of automated tasks ensuring fulfilment of GIS objectives was solved using standard tools of ArcGIS, ArcInfo and ArcReader software.
6. The information layers of the GIS "Population Census" base map were:
    (a) 'Administrative-Territorial and Territorial Units' (ATU and TU) layer. This consisted of topological polygons (rural settlements, village councils, urban settlements), which in their sum formed the corresponding districts, regions and the whole territory of the republic;
    (b) 'Census areas' layer. This was a polygon layer, including contours of census areas, along the boundaries of which it was topologically coordinated with the ATU and TU layer;
    (c) 'City Quarters' and 'Terrain Objects' layers. These layers were polygon layers, including contours of city blocks, contours of buildings, structures and other terrain objects;
    (d) 'Communications' layer. This was linear and included watercourses, centrelines of streets and roads, bridges and overpasses;

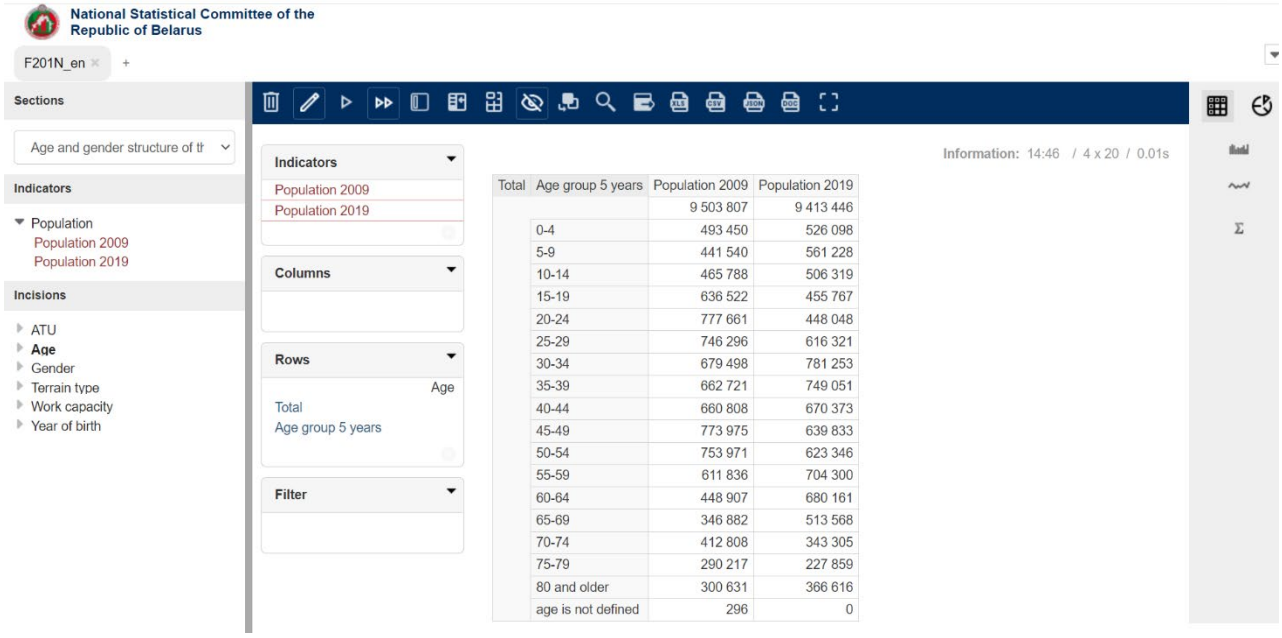
(e) The ‘Annotations’ layer had a point localization character and contained captions of objects with undefined localization character.

7. Currently, the ‘ATU and TU’ layer is updated according to the data of the Unified Register of Administrative-Territorial and Territorial Units; the address layer - according to the data of the Register of Addresses of the National Cadastral Agency; and the auxiliary layers - according to the data of the navigation map, OpenStreetMap.

8. Later on, the GIS ‘Population Census’ was used to disseminate the final data in the information and analytical system ‘Population Censuses data of the Republic of Belarus’ (IAS PC).

9. The system became available to users at the end of October 2021. It contains final data from the 2009 and 2019 censuses, on population size, age composition and marital status, fertility, education level, national composition, native language and language usually spoken at home, economic characteristics of the population, migration and temporary residents, household composition and amenities. The IAS PC also has various data visualization tools: graphs, charts, cartograms.

Figure 1
IAS PC interface



10. The system unloads the obtained visualization results in machine-readable formats, which allows the user to work with the information in other systems or databases. You can familiarize yourself with the IAS PC work at **https://census.belstat.gov.by/.**

III. IAS ‘Geostatistics’

11. The adoption of the 2030 Agenda for Sustainable Development at the global, regional and national levels has required improved data harmonization with higher quality, accuracy, timeliness and detail. National statistical offices and national cadastral agencies play a key

role in this process. The integration of statistical and spatial data is recognized as one of the most promising methods for providing timely, reliable and detailed information.

12. Geographic location is an ideal basis for combining different layers of information across space and time. The use of different spatial scales, from grid to regional level, opens up limitless possibilities for analysis and interpretation.

13. Taking into account the growing interest in the use of geographic information systems as a convenient and user-friendly tool for presenting statistical results, Belstat has created IAS 'Geostatistics' based on ArcGIS, which became available to users in December 2023.

14. IAS 'Geostatistics' is designed for:

    (a) linking official statistical information with the relevant geographical objects;

    (b) accomplishing spatial analysis and displaying official statistical information on a map, including the population census final data;

    (c) providing users the official statistical information and spatial data.

15. The system is designed based on the following architecture:

    (a) Database level (a centralized database organized in a DBMS was used);

    (b) Application level;

    (c) Web presentation layer;

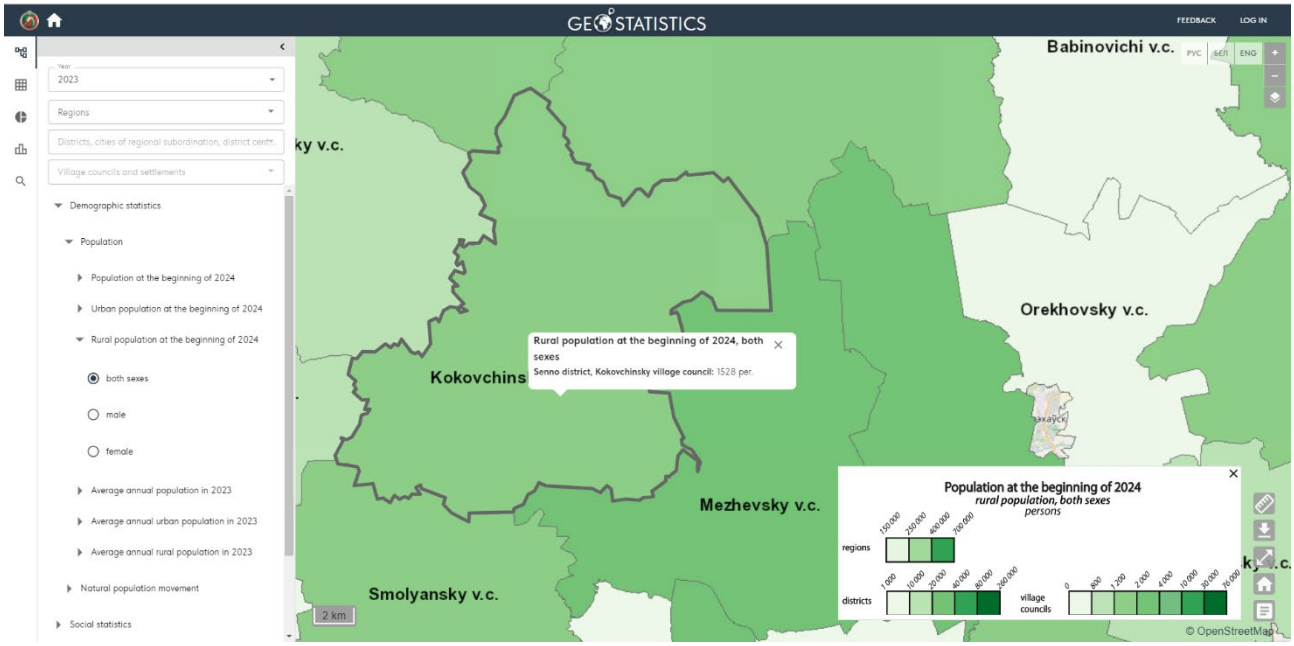
    (d) User level.

16. The geography of Geostatistics users is quite extensive, because the interface is also available to the English-speaking audience.

17. In addition, the functions of standard map tools are supported. The ruler tool allows you to measure and display the distance between specified points. The scale tool allows you to change the scale of the interactive map. The maximum scale is 1:1000. It is possible to select the map base or disable it if necessary.

18. Users of the system have the opportunity to interactively obtain information on the territory of interest of the republic, taking into account its socio-economic and demographic characteristics, generate tables according to individual requests, build graphs, charts and cartograms, and upload them in a convenient format. Various disaggregations are also available: by gender, type of locality, forms of ownership and types of economic activity of enterprises. For some indicators, information is available up to the village council level.

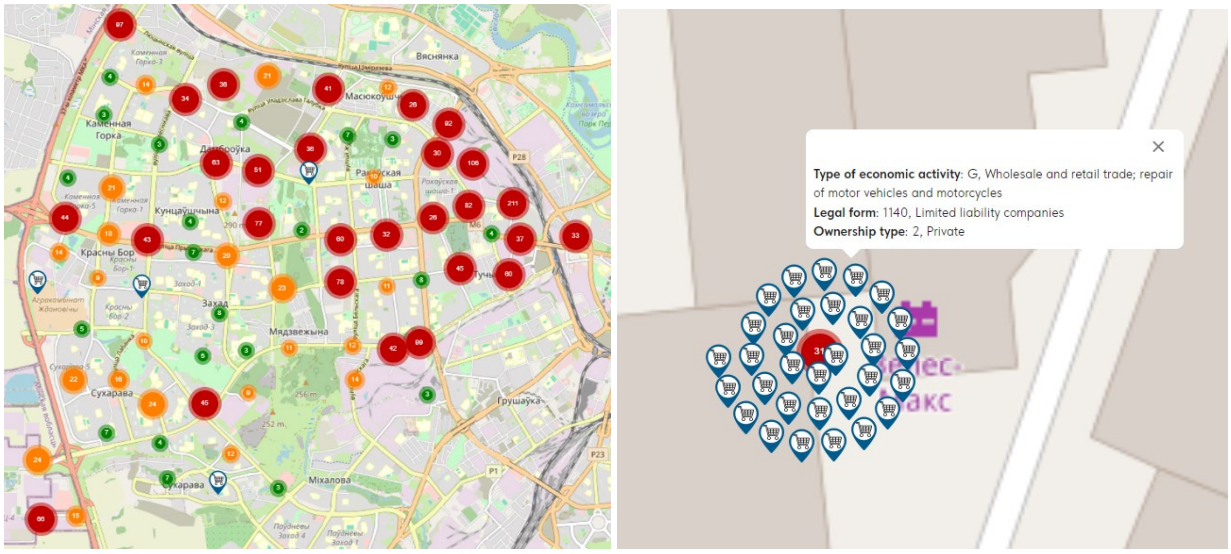
Figure 2
Interface of IAS 'Geostatistics', detailing down to the level of village councils



19. IAS 'Geostatistics' is an innovative tool for dissemination of official statistical information. It is loaded with information on key branches of statistics, including business demographics.

20. In 2023 Belstat undertook work on determination of geographical coordinates of all objects of statistical register, and implemented the possibility to add X,Y coordinates to the output information. This allows creation of geospatial visualizations of objects from the statistical register in IAS Geostatistics using different statistical indicators as attributes.

Figure 3
Enterprises by types of economic activity in IAS 'Geostatistics'



21. The system's capabilities are integrated into the process of Sustainable Development Goal (SDG) assessment and monitoring, which contributes to more effective management and informed strategic decision-making. You can familiarize yourself with the system's capabilities at **https://gis.belstat.gov.by/.**

22. Already in 2024, using ArcGIS, Belstat specialists have carried out an experimental calculation of SDG indicator 11.2.1, 'Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities', and its visualization in IAS 'Geostatistics' for a distance of 500 metres from public transport stops.

23. The legislative framework allows the National Statistics Committee to obtain information from information resources (systems) free of charge. Thanks to this, information from the address register of the National Cadastral Agency was obtained. The source of data on population was the final data of the population census with geographical reference. It was possible to build polygons corresponding to the condition of distance of 500 metres by linking the population data and the point layer of public transport stops from OpenStreetMap.

Figure 4
Cartographic representation of indicator 11.2.1 for the City of Minsk

24. The improvement of geospatial information management and its use in different spheres of the national economy is promoted by the development of cooperation between the National Statistical Committee and the National Cadastral Agency. This work requires continuous improvement, taking into account international standards and practices in the field of geospatial information.

25. In IAS 'Geostatistics' the possibility to set up programme interaction with external information systems via an API-interface has been implemented. This will allow interaction with the National Geoportal, which will be the core of the National Spatial Data Infrastructure (NSDI), through web services.

26. The establishment of the NSDI was started in January 2024. The State Property Committee is responsible for organizing the creation, functioning and development of the NSDI, and for analyzing its functioning.

27. Currently, the development of information resources with spatial data is carried out by various structures, mainly at the departmental level. The task of the NSDI is to unite these sectoral resources on one National Geoportal. This will provide consumers with an opportunity to quickly find the necessary information based on the 'one-stop-shop' principle, significantly reducing the time for its collection, processing and actualization.

28. The main purpose of the NSDI and the National Geoportal is to create conditions for sustainable economic development, environmental protection, security, prevention and elimination of emergency situations and other spheres of activity.

IV. Conclusions

29. Thus, IAS 'Geostatistics' has a powerful potential in strengthening national statistics: the system of statistical indicators available for visualization is expanding, the dynamic series is deepening; new SDG indicators with geospatial reference are calculated and become available for visualization.

30. The integration of GIS technologies into the process of SDG assessment and monitoring in Belarus allows for a more accurate and comprehensive analysis of progress towards achieving the SDGs.

31. The efforts undertaken to create the National Spatial Data Infrastructure in Belarus in January 2024 are a significant step towards its use in various sectors of the national economy.