GI_Forum 2021, Issue 1
Page: 158 - 168
Best Practice Paper
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DOI: 10.1553/giscience2021_01_s158

Nationalization of Indicators for Sustainable Development Goals in the Republic of Kazakhstan through Geoinformation Technologies

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Abstract

From the first days of independence, Kazakhstan has paid attention to sustainable development and successfully achieved the Millennium Development Goals and in 2015 launched the implementation of the 2030 Agenda for Sustainable Development. The article discusses the issues of monitoring and reporting on the SDGs in Kazakhstan, the priority of nationalization of indicators, the creation of a statistical database on the SDGs, the definition of data sources, and methodology for calculation. Geospatial data are inevitable for the integration of information about society, economy and environment. A web-portal developed by the authors is presented that allows to assess the quality of life of the population in different regions based on the SDG indicators.

Keywords: sustainable development goals, geospatial information, geoinformation technologies, atlas information system, Republic of Kazakhstan

1 Introduction

In 2015 in New York, the UN adopted the "The 2030 Agenda for Sustainable Development" - aimed at achieving progressive, sustainable development of all countries of the world (United Nations, & Nations, U. (2015). Kazakhstan, among other states, also took an active part in the development of this Agenda.

The Sustainable Development Goals (SDGs) are a set of goals for future international cooperation that replaced the Millennium Development Goals (https://www.un.org/ru/documents/decl_conv/declarations/) at the end of 2015. The SDG goals are planning to achieve from 2015 to 2030. To track progress on each goal developed a set of quantifiable indicators, targets, and observables specific to each goal. The final document, "Transforming Our World: the 2030 Agenda for Sustainable Development," contains 17 global goals and 169 related targets. The SDGs adopted by 193 UN member states.

The targets of the SDGs largely coincide with the priorities of the Republic of Kazakhstan outlined in the development documents: the Development Strategy "Kazakhstan-2050", the Strategic Development Plan until 2025, the "National Plan – 100 Concrete Steps" for the implementation of five institutional reforms, Five social initiatives of the Head of State and the State Program "Ruhani Zhangyru" (https://www.akorda.kz/ru/official_documents-/strategies_and_programs). These national programs and initiatives aimed at improving the quality of life of all segments of the population, creating a sustainable economy and strengthening human capital in the republic. To date, about 80% of the SDG objectives are reflected in the documents of the state planning system of Kazakhstan.

The 2030 Agenda and its 17 goals call for a balance of social, economic and environmental dimensions to ensure inclusive and sustainable economic growth, social inclusion and environmental sustainability. Thus, Kazakhstan sets the main guidelines of its state policy to ensure social justice and environmental sustainability, the transition from short-term planning to long-term vision. The assumption of social and environmental costs as investments in sustainable development, and the limited recognition of planetary boundaries and the need for systemic change "by enhancing well-being and quality of life of the population of Kazakhstan and the country's entry into the top 30 most developed countries of the world while minimizing the burden on the environment and degradation of natural resources." (Decree of the President of the Republic of Kazakhstan 2013).

Thus, the SDGs are in many respects consistent with Kazakhstan's development efforts and can serve as a useful and convincing strategic framework for addressing national challenges.

Monitoring and reporting on the SDGs are receiving close attention. Nationalization of indicators, creation of a statistical database on SDGs, identification of data sources, and methodology for calculation are in priority.

2 Material and Methods

Research uses theoretical and methodological analysis of scientific literature, methods of comparative and structural analysis, grouping and systematization of databases, and geoinformation technologies. Statistical and analytical data are collected from the national SDG reporting platforms of the Republic of Kazakhstan, monographs, scientific articles, publications and reports of the UN, etc.

3 Results and Discussion

The role of big data in the analysis of SDG indicators has been considered by many scientists (MacFeely 2019; Breuer et al., 2019; Allen et al., 2019).

Information about the physical, chemical, and biological systems of the planet that are needed to achieve, monitor, and monitor the SDGs can be detected using remote sensing technologies (Masó et al., 2019). Remote sensing and GIS methods use satellite data that provide a synoptic overview with global and local coverage at different spatial resolutions. These approaches can

also be used to monitor the impact of climate change on various components of aquatic and terrestrial ecosystems, in addition to field survey data (Avtar et al., 2013).

Location plays a huge role in integrating information about society, the economy, and the environment, and is key to tracking progress towards each of the SDGs. The UN recognizes the role of location in integrating information about society, economy, and environment, while also simply tracking each of the SDGs. Over the years, the organization has worked to combine geospatial and statistical information to visualize patterns, address data gaps, and effectively channel resources into areas most in demand to improve overall development outcomes (Paul Cheung 2015).

Figure 1: Correlation of SDGs with the goals and objectives of documents of the State Planning System of the Republic of Kazakhstan

The United Nations Statistics Division (UNSD) is now teaming up with ESRI to conduct research for testing a data center that will help target Member States measure, track and report on their progress towards achieving the SDGs in a geographical context.

This data research makes it possible to store all the information in one place. As part of the project, several participating countries are leveraging their existing data systems and deploying the ArcGIS Hub together with ArcGIS Enterprise to help their national statistical

organizations integrate SDG-related data into their work. The event also aims to ensure that national statistical organizations align their data and systems with other SDG stakeholders in the country, including mapping agencies, ministries, natural resources and environment agencies.

Kazakhstan, as a country that has committed itself to achieving the Sustainable Development Goals, is actively working in all areas and contributing to the successful achievement of global goals. The state planning system is consistent with the SDG targets (Figure 1).

Monitoring and reporting on the SDGs are receiving close attention in the Republic of Kazakhstan. Nationalization of indicators, creation of a statistical database on SDGs, identification of data sources, and methodology for calculation are in priority. The main government body responsible for collecting, processing and disseminating data on the SDGs is Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. As a result of the work carried out to nationalize the Sustainable Development Goals, a nationalized list of 17 goals, 169 targets and 297 indicators was approved (with the addition of 76 national indicators, 35 of which are proposed additionally) (Figure 2).

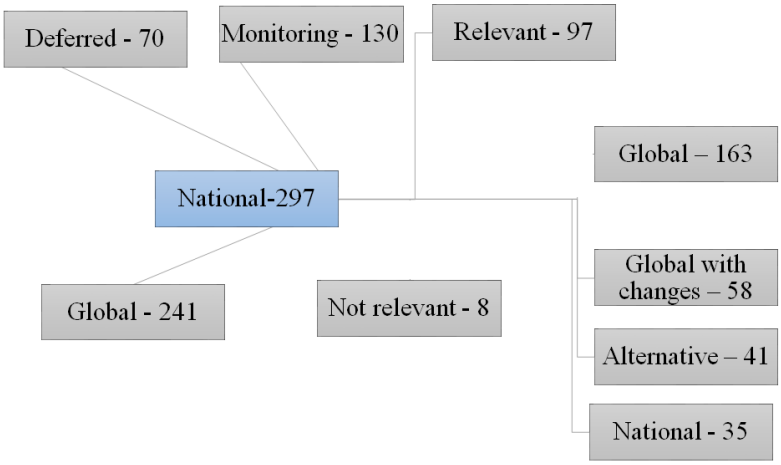

Figure 2: Nationalized list of SDG indicators in the Republic of Kazakhstan

At the same time, according to the results of the analysis, the indicators were grouped into four categories, including:

- Relevant indicators, which are the highest priority for policy implementation - 97;
- Some of the indicators that need to be monitored taking into account the current policy were proposed for monitoring - 130;
- Deferred indicators for which there are currently no calculation methodology or baseline values - 70;
- Not relevant for the country - 8.

At this stage, it is planned to carry out monitoring in the first two categories, where the initial data have already been determined. Work on deferred indicators will be phased in as the methodology is agreed globally and national data sources are identified.

The national SDG monitoring and reporting system consists of two main elements: the integration of SDG indicators into documents of the state planning system and official statistics. The data are published on the official web resources of state bodies in the form of official statistics and conclusions based on the results of monitoring and evaluation of strategic and program documents. Official statistics will play a key role in providing data for monitoring the SDGs and related targets. The Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan has also developed a national SDG reporting platform, which is under development and is available at: https://kazstat.github.io/sdg-site-kazstat/ (Figure 3).

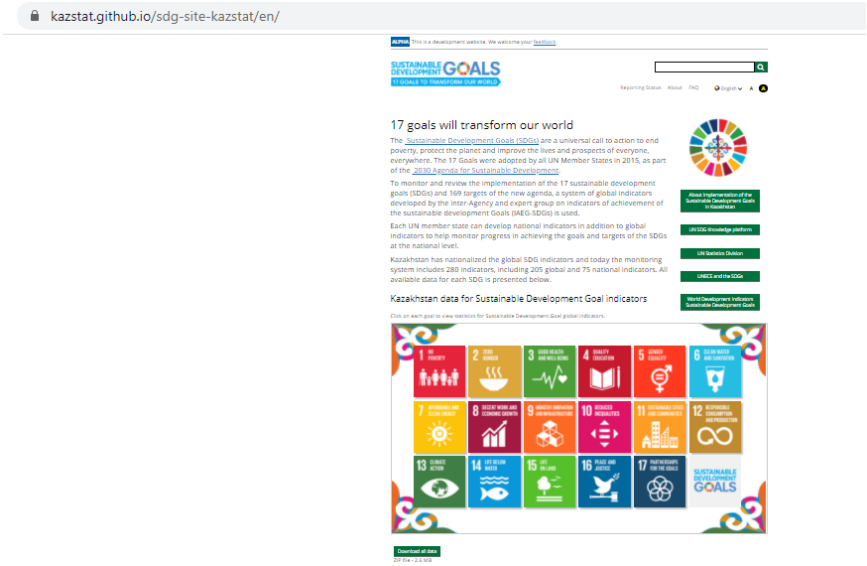

Figure 3: National SDG reporting platform Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan https://kazstat.github.io/sdg-site-kazstat/

The purpose of this platform is to provide Kazakhstan with data on both global indicators of the achievement of the Sustainable Development Goals (SDGs) and national indicators. In addition, it provides the interested public with constantly updated information on the status of the SDG indicators in Kazakhstan and detailed information on their calculation methodology. Data from monitoring SDG indicators in Kazakhstan are presented on the website in the form of tables and graphs (Figure 4).

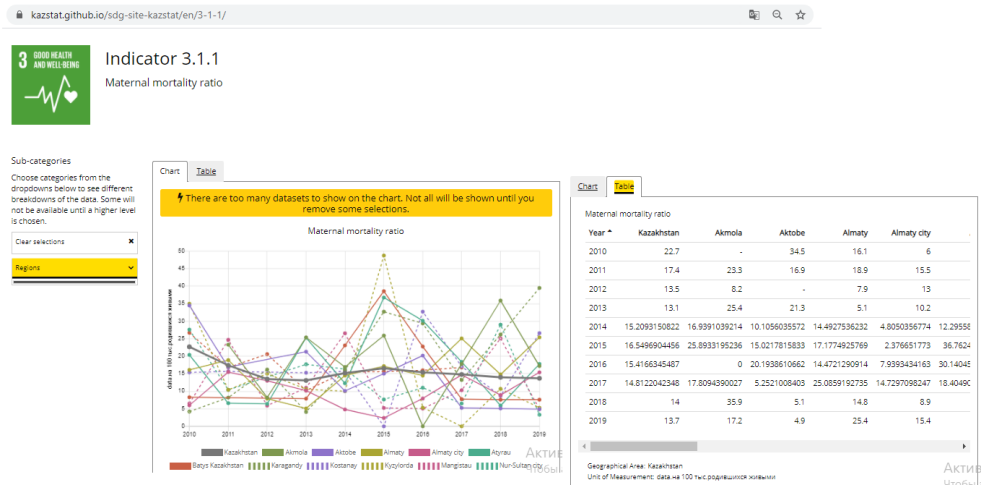

Figure 4: Indicator "Maternal mortality ratio" on the national SDG platform of the Republic of Kazakhstan https://kazstat.github.io/sdg-site-kazstat/en/

Unfortunately, geospatial data is not yet presented in the national SDG platform of the Republic of Kazakhstan. The continuous flow of information to adapt management methods to the changing situation during the implementation of the SDGs emphasizes the importance and feasibility of introducing a geographic information system for researching territorial aspects and addressing SDG issues. In this regard, work is underway in Kazakhstan to create a geospatial database for SDG indicators. On the basis of Al-Farabi KazNU a scientific study "Development of an atlas information system for a comprehensive spatial analysis of the quality of life of the population of the regions of the Republic of Kazakhstan as part of the implementation of the program" Digital Kazakhstan" was carried out, where the quality of life of the population of the regions was assessed using SDG indicators. During the work, a geodatabase was created for SDG indicators, thematic maps on the website of the developed atlas information system.

The Atlas Information System of the Quality of Life of the Population is a geo-informational web system for poly-scale organization of data, mapping, modeling and forecasting the situation in the field of research of indicators (economic, social, demographic and natural-ecological, SDGs) of the quality of life of the population. The main feature of the atlas information system in comparison with the geographic information system is the expanded capabilities of the cartographic representation of spatial data in the AIS.

Of course, the management of QoL indicators for the SDGs requires an exhaustive set of input data, including natural and socio-economic topics. Depending on the presence or absence of a particular set of data, various types of analysis will be available and, accordingly, management decisions of different complexity and flexibility will be available. On the basis of the considered QoL indicators, as well as the experience of using GIS in the management of QoL indicators, a conceptual scheme for the use of geoinformation technologies is proposed (Figure 5).

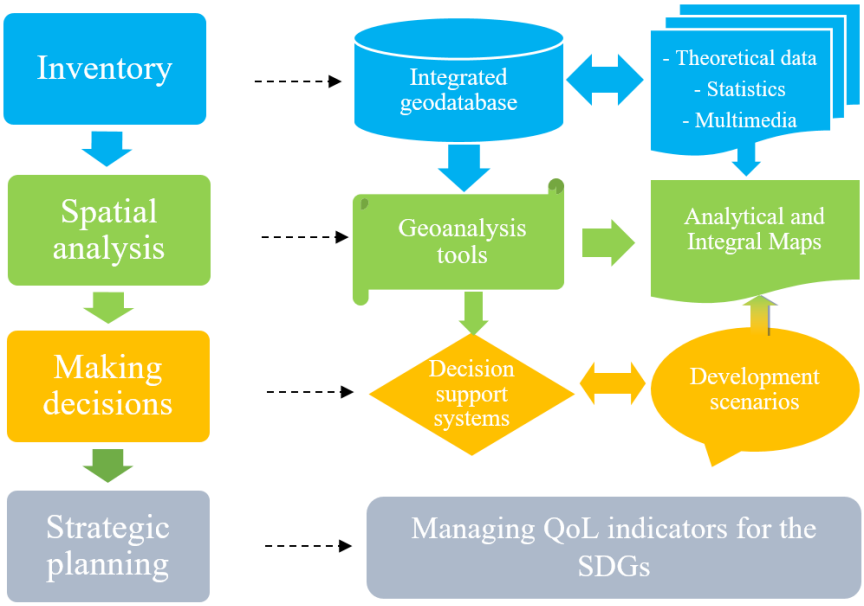

Figure 5: Algorithm for the use of geoinformation technologies in the management of QoL indicators for the SDGs

AIS QoL is characterized by a multi-level structure, consisting of blocks of information - the main groups of indicators characterizing the quality of life of the population: economic, social, demographic and natural-ecological, SDGs. Each of the blocks has two structural components. The first is the structure of files by type (maps and schematic maps, text descriptions, graphic material, tables). The second is the corresponding internal structure (blocks-sub-blocks-indicators), developed based on the content of the block. AIS QoL made it possible to integrate data from various sources, to form and collect information in the form of a single geoinformation base, varied in detail, time coverage, methods of obtaining, a set of indicators, types of presentation. So, to ensure the functioning of the AIS, a structure was developed and a geodatabase (GDB) was formed according to objective indicators of the quality of life of the population, consisting of two types of information: statistical and spatial. The spatial database is represented by vector layers previously created and processed in GIS and corresponding to the basic requirements of vector information (detail, reliability, accuracy, unity of the coordinate system and projection, etc.). Methods of geoinformation analysis, ERS processing, and digital mapping methods were used through ArcGIS Desktop in creating a digital basis. Each layer of the base is accompanied by attributive information in three languages about the qualitative and quantitative characteristics of the object.

The statistical data of the AIS QoL database are partial and integral indicators of the quality of life of the population for the following groups of indicators: economic, social, demographic, natural and ecological, SDGs. A total of 340 indicators were collected, including 71 SDG indicators (Figure 6).

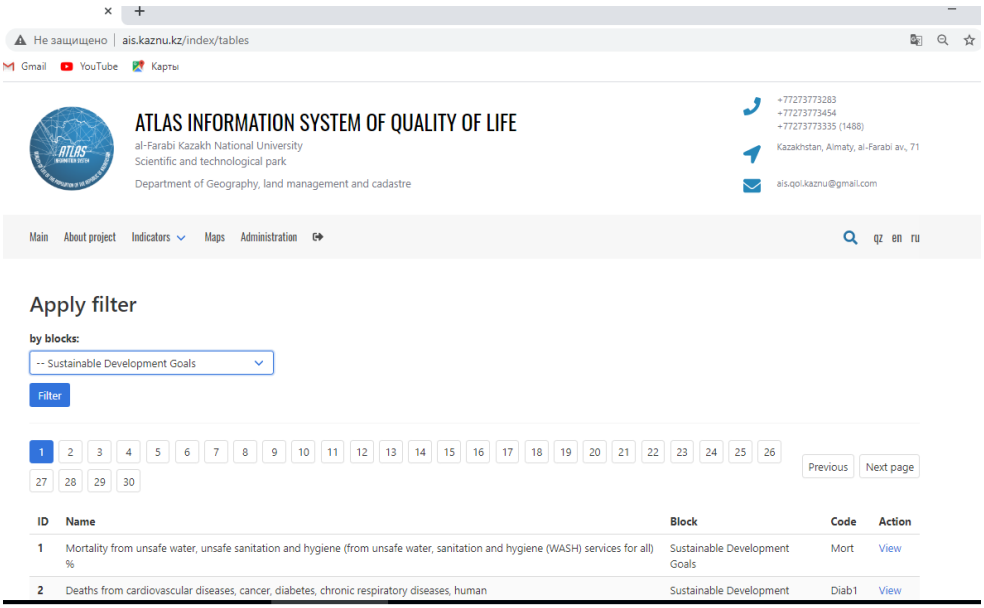

Figure 6: SDG indicators on the AIS QoL website http://ais.kaznu.kz/index

The development of AIS QoL in the form of a website began with the formation of the database structure and dependencies between the database tables. PostgreSQL 9 was chosen as the database management system, which supports tools for creating and storing procedures.

Geographic data, previously created and processed in GIS, are uploaded to the site as a cartographic base for all future thematic maps of AIS QoL. The formation of thematic maps of QoL was carried out by linking the statistical indicators of QoL uploaded to the site to the vector cartographic layer of administrative regions.

An important feature of the website is the ability for the user to further replenish and update the database and automatically compile new thematic maps based on requests, using the site's statistical data on indicators. This creates conditions for further monitoring and research of QoL indicators of regions, both in the context of regions and in the context of districts of cities of republican significance.

The visualization function of AIS QoL data is a presentation of QoL indicators in the form of maps, tables, texts and graphs and is the result of geoanalysis in the most understandable and convenient form for solving specific problems of monitoring and managing the level of QoL development in the regions of the Republic of Kazakhstan. AIS QoL allows to make inquiries and visualize processes.

The function of geoanalysis and modeling of AIS QoL allows a means of overlaying thematic layers - indicators of economic, social, demographic and natural-ecological blocks of QoL indicators of the regions of Kazakhstan for 1999-2018 to carry out interactive implementation of integrated maps. These cartographic models make it possible to analyze the situation, identify patterns of development, relationships in spatial distribution, identify trends in the development of processes for solving specific problems, in this case for monitoring and

managing QoL indicators and making decisions to increase the QoL level in the regions of Kazakhstan.

When creating the site, the determining factors were: the ability to implement information retrieval functions; the possibility of integrated processing of cartographic and text data; convenient forms of dialogue with the user; the ability to adapt the atlas to changes in the forms of input and output documents; the presence of a variety of data models specialized in information processing tasks, closely integrated with a supporting atlas information system; flexibility in choosing the architecture of the system supporting the atlas; openness to external programs.

Thematic maps of AIS QoL reflect the indicators of the SDGs in the field of education, health care, social sphere, employment, as well as environmental changes in the regions of the Republic of Kazakhstan. Visualization of thematic maps by the method of cartograms gives a clear picture of the intensity of certain processes and phenomena, allows to reveal the spatial differentiation of the development of regions by the level of QoL and SDG indicators (Figure 7).

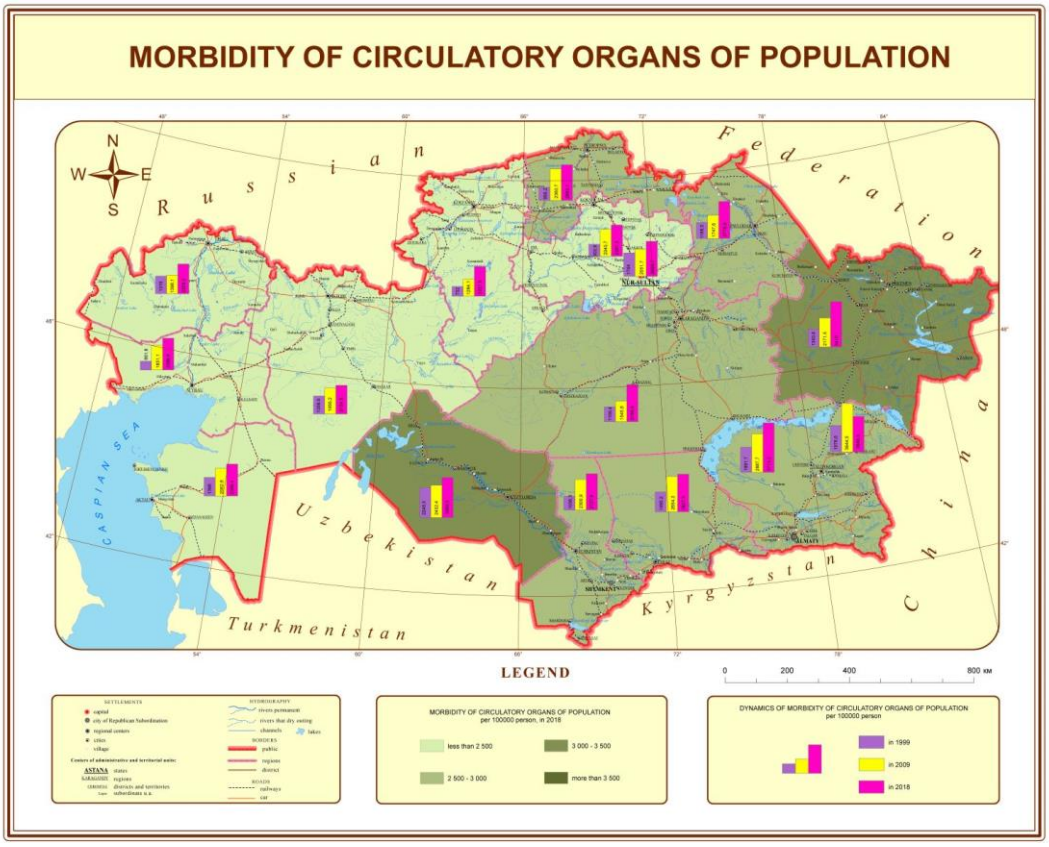

Figure 7: Morbidity of circulatory organs of population in Republic of Kazakhstan

SDG 1 is poverty eradication. The use of alternative methods based on GIS and digital AIS QLM maps (the share of the population with incomes below the subsistence level, poverty indicators, average per capita nominal monetary incomes of the population, subsistence minimum, regional distribution of poverty) based on geospatial data, provide information on the spatial differences of the regions of the republic, related to various SDG 1 indicators. These maps are an important tool for developing effective policies aimed at reducing regional inequality through the implementation, regulation and improvement of social protection programs for the allocation of subsidies, pension payments, efficient resource use, unemployment insurance, etc. (Avtar et al., 2019).

Health system indicator maps, along with indicators of infant and maternal mortality in the regions of Kazakhstan, allow to identify regional differences for effective and intensive allocation of budgetary funds and human resources in areas with low indicators to improve the situation to achieve SDG 3.

SDG 4 - getting quality education is the most important condition for improving the quality of life of people and sustainable development. Maps of the education system, reflecting indicators in the field of preschool, school and higher education in the regions of Kazakhstan, as well as teaching staff and educational coverage of the population, clearly reflects the relationship, deficit and surplus of places, professional staff in these institutions. Also relevant during the COVID-19 pandemic and distance learning is a map of access to the Internet in the regions, which demonstrates the access of students and teachers to educational platforms and learning resources. Geospatial representation allows you to identify problem regions for effective and intensive coverage of the population with education, personnel and Internet accessibility.

AIS QoL maps reflect certain aspects of SDG 5. These are maps of the ratio of the male and female population in the regions, gender and age structure, indicators of male and female population life expectancy, incomes and wages of men and women, etc., which allow identifying patterns and conducting a retrospective analysis of gender aspects of the quality of life.

The AIS QoL considers the cities of republican significance Nur-Sultan and Almaty, where 15% of the population of the republic lives. These megacities are centers of economic growth, providing more than 30.5% of GDP. Rapid urbanization leads to an increase in inadequate and congested infrastructure and services (such as waste collection and water and sewerage systems, roads and transport), worsening air pollution and unplanned urban sprawl. Cartographic visualization allows to display the disproportions in the development of individual indicators of the quality of life of the population in the administrative districts of cities. Research data reflect challenges for SDG 11.

The introduction of AIS QoL in the process of teaching bachelors, undergraduates and doctoral students of the university, work with SDG indicators within the AIS QoL is a key moment in the implementation of the implementation of the SDGs in universities. In particular, it provides a basic understanding and visual representation of the subject areas of each of the SDGs, allows to provide in-depth knowledge in the field of both geographic information systems and for the implementation of the SDGs, and expand opportunities for building the potential of future specialists to solve sustainable development problems.

4 Conclusion

Achieving the SDGs undoubtedly requires a huge global concerted effort to effectively leverage the sharing, processing and aggregation of data in a multidisciplinary framework. National Geospatial Information Agencies will need to work closely with national professional communities in the area of statistics and Earth observation

At present, it is becoming easier to obtain spatial geographic data, but the key point is the collection, organization, and management of databases to correctly use this data for analysis, monitoring, and management when making strategically important decisions of states. Spatial analysis plays an important role in determining the causes and effects of a given phenomenon, e.g. for agriculture, global health or nature protection, based on classic GIS procedures like map overlays and assessing the relationships between them.

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