European Union

GREEN WELLBEING INDICATORS IN POLAND

Copernicus Sentinel data is being used by Statistics Poland to improve the quality of its data and better monitor green areas and wellbeing indicators.

THE CHALLENGE

Green areas provide vital local functions such as recreation and bioclimatic regulation, especially in urban areas. In addition to improving the overall quality of life for citizens, green spaces also provide opportunities to improve physical and mental health, promote community cohesion, and make cities and neighbourhoods more desirable places to live and work[1].

The constantly changing climate in Poland, particularly in the central and western regions, leads to persistent droughts, causing significant crop losses. Moreover, according to the OECD, Poland ranks in the bottom two deciles in terms of wellbeing indicators related to environmental quality, specifically, indicators which monitor the extent and quality of vegetation at the Local Administrative Unit (LAU) level[2].

Urban green policies are based on statistical data on green areas as defined in the Polish Environmental Protection Act, in line with EU directives[3]. Traditionally, **Statistics Poland (GUS)** collects all data from local administrations, but these are often insufficiently homogeneous because they are subject to human error when respondents fill in questionnaires, as they use different sources, and data from different administrative units are not updated annually. In order to overcome such problems, Statistics Poland joined the ESA initiative GAUSS (Generating Advanced Usage of Earth Observation for Smart Statistics), which specifically aims to address these challenges by combining the commonly used sources for official statistics with other data sources such as satellite imagery (including Sentinels). The goal of the initiative was to ultimately develop the next generation of statistical data collection and analysis methodologies[4].

1. GAUSS project–D9, Final Report, Issue 1.0
2. https://www.oecd.org/
3. https://www.trade.gov/country-commercial-guides/poland-environmental-technologies
4. https://eo4smartstats.com/

More information on **www.earsc.org/sebs**

HOW SATELLITES CAN HELP

Aiming to use satellite data for monitoring society in official statistics, the Polish Institute of Geodesy and Cartography (IGiK), in cooperation with Statistics Poland (GUS), developed a methodology based on the use of Sentinel data to create new wellness-related environmental quality indicators.

IGiK conducted an analysis and examination of green areas at the level of local units or communes using satellite data and information derived from Copernicus. More specifically, they assessed the extent and condition of Polish vegetation statistics in urban areas with the aim of making such information available to the public.

Hence, using Sentinel-2, ERA5-Land products, and CLMS products, IGiK developed two sets of indices, which will soon be discussed, for all administrative units (LAU) in Poland. These were related to i) the number of green spaces within urban areas, and ii) their condition in terms of e.g. vegetation status, meteorology, entomology, etc. Due to the lack of data, the validation –carried out by Statistics Poland– was based only on empirical experience and in-situ data collected in the repositories of the Remote Sensing Centre of the Institute of Geodesy and Cartography.

The first set of indexes were NDVI (Normalised Difference Vegetation Index), NDII (Normalised Difference Infrared Index), and High-Resolution Vegetation Phenology and Productivity (HR-VPP) products, derived directly from high-resolution Sentinel-2 satellite data and CLMS products (sourced from the WEkEO platform). The second set was carried out using products from the ERA5-Land reanalysis dataset to address the impacts of climate change and human activities on ecosystems, and to monitor vegetation dynamics. These were the total precipitation, the soil temperature, the air temperature, and the surface radiation and they were analysed with Google Earth Engine.

The data were hosted on a virtual machine equipped with a toolbox to automatically determine the extent and condition of green areas for all municipalities in Poland once a year.

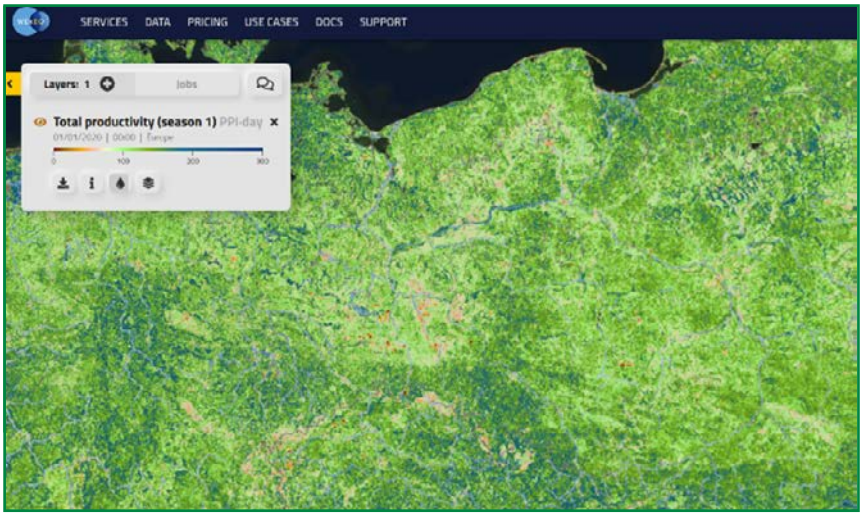

Figure 2: Vegetation Phenology and Productivity products - Total productivity, yearly, source: https://www.wekeo.eu/data

The satellite data:

Sentinel-2 carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times provides unprecedented views of Earth. Sentinel-2 images can be used to determine various plant indices such as leaf area, chlorophyll and water content, providing information useful for agricultural and forestry practices and for helping manage food security. Sentinel-2 also provides information on pollution in lakes and coastal waters. Images of floods, volcanic eruptions and landslides contribute to disaster mapping and help humanitarian relief efforts. Copernicus Sentinels data are available under an open and free data policy.

Sentinel-2 data can be accessed at https://dataspace.copernicus.eu

More info:
https://sentinels.copernicus.eu

The Service Provider

The Polish Research Institute of Geodesy and Cartography (IGiK), headquartered in Warsaw, was established almost 80 years ago. It operates according to the provisions of the scientific institutes and focuses mainly on remote sensing, spatial data, and GIS processing.
IGiK is supervised by the Minister of Development and Technology, and it represents Poland in the International Cartographic Association (ICA).

http://www.igik.edu.pl/

WHO IS CONCERNED?

The central government administration office in Poland, Statistics Poland (GUS), is entrusted with collecting, analysing, and disseminating statistics regarding the country's economy, population, and society, at both national and local levels.

Being collected by GUS, the extent of Poland's green areas was established for the period 2017-2021 across the whole of the land, where distinct densities were observed. The highest density of green areas was recorded in all years for larger cities (e.g. Poznań, Warsaw, Kraków, Katowice), while the share of green areas was smaller in rural or urban-rural communes.

To demonstrate and verify the results obtained for the entire area of Polish communes, an application dedicated to the Statistics Poland team was developed (Figure 3). As a result of the application developed, Statistics Poland are better able to help government and local administration units fulfil their duties, such as managing environmental protection activities within their districts. Communes rely on informative data to prepare protection and development strategies, with the application allowing for optimal performance of these tasks.

Moreover, due to administrative changes in 2023, 15 urban settlements in Poland newly gained "city" status. The new administrative division significantly affects the management and collection of city statistics, including "greenness". Thanks to the encompassing nature of Sentinel data, it is possible to change administrative borders for all new cities at any time within the application, meaning current and historic statistics can be gathered swiftly and efficiently.

The Primary User

Established in 1918, Statistics Poland (Główny Urząd Statystycznyc, GUS in Polish) provides reliable, objective, and systematic information on the socio-economic situation of the country. The President of Statistics Poland is a central body of public administration in the field of statistics and is the coordinator of the Polish system of official statistics. The emerging and constantly growing information needs of numerous stakeholders have triggered Statistics Poland's endeavour to strengthen its information potential, including experimental statistics keeping.

Statistics Poland

https://stat.gov.pl/en/

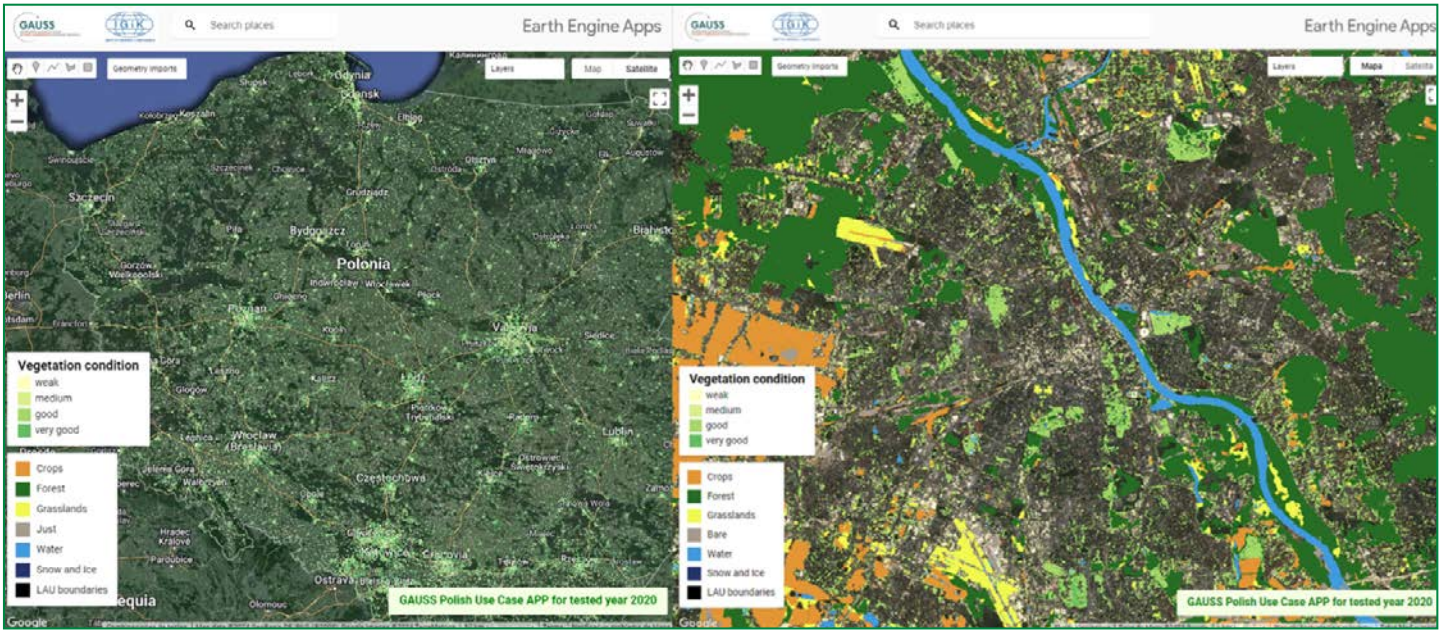

Figure 3: Extent and condition of green areas application for Statistics Poland (GUS) Team (Poland and Warsaw view)

WHAT ARE THE BENEFITS?

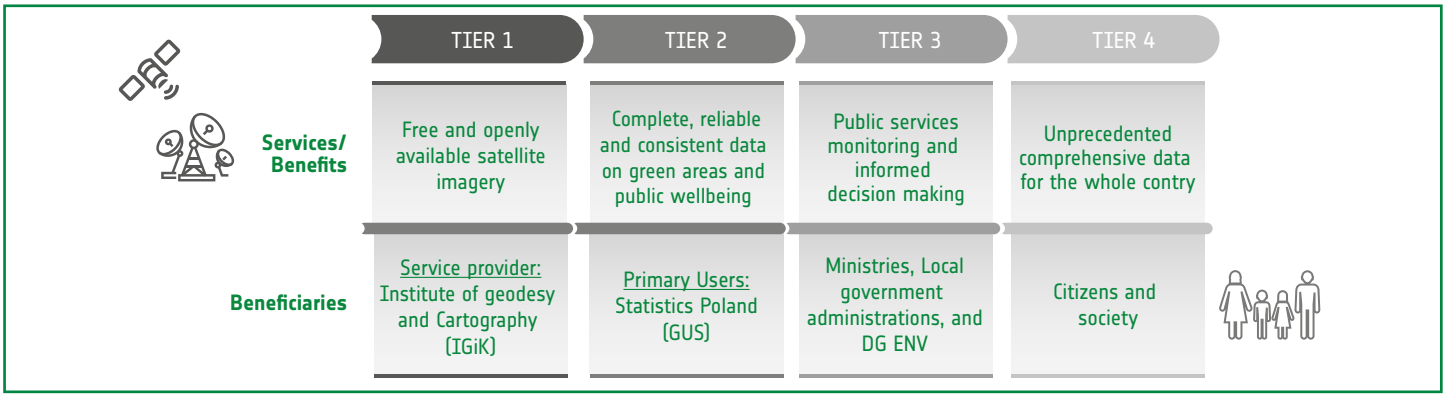

Figure 4: Value chain of the main stakeholders and beneficiaries

The comprehensive information in green areas obtained by Polish authorities and civilians holds substantial value for GUS and its databases, enhancing its knowledge and oversight capabilities and fulfilling its mission to provide information and increase transparency. Thanks to this data, GUS will be able to properly benchmark Poland against other countries' well-being indicators related to environmental quality, as the data will now be more reliable and standardised.

Other government agencies such as ministries and local government administrations across different levels and sectors also benefit from this information, as they can derive useful knowledge on methods to monitor the performance of the public services they offer and make well-informed decisions accordingly. For instance, they have comprehensive databases to support the analysis and monitoring of the factors behind Poland's low wellbeing statistics.

The pilots of this activity were carried out as part of ESA's GAUSS project, which aimed to produce smart and unprecedented digitised statistics for decision making in Poland, Finland and Greece. Thanks to the GAUSS project, information on the quality of green areas has been gathered for the first time and made available to citizens[6]. The data collected through the project has supported the Public Services Monitoring System and could be included in the regular data collection procedures of Statistics Poland as part of experimental statistics, with the potential to become a regular part of official statistical production. When these experimental statistics are made available to the public, they can provide value in various ways, including in managing the provision of official services. At the project's final meeting in 2023, ESA and GUS agreed on the potential for further exploration and expanding the project's scope.

The monitoring and reporting of SDG indicators, especially those related to the environment and ecosystem accounts, has been a significant contributor to the added value. IGiK has implemented the assumptions of SDG 11: Target 11.7: Universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children. The expected future benefits are even more significant, as they will be able to extract valuable insights and also analyse the dynamic evolution and impact of related policies. Moreover, ensuring equal access to high-quality public information is a primary government duty towards its citizens.

Societal

The factors behind Poland's low wellbeing statistics can be identified and monitored. GUS can fulfil its mission to provide information on citizens' wellbeing (which includes green spaces) with the goal of increasing transparency and ultimately improving public wellbeing (Tier 4).

Environmental

These benefits can now be shared with smaller statistical groups and shown to different environmental institutions. This will allow everyone to make better informed decisions when it comes to protecting green areas (Tiers 3 and 4).

Economic

Thanks to Copernicus' free and open data, IGiK and GUS were able to monitor green spaces with reduced costs (Tiers 1 and 2).

Regulatory

Institutions and government agencies are better able to fulfil their mandate of providing their citizens with the information on key indicators. Moreover, through the upgrade of the national statistics quality and quantity, these can be leveraged to drive policies that are based on factual data (All tiers).

6. https://stat.gov.pl/en/experimental-statistics/quality-of-life/

EXTENDED IMPACT

At the Directors General of the National Statistical Institutes (DGINS) 2021 Conference in Warsaw, the use of satellite data for the analysis of green spaces was presented. The results were welcomed and underlined the need for data to support data space initiatives in various fields, in particular the "Green Deal Data Space", the "Common European Agricultural Data Space", the "Common European Industrial (Manufacturing) Data Space", etc. This is also true for supporting the public administrations in decision-making processes such as urban planning, emergency mapping and early warning systems, border and maritime surveillance[7].

The national database of green space indicators will be continued and monitored over the next few years in order to build trust in the results. Eventually, this will be integrated into Polish official statistics, aligning with the strategy of incorporating Earth Observation data into the production of smart statistics. An example is the Strategy on Agricultural Statistics 2020 and beyond, which promote new innovative techniques and data sources.

IGiK recognises that, thanks to the close cooperation of the consortium with Statistics Poland, it is possible to present the perspectives of satellite data for the further development of national statistics in aspects beyond the original scope of GAUSS[8].

Finally, many Member States and Eurostat, national statistical institutes, international organisations, etc. are already using satellite data for statistical purposes and see the need for close cooperation and exchange of experience. They call for the introduction of training for statisticians, including methodology as well as IT issues, to develop the use of Earth Observation in statistics and gain skills in the use of new technologies.

ABOUT THE PROJECT

The Sentinel Benefits Study (SeBS) is conducted by EARSC (European Association of Remote Sensing Companies) with partners The Greenland, IIASA (International Institute for Applied Systems Analysis) and Evenflow on behalf of the European Space Agency (ESA). It has the goal to study 20+ full cases by analysing the impact of the use of Sentinel data along a value-chain. This short case has been prepared where there has been an interesting use made of Sentinel data, but it has not (yet) been possible to conduct a full case. It tells the story of the use of Sentinel data without going deeply into the economic or environmental benefits.

Figure 5: DGINS 2021 Conference in Warsaw

> ***"The service developed by IGiK fits perfectly with the message of the Warsaw Memorandum. Thanks to the cooperation with the Institute, Statistics Poland is implementing solutions that enable the use of Sentinel data for statistical production."***
>
> *Marek Pieniążek, GUS*

We acknowledge that the understanding of the case was supported by discussions with Marek Pieniążek from GUS, as well as Ewa Panek-Chwastyk and Katarzyna Dabrowska-Zielinska from IGiK. We thank them for their valuable insights and availability.

Do you know an interesting case demonstrating the benefits derived from the use of Sentinels data?

Email info@earsc.org

More Information on Sentinels Benefits Studies:

www.earsc.org/sebs

European Union

The Sentinels Benefits Study is funded by the EU and ESA.
The views expressed in this study cannot be taken to reflect the official position of the EU or of ESA.

7. https://www.trade.gov/country-commercial-guides/poland-environmental-technologies
8. https://eo4smartstats.com/