Acta Sci. Pol.
Formatio Circumiectus 22 (1) 2023, 65–78
ENVIRONMENTAL PROCESSES

www.acta.urk.edu.pl ISSN 1644-0765 DOI: http://dx.doi.org/10.15576/ASP.FC/2023.22.1.65

ORIGINAL PAPER Accepted: 11.04.2023

GIS TOOLS IN THE VISUALISATION OF A LOCAL SPATIAL MANAGEMENT PLAN

Joanna Wasylik, Ewa Dębińska, Kamil Maciuk✉

Department of Integrated Geodesy and Cartography, AGH University of Science and Technology, Mickiewicza 30, Krakow 30-059, Poland

ABSTRACT

Aim of the study

The main objective of the study was to analyse the possibility of using GIS tools for 3D modelling of data presented on local spatial development plans (LSMP), with the view to maximising the use of planning provisions.

Material and methods

Publicly available LSMP for the analysed scope were used in order to obtain the maximum building height for each section of the studied area. Then, based on data obtained from the Open Street Map (OSM) and the database of topographic objects (BDOT10k), areas were identified where further construction or increasing the height of existing buildings could be permitted.

Results and conclusions

The analyses obtained made it possible to determine the regions for which increased development is possible. This type of knowledge can be useful for facility owners, real estate developers, and most importantly for public administration bodies – so that they are aware of planning provisions or possible elements in the MPZP that should be changed in order to prevent excessive building density. Such excessive development could result, for example, in obscuring the visibility of the sun for selected areas or blocking urban ventilation corridors. Thus, this type of study provides a very simple way of visualising the maximum possible development in the newly created local plans, and other similar analyses.

Keywords: GIS, local spatial management plan, spatial planning, ArcGiS

INTRODUCTION

Spatial Information Systems are characterised by the presence of spatial information: about location, spatial relations and geometric properties, as well as the presence of coordinates in the adopted reference system (Zygmuniak, 2016). The objects included in spatial information systems are very diverse; they can include artificial or natural objects, but also social, natural and economic phenomena (Yang et al., 2022). There are two possibilities for the spatial presentation of objects: two-dimensional and three-dimensional; everything depends on the issue and the needs posed by the task at hand (Ghilani and Wolf, 2006). Another feature of spatial information systems is the possibility of cartographic presentation (Głażewski et al., 2010). Spatial analysis can also be performed which, through modelling in the system, facilitates visualisation of the real-world phenomena (Brown et al., 2005). Spa-

✉e-mail: maciuk@agh.edu.pl

tial information systems constitute a very broad field that requires many components to function properly; these include hardware and people – whereas the hardware is more than just computers and software (Maguire, 1991; Hotz, 2005). Surveying instruments are also necessary, without which the acquisition of real-world data would be impossible (Wang et al., 2022). Subsequent data processing also requires special equipment and operators. All the processed data have their attributes, which are divided into spatial attributes (defining the location, size and geometric shape of objects and their topological relationships) and descriptive attributes (defining other properties and relationships of objects) (Brown et al., 2005; Zlatanova, 2015). As in any field related to geodesy, accuracy is important. It is on the basis of this that spatial information systems were divided into domains (Sówka et al., 2011):

– Land Information System (LIS): uses data directly from field measurements or large-scale aerial photography – application in large-scale maps, 1 : 5000 and larger.
– Geographic Information System (GIS): uses processed data – application in medium- and small-scale maps, 1 : 10000 and smaller (gisplay, 2023).

It is a group of organisational, legal, technical and economic measures that guarantee universal access to the country's spatial data, provides geoinformation services, and finds applications in a various fields, e.g. engineering, tourism or geography (Kozioł and Maciuk, 2020; Maciuk et al., 2021). This ensures an increase in the competitiveness of the economy, taking into account the principles of sustainable national development (Andreoni and Miola, 2016). Spatial data models are used to present elements of the real world in terms of their shape, spatial location and relationships; these constitute the main element of spatial information systems. The classification of elements used in models due to their spatial dimension is as follows: point (0D – zero-dimensional), line (1D – one-dimensional), area (2D – two-dimensional) and solid (3D – three-dimensional) (Bieda et al., 2021; Li et al., 2022). As a rule, objects are presented by a set of points with specific coordinates in a given reference system. To represent the real world, we use objects – point, line and area. The complexity of the process of presenting the real world depends on the elements presented. This is because it is necessary to remember the relational relationships of objects (Hanson, 1994). There are the following structures of objects: tree-type structure (linear objects, e.g. river systems), network structure (linear objects, e.g. road systems), and polygon network structure (adjacent areas, e.g. land parcels).

The LSMPs, which constitute acts of local law, are documents prepared as two-dimensional drawings (Balawejder et al., 2021). However, due to their content – including information on the allowed number of floors in multi-story buildings among other things – they touch upon the third dimension of the space they concern. The main purpose of the present paper was to examine the currently available materials on LSMPs created by local governments and GIS tools allowing for the creation of 3D visualisations for LSMPs. Research on the LSMP had already been conducted in the areas like using orthophotomaps in processes of approving local spatial development plans (Kulesza and Florek-Paszkowski, 2018), classification errors (Adamiak et al., 2020), economic consequences of LSMPs (Śleszyński et al., 2021; Walczak et al., 2021)along with significant burdens. Private property is subject to special protection, but the public good is less valued. The article attempts to assess the situation in Poland, recalling also the experiences of spatial management systems from other European countries. It combines legal, economic, and geographical perspectives. The specific objectives were demonstration of geographical (interregional and functional or other databases (Blaszke et al., 2021; Bucała-Hrabia et al., 2022; Sikora and Kaczyńska, 2022; Michalik and Zwirowicz-Rutkowska, 2023).

METHODS

In its theoretical aspect, LSMP is the science of the goals and methods of rational formation, development and use of space; it is a complex scientific discipline, interrelated with other sciences. In the practical aspect, it is defined as the totality of activities aimed at the rational development of space, taking into account the current and future needs of society. It is the activity of optimal use of natural and acquired characteristics of areas and rational distribution in space of production forces, settlements, and service facilities. An LSMP is a planning document prepared at the municipal level, adopted to determine the functional designation of areas, modes of development and construction. In such a document, a potential investor can obtain information on land use and detailed guidelines on what kind of construction facilities can be built there and what their permitted dimensions are, as well as how much space they can occupy within specific plots of land. The preparation of an LSMP is not mandatory, so it does not occur uniformly throughout the country. However, there are areas for which the creation of an LSMP is mandatory. Such areas include: areas of public space, areas requiring real estate consolidation and subdivision, areas for the distribution of large-scale commercial facilities, and areas for which the preparation of an LSMP is required under separate regulations.

The document consists of two parts: descriptive and visual. The descriptive part – the resolution – is the text of the Plan's findings, and the visual part – the annex to the resolution – is the drawing of the Plan. The descriptive part includes: the legal basis for the preparation of the LSMP; general arrangements for the entire Plan as well as specific, detailed ones; explanations to the graphic part; and the rules of implementation. General arrangements define, among others: the limits of the development, the principles of preserving spatial order, the principles of protecting the natural environment and landscape, the principles of modernising development and infrastructure elements. The drawing of the plan includes the boundaries of the study, as well as the boundaries of the areas with their designation symbolising the purpose of the area. This is implemented by means of different-coloured markings and abbreviated descriptions, the elaborations of which can be found in the text of the resolution (Sejm, 2003; Bieda et al., 2012).

The LSMP is a document used by a very broad group of recipients; therefore care should be taken to make it universally accessible and as readable as possible to everyone. Advances in technology and access to a very wide range of tools make it possible to present spatial data in different ways. GIS software offers a whole host of tools so that the presentation of spatial data can be perfectly tailored to the selected issues. The project shows how to visualise the LSMP using ArcGIS software to make it even clearer and more readable for the viewer.

In the age of unlimited access to the Internet, interactive viewing of data is often available, especially those representing the surrounding space. This is an argument in favour of creating three-dimensional models for LSMP, and solutions of this kind are already being introduced worldwide, as well as in Poland.

Currently, 184 local plans are in force within the City of Kraków, covering 61.3% of the entire city, whereas 2 plans are pending adoption, and 153 plans are currently being drawn up (data as of 09.11.2018) (Miasto Kraków, 2023) (Fig. 1).

The present study was made for the area included in the LSMP as the 'Area of Aleja Ignacego Daszyńskiego' (Fig. 2).

The area is located in the central part of the city. It is bounded to the north by Grzegórzecka street, to the south by Podgórska street, to the east by Kotlarska street and to the west by railroad areas. Aleja Daszyńskiego runs through the centre of the area. The surface area of the sector covered by the plan is 45.68 ha (Rada Miasta Krakowa, 2014) (Fig. 3).

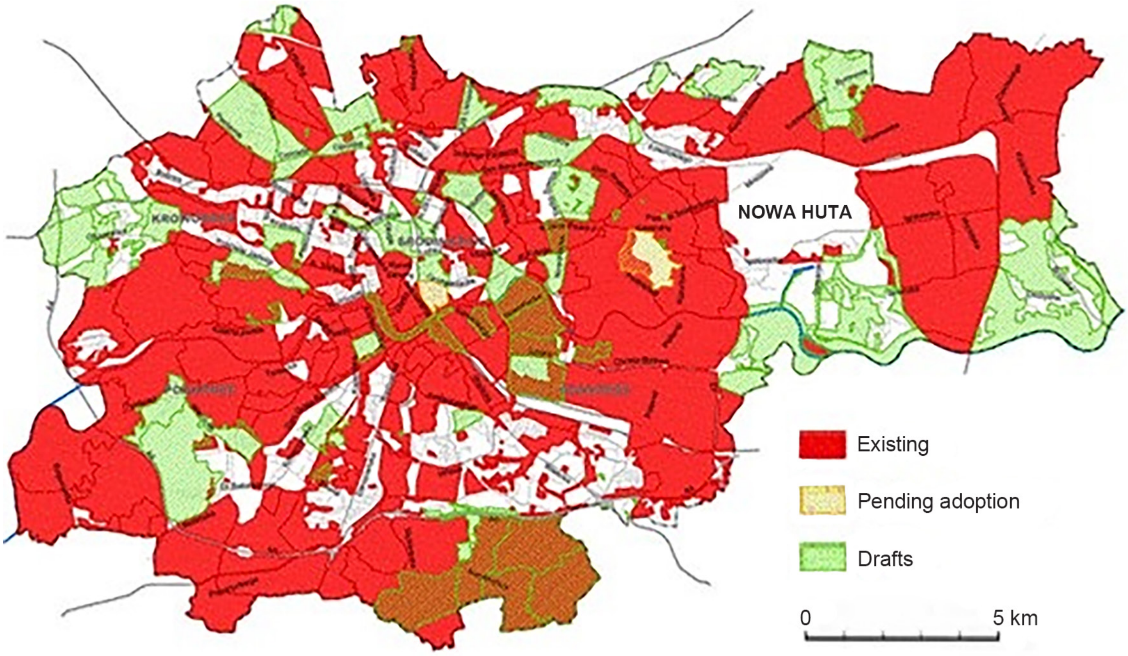

Fig. 1. Summary map of the coverage of the LSMP of Kraków (source: Miasto Kraków, 2023)

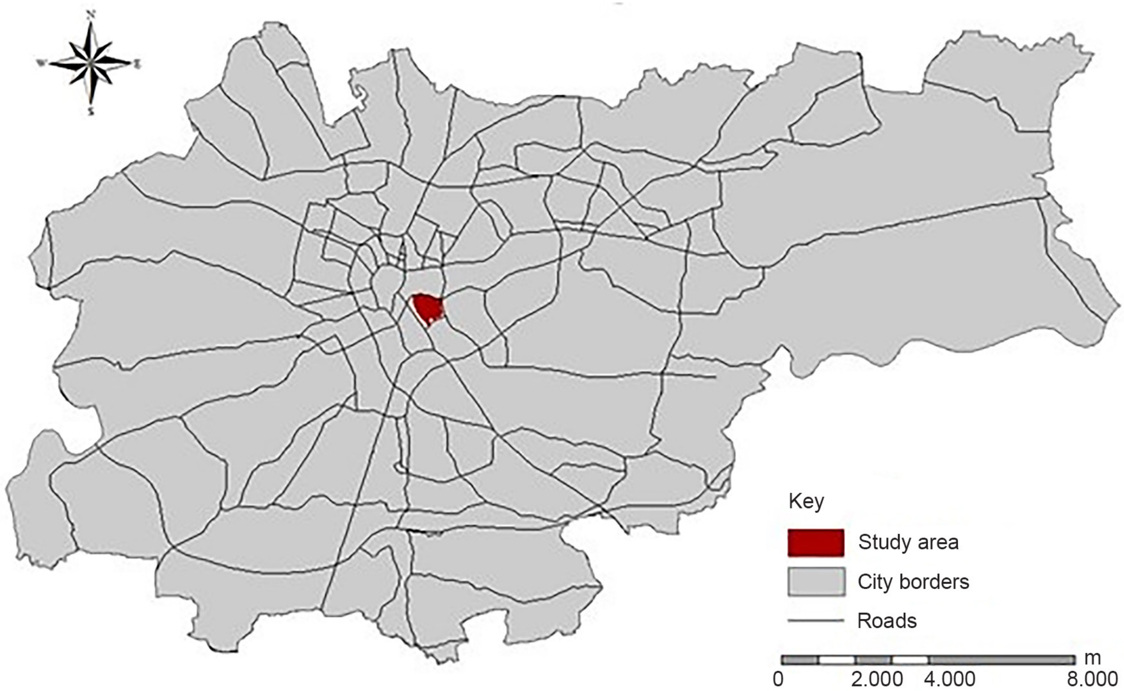

Fig. 2. Location of the study area (source: own study)

Fig. 3. Map with the boundaries of the plan and its area (source: own study using © OpenStreetMap (and) contributors)

RESULTS

Work on the geo-visualisation of the LSMP began with the acquisition of the plan drawing. For the existing plans it is available on the web portal of the Public Information Bulletin of the City of Kraków in two forms – PDF and DGN. Otherwise, for plans pending adoption, only PDF drawings are made available. It is a colour plan on a map base, along with a key and out-of-frame description (Fig. 4).

The second format, which can be obtained directly from the portal, is DGN. It contains the drawn boundaries of the plan, and the boundaries of the development zones, along with abbreviated descriptions. Since the project is being carried out for an LSMP that is currently pending adoption, it was only possible to use the PDF form. In order to use it as a raster, the drawing was converted to TIFF format, which is the most common graphic format that has the ability to be georeferenced. Next, calibration of the acquired plan was performed, and for this purpose, the 'Georeferencing' tool in ArcMap was used. It began with the preparation of the working environment. A layer of buildings from BDOT10k was imported into the program, and the entire project was assigned the coordinate system that is valid for Poland: UWPP 1992. The raster was then added and calibrated based on the characteristic inflection points of the plan's boundaries, finding their equivalents on the buildings layer. A first-degree affine transformation was applied, and 8 points were fitted into it. In urban planning such high accuracies are not typically used in surveying, as centimetre-level results are not required.

In order to visualise the LSMP, its components are necessary, which include roads, surface water, buildings and structures, and natural objects, among others.

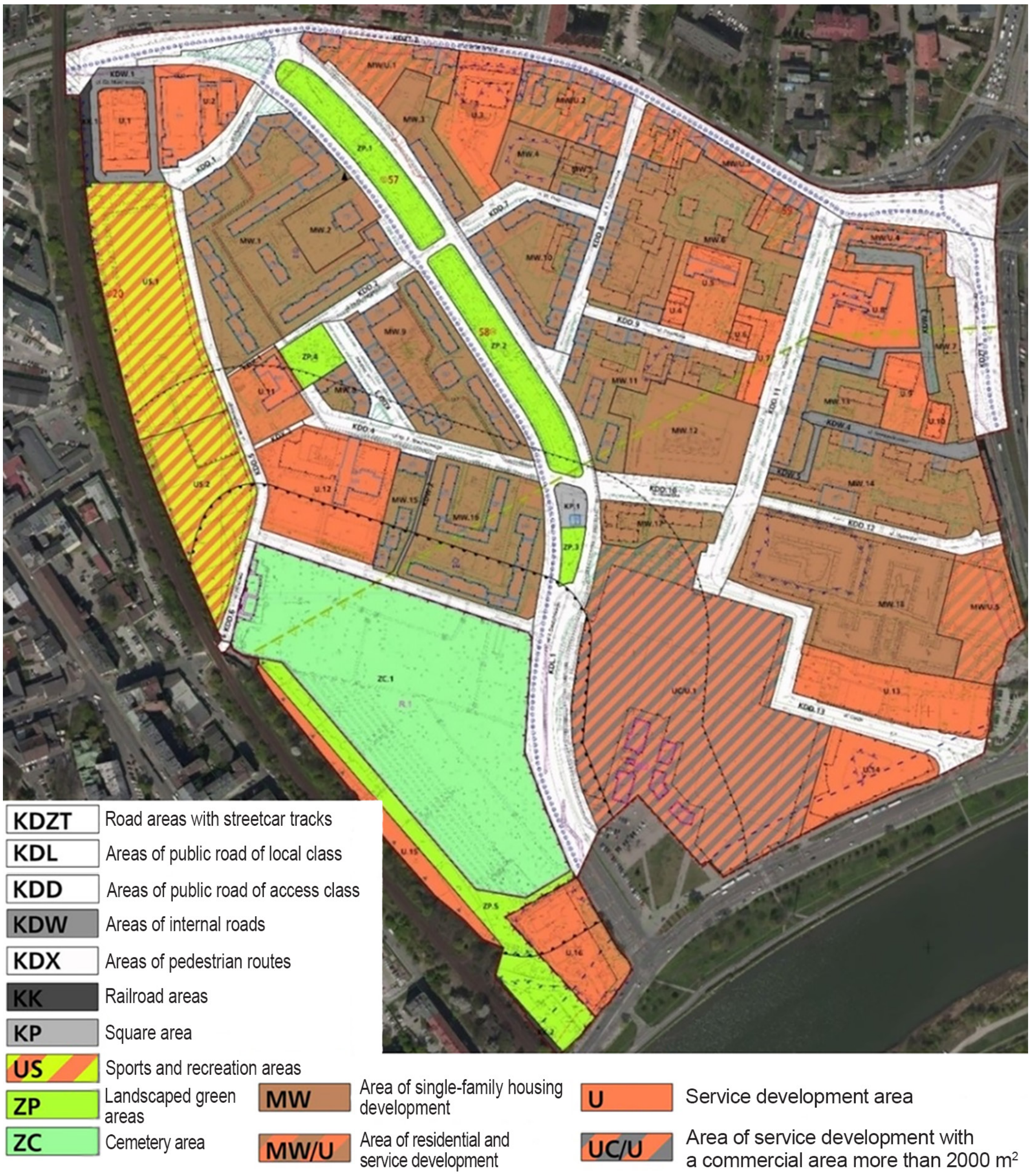

Fig. 4. LSMP of the 'Area of Aleja Ignacego Daszyńskiego' (source: Rada Miasta Krakowa, 2014)

When there are currently no facilities in a given development area, it is necessary to draw them in according to the plan. However, in cities such as Kraków, it is very rare to find lad that has not been subject to development. In the case of the area subjected to the project's analysis, various types of objects were encountered, testifying to the previous development of the area. Objects can be observed directly in the field, on satellite maps of popular browsers, as well as in data obtained from surveying centres, in this case, the Database of Topographic Objects (BDOT10k). Visualisation of the LSMP will typically be based on that. From the dataset, only those data that will be used for geo-visualisation have been extracted: buildings, roads, roadways, surface water, natural objects – trees, tracks, forest and wooded areas, sports and recreation facilities and petrol stations. These are polygon, point or line layers depicting the geometry and spatial position of the objects (Fig. 5).

The objects included in BDOT10k are up to date as of 2015. Therefore, it can be expected that changes to existing objects may have occurred since then. Verification was performed using a map base in the form of the Open Street Map topographic map (Fig. 6), constituting an increasingly popular source of free and publicly available spatial data. It is possible to view these maps as well as edit and add to them, which has both advantages and disadvantages. The indisputable advantage is the timeliness of the data, as users make changes on an ongoing basis. Yet the reliability of the data may sometimes be called into question. The map below shows the differences between the building layer from BDOT10k and the layer from OSM.

Not all of the marked buildings were applied to the target layer. In the development area designated as 'Landscaped green area' (ZP.5) buildings are shown, however there is no provision in the resolution about the conditions of their existence. Therefore, they are not included below; instead they are shown against the background of the development area and the map base (Fig. 7).

The result is the already-complete layer of buildings, which the map presents (Fig. 8).

An important element affecting spatial visualisations is the terrain, which becomes particularly important when the study area greatly varies in terms of elevation. In urban areas, it is far less important, due to the negligible variation in relief. However, it is worth enriching spatial visualisations with this type of data. For the purposes of the project, data obtained from the portal of the Central Centre for Geodesic and Cartographic Documentation (CODGiK) was used. This is a Numerical Terrain Model with a grid interval of at least 100 m for the Małopolska voivodeship (Fig. 9).

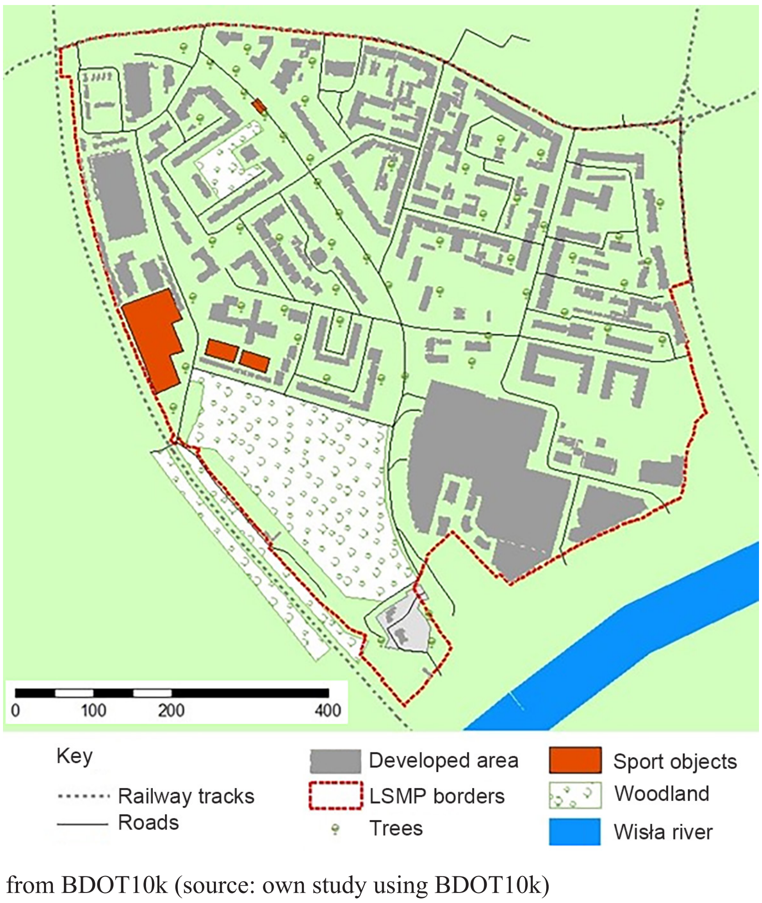

Fig. 5. Objects extracted from BDOT10k (source: own study using BDOT10k)

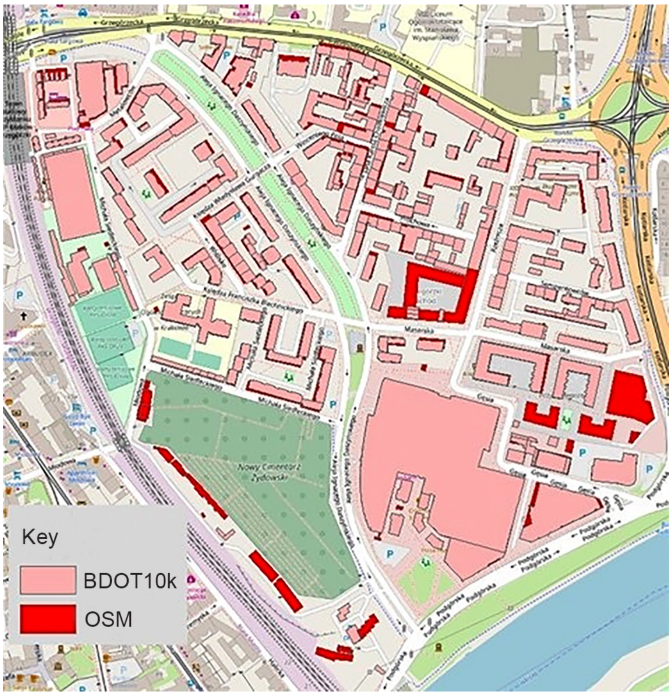

Fig. 6. Comparison between the building layers extracted from different sources (source: own study, BDOT10k, ©Open-StreetMap (and) contributors)

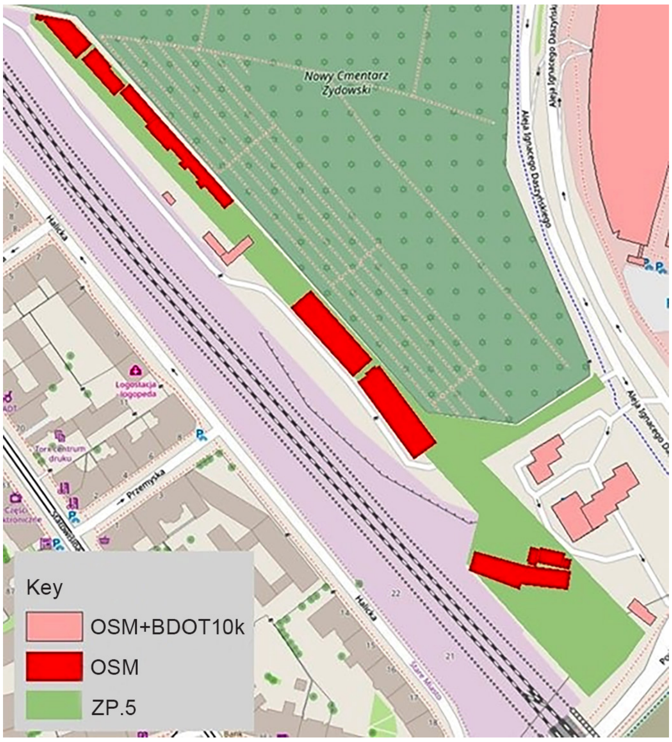

Fig. 7. Buildings not added to the buildings' layer (source: own study, BDOT10k, ©OpenStreetMap (and) contributors)

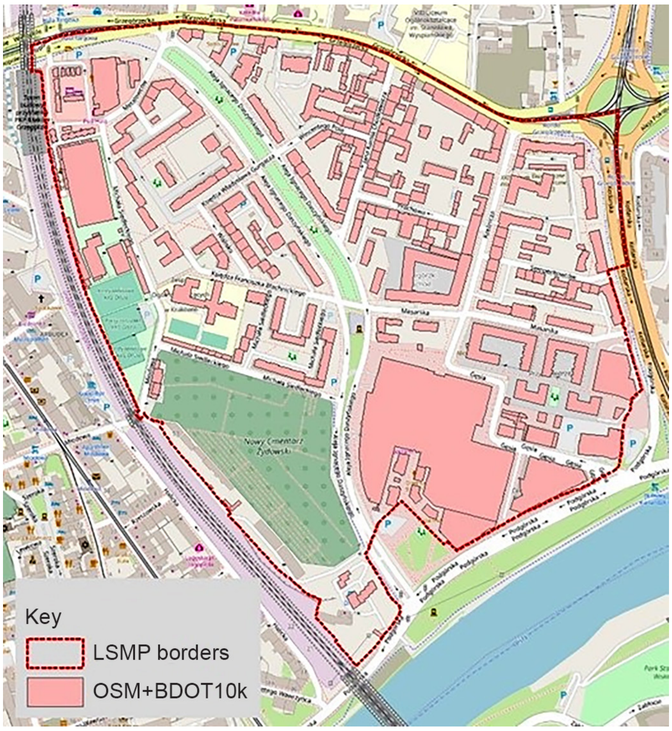

Fig. 8. Complete layer of buildings (source: own study, BDOT10k, ©OpenStreetMap (and) contributors)

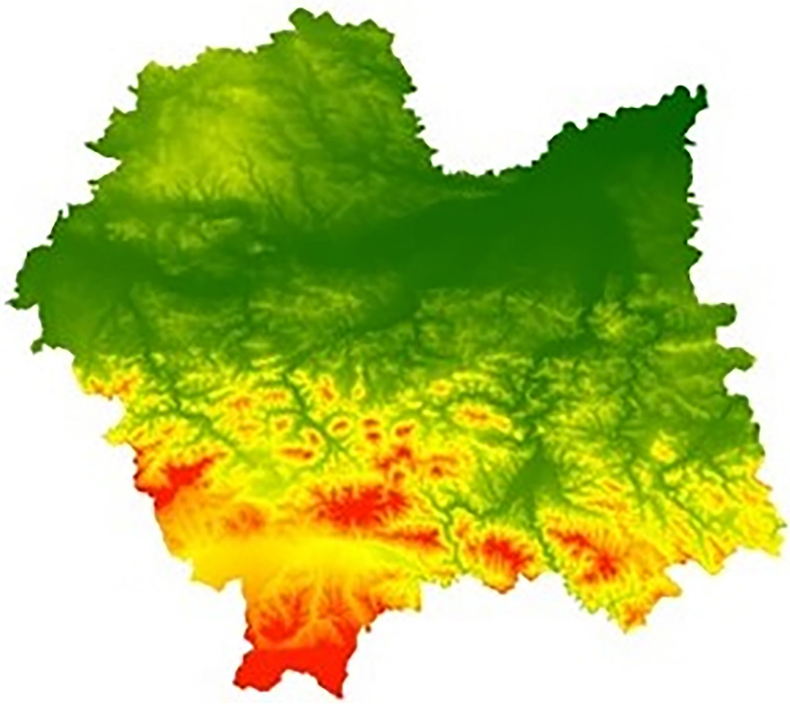

Fig. 9. DTM of the Malopolska voivodship (source: own study and GUGiK, 2022)

The data is made available in the form of a text file, so it needs to be processed properly in order for it to be applied in spatial visualisation. In the first step, the QGIS program tool was used, which created a raster in TIFF format. By default, the image is created in greyscale tones, however, it is more expedient to represent landform data using hypsometric colours.

An essential element for visualisation is the assignment of appropriate attributes to objects. For this, the polygon layer was used that had been created previously, containing the development areas. The function of concatenating data based on their spatial location was used. As a result of the operation, buildings were given an additional attribute, i.e. the maximum height in accordance with the resolution. The operations were then transferred to the ArcScene application, where a spatial presentation of the data in three dimensions is possible. A layer of landforms (DTM) and buildings was imported. The settings in the properties of the buildings' layer were changed so that they were elevated in height. Base elevations were established, draped from the specified surface – DTM. Then an elevation value for the objects equal to the 'MAX height' attribute was introduced. As a result of the performed actions, three-dimensional buildings were created (Fig. 10).

The following visualisation shows the elevated buildings, with a raster background in the form of a drawing of the LSMP (Fig. 11).

The final product of the project is a visualisation that combines all the components developed so far. These are the complete collected data, presented in a three-dimensional space (Fig. 12). The results can be presented with classic drawings, as well as animations that allow the site to be viewed from different perspectives.

According to the principles of spatial visualisation, a maximum of 7 levels of classification should be used, presented using different shades of colour. In the study for the presentation of maximum building heights, as many as 13 classes were included, which resulted from the provisions of the LSMP. Therefore, the final visualisation was created in accordance with the above-described principle, using the classification of size by the method of equal ranges.

DISCUSSION

The purpose of the study was to visualise the LSMP with the use of GIS tools, illustrated with the example of the 'Area of Aleja Ignacego Daszyńskiego'. The final product is a three-dimensional visualisation of the specified area, consistent with the findings of the LSMP. The entire study was preceded by a thorough review of the resolution of the Kraków City Council. Based on its findings, all the necessary attributes were assigned to the used and newly created objects. The

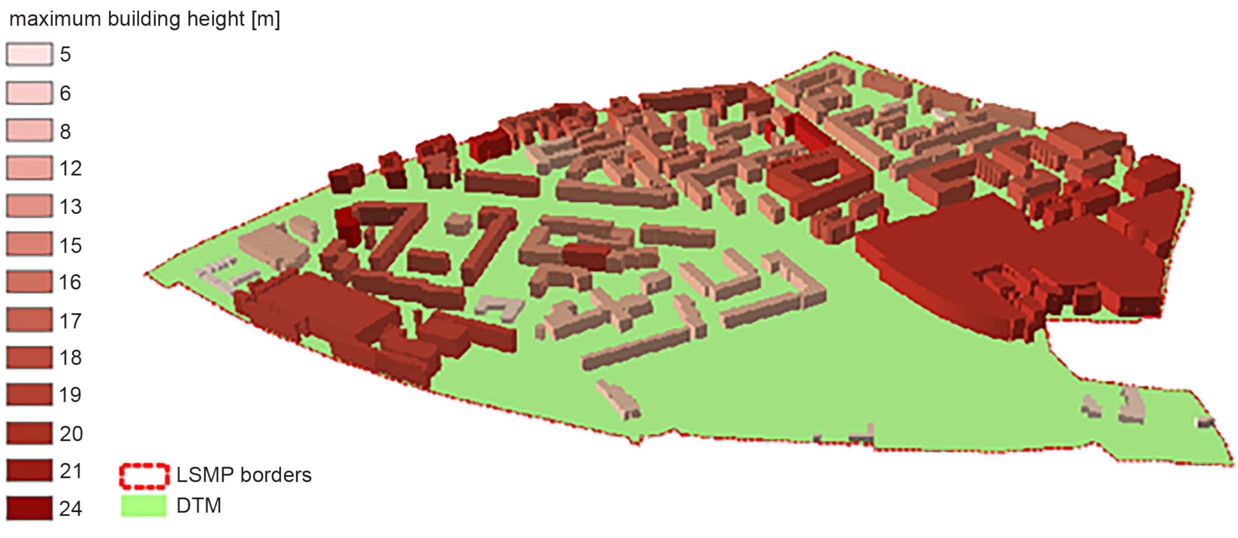

Fig. 10. Elevated buildings in height (source: own study using DTM, BDOT10k and © OpenStreetMap (and) contributors)

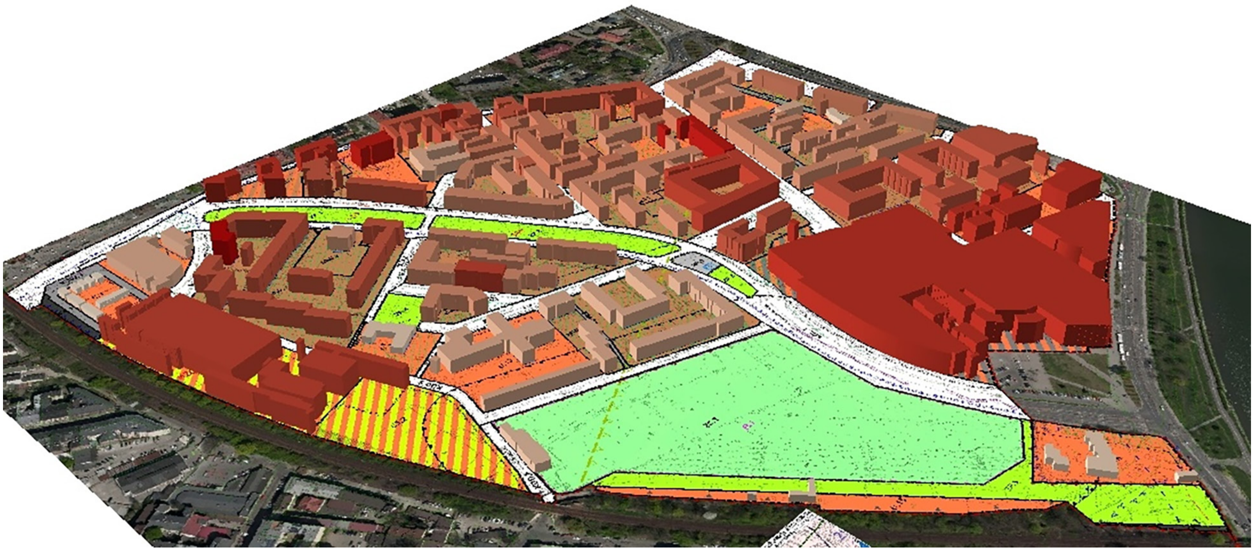

Fig. 11. Elevated height buildings against the background of the LDMP (source: own study using DTM, BDOT10k and © OpenStreetMap (and) contributors)

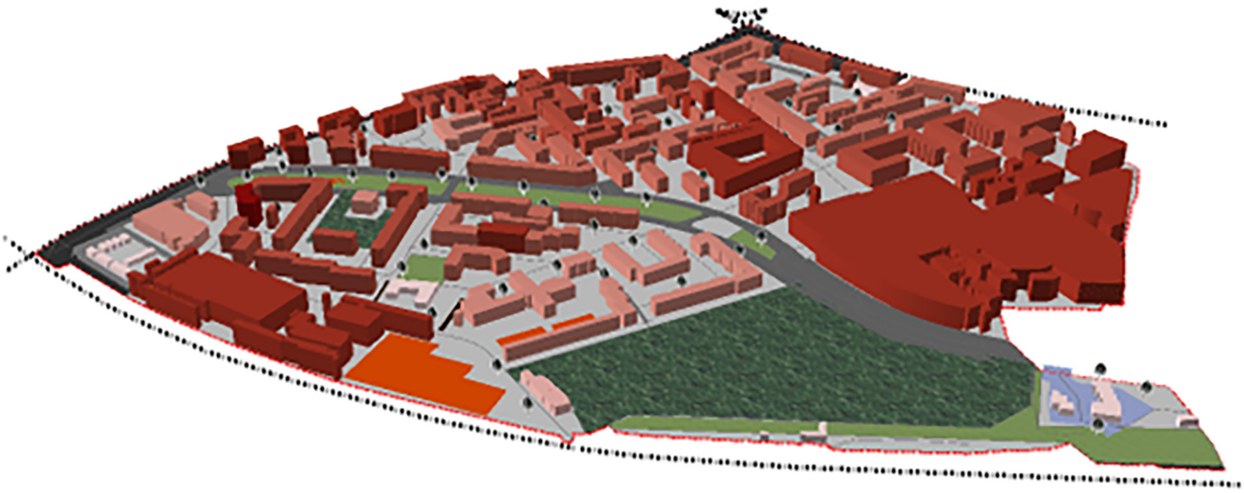

Fig. 12. Three-dimensional visualisation of the area with class generalisation (source: own study using DTM, BDOT10k and © OpenStreetMap (and) contributors)

data was also analysed in terms of its timeliness, and important gaps were filled. For all data used, a consistent coordinate system was given, which is valid for Poland. The project includes a description of the data processing and all the steps leading to the final visualisation. Moreover, similar research in other countries focused also on a connection between nature and culture (Kyvelou and Gourgiotis, 2019; Stoeglehner and Abart-Heriszt, 2022), on the problem of urbanisation (Salata et al., 2019; Wachter and Wytrzens, 2022) the traditional quantitative land use change analyses need to be integrated with a more accurate spatial and qualitative evaluation of the effects of the land use zoning of municipal land development plans and of the connected supplementary regulations (e.g., local building regulations, and on sustainable development

(Hermanns et al., 2015; Robert and Schleyer-Lindenmann, 2021) as reflected in LSMP. It should also be noted that the development of this type of study is only feasible on the basis of publicly accessible data, available at no extra charge. In that case it would be necessary to replace the information extracted from BDOT10k with their counterparts from Open Street Map. This is an unquestionable cost-efficiency benefit for the authorities responsible for preparing LSMPs. In conclusion, it was found that GIS tools are perfect for this type of work. Although making a visualisation of the LSMP in three-dimensional form involves more work, it is definitely more interesting for the potential recipient. Due to the fact that the LSMP for the development area is only just coming into force, there is a potential opportunity for future investors to use the created visualisation.

CONCLUSIONS

The conducted research proves that local government units only need GIS tools and qualified staff in order to create 3D visualisations for LSMPs as well. The use of 3D visualisations in the planning process significantly contributes to improving the readability and increasing the level of understanding of planning documents, it facilitates residents' participation in public consultations, and it increases their knowledge of urban planning. The creation of 3D visualisations generates a lower cost and gives more freedom to modify and make changes in the planning process compared to 3D models. The proposed solution facilitates the presentation of planning intentions and opportunities on the Internet, and the introduction of a 3D model in urban planning opens up a range of possible GIS analyses, such as shading analyses, solar cadastre, and 3D noise maps. However, such a change would also require changes in Polish legislation. Another problem pertaining to the use of GIS tools in the development of local land use plans is that the persons responsible for drafting these documents are often unfamiliar with such tools, and often the analyses are done in analogue format. In addition, the increasing awareness and importance of digital tools will result in an increase in the quality of the plans that are passed, by taking into account all the factors affecting the process.

ACKNOWLEDGEMENTS

Scientific research project No. 16.16.150.545.

REFERENCES

Adamiak, M., Biczkowski, M., Leśniewska-Napierala, K., Nalej, M., Napierala, T. (2020). Impairing land registry: Social, demographic, and economic determinants of forest classification errors. Remote Sensing, 12 (16), 1–25. DOI: https://doi.org/10.3390/rs12162628.

Andreoni, V., Miola, A. (2016). Competitiveness and sustainable development goals. Luxembourg: Publication Office of the European Union. DOI: https://doi.org/10.2788/64453.

Balawejder, M., Kolodiy, P., Kuśnierz, K., Sebzda, J. (2021). Analysis of local spatial development plans for the smart city of Rzeszow (poland). GIS Odyssey Journal, 1, 1, 147–162. DOI: https://doi.org/10.57599/gisoj.2021.1.1.147.

Bieda, A., Balawejder, M., Warchoł, A., Bydłosz, J., Kolodiy, P., Pukanská, K. (2021). Use of 3d technology in underground tourism: Example of Rzeszow (Poland) and Lviv (Ukraine). Acta Montanistica Slovaca, 26 (26), 205–21. DOI: https://doi.org/10.46544/ams.v26i2.03.

Bieda, A., Hanus, P., Hycner, R. (2012). Geodezyjne aspekty planowania przestrzennego i wybranych opracowań projektowych. Katowice: Gall.

Blaszke, M., Nowak, M., Śleszyński, M., Mickiewicz, B. (2021). Investments in renewable energy sources in the concepts of local spatial policy: The case of Poland. Energies, 14 (23). DOI: https://doi.org/10.3390/en14237902.

Brown, D.G., Riolo, R., Robinson, D.T., North, M., Rand, W. (2005). Spatial process and data models: Toward integration of agent-based models and GIS. Journal of Geographical Systems, 7 (1), 25–47. DOI: htpps://doi.org/10.1007/s10109-005-0148-5.

Bucała-Hrabia, A., Kijowska-Strugała, M., Śleszyński, P., Rączkowska, P., Izdebski, W., Malinowski, Z. (2022). Evaluating the use of the landslide database in spatial planning in mountain communes (the Polish Carpathians). Land Use Policy, 112 (march 2021). DOI: https://doi.org/10.1016/j.landusepol.2021.105842.

Ghilani, Ch.D., Wolf, P.R. (2006). Coordinate transformations. [In:] Adjustment Computations: Spatial Data Analysis, 345–368. Hoboken, New Jersey, USA: John Wiley & Sons, Ltd. DOI: https://doi.org/10.1002/9780470121498.ch18.

gisplay (2023). gisplay.pl – portal geoinformacyjny. https://gisplay.pl/

Głażewski, A., Kowalski, P.J., Olszewski, R., Bac-Bronowicz, J. (2010). New approach to multi scale cartographic modelling of reference and thematic databases in Poland. [In:] Lecture Notes in Geoinformation and Cartography, 89–106. Berlin–Heildelberg: Springer. DOI: htpps://doi/10.1007/978-3-642-03294-3_6.

GUGiK (2022). CODGiK Centralny Ośrodek Dokumentacji Geodezyjnej i Kartograficznej GUGiK. https://www.bip.gov.pl/subjects/6245,centralny+ośrodek+dokumentacji+geodezyjnej+i+kartograficznej+gugik+.html.

Hanson, A.J. (1994). Geometry for n-dimensional graphics. Graphics Gems. San Diego, CA, USA: Academic Press Professional, Elsevier, 149–170. DOI: htpps://doi:10.1016/b978-0-12-336156-1.50024-0.

Hermanns, T., Helming, K., Schmidt, K., König, H.J., Faust, H. (2015). Stakeholder strategies for sustainability impact assessment of land use scenarios: Analytical framework and identifying land use claims. Land, 4 (3), 778–806. DOI: https://doi.org/10.3390/land4030778.

Hotz, J. (2005). Spatial data acquisition software for professional surveyors and gis data collectors. FIG Working Week 2005 and GSDI-8, https://www.oicrf.org/-/spatial-data-acquisition-software-for-professional-surveyors-and-gis-data-collectors (accessed: July 5, 2023), 1–15.

Kozioł, K., Maciuk, K. (2020). New heights of the highest peaks of Polish mountain ranges. Remote Sensing, 12 (9), 1446. DOI: https://doi.org/10.3390/rs12091446.

Kulesza, Ł., Florek-Paszkowski, R. (2018). The suitability of an orthophotomap in the process of approving local spatial development plans. Real Estate Management and Valuation, 26 (4), 78–89. DOI: https://doi.org/10.2478/remav-2018-0038.

Kyvelou, S.S., Gourgiotis, A. (2019). Landscape as connecting link of nature and culture: Spatial planning policy implications in Greece. Urban Science, 3 (3), 81. DOI: https://doi.org/10.3390/urbansci3030081.

Li, S., Chen, Z., Wang, Z., Weng, M., Li, J., Zhang, M., Lu, J., Xu, K., Pan, F. (2022). Graph-based discovery and analysis of atomic-scale one-dimensional materials. National Science Review, 9 (6). DOI: https://doi.org/10.1093/nsr/nwac028.

Maciuk, K., Apollo, M., Mostowska, J., Lepeška, T., Poklar, M., Noszczyk, T., Kroh, T., Krawczyk, A., Borowski, L., Pavlovčič-Prešeren, P. (2021). Altitude on cartographic materials and its correction according to new measurement techniques. Remote Sensing, 13 (3), 444. DOI: https://doi.org/10.3390/rs13030444.

Maguire, D.J. (1991). An overview and definition of GIS. Geographical Information Systems. Vol. 1: Principles, 9–20.

Miasto Kraków (2023). BIP – Biuletyn Informacji Publicznej Miasta Krakowa. https://www.bip.krakow.pl

Michalik, A., Zwirowicz-Rutkowska, A. (2023). A geoportal supporting spatial planning in Poland: Concept and pilot version. Geomatics and Environmental Engineering, 17 (2), 5–30. DOI: https://doi.org/10.7494/geom.2023.17.2.5.

Rada Miasta Krakowa (2014). Uchwała Nr CXVI/1823/14 Rady Miasta Krakowa z dnia 24 września 2014 r. w sprawie przystąpienia do sporządzenia miejscowego planu zagospodarowania przestrzennego obszaru "Rejon Alei Ignacego Daszyńskiego'. https://www.bip.krakow.pl

Robert, S., Schleyer-Lindenmann, A. (2021). How ready are we to cope with climate change? Extent of adaptation to sea level rise and coastal risks in local planning documents of southern France. Land Use Policy, 104, 105354. DOI: https://doi.org.10.1016/j.landusepol.2021.105354.

Salata, S., Peccol, E., Borsato, O. (2019). A framework to evaluate land take control policy efficiency in Friuli Venezia Giulia, Italy. Sustainability (Switzerland), 11 (22). DOI: https://doi.org/10.3390/su11226406.

Sejm (2003). Ustawa z dnia 27 marca 2003 r. o planowaniu i zagospodarowaniu przestrzennym. https://isap.sejm.gov.pl/isap.nsf/docdetails.xsp?id=wdu20030800717.

Sikora, D., Kaczyńska, M. (2022). The cultural ecosystem services as an element supporting manor landscape protection. Sustainability (Switzerland), 14 (13). DOI: https://doi.org/10.3390/su14137733.

Sówka, I., Skrętowicz, M., Zwoździak, J., Kunecka, J. (2011). Application of a GIS technique to odour emission inventory. Ecological Chemistry and Engineering S, 18 (4), 445–453.

Stoeglehner, G., Abart-Heriszt, L. (2022). Integrated spatial and energy planning in Styria – A role model for local and regional energy transition and climate protection policies. Renewable and Sustinable Energy Reviews, 165 (May), 112587. DOI: https://doi.org/10.1016/j.rser.2022.112587.

Śleszyński, P., Nowak, M., Sudra, P., Załęczna, M., Blaszke, M. (2021). Economic consequences of adopting local spatial development plans for the spatial management system: The case of Poland. Land, 10 (2), 1–22. DOI: https://doi.org/10.3390/land10020112.

Wachter, M., Wytrzens, H.K. (2022). Barn or building lot? A cross-case comparison viewing the role of agricultural interests in Austria's local spatial planning processes. Land Use Policy, 122 (August), 106347. DOI: https://doi.org/10.1016/j.landusepol.2022.106347.

Walczak, Z., Topolińska, M., Walczak, N., Laks, I., Szymczak-Graczyk, A. (2021). Feasibility analysis regarding the manner of development of the former Edmund Szyc stadium area in Poznań. Rocznik Ochrona Środowiska, 23, 11–22. DOI: https://doi.org/10.54740/ros.2021.001.

Wang, S.V., Sreedhara, S.K., Schneeweiss, S., Franklin, J.M., et al. (2022). Reproducibility of real-world evidence studies using clinical practice data to inform regulatory and coverage decisions. Nature Communications, 13, 1–11. DOI: https://doi.org/10.1038/s41467-022-32310-3.

Yang, L., Driscol, J., Sarigai, S., Wu, Q., Chen, H., Lippitt, Ch.D. (2022). Google Earth engine and artificial intelligence (AI): A comprehensive review. Remote Sensing, 14 (14), 3253. DOI: https://doi.org/10.3390/rs14143253.

Zlatanova, S. (2015). Topological relationships and their use. [In:] Encyclopedia of GIS. Springer, Cham, 1–21. DOI: https://doi.org/10.1007/978-3-319-23519-6_1548-1.

Zygmuniak, A. (2016). Możliwości wykorzystania obywatelskiej informacji geoprzestrzennej na przykładzie projektu GeoSmartCity. Roczniki Geomatyki, 75 (5), 639–646.

ABSTRAKT

NARZĘDZIA GIS W WIZUALIZACJI MIEJSCOWEGO PLANU ZAGOSPODAROWANIA PRZESTRZENNEGO

Cel pracy

Głównym celem pracy była analiza możliwości wykorzystania narzędzi GIS do modelowania danych 3D zawartych w miejscowych planach zagospodarowania przestrzennego (MPZP), w celu właściwej i maksymalnie korzystnej realizacji jego zapisów.

Materiał i metody

Wykorzystano ogólnodostępne MPZP dla analizowanego zakresu w celu uzyskania maksymalnej wysokości zabudowy dla każdego fragmentu terenu poddanego badaniom. Następnie na podstawie danych pozyskanych z Open Street Map (OSM) oraz bazy danych obiektów topograficznych (BDOT10k) określono tereny, na których dopuszczona jest budowa nowych obiektów lub zwiększenie liczby kondygnacji istniejących budynków.

Wyniki i wnioski

Uzyskane wyniki analiz pozwoliły wyznaczyć rejony, dla których możliwe jest zwiększenie zabudowy. Tego typu wiedza może być przydatna dla właścicieli obiektów, deweloperów, a przede wszystkim dla organów administracji publicznej, dostarczając informacji na temat planowania, a także określonych elementów w MPZP, które należałoby zmienić, aby nie dopuścić do nadmiernego zagęszczenia zabudowy. Nadmierne zagęszczenie zabudowy może ograniczyć dostęp światła słonecznego do wybranych obszarów lub doprowadzić do zamykania korytarzy przewietrzania miasta. Tym samym tego typu badania pozwalają w bardzo prosty sposób na wizualizację maksymalnej możliwej zabudowy na potrzeby nowo utworzonych planów miejscowych i innych tego typu opracowań.

Słowa kluczowe: GIS, miejscowy plan zagospodarowania przestrzennego, planowanie przestrzenne, ArcGiS, MPZP