

## The problem of the modernisation of land and building register in Poland as exemplified by the village of Rejowiec

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**Abstract:** The right of ownership is the broadest and one of the most basic property rights, which allows the owner to use and dispose of possessions without the participation of third parties. Therefore, the process of modernising the land and building register (MLBR) is extremely important considering, for example, that the data contained in this register is the basis for the subsequent calculation of public-legal obligations associated with the owned property, such as taxes. According to the current legislation, the data collected in the land and building register (cadastre) on the type of land use in combination with the soil classification of agricultural and forest land, the use of the property, its purpose and other information, are the basis for determining the agricultural, forest and real estate taxes by the competent authority. In Poland, in most cases, we have to deal with a situation in which the data appearing in the register differs from the actual state. Municipal budgets suffer losses because of this, and owners of properties of similar area and value sometimes pay completely different taxes. In this paper, the authors show a practical example of MLBR and the problems existed with it.

**Keywords:** register, parcel, land and building register, cadastre

### 1. Introduction

The applicable provisions of the geodetic law impose an obligation on the starost (mayor of a city with county rights) to maintain a land and building register and to keep it up to date [1–3]. The functioning of the cadastre is related to the implementation of a number of statutorily defined tasks of different natures, which entail costs and bring economic benefits from the sale of registration data [4]. In order to systematically improve the service for those who use the records, modernisation of the records is carried out in a way that ensures continuous operation [5]. Undoubtedly, this process is complicated and complex primarily because it concerns, among other things, problems related to changes in the area of land plots or changes in land use [6]. Noszczyk and Hernik [2] extensively discuss the reasons for the need for modernisation. They draw attention to the determination of the area of land, the uses of individual parcels and the problem of their misclassification, which is also mentioned by Sadowski and Dawid [1, 7]. Similar research focused on other aspects, such as whether the share of land used by farms within the surface of cities is determined by the mechanism of land rents, the role of the freeholder in selected administrative proceedings and surveying processes, Land Administration System, or legal-surveying documentation in the registration of rights to properties. Currently, this topic is also related to the informatisation of land registers in Poland and other EU members, verification and update of cadastre data, or territorial differences in agricultural investments co-financed by the European Union in Poland. In recent years, there has been extended research on the usage of UAVs (unmanned aerial vehicles) in cadastre. UAVs offer the possibility of rapid, widespread and low-cost modernisation of land and building registries, but the Polish law does not allow using them for this purpose.

The overarching goal of MLBR (modernisation of the land and building register) is to gradually improve the quality of the data collected [18, 19]. The modernisation involves a set of technical, organisational and administrative activities, regulated by law. It is carried out on an ongoing basis as part of the ongoing updating of the cadastre by making documented changes to the registration database [20]. The regulation [5], first introduced in 1996, strictly specified its objectives. The various stages and methods of establishing boundaries were defined in Annexes 12 and 13 to the regulation [5]. The concept of modernisation was also defined in a 2001 decree [21] that focused on aspects of completing or creating a full range of data sets, modifying the existing ones, and improving the operation of the information system supporting the registration database. According

to the current legislation [22], the MLBR is carried out on the basis of a project agreed upon with the provincial surveying and cartographic supervision inspector, after consultation with the Chief Land Surveyor. The current regulations allow for greater freedom in carrying out the modernisation. However, in most cases, the practices developed on the basis of previous regulations are used.

Siejka et al. also point out the aspect of the numerical description of boundaries as a set of registration data (coordinates of the points defining the course of boundary lines) [20]. They raise the question of accuracy and its strict criteria. However, a supplementary answer is § 82 of the regulation cited in the article [21]. It describes the case when the position of boundary points cannot be determined with the required accuracy and specifies particular accuracy indications that deviate from the norm. Changes in the application of the above provisions were brought about, in addition to the regulation in force since 1 January 2014, by the announcement of 10 June 2016 [23]. It noted the repeal of the third of the primary goals of modernisation - developing a computer system.

Another issue widely discussed in the literature is the aspect of execution itself. As mentioned in the publication [24], Article 24a of the PGiK Law [3] specifies particular activities that need to be performed in order to properly carry out the MLBR. The article identifies variants of ways to carry out the work. It also defines the principles and the procedure to be followed in determining the accuracy of points. These provisions are in accordance with the provisions contained in the Law [3]. The steps to be taken to carry out the update and the discussion of the various options for the scope of work is also addressed by Zaremba & Zoń [25]. In addition, they draw attention to the provisions of Instruction G-5 [26] in the context of the development of the modernisation project and evaluation of the information system. The G-5 instruction was not a binding legal act, but it contained guidelines that were used in the modernisation process. Currently, the Head Office of Geodesy and Cartography has prepared special studies containing recommendations and good practices for LBR modernisation. The study is available on the Office's website. It is also worth emphasising here the importance of the mentioned [24, 25] project of MLBR records, listed as one of the modernisation activities, acquiring the status of land and building records [27].

Another thing that is important from the point of view of the discussed issue is the aspect of MLBR records in the tax context. As mentioned by the authors, who used the example of the municipality of Michałowice [2], it brings with it an increase in income that feeds the municipal budget, but this is not always due to an increase in the tax rate, but to an increase in the tax base, that is, quoting [2], the area of land and the number of buildings that were previously unreported. In the article, the authors discuss this problem in detail, as well as the consequences it entails. Similar topics are also addressed by Sadowski [7], who additionally pointed out the irregularities resulting from the negligence of offices that for years did not exclude investment plots from agricultural production, as well as from the actions of designers, architects and investors who consciously take advantage of the regulations and exclude areas of less than 5 acres from agricultural production, and thus avoid paying the exclusion fee. Other authors who address similar topics are Sobolewska-Mikulska and Cienciala [11] or Kotlarz [28].

Another very important, if not the most important stage of the MLBR for land owners was the release of the land and property register documentation for review. The above activity is executed based on Article 24a of the Geodetic and Cartographic Law [3], which includes the following provision: the land and property register documentation is subject, for a period of 15 working days, to submission for review by natural persons, legal persons and organisational units without legal personality at the county district office. During this period, anyone whose legal interests are affected by the disclosed data may submit their comments, for which an appropriate protocol is drawn up. According to the following paragraphs, the county head is required to release and announce it in the national press. The decree also includes information on how to handle the above-mentioned complaints. This activity should take place with the participation of an authorised employee of the district office licensed to perform works mentioned in point 2 of the relevant legal act (demarcation and division of real estate (land) and preparation of documentation for legal purposes) and the contractor of the work within 15 working days after the release for review. At this time, they jointly decide on the acceptance or rejection of the submitted comments by making an appropriate note in the minutes, referring to the content of the comments and whether they have been accepted or rejected. After the expiration of the aforementioned deadline, the modernised data contained in the land and property register documentation become LBR data and are subject to disclosure in the LBR database. Information about this shall be announced by the starost in the official gazette of the voivodship and in the Public Information Bulletin on the website of the local administrative unit. If an interested party with a legal interest in the disclosed data finds any irregularities, they have the right to report them within 30 days from the date of announcement of the information in the official gazette of the voivodship. Such objections are treated as requests to change the data included in the cadastre and are resolved by the starost by way of a decision. Until such a decision is issued, the data on land, buildings or premises disclosed in the descriptive and cartographic records are not binding [3].

The primary purpose of this paper is to analyse in detail and present a number of processes related to the MLBR. The aspect of the impact of modernisation on the quality of the resulting data feeding the LBR database will also be studied. A secondary objective will be to determine the impact of the aforementioned project on the increase in the revenue coming into the municipal budget each year.

## 2. Methods

Rejowiec is a village located in Świętokrzyskie Voivodship, Jędrzejów Powiat, Nagłowice Commune (Figure 1) [29, 30]. It is located in the basin of the Biała Nida River. The area of the village is included in the Włoszczowsko-Jędrzejowski Protected Landscape Area. In the near vicinity there are the towns of Nagłowice, Ślęcin, Chycza, Chycza-Brzóstki, Kuźnice.



Figure 1. Location of Rejowiec village on the map of Poland and Nagłowice commune, Source: Google Earth [29, 30]

According to the information contained in the LBR modernisation project for the Nagłowice cadastral unit, the area of the cadastral district covers 145 hectares of land, among which 180 cadastral plots and about 118 buildings can be specified. The distribution of land uses according to the document is shown in the Table 1. No reclaimed land requiring reclassification was identified in the village in question. The estimated number of parcels to be updated in terms of land use and soil classification was 36.

Table 1. Distribution of land use within Rejowiec before modernisation.

| Agricultural lands |              | Urbanised and built-up areas |              | Wp and Ws | Other land uses |
|--------------------|--------------|------------------------------|--------------|-----------|-----------------|
| Total              | Including Br | Total                        | Including Tk |           |                 |
| 130                | 6            | 1                            | 0            | 0         | 14              |

Note:

- Br - developed agricultural land;
- Tk - railway areas;
- Wp - land under flowing surface waters;
- Ws - land under standing surface waters

Surveying field measurements from 1982 were used as source material for the establishment/restoration of the LBR. The estimated number of boundary points was 507 in total. The average errors in the position of these points did not have a uniform distribution; its structure is shown in Table 2.

The functioning cadastral map was derived from vectorisation of the raster at a scale of 1:5,000. It was maintained in the current "2000" coordinate system for zone 7. The master map within Rejowiec was in the form of a hybrid map (i.e., map raster supplemented with vector data) maintained at a scale of 1:1000 in the "2000" zone 7 system - similar to the cadastral map. There were 5 sheets of source materials in non-electronic form, as well as 73 technical reports prepared in connection with the update of LBR, GESUT, BDOT500 and base map data. In addition, the number of buildings oscillated around 102.

Table 2. Proportion of boundary points with an average position error in particular ranges before MLBR [m]

| $\leq 0.10$ | 0.11-0.30 | 0.31-0.60 | 0.61-1.00 | 1.01-3.00 | $\geq 3.00$ |
|-------------|-----------|-----------|-----------|-----------|-------------|
| 0%          | 10%       | 10%       | 70%       | 10%       | 0%          |

### 2.1 Analysis of source materials

The first and most important stage in the modernisation of cadastre records is to conduct a thorough and careful analysis of the source materials. It is also worth noting that both the process itself and the end result of these activities are decisive in terms of the subsequent time consumption of the study and the amount of field work to be done.

In the MLBR process, the analysis of source materials plays a key role, since it makes it possible to convert the coordinates of boundary points from archival records to the current system, and thus reconstruct the state that was once accepted without having to carry out the entire process from scratch. In addition to purely implementation-related aspects, such as saving time or reducing the amount of field work, the obligation to use the geodetic control network is a direct result of the law. The Ordinance on standards of surveying [31] indicates that site measurements for the purpose of restoring boundary markers or delineating boundary points shall be performed with the use of resource materials that enable the reconstruction of the location of such points in the field. The previous regulation [32] clarified that situational geodetic surveys for the purpose of renewing boundary markers or delineating boundary points shall be performed with the use of observational data that determines the location of such markers or boundary points based on the geodetic control network that was used to acquire such data.

### 2.2 Field inspection

Another very important step in the MLBR process is to conduct a field interview, the necessity of which was also mentioned in the SIWZ (specific contract terms and conditions), where a provision was included that the tasks of Stage I include conducting a field interview regarding the comparison of land and building registration materials contained in the LBR with the facts on the ground. The necessity of performing the above activities resulted directly from the law. In the decree [32], which is no longer in force, section 7, paragraphs 1 and 2 included the provision:

1. Site and shall be preceded by a field interview, aimed at:
  - 1.1 field identification of points of the geodetic control network and boundary markers;
  - 1.2 comparing the content of DGCR (district geodetic and cartographic resource) materials with the actual state of affairs;
  - 1.3 acquisition of information about the area to be surveyed that is relevant to the scope of the planned surveying work.

The results of the field interview shall be marked in red on a copy of the basic or cadastral map.

### 2.3 Supplementary materials

The aforementioned stage of field interviewing, and especially its results, are particularly important, as they provide the necessary information regarding the type and scope of objects for which a supplementary survey should be carried out. The technical manual G-4 [33], which is no longer legally binding, defines that it is a set of technical activities that allow for making geodetic and cartographic documents conform to the terrain in terms of the required content. According to the above, supplementary surveying is aimed at updating the existing content of the basic map and enriching it with (situational and altitude) details that are important from the point of view of investments carried out in the area or current economic needs. This paper will describe the supplementary measurements of boundaries, buildings and contours and land uses which were carried out in accordance with the requirements of the SIWZ.

### 2.4 Supplementing the database as part of MLBR

As already mentioned in this work, the primary purpose of conducting MLBR by the starostes is to complete the registration database and create (or modify the existing) datasets so that they comply with the requirements of the regulation. With this in mind, the results of all of the stages described above were collected, processed, and then used to create the core part of the land and property register documentation.



### 3. Results

#### 3.1 Analysis of source materials

As part of the analysis of the accessibility of the existing geodetic control network and the verification of its status, the work in the Rejowiec village area began by locating the points of the Class III network and monuments established during the work on the survey of the boundaries of the Rejowiec village, which are also the points of the border of the State Forest lands and of the Class III network. One of the review sketches of the detailed horizontal control network at a scale of 1:25,000, used during the modernisation works, is reproduced below (Figure 2).

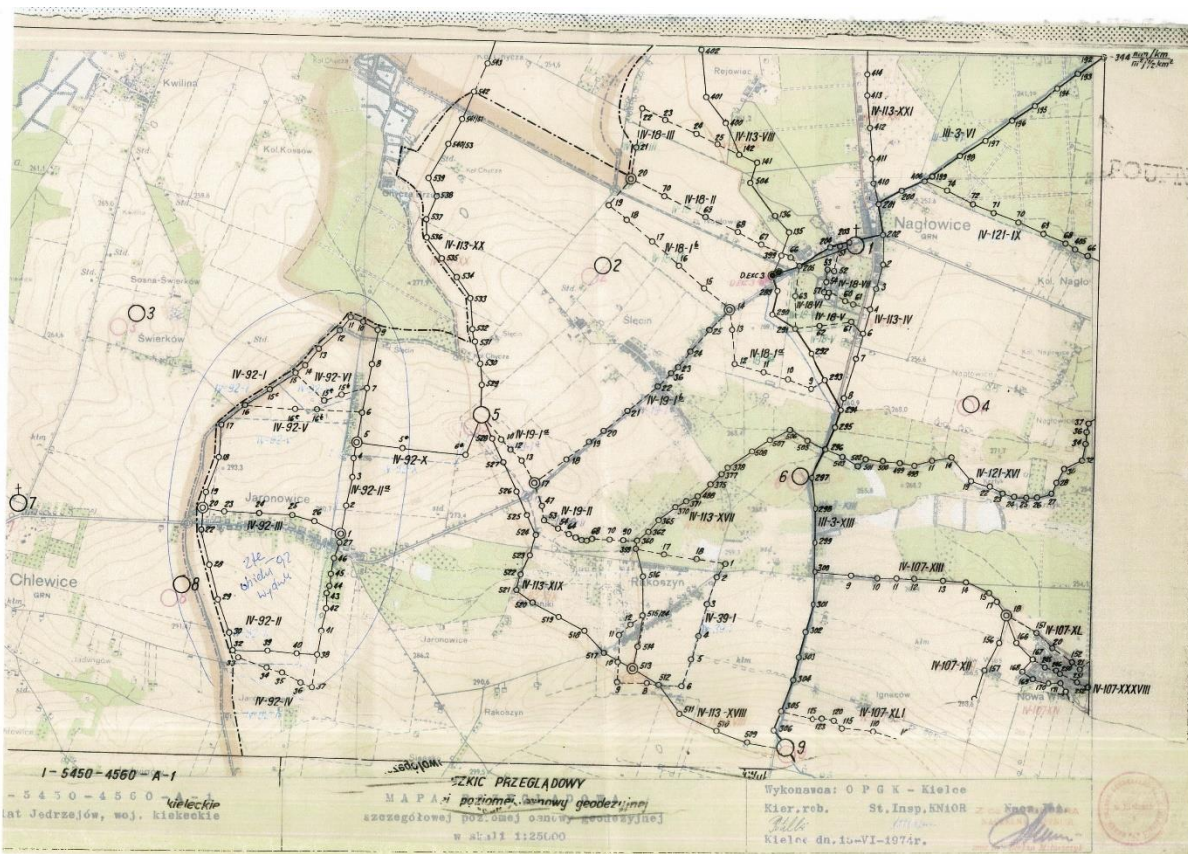


Figure 2. Survey sketch of the detailed horizontal control network at a scale of 1:25,000, sheet I-5450-4560-A-f. Source: PZGiK internal collections.

As a result of the field interview, 29 points were found, two of which constituted class II points (stabilised with a concrete pole; number 400 and 401); eight points constituted class III points (number 1029, 1030, 1032, 1033, 10280, 10290, 10320, 10330 – stabilisation: concrete pole); and 19 points constituted geodetic control network points, stabilised mostly with granite poles, some individual points with bottles and iron pins. The aforementioned Class II and Class III points were measured - thus checking their correspondence with catalogue coordinates. Subsequently, the individual points of the geodetic network were also found and measured; their location was reconstructed on the basis of archival records, as described in the next subsection. Figures 3 and 4 show sample monument points found during the field interview and their condition.





Figure 3. Examples of geodetic control network points found. Source: the authors' archive.



Figure 4. An example of a damaged control network point found during a field interview. Source: the authors' archive.

After the above steps were carried out, the data were merged, relating the points of the control network by linear-angular measurement to the Class II and Class III points. Subsequently, alignment was carried out which covered only the boundary points of the forest complex adjacent to the Rejowiec cadastral district, and located in the Nagłowice area, as well as the boundary points located on the Rejowiec bypass at the junction with the Chycza cadastral district. The obtained data were used in the alignment process carried out in the Geonet system. The list of coordinates of the control geodetic network and their comparison with catalogue coordinates showed deviations ranging from 0.01 m to as much as 0.61 m.

As mentioned above, any work related to the analysis of the course of boundaries or the location of boundary points should begin with an examination of the existing relevant documents. In view of the above, the work began with an attempt to find materials useful for determining the boundaries of the district in question. As a result of the analysis, it was concluded that the boundary of the cadastral district with the Chycza cadastral district should be adopted on the basis of the consolidation operation and the measurement of the existing boundary points on the ground. In terms of establishing the course of the boundary between the village areas and the State Forest land, what proved to be helpful was the 1958 surveying documentation of the Oksa Forest District and the database of network sketches contained therein, on the basis of which it was possible to find and measure

the polygon points of the geodetic network. The boundary with the Nagłowice village was adopted from the works carried out earlier in this area. The analysis of the perimeter of the village was followed by the analysis of archival survey records for the remaining parcels of land. A total of 23 survey records were analysed, four of which were not usable. The main reason for this decision was the lack of any possibility of accurately determining the coordinates of the boundary points that appear in these survey records. The measurements were often performed in the local coordinate system of which no documents remain that would allow for determining the location of points in the currently valid coordinate system. In addition, in most cases no permanent stabilisation of network points had been carried out.

Such discrepancies qualified the survey in question for re-measurement and determination of boundary points in the presence of the interested parties on the land in question. It is also worth noting that a similar procedure was applied to the boundaries the only source of which was the cadastral map. The LBR, which was in effect until then, showed large shifts of boundaries in relation to their course on the ground, reaching up to 10 meters in places, and as a result of the arrangements made with the District Surveyor (also included in the work log and signed by an authorised person), it was determined that such boundaries should be established directly on the ground based on the indications of the interested parties and peaceable possession. The remaining survey records were considered reliable both in terms of accuracy and timeliness, so it was decided to enter them into the LBR database.

The vast majority of archival survey records that were classified as usable materials were documents from divisions of individual land plots. Four survey records were made in the "1965" coordinate system. Two contained information about the performed stabilisation in the form of boundary posts, while one contained information about wooden piles. In view of the fact that many of the analysed records did not contain any information on the mentioned subject, it was decided to measure the boundary points after finding them, and then, if they met the standards of accuracy and timeliness, to enter them into the LBR database. Among the archival materials, in addition to the above-mentioned documents, there were also survey records on the establishment/determination/measurement of boundaries, verification of land use within, or unit classification records. The principle of their inclusion in the LBR database was the same as in the case of subdivision work. A summary of the boundary points found as a result of archival operations is summarised in Table 3.

Table 3. Summary of boundary points found in archival records. Source: authors' compilation made on the basis of the annexes to the records for submission No. DGK.6640.1655.2019, "Geox" Usługi Geodezyjno-kartograficzne s.c.

| Report ID        | Point ID in base     | Point ID in report | Stabilisation type | Work type                                           |
|------------------|----------------------|--------------------|--------------------|-----------------------------------------------------|
| P.2602.1996.845  | D.260204_2.0011.1001 | 1001               | fence post         | Measurement of the parcel boundaries<br>61          |
| P.2602.1996.845  | D.260204_2.0011.1003 | 1003               | boundary stone     |                                                     |
| P.2602.1996.845  | D.260204_2.0011.1005 | 1005               | fence post         |                                                     |
| P.2602.1996.845  | D.260204_2.0011.1006 | 1006               | fence post         |                                                     |
| P.2602.1996.845  | D.260204_2.0011.1002 | 1002               | fence post         |                                                     |
| P.2602.2009.1082 | P.2602.94            | P-94               | iron pin           | Determination of parcel boundaries 331 (road)       |
| P.2602.2014.947  | D.260204_2.0011.26   | 26                 | boundary stone     | Reconstruction of parcel boundaries 43              |
| P.2602.2014.947  | O.260204_2.178       | 100                | boundary stone     |                                                     |
| P.2602.2014.947  | O.260204_2.179       | 101                | boundary stone     |                                                     |
| P.2602.2014.947  | D.260204_2.0011.28   | 11-29              | fence post         |                                                     |
| P.2602.2014.947  | D.260204_2.0011.42   | 103                | boundary stone     |                                                     |
| P.2602.2014.947  | D.260204_2.0011.40   | 43                 | fence post         |                                                     |
| P.2602.2015.1458 | D.260204_2.0011.49   | 4/4                | boundary stone     | Measurement of the parcel boundaries 39             |
| P.2602.2015.1458 | O.260204_2.180       | 1/2                | boundary stone     |                                                     |
| P.2602.2015.1458 | O.260204_2.181       | 11/1               | boundary stone     |                                                     |
| P.2602.2015.1458 | D.260204_2.0011.48   | 3/2                | boundary stone     | Measurement of the parcel boundaries 10/3 (stage 1) |
| P.2602.2018.2230 | D.260204_2.0011.85   | gu4                | boundary stone     |                                                     |
| P.2602.2018.2230 | D.260204_2.0011.84   | gu3                | boundary stone     |                                                     |
| P.2602.2018.2230 | D.260204_2.0011.83   | gu2                | boundary stone     |                                                     |
| P.2602.2018.2230 | D.260204_2.0011.82   | gu1                | boundary stone     |                                                     |

### 3.2 Field inspection

The current amended wording of the cited regulation [31] does not include such a detailed description of the above activities; however, this aspect is still considered important. In addition, it was specified as one of the mandatory elements of the technical report. In connection with the provisions contained in the SIWZ and in accordance with the applicable regulations, a field interview was carried out in the area of the village of Rejowiec, as a result of which a field interview building map was created on the base map in the "2000" zone 7 system. On the individual sheets of the field interview maps, the missing buildings that were to be subject to measurements were drawn in red, non-existent ones were removed, and address numbers were supplemented in accordance with the list of address numbers maintained by the Municipality Office. In addition to the maps containing changes to the buildings, a separate sheet of the field interview map was prepared at a scale of 1:3,000 that presented usable land, indicating its types and area of their actual occurrence.

### 3.3 Supplementary materials

On the basis of the analysis of source materials that had already been carried out, it was possible to select the boundaries of registered land parcels that needed to be established on the ground in the presence of the owners. The above-described detailed analysis of the available source materials contained in the PZGiK database and the field interview were followed by the preliminary selection of the boundaries of the parcels of land that required determination on the ground in the presence of their owners. In accordance with previous records, at this stage points from archival records were also recalculated, and then after checking the accuracy criterion, they were compared with those existing in the database. An excerpt from the summary with deviations for individual points is provided in Table 4.

Table 4. The results of checking the recalculation of boundary points from the survey reports. Source: authors' compilation based on the attachment to the notification no. DGK. 6640.1655.2019, "Geox" Usługi Geodezyjno-kartograficzne s.c.;\* subscripts: c – calculated, m - measured

| Point ID in base     | Point no. in report | X <sub>c</sub> * | Y <sub>c</sub> | X <sub>m</sub> | Y <sub>m</sub> | dx [m] | dy [m] | dp [m] |
|----------------------|---------------------|------------------|----------------|----------------|----------------|--------|--------|--------|
| D.260204_2.0011.26   | 26                  | 5617557.77       | 7435828.70     | 5617557.84     | 7435828.68     | -0.07  | 0.02   | 0.07   |
| D.260204_2.0011.1001 | 1001                | 5617638.68       | 7435822.02     | 5617638.74     | 7435822.05     | -0.06  | -0.03  | 0.07   |
| D.260204_2.0011.1003 | 1003                | 5617667.92       | 7435833.95     | 5617667.84     | 7435833.87     | 0.08   | 0.08   | 0.11   |
| D.260204_2.0011.1005 | 1005                | 5617621.63       | 7435860.15     | 5617621.63     | 7435860.17     | 0.00   | -0.02  | 0.02   |
| D.260204_2.0011.28   | 11-29               | 5617522.67       | 7435895.45     | 5617522.73     | 7435895.43     | -0.06  | 0.02   | 0.07   |
| D.260204_2.0011.49   | 4/4                 | 5617747.05       | 7435873.86     | 5617747.10     | 7435873.87     | -0.05  | -0.01  | 0.05   |
| D.260204_2.0011.40   | 43                  | 5617540.11       | 7435905.15     | 5617540.20     | 7435905.23     | -0.09  | -0.08  | 0.12   |

In the case of the boundaries of land parcels that needed to be completed, notices were drawn up for their owners, described in the first part of the subsection, detailing, respectively, the schedule of work planned for the day. The mandatory parts conditioned by the regulation were included in each of them. The owners were also informed about the planned works by means of other locally available methods. The next important aspect from the point of view of the work was the actual stage of the said work carried out directly on the ground. It took place on 31.08-09.09.2021. What proved helpful in streamlining the work was an index of registered parcels of land, which included information on the parcel numbers and the numbers of pages assigned to them in the records and on the sketch of the findings, taking into the account the number of the notice provided.

All of the field work focused on establishing the course of boundaries for which there were no reliable materials on the basis of which it would be possible to determine them. In the presence of the owners of each property, a record of the determination of the course of boundaries and a sketch (given them to sign) were drawn up. In the absence of the person summoned, the course of the borders was determined on the basis of the last peaceable possession. The protocol also included comments made by the parties and information about bystanders arriving with proper authorisation. The relevant land register numbers were obtained by comparing the LBR dataset with the land register data maintained in the NKW system from the Central Land Register Information. In the case of unregulated legal status, such information was also included in the record. As mentioned earlier, an integral part of the records are sketches of the determination of the course of the borders. Measurement of the boundary points was carried out using the method of polar measurements and GNSS.

By bringing the existing documentation in line with the actual state of affairs, after making accurate calculations, the area possessed by many owners increased or decreased. This was a consequence of undetermined boundaries, where in the case of many of them the only source of the data was the measurement made based



on the digitisation of the cadastral map, which consequently is characterised by an error in the position of the boundary point reaching up to 3.00 m. Accordingly, a map of the obtained deviations and a graph were generated for all data (Figure 5), as well as attachment 1.

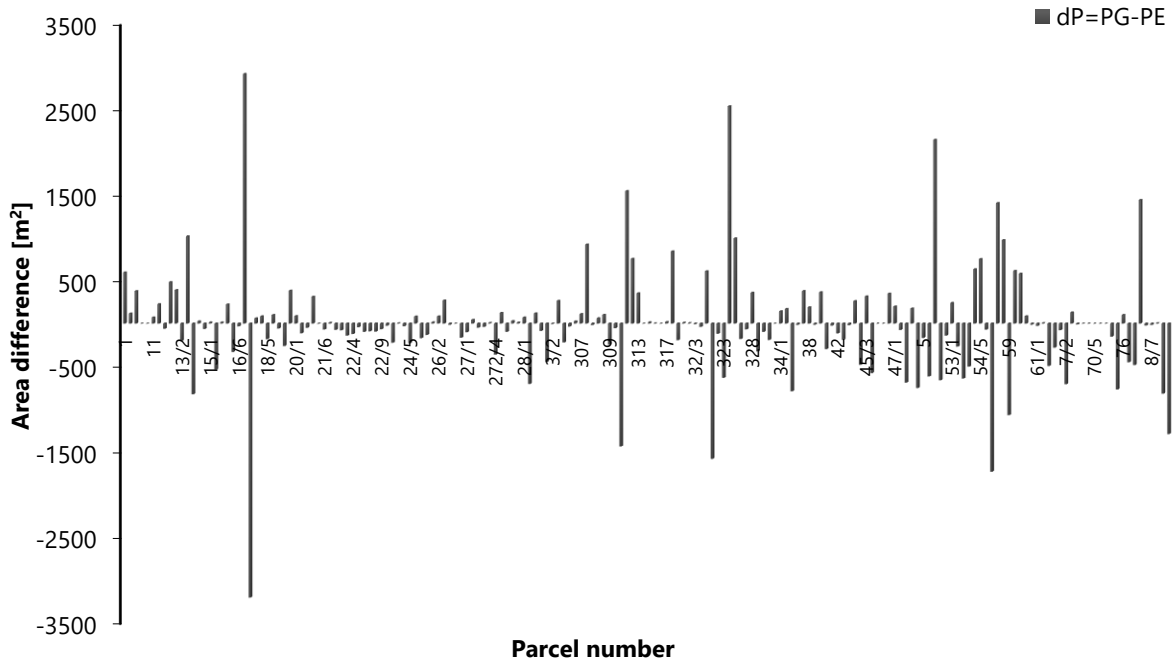


Figure 5. Differences in the areas of the parcels. Source: the authors.

A completely different sentiment could be observed if the updates resulted in overestimations or shortages, but for owners of unconnected plots of land. In each of these cases, one of the parties became the aggrieved party thus losing or gaining not only land, but also all kinds of subsidies in case of failure to meet the criterion of the required acreage size. At the end of the work described earlier, the differences obtained were summarised using a difference map and a deviation histogram generated in QGIS software (Figure 6). In the case of the latter, the vertical axis corresponds to the magnitude of the obtained deviations, while the horizontal axis corresponds to the number of plots affected by the disparity. As can be seen, the shape of the histogram resembles a Gaussian normal distribution. This means that the vast majority of the obtained values oscillate around the centre of all results - the median - which is 0 m<sup>2</sup>, while the further away from it, the smaller the number of the obtained disparities of results.

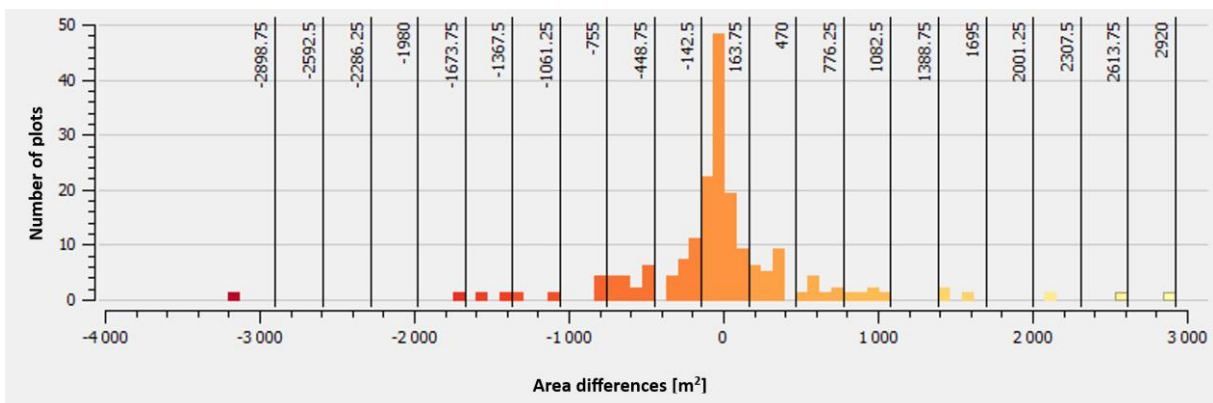


Figure 6. Histogram of the obtained area differences before and after the update, Source: authors' data compiled using QGIS software. Source: the authors.

A graphical representation of the above findings and a supplement to it is the aforementioned map of disparities of the calculated areas before and after modernisation (Appendix). It lists in colour 20 ranges corresponding to the obtained disparities. Those with the largest negative disparities were assigned the most intense, dark colours, while those with smaller or positive disparities were assigned lighter and less intense colours.

The effect of the conducted process and its interpretation coincides with that obtained by means of the histogram, which confirms the correctness of the performed calculations.

Conducting supplementary measurements on buildings was primarily aimed at completing and establishing a register and building files. Due to the fact that there were no premises in the Rejowiec village area, the stage of work related to establishing or updating the register or the directory of premises was skipped. In order to complete the databases used to generate the aforementioned reports, the entire work began with a field interview. At this stage it turned out to be crucial because, due to the repeated change of regulations over the years and the lack of public awareness, many buildings had not been reported, inventoried and, as a result, also recorded in the LBR, even though they were subject to such an obligation. One of the most common cases of this type is the issue of garages, which were listed in the LBR usually depending on whether they were fixed to or in the ground and what components and materials they were made of. Similar doubts arose in the case of decisions to list sheds, gazebos, or other outbuildings. A problematic issue in these cases was often the determination of the area of construction, the usable area (often impossible to be measured properly), or sometimes the determination of the type of land on which the object was located. As a result of inaccuracies accumulating over the years, a supplementary measurement of buildings was necessary. As mentioned above, its initial summary was visualised on the field interview building map containing the necessary data for the creation of building records. It was made on printouts of the vector base map in the 2000 plane coordinate system (zone 7). An example of a result of the mentioned work is presented in the following illustration (Figure 7).

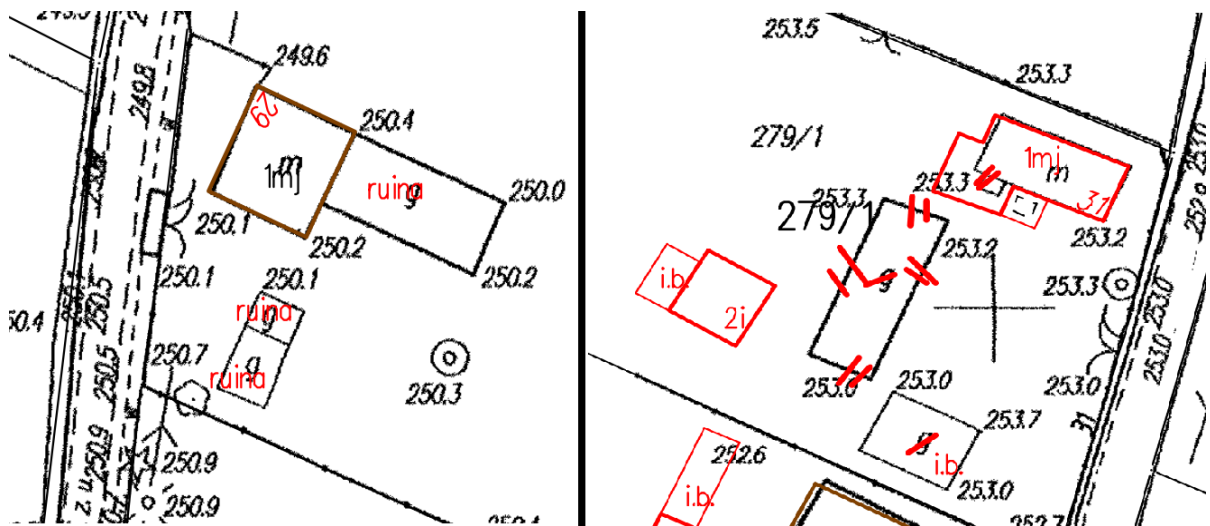


Figure 7. Excerpt from the field interview building map, Source: study made under application no. DGK. 6640.1655.2019, "Geox" Usługi Geodezyjno-kartograficzne s.c.

The next step was to inspect the location of the existing buildings in order to assess the reliability and validity of the data contained in the relevant records. For this purpose, relevant sketches were drawn up, measurements were taken on the ground, and then deviations were calculated, and the obtained results were compared with the values in the documentation. The obtained deviations do not reach high values and meet the assumed accuracy criterion. The maximum difference between the control measurement and the archival measurement was recorded for picket No. 43 from the control measurement of the building no. 54/2;1. Spatially, it amounted to  $d_p = 0,17$  m ( $d_x = -0,13$  m,  $d_y = -0,11$  m). As a result of the comparison performed, the results obtained were considered to retain relative accuracy and validity, so it was decided to leave them in the existing LBR database in their current form. Having carried out the above activities, on the basis of the field interview building maps prepared for the MLBR, the subsequent step was to acquire data that would allow supplementing the current database with objects for which there was previously a lack of mapping data (materials in the PODGiK resources). To this end, field sketches of the buildings were drawn up and the buildings were measured. Moreover, registration data sheets were made for them. Address numbers of properties and buildings were adopted according to the list of address numbers maintained by the Municipality Office, verified and supplemented during the field interview. Photographic documentation was also prepared for the buildings included in the survey.

As a result of the measurements described above, it was possible to supplement the LBR database with descriptive information about the buildings - that is, to establish appropriate files for each building. In accordance with the current regulations, the information on buildings in each file was sorted into headings corresponding to the land registration units on which the buildings are located. In the case where a building was located on more than one land registration unit, information about it was shown in all the positions of the building

file corresponding to those land registration units. If it was an object of ownership separate from the land, information about the identifier of the corresponding building registration unit was included in the file.

Based on the data obtained, it was possible to precisely determine the area of each building with the required accuracy of 1 m<sup>2</sup>. As a result of the work performed, the number of buildings disclosed in the LBR (for which there is a register, a file) increased from 0 to 108 objects. With regard to the subject matter related to the collection of data to complete the register of premises and, by extension, the mapping of premises, no such work was performed, as no premises were recorded in the surveyed area.

The primary purpose of performing the above work was to feed the relevant databases and supplement them with data meeting the criterion of accuracy and timeliness. In addition to this, as part of submission of the surveying documents, lists of land changes were also made for each parcel of land. A brief surface summary of the land use analysis showing the status before and after modernisation is provided in Table 5.

Table 5. Summary of area of land before and after modernisation

| Old state |           | New state |           |
|-----------|-----------|-----------|-----------|
| Use type  | Area [ha] | Use type  | Area [ha] |
| B         | 0.5910    | B         | 0.9544    |
| Bp        | -         | Bp        | 0.0980    |
| Br        | 5.9854    | Br        | 6.2524    |
| dr        | 2.7900    | dr        | 2.8437    |
| Ls        | 11.7810   | Ls        | 11.6325   |
| Lzr       | -         | Lzr       | 12.6246   |
| Ł         | 20.0200   | Ł         | 18.1560   |
| N         | 2.6700    | N         | 2.4660    |
| Ps        | 0.4800    | Ps        | -         |
| R         | 98.8774   | R         | 89.7028   |
| S         | 1.2222    | S         | -         |
| W         | 0.2000    | W         | 0.4542    |
| Wp        | 0.1200    | Wp        | 0.0747    |
| Σ         | 144.7370  | Σ         | 145.2593  |

Note: B - residential areas; Bp - urbanised undeveloped areas or areas under development; Br - developed agricultural land; dr - roads; Ls - forests; Lzr - wooded and shrubby areas on agricultural land; Ł - permanent meadows; N - wasteland; Ps - permanent pastures; R - arable land; S - orchards; W - land under ditches; Wp - land under flowing surface water.

### 3.4 The database supplement as part of MLBR

In the Rejowiec cadastral district, all work related to the creation of the land and property register documentation was completed in parallel with other areas covered by the order, which consisted of the cadastral districts of Chyca Brzóstki, Jaronowice, Kuźnice, Rejowiec and Ślęcin (Nagłowice cadastral unit). In addition to the activities described in the previous sections, the contractor also carried out the necessary work to bring the resulting LBR database into consistency with the BDOT500 and GESUT databases, even though they were not the subject of the order.

The final stage in the MLBR process is feeding all databases with the data acquired in the course of the work. As included in the conditions for stage II, this primarily concerns the creation of digital collections of boundary points, cadastral parcels, data on land use contours, classification contours, buildings, objects permanently attached to buildings, and data on premises constituting separate properties. However, in addition to the data relating directly to the boundaries of registered parcels, the attributes of boundary points, their areas, the types of buildings shown on the parcels or verification of land use, it should also be noted that feeding the databases also included the issue of verifying data on address numbers of properties and buildings. The above were adopted in accordance with the letter received from the Nagłowice Commune Office conditioning that the register of address numbers is kept in the EMUiA system (the Register of Localities, Streets and Addresses). After analysis, the address numbers of properties and buildings were adopted in accordance with the list of address numbers maintained by the Municipality Office, verified and supplemented during the field interview. As part of the work, a request was also made to obtain information from relevant authorities on buildings



listed in documents such as the register of notifications of construction, demolition and changes of use, information on road categories and their numbers assigned under public road regulations under the permanent management of the General Directorate of National Roads and Highways, and the Statistical Office in Kielce (to obtain data on the boundaries of statistical districts and their identifiers). Another request was directed to the National Heritage Institute to obtain the register of historical monuments. In the case mentioned in the response, the authority referred the contractor to the Voivodship Conservator of Monuments as the authority competent to provide this information. It was found that there were no such monuments in the vicinity of the village of Rejowiec. As mentioned in an earlier section of the work, the attribute KW (Land Register) number was established by comparing the LBR dataset with the land register data maintained in the NKW (New Land Register) system from the Central Information of Land and Mortgage Registers. This attribute was completed by obtaining data from the Central Register of Forms of Nature Protection and entering "no" or "yes" values for parcels with a form of nature protection. In the course of the work, it was also found that the developed map was consistent with the content of the orthophoto. Thanks to the acquisition of all the above-mentioned data, after the work was verified by an authorised inspector, it was possible to prepare an appropriate report on the completion of the work and transfer the documentation, completed and updated in terms of completeness, timeliness and accuracy, to the Ordering Party.

#### **4. Impact of MLBR on the municipality's finances**

Modernisation of land and building records is a process that affects not only the quality of the resulting data that feeds various databases but also greatly affects the property taxes paid at a later date. As a result of the analysis carried out in the Rejowiec village area, it was found that while in the case of the area and types of land uses present there, their quantity will not change drastically and will not have a major impact on municipal finances, it will be different in the case of buildings. According to Article 2(1) of the Law on Local Taxes and Fees, both the land and the building located on it are subject to property tax separately. What is noteworthy, according to the same law, agricultural land or forests are not subject to real estate tax, except for those occupied for business purposes [34]. Therefore, although there is little or no tax on the land, buildings located on it are taxed, and unfortunately, at an amount several times higher. Taking this into account, despite the fact that the Nagłowice Commune, in its resolution on tax exemption [35] in § 1 para. 1, exempted residents from paying real estate tax in the case of residential buildings or their parts located on farmland, with the exception of buildings related to business activities, tax value on all other buildings - not covered by this provision - will still be high. As can be concluded from the work carried out, the total built-up area for the buildings shown after the MLBR of the village of Rejowiec amounted to 9,004 m<sup>2</sup>, which, translated into the number of 108 objects, will be a realistic reflection of the actual state of affairs.

Considering the above results, it can clearly be stated that the conducted modernisation will significantly affect the state of the budget of the Nagłowice Commune, thereby bringing equality to the residents and levelling out any irregularities occurring on individual properties.

#### **5. Conclusions and discussion**

Summarising all the information gathered in this work, it can be concluded that the process of cadastre modernisation of is a very broad, difficult and labour-intensive issue. In doing so, it is necessary to demonstrate not only professional skills, but also advanced soft skills, since the nature of the work is entirely based on contact with other people, from the employees of the relevant institutions to landowners.

Despite the multi-stage nature of the work, it was possible to generate relevant summaries showing, for example, the quality of the materials that feed the PZGiK databases. As the figures showed, despite the fact that the protection of boundary marks is legally sanctioned with respect to only a few of them, this protection actually occurs. The results of the control survey showed unequivocally that the boundary marks were repeatedly displaced (or completely removed, e.g., as a result of ploughing), thereby causing a deterioration in the quality of the data gathered in LBR.

The modernisation was intended to bring the existing documentation in line with the facts on the ground. Thus, it is a fact that on more than one occasion owners overestimated or underestimated the amount of land they owned as a result of undetermined boundaries, which was of immense importance for any subsidies or grants they received.

With regard to buildings, it is worth noting that before the modernisation was conducted, there was no base where their data would be collected. Of course, some of them had been measured in the course of work related to orders such as updating the base map, but it was nevertheless in the process of the issue in question that an official building register was established for the first time. This aspect will undoubtedly be of great importance for the state and functioning of later databases.

As for the aspect of land contours and land use, although it was not found necessary to carry out soil classification of land, the designations functioning in the database were adjusted to the actual state and in accordance with the current interpretation of the law. This was important considering, for example, the areas designated as residential areas. As a result of the modernisation, their number shown in the database almost doubled. Although in the case of Rejowiec their number is much smaller than in the case of other neighbouring units, this will undoubtedly have an impact on the amount of taxes paid by the owners at a later time, as in the case of the area of building development.

One of the most difficult tasks faced by today's surveyors is the subject of updating contours and land use. This is an extremely intricate activity due to different interpretations of the regulations in the context of whether or not an area meets the criteria for the possibility, or even the necessity, of applying changes. This is mainly due to the fact that it is contingent on a subjective assessment of the contractor. In the Rejowiec village area, the largest number of changes in terms of supplementary measurements of contours and land uses concerned updating/replacing designations from the following groups: agricultural land and built-up and urbanised land. According to Annex No. 6 to the Regulation [23], it contains the definitions of selected types of land use whose modifications took place within the MLBR in the Rejowiec village area. Considering the provisions contained therein, a meticulous analysis of the land uses in the area in question was carried out, comparing data from the classification survey, the current LBR database and the actual state of the land. As a result of the work carried out, it turned out that the previously functioning cadastral map contained many irregularities which had not been changed when the subsequent regulations came into force. In addition, not all the information contained in descriptive form was reflected graphically.

At this stage of work, all such issues were corrected and adjusted to comply with the current legal nomenclature. Most changes resulted from the previous non-disclosure or occasional disclosure of Lzr (Wooded and shrubby areas on agricultural land) and Br (Developed agricultural land).

When analysing the obtained results, it is clearly visible how the definition of individual land uses and their actual use have been changed over the years. According to the original state in the LBR database in effect until the modernisation, arable land occupied almost 99 hectares. Due to changes associated with the economic processes and migration, this number has decreased by almost 10 hectares. In addition, the result of juxtaposing the documentation with the current map and bringing them in line with each other is noticeable. As already mentioned, it contained numerous omissions, which were corrected in the MLBR process. This is clearly evident in the case of wooded and shrubby areas on agricultural land (Lzr), which is an expression that was introduced into the legal nomenclature on 31.12.2013, while in the database the term had been in use until the modernisation was carried out. A similar situation applies to the term "developed agricultural land (Br)", which, although unofficially used earlier, nevertheless officially appeared in the regulation only at the end of 2013. After performing a comparison of the descriptive part of the LBR with the content of the cadastral map in terms of the type and extent of land use and bringing them into coherence, it was not found necessary to carry out soil classification of land.

With reference to financial obligations, it is also worth emphasising the positive side effect of this project, which is the equalisation of social disparities. In connection with bringing the state of the database in line with the actual state of affairs, it is possible to avoid conflicts that arise in connection with the so-called injustice in the calculation of fees. Thanks to the issue raised, each owner will receive a calculation depending only on what they actually own, and not as before according to the data they had entered into the documentation (in many cases unsupported by any measurement).

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Attachment 1. Differences in calculated area [m<sup>2</sup>]Differences in calculated area [m<sup>2</sup>]