Cadastral Data Modernisation In The Land Management Process

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Keywords: cadastral data; land management; data modernisation

SUMMARY

Interest in issues related to the consistency of cadastral data in documents in the field (terrain) is a consequence of the data being used in many economic processes and in land management. It has a crucial impact on an increase in consumer trust and on the quality of decisions taken. The technical reliability of cadastral data is also a condition of the legal security of boundaries. Therefore, regular updates of cadastral data are of key importance in planned investment processes. Many entities that gather and share cadastral data strive to improve their quality. Discrepancies between data gathered in the cadaster and the field are caused by various factors, including (a) ambiguous definitions of individual groups of land use, (b) the multitude of land-use types within individual groups, which makes their interpretation difficult, (c) changes in the regulations on classification of individual groups, (d) changes of qualification of objects which have to be disclosed in cadastral data, (e) required accuracy of data entries, and (f) failure to report the changes by real estate owners, (g) high cost of the plot boundaries inventory in the field, (i) the duration of the measurement process.

This study aimed to analyse cadastral data concerning the coherence between the document data and the field. The comparison concerned the plot size, boundaries of land use areas and their types. The study area covers five villages in the rural part of the commune of Łomża. It is situated in the Podlaskie Voivodship, in the northeast of Poland. The size of 2,439 plots and the methods of use within those plots were compared.

The results of the analysis showed that the changes in the plot area between the documents and the condition on the ground fluctuate from 5% to 58%. The rest of the examined indicators also show a significant deviation. This indicates that a cadastral data upgrade process is desired. Modern measurement technologies should have a positive impact on the high cost of a plot boundary inventory in the field and the duration of the measurement process.

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1. INTRODUCTION

The importance of current information in the cadastral systems has been emphasised in the international literature many times. These issues attract attention because cadastral data are used in many economic activities, e.g. spatial planning, establishing tax and charge obligation, describing real estate in perpetual registers, public statistics, real estate management, etc. The coherence between the state of space at the plot level in public documents and the actual situation in the field is essential for an increase in consumer confidence and trust and affects the decision quality (Wubie et al., 2021, Roić et al., 2021, Alshikhi et al., 2018). The technical reliability of cadastral data is also a condition of the legal security of boundaries (Kocur-Bera, Stachelek, 2019, Kocur-Bera, Frąszczak, 2021, Kocur-Bera, 2019).

In 2021, the Working Party on Land Administration (WPLA), FAO and FIG presented their activities concerning the future of geospatial data. A study conducted among land administration bodies suggests that the solutions concerning spatial data, including cadastral data, are shifting from the so-called conventional model towards digital ecosystems and greater inclusion of the private sector (see Fig. 1). This is the most visionary scenario. It represents a highly automated and multilateral environment in which the private sector has a large share and management moves to an ecosystem of technology, platforms and various stakeholder groups. This concept facilitates the automation and transparency of processes and enables a wide range of the user's applications. It also provides a built-in evolutionary environment which, in a complex context, can transform over time and adapt to new customer expectations (https://www.fig.net/news/news_2021/12_eastern_economic_forum.asp).

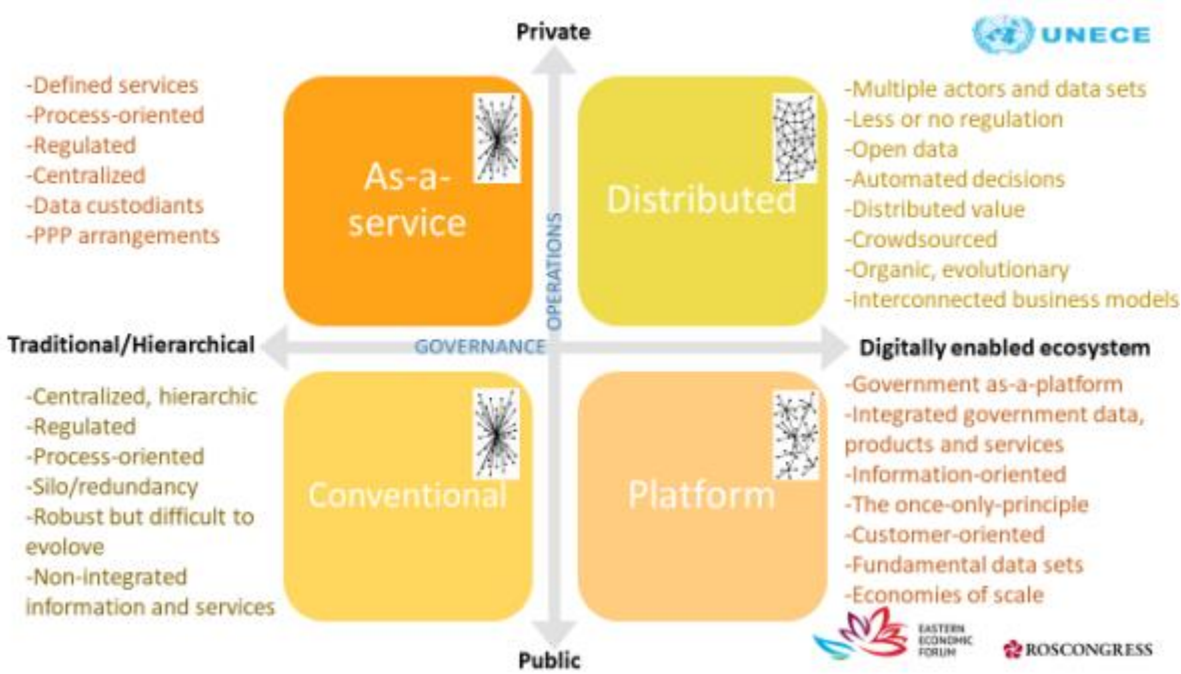


Figure 1. Four future scenarios based on global megatrends and domain-specific drivers. Source: FIG, 202 (https://www.fig.net/news/news_2021/12_eastern_economic_forum.asp).

The universality of the use of geospatial data, of which cadastral data is a part, necessitates its adequate quality. Effective data verification and regular updating are essential in land management (Nouvel et al., 2017; Stepanov, 2020). Land management is the process of managing the use and development of land resources in urban and rural environments. Land management can have a positive or negative effect, not only on land ecosystems but also on public finances. Improper use of land can degrade it, reduce productivity and disturb the natural balance (Foley et al., 2005). The lack of consistency between the status in the field with the status found in documents in countries where the tax system is based on the use of land and its area (e.g. in Poland) results in significantly reduced tax revenues.

Being in possession of up-to-data geospatial data is therefore extremely important in making all investment, tax, and other decisions. Cadastral data can be updated, temporarily verified or modernised. The updating process usually relates to the limited amount of data, and periodic verification concerns cadastral map with the actual status (checked at least once every 15 years), while data modernisation enables the comprehensive updating, over a larger area (commune, district), of data on owners/holders, legal form, technical and graphical data of a plot/real estate (surveying-legal part and descriptive-cartographic data). Modernisation of the land and building register in Poland is a package of technical, organisational and administrative measures taken by the starost (the body responsible for cadastral data) (Regulation, 2021). Its aim is to supplement the cadastral database and to create a full range of registry data sets and their modification. It is carried out strictly in accordance with the legally established diagram (see Figure 2). A modernisation plan is prepared, which is made public together with the information on starting the geodesic work. After it is completed, all the parties concerned can report their comments on the project. A decision to accept or reject the comments is taken within 15 days. It is then communicated to the persons concerned and the data become up-to-date cadastral data. Each real estate owner can raise objections concerning the data within 30 days of the publication of information on accepting the data after modernisation as up to date in the voivodeship official journal. The starost settles the dispute by issuing a decision. Geodesic field and photogrammetric measurements are the basic methods of cadastral data modernisation.

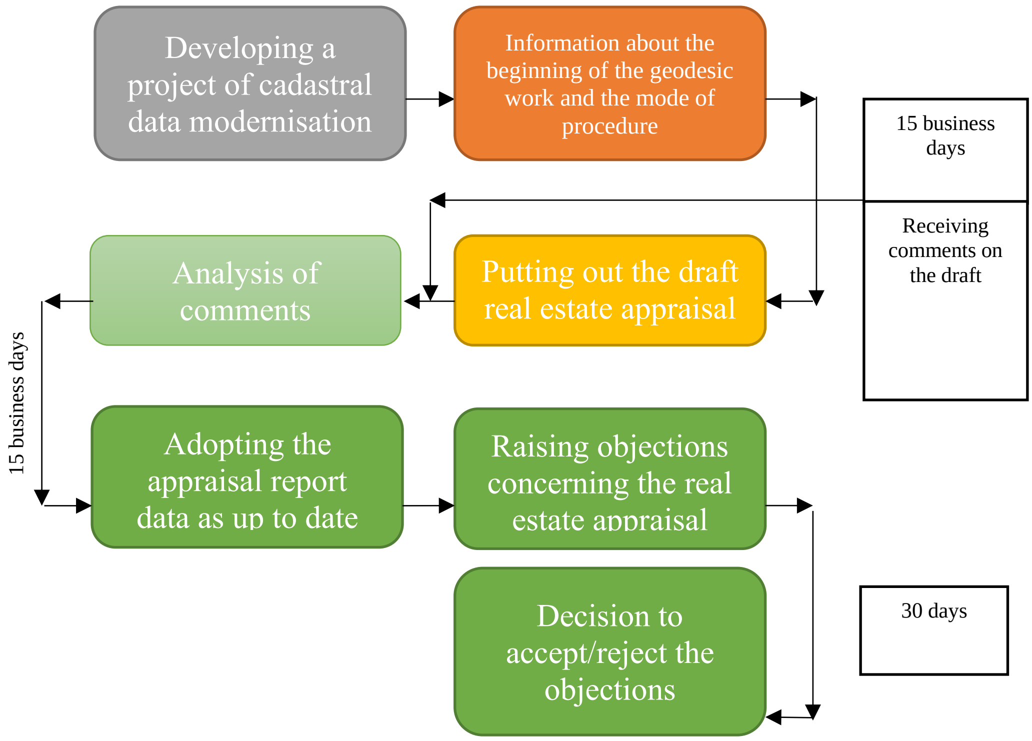


Figure 2. Stages of an administrative procedure of cadastral data modernisation. Source: (Kocur-Bera, Frąszczak, 2021).

It is required that the photogrammetric measurements, based on images acquired by large-format or aerial digital cameras, should be highly accurate.

This study aimed to analyse cadastral data concerning differences between the document data (cadastral data) and the state in the field after the cadastral modernization process. The differences concerned the plot area, boundaries of land-use methods and their types.

2. MATERIALS AND METHODS

The study area covers five villages in the rural part of the commune of Łomża. It is situated in the Podlaskie Voivodship, in the northeast of Poland. The commune occupies an area of 207.41 km², with agricultural land accounting for 75% of its area and forests for 25%. The population is 11,073. There are 40 villages in the commune. The analysis was performed in the villages: Bacze Suche, Bożenica, Czaplice, Gać and Lutostań (see Figure 3).

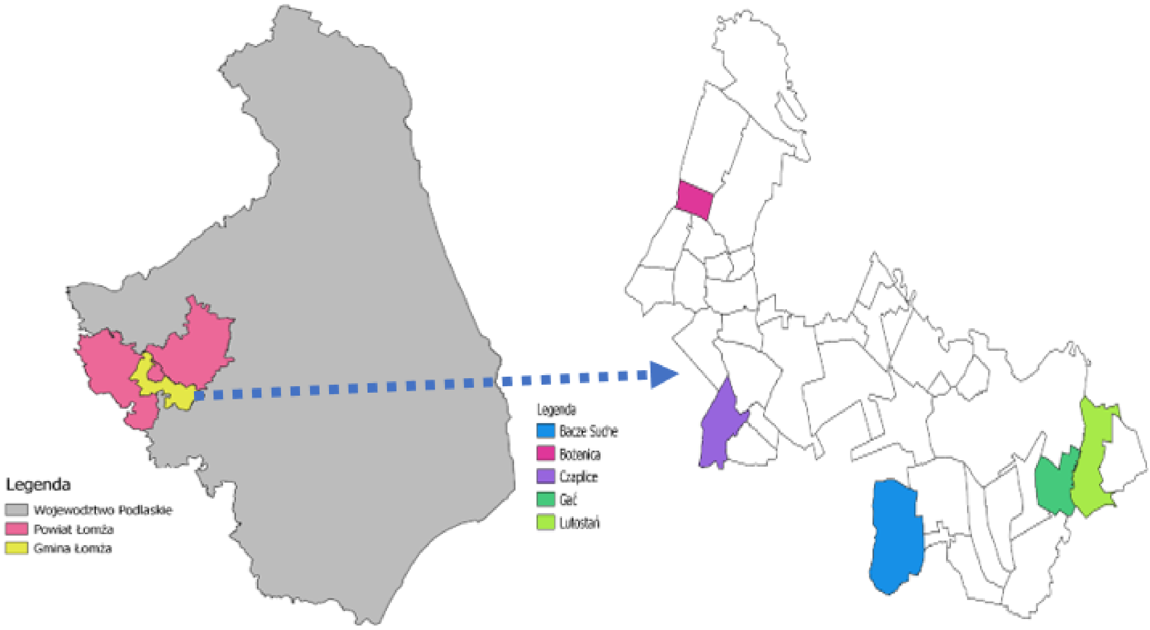


Figure 3. Area of the research.

The data for the research were obtained from the Starost Office in Łomża. The data described the plot condition and the methods of use before and after cadastral data modernisation. A comparison of both states revealed differences between the plot status as shown in cadastral documents and the status on the land (cadastral data modernisation is based on the current land occupation and use). The size of 2,439 plots and the methods of use within those plots were compared. Figure 4 provides a listing of the basic data describing the objects under study.

Figure 4. Basic data describing the objects under study

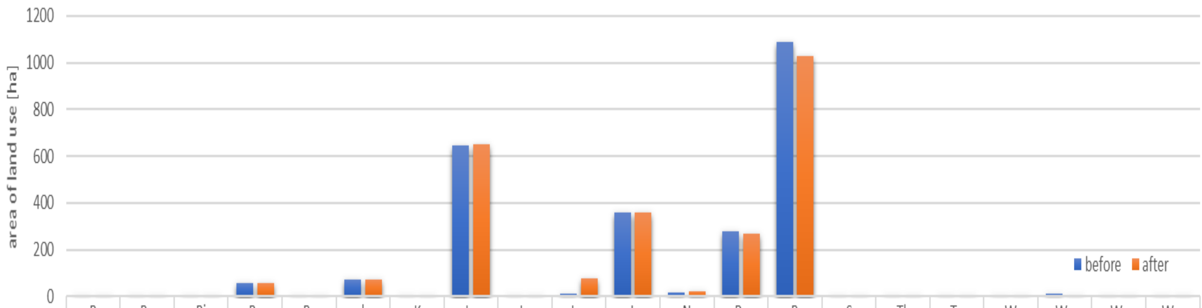
No.	Name of the object	Number of plots in objects	Area of the object [ha]
1	Bacze Suche	613	950.3267
2	Bożenica	247	181.9406
3	Czaplice	519	446.6454
4	Gać	466	397.1986
5	Lutostań	594	620.3382

The study used the methods of direct comparison of the status of the surveying and legal description and descriptive-cartographic documentation found before the modernisation process, with the status after the modernisation, which reflects the actual status found in the field. Comparative methods (Leszek, 2013) are widely used in the social sciences but are perfectly suited to identifying areas which are undergoing changes and transformation.

3. RESULTS AND DISCUSSION

The village areas increased in three of the objects under analysis – Bacze Suche, Bożenica and Czaplice – after data modernisation was completed, and they were compared with the status in the field. The increase is not spectacular, but it ranged from 753 m^2 to 1567 m^2. In general, 83% of the area of the plots in the village of Bacze Suche changed, whereas 17% remained unchanged. The changes were usually rather small, ranging from 1 to 100 m^2, the area changed by more than 1000 m^2 in fourteen cases, and in one – by more than 5481 m^2. The greatest change was noted in the case of a forest plot. Regarding the village of Bożenica, the area of 76% of the plots changed, with the greatest change amounting to 904 m^2. The area of the village of Czaplice also increased – by 1567 m^2. The area of 10% of the plots in this object did not change, and the changes in the other objects ranged from 1 to 100 m^2. The area of four objects changed by more than 1000 m^2, and the greatest change was 1861 m^2. The area of the other two objects – the villages of Gać and Lutostań – decreased. In the former case – by 4861 m^2, and in the latter – by 1319 m^2. There were only two plots in the village of Gać whose area changed by more than 1000 m^2. The situation in the village of Lutostań was different. The area of 20 plots changed by more than 1000 m^2, with the greatest change being 14,708 m^2 for a plot neighbouring a watercourse.

The analysis of the changes in agricultural land area in all the objects indicates that the land category called mining land (symbol K) no longer exists, and two new categories appeared: land under standing surface water (symbol Ws) and land overgrown with trees and bushes (symbol Lz). The greatest changes were determined for land overgrown with trees and bushes in agricultural land (symbol Lzr) (the change amounted to 699,273 m^2). The area of the arable land (symbol R) decreased by 629,140 m^2. A comparison of changes in the area of each type of land use is shown in Figure 5, in Figure 6 – description of the symbols of land use, and in Figure 7 - listing of the major change indices for all the villages under analysis.



	B	Ba	Bi	Br	Bz	dr	K	Ls	Lz	Lzr	Ł	N	Ps	R	S	Tk	Tp	W	Wp	Ws	Wsr
before	0,9012	0	3,1664	56,909	0,25	74,9437	0,06	645,323	0	13,813	358,09	19,6738	279,074	1089,8	1,561	9,38	0	8,9052	10,8231	0	0,27
after	1,9121	0,0972	0,7342	56,6566	0,3208	72,8004	0	650,511	0,2782	79,7401	356,959	20,1654	268,924	1026,89	1,3427	9,2056	0,4882	8,8269	9,6635	0,3873	0,2689

type of land use

Figure 5. Comparison of land-use area before and after cadastral data modernisation.

Figure 6. Description of the symbols on Figure 5

Symbol of the land use	Description
B	residential areas
Ba	industrial areas
Bi	other built-up areas
Br	developed agricultural land
Dr	roads
K	mining land
Lz	land overgrown with trees and bushes
Ls	forests
Lzr	agricultural land overgrown with trees and bushes
Ł	permanent meadows
N	unused
Ps	pastures
R	arable land
S	orchards
Tk	railway areas
Tp	other transport areas
W	land under melioration ditches
Ws	land under standing surface water
Wsr	land under ponds

Source: own study on Regulation, 2021.

Figure 7. Listing of the major change indices for all the villages under analysis

Name of object	Number of plots in objects	Area of object [ha]	Max. increase in area [%]	Max. decrease [%]	Number of plots with no change
Bacze Suche	613	950.3267	5	58	104
Bożenica	247	181.9406	38	40	59
Czaplice	519	446.6454	11	12	56
Gać	466	397.1986	39	38	73
Lutostań	594	620.3382	10	47	58

Source: own study.

The accuracy of information acquired by real estate managing entities from public records has a direct impact on the land management processes (Samojłowicz, 2019). Discrepancies between data gathered in the cadaster and in the field are caused by various factors. They include: (a) ambiguous definitions of individual groups of land use, (b) the multitude of land-use types within individual groups, which makes their interpretation difficult, (c) changes in the regulations on classification of individual groups, (d) changes of qualification of objects which have to be disclosed in cadastral data, (e) required accuracy of data entries, and (f) failure to report the changes by real estate owners (Cienciała et al., 2021, Kocur-Bera, 2019). Therefore, data are often obsolete, and they have to be modernised regularly. Data quality is very important in land management processes as it affects the public finance level (Starček, Šubic Kovač, 2019). It concerns not only an incorrect plot area, which is a conversion factor for the value of real estate sold, but also for the annual real estate tax revenue (this tax calculation in Poland is still based on the area and the method of use). The real estate tax revenue differs depending on the land-use area (see Figure 8, in which the area of land use in documents and in the ground are different).

Changes can be rapid in some land-use types. This mainly concerns the range of flowing waters, dirt roads and land overgrown with trees and bushes. They are a consequence of the natural method of its use. Climate change also brings about changes to the borders of various land-use methods. Climate-related scenarios suggest that climate change will result in a decrease in the water balance, with consequent reduction of high surface evaporation areas and small retention (Serba et al., 2009, Mirkowska, 2009, DePaula, 2020). This results in an expansion of natural vegetation in agricultural land and the desertification of land.

Figure 8. Actual land use status in the field, and the cadastral data status.

4. CONCLUSION

The process of modernising cadastral data, which are part of geospatial data, is very important. These data are a very important group of information that provides the basis for making decisions in land management.

The study compared the status of real estate found in the field to the status found in administrative and legal, and descriptive-cartographic documents. Since these statuses differed considerably, the regulatory body commissioned the modernisation of cadastral data. The maximum differences in plot sizes before and after the modernisation of cadastral data were up to approx. 60%. Moreover, changes in plot uses were noted. The greatest changes in the uses concerned forests, meadows, pastures and arable land. This shows that the data modernisation process is very important in maintaining the consistency of the documentation with the status in the field.

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BIOGRAPHICAL NOTES

Mrs Katarzyna Kocur-Bera. In 2002, she received her PhD at the University of Warmia and Mazury in Olsztyn, Poland. In the same year, Ms Kocur-Bera was granted a state licence from the President of the Office of Housing and Urban Development in the fields of real estate appraisal and the machines and equipment permanently attached to the ground (number 3895). In 2017, she was awarded the academic degree of D.Sc. (doctor habilitated). Since 2018, she has worked as an Associate Professor and Vice President of the scientific discipline at the Faculty of Geoengineering (University of Warmia and Mazury in Olsztyn, Poland). Her principal interests include the development of rural areas, land management, land consolidation, land and property registry, land use/land cover and common agricultural policy. She is also a member of the Polish Association of Real Estate Appraisers, the Rural Development Society and the Association of Polish Surveyors.
Her most important scientific achievement in the last five years concerns the publication cycle about the quality of cadastral data and the identification of various spatial phenomena occurring in rural areas and around cities.

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