



ASSESSMENT OF THE IMPACT OF THE TOMASZÓW LUBELSKI BYPASS ON THE SPATIAL STRUCTURE OF RURAL AREAS

Monika Piwko, Przemysław Leń

Summary

In recent years, the road network in Poland has undergone significant development, meeting the objective of creating a coherent network of roads to ensure the efficient functioning of passenger and freight transport. Linear investments, such as the construction of motorways, expressways or bypasses, are an important element that improves the safety and comfort of the life of residents, and has a significant impact on the economic and regional progress. In addition to the undoubted benefits of constructing a bypass, its possible negative impact on the surrounding agricultural and forest areas should be emphasised. Poor planning and construction of the bypass itself, without prior programming of survey and management works, can lead to disturbances in the spatial structure of neighbouring villages.

This study attempts to analyse and evaluate the impact of the construction of the Tomaszów Lubelski bypass on the spatial structure of rural areas located in the eastern part of Tomaszów County (Lubelskie Voivodeship), which is a 9.58 km long section of the S17 Warsaw – Hrebennie expressway. The study undertook a detailed analysis of only those factors that adversely affect the spatial structure of rural areas. On the basis of research on the subject, factors affecting and significantly changing the spatial structure of rural areas were identified, which allowed to formulate final conclusions regarding the problem of realising linear investments in relation to shaping the space of rural areas.

Keywords

spatial structure • land use • linear investments • bypass • land consolidation • landscape planning

1. Introduction

The construction of linear investments is not only a significant element of the economic or business development of a region, but also has a significant impact on the safety and comfort of the life of its inhabitants. Therefore, it is extremely important that the entire process of planning, implementation and construction itself of these investments is based on interdisciplinary analyses of its impact on the surrounding areas. Particular

attention should be paid to the fact that the construction of linear investments, i.e. motorways or expressways, interferes with the spatial structure of the surrounding areas, and consequently causes significant changes in the functioning or spatial management of these areas. Depending on the location, the main land use changes influence agriculture, forestry and urbanisation [Bürgei et al. 2004, Hersperger and Bürgei 2009; Olah et al. 2009, van der Ree et al. 2011, Ikiel et al. 2012, Keken et al. 2014, Fiedeń 2019]. It is agriculture that suffers the most from the negative impact of this type of investment due to the disorganisation of the agricultural workplace [Dzikowska 2006]. This is because as a result of the construction of a bypass, there are significant changes in the ownership and spatial functionality in the area covered by the linear investment. Among the most important losses caused by the construction of a bypass included can be: the loss of agricultural land used for construction, a decrease in the quality of land in the immediate vicinity of the road, an increase in agricultural transport expenditures and deterioration of the land configuration [Harasimowicz 1998, Baciór 2012]. As a consequence, the agricultural potential is definitely degraded and the measures aiming at sustainable and multifunctional rural development cannot be carried out. According to the literature research, it can be unanimously concluded that this kind of project, from the perspective of an agricultural holding, can only bring negative effects that change the hitherto existing conditions [Dzikowska 2006].

This study attempts to analyse and evaluate the impact of the Tomaszów Lubelski bypass on the spatial structure of rural areas. The construction of the bypass was primarily meant to relieve the excessive traffic passing through the town centre, to improve the living conditions of the inhabitants of the built-up areas and to streamline the traffic flow in the existing transport corridor. The scale of the problem faced by the inhabitants of Tomaszów Lubelski and neighbouring towns is confirmed by a report by the General Directorate for National Roads and Highways [GDDKiA]. According to the General Traffic Census, almost 18,000 vehicles per day pass through the town. Such intensive traffic, considering the available road infrastructure and the characteristics of the town, creates significant difficulties not only for locals but also for cross-border transport. This is due to the fact that Tomaszów Lubelski plays an important role in transit traffic on the S17 Warsaw–Hrebennie expressway, as it connects the Warsaw and Lublin agglomerations and directs traffic through Zamość towards Lviv. The implementation of the investment in question was justified in terms of the economic development of the region and the improvement of road infrastructure. However, despite the undoubted benefits of the bypass, its negative impact on the surrounding agricultural and forest areas must be emphasised.

The data processing showed only negative effects on the spatial structure resulting from the construction of the bypass. Among the positive aspects of the investment, mainly the socio-economic factors should be mentioned. However, due to the large area of research, the analysis of e.g. the impact of the bypass in Tomaszów Lubelski on the comfort, the reduction of commuting time or the safety of the inhabitants would require extensive surveys of the opinions of the inhabitants. Therefore, this paper consists of a detailed analysis of only those factors that negatively transform the space

of rural areas. Such an approach allows us to learn about the actual state of land ownership and use in the areas affected by the investment, which has, by design, deteriorated.

The study presents the results of analyses of the impact that the construction of the bypass in Tomaszów Lubelski has had on the surrounding areas. This study includes the characteristics of individual precincts according to such criteria as: the average area and the number of plots in a given registration unit, the percentage of plots without access to roads, as well as a comparison of plots according to registration units. Based on a range of studies, the factors that affect and significantly change the spatial structure of rural areas were distinguished and used to formulate the final conclusions on the subject of implementing linear investments. The study also took into account the characteristics of the structure of the areas of south-eastern Poland.

There are previous studies in the subject literature on the chequered pattern of land, which univocally indicate prevailing difficulties in rational management in these areas. This is mainly a consequence of the significant fragmentation of plots, their small area, irregular shape, the lack of access to roads or the considerable distance of the plots from economic centres [Król 2014, Król and Leń 2016]. Due to such numerous indications of the negative impact of constructing linear investments, such as a bypass, each time projects are developed, an assessment of their impact on the surrounding areas should be carried out. It is this type of analysis that should be the basis for making appropriate location decisions [Bartkowicz and Bartkowicz 1998].

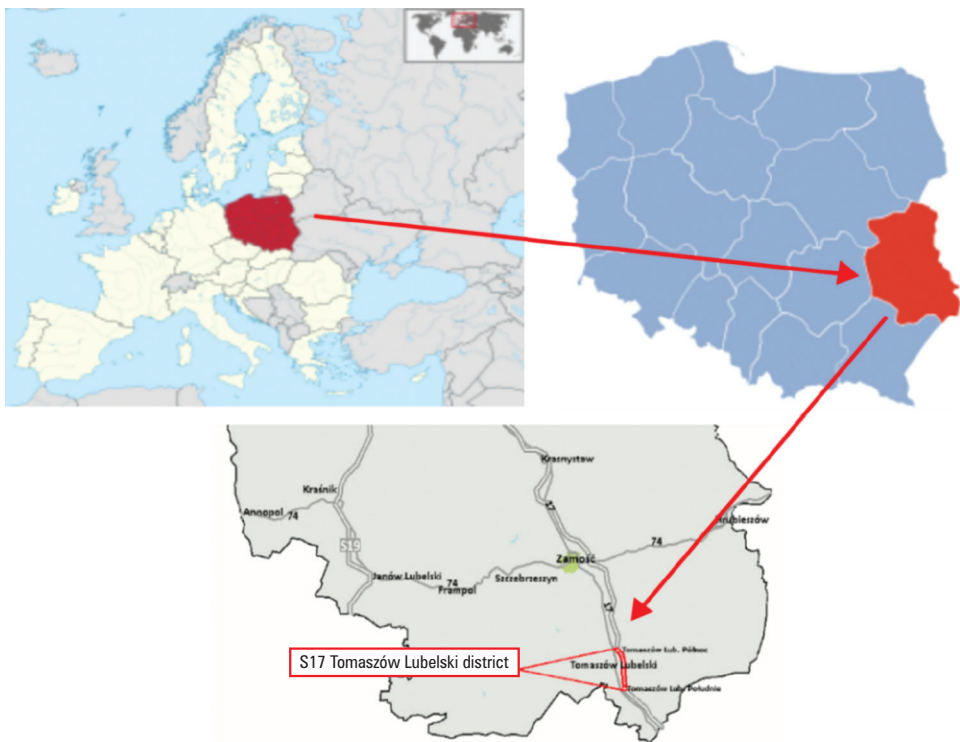
The optimum solution to minimise, or even eliminate, the adverse effects of these investments on rural areas is to implement infrastructural consolidations. Responsibility for guiding and financing this type of work lies with the General Directorate for National Roads and Motorways. There have been studies on the appropriateness of implementing infrastructural consolidations in parallel with or before initiating such investments. Combining a linear investment construction project with an instrument of land consolidation would result in a reduction of investment costs, minimalization of its impact on production space and improvement of arable land accessibility [Leń and Jakimiak 2022]. Therefore it is so important to assess the impact of linear investments on the surrounding areas for each project, and – if necessary – implement measures that minimise the negative impact on the spatial structure of rural areas.

2. Material and methods

The analyses focused on the Tomaszów Lubelski bypass, which is a 9.58 km long section of the S17 Warsaw–Hrebenne expressway. This object crosses the area of five cadastral precincts, i.e. Dąbrowa Tomaszowska, the town of Tomaszów Lubelski, Łaszczówka Kolonia, Łaszczówka and Jeziernia, with a total area of 3991,40 ha, which are located in the eastern part of the Tomaszów Lubelski county (Lubelskie Voivodeship). An important feature of the county's location is that it is in direct proximity to Ukraine and the border crossing at Hrebenne is located within its territory.

Geodetic data were made available by the County Centre for Geodetic and Cartographic Documentation (PODGiK) in Tomaszów Lubelski in 2022. The EGIB

database was obtained – graphical data in the shp format and description data in SWDE format. In the first stage of work, graphical data was combined with description data in order to supplement information regarding individual plots. This was possible by converting cadastral data from the SWDE format into a spreadsheet format, which then was combined with a table of attributes of graphical data in the QGIS 3.24.3 Tiler software. A number of analyses were carried out on the basis of the collected materials and these allowed us to characterise the individual cadastral districts through which the bypass passes in terms of, among other things, the average area of a farm and its number of plots, percentage of plots without road access, percentage of plots by registration units and the number of plots affected by the bypass and their area. A spatial picture of the location of the study area is illustrated in Figure 1.



Source: Authors' own study

Fig. 1. Spatial location of the bypass in Tomaszów Lubelski

3. Discussion

Based on the description data obtained from the PODGiK it was possible to characterise individual cadastral precincts that are crossed by the bypass. These precincts were analysed in regard to their number of plots, the average area of a plot within a farm,

and the number and area of plots without access to roads. Five cadastral precincts were covered by the analyses – four rural precincts and one urban.

Table 1. Cadastral data on individual precincts

| Cadastral precinct | Precinct's area [ha] | Number of registration units | Number of plots | Average area of plot in a farm [ha] | Number of plots without access to roads | Area of plots without access to roads [ha] | Share of plots without access to roads | |
|---------------------------|----------------------|------------------------------|-----------------|-------------------------------------|---|--|--|---------------|
| | | | | | | | Number of plots | Area of plots |
| Dąbrowa Tomaszowska | 127.4451 | 174 | 350 | 0.4727 | 81 | 9.9519 | 23.14% | 7.81% |
| Jeziernia | 1628.8600 | 601 | 1546 | 0.6541 | 64 | 13.9393 | 4.14% | 0.86% |
| Łaszczówka | 636.9441 | 669 | 1649 | 0.4232 | 175 | 13.6679 | 10.61% | 2.15% |
| Łaszczówka Kolonia | 268.7362 | 342 | 697 | 0.4387 | 126 | 9.0695 | 18.08% | 3.37% |
| Town of Tomaszów Lubelski | 1329.4904 | 5219 | 9431 | 0.1186 | 1914 | 65.8761 | 20.29% | 4.95% |

Source: Authors' own study

The Dąbrowa Tomaszowska precinct is the smallest among the studied, consisting of 350 plots belonging to 174 registration units, which gives 1.99 plots per farm on average. Meanwhile, the average area of a plot in a farm is approx. 0.47 ha. Despite its small area, the road infrastructure in this precinct is flawed, because up to 81 plots remain without access to roads, which amounts to almost $\frac{1}{4}$ area of all plots. In terms of the area of plots without access to roads, Dąbrowa Tomaszowska also has the highest percentage.

The next analysed precinct is Jeziernia, which is the largest in terms of area. It consists of 601 plots that belong to 1546 registration units. The average area of a cadastral plot (0.6541 ha) and accessibility to plots is the best in the studied village. Out of 1546 plots, only 64 do not have any access to roads, which is a satisfactory result. The percentage share of plots without access to roads in terms of their number and average areas is low. Thus, it can be deduced that road infrastructure in Jeziernia is developed to a good level, enough to secure free access to plots for as many farmers as possible.

The third studied precinct is Łaszczówka. It is characterised by the highest number of plots, which in relation to the area of the entire precinct results in a low value of the average area of a plot within a farm. Łaszczówka is also distinguished by a significant percentage of plots without access to roads.

Łaszczówka Kolonia is a precinct with the second smallest area. Although it has almost half the number of registered units and the number of plots of Łaszczówka, the

average area of a plot within a farm is similar in both precincts. There are also many plots without road access in Łaszczówka Kolonia (126), which in terms of the total number and area of plots in the precinct gives 18.08% and 3.37%, respectively. This shows that the village struggles with unfavourable road infrastructure.

The last analysed precinct is the town of Tomaszów Lubelski. It has a large area, the most registration units and plots, as well as the largest area and the most plots without access to roads. However, due to the fact that it is an urban precinct, it has the lowest average area of a plot in a farm among the studied precincts.

A summary of the analysis of cadastral data indicates that the most important management problem in this area is the significant number of plots without access to public roads. This is an issue in four out of five precincts. It has negative consequences, e.g. private access roads have to cross agricultural plots, thus reducing their potential for agricultural production. Besides the already existing problem with access to road infrastructure, the situation has been aggravated by the construction of the bypass. A division of existing development by the investment has led to a situation where some plots are surrounded by bypass lanes. In such cases, the owner has no way of accessing the plots.

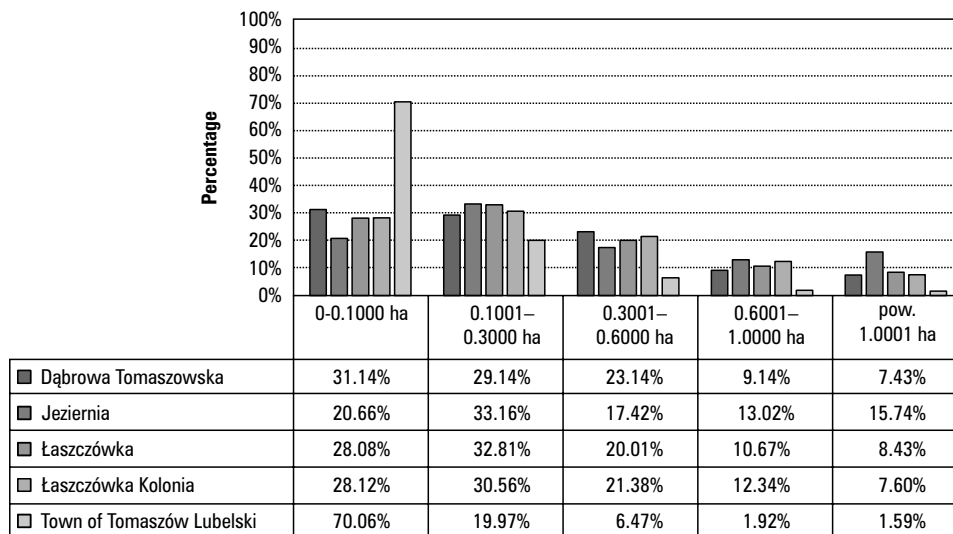
The analysis of cadastral data indicated the problem of land fragmentation, which means that a farm belonging to one owner comprises plots spread over the precinct. This process has been driven by the divisions of previously existing plots between heirs, the intention to sell properties with a smaller area, but also by divisions related to the need to take over the plots for the construction of the bypass. This situation has a negative impact on the spatial structure of the land, but also on the economic aspects of farming, as the farmer's workload has increased due to the lengthening of the access to the plots and thus his working time.

As a result of the construction of the bypass the already existing chequered pattern of land has been exacerbated, making farming difficult. In many cases, the plots belonging to the same owner lie on opposite sides of the expressway. This increases the distance the owner has to travel between the plots. Based on observation of the plots bordering a bypass lane and the plots crossed by a bypass lane, it can be assumed that they were one plot previously, with a more favourable shape or area for the farmer.

The figure below presents a detailed analysis of the area of plots in individual cadastral precincts.

All rural precincts are characterised by a predominance of plots with a small area in relation to the total number of plots. The issue of land fragmentation is particularly evident in Dąbrowa Tomaszowska, where 31.14% of the plots have an area of less than 0.1000 ha. In Jeziernia this indicator presents a much better picture – here, plots with an area between 0.1001–0.3000 ha are predominant, and it also has the highest percentage of plots over 1ha – this category of plots accounts for 15.74%. In Łaszczówka and Łaszczówka Kolonia these indicators are very similar – plots with areas between 0–0.1000 ha and 0.1001–0.3000 ha predominate. The urban precinct of Tomaszów Lubelski is dominated by plots of a very small area. Over 70% of all plots are below 0.1 ha, and almost 20% of plots are in the range between 0.1001–0.3000 ha. It can be concluded that each of the analysed precincts faces a clear problem of land fragmentation.

Percentage of plots with a given area in relation to the total number of plots in a precinct



Source: Authors' own study

Fig. 2. Fragmentation of plots in precincts

The problem of land fragmentation was heavily influenced by the construction of the bypass, e.g. it affected the average area of plots in a precinct. The construction seized, respectively: 65 plots in Dąbrowa Tomaszowska, 232 in Jeziernia, 152 in Łaszczówka, 77 in Łaszczówka Kolonia and 374 in Tomaszów Lubelski. These plots have both irregular shapes, depending on the route of the bypass lane, and small area. Jeziernia has the smallest average surface area of a plot occupied for the construction of an investment, it is only 0.0194 ha. Analysing the values of the average area of a plot of land occupied for the construction of the bypass, it can be noted that the value of the average area of a plot in a precinct has been significantly reduced (Table 2).

Table 2. Statistics on the plots seized for the construction of the bypass

| Cadastral precinct | Registration unit no. | Number of plots seized for the bypass | Average area of plots seized for the bypass [ha] |
|---------------------------|-----------------------|---------------------------------------|--|
| Dąbrowa Tomaszowska | G.160 | 65 | 0.0206 |
| Jeziernia | G.666 | 232 | 0.0194 |
| Łaszczówka | G.612 | 152 | 0.0312 |
| Łaszczówka Kolonia | G.333 | 77 | 0.0459 |
| Town of Tomaszów Lubelski | G.5207 | 374 | 0.0310 |

Source: Authors' own study

In effect of dividing existing plots for the bypass lane there are residual areas. According to the Property Management Act, an *residua* area is a part of a property created by a division, but not seized by a road investment. If part of a property is taken over, but the remaining part is not suitable for proper use for existing purposes, the road manager responsible for the investment is obliged to acquire, that part of the property [Act... 1997]. In most cases the residual areas have been seized by the General Directorate of National Roads and Motorways. However, it has been noticed that some plots with very small area adjacent to the bypass lane belong to owners from the 7 registration group, i.e. natural persons. In such situation there is no rational way of utilising these properties. From economic point of view, cultivating land in such small area is completely unprofitable, so it can be expected that these lands will be set aside. Leaving residual areas with the current owner also causes a financial burden due to agricultural tax. In such cases, the landowner is responsible for paying fees for land that is not farmed.



Source: Authors' own study

Fig. 3. An example of the creation of residual areas

In addition, the studied area is characterised by favourable conditions for agriculture due to the occurrence of soils of good bonitation classes. The municipality is dominated by soils of high classes, with brown soils developed on loess formations, podzolic and pseudo-podzolic soils and rendzina soils. The agricultural potential was reduced by the exclusion of good soils from agricultural production. The land bordering the

bypass strip is mainly arable land with soils of the III and IV classes, i.e. fertile land, useful for agriculture. Moreover, the bypass cuts through forests. It can be assumed that unfavourable changes in the structure of land use were made – part of the forest had to be cut down and the forest plots were allocated for the construction of the investment.

4. Conclusion

Based on the discussed factors, it can be concluded that the construction of the bypass in Tomaszów Lubelski has had a negative impact on the spatial structure of rural areas. The negative assessment is a consequence of the following problems in the studied area:

- obstructed access to roads due to the cutting through the existing plots by the bypass lane,
- change of shape and size of plots causing problems in rational farming,
- excessive fragmentation and dispersion of plots belonging to the same registration unit,
- creation of residua areas (particularly problematic are the residual areas that are not purchased by the State Treasury),
- exclusion of land of good quality classes from agricultural production,
- unfavourable changes in the land use structure.

The above-mentioned problems affecting agricultural areas restrict the rational use of plots and hinder the sustainable and multifunctional development of farms. Research has shown that the spatial structure of neighbouring villages has deteriorated considerably. In the longer term, the consequences of these changes are negative for land management and use, including difficulties in farming, increasing distances to the fields, and thus increasing the work time and workload for the farmer. Therefore, it can be concluded that the construction of a linear investment without prior land improvement works, i.e. land consolidation and exchange, causes significant disorganisation of the agricultural structure in the area. When planning a linear investment that has a negative impact on rural areas, a detailed analysis of the urgency of land management works should be carried out and, if necessary, this process should be combined with the planned investment.

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Inż. Monika Piwko
University of Life Sciences in Lublin
Department of Environmental Engineering and Geodesy
ul. Akademicka 13, 20-950 Lublin
e-mail: monikapiwko842@o2.pl

Dr hab. inż. Przemysław Leń, prof. UP
University of Life Sciences in Lublin
Department of Environmental Engineering and Geodesy
ul. Akademicka 13, 20-950 Lublin
e-mail: przemyslaw.len@up.lublin.pl
ORCID: 0000-0003-0810-9986