

THE IMPACT OF LINE INVESTMENTS ON THE SIZE OF THE PLOT PATCHWORK IN RURAL AREAS – A CASE STUDY

Justyna Wójcik-Leń, Ph.D.

*Department of Surveying and Geoinformatics
School of Engineering and Economics in Rzeszów
Rzeszów, Poland
e-mail: justynaa.wojcik@wp.pl*

Żanna Stręć, M.Sc.

*Department of Environmental Engineering and Geodesy
University of Life Sciences in Lublin
Lublin, Poland
e-mail: zanna.krol@up.lublin.pl – contact person*

Abstract

Motorway construction has a negative impact on the spatial structure of agricultural land in rural areas, which has caused limitations in lifestyle and human work in the fields. Line investments such as a motorway have an actual influence on increasing the distances between plots which are the property of a single owner, dividing plots crossing the designed motorway section, increasing the number of plots, deteriorating the technical infrastructure and the road network or limiting the use of land. The impact of motorway routing was analyzed in southeastern Poland on the A4 motorway section, in Ropczyce-Sędziszów county, which splits the village of Borek Mały into two parts: northern and southern. The agricultural space in the village can be improved through the consolidation and exchange of land. The main goal of land consolidation is creating favourable conditions for agricultural management connected with improvement in the structure of farms, the configuration of land, as well as adaptation of plots to the terrain and the pattern of roads, including motorways. This paper is a continuation of studies aiming to carry out the analyses of the distribution of individual farmland within the internal and external plot patchwork and to determine the size of land that is the property of non-resident owners in the village split by the motorway.

Key words: rural areas, non-resident owners, plot patchwork, village, consolidation, motorway

Introduction

Previous studies have shown that line investments such as a motorway or expressway normally make up a small share in the total area of the village. However, they have an irreversible impact on the spatial structure of land – intersecting groups of plots and splitting plots forming part of a single farm – that following motorway construction is situated on both sides of the village (HARASIMOWICZ, JANUS, 2009), (WÓJCIK-LEŃ, STRĘĆ, 2017). Such investments not only disturb the spatial development of the village but also interfere with the ecosystems as new, foreign elements of land. They have a negative effect on cropland, tree stands, soils, orchards and human health (NOGA, 1996a, 1996b). The above-quoted reasons for degradation of a part of agricultural land depend on the actions or omissions of people who should be the most concerned about increasing the agricultural production space, that is, farmers. However, institutions making infrastructural line investments also have a huge impact on creating small irregular plots often without access whose cultivation or other management is actually impossible or economically unreasonable (JAKIMIAK, LEŃ, 2017).

The development of agriculture in Poland and its production capacity is much differentiated in terms of space. One of the reasons for such a situation is the process of long-term transformations of agricultural management in areas with different social and economic situation continuing for many years (WÓJCIK-LEŃ, SOBOLEWSKA-MIKULSKA, 2017; STAŃCZUK-GAŁWIACZEK, 2017; SOBOLEWSKA-MIKULSKA, STAŃCZUK-GAŁWIACZEK, 2018). Individual farmland is very often located within the plot patchwork so it is scattered between plots forming part of other farms. An internal patchwork is the one where the owner is a resident of the village in which he/she owns land and an external patchwork occurs when the owner is not a resident of the area in which his/her land is situated (NOGA, 1977). In Poland the internal and external plot patchwork is a serious problem, which inhibits building a full value cadastre of real estates in Poland (DAWIDOWICZ, ŻRÓBEK, 2014; MIKA, LEŃ, 2016; MIKA, 2016; MIKA, 2017; LEŃ et al., 2017; HANUS et al., 2018; DAWIDOWICZ, ŻRÓBEK, 2018). This problem is further aggravated by line investments. Studies concerning plot

patchwork show that the problem was present in many regions of Poland, e.g. south-eastern (JANUS, 2018; JASIŃSKA, 2017; LEŃ, 2017a,b,c,e), eastern (NOGA, KRÓL, 2016; KRÓL, LEŃ, 2016; STREK, 2017) and central parts of the country (LEŃ, 2017d, LEŃ et al., 2017). A chance for remedying the discussed situation in rural areas is rural management works allowing comprehensive changes to agricultural space such as consolidation of land.

Routing of A-4 motorway in the area covered by the study

In Ropczyce-Sędziszów county the motorway runs through 8 villages. From the rural commune of Ostrów it intersects the villages: Borek Mały, Kozodrza, Ostrów and Skrzyszów, whereas from the urban-rural commune of Sędziszów Małopolski: Boreczek, Borek Wielki, Czarna Sędziszowska and Wolica Piaskowa. The motorway section passing through the territory of the county is 18.12 km long. In the west it is linked to the rural commune of Dębica, and in the east – to the rural commune of Świlcza. The routing of the motorway is illustrated in Fig.1.



Fig. 1. Routing of A4 motorway in Ropczyce-Sędziszów county.

Source: Data obtained from PODGiK (District Centre of Geodetic and Cartographic Documentation) in Ropczyce.

Table1. Routing of A4 motorway in the analyzed village.

Villages	Northern part of the village (ha)	Southern part of the village (ha)	Motorway (ha)	Length (km)
Boreczek	87.77	150.60	12.88	0.73

Source: Data obtained from the Register of Land and Buildings (EGiB).

Internal plot patchwork

One of the core parameters of the plot patchwork is the location of human dwellings in relation to plots owned by the farm. For economic reasons, the dwelling should preferably be central in relation to other plots. Such an arrangement ensures a proper distance from agricultural land, which contributes to reducing fuel consumption and the farmer's workload (WOCH, 2011). The number of plots per farm depends on the area of the farm, valuation class, the structure of farmland and natural conditions in the specific area. With regard to production economics, a farm should not consist of more than six plots (NOGA, 2006). The specified parameters have an extremely adverse influence on the internal plot patchwork. An excessive number of plots, and in addition their size, shape or scattering, have a negative impact on the farmer's work effectiveness. The internal plot patchwork was analyzed based on a sample of 10% of farms with different technical parameters of soil, all located in the analyzed village. The table presents the number and average area of plots per farm, while the maps illustrate the shape and location of the plots in relation to the dwelling place.

The results of the studies (Table 1) show, using the example of 8 selected farms in the village of Borek Mały, that the farms consist of 3 to 11 plots, with their areas ranging from 1.37 to 4.42 ha. The average plot area is from 0.23 ha for farm no. 4 to 1.47 ha for farm no. 5, which consists of 3 cadastral plots only. Figure 2 indicates that plots in the analyzed village are characterized by very unfavourable geometry and a small area. Plots which belong to farm no. 5 are situated next to one another, forming a broad area. At the same time, it is the largest of all the analyzed farms. Farm no. 8 consists of plots scattered throughout the village. In addition, the plots are narrow and elongated as well as small and unshapely. Five farms have plots

located on both sides of the motorway. It is clear that the routing of the motorway has a destructive effect on farming options in the analyzed area.

Table 2. Farms in the village of Borek Mały.

Farm number	Area (ha)	Number of plots	Average plot area (ha)	Plot numbering
1	1.37	5	0.27	75, 81, 383, 388, 389
2	1.64	6	0.27	239, 250, 255, 376, 378, 379
3	3.64	5	0.73	116/4, 230, 232/1, 350, 395
4	3.03	11	0.28	219/2, 219/3, 244, 248/1, 248/2, 249, 251/1, 251/2, 252/1, 272/1, 375
5	4.42	3	1.47	42, 94, 97
6	1.93	7	0.28	50, 56, 74, 125/4, 162, 164, 306
7	3.28	11	0.30	91, 132/4, 208, 209, 236/1, 263, 335/3, 335/4, 336/2, 363/2, 386
8	1.58	7	0.23	49, 55, 135/4, 145, 147, 322, 409/2

Source: Data obtained from the Register of Land and Buildings (EGiB).

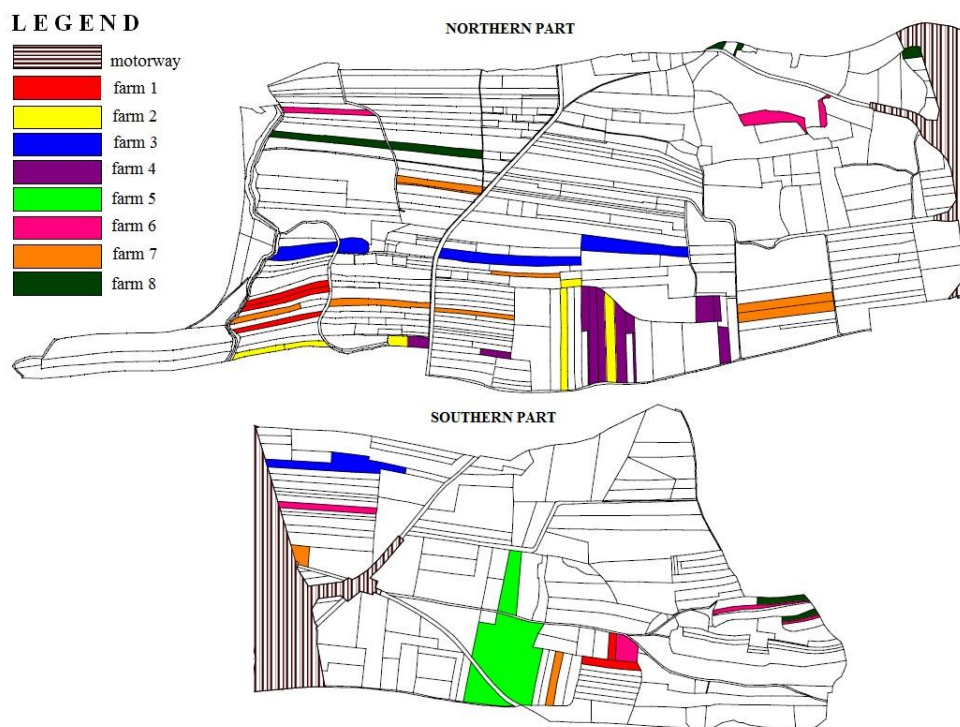


Fig. 2. Spatial distribution of the analyzed farms in the village of Borek Mały.

Source: Own elaboration.

External plot patchwork

The formation of an external plot patchwork is connected with the impact of villages in the commune, county, voivodship and the country. The occurrence of land owned by non-residents is an unfavourable phenomenon generated by inheritance, transfer of land to successors, and thus the division and fragmentation of land (WOCH, 2007). The dimensions of the external plot patchwork are illustrated in Table 3.

The studies showed that land owned by non-residents occupied an area of 105.99 ha, which corresponds to a 45.92% share in land owned by individuals, 119 of whom owned 196 plots accounting for 40.83% of all plots in the private sector. Among resident owners, residents of Borek Wielki own the highest number of plots corresponding to 5.16%, followed by residents of Zdżary – 4.76%. Owners of plots in Borek Mały who are residents of Kozodrza occupy an area of 3.87 ha, whereas those who are residents of Boreczek – 3.81 ha. Other plots are the property of owners living in Ropczyce-Sędziszów county and occupy an area of 11.87 ha, and those owned by owners living in the voivodship account for 6.19% of the area of the analyzed village.

Table 3. External plot patchwork in the village of Borek Mały.

No.	Village	Owners	Area (ha)	% share in total area	Number of plots	% of plots
<i>Villages</i>						
1	Borek Wielki	20	11.90	5.16	22	4.58
2	Zdźary	13	10.99	4.76	18	3.75
3	Kozodrza	9	3.87	1.68	13	2.71
4	Boreczek	5	3.81	1.65	9	1.88
5	Other – county	19	11.87	5.14	25	5.21
6	From the voivodship	5	14.28	6.19	18	3.75
7	Other	3	4.19	1.82	11	2.29
<i>Cities and towns</i>						
8	Ropczyce	20	21.09	9.14	38	7.92
9	Sędziszów Młp.	16	17.33	7.51	28	5.83
10	Rzeszów	4	3.81	1.65	7	1.46
11	Dębica	5	2.85	1.23	7	1.46
Total		119	105.99	45.92	196	40.83

Source: Data obtained from the Register of Land and Buildings (EGiB) in Ropczyce.

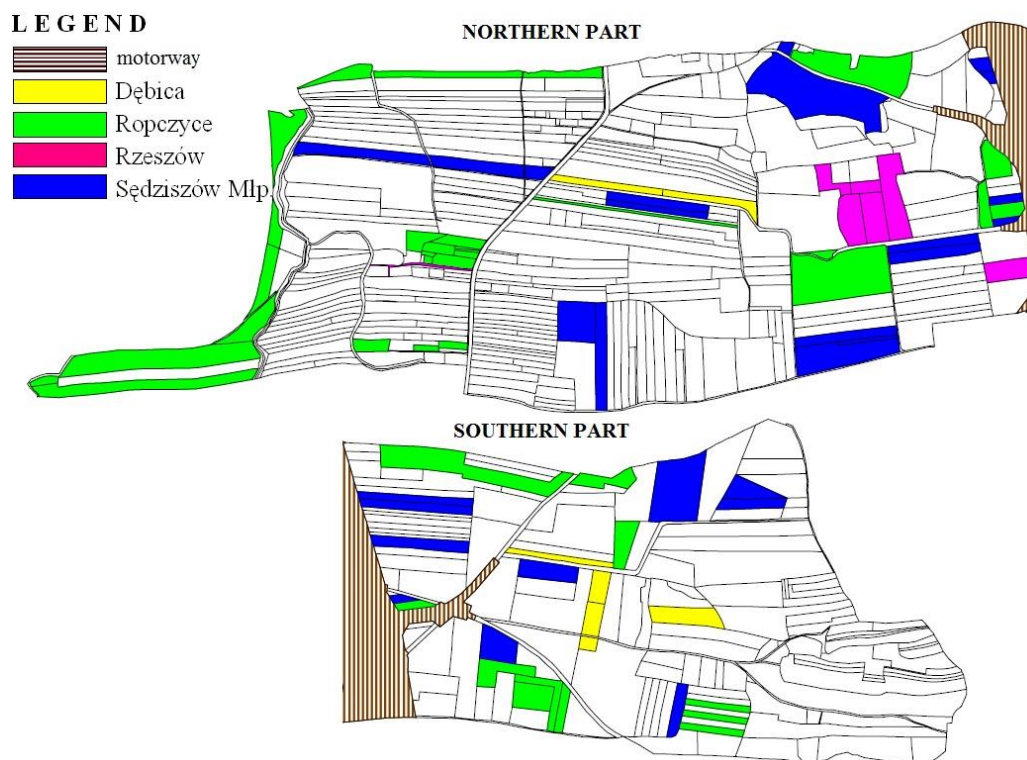


Fig. 3. Spatial distribution of land owned by residents of cities and towns.

Source: Own elaboration.

A high percentage of land in the analyzed village is the property of owners living in the nearby cities and towns: Ropczyce – 21.09 ha, which accounts for 9.14% and Sędziszów Małopolski – 17.33 ha, i.e. 7.51% of the total area of private land. Owners of plots who live in Rzeszów and Dębica have respectively a 1.65 – 1.23% share in the total area of land owned by individuals in Borek Mały. Owners who are residents of Ropczyce own the highest number of plots, accounting for 7.92%. The spatial distribution of land within the external plot patchwork owned by residents of cities and towns is illustrated by Fig. 3. The plots are located on both sides of the village, in different places, and often a few plots are adjacent.

Conclusions

The studies showed that the construction of a motorway had negative effects on the configuration and location of plots in the analyzed villages. The land was split into smaller parts situated on the northern and eastern side of the village, which increased the fragmentation of plots. The internal and external plot patchwork is another problem. Following the construction of a motorway, plots forming part of a single farm are not situated on the same side on which the farmer's dwelling is located. The problem of plots being the property of non-resident owners was aggravated – the percentage of such land in the total number of plots in the village increased. In addition, plots owned by residents of other villages were separated from plots located on the other side of the motorway. The construction of a motorway made access to plots difficult. Despite service roads being built on both sides of the motorway, there are no roads providing access to agricultural land, which increased the cost of access. The presented information illustrates the huge impact of the routing of the motorway on farms.

Therefore, in the first place, land exchange works should be carried out, followed by consolidation works since such works would help eliminate the adverse effects caused by the construction of the A-4 motorway. Such a solution could offer many favourable options for improving the life and work of residents of rural areas.

References

- DAWIDOWICZ, A., ZROBEK, R. 2014. *Analysis of concepts of cadastral system technological development*. In: 9th International Conference Environmental Engineering (9th Icee) - Selected Papers.
- DAWIDOWICZ, A., ŻRÓBEK, R. 2018. *A methodological evaluation of the Polish cadastral system based on the global cadastral model*. Land Use Policy, 73: 59–72.
- HANUS, P., PEŃSKA-SIWIK, A., SZEWCZYK, R. 2018. *Spatial analysis of the accuracy of the cadastral parcel boundaries*. Computers and Electronics in Agriculture, 144: 9–15.
- HARASIMOWICZ, S., JANUS, J. 2009. *Ocena efektów scalenia gruntów w pasie oddziaływania autostrady A-4 we wsi Brzezine (Evaluation of effect of consolidation works in Brzezine village within the area influenced by the A4 motorway)*. Infrastructure and Ecology of Rural Areas, 4: 239–249.
- JAKIMIĄK, M., LEŃ, P. 2017. *Analysis of impact of new road projects on creating areas excluded from agricultural production*. Geomatics, Landmanagement and Landscape No. 2, 83–90.
- JASIŃSKA, E. 2017. *Land use efficiency on example of the transformation of rural properties*. In: The 10th International Conference Environmental Engineering : selected papers : April 27–28, 2017, Vilnius, Lithuania.
- KRÓL, Ż., LEŃ, P. 2016. *Szachownica gruntów indywidualnych wyznacznikiem pilności wykonania prac scalenia i wymiany gruntów (Individual Plot Patchwork: Determination of the Urgency in the Realization of Consolidation and Exchange of Land)*. Infrastructure and Ecology of Rural Areas, II/1: 311–322.
- MIKA, M. 2016. *Proposals for changes in surveying-legal procedures for the needs of cadastre in Poland*. Reports on Geodesy and Geoinformatics, 102(1): 67–77.
- MIKA, M. 2017. *The concept of cadastral tax rates modeling on the example of premise real estates with residential properties in Poland*. Acta Scientiarum Polonorum-Formatio Circumiectus, 16(1): 3–14.
- MIKA, M., LEŃ, P. 2016. *Analysis of the faulty spatial structure of land in the context of assessing the quality of cadastral data in Poland*. 16th International Multidisciplinary Scientific GeoConference SGEM 2016, www.sgem.org, SGEM2016 Conference Proceedings, June 28 - July 6, 2016, Book 2 Vol. 2, p. 91–100.
- LEŃ, P. 2017a. *The ranking destination areas for land consolidation works, due to the size checkerboard land on the example of Białaczów*. In: "Environmental Engineering" 10th International Conference Vilnius Gediminas Technical University.
- LEŃ, P. 2017b. *The size of an external patchwork of fields as an indicator of urgency for land consolidation and exchange on the example of the commune of Lesko*. Journal of Water and Land Development, 33: 107–114.
- LEŃ, P. 2017c. *Wpływ oddziaływania miast na rozmiary występowania gruntów różniczan zamiejscowych na przykładzie wsi gminy Lesko (The impact of cities on the size of external plots of non-resident owners on the example of the commune of Lesko)*. Ecological Engineering, 18(4): 190–198.
- LEŃ, P. 2017d. *The size of the external patchwork of fields as an indicator of the need for land consolidation and exchange in the villages of the commune of Drzewica*. Journal of Water and Land Development, 33: 99–106.
- LEŃ, P. 2017e. *Methodology of hierarization of the work of land consolidation and land exchange*. In: The World Multidisciplinary Earth Sciences Symposium. IOP Conf. Series: Earth and Environmental Science, 95, September 11–15, 2017, Prague.

- LEŃ, P., OLENIACZ, G., SKRZYPCZAK I., MIKA, M. 2017. *Methodology for Assessing the Size and Liquidation of the Outer Patchwork of Land*. In: The World Multidisciplinary Earth Sciences Symposium. IOP Conf. Series: Earth and Environmental Science, 95, September 11-15, 2017, Prague.
- NOGA, K. 1977. *Analiza międzywioskowej szachownicy gruntów na przykładzie wsi położonych w górnym dorzeczu Soły. (An analysis of an inter-village patchwork of land using the example of villages located in the upper basin of the river Soła)*. Scientific Papers of the Academy of Agriculture in Kraków, The Scientific Session Series, 7: 153–170.
- NOGA, K. 1996a (red.) *Group work. Ocena oddziaływania autostrady na grunty rolne i leśne (od Tarnowa do wsch. granicy z woj. rzeszowskim) (Assessment of the impact of the motorway on agricultural and forest land (from Tarnow to the eastern border with the Rzeszow voivodship))*. Maszynopis Zakładu Geodezyjnego Urządzenia Terenów Wiejskich Akademia Rolnicza, Kraków.
- NOGA, K. 1996b (red.) *Ocena oddziaływania autostrady A-4 na grunty rolne i leśne (w granicach woj. rzeszowskiego) (Assessment of the impact of the A-4 motorway on agricultural and forest land (within the boundaries of the Rzeszow voivodship))*. Maszynopis Zakładu Geodezyjnego Urządzenia Terenów Wiejskich Akademia Rolnicza, Kraków.
- NOGA, K. 2006. *Efektywność ekonomiczna scalenia gruntów. Kompleksowe scalenie gruntów rolnych i leśnych oraz jego wpływ na środowisko (Economic efficient of land consolidation. Comprehensive consolidation of agricultural and forestry land and its impact on the environment)*. IUNG-PIB, Puławy. p. 124-142.
- NOGA, K., KRÓL Ź. 2016. *The Patchwork of Land as a Problem Restricting the Development of Rural Areas*. Barometr Regionalny. Analizy i Prognozy, 14(3): 165-173.
- SOBOLEWSKA-MIKULSKA, K., STAŃCZUK-GAŁWIACZEK, M. 2018. *The assessment of the scope of implementation of the idea of multifunctional rural development in land consolidation projects in Poland*. Journal of Agribusiness and Rural Development, 1 (47): p. 81-88.
- STAŃCZUK-GAŁWIACZEK, M. 2017. *Assessment of the Spatial Effects of Land-Consolidation Works Carried out in Poland in the years 2007-2013*. Geomatics and Environmental Engineering, 11(3): 107-115.
- STREK, Z. 2017. *Engineering for rural development analysis of demand for land consolidation in Milejów commune, Łęczna district*. The Proceedings of the International Scientific Conference Engineering for Rural Development, Jelgava, p. 593-599.
- WOCH, F. 2007. *Organizacja przestrzenna gospodarstw rolniczych oraz jej wpływ na efektywność gospodarowania (Spatial organization of agricultural holdings and its influence on the effectiveness of farming)*. IUNG-PIB, Puławy, p. 117-137.
- WOCH, F. 2011. *Efektywność gospodarcza i ekonomiczna scalania gruntów w Polsce (Economic efficiency of land consolidation in Poland)*. IUNG-PIB, Puławy. p. 7-50.
- WÓJCIK-LEŃ, J., STREK, Ź. 2017. *The share of land belonging to non-resident owners in a village intersected by a motorway - case study*. Geographic Information Systems Conference and Exhibition, GIS ODYSSEY 2017: Conference proceedings, 4th to 8th of September 2017, Trento – Vattaro, Italy, p. 427-435.
- WÓJCIK-LEŃ, J., SOBOLEWSKA-MIKULSKA, K. 2017. *Specific features of development of selected agricultural problematic areas in the land consolidation process*. Journal of Water and Land Development, 34: 249–258.
- WÓJCIK-LEŃ, J., STREK, Ź. 2017. *Proposal for Land Consolidation Project Solutions for Selected Problem Areas*. In: The World Multidisciplinary Earth Sciences Symposium. IOP Conf. Series: Earth and Environmental Science, 95, September 11-15, 2017, Prague.