Technical Infrastructure as a Barrier to Rational Land Use in Rural Areas - Case Study of Poland

Natalia SAJNÓG, Katarzyna SOBOLEWSKA-MIKULSKA, Poland

Key words: technical infrastructure, rural areas in Poland, land use.

SUMMARY

Technical infrastructure (civil engineering infrastructure), including among others roads, electricity lines, gas pipelines, and oil pipelines, is a fundamental need of every socially and economically developing country. Socio-economic development results in the implementation of new infrastructure projects, largely concerning rural areas due to the land use structure in Poland.
Positive – quantifiable effects in the form of the existence of the infrastructure are evident at the national and/or regional level. At the local level, however, the effects are negative. This results from the annoyance and nuisance caused by investments and affecting a specific group of people, including expropriation, restrictions on the manner of use, limitations in rational land use, environmental damage, noise nuisance, etc.
The paper aims at the assessment of the impact of technical infrastructure on the conditions of rational land use in rural areas in Poland. Research shows that the scale of limitations and difficulties associated with the presence of technical infrastructure results primarily from the technical parameters of the infrastructure, manner of its occurrence within the boundaries of a given land property and type of land use in question.

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1. INTRODUCTION

Infrastructure constitutes basic facilities and institutions necessary for the functioning of the economy and society (Encyklopedia PWN, 2012). It can be divided into economic infrastructure, covering services in the scope of transport, communication, energy engineering, melioration, etc. (e.g. ports, railway network, power plants, water dams), and social infrastructure, represented by services in the scope of law, security, education and science, culture, social care, health services, etc. (e.g. schools, hospitals, courts, prisons, state administration institutions). In the scope of the former (economic infrastructure), due to its specificity, i.e. long period of implementation, permanence, and technical indivisibility, technical infrastructure is designated. It is a group of basic objects, facilities, and installations such as: roads, bridges, and electricity and telecommunication service networks, necessary for the proper functioning of society and production sectors of the economy (Borcz, 2000).

Rural areas occupy approximately 93.1% of the territory of Poland (GUS, 2017). The land use structure is dominated by arable land, followed by forests, waters, transport areas, residential areas, mining grounds, and fallow land. Due to the linear character of technical infrastructure, i.e. its course through a very high number of properties, all the resulting consequences (including multiple limitations) particularly concern arable land (Kowalczyk et al., 2016; Sajnóg & Sobolewska-Mikulska, 2017a), occupying approximately 60.2% of the territory of the country (GUS, 2017). The infrastructure also largely affects rural landscape which has been subject to quite slow, but constant transformations. According to Hernik, Gawroński and Dixon-Gough (2013), landscape is the most diverse in rural areas.

It should be emphasised, however, that technical infrastructure is a fundamental need of any developing country. Its existence and further development is inevitable. Positive – quantifiable effects of implementation of investments in the form of existence of new roads, electricity lines, oil and gas pipelines are evident at the regional, national, or even international level. Negative effects, however, such as: expropriation, various restrictions on the manner of land use, clearing of trees, landscape damage, or noise are only experienced on the local level. A given public purpose investment, i.e. an undertaking that is usually impossible to avoid, interferes with a very specific group of persons (particularly farmers) that have to bear with a number of nuisances.

The objective of the article is the assessment of the effect of technical infrastructure on the conditions of rational land use in rural areas in Poland. For the purposes of the paper, the analysis covered technical infrastructure constituting so-called transmission devices, i.e. among others: power lines, gas pipelines, oil pipelines, water pipelines, and other similar devices of public purpose, i.e. negatively affecting the spatial conditions and value of properties.

2. LIMITATIONS ON PROPERTIES IN THE SCOPE OF PARTICULAR STAGES OF THE INVESTMENT PROCESS – CONSTRUCTION OF TRANSMISSION DEVICES

Particular stages of the investment process in the scope of construction of transmission devices impose numerous limitations on land properties. Such limitations, depending on their type, restrict the freedom of activity of the owner of the land property in various ways. As a rule, however, they have an economic aspect, because they are related to loss of property.
The investment process involves three main stages:

a) formal-legal stage,
b) construction stage,
c) commissioning and operation stage.

In the scope of the first formal legal stage of the investment, limitations can be distinguished related to:

- change of disposition or manner of management of land resulting from the introduction of the location of the investment project into planning documentation,
- the establishment of transmission easement (limited property right) or issuing an administrative decision limiting the way of use of a land property, constituting two basic legal titles obtained by transmission companies for the purpose of construction and exploitation of transmission devices.

In the scope of the second stage of the "construction", limitations can be distinguished resulting from:

- lack of possibility to use the land property in the construction belt,
- potential deterioration of conditions of use of the land property.

The third stage of "commissioning and exploitation" is accompanied by limitations related to:

- the existence of a transmission device in the space of the land property, resulting from the actual use of the land property by the transmission company,
- the obligation of making the land property available for the purpose of performing maintenance and repair works.

The main stages of the investment process in the scope of construction of transmission devices, as well as determinants of potential limitations and the related compensations are presented in Table 1.

Table 1. The main stages of the investment process in the scope of construction of transmission devices.

STAGES		
FORMAL LEGAL	**CONSTRUCTION**	**COMMISSIONING AND EXPLOITATION**
DETERMINANTS OF POSSIBLE LIMITATIONS		
1. change of purpose of manner of use of land resulting from planning documentation **2. obtaining legal titles by transmission companies for the purposes of the construction and exploitation of transmission devices**	**1. no possibility of use of the real estate in the construction belt** **2. deterioration of conditions of use of the real estate**	**1. existence of a transmission device in the space of the land property** **2. obligation to make the land property available for the purpose of performance maintenance and repair works**
1. The first is the change of disposition or manner of land use resulting from the introduction of the location of the investment project into planning documentation (local spatial development plan or issuance of a decision on the conditions of land development and land management). The limitation is particularly associated with devices with a considerable environmental impact, and can be manifested in the regulation of the disposition of the land property, e.g. from construction to agricultural use. Notice, therefore, that the limitation will not always occur. Such a situation will occur in a case when e.g. given land already was under agricultural use, and the implemented investment project does not introduce changes in the scope. The area disclosed in planning documentation in the scope of which a potential limitation will occur depends on the type of transmission device, its technical parameters, manner of occurrence in relation to the surface area, and environmental impact, including safety of property as well as human health and life. 2. The second limitation results from the necessity of obtaining by the transmission company of a legal title for management of the land property for the purpose of the construction and later exploitation of the transmission device. The limitation will currently always occur, because in Poland since 1975, the application for a building permit is obligatorily accompanied by such a document. Two primary legal forms permitting the construction and then exploitation of transmission devices by transmission companies are currently preferred, (Sajnóg, 2015, Trembecka 2014, 2016): a) transmission easement, i.e. limited property right (Civil Code act, 1964) - involves encumbering the land property for the benefit of the transmission company which intends to construct or who owns the transmission devices, with a right involving the purpose of such devices. Therefore, the said property right can be applicable both to new investments (the construction will be implemented in the future) and to the regulation of the as-is state on the land property – regulation of circumstances (a transmission company constructed a transmission device in the space of another person's land property without holding the relevant legal title to the land in the scope). b) administrative decision limiting the manner of use of the real estate (Real estate management act, 1997) – issued in relation to the need of the construction of transmission devices in the space of the land property. Therefore, it only concerns new (planned) investments. All of the following conditions must be met for the decision to be issued: (i) it must be a public purpose investment; (ii) the real estate limitation must result from the local spatial management plan or decision on the establishment of the location of a public purpose investment; (iii) the forecast conducted with the owner of the real estate concerning obtaining permission for the construction of transmission devices based on an agreement had a negative result.	1. In the scope of the construction stage, a limitation in the form of lack of possibility to use the land property in the construction belt will usually occur. The belt and related nuisances particularly accompany the construction of underground transmission devices. In such a situation, the construction belt is composed of a belt of earthworks, belt of ground deposition, and belt of transport (of materials and equipment) and assembly. 2. In the scope of the construction stage, in relation to the implementation of the investment process in open earthworks, also temporary deterioration of the conditions of use of the land property may occur. The limitation will then result from a prolonged time of transport to the "separated" part of the land property. The permanent character of such a limitation can in turn accompany earth-bound devices such as hot water pipes. In both of the cases, as a rule, such limitations can result in lack of profitability of conducting agricultural production on the separated land or at all	1. A limitation which will always occur in the scope of the third stage results from the actual use of nother person's land property by the transmission company, defined as permanent and physical existence of the device in its space. 2. The second limitation in the scope of the third stage results from the obligation to make the land property available for the purpose of performance of maintenance and repair works. Such a limitation is a consequence of legal titles obtained by the transmission company in the scope of the formal legal stage.
COMPENSATIONS		

1. The remaining limitations which should be associated with so-called planning damage result in entitlement to compensation corresponding to the decrease in the value of the real estate (Act 2003). The payer of the compensation is the commune, whereas in the scope of the arrangement prepared earlier the transmission company usually undertakes to reimburse the costs incurred by the commune. The methodology of the estimation of the value of the planning damage was described among others by Konieczny and Kowalczyk (2014) and Sajnóg (2015), pointing out that the estimation should be determined based on the state of the subject of the valuation as at the date of occurrence of the damage, and prices as of the date of determination of the compensation. 2. For the established transmission easement, the owner of the land property is entitled to remuneration payable on a one-off basis or cyclically, resulting from the provisions of the civil code act (1964). The remuneration results from the shared use by the transmission company of another person's land property defined as the existence of a device in the space of the land property and use of land for the purpose of performing exploitation and repair works. Notice, however, that the limitation itself occurs already at the moment of establishment of the legal title (transmission easement), and not actual construction and functioning of the device in the space of the land property. The established legal title as a limited property right encumbers the entire land property, although it is executed in a specified scope. Therefore, it contributes to a reduction of the value of the real estate, eventually corresponding to the value of the established right (Konieczny, 2012; Sajnóg, 2015). The administrative decision limiting the manner of use of the real estate - oblige the investor to pay compensation for any potential damage caused in the land property during the construction of transmission devices, and for a potential reduction of the value of the land property. They are also obligatory for the investor in the scope of compensation for damages which may result in the future in relation to making the land property available for the purpose of performance of maintenance and repair works. "The value of the damage" should be determined based on the state of the object of valuation as at the date of its occurrence, and prices as of the date of determination of the compensation.	1. In the construction belt, damages will occur in component parts of the land property and in benefits from the land property for which compensation is due. The compensation, depending on the obtained legal title, will result from two different legal provisions. In the case of transmission easement, it will results from the Civil Code act (1964), and it should not be identified or considered in the estimation of the value of the compensation for common use of the real estate, and in the case of an administrative decision limiting the manner of use of the land property, from the real estate management act (1997). 2. For potential damage resulting from the limitation, including a reduction of the value of the land property, the owner is entitled to compensation pursuant to two different acts (analogically as in the case of limitation related to the lack of possibility to use the land property in the construction belt).	1. All property equivalents resulting from such a limitation are already considered at the formal legal stage, i.e. in the scope of the legal title obtained by the transmission company – transmission easement or administrative decision limiting the manner of use of the land property. 2. Compensation is due for any damage related to making the land property available for the aforementioned purposes, and a potential reduction of the value of the land property. Such compensation is estimated and determined after its actual occurrence. The obligation of payment of the cash equivalent results from two different acts, analogically to the case of the damage described earlier. In the case of lack of consent of the owner of the land property to perform maintenance and repair works and remove failures, with the previously determined legal title – transmission easement, the starost can issue an administrative decision obliging for making it available pursuant to the act on real estate management. Then, the estimation and payment of compensation also result from the legal provision (Act 1997).

Source: Own elaboration, based on Sajnóg & Sobolewska-Mikulska (2017b)

3. EFFECT OF TRANSMISSION DEVICES ON THE CONDITIONS OF RATIONAL USE OF ARABLE LAND IN POLAND

In the scope of the discussed issue, limitations resulting from permanent and physical existence of a transmission device in the space of a land property are of key importance. The limitations particularly depend on the following criteria:

1. Type of transmission infrastructure
2. Its occurrence in reference to the ground surface
3. Parameters of transmission infrastructure
4. Purpose of the property/land use in the property
5. Course of infrastructure running through the property

Re.1. Transmission devices are defined as devices used for the supply or collection of liquids, vapour, gas, electricity, and other similar devices. It is a division by the criterion of function. They particularly include: overhead power lines, gas pipelines, oil pipelines, cable power and signalling lines, telecommunication lines, water supply pipelines, sewage pipelines, heat distribution pipelines.

Re. 2. Transmission devices can be divided by location towards the ground surface:

- underground, i.e. located under the ground surface, or on the bottom or under the bottom of a water reservoir or river,
- on-ground, i.e. located on the ground or above ground with the distance from the ground surface preventing use of the ground,
- overhead, i.e. suspended above ground in a way permitting the use of land for purposes other than those related to transmission.

Table 2. Division of transmission devices by the criterion of function and occurrence towards ground surface.

TRANSMISSION DEVICES		
Underground	**On-ground**	**Overhead**
heat distribution pipelines	heat distribution pipelines	Power lines
oil pipelines	gas pipelines	telecommunication lines
gas pipelines	volumetric objects related to the transmission and sitribution of media	other
sewage pipelines	other	
water supply pipelines		
cable power lines		
cable telecommunication lines		
collectors		
other		

Source: Own elaboration.

Re. 3. The type of a transmission device determines its technical parameters. For example, for gas pipelines and oil pipelines they are maximum working pressure and nominal diameter, and for power lines nominal voltage.

Re. 4. Depending on their type and parameters, transmission devices can be accompanied by the so-called area of impact of the object, i.e. an area designated in its vicinity introducing

limitations related to the object in its land use. In Poland, the area should be designated based on legal provisions. The analysis of the provisions shows that next to the type of the device and its technical parameters, the range of the area should particularly depend on the land use (built-up areas, arable land, forests). For example, for gas pipelines, the range of limitation in the form of ban on construction is surprisingly the greatest for arable land (class III of land location).

Table 3. Minimum distances from the axis of a steel gas pipeline to buildings depending on the land location class.

No.	**Maximum working pressure /nominal diameter**	**LAND LOCATION CLASS**		
		I- land built-up with multi-family residential buildings	II- land built-up with single family and homestead buildings	III – unbuilt land (including arable land)
		Distance from the axis of the steel gas pipeline to buildings [m]		
1	0.5<MPa≤1.6	1.0	2.0	3.0
2	1.6<MPa diameter 150≤DN	2.0	4.0	6.0
3	1.6<MPa diameter 150<DN≤300	3.0	6.0	9.0
4	1,6<MPa diameter 300<DN≤500	4.0	8.0	12.0
5	1.6<MPa diameter 500<DN	6.0	12.0	18.0

Source: Own elaboration, based on Regulation (2013).

In the case of overhead power lines, the area of their impact particularly depends on the noise level and generated electromagnetic field.

Tables No. 4 and 5 present physical parameters characterising the effect of electromagnetic fields on the environment and their acceptable levels, respectively for areas designated for residential building development and for areas accessible for the public.

Table 4. Acceptable levels of physical parameters characterising the electromagnetic field for frequencies of the electricity network for areas designated for residential building development.

Range of frequencies of the electromagnetic field	Electric component	Magnetic component
50 Hz	1 kV/m	60 A/m

Source: Own elaboration based on Regulation (2003).

Table 5. Acceptable levels of physical parameters characterising the electromagnetic field for frequencies of the electricity network for places accessible for the public.

Range of frequencies of the electromagnetic field	Electric component	Magnetic component
from 0.5 Hz to 50 Hz	10 kV/m	60 A/m

Source: Own elaboration based on Regulation (2003).

According to the above tables, for frequencies of electricity networks (the highest voltages of 220-400 kV) amounting to 50 Hz, the threshold value of the amperage of the magnetic component of the electromagnetic field both for areas accessible for people and those designated for residential building development equals 60 A/m. Differences occur in threshold levels of the electric component which for areas designated for residential building development should not exceed 1 kV/m, and for places accessible for the public 10 kV/m.
According to Szuba (2008) in reference to overhead electricity transmission lines, the issue to resolve remains the threshold value of 1 kV/m, because in Poland all lines are designed in a way to avoid exceeding the value of 10 kV/m for the electric component (Fig. 1) and 60 A/m for the magnetic component (Fig. 2) in any place accessible for the public.

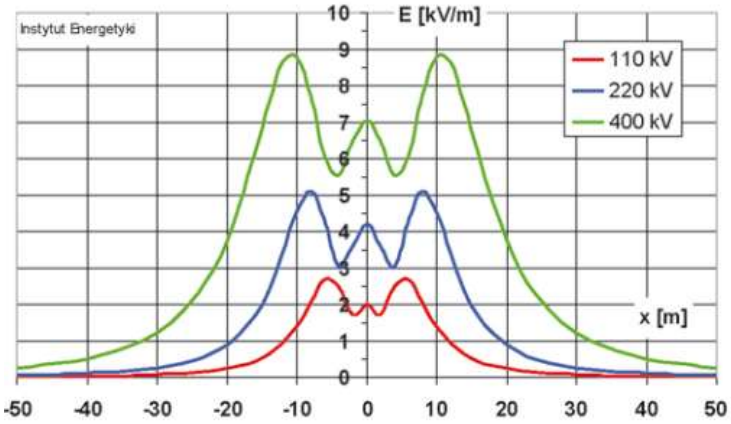

Fig. 1. Example distributions of the electric field in the surroundings of high voltage electricity transmission lines.
Source: Różycki (2011).

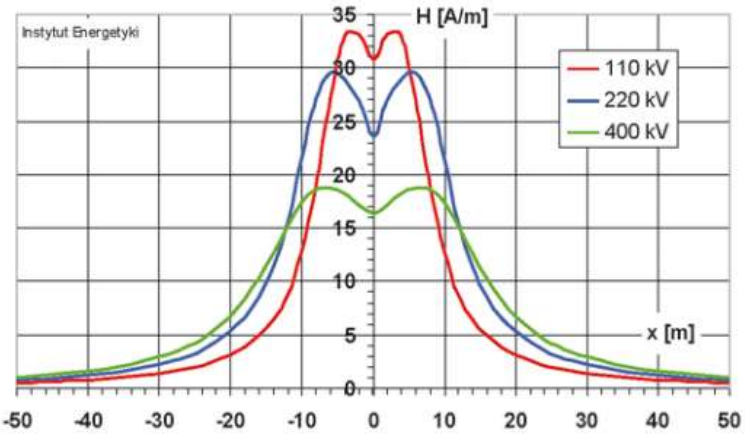

Fig. 2. Example distributions of the magnetic field in the surroundings of high voltage electricity transmission lines.
Source: Różycki (2011).

According to the Regulation (2007), the acceptable level of noise is only subject to a norm for built-up areas. Legal provisions do not regulate threshold values of noise level for agricultural and forest areas.
Re. 5. Finally, the factor considerably affecting rational land use is the course of the device running through the property. The criteria discussed earlier remain important of course, namely the type of device, its occurrence towards ground surface, technical parameters, and area of impact of the object. It is the course of the device, however, that can determine whether, in an extreme case, additional land (outside of the area of impact of the object) will be excluded from current land use (Fig 3c).

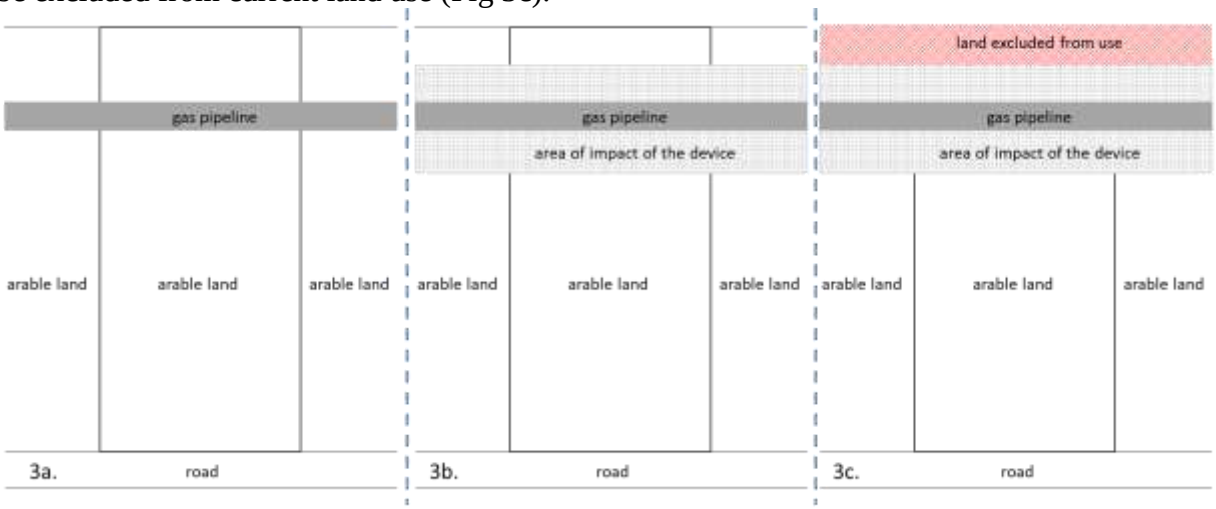

Fig. 3. Examples of a gas pipeline running through the property with possible limitations. Source: Own elaboration

4. CONSLUSIONS

According to the article, at each of the three stages of the investment process involving the construction of transmission devices, the owner of the land property in the space of which the investment is implemented is subject to limitations. Such limitations have different character (permanent, temporary), and different economic aspect.
At the stage of the functioning of the device, the accompanying limitations are of permanent character, i.e. they are particularly strenuous, and involve the physical existence of the device in the space of the property as well as additional bans and obligations such as: ban on construction in the area of impact of the object, ban on planting high trees, or obligation to make the property available for repair and maintenance of the device. Therefore, the type and range of limitations particularly results from: the type of transmission device, its technical parameters, occurrence towards ground surface, purpose of the property (its land use), and course of the device running through the property. As evidenced, the latter factor can cause additional nuisances, potentially resulting in the exclusion of the property from its current use, or lack of possibility of rational land use in its specified part.

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BIOGRAPHICAL NOTES

Natalia Sajnóg, Ph.D. eng. - Assistant Professor, valuer appraiser. Research interests: real estate appraisal, spatial development, real property management, transmission infrastructure, transmission servitude, cadastre, sustainable development of rural areas. Author and co – author of academic monographs, academic papers, scietific expertises. Member of: Warsaw Association of Certified Property Valuers, Association for the Development of Rural Areas, Association of Polish Surveyors, Scientific Real Estate Association.

Katarzyna Sobolewska - Mikulska - Associate Professor at the Warsaw University of Technology. Research interests: cadastre, sustainable development of rural areas special land consolidations process in sustainable and development aspects, real estate appraisal, spatial development, real property management, transmission infrastructure. The supervices of four for completed and defended doctoral theses in this areas. The boss of Department of Cadastral and Land Management and Post-Graduate Studies in Rural Development and Valuation of Property at the Warsaw University of Technology's Faculty of Geodesy and Cartography. Member of: the Section of Geoinformatics of the Committee on Geodesy of the Polish Academy of Sciences PAN, the Polish Real Estate Scientific Society, deputy Chair, the Rural Development Society. Author and co – author of academic monographs, academic papers, scietific expertises and expersts.

CONTACTS

Natalia Sajnóg, Ph.D. eng.
Warsaw University of Technology
Faculty of Geodesy and Cartography
Department of Cadastre and Land Management
Sq. Politechniki 1
Warsaw
POLAND
Tel. +48 22 234 75 89
Email: natalia.sajnog@pw.edu.pl

Katarzyna Sobolewska-Mikulska, Associate Professor
Warsaw University of Technology
Faculty of Geodesy and Cartography
Department of Cadastre and Land Management
Sq. Politechniki 1
Warsaw
POLAND
Tel. +48 22 234 75 89
Email: katarzyna.mikulska@pw.edu.pl