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EFFECT OF LINEAR INVESTMENT ON AGRICULTURAL USES ON THE BASIS OF VALIDITY OF ESTIMATED COMPENSATION

Purpose. *The work takes up topic with the impact of gas pipeline investments in the agricultural space. The reduction in the productivity of agricultural areas is felt by farmers already at the stage of investment construction (loss of benefits, reduction of property value, additional costs for biological reclamation). The purpose of the article is to determine the impact of the high-pressure gas pipeline by open trench method on agricultural land on the basis of estimated compensation. Estimating the value of compensations for field crops and reducing yield and biological reclamation as an issue that raises many doubts. Determining the appropriate compensation for losses incurred in field crops, due to temporary partial occupation of the area is often a matter definitely resolved in civil proceedings by the court.*

Methodology / approach. *The research was supposed to answer the question whether the unit cost of biological reclamation after the installation of the high pressure gas pipeline depends on the type of use and the type of crops being cultivated. Assumed, among others that the decrease in the value of benefits (yielding of plants) is higher, the higher the soil quality class and that the decrease in the value of the property depends on the type of soil valuation class. Determination of the gas pipeline impact of the high-pressure line investment is presented on the example of the 34 km section of the gas pipeline, running through the villages of Zawonia and Długołęka communes, ie Budczyce, Byków, Cielętnik, Czeszów, Kamieniec, Krakowiany, Michałowice, Pęciszów, Piecowice, Tarnowiec, Zaprężyn, and Zawonia (areas located in the Lower Silesia Voivodship).*

Results. *As a result of the conducted research, it was established on the basis of the estimated compensations that the cost of biological reclamation after building the high pressure gas infrastructure does not depend on the type of use and the type of crops being cultivated. It was also found that the decrease in the value of benefits (yielding of plants) is all the greater, the higher the soil quality class.*

Originality / scientific novelty*. The study looked for the answer to the question: Does the unit cost of biological reclamation after the implementation of the high-pressure gas pipeline depend on the type of use and type of crop being cultivated. It was assumed that the decrease in the value of benefits (yielding of plants) is all the greater, the higher the soil quality class and that the decrease in value of benefits (yielding of plants) depends on the type of cultivation per 1 m^2. It was also assumed that the decrease in the value of the property depends on the type of soil valuation class. For the purposes of the study, the authors collected data indicating the value of compensation, including to the size of the surface.*

Practical value / implications. *Determination of the impact of high pressure gas pipeline construction using the open trench method on agricultural land on the basis of compensation paid indicates that the reduction in the value of benefits depends on the type of crops.*

Key words: *compensation for the implementation of the gas pipeline, compensation for the reduction in yield, costs of biological reclamation, estimated value of compensation for the foundation of gas infrastructure.*

Introduction and review of literature. The impact of investments related to the construction of DN1000 gas pipelines on agricultural diameters is different, at individual stages of the investment process. About the investment and construction process [1], as a sequence of planning, design, technical and construction activities or activities that make up the construction of the building, its operation and decommissioning [2]. Construction of underground line investments is associated with significant economic expenses. According to Zwierzchowska [3] in general, costs occurring during the construction of underground pipelines can be divided into two groups: investment and additional. Among the investment costs are listed, among others costs related to planning, designing and supervision also remuneration for contractors, subcontractors and suppliers. The second group of costs – additional costs, includes, among others compensation for property owners and damaged areas, and for profit losses resulting from temporary restriction of access through work. In addition, social costs can also be mentioned in this group [4; 5; 6] – costs resulting from the destruction of the natural environment (noise, vibrations, air pollution).

Criteria taken into account during comparisons in the method of multi-criteria decision making Analytic Hierarchy Process (AHP) are: technical costs, economic costs, social costs, ecological costs. Criteria are described in more detail in the publication [7].

It should be stated, that the factor determining the implementation of planned investment intentions is the economic viability of investments broadly understood. The investment also includes damages paid for damages incurred as a result of the construction of the gas pipeline in agricultural areas. The construction of high-pressure gas pipelines is of strategic importance for the energy security of the whole country and for the development of the Lower Silesia region. Along with technological and technical progress, the economic and economic effects of agricultural production depend on anthropogenic factors [8].

The research analyzed the impact of network implementation using the open trench method for agricultural lands. As established in the previously published studies [7], the open excavation method is mainly used in agricultural areas. The width of the assembly line in the case of the gas pipeline is 30–33 m or less, depending on the terrain conditions. The technology of making the excavation requires removal of the humus layer and putting it outside the work zone. The removed humus is stored separately from the remaining soil from the excavation. Humus is stored within the assembly belt in a way that allows its use for reclamation work. After completion of the construction, the excavation is covered with layers, and the top layer is the humus deposited earlier.

Restoration of the biological properties of the ground to the state before the construction works. Is a process that requires resources, time and often does not meet the expectations of the land user. In such a situation, the person who is entitled to the real estate (owner, perpetual usufructuary) is entitled to compensation for property damage arising, among others, in connection with the implementation of the line investment and its temporary occupation of the area.

Compensation in Polish legislation is a benefit due in cases specified by law or

contract with an entity that suffered damage. The word compensation is in Polish the word damage and it is used in relation to property damage [9]. The damage to property is limited only to losses that have occurred against the will of the aggrieved party [10].

Compensation should correspond to the value of the damage suffered and should be the difference between the value of the property before the construction of the device and the value of the property after its construction [11]. The extent of damage results from the type and area of restrictions on the use of real estate [12].

Compensation determined by way of administration for limiting the use of real estate may relate only to the area of attachment of the property indicated in the decision authorizing the attachment [13]. The extent and scope of damage depends on:

1. Duration of investment.
2. Real estate function specified in planning documentation.
3. Condition of real estate development.
4. Technical infrastructure parameters.
5. Technical aspects of the infrastructure, etc.

If compensation is paid in accordance with the rules applicable to expropriation, the market value of the property is determined as at the date of the decision approving the division of property and according to market prices as at the date of the decision determining the compensation [14; 15].

The aforementioned elements of assessing the value of real estate are key, as compensation takes the form of compensation for the loss of ownership and perpetual usufruct, which determine the coefficients of the state of the property [16]. In determining the amount of compensation, it is required to provide the scope of expropriated property based on the local plan in accordance with art. 15 ust 2 pkt 1 u.o.p.z.p [17; 18].

Compensation may be associated with a temporary reduction in soil biological activity, and thus a temporary reduction in yield in agricultural areas. The weight of the construction and transport equipment moving along the assembly line and the storage of materials used for the construction of the gas pipeline (mainly pipes) may lead to soil compaction, which results in a structural breach. In areas of arable land it may also lead to deterioration of soil structure and reduction of its biological activity (compensation for biological reclamation).

The purpose of the work is to determine the impact of the high-pressure gas pipeline by open excavation method on arable lands on the basis of compensations paid. The research was based on the estimated value of compensation due to landowners or perpetual usufructiaries of real estates located along the route of the construction of the gas pipeline for actual damages.

The purpose of the article. During research, the high-pressure gas pipeline impact was analyzed using the open excavation method for agricultural lands. In accordance with the provisions of the Act of 3 of February 1995 on the protection of agricultural and forest land [19] agricultural land is divided into arable and wasteland. Agricultural land includes: arable land, orchards, permanent meadows, permanent pasture, built-up agricultural land, land under ponds, suburban land, tree-lined land

and shrubbery on agricultural lands.

The research was carried out during the construction of a high-pressure gas pipeline along the route from Czeszów to Kiełczów, from ZZU Czeszów in the municipality of Zawonia to ZZU Kiełczów in the commune of Długołęka, in the Lower Silesia Voivodship. The investment project involved the construction of a 34 km high-pressure gas pipeline with technical parameters, i.e. with a diameter of 1000 mm, for the MOP medium pressure of 8.4 MPa (Fig. 1).

The investment area ran through areas qualified, among others as: Class II to VI (Ar) arable land, Class IV – V (M) permanent meadows, forests and forest land (F), roads (Rd) and ditches (D), different areas (Di), wasteland (W), inland flowing waters (In), wooded and bushy land (Wo), other built-up areas (Bu), industrial areas (Ind), railways (Ra). The vast majority of the gas pipeline runs through the areas of agricultural land in the communes of Zawonia and Długołęka.

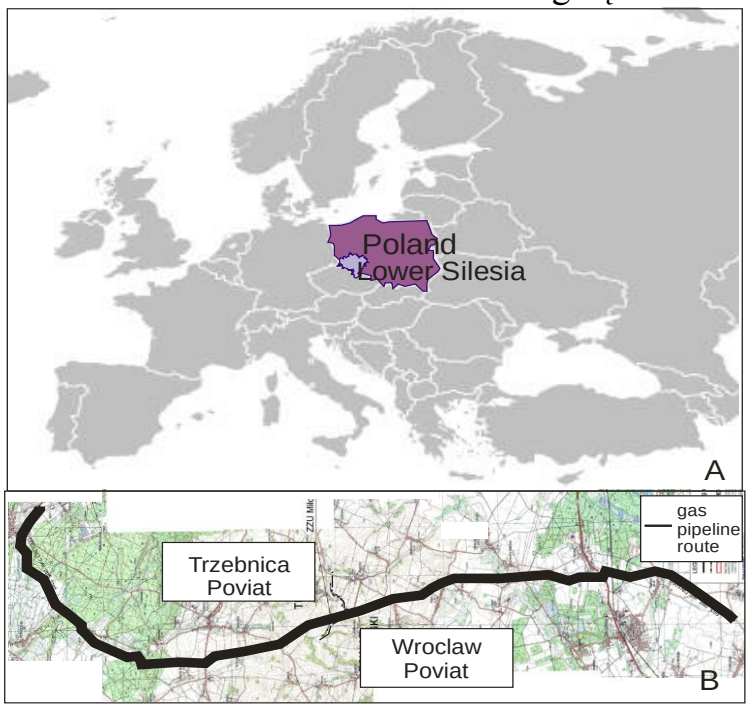

Fig. 1. (A) Location of the area in Poland
(B) The route of the gas pipeline along the ZZU Czeszów - ZZU Kiełczów route
Source: own study by the authors.

In terms of their suitability for agricultural production, the area of Zawonia commune is divided into lighter soils – worse IV–VI bonitation classes (these are soils belonging to the complex of very light and light rye soils) and the compact soil areas of the II–IV bonitation class. The largest area is taken up by brown soils, podzols, mady and organic soils. Within the brown and podzolic soils there are complexes of good and very good wheat arable soils, very good and weak rye soils. The area of the Długołęka commune is one of the areas with high concentration of agricultural land, where arable land covers over 82 % of agricultural land, of which over 50 % is arable land I–III of the bonitation class, about 30 % arable land is medium-quality bonitation soil (class IVa and IVb) the rest are soils intended for afforestation, where the wheat complex predominates over the rye complex.

Prevailing soils in the most part pseudopodous soils, black soils and muck soils occur in small areas, most often in field depressions.

For the purpose of the work objective, basic information on the property occupancy for the purposes of gas infrastructure implementation, area occupied by the investment, crop type, site valuation for the investment, estimated property value reduction, damage incurred during temporary construction work, building values and equipment were collated, loss of income during the construction works, temporary reduction of benefits, renewal of green use (meadows), biological reclamation, compensation for the foundation of above-ground infrastructure, compensation for the provision of real estate. Detailed data were collected for a total of 100 midwives properties along the route of the network.

In order to obtain an answer to the question asked and to verify assumptions, statistical analyzes were carried out. The difference in the results measured on a quantitative scale between more than two groups was checked using the Kruskal-Wallis test. For post hoc testing, a multiple-rank comparison test was used. Correlations between variables were verified using the Spearman correlation coefficient. This coefficient takes values from +1 (strong positive correlation, with the increase of one variable, the second variable increases), through 0 (no correlation) to -1 (strong negative correlation, increase in the value of one variable, was related to the decrease in the second variable). In statistical analyzes, the significance level $p = 0.05$ was assumed. Analyzes were made using the SPSS program.

Results and discussion. In the course of the research, it was assumed that the unit cost of biological reclamation after the construction and thus the biological reclamation of agricultural land after the construction of a linear investment of the high pressure gas pipeline depends on the type of use and the type of crops cultivated (per 1 m^2). Based on the observation of observations, it was found that the average cost of reclamation, per 1 m^2, was 0.77 PLN, with a standard deviation of 0.52 PLN. At least half of the costs did not exceed 0.52 PLN, 0.52 PLN was also the most frequently appearing value. The distribution of costs ranged from 0.0 PLN to 20 PLN (Table 1).

Table 1

Measures of central tendency and dispersion. The cost of biological reclamation per 1 sq m in PLN

Specification	Statistical measures					
	M	SD	Me	Do	Min	Max
The cost of reclamation	0.77	0.52	0.52	2.12	0.00	20.00

Note. M – mean, SD – standard deviation, Me – median, Do – dominant, Min. – minimum value, Max. – maximum value.

Source: own study by the authors.

Correlation analysis did not show statistically significant correlations between the cost of reclamation and the value of the bonitation class ($p = 0.766$) – Table 2.

In order to determine the costs of reclamation, depending on the cultivation conducted, the type of cultivation was determined during the investment. On the route of the completed gas pipeline, most often wheat was grown (31 %), rarely

triticale (9 %), oilseed rape (9 %).

Table 2

Spearman's rank correlation coefficient values. The relationship between the cost of reclamation and the soil quality class

Specification	Statistical measures	Bonitation class
The cost of reclamation	Correlation coefficient	0.030
	Significance (two-sided)	0.766

Source: own study by the authors.

A large percentage of real estate did not grow at all (32 %) (Fig. 1).

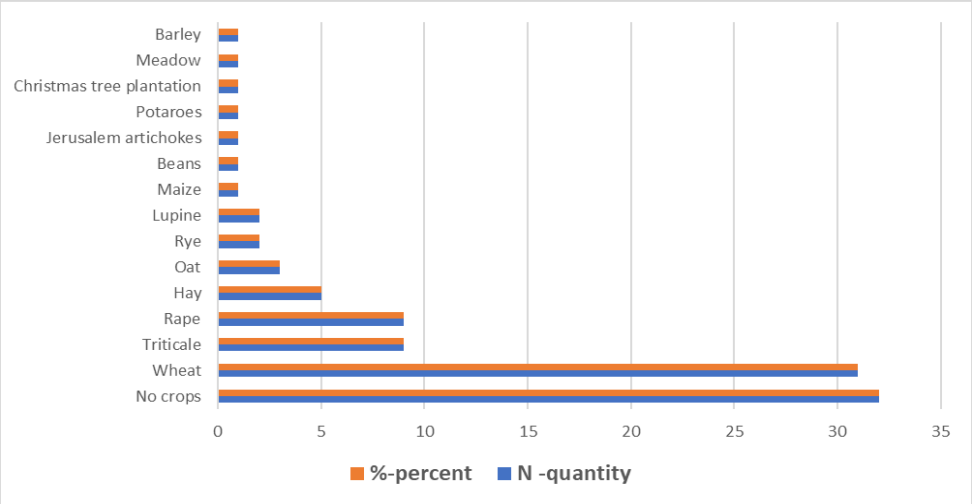

Fig. 1. Cultivation carried out on the route of the construction of the gas pipeline

Source: own study by the authors.

The highest unit cost of reclamation was incurred for faba bean (8.97 PLN), a full list of costs is presented in Table 3.

Table 3

Unit cost of biological reclamation divided into crops

Type of crop		The unit cost of biological reclamation		
		N	M	SD
Crops	Faba beans	1	8.97	.
	No crops	32	1.08	3.52
	Hay	5	0.56	0.05
	Rye	2	0.55	0.02
	triticale	9	0.52	0.00
	Maize	1	0.52	.
	Rape	9	0.52	0.01
	Oat	3	0.52	0.00
	Lupine	2	0.52	0.00
	Christmas tree plantation	1	0.52	.
	Meadow	1	0.52	.
	Barley	1	0.52	.
	Wheat	31	0.50	0.09
	potatoes	1	0.50	.
	Jerusalem artichokes	1	0.03	.

Note. N – number, M – mean, SD – standard deviation.

Source: own study by the authors.

Statistical analysis using the Kruskal-Wallis test did not show statistically significant differences in the cost of reclamation between groups separated by the type of crop (p = 0.496) in Table 4.

Table 4

Cost of reclamation divided into crops

Crops	M	SD
No crops	1.08	3.52
Lupine, faba bean, maize, Jerusalem artichoke, rape	1.09	2.27
Meadow, hay	0.56	0.05
Rye, triticale, wheat	0.50	0.08
Oats, barley	0.52	0.00
Kruskal-Wallis test	$\chi^2 = 3.38$; $p = 0.496$	

Note. M – mean, SD – standard deviation.

Source: own study by the authors.

Decreasing the value of benefits (yielding plants). The average reduction in value of benefits per 1 m^2 was 0.17 PLN, with a standard deviation of 0.32 PLN. The distribution of values ranged from 0.0 PLN to 2.84 PLN per square meter (Table 5).

Table 5

Measures of central tendency and dispersion. Decrease in the value of benefits per 1m^2 in PLN

Specification	Statistical measure					
	M	SD	Me	Do	Min.	Max.
Decrease in value of benefits	0.17	0.32	0.10	0.00	0.00	2.84

Note. M – mean, SD – standard deviation, Me – median, Do – dominant, Min. – minimum value, Max. – maximum value.

Source: own study by the authors.

There was a statistically significant relationship between the decrease in the value of benefits and the value of the bonitation class (p < 0.001). The better the quality of soils, the greater the decrease in the value of benefits (Table 6).

Table 6

Spearman rank correlation coefficient values. The relationship between the decrease in value of benefits and the soil quality class

Specification	Statistical measure	Bonitation class
Decrease in value of benefits	Correlation coefficient	-0.430
	Significance (two-sided)	<0.001

Source: own study by the authors.

In comparison with other usable values (2.84 PLN per 1 m^2), for all eligible values were higher, a full list is presented in Table 7.

Statistical analysis using the Kruskal-Wallis test showed a statistically significant difference in values between particular crop types (p = 0.001). Further post hoc analysis, that the cultivations of lupine, faba bean, maize, etc. (the highest decrease in value) were significantly different from meadows (p = 0.023) and from land without crops (p = 0.021) (Table 8).

Table 7

Decrease in value of benefits broken down into crops

Type of crop		Decrease in value of benefits		
		N	M	SD
Crops	Faba beans	1	2.84	.
	potatoes	1	0.24	.
	Rape	9	0.20	0.08
	Wheat	31	0.18	0.18
	Maize	1	0.16	.
	Christmas tree plantation	1	0.15	.
	No crops	32	0.14	0.22
	triticale	9	0.11	0.15
	Lupine	2	0.11	0.13
	Meadow	1	0.10	.
	Barley	1	0.09	.
	Hay	5	0.02	0.03
	Jerusalem artichokes	1	0.02	.
	Rye	2	0.01	0.01
	Oat	3	0.01	0.01

Note. N – number, M – mean, SD – standard deviation.
Source: own study by the authors.

Table 8

Decrease in value of benefits broken down into crops

Crops	M	SD
No crops	0.14	0.22
Lupine, faba bean, maize, Jerusalem artichoke, rape	0.36	0.72
Meadow, hay	0.04	0.04
Rye, triticale, wheat	0.16	0.17
Oats, barley	0.03	0.04
Kruskal-Wallis test	$\chi^2 = 17.84$; $p = 0.001$	

Note. M – mean, SD – standard deviation.
Source: own study by the authors.

The conducted analyzes showed that the decrease in the value of real estate (per 1 sq m) is not related to the quality of soils. The average reduction in the value of real estate per 1 m^2 was 2.20 PLN, with a standard deviation of 6.87 PLN. The distribution of values ranged from 0.0 to 33.87 PLN per square meter (Table 9).

Table 9

Measures of central tendency and dispersion. Decrease in property value per 1 sq m in zlotys

Specification	M	SD	Me	Do	Min.	Max.
Decrease in property value	2.20	6.87	0.14	0.00	0.00	33.87

Note. M – mean, SD – standard deviation, Me – median, Do – dominant, Min. – minimum value, Max. – maximum value.
Source: own study by the authors.

The correlation analysis did not show any statistically significant links between the decrease in the value of the property and the value of the bonitation class (p = 0.419) (Table 10).

Table 10

Spearman rank correlation coefficient values. The relationship between the decrease in value of benefits and soil classification

Specification	Statistical measures	Bonitation class
Decrease in property value	Correlation coefficient	0.080
	Significance (two-sided)	0.419

Source: own study by the authors.

Conclusions. The analyzes allowed to answer the question raised regarding the unit cost of biological reclamation after the construction of the gas infrastructure and its dependence on the type of use and the type of crops cultivated. Monitoring of open excavation methods as a technical aspect on agricultural land by analyzing the value of damages incurred by owners / perpetual users should be analyzed by the investment investor to obtain information on the state of actual expenditure incurred and to plan full expenditure in the planned route of the gas pipeline and to assess the financing of the considered variants of projected gas infrastructure investments. It was established that the cost of biological reclamation after construction of high-pressure gas infrastructure does not depend on the type of use and type of crop cultivation. Correlation analysis did not show statistically significant links between the cost of reclamation and the value of the bonitation class and the type of cultivation carried out.

The analysis showed that the decrease in the value of benefits (yielding of plants) is all the greater, the higher the soil quality class and that the decrease in value of benefits (yielding of plants) depends on the type of cultivation per 1 m^2. On the basis of the analyzes carried out, a statistically significant relationship was found between the decrease in the value of benefits and the value of the bonitation class – the better the quality of soils, the greater the decrease in the value of benefits.

The research did not confirm the assumption that the decrease in the value of the property depends on the soil quality class. The correlation analysis did not show statistically significant links between the decrease in the value of the property and the soil quality class.

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