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IMPACT OF SMALL WIND TURBINES ON THE SURROUNDING AND AGRICULTURAL ENVIRONMENT

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This study aims to present the impact of wind turbines on the agricultural environment. Scientific articles and publications have been analysed. The performance characteristics of wind turbines and their wide-ranging effects as a renewable energy source are presented. A questionnaire survey was conducted to obtain detailed information on the appropriateness of building wind turbines near residential areas and agricultural communities. It was carried out in December 2023 in Mszczonów using a survey questionnaire. The research group was people living in areas close to wind farms.

A comparative analysis shows that the benefits of building wind farms outweigh the losses. Wind power plants are built on land and at sea, providing energy security for the modern economy and civilisational development. In contrast to coal and gas, the low cost of electricity production in wind power plants is beneficial for their rapid development. In addition, wind power plants do not emit harmful compounds into the atmosphere, making them environmentally friendly and reducing global warming. The surveyed farmers pointed out the acquisition of cheaper energy for their farms and the possibility of leasing land to construct turbines, which increases their income. Wind energy has the most significant energy potential among all renewable energy sources, so its expansion will positively impact the Polish economy.

Key words: *renewable energy sources, wind power plant, offshore power plant, environment, agriculture, landscape.*

ВПЛИВ МАЛИХ ВІТРОВИХ ТУРБІН НА НАВКОЛИШНЄ СЕРЕДОВИЩЕ ТА СІЛЬСЬКЕ ГОСПОДАРСТВО

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Метою цієї роботи є дослідження впливу вітрових турбін на сільськогосподарське середовище. Проаналізовано наукові статті та публікації з зазначеної вище тематики. Представлено експлуатаційні характеристики вітрових турбін та їх широкий спектр впливу як відновлюваного джерела енергії. Проведено анкетне опитування для отримання детальної інформації щодо

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доцільності будівництва вітрових турбін поблизу житлових районів та сільськогосподарських громад. Опитування проводилося у грудні 2023 року в Мицоніві (Польща) з використанням анкетування. Дослідницькою групою були люди, які проживають у районах, близьких до вітрових електростанцій.

Результати порівняльного аналізу засвідчують, що переваги будівництва вітрових електростанцій переважають над втратами. Вітрові електростанції будуються на суші і на морі, забезпечуючи енергетичну безпеку для сучасної економіки і розвитку цивілізації. На відміну від вугілля і газу, низька собівартість виробництва електроенергії на вітрових електростанціях сприяє їх досить швидкому розвитку. Крім того, вітрові електростанції не викидають шкідливих сполук в атмосферу, що робить їх екологічно чистими і сприяє послабленню темпу та інтенсивності глобального потепління. Опитані у процесі дослідження фермери відзначили отримання дешевшої енергії для своїх господарств та можливість оренди землі для будівництва турбін, що сприяє значному збільшенню їхніх доходів. Підтверджено, що вітроенергетика має найбільший енергетичний потенціал серед усіх відновлюваних джерел енергії, оскільки її поширення та розбудова є перспективною і може мати позитивний вплив на польську економіку.

Ключові слова: Відновлювані джерела енергії, вітрова електростанція, офшорна вітрова електростанція, навоколишнє середовище, сільське господарство, ландшафт.

Introduction

Innovative technologies, regulatory changes, and global environmental initiatives shape wind power development. Globally, wind energy contributes around 3% of global electricity consumption. The European Union aims to make Europe the first continent to use wind power by 2050. Europe became the first continent to become climate-neutral. Zero greenhouse gas emissions is a goal that requires the implementation of long-term solutions and the emergence of new investments. “In July 2021, The Commission adopted ‘Fit for 55’ – a package of proposals to align the EU’s climate, energy, land use, transport and tax policies to achieve the CO₂ reduction target by 2030” (Fragkiadakis & Vrontisi, 2023).

Wind energy is related to wind power. Winds that blow over land where wind turbines can be built have a global energy potential of 40TW. Economic considerations say that winds blowing less than 100m are used most often, but investors plan to build windmills over 200m. The energy sector in Poland is dependent on external oil supplies. “Windmills can be part of a sustainable energy mix in Poland to support the decarbonisation process and reduce dependence on fossil fuel supplies” (Polish Wind Energy Association, 2022). Energy policy requires a new approach, as the construction of wind turbines is about onshore and offshore energy. The development of three types of wind installations is recommended: wind farms, i.e., the siting of clusters of dozens of wind turbines; distributed wind energy, i.e., individual wind turbines of small capacity; and offshore wind power plants. In addition, “solar sources should be an investment compliment, as their joint operation results in a more stable energy

supply for consumers” (Ehrenhalt, 2022). Particularly attractive for building offshore wind farms are areas such as the Baltic Sea coast, the open areas of Warmia, Mazury, and Pomerania, the foothills of southern Poland, Podkarpacie and Lower Silesia. The first Polish private energy group to do so is Polenergia SA, which has received a positive decision from the Regional Directorate for Environmental Protection in Gdansk regarding constructing the Maritime Wind Farm Bałtyk Środkowy III. “The wind farm construction is preceded by the installation port in Swinoujscie, which is expected to be ready between 2024 and 2025. Construction of Baltic Power will begin next year with the foundations. In 2025, 76 Vestat turbines of 15 MW each are scheduled to be installed. The first electricity from the farm is expected to flow in 2026” (Zieniewicz, 2022). It is worth mentioning that the Baltic Power offshore wind farm project won the European Transaction 2023 award.

“Unlike power plants powered by conventional energy sources, wind power generation does not require any fuel, so no toxic compounds are released into the atmosphere, and no waste is created. In addition, the absence of fuel means that there are no costs associated with it, which frees the price of wind power from the fluctuating prices of coal, oil, natural gas, or nuclear fuel. With the prospect of a continued decline in conventional fuel stocks, wind power’s steady (and even falling) price encourages investment in this energy source” (Kmieciak & Smiech, 2019).

New power plants are being adapted using renewable energy sources from solar panels and wind turbines. On 23 April 2023, an amendment to the Windmill Act came into

force, which requires wind turbines to be built within 700m of buildings. Local communities will make decisions on the development of windmills within a municipality, considering the local spatial plan. In order to assess the minimum distance – between 10 times the maximum height of a wind turbine (the10H rule) and the minimum distance for residential buildings of 700m, a strategic environmental impact assessment (SEA) will need to be carried out as part of the LSDP. The Wind Act also introduces minimum distances of wind turbines from electricity transmission lines and prohibits the construction of residential buildings near existing wind turbines (Pisarek, 2024).

Poland’s energy policy is based on the Energy and Climate Package. It stipulates that trading in greenhouse gas emissions caused by extracting primary energy requires special permits. The European Commission wants to bring about a reduction in free allowances at an accelerated pace. “Maritime transport is to join the ETS, and the aviation rules will be tightened. On the model of the ETS, a separate mechanism is to be created for transport, construction and the insulation of buildings, which means that the CO₂ emission costs will also be imposed on these sectors.” (European Commission, Fit for 55 2021 package). Figure 1 shows the data related to wind farm revenues in Poland.

It can be seen from the graph above that wind companies are among the most profitable subsectors for acquiring electricity, which has a positive impact on the Polish industry. Areas with varying wind conditions influence the efficiency of wind turbines. “Poland’s National Electricity System, with a total installed capacity of more than 61.4 GW, is primarily based on coal-fired sources. Large fossil fuel-fired power plants and combined heat and power plants dominate the electricity sector. As of February 2023, their combined share of the installed capacity of the NPS was approximately 59.3%” (DWF Guide, 2023). The coastal belt represents the most critical ground for establishing onshore and offshore turbines. The IMGW Meteorology Centre has developed a division of Poland according to wind energy zones, as shown in Figure 2.

It is a fact that wind turbines affect the natural environment and people. Noise, electromagnetic field emissions, stroboscopic effects, glare, fire, and ice hazards are noted. Developer work must, therefore, consider the provincial spatial plan and its suitability. Many farms also undergo an environmental impact assessment and receive an environmental decision for a viable project. It is a myth that wind turbines contribute to mass bird deaths. In Poland, a monitoring system has been developed, allowing HD cameras to be mounted on windmill towers to warn of danger



Fig. 1. Revenues and financial performance of wind farms in Poland

Source: compiled from Central Statistical Office data [Derski B., 2021].

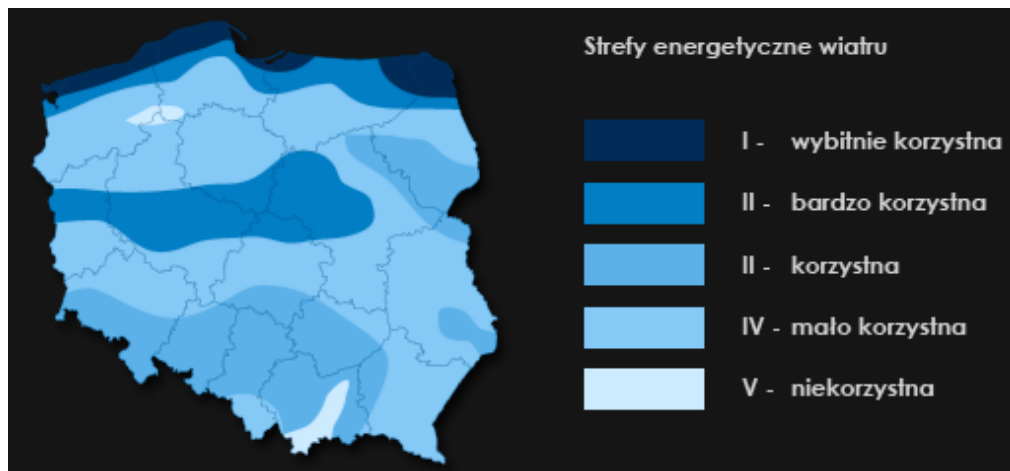


Fig. 2. Map of the division of Poland into wind zones

Source: Study from IMGW Meteorology Centre

with warning signals such as light, sound, or automatic turbine stopping. “The tests carried out have confirmed the effectiveness of the system. The camera can detect up to 80% of a flying red kite within 400m of a wind turbine. The system also reduces the intermittent turbine-only collision with the bird by almost 80%. False detections are only 4% of the time. With this system, birds effectively avoid the wind turbine obstacle” (Pisarek, 2024).

Malfunctions of wind turbines are possible and sometimes result from causes beyond human control. These result in financial losses. Factors contributing to turbine failures include lightning, which damages turbine components through tall structures mounted in the open. Existing lightning protection is designed to protect the turbines from the consequences of failure. Another factor is the detachment of components or entire rotor blades, which is counteracted by periodic maintenance by specialised service teams. The greatest threat, however, is icing and turbine fires. Icing mainly affects areas with cold climates, such as in the mountains. Ice detaching from the windmill and blades is sometimes the most common cause of failures and accidents associated with wind turbines. Fires, conversely, usually involve flammable components such as the nacelle, tower, and the sub-installation to which the turbine is connected. Malfunctions are caused by lightning strikes, damage to electrical circuits, formation of high resistances due to poor connection between mating components, overvoltages in transformer windings, mechanical damage to generators, high surface temperatures caused by the operation of the mechanical brake, high

temperatures caused by lack of or insufficient lubrication of mechanical components and improper maintenance. The solution may lie in using systems that detect fires quickly and training wind turbine operators so that timely damage detection will prevent future fires.

Wind energy is also essential for the agricultural environment. Household wind turbines are an investment with financial and environmental benefits, as wind energy is one of the cleanest renewable sources. Reduced carbon dioxide emissions and less dependence on conventional energy sources are vital arguments for such an investment. “Landowners on which investors want to build wind turbines can gain additional funding. Data shows that in 2022. A farmer earned around PLN 16,000. per year even if the windmill was not located on his agricultural land” (Zieniewicz, 2022).

Wind turbines for the farmers produce electricity through the power of the wind. The windmill turbine converts the kinetic energy from the wind into mechanical energy from which the rotor rotates. It makes the windmill capable of powering any business. Different power production values can be achieved depending on the turbine’s power. A small installation of 2kW can quickly meet a seasonal cottage’s needs, possibly reducing the electricity bill and power lighting and some electronics. Typically, a 5kW wind installation should cover the needs of a smaller farm. With this solution, farmers do not have to worry about rising electricity prices or even think about using renewable energy from the turbine to heat their home or heat domestic hot water.

Wind turbines often trigger discussions regarding landscape degradation. There is a perceived divide in the public perception of wind farms. Some people state the need for RES development, but on the other hand, concerns about the visual impact of wind turbines cause much concern. “Conducted by the team of K. Molnarov and colleagues, the study aimed to objectify this impact and identify the factors determining how people evaluate these constructions. The visual quality of the landscapes in which these structures are to be placed, the number of structures and their distance from the viewer, and various characteristics of the respondents were studied. It was found that wind turbines are also better accepted if their number in the landscape is limited and if the structures are far from viewpoints such as settlements, transport infrastructure, and viewpoints” (Jasiński & Kacejko, 2022). The CBOS survey confirms that the majority of Poles are in favour of building wind turbines. Figure 3 presents the results.

The problem is still insufficient subsidies for windmill investments, which delays their creation. The Environmental Protection and Water Management Fund wants to introduce the ‘Moja elektrownia wiatrowa 2024’ programme, which will offer 400 million, guided by environmental objectives and the desire to increase the energy efficiency of Polish households. “It offers a unique opportunity to subsidise the purchase and installation of wind turbines of up to 20kW, including a 10kw backyard wind turbine

and a 5kw backyard wind turbine, as well as associated energy storage facilities. Under the programme, beneficiaries can expect to cover up to the eligible costs of the installation, with a maximum grant of up to PLN 30,000 for a household wind turbine and up to PLN 17,000 for an energy storage facility” (Environmental Protection and Water Management Fund 2024).

Material and methods

The study aimed to report on the impact of small wind turbines on the surrounding and agricultural environment. The main research problem was formulated:

1. What impact do wind turbines have on the agricultural environment?

The research scope concerned the literature analysis on the subject and the survey results conducted in Mszczonów. Based on the primary research problem, specific research questions were formulated:

1. What benefits and losses do wind turbines generate for farmers?

2. Do farmers benefit from the energy generated by wind turbines?

3. What impact do wind turbines have on the human and animal environment?

4. What are the advantages and disadvantages of building wind turbines near farmers’ homes?

Farmers who live near wind turbines and benefit from the energy they generate participated in the survey. Based on a survey questionnaire, the respondents answered questions about the rationale for building wind turbines and their environmental impact. The

CBOS

RYS. 1. Farmy wiatrowe umożliwiają pozyskiwanie energii elektrycznej z wiatru. Czy popiera Pan(i) rozwój lądowych farm wiatrowych w Polsce czy też nie?

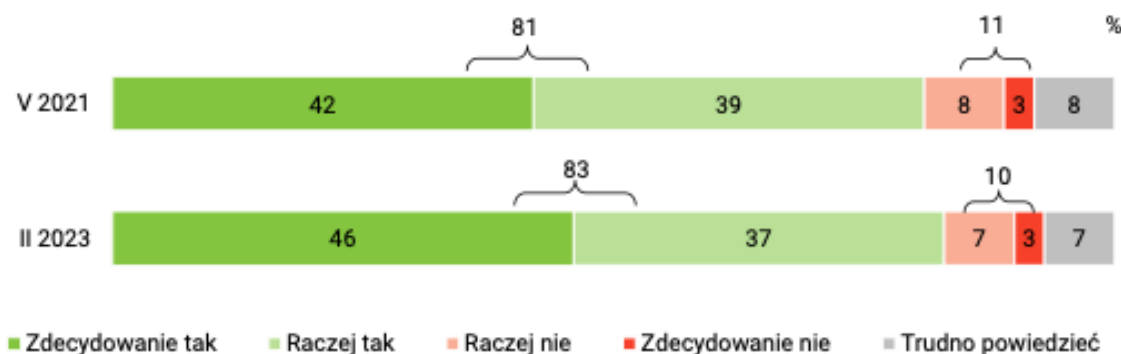


Fig. 3. Poles’ opinion on the construction of wind farms in Poland

Source: CBOS study

survey included ten closed questions and six open questions. The survey was intended for 100 people, but 96 responded. 4 questionnaires were not returned.

The main wind power plant in Mszczonów is located on the industrial premises of the “KERAMZYT” Light Aggregate Company. It is located close to people’s places of residence, where 1MW and 2 MW turbines have been in operation since 2012. Mszczonów residents objected to constructing further turbines, but the Mszczonów site council rejected the complaint. The benefits of the wind turbines helped the decision. The residents of Mszczonów in this study will be able to comment on the current turbines and those newly constructed, allowing the research questions to be answered more accurately.

Results

The answers to the open-ended question show that building wind turbines near farmers’ homes generates more benefits than losses. The benefits include less pollution in the air, energy generation at a low cost, farmers

benefiting from cheaper energy for households and agriculture, and the possibility of leasing land to investors who want to build a small wind turbine. Among the losses are the negative impact on the landscape, the undervaluation of the land when sold, and noise emissions. Table 1 presents the results.

The respondents live in areas in the Mazovia region where small wind turbines operate. All confirmed that there are wind turbines in their area. Residents did not specify the number of wind turbines in their area but answered a question about their opinion on the development of wind farms in Poland (Fig. 4).

Most farmers believe that turbines impact the agricultural environment (80 people) and acknowledge that they benefit from the energy generated by wind turbines. Sixteen people denied this. There were 48 responses regarding the impact in relation to the price of the energy harvested (Table 2).

According to farmers, wind turbines impact human and animal life. Thirty-two people

Table 1

Benefits and losses of building wind turbines according to farmers

Benefits	Persons	Losses	Persons
Less pollution in the air	12	Negative impact on the landscape	8
Low-cost energy generation	24	Under-valuation of land for sale	24
The use by farmers of cheaper domestic and agricultural energy	20	Noise emissions	16
Possibility of giving away land investors	12		

Source: own elaboration based on own research, * respondents answered the open question

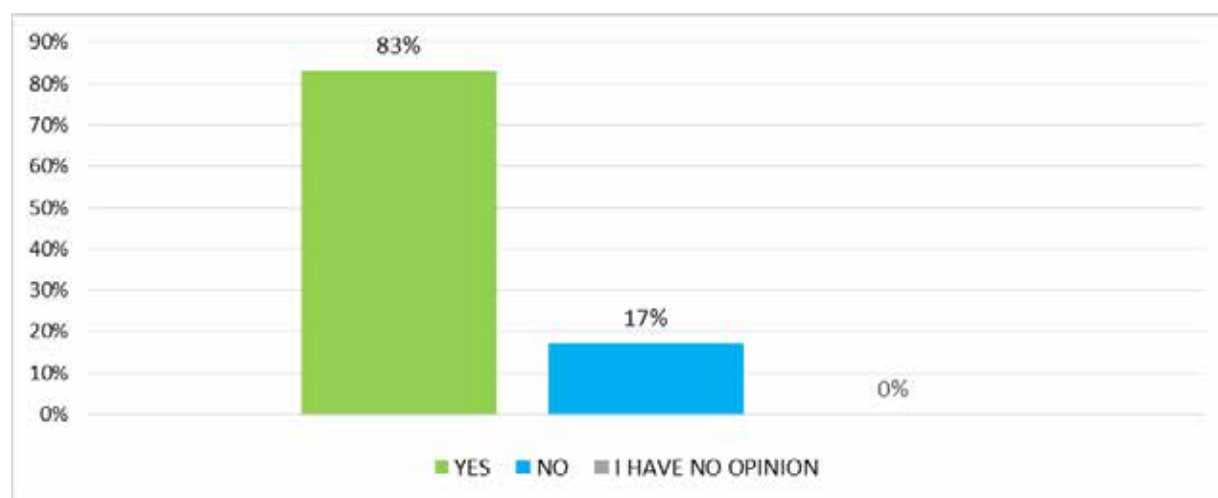


Fig. 4. “Impact of wind turbines on the agricultural environment”

Source: compiled from own research

Table 2

“Farmers’ views on the impact of wind turbines”

Impact of wind turbines	Quantity answers provided
The most visible impact is in relation to the price of the energy generated	48

Source: compiled from own research, * respondents answered the open question

stated that humans feel the presence of the turbines, while four people have no opinion on the subject. Among the sensations mentioned were lousy mood, headaches, insomnia, irritation, and sleepiness. These feelings can be exacerbated by low-frequency noise and hum and the generation of electromagnetic fields. Fifty-six farmers stated that the turbines do not impact the animal environment, while 40 confirmed this theory. Large wind installations are now equipped with warning systems in light signals, sound signals, or automatic turbine stops. Such measures are designed to prevent collisions between birds and turbines (Fig. 5, Table 3).

Table 3
 “Self-perception of surveyed people living near wind turbines”

Self-assessment	The number of replies given
Poor well-being	32
Nervousness	8
Headaches	32
Insomnia	32
Drowsiness	8
Imbalances	-
Respiratory infections	-
Other	-

Source: compiled from own research, * respondents answered the open question

The farmers surveyed pointed out the advantages and disadvantages of building wind turbines near their homes. Among the advantages emerged again: the acquisition of cheaper energy for households and farms, the possibility of leasing land for the construction of wind farms, the development of new technologies, and the reduction of air pollution. The most significant disadvantage, and the reason for not building wind farms, is the still small amount of funding that would contribute to farmers willingly reaching for an energy solution such as domestic small wind farms. Other disadvantages include landscape degradation, noise-causing people to move to quieter places and the dangers of ice and fires (Table 4).

Discussion

The findings confirm that wind turbines have an impact on the agricultural environment. Respondents indicated that the benefits outweigh the losses, making the case for developing wind farms onshore and offshore.

Renewable energy sources are an indisputable part of international climate and energy policy. They influence the development of the economy, including the agricultural economy. Wielewska I. et al. (2017) consider that RES influences energy demand growth. Napieraj K. and Stańczak M. (2013) argue that wind turbines contribute to the production of energy in an environmentally friendly way, as they contribute to the elimination of toxic waste, which is also confirmed by the results of this study. CBOS surveyed Poles’ attitudes towards onshore wind energy, which found that ‘the vast majority of Poles (83%) support the development of onshore wind energy, with only a few (10%) taking an opposing stance on the issue. Compared to the results from nearly two years ago, the public’s attitude on this issue has not changed. [...] A wind farm near where they live would be accepted by more than two-thirds of those surveyed (68%), while more than one-fifth (22%) would oppose its construction. For less than two years, the level of approval of the presence of wind turbines near the place of residence has increased slightly (by five percentage points)’ (CBOS..., 2023). The formation of public opinion regarding the construction of wind turbines is possible thanks to the media, which determines the scale of onshore and offshore wind energy development (Bednarek-Szczepańska, 2023).

Piotr Kacejko gave an interview to Oko Press (2023) in which he was unequivocal about the lack of data confirming the harmful effects of wind turbines on humans. He discussed a study conducted among employees of factories close to the farms. “According to a report published by Prof. Dariusz Pleban of the Central Institute for Labour Protection, 54 percent of people employed at sites between 0.5 and 1 km from the turbines can hear their sound. However, the survey results indicated

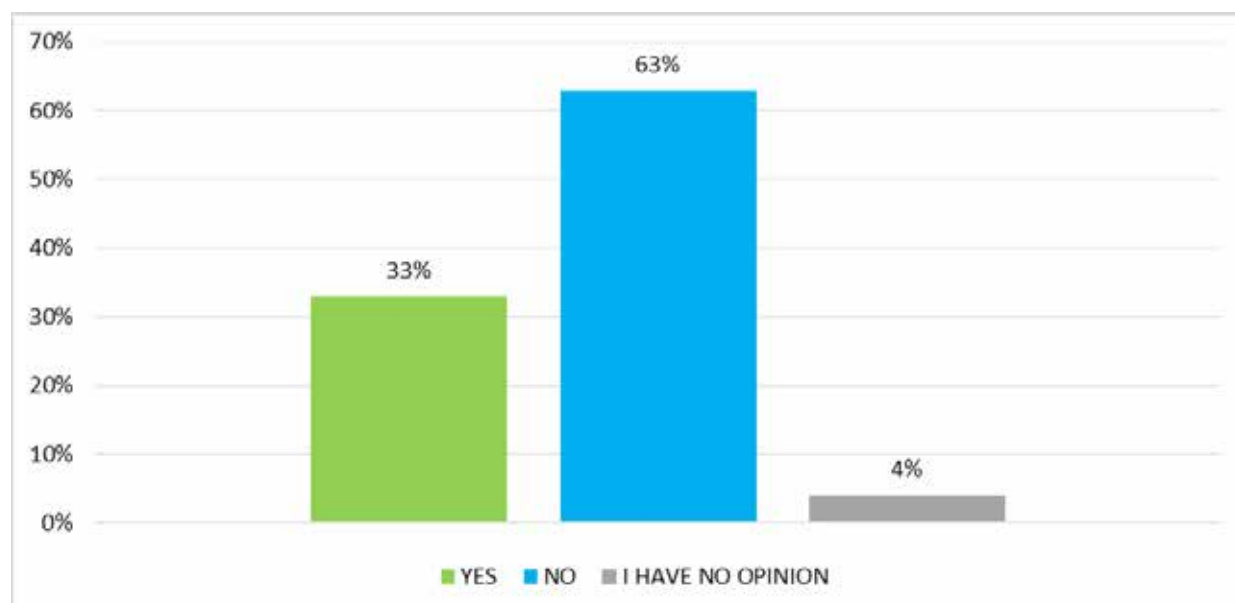


Fig. 5. "Impact of turbines on human well-being according to people surveyed"

Source: compiled from own research

that workers generally felt little discomfort at sound levels below 50 dB – audible at distances of less than 100 meters from the turbine, according to Prof Kacejka." This study shows that most farmers believe that human beings are slightly affected by noise from turbines.

Concerning environmental and animal risks, modern wind turbines have a monitoring system to detect birds approaching the turbines. According to a study by the British Ecological Society, modern monitoring has made it possible to reduce bird mortality in wind farm areas by 82%. Farmers also believe that wind turbines do not contribute to bird or animal mortality.

According to Janusz Gajowiecki, President of the Management Board of the Polish Wind Energy Association, subsidies for constructing small wind farms will increase. Furthermore,

subsidies are envisaged for farmers and local investors who decide to build wind farms. The Ministry of Climate and Environment intends to include subsidies for small wind turbines in the Current programme. A public consultation on the details of this project ended on 5 February 2024. Support for small wind turbines is to be launched as early as 2024. "The development of this technology in Poland is also in line with the main principles of the European Green Deal, an EU programme aimed at achieving the EU's offshore renewable energy strategy" (Senate Office..., 2020).

In summary, wind turbines have both advantages and disadvantages. The main advantages include using renewable wind energy and avoiding harmful emissions. These power plants can be built quickly and relatively cheaply and do not require a fuel

Table 4
 Advantages and disadvantages of building wind turbines near farmers' homes

Benefits	Persons	Failures	Persons
"Sourcing cheaper energy for households and agriculture"	72	"Insufficient amount and quantity of subsidies for the construction of small wind farms"	36
"The possibility of leasing land for the construction of a wind power plant"	12	"Landscape degradation"	8
"Development of new technologies"	12	"Noise causing people are moving to quieter places"	20
"Reducing air pollution"	12	"Ice and fire hazards"	16

Source: compiled from own research, * respondents answered the open question

supply. On the other hand, the disadvantages are the instability of power production and the potential negative environmental impact. In order to fully exploit the potential of wind power, it is necessary to integrate it harmoniously into the electricity system. "The entry into force of the Law of 8 February 2023 should contribute to the development of local businesses directly or indirectly related to the construction of wind power plants in the area and may also have a positive impact on the construction industry related to housing, due to the abolition of the 10H rule for the construction of residential houses in the vicinity of a wind power plant. Unlocking municipal development in this area will have a positive social and economic dimension".

Conclusions

Based on the literature shown and the survey carried out in Mszczonów, the following conclusions can be drawn:

Sixty-eight farmers believe that wind turbines generate more benefits than losses. Among the benefits, less air pollution, obtaining energy at a cheaper cost, and the possibility of leasing land for wind turbines were singled out. 8 include landscape degradation among the losses.

All the farmers surveyed live in areas close to wind turbines and benefit from the energy extracted from them.

Respondents most appreciated the low energy price of wind turbines (44 respondents).

Farmers cited the advantages of wind turbines in terms of the low cost of energy production (72 people), the possibility of making a profit by leasing land (12 people), and the development of new technologies (12 people). Disadvantages included noise from the turbines (20 people), degradation of the landscape, and a factor that plays a decisive role in the construction of turbines, as well as the low subsidies for the construction of wind turbines (36 people).

The above considerations, the literature analysis, and the research results have led to the main research problem. The validity of building wind turbines, including those close to where people live, has been established. The new technology makes it possible to obtain cheaper energy, reducing air pollution. Building turbines close to homes allows the use of energy produced at a low cost, reducing maintenance costs. In addition, the subsidies planned for creating this type of investment will promote the construction of small wind turbines near farms.

Bibliography

Bednarek – Szczepańska M. Wizerunek energetyki wiatrowej i jej oddziaływania na społeczeństwo w świetle doniesień mediów regionalnych i lokalnych w Polsce. *Czasopismo Geograficzne*. 2023. Vol. 94 (2), p. 263–288. <https://doi.org/10.12657/czageo-94-11>.

CBOS Public Opinion Research Centre. *Opinions on wind energy*, Vol. 2, p. 2–3.

Derski B. Giant profits of wind farms. 2021. [Electronic resource] URL: <https://wysokienapiecie.pl/36763-gigantyczne-zyski-farm-wiatrowych/> (access date 24.02.2024).

DWF. Guide to the Polish RES auction system.

Ehrenhalt W. Opinion of the ZPP Chief Expert on Energy: Prospects for the development of wind farms and photovoltaic sources in light of the laws currently under procedure. *ZPP*, Warsaw, 2022. 1–2.

Fragkiadakis K., Vrontisi Z. (Ed.) Publications Office of the European Union. *Fit for 55 climate package: Impact on EU employment by 2030*, Luxembourg, 2023. P. 1.

Environmental Protection and Water Management Fund. 2024. *My Wind Power Plant 2024 – Funding and Grants*, 2024. P. 1.

Jasiński A.W., Kacejko P. (Ed.) Wind power plants in the human environment, Monographs, Lublin. 2022.

Chancellery of the Senate, Office of Analyses, Documentation and Correspondence. *Morskie Farmy Wiatrowe – aktualna sytuacja w Polsce i na świecie*, Warsaw, 2020. P. 4.

Chancellery of the Senate, Office of Analyses, Documentation and Correspondence 2023 Assessment of the Regulatory Effects of the Provisions of the Act on Amendments to the Act on Investments in Wind Power Plants and Certain Other Acts, Opinions and Expert Reports, Warsaw.

Kmiecik M., Śmiech S. (Ed.) Wind energy as a component of the national energy security system. *International Security Yearbook*, 2019. P. 294.

Napieraj K., Stańczak M. Advantages and barriers of wind energy development. Jan and Jędrzej Śniadecki University of Technology and Life Sciences in Bydgoszcz. 2013.

Pisarek Ł. Wind power plants and the shaping of the agricultural environment. Łomża. 2024.

Polish Wind Energy Association. *Potential of offshore wind energy in Poland*. Warsaw, 2022. pp. 1–10.

Council of the Union of the European Commission. *Fit for 55 package*, 2021. pp. 1–12.

Wielewska I., Sobczyk W., Gliniak M. Energy from renewable sources as social welfare according to the opinion of Polish farmers. *Folia Pomeranae Universitatis Technologiae Stetinesis*, 2017. Vol. 333 (86). P. 93.

Zieniewicz R. How much will you earn for leasing agricultural land for a wind installation in 2022–2022. [Electronic resource] URL: <https://www.farmer.pl/biznes/ile-zarobisz-za-dzierzawe-gruntu-rolnego-pod-instalacje-wiatrowa-w-2022-r,118182.html> (access date 20.02.2024) [in English].

References

Bednarek – Szczepańska M. (2023). Wizerunek energetyki wiatrowej i jej oddziaływania na społeczeństwo w świetle doniesień mediów regionalnych i lokalnych w Polsce [The image of wind energy and its impact on society in the light of regional and local media reports in Poland]. *Czasopismo Geograficzne [Geographical Journal]*. 94 (2), 263–288. <https://doi.org/10.12657/czageo-94-11> [in Polish].

CBOS Public Opinion Research Centre. *Opinions on wind energy*, 2, 2–3 [in English].

Derski, B. (2021). Giant profits of wind farms. [Electronic resource] URL: <https://wysokienapiecie.pl/36763-gigantyczne-zyski-farm-wiatrowych/> (access date 24.02.2024) [in English].

DWF. Guide to the Polish RES auction system [in English].

Ehrenhalt, W. (2022). Opinion of the ZPP Chief Expert on Energy: Prospects for the development of wind farms and photovoltaic sources in light of the laws currently under procedure. *ZPP*, Warsaw, 1–2 [in English].

Fragkiadakis, K., & Vrontisi, Z. (ed.). (2023). Publications Office of the European Union. *Fit for 55 climate package: Impact on EU employment by 2030*, Luxembourg, 1 [in English].

Environmental Protection and Water Management Fund. (2024). *My Wind Power Plant 2024 – Funding and Grants*, 1 [in English].

Jasiński, A. W., & Kacejko, P. (ed.) (2022). Wind power plants in the human environment, Monographs. Lublin [in English].

Chancellery of the Senate, Office of Analyses, Documentation and Correspondence. (2020). *Morskie Farmy Wiatrowe – aktualna sytuacja w Polsce i na świecie*, Warsaw, 4 [in English].

Chancellery of the Senate, Office of Analyses, Documentation and Correspondence 2023 Assessment of the Regulatory Effects of the Provisions of the Act on Amendments to the Act on Investments in Wind Power Plants and Certain Other Acts, Opinions and Expert Reports, Warsaw [in English].

Kmiecik, M., & Śmiech, S. (ed.) (2019). Wind energy as a component of the national energy security system. *International Security Yearbook*, 294 [in English].

Napieraj, K., & Stańczak, M. (2013). Advantages and barriers of wind energy development. Jan and Jędrzej Śniadecki University of Technology and Life Sciences in Bydgoszcz [in English].

Pisarek, Ł. (2024). Wind power plants and the shaping of the agricultural environment. Łomża [in English].

Polish Wind Energy Association. (2022). *Potential of offshore wind energy in Poland*. Warsaw, pp. 1–10 [in English].

Council of the Union of the European Commission. (2021). *Fit for 55 package*, pp. 1–12 [in English].

Wielewska, I., Sobczyk, W., & Gliniak, M. (2017). Energy from renewable sources as social welfare according to the opinion of Polish farmers. *Folia Pomeranae Universitatis Technologiae Stetinesis*, 333 (86), 93 [in English].

Zieniewicz, R. (2022). How much will you earn for leasing agricultural land for a wind installation in 2022? [Electronic resource] URL: <https://www.farmer.pl/biznes/ile-zarobisz-za-dzierzawe-gruntu-rolnego-pod-instalacje-wiatrowa-w-2022-r,118182.html> (access date 20.02.2024) [in English].

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