



Volume 121

2023

p-ISSN: 0209-3324

e-ISSN: 2450-1549

DOI: <https://doi.org/10.20858/sjsutst.2023.121.11>



Journal homepage: <http://sjsutst.polsl.pl>

Article citation information:

Piotrowska-Trybull, M., Kozuba, J., Sirko, S. Airport as a factor shaping the socio-economic situation in the municipality in a changing reality. *Scientific Journal of Silesian University of Technology. Series Transport*. 2023, **121**, 167-188. ISSN: 0209-3324.

DOI: <https://doi.org/10.20858/sjsutst.2023.121.11>.

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AIRPORT AS A FACTOR SHAPING THE SOCIO-ECONOMIC SITUATION IN THE MUNICIPALITY IN A CHANGING REALITY

Summary. Airports, as a component of air transport, combine air transport with other modes of transport to strengthen the transportation accessibility of a place in space, attract investors, and stimulate the development of the area. Taking into account that these issues are less exposed in relation to their immediate surroundings, research was undertaken to determine how representatives of the authorities and residents of communes (taking into account the nature of the communes and the size and location of the airport) perceive airports, located within their communes, in the context of their impact on the socio-economic situation in the communes. This was achieved by analysing the communes' strategic documents and data on the operation of communes and airports from 2016 to 2021. These data were obtained from the Civil Aviation Authority, the Central Statistical Office, the International Air Transport Association, and the International Airports Council. In an effort to better understand the relationship between the airport and the commune in which it is located, poll research was carried out using survey and interview techniques. The research focused on 10 airports spread across Poland. A total of 1,200 surveys were conducted among residents of communes, and 10 interviews

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were conducted with representatives of local governments and the port. To analyse the collected data and present the results, Statistica v.13.3 and R/RStudio software were used.

Keywords: airports, commune, impact, local, development, pandemics

1. INTRODUCTION

The initial period of air transport was characterised by poor travel comfort, a lack of airport facilities, and unreliable aircraft that carried a small number of passengers. Airports, which were established during this period, were located close to cities and also served as entertainment centres, often attracting more visitors than passengers. During this period of air transportation, most passenger aircraft did not need extensive airport infrastructure. An increased interest in airplanes as a means of transportation came in the 1930s and 1940s as a result of technological advances in the aviation industry, including the introduction of multi-engine aircraft. Their use, however, entailed the need for paved and longer runways (Ashford), which in turn led to the expansion of airports and their occupation of more and more space.

The transformations that took place after World War II, including technological advances, improvements in travel convenience, the provision of innovative passenger services, lower ticket prices, improved safety ratings, the development of low-cost airlines, and the experience of successive generations, contributed to the popularity of air transportation (Kozuba et al., 2021; *A Statistical Analysis...*2018; *Aviation benefits ...*, 2016; Forsyth et al., 2010; Mayo et al., 2009; Graham et al., 2008). Attention should also be paid to the deregulation of the air passenger transport market. In the European Union (EU), this process took place in the 1980s and 1990s. In Poland, the changes in this area were a consequence of Poland's accession to the EU and the adoption of solutions in force in the Community. They manifested themselves in quantitative and qualitative changes in the infrastructure of airports, making it possible to serve an increasing number of passengers (Nicoll et al., 2002; Hozzman, 2015).

The introduction of faster and larger aircraft, which evolved to meet the needs of expanding air transport and contributed to the growth in passenger numbers and cargo volumes, led to the lengthening of runways (runway requirements continued to grow until the mid-1970s (Ashford)). Taxiways, infrastructure allowing safe take-offs and landings, and ground facilities used for aircraft operations and during passenger and cargo handling were also being expanded. Consequently, airports, by linking air transport with other modes of transport, occupying a specific area with fixed facilities within their boundaries, meeting the needs of passengers and crews and enabling the movement of various cargoes, present themselves as a complex system that affects the environment in certain ways (Schmitt et al., 2016; Wensveen, 2015).

2. LITERATURE REVIEW

Airports are part of the transportation infrastructure (they are a component of the internal infrastructure factor of local and regional development). Thus, they affect development in the social and economic dimension, in particular the conditions for doing business, transport accessibility, transport expenses, as well as the state of the natural environment (Kupiec, 1999), determine the economic competitiveness and investment attractiveness of a specific space (Hryniewicz, 1998; Trojanek 1996). They contribute to the attraction of investors to a specific location and greater recognition of a specific region, including smaller territorial units such as

communes in the area where they are located. Designed and organized in accordance with the expectations of passengers and airlines, they are a showcase for the region, commune, and city (Kaufan, 2013; Czerkowski, 2019; *Program rozwoju ...*, 2015). There are also a number of companies that provide certain services at airports, both for travelers and the local community (Freatly et al., 1998). Thus, airports can be seen as an important factor leading to the emergence of modern infrastructure, which supports the modernization of the economy and is an engine of economic growth (Malizia, Feser, Renski, Drucker 2021), which, involving residents and businesses, leads to an increase in the accessibility of a specific place for tourists, the investment attractiveness of the region and the communes in which it is located (Piotrowska-Trybull et al., 2022; Beer, Clower, 2020; Blakely, Leigh, 2010; Graham, 2008; Porter 1998; https://transport.ec.europa.eu/transport-modes/air/airports_en; <https://www.aci-europe.org/about-us.html>), fosters job creation and increases budget revenues for local government units (Madras, 2014; Huderek-Glapska, 2011; Airports Council International, *The social and economic impact of airports in Europe*, York Aviation 2004).

There are a number of expectations ahead for the airports, sometimes difficult to reconcile. On the one hand, an airport ensuring the implementation of the highest possible number of operations and passengers carried should be located close enough to the main population centres, on the other hand, far enough away so that the noise resulting from the use of large aircraft, is kept at an acceptable level (*European Aviation...*, 2022; <https://www.easa.europa.eu/eaer/downloads>; *WAYPOINT 2050*, 2020; *Destination 2050*, 2021; *EUROCONTROL Forecast ...*, 2021). The presence of an airport is also combined with increased human and vehicle traffic in its surroundings, which also contributes to noise. The impact of the airport on the flora and fauna of the area is also important, as is the generation of pollution resulting, for example, from the presence of large paved areas and the use of aircraft handling equipment. One should also not forget the problems associated with moving large numbers of passengers (waste disposal).

The environment of an organisation has always been subject to change, but nowadays, these changes are accelerating, and the periods based on which they can be identified are shorter. These changes, often global in nature, significantly affect organisations. Along with others, rapidly developing technologies have had a significant impact on societies and organisations, creating new conditions and influencing the shape of the future (Bobillier et al., 2021; Marr, 2021; Coron et al., 2020; Alban et al., 2019). While the use of modern technology, which leads to changes in people's lives, carries certain risks (Klowden et al., 2021; Ross, 2017; McAfee et al., 2017; Goodman, 2016), changes that are derived from suddenly occurring phenomena (Taleb, 2020) cause major disruptions in the functioning of organisations. This turbulence, among other things, depends on the industry to which the organisation belongs. This was made clear by the Covid 19 pandemic, which disrupted societies and organizations and contributed to the introduction of solutions (Larson, 2021) that had not been used before.

Considering that airports are open systems, it is a natural sequence that the changes that take place in their environment affect their operation to a greater or lesser extent. Such a situation was encountered by airports with the emergence of the Covid-19 pandemic. Confirmation of its unprecedented impact on the situation in the aviation industry can be found by analysing the data provided in reports (*Air Connectivity. Measuring the connections that drive economic growth* (IATA); *Airport Industry Connectivity Report 2020* (ACI); *Airport Industry Connectivity Report 2021* (ACI), *ICAO Safety Report*, 2021 Edition).

3. RESEARCH METHODOLOGY

3.1. Organisation of the research

The aim of the research was to determine how the size of the airport, its location in the commune, and the nature of the commune affect the opinions of residents and government officials in the context of the port's impact on the socio-economic situation and the environment in their commune in a dynamically changing environment.

The research was carried out in two stages. In the first one (February-March 2021), communes with airports in Poland were identified, and five communes were drawn. These included rural communes (Trzebowniko, Ożarówice, Zabierzów), an urban-rural commune (Goleniów) and an urban commune (Świdnik). The following airports are located on their territory: Rzeszów-Jasionka, Katowice-Pyrzowice, Kraków-Balice, Szczecin-Goleniów, and Lublin. Aiming to determine how the socio-economic situation in the drawn communes is influenced by the airports located on their territory, an analysis of socio-economic indicators (for 2016 - 2021) and information contained in municipal development strategies, reports on their condition, and local revitalisation programs was carried out. All the communes where the study was carried out in both the first and second stages had airports in the analysed period 2016 - 2021. The time frame adopted allowed us to characterise the functioning of airports and communes, in the period before and during the pandemic. In order to deepen the knowledge of the importance that representatives of local authorities, give to the presence of the airport and its impact on socio-economic processes in their communes in February and March 2021, a survey was also carried out among residents of communes and representatives of local governments. From each commune, taking gender and age into account, 120 people were drawn (600 people in total), while interviews were conducted with five municipal government employees (one from each commune).

In the second stage, the surveys were carried out in urban communes (Gdańsk, Bydgoszcz, Łódź, Poznań, Wrocław), within the borders of which airports are located: Lech Wałęsa Gdańsk, Bydgoszcz, Łódź, Poznań-Ławica, Wrocław-Strachowice (the names of the ports are in accordance with the nomenclature presented on the ULC website). The analysis of socio-economic indicators (2016 - 2021) and information contained in the strategies and reports on the state of the studied communes was accompanied by survey research (first quarter of 2022), where 600 residents of the communes were surveyed, as in the first stage (120 people were drawn from each commune, taking gender and age), and one representative of the authorities, from the commune, was interviewed. In the case of Gdańsk, the interview was conducted with a representative of the airport. Despite attempts to contact a representative of the local government in Gdańsk, unfortunately, the interview could not be completed. As a result, a decision was made to direct an interview request to the airport, to which a positive response was received. A total of 1,200 residents of the communes and 9 representatives of the local government and a representative of the port participated in the first and second stages of the survey. The distribution across Poland of communes and airports located within them, along with the nature of the commune, is shown in Figure 1.

Research with the participation of residents of communes (questionnaires) and representatives of local authorities and the port (interviews) was carried out using structured questionnaires. The survey was conducted using the Computer Assisted Telephone Interview (CATI) method.



Fig. 1. Communes where the surveys were carried out and airports located on their territory
Source: own study

3.2. Data analysed

Data on communes were obtained from the Local Data Bank of the Central Statistical Office and from the websites of the communes where the surveys were conducted. Respondents' answers to individual questions obtained during the survey were included in an Excel file, where columns corresponded to successive questions included in the survey, while cases (rows) mapped the answers of successive individuals. This file, used during statistical analyses, was expanded to include additional variables (airport size, airport location, nature of communes drawn (see analyses conducted)). The interviews were recorded, which made it possible, as a result of transcription, to prepare, from each interview, a separate text file. These files were used to analyse the text contained therein.

Data on the airports presented (for 2016–2021) was obtained from the Civil Aviation Authority (ULC) and the airports' websites. Characterisation of the air transport situation was possible as a result of analysis of the Air Passenger Market Analysis and Air Cargo Market Analysis reports presented on the International Air Transport Association (IATA) website (<https://www.iata.org/en/publications/economics/>), and analysis of information posted on the International Airports Council (ACI) website (<https://www.aci-europe.org>).

3.3. Analyses conducted

The data gathered from various sources was prepared, as pointed out, for example, by D. Delen (2020), for further investigation. In addition to analyses of documents obtained from the communes' websites (municipal development strategies, status reports, local revitalisation programs), data obtained from the CSO website, airport websites, the International Air Transport Association website, and during surveys and interviews were studied. These were carried out using the following programs: Excel, Statistica v.13.3 and R/RStudio. Exploring the data obtained during the survey, a test was used to verify statistical hypotheses χ^2 . A standard significance level of $\alpha = 0.05$ was adopted. Analyses of the text (reports of the International Air Transport Association, text files after the transcription of interviews, information posted on

airport websites) included preprocessing of the text, creation of word frequency matrices, counting of word frequencies in individual interviews, and analysis of emotions during interviews. These issues are discussed in papers (Bruce et al., 2020, Freeman et al., 2019; Wickham et al., 2018; Silge et al., 2017; Kwartler, 2017; Friendly et al., 2016).

Considering that airports differed in terms of the number of flight operations carried out and the number of passengers checked in, using data for these variables and applying cluster analysis (Euclidean distance, Ward's method), four groups of airports were identified by size (group 1: Kraków-Balice, group 2: Lech Wałęsa Gdańsk, Katowice-Pyrzowice, group 3: Poznań-Ławica, Wrocław-Strachowice, group 4: Rzeszów-Jasionka, Szczecin-Goleniów, Bydgoszcz, Lublin, Łódź). Airports were also differentiated by their location in relation to major cities. From the perspective of this variable (location), the first group included airports located within the borders of Gdańsk, Bydgoszcz, Poznań, Łódź, Wrocław (the average distance of the airport to the center in the group of these cities is 7.2 km); the second group included airports located near Szczecin, Lublin, Rzeszów, Kraków, Katowice (the average distance of the airport to the centre of these cities is 22.8 km). These variables, in addition to the variables included in the metric (gender, age, education, distance of residence from the airport), were used when analyzing the answers that were given by the respondents (residents of communes).

4. RESULTS OF THE RESEARCH

4.1. Socio-economic characteristics of communes where airports are located

The communes where the survey was conducted were diverse in terms of economic potential, population potential (Table 1), urban and/or rural character, and geographic location. The identified differences interacted with the way cities and communes perceived the airport located on their territory, including the possibility of using its potential for the benefit of development processes in each unit.

Urban communes

Bydgoszcz city located in the Kuyavian-Pomeranian Voivodeship, in the north of Poland, which is the seat of the provincial governor and forms, together with Toruń, the Bydgoszcz-Toruń agglomeration. In the development strategy of the city of Bydgoszcz until 2030, modern transport and communication were adopted as one of the key areas of the city's development, referring, on the one hand, to local transport ensuring efficient movement of residents of the city and neighbouring communes within the metropolitan area, and on the other hand, to ensuring national and international accessibility, appropriate quality of information and communication infrastructure, as well as a sustainable transport system (*Bydgoszcz 2030*, p. 3). Among its assets, Bydgoszcz points to its role as an important transportation hub in road, rail, air and inland waterway transportation (*Bydgoszcz 2030*, p. 7). In the context of the city's strengths in the economic dimension, namely the availability of investment land and a diversified economic structure, the issues of transportation accessibility through integrated and sustainable transportation seem extremely important for the development of the Bydgoszcz metropolitan area. With regard to air transportation, the strategy highlights the weaknesses arising from the network of connections available at Bydgoszcz Port and emphasizes the need to expand the port. In 2021, the airport launched flights to Kraków and resumed flights to Kiev.

In addition to permanent connections, seasonal flights to Dublin, Kiev and Antalya were implemented (*Raport o stanie miasta*, p. 239).

Gdańsk, located in northern Poland, is the capital of the Pomeranian Voivodeship. Together with Gdynia and Sopot, it forms a polycentric metropolitan area. Gdańsk is a city well connected with other cities and regions in Poland and abroad. Gdańsk is home to a seaport and an airport considered to be the poles of its growth (*Gdańsk 2030 Plus Strategia Rozwoju Miasta*, p. 22). In recent years, investments have been made at the airport, consisting of the construction of a new passenger terminal along with the expansion and modernization of airport and port infrastructure, increasing accessibility and comfort for travelers, as well as improving connections between the airport and seaport. European Union, Cohesion Fund, Infrastructure and Environment Program (<https://www.airport.gdansk.pl>).

Among Gdańsk's competitive advantages, the technical infrastructure - transport and logistics - is pointed out, which enables it to handle the growing number of passengers and goods (Szmytkowska, p. 118). The developed transport function accounts for investment attractiveness and is the basis for the development of other industries in the city, and plays an important role in connecting the countries of northern and southeastern Europe (*Gdańsk 2030 Plus Strategia Rozwoju Miasta*, p. 20).

Tab. 1

Socioeconomic indicators of communes in 2016 and 2021

Communes	Population [Thousands]		Migration balance per 1,000 population		Increase birth rate per 1,000 population		Share of registered unemployed as a percentage of the working age population [%]		Employed per 1000 of the population		Entities registered in the REGON register per 10,000 population	
	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021
Bydgoszcz	353.9	334.0	-2.3	-5.9	-1.3	-6.9	3.8	2.1	346	364	1213	1359
Gdańsk	463.7	486.3	2.7	2.1	1.4	-2.13	2.9	2.5	353	372	1626	1787
Łódź	696.5	664.9	-1.2	-1.9	-5.0	-9.96	6.6	5.4	336	374	1331	1493
Poznań	540.4	545.1	-3.3	-2.2	1.0	2.76	2.0	1.7	452	461	2045	2257
Wrocław	637.7	674.3	3.2	1.4	1.0	-2.02	2.6	1.9	420	434	1826	1984
Świdnik	39885	37.4	-3.9	-6.4	0.2	-7.57	7.1	5.1	218	238	887	1021
Zabierzów	25.8	29.1	10.4	14.3	0.1	-0.9	3.5	2.7	495	331	1276	1463
Trzebow-nisko	21.2	23.6	4.9	16.9	5.0	0.6	5.8	4.6	283	445	809	997
Ożarówce	5.7	5.9	4.2	11.9	0.2	-4.3	4.6	3.6	533	588	1171	1279
Goleniów	35.8	37.0	0.4	4.2	2.3	-2.4	3.5	2.1	355	372	1285	1406

Source: <https://bdl.stat.gov.pl/bdl/dane/teryt/tablica#>

One of the directions of activities adopted in the strategy under the objective - Innovative City is: Strengthening the competitiveness of the seaport and airport and improving external transport accessibility. <https://bdl.stat.gov.pl/bdl/dane/teryt/tablica> Investments are being made in the areas around the port, which in the future will result in new jobs (the so-called Airport City), logistics, services, and high-tech industry are developing there (*Gdańsk 2030*, p. 33, <https://airportcitygdansk.pl/index.html>); *Raport o stanie Miasta Gdańska* p. 8)). According to the data presented in the Report on the State of the City of Gdańsk (*Raport o stanie Miasta Gdańska*), air transport carried out at the port in 2021 was characterized by an upward trend (*Raport*, p. 158), with more passengers handled as well as more cargo handled compared to 2020. Passengers used 108 air connections, including 95 scheduled airlines and 13 charter connections. During summer, carriers offered flights to 23 countries to 77 airports (*Report*, p. 168).

One of the strengths of Łódź, the capital of the Łódzkie Voivodeship, is its location in central Poland at the intersection of two TEN-T (Trans-European Network-Transport) network corridors covering road, rail, air, sea and river routes. Władysław Reymont Airport, located not far from Łódź, plays an important role in the city's development by increasing its transport accessibility and investment attractiveness (*Łódź 2021*, s. 6), handling both passenger traffic (in 2021, 69,320 passengers were handled at the airport) and cargo traffic (in 2021, 7355 k, an increase of 19.6% compared to 2020). Two new carriers were recently acquired: Lumiwings offering flights to selected destinations in Southern Europe and SkyUp offering flights to Kiev (*Łódź 2021*, p. 17). In 2022, holiday charters from Łódź airport included flights to Turkey (Antalya, Bodrum), Greece (Zakynthos, Rhodes, Crete), and Bulgaria (Bourgas). The majority shareholder of the airport is the city of Łódź (95.62%) (<https://www.lodz-airport.pl/pl/moje-lotnisko/o-firmie>). The city in 2021 increased its share capital in the company to enable it to repay its investment obligations (*Łódź 2021*, p. 109).

Poznań, the capital of the Greater Poland Voivodeship, located in the western part of Poland, at the intersection of two TEN-T network corridors (North Sea-Baltic and Baltic-Adriatic), plays the role of a base city-node (*Strategia rozwoju miasta Poznania 2020+*, p. 67). In the development strategy of the city of Poznań 2020+, priority 1. A strong metropolis assumes the intensification of international contacts and ties, including measures to support the expansion of the network of rail, road and air connections with other cities (p. 29). One of the tasks serving this purpose is the planned, in the period 2025-2030, creation of a railway connection with Poznań-Ławica Airport (since 2020, works on the preliminary feasibility study for the development of Poznań Railway Node are in progress) (<https://www.rynek-kolejowy.pl/mobile/powstanie-koncepcja-rozwoju-poznanskiego-wezla-kolejowego-95782.html>) and its connection with the tram and bus network and P+R car parks, as well as the expansion of the airport infrastructure (*Strategia*, p. 63; *Raport o stanie miasta Poznania*, p. 632).

In the context of air transport in Poznań, locations have been identified that are particularly exposed to aviation noise – in the area of Poznań-Ławica Airport and the military airport in Krzesiny. Among other things, the disadvantages for residents were reduced, night flights were restricted, and the technical condition of airport facilities was improved (*Raport o stanie miasta Poznania*, p. 279). At the same time, the airport continued to pay compensation for the establishment of a restricted use area around the airport in 2021, financed by the company's bonds (*Raport*, 689). Poznań Airport, like other airports in Poland, was rebuilding air traffic after the pandemic in 2021. According to the data, more than 1 million passengers were served at the port in 2021 (a 60% increase compared to 2020). At the same time, the port was investing

in systems for cyber threat reporting; network visibility management; intruder detection within the port; and also upgrading the cargo terminal premises (*Raport*, p. 639).

Wrocław, the capital city of the Lower Silesian Voivodeship, is located in south-western Poland. Wrocław Airport handles passenger and cargo flows. In 2021, like other ports in Poland, it registered a significant increase in passengers served compared to 2020. (41%), but failed to return to the values recorded in 2019. With regard to the weight of goods carried between 2018 and 2021, the highest value was recorded in 2021, it was - 11211 tonnes (*State of Wrocław Report*, p. 205). The airport also carried out military and civilian air operations in the field of saving human health and life as complementary to the primary scope resulting from the function of a public-use airport (*Report on the State of the City of Wrocław*, p. 205). The commune of Świdnik is located in the Lubelskie Voivodeship in eastern Poland, approximately 10 km from Lublin, with access to the railway line connecting Lublin with Warsaw, Kiev and Lviv. The airport located in the commune is recognised as a strength in the commune's development strategy (*Development Strategy of Świdnik Commune for 2015-2025*, p. 14).

Rural communes

The Zabierzów commune is located in the Małopolska province in the vicinity of the provincial capital Kraków (13 km). The close location of the commune in relation to a large city and good transport links to it enable residents to access a larger and more diverse labour market; access to institutions providing educational, health and cultural services; and the existing natural assets make it perceived as an attractive place to live. One of the factors important for the commune in the context of development processes is the airport, which affects the economic activity and investment attractiveness of the place.

The Trzebownik commune is located in the Podkarpackie voivodeship, approximately 7 km from the voivodeship capital, Rzeszów. Among the factors that determine the development in Trzebownik commune are Podkarpacki Park Naukowo-Technologiczny Aeropolis (Podkarpacki Science and Technology Park Aeropolis) (part of SSE Euro-Park Mielec) and the neighbouring Rzeszów-Jasionka Airport. The activities of these entities support the changes in the economic structure of the commune towards industry (*Development Strategy of Trzebownik Commune*, p. 11, 71, 77).

The commune of Ożarów, is located in the south of Poland in the Silesian Voivodeship. On the commune's territory there is an economic activity zone and an airport, which determine its development, making it attractive to new residents and entrepreneurs (*Strategy for solving social problems of Ożarów*, p. 87-88).

Urban-rural commune

The commune of Goleniów is located in north-western Poland, in the West Pomeranian Voivodeship, approximately 36 km from Szczecin. In the commune, investments have been made in transport infrastructure to integrate road, rail and air connections, thus influencing the commune's transport accessibility, improving the movement of residents and strengthening the investment attractiveness for domestic and foreign investors (*Development Strategy of Goleniów Commune for 2014-2023*, p. 18, 20).

4.2. Characteristics of airports in the context of their impact on the situation in communes

An analysis (Text Mining) of the International Air Transport Association's reports on passenger and Cargo traffic from 2018 to 2022 showed that problems specific to this mode of

transport, in addition to the figures quoted, were evident in the vocabulary used. While reports until the end of 2019 often featured the word "growth" or an indicator showing air carriers' revenue per passenger-kilometer, words related to pandemic, restrictions, and decline were more common in subsequent studies (Sirko, 2022). In 2021, there is a revival of the aviation market 2021 (<https://www.iata.org/en/publications/economics/>). This is a positive sign, offering hope for a return to normality. However, it is important to remember that the return to pre-pandemic conditions will be spread out over time.

The problems faced by international airports have also been and continue to be associated with airports that offer shorter-haul connections. Based on data obtained from the ULC, it was found that until 2019, the number of flight operations was increasing at the airports shown in Figure 1. At most of them, this translated into an increase in the number of passengers served. In the first half of 2020, similar to other airports, there was a clear decline in the number of flight operations performed and the number of passengers handled at these airports. Figure 2 shows how the number of flight operations performed at these airports changed in the subsequent quarters of 2020 and 2021 (compared to the corresponding quarters of 2019). Analysing the depicted data, we can see that regardless of the size of the airport, viewed through the prism of the number of flight operations performed and the number of passengers checked in (in the figure, the lines reflect the adopted division into four groups of airports - see the organisation of the research), the changes at airports were similar.

Airports provide important logistical support for short-, medium- and long-distance freight traffic. In the age of globalisation, when cooperating companies are spread out in different locations and people use the Internet to make purchases in different parts of the world, air transport is gaining in importance due to delivery times. It is a good solution for transporting high-value, perishable goods, which, by supporting the JIT strategy, allows inventories to be kept at a certain level. Due to the strict controls at airports, it is also a safe mode of transport. Developed and modernised infrastructure at airports (cargo terminals) favours the movement of cargo by air. However, this mode of moving goods has certain limitations related to the type, dimensions and weight of the cargo (<https://cargosad.pl/fracht-lotniczy/>).

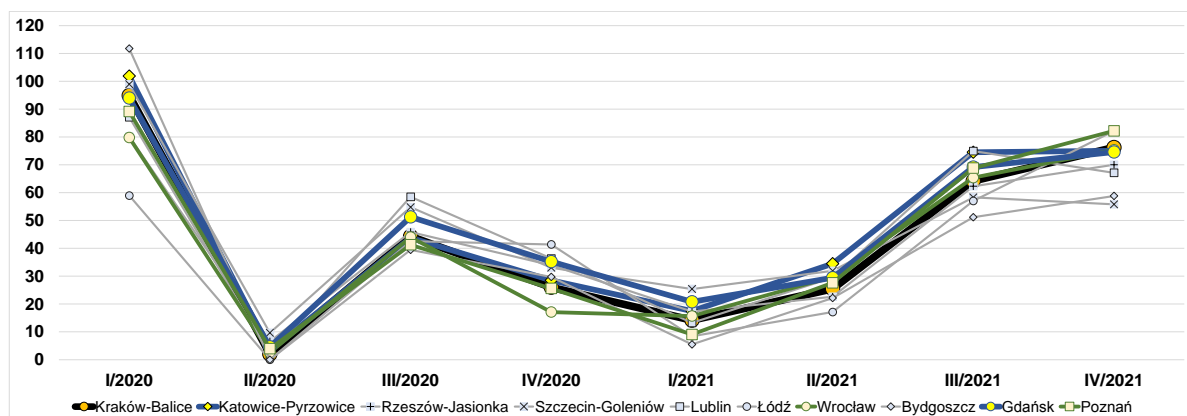


Fig. 2. Number of operations carried out at airports in relation to 2019 (data in %)

Source: own compilation based on data from ULC

According to data posted on the Civil Aviation Authority's website on the amount of cargo handled in domestic and international traffic at the airports featured in the article, the impact of the Covid-19 pandemic on the amount of cargo carried was less pronounced than for passenger traffic. From mid-2020 onwards, an increase in the amount (kg) of cargo transported is evident.

The frequency of their occurrence in individual descriptions was not the same. Among the three most frequent words in individual descriptions were (Gdańsk: *noise, environmental, environment*, Bydgoszcz: *waste, management, environment*, Poznań: *waste, operations, air*, Wrocław: *noise, waste, system*, Katowice-Pyrzowice: *waste, protection, environmental*).

4.3. Inhabitants and representatives of communes on the impact of the airport on the socio-economic situation in their communes

Residents taking part in the survey were mostly satisfied (72.2% of women, 71.4% of men) with the presence of the airport in their commune. While they were most numerous in each commune, they were most numerous in urban communes where airports are located within the borders of large cities (Bydgoszcz 88.3% of respondents, Gdańsk 84.2%, Łódź 84.2%, Wrocław 83.3%, Poznań 77.5%). In communes that are located at some distance from larger cities, the percentage of such indications was lower. Those expressing dissatisfaction with the presence of the airport were most numerous in rural communes (Ożarówice, Zabierzów), living close to the airport (no more than 5 km away). Respondents' opinions on the presence of the airport and its impact on the quality of life in their commune largely coincided (statistically significant relationship with high strength of association, $p = 0.0000$) - Figure 4.

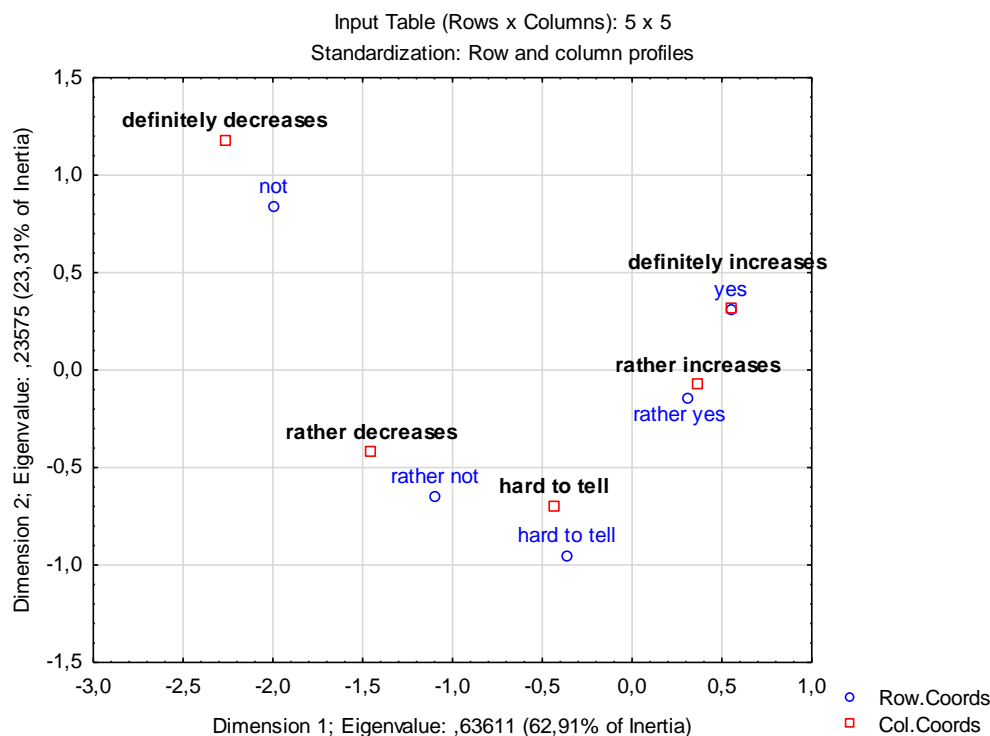


Fig. 4. Respondents' opinions on the presence of the airport and its impact on the quality of life in their commune

Source: own study

The highest percentage of responses indicating that the airport improves the quality of life was recorded in communes (Wrocław 84.2%, Gdańsk 80.8%, Łódź 78.3%, Bydgoszcz 76.7%, Poznań 71.7%). Other communes had fewer such responses (Zabierzów 58.3%, Ożarówice 57.5%, Świdnik 57.5%, Trzebowniko 55.8%, Goleniów 50.0%). Respondents in these

communes were also more likely not to take a clear position, choosing the answer 'difficult to say' (Goleniów 28.3%, Trzebowniko 27.5%, Świdnik 25.8%, Ożarowice 23.3%, Zabierzów 21.7%).

When analysing respondents' answers concerning the impact of the airport on the socio-economic situation in their commune, statistically significant correlations ($p < 0.05$) were found between the variables (mapped using arrows). In only one case (location of the airport - the airport attracts investors) was there an average strength of relationship, in the others, it was weak (Figure 5).

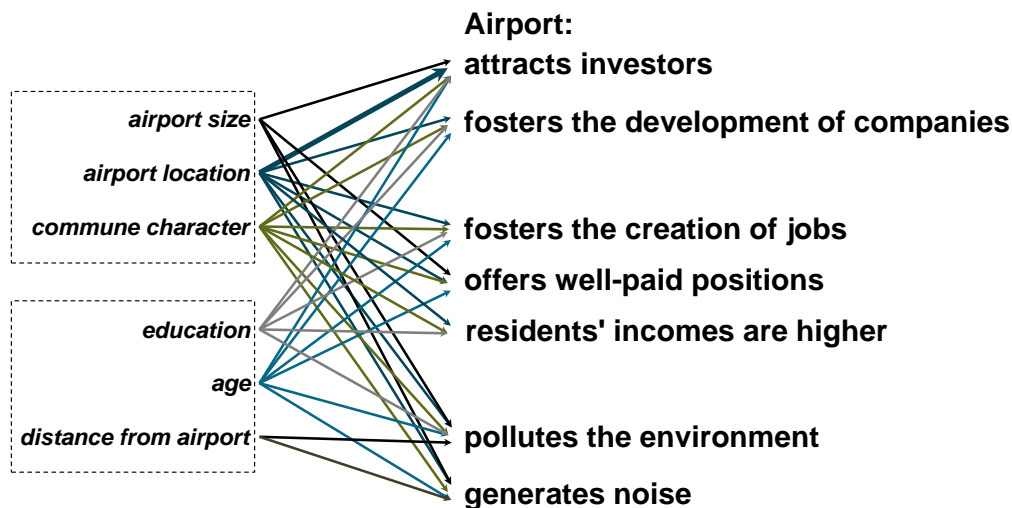


Fig. 5. Statistically significant relationships between variables
Source: own study

When referring to the impact of the airport on the socio-economic situation in their commune, the residents of the communes where the study was conducted perceived mainly economic issues, indicating that it attracts investors and promotes the development of local companies. Most such indications were found in urban communes where airports are located within the borders of large cities (e.g. Gdańsk - *airport attracts investors* - 92% of respondents, *airport fosters development of local companies* - 82%, Wrocław - *airport attracts investors* - 84% of respondents, *airport fosters development of local companies* - 85%). In communes located in the vicinity of urban agglomerations, the percentage of responses indicating such a relationship was significantly lower (e.g. Ożarowice - *airport attracts investors* - 55% of respondents, *airport favours development of local companies* - 55%, Goleniów - *airport attracts investors* - 53% of respondents, *airport favours development of local companies* - 55%). The highest number of people who perceived the importance of the airport as a magnet for investors and its impact on the development of local companies was among those with higher education and among people of working age (18-44 years).

Slightly fewer respondents perceived the role of the airport in the local labour market, indicating that it creates jobs for the local population and offers well-paid positions. Again, the highest percentage of responses perceiving such a relationship was found among respondents from urban communes where the airport is located (e.g., Wrocław - *the airport fosters job creation* - 81%, *the airport offers well-paid positions* - 72%, Bydgoszcz - *the airport fosters job creation* - 72%, *the airport offers well-paid positions* - 77%). Among respondents from rural communes, the percentage of these indications was lower - *airport favours job creation* -

61%, *airport offers well-paid positions* - 55%. The favourable impact of the airport on the labour market situation was most often seen by those with higher education, most often by those aged 18 to 44, and by gender by men aged 45 to 64 and women aged 45 to 59.

The possibility of obtaining employment at the airport or in companies that operate as a result of its presence are circumstances conducive to improving the financial situation of residents of the communes. Analysing the respondents' answers, which concerned the role of the airport as a factor in dynamising the functioning of companies and the situation on the labour market, it was found that, in the opinion of those taking part in the survey, all these circumstances (statistically significant correlations with high strength of association, $p = 0.0000$, while in the case of the question favours the development of local companies, average strength of association) contribute to the fact that residents' incomes are higher. Figure 6 shows the distribution of respondents' responses regarding the increase in residents' incomes and the role of the airport as an employer where residents of the commune can find employment. The beneficial impact of the airport was most frequently perceived among respondents with higher education who lived in large cities.

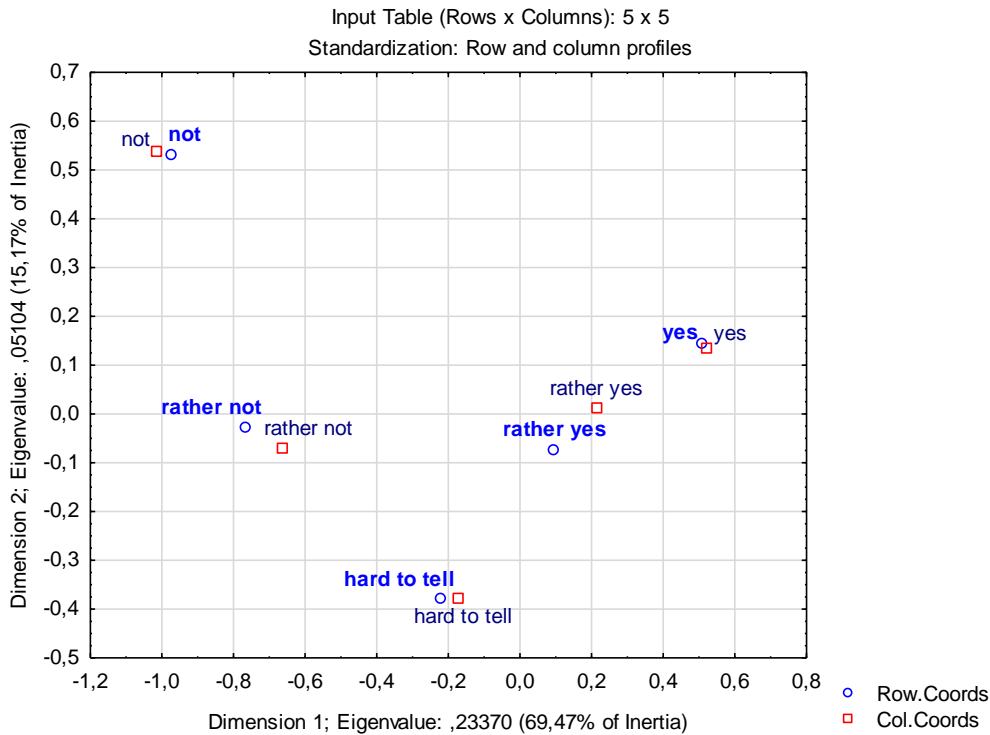


Fig. 6. Distribution of respondents' answers regarding the improvement of residents' financial situation and job creation in the context of the presence of the airport
Source: own study

The consequences of the presence of an airport are noise and pollution problems. These were pointed out by 53% and 45% of respondents respectively. Airports are centres of activity, with very extensive paved surfaces, which have to cope with drainage and, in situations of heavy rainfall, with water run-off. It is also important to ensure that the chemicals used in aircraft operations do not enter ground or surface water. Measures taken to reduce noise nuisance are the introduction of hours when aircraft do not take off and land at the airport or (where possible) the use of runways in such a way as to reduce noise.

Problems of noise nuisance were highlighted by 67% of respondents in Poznań, 66% in Wrocław, 61% in Gdańsk, 60% in Bydgoszcz, 58% in Ożarówice and 52% in Łódź. In the remaining communes, the problem was perceived by a smaller percentage of respondents (Zabierzów 48%, Goleniów 42%, Świdnik 38%, Trzebowniko 35%). The adverse impact on the environment was perceived by 52% of residents in Poznań, Ożarówice and Zabierzów, 50% in Gdańsk. In the remaining communes, the problem was perceived by less than half of the respondents. Noise nuisance was mainly noticed by people from large cities and those from other locations living near the airport (Figure 7).

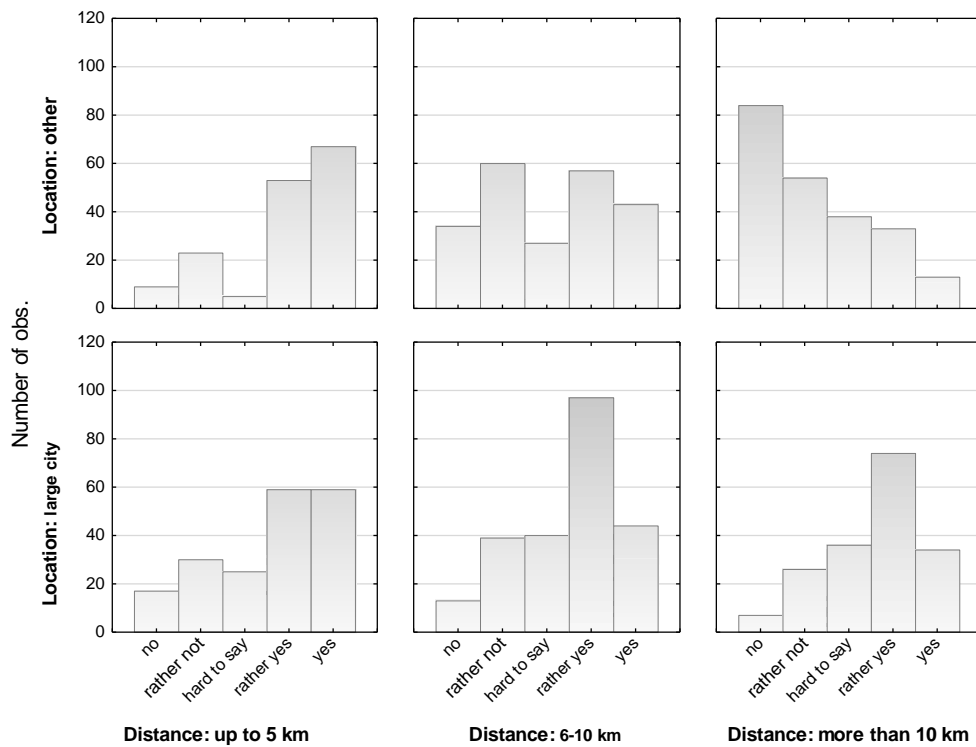


Fig. 7. Respondents' opinions on noise from the airport, taking into account its location and distance from the airport
Source: own study

The impact of the airport on the socio-economic situation in the commune where it is located was perceived by the communes, as can be found both in the documents of the communes and in the statements made by representatives of the authorities and the port. Among the words that were spoken by representatives of the local authorities and the port, words expressing emotions accounted for 20%-25%. The analysis of these statements (Text Mining) highlights the variation of emotions among the interviewees (Figure 8).

Among the words uttered by the representatives of the communes, words related to expectation and trust predominated. At the same time, the share of these emotions, in the group of communes located close to larger towns (rural communes), was clearly differentiated (from 24% to 50%). In the trust situation, the gap is as follows: rural communes from 12% to 26%, urban communes from 18% to 35%. The expectations expressed in the statements were mainly related to the recovery of passenger traffic. At all surveyed ports, the number of operations in 2021 compared to 2020 was higher but did not reach the value of 2019. - the year before the outbreak of the SARS-COV-2 pandemic. Depending on the location of the airport within

the city limits or in a commune neighbouring a large urban centre, the accents regarding the impact of the port in the socio-economic dimension were distributed slightly differently. In the former case, the port was regarded as a growth pole, a transport hub and, in the context of the TEN-T network, a base city - a node that favours the development of passenger and cargo traffic.

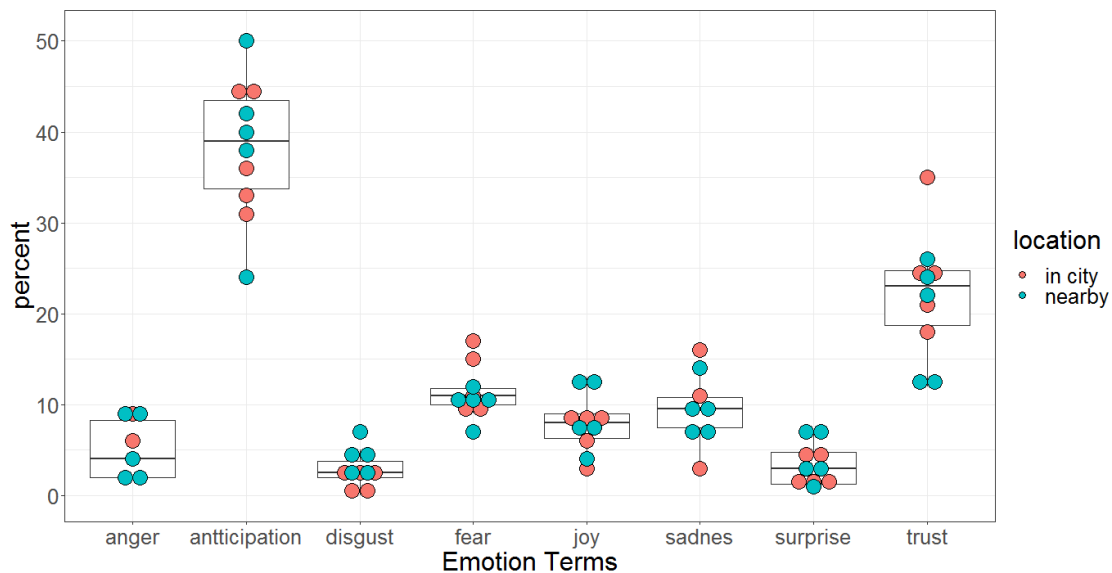


Fig. 8. Distribution of emotions in the words uttered by representatives of communes and the port
Source: own study

The development of tourist traffic, which is one of the consequences of the port's presence in the city, is conducive to increasing the turnover of businesses in the hotel, catering, cultural and other sectors and to intensifying trade. Key in this respect is the accessibility of the port for residents and tourists in economic (competition of airlines, presence of low-cost carriers) and spatial terms, as well as accessibility for businesses, which increases the attractiveness of a specific location. It is also worth emphasising that in individual cities, with the participation of public and business partners, a number of infrastructural investments have been made that have increased the accessibility of the port in space (reconstruction of streets, changes in traffic organisation, construction of bypasses, railway stations, and bus stops), reduced the congestion of access roads to the port, and shortened travel time. In addition, further measures are planned in the infrastructural area to increase the comfort of travel as well as reduce business costs. In the second case, the port is a growth pole in the commune, attracting investors who locate in specially created business zones, creating jobs, as well as gaining access to a large and absorptive market due to the proximity of the city and also to foreign markets through the port. Furthermore, the presence of terminals in towns adjacent to major metropolitan areas encourages the growth of economic endeavors related to airports.

It is also worth noting that the dynamics of passenger traffic at some of the ports were linked to a wave of economic emigration after Poland's accession to the European Union, including to the UK, Germany, Ireland, Italy, France, the Netherlands, Belgium, and also Norway, which was reflected in the flight networks (emotions expressing anticipation, trust, and joy).

Emotions expressing joy in the statements of respondents concerned the perception of the presence of the port as a reason to be proud, an element strengthening the prestige of the city

and confirming its importance in the national and international network of agglomerations and metropolises, as well as an opportunity for further investments in the city and new directions of its development.

In the context of negative emotions such as fear, sadness, and anger, the statements referred to the restructuring activities at the airports resulting from the significant reduction in air operations during the pandemic and the consequent decline in their revenues, as well as financial losses. In view of the fact that cities are shareholders in airport companies, in some cases majority shareholders, this also meant a loss to their budgets. The financial dimension also appeared in the context of statements concerning a reduction in tourist traffic, which in effect meant certain losses for cities. Less tourist traffic means less turnover in, among others, the hotel, catering and cultural industries, including the loss of jobs by some of the employees working in these industries and, as a result, a reduction in tax revenue to the cities' budgets. In relation to the location of ports, negative emotions are generated by the noise generated by aircraft, the high volume of traffic in the vicinity of the port and restrictions on the development of space regarding restricted use areas. Sometimes this also involves the need for individual ports to compensate residents.

5. CONCLUSIONS

The research was conducted during a period when airports were not operating at full capacity due to the pandemic, but the measures they were taking and the increase in passenger interest in travel in 2021 were having an impact on increasing the number of airport operations. The survey involved respondents from the communes - residents, local authorities and a representative of the port in the area where the airports were located. Both the airports and the communes varied. In the first case, the differences were due to the size of the airports, the number of flight operations by passenger and cargo traffic, and the domestic and international flight destinations offered to customers. In the second case, the differences were related to the communes, in particular their urban and/or rural character, their economic potential and structure, and their population potential. Despite the differences in both cases, it was also possible to identify similarities. From the airports' perspective, as a result of the SARS-COV-2 pandemic, there was a downward trend in the number of flight operations carried out, especially in passenger traffic, which clearly reduced this traffic and, in the second quarter of 2020, stopped it completely after almost a decade of growth (since the economic crisis in 2008). Then, from 2021 onwards, airports registered an increase in operations and a recovery in passenger traffic, although they did not reach the values characteristic of 2019. With regard to communes, on the other hand, they have been characterised over the years by increasing transport accessibility and progressive investment attractiveness. There were economic activity zones, industrial parks, and science and technology parks in the vicinity of airports, which attracted entrepreneurs and fostered job creation. Referring to the labour market situation in the surveyed communes in 2021, there was an improvement in the number of employed and unemployed compared to 2020, but in many cases these indicators were lower than in 2019, which in many respects was characterised by the most favourable values of socio-economic indicators in the 2016-2021 period. Most of the communes surveyed recorded population growth, the exceptions being: Bydgoszcz, Łódź, Świdnik. These cities were characterised by a negative total migration balance and a negative natural increase. With regard to the latter indicator, it should be noted that in the period from 2020, it concerned 9 of the examined communes, except for Trzebowńsko commune, where it was a positive value (however, with a clear downward trend).

In the communes and ports surveyed, similar patterns were observed in terms of the changes to which the socio-economic indicators were subjected.

Respondents' opinions on the impact of the airport on the socio-economic situation of the communes were mostly positive, with responses at the upper end of the scale, but varied from location to location. They were significantly influenced by the location of the airport, the size of the airport, including the number of air operations and their directions, and the nature of the commune. Among the impacts of the airport on the commune, the following were noted: direct, indirect and induced impacts (Graham, 2008). During the survey, respondents perceived direct (employment, noise), indirect (income generated in the goods and services supplier chain), and induced (increased turnover and jobs in hospitality, catering, etc.) effects. In the case of large urban communes, airports were seen as important elements that increase the transport accessibility of a specific place in space, following which they favour the intensification of tourist traffic and, consequently, the development of industries that serve this traffic. At the same time, due to its size and socio-economic potential, increased transport accessibility was an element that favoured the diversification of the labour market, attracting investors and dynamising trade. In the case of smaller communes neighbouring large cities, the airport was a source of jobs partly in companies located at the airport, but also in companies providing services around the airport. In these communes, infrastructural investments were made, which, combined with specially prepared investment areas, provided an incentive for domestic and foreign entrepreneurs to undertake economic activity. Environmental protection issues are also strongly emphasized in studies, reports, and strategies. In the past, due to the solutions used, including the technical sophistication of aircraft, the area occupied by airports, and the number of people transported, they were not so relevant. Nowadays, however, airports, local authorities and residents alike emphasise the importance of environmental measures. Airports are investing in solutions that protect the natural environment and reduce pollution and noise.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors alone are responsible for the views expressed in this article, and they do not necessarily represent the views, decisions or policies of the institutions they are affiliated with.

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Received 19.07.2023; accepted in revised form 30.09.2023



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