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CONSUMER BEHAVIOR OF INHABITANTS OF KALININGRAD DISTRICT IN THE POLISH-RUSSIAN LOCAL BORDER TRAFFIC ZONE

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ABSTRACT

Local Border Traffic (LBT) established on the Polish and Russian border in 2012 created new market opportunities for Russian consumers from the Kaliningrad District, which led to a question of how the changing political, economic and social conditions impacted consumer behavior of Russians in the border market of LBT. The study aimed to answer this question based on a survey of 1,022 respondents from Kaliningrad District, carried out in 2012–2016. Findings show that Russian consumers benefitted from cross-border shopping and trade and contributed to local development on both sides of the border until administrative and economic barriers appeared. The unfavorable border crossing regulations, ban on the import of agri-food goods from Poland to the Russian Federation, and increasingly unfavorable ruble exchange rates changed the behavior of Russian consumers significantly, decreasing their purchase and consumption of goods and services bought in the LBT zone in Poland.

Key words: local border traffic, consumer behavior, Russian consumers, Kaliningrad District

JEL codes: D12, D91, E27

INTRODUCTION

After Poland's accession to the European Union in 2004, the Polish north-eastern and eastern border became an external border of the European Union. To relieve the negative effects of visa requirements for the inhabitants of the Polish-Russian border area and enable continuation of trade, as well as social and cultural exchange [Chmieliński and Wawrzusiszyn 2017], a Local Border Traffic (LBT) between Poland and the Kaliningrad District – KD (also: Kaliningrad Oblast) was established in 2012. Establishing local border traffic between an European Union member state and a non-EU country was made possible based on the Regulation (EC) No 1931/2006 of the European Parliament and of the Council of December 20, 2006, laying down rules on local border traffic at the external land borders of the Member States and amending the provisions of the Schengen Convention.

The main aim of LBT was to stimulate cross-border collaboration [Żęgota 2014] which could enhance the competitiveness of border regions [Palmowski and Fedorov 2020] and improve the standard of living of their inhabitants [Witkowski 2014]. The new opportunities for cross-border trade and shopping defined new research areas. These areas include market behavior of inhabitants of border regions, which is an extremely complex phenomenon. It depends on the political and economic situation, built up of numerous situational factors that may accelerate, delay or

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completely stop the participation of market entities in cross-border trade.

The Russian Federation (Russia) has been a very important economic partner, whose favors are sought by many economies in the world, despite the dynamically changing geopolitical conditions, the specificity of the behavior of Russian consumers, the instability of the Russian market and difficulties in developing the principles of bilateral cooperation. The Ipsos Global Trends [2017] report showed that Russians were among the societies least satisfied with their standards of living and with what they had achieved in their lives. In addition, differences in the behavior of Russian consumers is very much dependent on their place of residence due to the huge geographic extent of the country, and varied culture, mentality, values and financial possibilities [Chernova et al. 2017]. Thanks to the Agreement on the local border traffic [Umowa… 2012], and the development of a free market economy, the facilitation and functioning of local border traffic between the Republic of Poland and the Russian Federation caused a change in the availability of Polish market goods for Russians. Thus, on the one hand, Russians living in KD could purchase goods and services in Poland, being a part of the European Union single market. On the other hand, the massive presence of KD residents had a significant impact on retail trade in the zone covered by LBT on the Polish side [Batyk 2020a].

The Agreement on the local border traffic [Umowa… 2012] signed by Poland and the Russian Federation in 2012, laid down rules for the development of cross-border trade between these two countries. According to Powęska [2016], the development of cross-border trade depends on:

– economic factors such as differences in prices of goods, differences in population income, taxes, the level of socio-economic development, quality of goods and the level of market supply;
– formal and legal factors including possibilities of crossing the border, control systems, flow of information and security;
– infrastructural and technical factors, e.g. technical infrastructure and spatial accessibility;
– organizational and behavioral factors, i.e. population behavior, service level, interpersonal relations, trade organization, entrepreneurship, readiness to travel and forms of trade.

Promotion of global consumption that results in the unification of consumption also has a huge impact on the behavior of consumers in border markets [Schiffman and Kanuk 2004, Zalega 2012]. Additionally, the behavior of consumers in border markets largely depends on their optimism.

The development of cross-border trade on the Polish-Russian cross-border market was significantly influenced by an increase in the spatial mobility of the inhabitants of the border regions. This mobility started on July 27, 2012 and continued until July 4, 2016. During this period, there was a changeable dynamic in the number of Russians crossing the Polish-Russian border, which allowed distinguishing two stages of LBT functioning:

– from July 2012 to the end of 2014, when there was a gradual increase in the number of Russians entering Poland under the LBT;
– from 2015 until 2016, when there was a downward trend.

Unfortunately, geopolitical conditions and tense Polish-Russian relations led to a crisis in mutual relations and suspending of the LBT in 2016. The crisis was severe for all areas of cross-border cooperation, economic sectors, and especially for the inhabitants of border regions. Suspending the LBT changed the rules for crossing the Polish-Russian border – from that moment, all Russians who wanted to cross the border with Poland had to obtain a Schengen visa. It limited the cross-border mobility of many Russian inhabitants, especially people living in rural areas, whose financial situation was significantly different from that of the inhabitants of the city of Kaliningrad. The cost for a Schengen visa, along with the cumbersome and lengthy procedure of obtaining it, created a significant obstacle or even an insurmountable barrier for many of those residents [Powęska 2016, Batyk 2020b].

When the LBT agreement was in force, nearly 2.4 million Russians from KD entered Poland [Statystyki Komendy Głównej… 2017]. It raised a question of how LBT on the Polish-Russian border affected market behavior of inhabitants of the KD. As the literature lacks studies on this matter, the aim of this article is to answer this question and to verify the following hy-

pothesis: consumer behavior on border markets that allows local border traffic depends on exogenous economic and administrative factors.

METHOD

The hypothesis was verified based on the results of interviews conducted between 2012 and 2016 with 1,022 residents of KD purchasing goods on the Polish border market. Standardized face-to-face interviews were conducted. The selection of the research method was deliberate, as through the direct contact with respondents their reactions and emotions were revealed. Face-to-face interviews enabled achieving the most reliable research results. The research time span was characterized by a very high volatility of political, economic and social factors, such as: starting the LBT and the increased activity of Russians on the Polish border market, Russian embargo on agri-food products from the European Union, large currency exchange rate fluctuations, political tensions and hostile media propaganda influencing the public mood and the suspension of LBT. All those factors contributed to distinguishing the following four stages:

- stage I: lasted from July 27, 2012 (commencement of the LBT) to January 31, 2014. Border traffic on the Polish-Russian border significantly increased and so did the purchasing activity of Russian consumers;
- stage II: lasted from February 1, 2014 until December 31, 2014. In February 2014, Russia banned the import of agri-food products from the European Union countries, and in December the value of the Russian ruble fell sharply. There was a further increase in border traffic and the expenses of Russians in Poland;
- stage III: from January 1, 2015 to July 3, 2016 (suspension of the LBT). There was a relative stagnation in the currency market and a ban on the import of agri-food products from the to Russia. Border traffic decreased and Russians spent less money in Poland;
- stage IV: lasted from July 4, 2016 until December 31, 2016. There was a significant decrease in the intensity of border traffic and expenditures of Russians in Poland. It was a period of political tensions and hostile media propaganda influencing public attitudes.

To investigate into the effects of the Polish-Russian LBT on the customer behavior of inhabitants of KD, the questionnaire included 8 statements (Table 1) that enabled identification of this behavior and its changes at the above-defined four different stages of LBT functioning. The statements were elaborated based on the authors' experience and the direct observations of the studied phenomenon. Respondents were asked to indicate on a five-point Likert scale the strength of their agreement or disagreement to the eight statements describing their consumer behavior. Due to the use of an ordinal scale the study is quasi-quantitative. The scale had numerical values assigned to the following attitudes: 1 – strongly disagree, 2 – disagree, 3 – undecided, 4 – agree

Table 1. Descriptive statistics for the behavior of KD residents on the Polish-Russian LBT

No	Opinion	Mean	Dominant	Median	Std. dev.	Coefficient of variation
1.	I buy most food in Poland after establishing LBT	2.79	1	2	1.63	58.38
2.	I spend less money on food after establishing LBT	2.88	5	2	1.73	60.03
3.	I buy most non-food products in Poland after establishing LBT	3.62	5	4	1.47	40.61
4.	I spend less money on non-food products after establishing LBT	3.75	5	5	1.56	41.65
5.	The availability of Polish products increased in KD after establishing LBT	3.46	4	4	1.30	37.57
6.	After establishing LBT prices of Polish products sold in KD are lower	2.74	2	3	1.32	48.34
7.	After establishing LBT I make money on selling products brought from Poland	2.95	1	3	1.88	63.50
8.	I spend my leisure time more attractively in Poland after establishing LBT	4.23	5	4	0.85	20.12

Source: Authors' own research.

and 5 – strongly agree. The numerical values were used to measure the studied behavior.

Qualitative and quantitative analysis was applied to process the survey data.

RESULTS AND DISCUSSION

Table 2 presents the main socio-demographic characteristics of respondents, which show the distribution of responses in each stage of the research, i.e.: in stage I – 23.1%, stage II – 28.9%, stage III – 27.4% and stage IV – 20.6%.

The analyses used descriptive statistics such as: mean, mode, median, standard deviation, coefficient of variation (Table 1). Opinions indicating that after the introduction of LBT: Russian consumers spent their free time more attractively in Poland (4.23), they spent less money on non-food goods (3.75), they would buy most non-food goods in Poland (3.62) and the availability of Polish goods increased for them

Table 2. Main socio-demographics of respondents

Socio-demographics	$N = 1022$	Stage			
		I	II	III	IV
		%			
		23.1	28.9	27.4	20.6
Gender					
Females	51.2	55.9	47.8	52.5	48.8
Males	48.8	44.1	52.2	47.5	51.2
Age					
15–24	15.3	5.9	28.1	10.7	13.7
25–34	19.0	16.1	18.3	20.0	21.8
35–44	17.4	16.1	16.6	18.2	19.0
45–54	17.7	20.8	12.2	21.4	17.1
54 and more	30.6	41.1	24.8	29.7	28.4
Education					
Primary	4.7	6.4	2.0	6.8	3.8
Vocational	47.1	49.1	54.6	41.4	41.7
High school graduate	16.6	19.9	10.9	19.3	17.5
University graduate	31.6	24.6	32.5	32.5	37.0
Place of residence					
Rural areas	25.4	28.8	23.1	24.3	26.1
Town with less than 50 thousand inhabitants	25.4	32.2	18.6	28.6	23.2
City with more than 50 thousand inhabitants	49.2	39.0	58.3	47.1	50.7
Number of persons in the household					
1–2	33.7	32.6	30.2	36.4	36.0
3–4	47.4	46.6	52.2	43.2	47.4
5 and more	18.9	20.8	17.6	20.4	16.6
Profession					
Own business	18.9	23.7	20.7	15.7	15.2
Employed by the state enterprise	21.2	26.3	14.6	24.3	20.9
Administration employee	23.3	19.9	22.0	26.4	24.6
Unemployed	16.6	17.4	13.9	17.9	18.0
Student	14.0	5.1	26.4	8.6	13.7
Retired	6.0	7.6	2.4	7.1	7.6
Average monthly income per 1 person in the household					
Below 10 thous. RUB	23.5	22.9	23.1	23.9	24.2
10–15 thous. RUB	9.3	9.3	10.8	8.2	8.5
15–20 thous. RUB	15.5	22.9	13.9	11.1	15.2
20–25 thous. RUB	20.7	18.7	18.3	24.3	21.8
More than 25 thous. RUB	26.8	23.7	28.1	27.1	27.9
No answer	4.2	2.5	5.8	5.4	2.4

Source: Authors' own research.

(3.46) had the highest average values. At the same time, both the standard deviation and the coefficient of variation for these indications were the lowest, which may indicate a similar perception of the impact of LBT by KD residents.

The following opinions had a very high value of the coefficient of variation: After the establishing LBT: I receive income from the sale of goods imported from Poland (63.50), and I spend less money on food (60.03).

The behavior of KD residents varied most between stage II and stage IV (Table 3) in the following aspects:

- I buy most of my food in Poland: from 11.06% in stage II to 1.37% in stage IV (a decrease of 9.69 percentage points);
- I spend less money on food: from 14.87% in stage II to 2.54% in stage IV (a decrease of 12.33 percentage points);
- I buy most of the non-food goods in Poland – from 12.82% in stage II to 6.46% in stage IV (a decrease of 6.36 percentage points);
- I spend less money on non-food goods – from 17.81% in stage II to 9.00% in stage IV (a decrease of 8.81 percentage points);
- the availability of Polish goods increased in KD – from 13.01% in stage II to 1.27% in stage IV (a decrease of 11.74 percentage points);
- the prices of Polish goods sold in KD are lower – from 5.68% in stage II to 0.98% in stage IV (a decrease of 4.7 percentage points);
- I receive income from the sale of goods imported from Poland – from 12.72% in stage I to 6.65% in stage IV (a decrease of 6.07 percentage points);
- I spend my free time in Poland more attractively – from 15.85% in stage II to 8.02% in stage IV (a decrease of 7.83 percentage points).

The differences in the respondents' answers ranged from 12.33 percentage points (I spend less money on food) to 4.07 percentage points (the prices of Polish goods sold in KD are lower).

The findings of this research showed that Russian consumers' expenditure on food decreased from 42.2% in 2013 to 29.4% in 2014, while the share of expenditure on non-food goods increased from 50.5% in 2013 to 54.9% in 2014 and 57.5% in 2015. It confirmed results of other studies [GUS and US w Rzeszowie 2014, 2015, 2016]. Since 2014, there has been a significant decline in expenditures on the purchase of consumer goods in KD, which contributed to the economic slowdown in the exclave, where the consumption crisis was intensifying [Anczakowska 2016]. This problem was felt both by economic entities within the LBT and the national economy.

Russians used to buy agricultural and food products in Poland. Those were especially meat and its products, dairy products, as well as shoes and clothing [Batyk 2019]. Russians had the option to buy goods for their own needs at a lower price or to resell them for profit. A new category of participants appeared – they were less wealthy people for whom obtaining a visa was a heavy burden on the budget. Cross-border purchases were treated by communities of peripheral local government units located on the border as a stimulator of socio-economic development [Powęska 2020].

The structure of goods purchased by the inhabitants of Kaliningrad District in Poland changed significantly due to the introduced restrictions on the import of agrifood products from Poland to Russia. The ban on the import of meat and meat products, as well as milk and dairy products from Poland to Russia, in force since February 2014, also applied to individuals who would bring more than 5 kg of animal products to KD. Inhabitants of KD bought in Poland, both foodstuffs prohibited for import, as well as goods that they could transport across the border, such as: clothing and footwear, cosmetics, electronics, building materials. Russians' interest in purchasing luxury goods such as jewelry, leather goods, electronics, yachts and cars increased significantly. Data obtained from the Customs Chamber in Olsztyn showed that since 2015 the number of documents for goods purchased by Russians in Poland decreased, while their value increased.

The fall in the value of Russian currency did not significantly reduce the competitiveness of Polish goods in relation to Russian domestic products. The suspension of the export of Polish agri-food products to Russia resulted in their unavailability in legal retail trade in KD. However, the embargo did not cause a complete lack of Polish goods on the Russian market. Paradoxically, access to them in frontier trade increased. The research results indicate that

Table 3. Opinions of KD residents about the consequences of the Polish-Russian LBT in stages I–IV

	Opinions of KD residents on statements							
	1	2	3	4	5	6	7	8
	as % of responses							
Stage I: 27.07.2012–31.01.2014								
Strongly agree	9.78	12.92	10.76	13.01	8.32	5.58	12.72	11.25
Agree	3.91	0.59	3.82	1.27	7.53	3.52	1.17	9.00
Undecided	0.88	0.98	1.86	1.47	5.58	5.97	0.68	2.84
Disagree	4.70	4.70	4.21	4.40	1.17	4.99	0.68	0.00
Strongly disagree	3.82	3.91	2.45	2.94	0.49	3.03	7.83	0.00
Stage II: 1.02.2014–31.12.2014								
Strongly agree	11.06	14.87	12.82	17.81	13.01	5.68	11.35	15.85
Agree	5.58	1.57	6.95	1.66	9.20	4.99	0.98	10.57
Undecided	1.96	1.96	0.39	0.78	5.68	6.95	1.66	2.35
Disagree	5.09	5.38	4.70	4.6	0.78	7.44	0.59	0.10
Strongly disagree	5.19	5.09	4.01	4.01	0.20	3.82	14.29	0.00
Stage III: 1.01.2015–3.07.2016								
Strongly agree	3.62	4.99	9.10	14.09	3.91	2.15	9.59	11.06
Agree	2.15	0.59	9.00	4.11	7.34	3.42	3.52	8.32
Undecided	1.76	1.66	1.37	1.27	6.75	6.85	0.49	4.89
Disagree	5.97	5.87	3.03	3.13	4.70	8.12	0.98	3.13
Strongly disagree	13.89	14.29	4.89	4.79	4.70	6.85	12.82	0.00
Stage IV: 4.07.2016–31.12.2016								
Strongly agree	1.37	2.54	6.46	9.00	1.27	0.98	6.65	8.02
Agree	2.45	1.86	6.65	4.01	3.72	1.76	1.96	7.24
Undecided	1.96	1.66	2.54	2.45	4.21	4.99	1.37	4.31
Disagree	4.79	4.40	1.96	2.15	5.77	5.38	0.59	1.08
Strongly disagree	10.08	10.18	3.03	3.03	5.68	7.53	10.08	0.00

Explanatory note: 1 – I buy most food in Poland, 2 – I spend less money on food, 3 – I buy most non-food goods in Poland, 4 – I spend less money on non-food goods, 5 – access to Polish goods has increased in KD, 6 – prices of Polish goods sold in KD are lower, 7 – I earn income from the sale of goods imported from Poland, 8 – I spend my free time more attractively in Poland.

Source: Authors' own research.

the availability of Polish goods sold in KD increased significantly after the introduction of the embargo, from 8.32% of indications in the first stage to 13.01% in the second stage. Respondents' indications about the lower prices of Polish goods sold in cross-border trade in KD compared to store prices did not differ significantly between the first (5.58% of indications) and the second stage (5.68%).

In the opinion of Russian consumers, food products from Poland had a well-recognized, much higher quality compared to Russian domestic products. Therefore, they were worth paying a higher price. Even though many Russian media reports informed that the quality of food products from Poland was questioned by the Russian sanitary inspection services, the interest of Russian consumers in purchasing these products did not diminish. Only in the third and fourth stages of the research, after a sharp decline in the value of the Russian ruble and more detailed border controls, the respondents did not agree that the access to Polish goods in cross-border trade in KD increased and that the prices of these goods were lower compared to prices in Russian shops.

The LBT and the resulting possibility of multiple border crossings had a great influence on Russians' shopping on the Polish border market. This is illustrated by the results of the research in its fourth stage. Respondents disagreed with the opinion that they buy most of their food in Poland (10.08%) and spend less money on it (10.18%). The percentage of responses confirming the opinion that the respondents obtained income from the sale of goods imported from Poland decreased from nearly by half.

Suspending the LBT did not stop Russians from coming to Poland, but it resulted in quantitative restrictions [Bobryk 2020]. The sharp decline in the number of Russians crossing the Polish-Russian border led to direct economic losses. Those losses were estimated at EUR 20 million in the case of border regions of Poland and at EUR 50 million for the Kaliningrad District [Korneevets et al. 2017]. The count of losses did not include the multiplier effect, which significantly affects other economic indicators and the standard of living of the inhabitants of border regions [Sokół 2017]. The new situation that followed the suspension of the LBT indicated rather that the introduced changes did not inhibit the processes of convergence of consumption and cultural pluralism.

The results of the research confirm that the complex Polish-Russian relations are determined by political problems, impacting economic conditions and the technological and socio-cultural environment [Waldziński 2011]. Unfortunately, Poland's relations with KD are most often perceived through the prism of current problems, and not through long-term activities [Żukowski 2002]. The results of the research confirm that the complex Polish-Russian political relations determine economic conditions, and the technological and socio-cultural environment [Waldziński 2011].

CONCLUSIONS

The LBT established on the Polish and Russian border in 2012 created new conditions for Russian consumers – it allowed them to benefit from cross-border shopping and trade and thus contribute to local development on both sides of the border. However, such administrative and economic barriers as unfavorable border crossing regulations, ban on the import of agri-food goods from Poland to the Russian Federation and increasingly unfavorable ruble exchange rates changed the behavior of Russian consumers. Along with the decline in the purchasing power of Russian currency, the purchase of goods and services by Russian customers in Poland decreased. There was a significant decrease in the share of consumers who bought most of their food and non-food products in Poland, and those who spent less money on food and non-food products after establishing LBT. There were also less and less Russians who received income from sale of goods purchased in Poland, and who spent their leisure time in Poland more attractively. The changes in Russian consumers' behavior were caused by exogenous factors and impacted both their standard of living and local development negatively.

The findings and conclusions prove the hypothesis to be true – consumer behavior on border markets allowing local border traffic depends on exogenous economic, political and administrative factors. Findings and conclusions presented in the paper can be a basis for designing further research and for continuation of the discussion on how coexisting political, economic and social conditions impact consumer behavior in border markets with local border traffic.

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ZACHOWANIA KONSUMENCKIE MIESZKAŃCÓW OBWODU KALININGRADZKIEGO W POLSKO-ROSYJSKIEJ STREFIE MAŁEGO RUCHU GRANICZNEGO

STRESZCZENIE

Mały Ruch Graniczny (MRG) ustanowiony na granicy polsko-rosyjskiej w 2012 roku otworzył nowe możliwości rynkowe dla rosyjskich konsumentów z obwodu kaliningradzkiego. Wprowadzenie MRG zrodziło też pytanie o to, jak zmieniające się warunki polityczne, gospodarcze i społeczne wpłynęły na ich zachowania konsumenckie. Odpowiedź na to pytanie przyjęto za cel niniejszego opracowania zrealizowanego na podstawie wywiadów z 1022 konsumentami rosyjskimi z obwodu kaliningradzkiego przeprowadzonych w latach

2012–2016. Wyniki wskazały, że rosyjscy konsumenci odnosili i dostrzegali korzyści z zakupów i handlu transgranicznego oraz przyczyniali się do lokalnego rozwoju po obu stronach granicy do czasu pojawienia się barier polityczno-administracyjnych i gospodarczych. Niekorzystne przepisy na przejściach granicznych, zakaz importu towarów rolno-spożywczych z Polski do Federacji Rosyjskiej oraz coraz bardziej niekorzystny kurs rubla zmieniły znacząco zachowania rosyjskich konsumentów, zmniejszając zakupy oraz konsumpcję towarów i usług kupowanych na polskim rynku.

Słowa kluczowe: mały ruch graniczny, zachowania konsumenckie, konsument rosyjski, obwód kaliningradzki

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PRODUCTION POTENTIAL OF THE VEGETABLE SECTOR IN POLAND AND SELECTED EU COUNTRIES

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ABSTRACT

The aim of the research was to assess the production potential of the vegetable sector, as a factor of competitiveness, in Poland and selected EU countries. The evaluation of vegetable production was based on a comparative analysis of the level and changes in land area devoted to crops, yields, the number of farms and the average area of crops on the farm, the species structure of crops, the level of basic vegetable yields, and the resources of the factors of vegetable farm production from the FADN system. The research has shown that Poland's high and growing position in vegetable production results mainly from the high acreage of crops, their partially complementary structure, and above all from relatively low labour costs compared to other surveyed EU countries. On the other hand, the improvement of effectiveness is not supported by the large fragmentation of Polish farms, although an increase in the average area of cultivation per farm was observed in the examined period. The research shows that in most of the analysed countries there was still a large fragmentation of vegetable farms. The analysis of vegetable farm inputs (on the basis of FADN data) in selected countries also shows that in the analysed period, a decrease in production factor resources was observed in Poland, Italy and France.

Key words: vegetable production, vegetable farms, FADN, Poland , EU

JEL codes: Q12, D24, J24

INTRODUCTION

Within the agricultural sector the production and marketing of horticultural products (mainly vegetables, fruits, pot plants and cut flowers, or ornamental trees and shrubs) plays a specific role due to its high labour and capital intensity [Menrad and Gabriel 2009]. Vegetable production belongs to one of the most important branches of agricultural production. The world harvest in 2017 was over 1.1 billion t, while production alone covered 58 million ha. More than 75% of this production was obtained in Asia [Shahbandeh 2020]. EU vegetable production in 2017 was over 60 million t, with most being tomatoes (around 17 million t), followed by onions (over 5.5 million t), white and red cabbages (5.2 million t) and carrots (over 5.1 million t). As a comparison, in Poland in recent years, about 5.5 million tons of vegetables have been produced annually. In this area, Poland has been ranked third in the EU, after Spain and Italy [FAO 2020].

Poland's potential in terms of agricultural development opportunities, including the vegetable industry, is considerable compared to other EU countries. It is mainly related to substantial land resources and labour, although, in the case of the latter, a decrease in resources has been observed for several years with

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a simultaneous increase in labour costs, although as indicated by Ziętara and Sobierajewska [2013], compared to many EU countries, they were relatively lower at the beginning of the last decade. The agricultural land in farms in Poland in 2016 amounted to 14.4 million ha, which constituted 7.9% of the EU 28 area (4th place in the EU). The workload in 2017 in Poland amounted to about 1.84 million working in agriculture, i.e. 18.9% of total working in agriculture in the EU (2nd place in the EU) [GUS 2018].

Vegetable production in Poland plays an essential role in agricultural production and its importance is gradually increasing. The share of vegetables in the total agricultural output in Poland in 2017 was about 8.7%, in the total plant output about 18.0% and in the area of arable land (AL) about 1.6%. The share of vegetables and their preserves constituted about 5.0% in the export of food products and 23.3% in the export of plant products. According to data from The Agricultural Property Agency [KOWR 2018], in 2016, field vegetables were grown in 73,000 agricultural holdings, and vegetables under cover of about 9,000 holdings, as compared to 370,000 and 23,000 in 2005, respectively. The average area of vegetable cultivation in Polish agricultural holdings is also expanding, although it is still small. In 2016, the average area of field vegetables in a holding was 2.6 ha and undercover vegetables 0.5 ha. The development of the Polish vegetable industry was supported by relatively low labour costs, the increasing purchasing power of consumers, a developed processing industry, convenient geographical location for establishing business contacts, and changing nutritional trends [KOWR 2018].

RESEARCH METHODOLOGY

The aim of the research was to assess the production potential of the vegetable sector in Poland and selected EU countries as a factor of competitiveness. The countries which are the largest vegetable producers on the EU common market were selected for comparison. After initial data verification, Spain, Italy, Poland, France, the Netherlands and Germany were selected for further research. These countries had, depending on the year, a share of over 72% of total EU vegetable production.

The evaluation of vegetable production potential in Poland and selected countries was made based on a comparative analysis of the level and changes of the area of crops, yields, the number of farms and the average area of crops on the farm, the species structure of crops, the level of basic vegetable yields, and analysis of the resources of the factors of vegetable farm production from the FADN system. The European Farm Accountancy Data Network (FADN) was established in 1965 (Council Regulation 79/65). The network aims to collect agricultural holdings accountancy data in order to establish income and business analyses of agricultural holdings [Neuenfeldt and Gocht 2014]. FADN dataset is useful to estimate with a quantitative approach and, for a long time, the role and effect of political decisions about i.a. rural development implemented by the EU [Galuzzo 2014, Garrone et al. 2019]. The starting point in the analysis of crop structure and yields was the crop structure in Poland. Horticultural farms within the FADN are farms grouped into type 2 (GTF 2) based on the share of the value of production from each agricultural activity to the value of the total production of the holding, which specialises in the cultivation of vegetables, strawberries, mushrooms, flowers and ornamental plants.

Descriptive methods were used in the analyses, including the determination of percentages and the absolute and relative dynamics of changes in the application of:

- linear regression of the form:

$$f(x) = ax + b;$$

- exponential of the form:

$$f(x) = a^x.$$

indicating an average annual change in the phenomenon as a percentage.

In the study, data from EUROSTAT, GUS[1], IERiGŻ[2], the EU agricultural accounting system FADN, as well as literature on the discussed issues,

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were used. Data of the EU FADN system were obtained from the Agriculture and Rural Development Directorate-General (DG 6) of the European Commission (EC) in Brussels. The research covered the period of years 2004–2018[3], i.e. years after Poland's accession to the EU.

Taking into account the variability of weather conditions and the need to smooth out any deviations related to it, periods of five years were generally used. Due to the unavailability of data in some research areas, the periods may differ and be shorter, e.g. three years. Calculations were made of the average annual rate of changes in the area or harvests in the entire analysed period, without focusing on selected sub-periods, due to their different lengths. This was to clearly visualize the results. Tabular, graphic and descriptive methods were used to present the results.

PRODUCTION VOLUME AND AVERAGE CULTIVATION AREA

The largest area of field vegetable cultivation among EU countries in the years 2004–2018 was in Italy and amounted on average to 435.41 thousand ha (Table 1). Spain was in second place, France in third place, and Poland in fourth place with an average of 347.69 thousand, 247.65 thousand and 193.98 thousand ha respectively. The share of the above countries in the total EU cultivation area was 21.18, 16.91, 21.95 and 9.42% respectively. The vegetable harvest was also the highest in Italy (12.97 million t), followed by Spain (11.96 million t), with France (5.95 million t) and Poland (4.95 million t) in third and fourth place. Fewer vegetables were grown in Germany (110.56 thousand ha) and the Netherlands (82.81 thousand ha). The harvest was also lower in these countries, with the Netherlands in fifth place with an average harvest of 4.46 million t, which indicates high productivity of the vegetable industry in this country, and Germany in sixth place (3.42 million t). Also, according to a study by Filipiak and Maciejczak [2008], in the years 2004–2007 Poland was ranked fourth in global vegetable production in the EU after Italy, Spain and France. As indicated by De Cicco [2019] in 2017, the places of these countries in EU vegetable production have not changed.

Considering the changes between 2004 and 2018, in Italy and France, the area under cultivation and the harvest of ground vegetables decreased by –1.70 and –0.70% of the area and –1.3% of the harvest in both countries, respectively. In the other countries analysed, production increased. The annual increase in area was 0.76 and 0.46% in Germany and Poland, 0.15 and 0.02% in the Netherlands and Spain, and the harvest was 1.26 and 1.59%, and 0.80 and 1.06%, respectively. A comparison of the dynamics of changes in the area of crops and harvest shows that in most countries (except France and Italy) there was an increase in productivity per area unit. It should be emphasized that in the case of Poland, the indicated increase in production (changes in the cultivated area are particularly visible in Poland in the 2004–2008 and 2009–2013 sub-periods) does not confirm the results of previous research, which showed a clear decrease in the area of crops and harvest after 2004 [Olewnicki 2011, Jabłońska et al. 2017]. This discrepancy results from the fact that the Eurostat data used in this paper and the data of the Statistics Poland, used in the above publications are clearly different. On the other hand, the aforementioned downward trend, resulting from previous studies, was the result of a change in the definition of a vegetable farm by the Central Statistical Office, for which, since 2010, according to Eurostat rules, farms with more than 0.1 ha of crops were taken into account.

Regardless of the direction of changes in the area of vegetable cultivation, the number of vegetable farms has been decreasing in all countries surveyed. In the years 2005–2016, the greatest decrease was recorded in Poland, as much as by 75.58% (Table 2). However, it was partly a result of the mentioned change in the approach of Statistics Poland to the definition of a "vegetable commercial farm". The data of the agricultural censuses from 2002 and 2010 [GUS 2002, 2010] show that the number of farms decreased 5.6 times in those years, from 617.2 thousand to 110.2 thousand [Jabłońska et al. 2013]. A visible decrease in the number of vegetable farms also took place in Ita-

[3] In the case of the analysis of FADN farms, the research period covers the years 2004–2019.

Table 1. Cultivated area and ground vegetable harvest in selected EU countries in 2004–2018

Country	Period			2004-2018		
	2004–2008	2009–2013	2014–2018	average size	average annual change	share in the EU
	cultivated area					
	thousand ha				%	%
France	260.98	232.94	249.02	247.65	–0.70	12.05
Spain	368.72	306.90	367.44	347.69	0.02	16.91
Netherlands	85.56	79.73	86.95	84.08	0.15	4.09
Germany	109.58	109.96	117.44	112.33	0.76	5.46
Italy	485.06	407.43	413.75	435.41	–1.70	21.18
Poland	181.04*	208.33	189.41	193.98**	0.46	9.42
UE	2 108.64	1 916.75	2 101.79	2 055.73	–0.30	100.00
Country	harvest					
	million t				%	%
France	6.20	6.18	5.46	5.95	–1.30	10.41
Spain	12.15	9.99	13.74	11.96	1.06	20.93
Netherlands	4.49	4.76	4.92	4.73	0.80	8.27
Germany	3.21	3.52	3.63	3.45	1.26	6.04
Italy	13.96	12.82	12.14	12.97	–1.30	22.71
Poland	4.65*	4.71	5.42	4.95**	1.59	8.65
UE	57.42	51.11	62.84	57.12	0.68	100.00

* 2005–2008, ** 2005–2018,

Source: Authors' own study based on EUROSTAT data.

ly (by 42.24%), to a lesser extent in Spain, Germany and Holland (by 39.37, 37.74, 26.37%, respectively) and the smallest decrease was recorded in France (by 20.32%).

The result of the reported changes in the area of cultivation and the number of farms was an increase in the average cultivation area per farm. This phenomenon was mostly noticed in Poland, where the average area of a vegetable farm increased by 4.6 times between 2005 and 2016, while in Italy 2.03, Germany 1.73, The Netherlands 1.51 and Spain 1.10 times. In France, there was an increase of 3.21%. However, there is still a large fragmentation of farms in Italy, Spain and Poland. In 2016 the average farm grew vegetables on an area of 3.48 ha, 2.26 ha and 2.16 ha respectively. In France, it was 5.36 ha, in Germany 8.90 ha and in Holland 10.06 ha. This very low average area of vegetable crops in Polish, Spanish and Italian farms is not conducive to the improvement of economic efficiency of production and development

Table 2. Number of vegetable farms and average area under vegetables in selected EU countries in the years 2005–2016

Country	Number of farms				Average farm area			
	2005/ 2007	2010/ 2013	2016		2005/ 2007	2010/ 2013	2016	
	thousand units			index: 2005 = 100	thousand units			index: 2005 = 100
France	39.8	37.73	32.98	79.68	6.10	5.36	6.10	103.21
Spain	142.45	107.57	91.41	60.63	2.00	2.21	2.26	120.21
Netherlands	9.54	8.17	7.23	73.63	8.34	10.06	11.63	151.04
Germany	17.88	13.82	11.63	62.26	6.71	8.90	11.21	173.80
Poland	434.81	141.08	113.04	24.42	0.53	1.29	2.16	459.58
Italy	139.06	95.69	79.59	57.76	1.68	2.91	3.48	203.51

* available data for years 2005, 2007, 2010, 2013, 2016.

Source: Authors' own study based on EUROSTAT data.

of the whole sector. It adversely affects the competitive position. In comparison, according to Brzozowski and Zmarlicki (2017), orchard farms in Poland with a growing area of about 20 ha are considered to be highly competitive compared to their counterparts in neighbouring countries, and 13 ha and 8–13 ESU (European Size Units) are considered to be the minimum size for their development and competitiveness. It should be added that in all countries the area of vegetable cultivation on a single farm was much lower than that of typical agricultural crops. In 2010, the average farm area was 56.1 ha in Germany, 54.9 ha in France, 26.5 ha in the Netherlands, 9.6 ha in Poland and 8.0 ha in Italy [Nosecka et al. 2011].

PRODUCTION SPECIES STRUCTURE

In the countries studied, the species structure of field vegetable crops is different, determined to a large extent by climatic conditions. In Poland, the most important species are onions, cabbage, carrots and beetroot, which in the years 2004–2018 accounted for almost 50% of the total area of vegetable crops and 60% of the total harvest (Table 3). The first three species covered 13–14% of the total area each, and beetroot 6%. In the case of beetroot, cabbage and carrots, Poland is the largest producer in the EU and in the case of onions, it ranks second [Filipiak and Maciejczak 2008]. Carrots and, above all, onions also play a large role in the field vegetable crops of the Netherlands. Here, onion production occupied an average of 34% of the total crop area and provided 29% of the total vegetable harvest. It is worth emphasizing that in the case of onions in the Netherlands, there was a large increase in the share of cultivated area between the studied sub-periods, i.e. 2004–2008 and 2014–2018. The share of carrots in the area and harvest was 11%. Onions and carrots (9% each) and cabbages (7%) are important species in the German vegetable industry. In Germany and the Netherlands, the share of beet production is low.

It should be underlined here that the importance of the above species in the vegetable production in Poland decreased in the years 2004–2018 by several percentage points (though it should be noted, however, that the share of other vegetables clearly increased in the area and harvest, between the analysed sub-periods in Poland), while in the Netherlands and Germany the changes were insignificant, with the exception of onions in the Netherlands, whose share in the area of vegetable crops increased from 29 to 38%. It can, therefore, be concluded that from the point of view of the production structure, the Netherlands and Germany are growing competitors of Poland, taking into account further development of the sector. The southern European countries, i.e. France, Spain and Italy, are not competitors. Here the above four species are of lesser importance, with the total share in the area of cultivation at the level of 10%. In the Mediterranean countries, the main species is tomato, produced e.g. in Italy and Spain for about 24 and 16% of the vegetable area. Melons, peppers, watermelons, lettuces and endives are also relatively important vegetables. Thus, the structure of crops in Poland, as well as in Germany and the Netherlands, is complementary to those countries.

The decrease in the share of cabbage, carrots, onions and beets in the area of crops and the harvest of field vegetables in Poland is a result of the decrease in the production of these species. Despite the observed variability of the cultivation area and harvest in the analysed sub-periods, the area under cultivation between 2004 and 2018 decreased annually between 2.3 and 3.3%, and the harvest between 0.8 and 2.7% (Table 4). According to a study of Filipiak (2014), the decline in the area of cultivation of most vegetables in Poland began in the early 1990s. At the same time, the area of cultivation and the harvest of onions grew in other countries, as did cabbage and beetroot (apart from France), and carrots in Germany and the Netherlands. Thus, from a production point of view, Poland is reducing its competitive position, facing increasing competition from other countries on the market of leading Polish vegetables.

However, Poland continues to be a European leader in vegetable production. This primarily applies to cabbage and beets. In the years 2014–2018, the area under cultivation and harvest of cabbage in Poland was 2.5 and 1.7 times higher than in Germany, 4.9 and 6.2 times higher than in Spain, 4.4 and 8.2 times higher than in Italy, 8.3 and 5.3 times higher than in the Netherlands and 27.5 and 16.5 times higher than in France. Over the same period, and by country in

Table 3. Structure of area under cultivation and harvest of vegetables in Poland and selected EU countries in the years 2004–2018 [%]

Vegetable	Years																	
	2004–2018						in it											
							2004–2008						2014–2018					
	France	Spain	Netherlands	Germany	Poland	Italy	France	Spain	Netherlands	Germany	Poland	Italy	France	Spain	Netherlands	Germany	Poland	Italy
	cultivated area [%]																	
Cabbage	0.45	1.42	2.39	7.01	**13.66**	1.03	0.44	1.33	1.91	5.94	**18.58**	0.91	0.33	1.27	3.15	7.72	**12.05**	1.25
Carrot	5.28	2.13	10.58	9.42	**13.03**	2.81	5.40	2.34	10.04	9.29	**17.62**	2.73	4.97	1.81	10.43	9.71	**11.87**	2.81
Onion	4.06	6.67	34.11	9.59	**14.44**	2.90	3.39	5.87	29.37	7.82	**19.33**	2.64	4.86	6.79	37.71	11.38	**13.71**	3.12
Beetroot	1.09	0.25	0.62	1.31	**6.17**	0.15	0.92	0.17	0.41	1.21	**8.06**	0.10	1.2	0.31	0.87	1.45	**5.68**	0.21
Other*	89.12	89.53	52.30	72.67	**52.70**	93.11	89.85	90.29	58.27	75.74	**36.41**	93.62	88.64	89.82	47.84	69.74	**56.69**	92.61
Vegetable	harvest [%]																	
Cabbage	1.31	1.40	3.22	15.67	**23.01**	0.81	1.39	1.30	2.98	14.32	**29.70**	0.73	1.10	1.16	3.83	16.27	**18.34**	1.00
Carrot	9.71	3.45	11.31	16.71	**16.86**	4.23	10.01	3.78	11.30	16.74	**20.61**	4.28	10.19	2.86	11.63	17.28	**14.29**	4.31
Onion	6.44	10.05	27.97	14.08	**13.17**	3.04	5.67	8.92	25.15	11.93	**16.42**	2.72	7.79	9.64	29.98	15.95	**11.36**	3.55
Beetroot	2.08	0.32	0.66	1.87	**6.80**	0.10	1.82	0.19	0.53	1.68	**8.12**	0.07	2.47	0.40	0.84	2.13	**6.01**	0.16
Other*	80.46	84.78	56.84	51.67	**40.16**	91.82	81.11	85.81	60.04	55.33	**25.15**	92.20	78.45	85.94	53.72	48.37	**50.0**	90.98

*other brassica vegetables, leafy vegetables, fruit-growing vegetables, root, tuber and bulb vegetables, fresh pulses.

Source: Authors' own study based on EUROSTAT data.

Table 4. Cultivation area and harvest of particular vegetables in Poland and selected EU countries in the years 2004–2018

Country	Cultivation area					Harvest				
	period			2004–2018		period			2004–2018	
	2004–2008	2009–2013	2014–2018			2004–2008	2009–2013	2014–2018		
	thousand ha				average annual change in %	thousand t				average annual change in %
	cabbage									
France	1.16	1.33	0.83	1.11	–3.40	86.02	86.59	60.31	77.64	–3.80
Spain	4.91*	5.33**	4.67	4.95	.	157.64*	187.48**	159.97	167.72	.
Netherlands	1.63	1.65	2.74	2.01	4.72	133.80	134.60	188.42	152.27	2.82
Germany	6.51	8.06	8.99	7.85	3.27	459.20	573.35	590.92	541.16	2.28
Poland	31.00	25.59	22.83	26.47	–3.30	1 281.32	1 138.26	994.56	1138.05	–2.70
Italy	4.42	3.81	5.16	4.46	0.52	102.32	89.45	121.75	104.51	0.79
EU	121.42	100.46	101.80	94.56	2.17	3135.15	3623.70	3667.06	3475.30	1.58
	carrot									
France	14.08	12.75	12.39	13.07	–1.40	620.70	555.48	556.73	577.64	–1.20
Spain	8.62*	7.13**	6.66	7.40	.	459.77*	391.98**	392.88	413.18	.
Netherlands	8.59	9.02	9.07	8.89	0.58	507.60	524.00	572.23	534.61	1.16
Germany	10.18	10.17	11.30	10.55	1.11	536.83	566.86	627.43	577.04	1.55
Poland	29.39	23.85	22.48	25.24	–2.80	889.07	837.09	775.16	833.77	–1.50
Italy	13.22	11.79	11.63	12.21	–1.30	597.90	525.88	523.58	549.12	–1.40
EU	115.75	110.73	116.73	114.41	0.12	4958.43	4903.06	5462.66	5108.05	0.95
	onion									
France	8.84	9.24	12.10	10.06	3.02	351.38	372.83	425.83	383.35	1.92
Spain	21.65	22.96	24.95	23.18	1.22	1083.72	1198.42	1325.18	1202.44	1.92
Netherlands	25.13	28.12	32.79	28.68	2.60	1 129.20	1 360.20	1475.39	1321.60	2.38
Germany	8.57	10.39	13.25	10.74	4.31	382.58	496.52	579.12	486.07	3.86
Poland	32.24	25.72	25.98	27.98	–2.40	708.14	629.67	616.23	651.34	–1.60
Italy	12.80	12.13	12.90	12.61	0.08	380.08	373.71	430.89	394.89	1.12
EU	151.67	158.51	177.67	162.62	1.57	5 092.07	5636.49	6337.03	5688.53	2.03
	beetroot									
France	2.40	.	3.00	.	.	112.58	.	135.00	.	.
Spain	0.64*	0.64***	1.15	0.87	.	22.85	27.8	55.06	37.71	.
Netherlands	0.35	0.47	0.76	0.52	7.84	24.00	28.60	41.57	31.39	5.36
Germany	1.33	1.39	1.68	1.47	2.17	53.94	62.72	77.38	64.68	3.13
Poland	13.45	11.68	10.75	11.96	–2.30	350.12	333.14	326.09	336.45	–0.08
Italy	0.50	.	0.87	.	.	9.62	.	19.49	.	.
EU	26.45	17.09	21.14	21.56	–2.10	754.24	506.93	700.01	646.60	–0.60

*2004–2007, **2010–2013, ***2011

Source: Authors' own study based on EUROSTAT data.

the same order as above, beets were 6.3 and 4.2 times higher (than Germany), 9.3 and 5.9 (Spain), 12.4 and 16.7 (Italy), 14.1 and 7.8 (the Netherlands), 3.6 and 2.4 (France). Also, in Poland the area of cultivation and carrot harvest was the largest. The area was about 3 times higher than in Spain, 2.5 times higher than in the Netherlands and about 2 times higher than in Germany, France and Italy. Poland's carrot yield was 2 times (Spain), 1.4 times (the Netherlands and France), 1.2 times (Germany) and 1.5 times (Italy). As far as onions are concerned, Poland is a bigger producer than France, Italy and Germany, with harvests 1.5, 1.4 and 1.0 times higher, respectively, and an area about 2 times higher. But the Netherlands is the leader in the EU, with an average 2014–2018 onion harvest 2.4 times higher than in Poland, although it was grown on an area only 26% higher. In Spain, too, the harvest was 2.2 times higher, with the same area of cultivation.

COMPARISON OF YIELD LEVEL IN INVESTIGATED COUNTRIES

Not only the absolute level of production and the direction of change but also the productivity from the unit of area, which is the result of the level of yield achieved, is indicative of the production potential affecting the competitive position. The dynamics of changes in the area of cultivation and harvest of cabbage, carrots, onions and beets, presented in the previous chapter, show that in the examined period there was an increase in yields. Relatively the greatest improvement was recorded in Poland. Beet yields grew the strongest, by 1.52% per year, with an increase of 0.96% in Germany and a decrease of –2.5% in the Netherlands. Carrot yields grew annually by 1.36%, while in France, the Netherlands, Germany and Spain it was an increase by 0.93, 0.58, 0.44 and 0.25%, respectively, and in Italy a decrease by –0.10% (Table 5.). The growth of onion yields was slower, by 0.81% per year, in Poland and only in Italy was it faster, by 1.06%. In Spain, they grew by 0.73%, and in France, in Germany and the Netherlands, it decreased by –1.1, –0.5 and –0.2% annually. The situation with cabbage yields was similar. In Poland, it grew by 0.63% per year, with an increase of 0.28 and 0.69% in Italy and Spain and a decrease in the other three countries.

The above phenomenon of relatively faster crop growth in Poland should be assessed positively from the point of view of the further development of the vegetable industry and its competitiveness. This is necessary because Polish yields are still at very low levels. Most importantly, there is a big difference in comparison with vegetable yields in the Netherlands and Germany, because it is 1.6–2.0 times higher.

VEGETABLE PRODUCTION FACTOR STOCKS

The average area of a horticultural farm in the EU in 2004–2007 was approximately 6.2 ha a.a (agricultural area), while in 2016–2019 it was 6.71 ha a.a.. Between 2004 and 2019, the area of farms in the EU countries increased approximately by 1.0%. In all countries selected for the analysis, there was an increase in the area of horticultural holdings during the period considered. The largest increase in area was in Dutch farms (by 4.4% on average per year), German farms (by 4.1%) and Italian farms (by 4%), while the smallest increase was in Spanish farms (by 0.2% on average per year) and French farms (by 1.0% on average per year).

In 2016–2019, the largest holdings were observed in the Netherlands (13.2 ha a.a on average), followed by France (about 10.1 ha a.a on average) and Germany (about 9.5 ha a.a on average). By far the smallest holdings were in Italy (on average about 5.7 ha a.a) and in Poland (on average 5.4 ha a.a).

If we compare the size of Dutch, French and German farms with Polish farms, they were 2.5, 1.9 and 1.8 times larger, respectively (Table 6). At this point, it should be mentioned that the farms in the FADN system have been selected deliberately and include entities producing mainly for the market with a minimum economic size of 4 ESU[4].

[4]Since 2010, within the FADN classification, entities with a minimum economic size of 4 ESU (until 2010 2 ESU) have been classified into particular types, as well as into particular agricultural types on the basis of Standard Output (SO) (from 2010 Standard Gross Margin – SGM)

Table 5. Yields of particular vegetables in Poland and selected EU countries in the years 2004–2018

Country	Period				2004–2018		
	2004–2008	2009–2013	2014–2018				
	t/ha			index: Poland = 100%	t/ha	average annual change in %	index: Poland = 100%
				cabbage			
France	74.16	44.91	72.22	165	69.03	–0.50	159
Spain	31.85	35.25	34.27	78	33.83	0.69	78
Netherlands	82.09	81.38	68.60	157	77.37	–1.90	178
Germany	70.52	71.12	65.60	150	69.42	–1.00	160
Poland	41.34	44.48	43.78	100	43.48	0.63	100
Italy	23.15	23.47	23.88	55	23.50	0.28	54
EU	**25.82**	**36.07**	**36.06**	**82**	34.82	–0.40	**80**
				carrot			
France	44.08	43.55	47.96	139	45.23	0.93	135
Spain	53.37	55.16	56.02	162	54.94	0.25	164
Netherlands	59.06	58.09	63.16	183	60.11	0.58	179
Germany	52.74	55.73	55.77	162	54.75	0.44	163
Poland	30.25	35.10	**34.48**	**100**	**33.51**	1.36	**100**
Italy	45.23	44.60	45.08	131	44.98	–0.10	134
EU	**42.84**	**44.28**	**46.79**	**136**	44.58	0.84	133
				onion			
France	39.75	40.37	35.10	148	38.38	–1.10	150
Spain	50.08	52.94	53.50	226	51.93	0.73	203
Netherlands	44.93	48.37	45.03	190	46.11	–0.20	181
Germany	44.63	47.78	43.76	185	45.38	–0.50	199
Poland	21.96	24.48	23.71	**100**	**23.52**	0.81	**100**
Italy	29.69	30.80	33.47	141	31.32	1.06	123
EU	**33.57**	**35.56**	**35.68**	**150**	34.93	0.46	**149**
				beetroot			
France	46.91	.	45.01	148	45.91	.	161
Spain	35.81	.	47.61	157	41.82	.	147
Netherlands	68.97	61.37	55.76	183	62.27	–2.50	218
Germany	40.55	45.06	45.89	151	43.79	0.96	154
Poland	26.04	28.51	30.39	100	**28.50**	1.52	**100**
Italy	19.24	..	22.50	74	20.46	.	72
EU	**28.52**	**29.66**	**33.59**	**111**	30.20	1.00	**106**

Source: Author's own study based on EUROSTAT data.

Another resource to be analysed was the labour resources present in the horticultural holdings of the FADN system. In 2004–2007, on average in EU countries, labour resources were about 3.2 AWU per farm and 0.52 AWU per 1 ha a.a, while in 2016–2019 labour resources were 3.47 AWU per farm and 0.51 AWU per 1 ha a.a, respectively. During the period studied, EU countries experienced a slight increase in the labour resources (by 0.5% on average per year). In the analysed years in almost all countries selected for the study, an increase in labour resources was recorded, except for French and Polish agricultural holdings. The greatest increase in labour resources was observed in Dutch (by 3.1% on average per year), German (2.9%) and Spanish (by 1.9%) households. France and Poland experienced a decrease in labour resources of 0.9% and 0.4% on average per year. In 2016–2019, Dutch (8.56 AWU per farm) and German (6.45 AWU) farms had the highest labour resources per farm. The lowest labour resources were

in Italian (about 2.63 AWU per household) and Polish (2.74 AWU) households.

If we take into account labour resources per 1 ha UR, the highest labour resources were characterised by Dutch (approximately 0.70 AWU per 1 ha a.a on average in 2004–2019) and German (0.69 AWU per 1 ha a.a) farms. In other countries, labour resources were much lower and ranged from 0.35 AWU per 1 ha a.a (Spain), 0.48 AWU per 1 ha a.a (France) and 0.56 AWU per 1 ha a.a (Poland). In the studied period, almost all the countries experienced a decrease in labour resources per 1 ha a.a; only in Spanish farms was an increase observed (1.7% on average per year). In the case of Spain, an increase in total labour input per 1 ha a.a was associated with keeping the Agricultural Area at a similar level and an increase in total labour input. In the remaining countries, a decrease in labour input per ha a.a was observed, the highest in Italy (average annual decrease of 3.9%) and Poland (2.6%). Labour resources per 1 ha a.a in Poland were higher by about 60.0% than in Spain, and by 16.7% than in France, while lower than in the Netherlands by 20%, Germany by about 19.8%, and Italy by 12.5% (Fig. 1). The presented analysis of the labour input shows that labour intensity of vegetable production in Poland is higher than in the other EU countries selected for the study. Significantly higher labour input of Poland compared to the old EU-15 countries characterizes the entire agricultural production. In 2017, agricultural labour resources per 100 ha a.a[4] in Poland were 12.8, while in other countries they were: France 2.7, Germany 3.2, Italy 6.8 and the Netherlands 10.6 [CSO 2018].

In the period 2004–2019, average own labour inputs in vegetable farms in EU countries were about 1.40 FWU per farm and 0.44 FWU per 1 ha a.a. During the period investigated there was a decrease in own labour input on average per year by 0.71 and 1.71% respectively. In the examined period, a slight increase in own labour input per farm was recorded only in Polish (annual average by 0.37%) and German (annual average by 0.32%) agricultural holdings. In the remaining countries, a decrease in own labour input was observed, the highest in French agricultural holdings (annual average by 1.02%) and Italian agricultural holdings (annual average by 0.94%). The highest outlays of own labour per farm were observed in Dutch (1.66 FWU per farm), Polish (1.63 FWU) and French farms (1.55 FWU). The lowest expenditure of own labour per farm was in Spanish agricultural holdings (1.23 FWU).

If we take into account the own labour input per 1 ha a.a in the countries selected for the study, a decrease was recorded in all horticultural holdings. The highest decrease in own labour input per 1 ha a.a was recorded in Italian (on average by 4.98%), Dutch (4.81%) and German (by 3.81%) agricultural holdings. In the study period, the highest own labour input per 1 ha a.a was in Italian (on average 0.31 FWU per 1 ha a.a) and Polish agricultural holdings (on average 0.31 FWU per 1 ha a.a), while the lowest in Spanish (on average 0.14 FWU per 1 ha a.a), Dutch (on average 0.17 FWU per 1 ha a.a) and French (on average 0.18 FWU per 1 ha a.a) agricultural holdings.

The presented comparative analysis shows that vegetable production in Poland and Italy is based mainly on the farmer's and his/her family's labour. The share of own labour input in the total labour input in the holding was about 56.4% in Poland and about 55.6% in Italy. At the same time, in Poland in the analysed period the importance of own labour was increasing with the downward tendency of total labour input. The lowest share of own labour input in total labour input was in Dutch (on average 23.4%) and German (on average about 26.7%) agricultural holdings (Table 6).

The last resource describing horticultural holdings was the value of fixed assets (tangible assets). In 2004–2007, the value of fixed assets in EU countries averaged about 216.9 thousand euro per horticultural farm and 34.9 thousand euro per 1 ha a.a, while in 2016–2019 it was about 269.0 thousand euro per farm and 40.1 thousand euro per 1 ha a.a. In 2004–2019, the value of fixed assets per farm in the EU countries increased on

[4] Labour resources measured in terms of agricultural workers per 100 ha a.a, data on agricultural workers are presented according to the methodology of the International Labour Organization (ILO) and relate to persons of working age (15––64 years) engaged in work in agriculture, hunting, forestry and fishing that brings them a salary or income. Workers include people employed on the basis of an employment relationship and employers and self-employed.

Table 6. Inputs of production factors of farms specializing in field vegetable cultivation in Poland and selected EU countries in the years 2004–2019 [per farm and per 1 ha of UAA]

Country	Per farm			Per 1 ha of UAA		
	average 2004–2007	average 2016–2019	average annual change 2019/2004 [%]	average 2004–2007	average 2016–2019	average annual change 2019/2004 [%]
agricultural acreage [ha]						
Germany	5.93	9.48	4.1	×	×	×
Spain	8.25	7.51	0.2	×	×	×
France	8.42	10.06	1.0	×	×	×
Italy	3.32	5.66	4.0	×	×	×
Netherlands	7.66	13.21	4.4	×	×	×
Poland	4.54	5.38	2.2	×	×	×
EU	6.22	6.71	1.0	×	×	×
annual work unit [AWU]						
Germany	4.49	6.45	2.9	0.77	0.68	–1.2
Spain	2.84	3.73	1.9	0.35	0.49	1.7
France	4.38	3.98	–0.9	0.52	0.40	–1.9
Italy	2.45	2.63	0.2	0.74	0.47	–3.9
Netherlands	5.87	8.56	3.1	0.77	0.65	–1.3
Poland	2.87	2.74	–0.4	0.64	0.51	–2.6
EU	3.20	3.47	0.5	0.52	0.52	–0.5
family work unit [FWU]						
Germany	1.52	1.46	0.3	0.25	0.16	–3.8
Spain	1.16	1.23	–0.5	0.16	0.16	–0.7
France	1.43	1.55	–1.0	0.19	0.14	–2.0
Italy	1.36	1.43	–0.9	0.46	0.24	–5.0
Netherlands	1.62	1.66	–0.4	0.22	0.12	–4.8
Poland	1.65	1.63	0.4	0.35	0.31	–1.9
EU	1.34	1.40	–0.7	0.24	0.20	–1.7
fixed assets [thous. EUR]						
Germany	250.41	402.56	3.9	43.09	42.49	–0.2
Spain	190.23	287.93	2.9	22.79	38.28	2.7
France	140.25	152.52	0.6	16.67	15.17	–0.4
Italy	211.89	165.83	–2.1	63.96	29.43	–6.1
Netherlands	1039.27	1659.71	3.7	135.06	125.59	–0.7
Poland	102.29	125.84	1.8	22.72	23.39	–0.4
EU	216.92	268.99	1.4	34.91	40.08	0.4

* the valuation of fixed assets in France is understated according to the European FADN office.

Source: Authors' own study based on the EU FADN.

average annually by 1.44%, i.e. by EUR 3.5 thousand per year. In the years analysed, the value of fixed assets decreased only in Italy (by 2.1% on average per year). It indicates a worrying phenomenon of decapitalisation of horticultural holdings' assets in that country. In the remaining countries, an increase in fixed assets per farm was observed, with the highest increase in German farms (average annual by about 3.9%) and Dutch farms (average annual by 3.7%). In 2016–2019, Dutch farms were characterised by the highest nominal value of fixed assets (on average about EUR 1,659.7 thousand), followed by German farms (on average about

EUR 402.6 thousand) and Spanish farms (on average about EUR 287.9 thousand). The lowest value of fixed assets was characteristic for Polish (on average about EUR 125.8 thousand per holding) and French (EUR 152.5 thousand) agricultural holdings.

If we take into account the provision of land in fixed assets, the highest value of fixed assets per ha a.a was in 2016–2019 in Dutch farms (on average about EUR 125.6 thousand per ha a.a), followed by German farms (on average EUR 42.5 thousand) and Spanish farms (on average about EUR 38.3 thousand). The lowest value of fixed assets per 1 ha a.a was in French (on average EUR 15.2 thousand) and Polish farms (EUR 23.4 thousand). If we compare the level of land provision with fixed assets, the level in Poland was 436.8% lower than in the Netherlands, 81.6% lower than in Germany, and 63.7% lower than in Spain (Fig. 1).

In the period considered, the increase in the provision of land with fixed assets was only in Spanish agricultural holdings (on average by 2.7% per year). The high increase in fixed assets in Germany was due, on the one hand, to an increase in the value of fixed assets (by 2.9% on average per year) and, on the other hand, to a slight increase in land area (by 0.2% on average per year). In other countries, a decrease in the value of fixed assets per 1 ha a.a was observed, the highest in Italian farms (by 6.1% on average per year). In the Netherlands, a greater increase in farm area was observed than in the value of fixed assets per farm. The decrease in land endowment in Italy was due to a decrease in the stock of fixed assets per holding with a significant increase in the farm area.

The presented analysis indicates low land enhancement with fixed assets in horticultural farms in Poland. A much lower value of fixed assets per 1 ha a.a was indicated by Ziętara and Sobierajewska [2012] in their study in 2007–2009. Wigier's [2014] study shows that the low level of fixed assets and its decapitalisation characterises the whole of Polish agriculture, especially in small and medium-sized entities.

CONCLUSIONS

Poland's high and growing position in vegetable production results mainly from the high acreage of crops, their partially complementary structure, and above all from relatively low labour costs compared to other EU countries surveyed, which was also indicated in research by Ziętara and Sobierajewska [2012]. On the other hand, the improvement of efficiency is not supported by the large fragmenta-

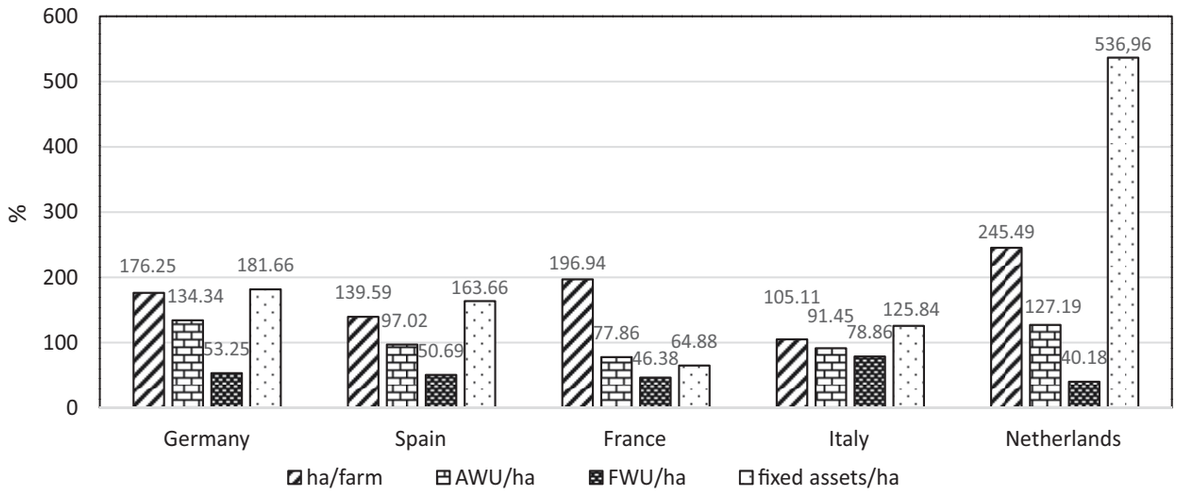

Fig. 1. Relation of inputs of production factors of farms specializing in the field cultivation of vegetables in total in Poland and selected EU countries in the years 2004–2019 [index: Poland = 100%]

Source: Authors' own study based on the EU FADN.

tion of Polish farms, although an increase in the average area of cultivation in individual farms in Poland was observed in the examined period. The average area of a vegetable farm increased in the years 2005–2016 as much as 4.6 times, while in Italy 2.03, Germany 1.73, the Netherlands 1.51, Spain 1.10 times. In France, it was an increase of 3.21%. The research shows that in most of the analysed countries there was still a large fragmentation of vegetable farms, i.e. in Italy, Spain and Poland. In 2016 an average farm grew vegetables on 3.48 ha, 2.26 ha and 2.16 ha, respectively. The increase in the production potential of the Polish vegetable industry is also evidenced by the fastest growing land productivity. During the period considered, an increase in the yields of basic vegetables was observed in selected countries. Relatively the highest increase in yields was recorded in Poland. However, still, the level of vegetable yields in Poland was much lower than in other EU countries.

The analysis of vegetable farm inputs (on the basis of FADN data) in selected countries shows that in the analysed period in the case of Poland, Italy and France a decrease in production factor resources was observed. In these farms, there was a decrease in the inputs of land, labour and fixed assets, and in the case of Poland, only the resources of own labour increased. In the case of Dutch farms, there was an increase in the area, but also a replacement of living labour with capital (decrease in total labour input with an increase in fixed assets). Labour-efficient technologies are likely to be introduced on these farms while increasing the area of the farms. At the same time, these farms had the largest manpower armament in the capital, and the largest fixed-asset equipment in the land. In German agricultural holdings, on the other hand, the increase in total assets was accompanied by an increase in total labour input, which may mean the introduction of less labour-efficient technologies. In these farms, there were the largest labour resources per farm, but these farms were also characterised by the largest area.

The largest amounts of own labour per ha of UR were observed in Polish and Italian farms. Relatively large outlays of own work per 1 ha of UAA in Poland and Italy mean that vegetable cultivation is based mainly on the farmer's and his/her family's own work. In addition, during the period considered, there was a decrease in the value of fixed assets in Italian, Polish and French holdings, indicating a worrying phenomenon of decapitalisation of vegetable holdings in these countries. In contrast, an increase in value occurred in Dutch and German holdings. Therefore, it should be stated that the Netherlands and Germany are growing competitors of Poland in terms of further growth of this sector. It should be stressed, however, that due to the growing problems with labour availability and very rapid wage growth, maintaining Poland's high position in vegetable production will be increasingly difficult.

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POTENCJAŁ PRODUKCYJNY SEKTORA WARZYWNICZEGO W POLSCE I WYBRANYCH KRAJACH UE

STRESZCZENIE

Celem badań była ocena potencjału produkcyjnego sektora warzywniczego jako czynnika konkurencyjności w Polsce i wybranych krajach UE. Ocenę produkcji warzywniczej oparto na: analizie porównawczej poziomu i zmian powierzchni ziemi przeznaczonej pod uprawę, plonów, liczby gospodarstw i średniej powierzchni upraw w gospodarstwie. Analizowano również strukturę gatunkową upraw, poziom plonów podstawowych warzyw, zasoby czynników produkcji rolnej z systemu FADN. Badania wykazały, że z jednej strony wysoka i rosnąca pozycja Polski w produkcji warzyw wynika przede wszystkim z dużego areału upraw, częściowo z ich komplementarnej struktury, a przede wszystkim z relatywnie niskich kosztów pracy w porównaniu z innymi badanymi krajami UE. Z drugiej strony za poprawą efektywności nie przemawia duże rozdrobnienie polskich gospodarstw, choć w badanym okresie zaobserwowano wzrost średniej powierzchni upraw w przeliczeniu na gospodarstwo. Z analizy nakładów w gospodarstwach warzywniczych (na podstawie danych FADN) w wybranych krajach wynika również, że w analizowanym okresie spadek zasobów czynników produkcji zaobserwowano w Polsce, we Włoszech i Francji.

Słowa kluczowe: produkcja warzywnicza, gospodarstwa warzywnicze, system FADN, Polska, EU

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PROFITABILITY OF PHOTOVOLTAICS IN POLAND: CASE STUDY OF A HOUSEHOLD

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ABSTRACT

Photovoltaics is increasingly used to convert solar energy into electricity in households, including in Poland. The development of this type of renewable energy results, on the one hand, from legal regulations related to climate and energy policies, and on the other hand, from the numerous benefits connected with the use of photovoltaics. These include both economic and environmental advantages. The aim of the work was to assess the profitability of installing photovoltaics in a Polish household in 2019–2021. Therefore, the costs of the investment are presented, as well as the benefits, mainly in economic terms. Different calculations and estimates concerning return on the invested capital are also shown. During the 31 months covered by the study, the cumulative positive balance of electricity that was generated above the energy consumed in the household exceeded 2,900 kWh, which resulted in an economic surplus of over PLN 1,600 (about EUR 360). What is more, the investment contributed to the protection of the natural environment which is the added value of the photovoltaics.

Key words: photovoltaics (PV), electricity, renewable sources, profitability, household, Poland

JEL codes: Q41, Q42, Q50, D14

INTRODUCTION

In the European Union, the following targets are currently in force in the area of climate and energy policy, planned to be achieved by 2030 [European Commission]: (1) reducing greenhouse gas emissions by at least 40%, from 1990 levels; (2) increasing the share of energy from renewable sources to at least 32%; (3) improving energy efficiency by at least 32.5%. This is, of course, a step forward compared to the 3 × 20% package, according to which by 2020 the share of energy from renewable sources in total energy consumption was to be at least 20%, calculated for the entire European Union. The current regulations therefore emphasize the importance of renewable energy sources (RES) as an important element of the wider energy system. In Poland, the key targets in the field of energy until 2030 include [Ministerstwo Gospodarki 2009, Ministerstwo Energii 2019]:

- striving to maintain zero-energy economic growth;
- reducing the share of coal in the production of electricity to the level of 56–60%;
- reducing the energy intensity of the Polish economy to the EU-15 level;
- increasing the effectiveness of electricity production through the construction of highly-efficient generating stations;
- promoting high-effective cogeneration technology;
- reducing greenhouse gas emissions by 7% in sectors not covered by the ETS system, compared to 2005 levels;
- achieving a 21–23% share of renewable energy sources in gross final energy consumption.

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Due to its climate and natural conditions, solar energy in Poland may not have optimal conditions for obtaining energy (e.g. in comparison with Southern Europe); however, the climate does allow for a much wider use of the sun than is currently being implemented. Solar radiation energy in Northern and Central Europe could provide around 25 to 40% (e.g. in Poland) of the demand for thermal energy during the year. To this end, it is important to install photovoltaic panels that convert solar energy into electricity, as well as solar collectors that accumulate solar energy and transform it into heat or electricity [Jastrzębska 2017].

Among the numerous advantages of using renewable energy, including that produced by photovoltaic panels, it is worth noting that it comes from inexhaustible resources (such as wind and sun) and is associated with much lower greenhouse gas emissions (no emissions when using energy, although emissions occur in the production of panels). Using renewable energy increases energy security, reduces the risk and possibly the scale of energy poverty[1], and offers independence from conventional energy. In addition, renewable energy is dispersed, so it reduces the costs associated with the construction of transmission lines. It can also serve as a stimulus for economic development at the local level and the creation of workplaces in the renewable energy sector, as well as related fields [World Bioenergy Association 2009, Góral 2014, Riffkin 2011, Borychowski and Czyżewski 2017, Guaita-Pradas and Blasco-Ruiz 2020, Olczak et al. 2020, IRENA and ILO 2021].

Photovoltaic panels can belong to large energy companies (the largest power plants in Poland are: Jaworzno, Czernikowo, Bierutów, Cieszanów or Ostrzeszów). They can also be part of the so-called 'prosumer' energy industry, where for example, a household owns photovoltaic panels and thus becomes both a producer and consumer of electricity [Popczyk 2014, Sobczyk 2020]. Prosumer energy is partly a response to growing energy prices, as it helps makes consumers less dependent on conventional energy supplies by independent generating their own energy, thus reducing household expenditure on electricity [Mirowski and Sornek 2015, Szpulak et al. 2017, Sobczyk 2020].

Government energy policies support prosumer initiatives through various subsidies and including dedicated programs. This is beneficial both for the subsidised households and for the country as a whole, because the prosumer energy sector helps fulfil the nation's required share of renewable energy as a percentage of total energy consumption. This support for investments in renewable energy from public funds is one of the key factors in the context of investment implementation [Chmieliński 2015, Szpulak et al. 2017, Guaita-Pradas and Blasco-Ruiz 2020, Brodziński et al. 2021]. Another important factor is the stability of laws and regulations, as so-called 'legislative risk' discourages businesses from undertaking investments, including RES micro-installations [Mirowski and Sornek 2015, Guaita-Pradas and Blasco-Ruiz 2020]. On the other hand, separate from the prosumer perspective, Hirschburger and Weidlich [2020] feel that due to a better match of energy supply and demand, photovoltaic panels are a more advantageous solution for municipal buildings than for residential ones.

The importance of renewable energy sources, including through use of photovoltaic panels, provided motivation for conducting this research. The aim of the study was to assess the profitability of investing in photovoltaic panels, using a household in Poland in 2019–2021 as an example. The costs of the investment are presented, as well as the benefits, focusing mainly on economic benefits. Different calculations and estimations concerning return on invested capital are also presented. It is assumed that photovoltaic panels are advantageous from both an economic and an environmental standpoint. The research differentiates between environmental economics and ecological economics. The first theory assigns priority to economic over environmental issues, adopting a so-called 'economization of the environmental'. In turn, ecological economics reverses this order and treats the natural environment as more important than the economic aspects. In this situation, it is rather a paradigm of greening the economy and economic activity [Costanza et al. 1997, Rogall 2010, Czaja 2012, Borys 2013, Prandecki et al. 2014]. In the context of a photovoltaic micro-installa-

[1] More about energy poverty – see [Wysokiński et al. 2017, Piwowar 2020, 2021].

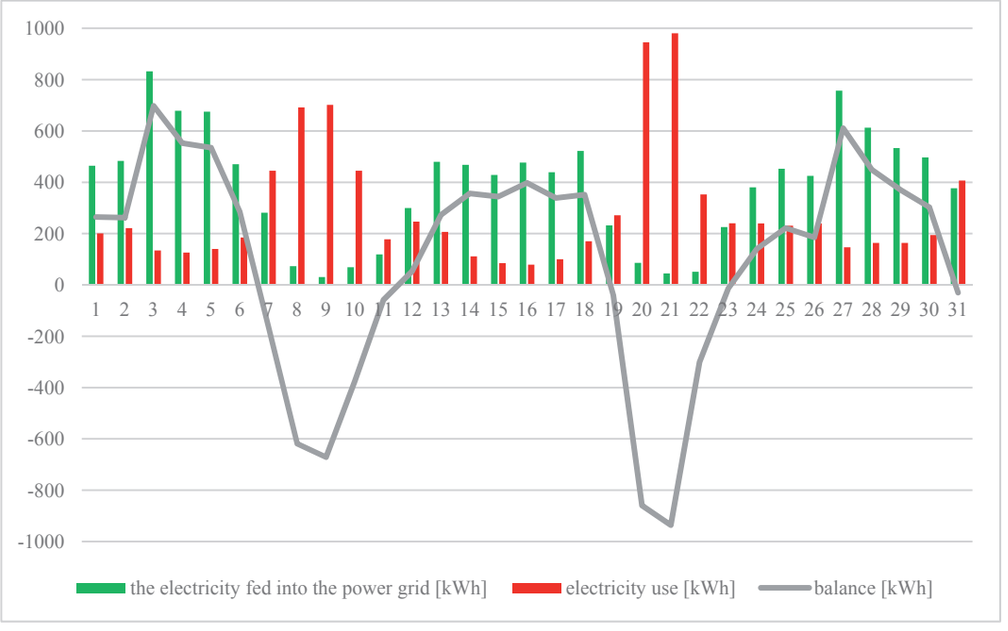
tion in a household, it is possible to achieve goals from both areas at the same time (economic benefits associated with environmental protection).

MATERIAL AND METHODS

The analysed installation consists of 24 photovoltaic panels mounted on the south side of a sloping roof of a single-family house, which is the most advantageous positioning in terms of effective use of solar radiation. This micro-installation is located in the Turek district, in the Wielkopolska voivodeship of Poland. The total cost of installation with assembly was PLN 18,000 (EUR 4,000), of which PLN 8,000 (EUR 1,780) (i.e. 44,4% of the total amount) was paid with support from public funds allocated for the installation of photovoltaic panels. Microeconomic data was collected individually for the period from April 2019 to the end of October 2021, i.e. the most recent available. The data was compiled on a monthly basis, so the series covers 31 periods. In each period, the amount of electricity fed into the power grid, household energy consumption, and energy prices are given. This allowed a calculation of the energy balance in the household, as well as the potential benefits, in the case of a surplus of energy fed into the grid compared to the energy used. The work uses elements of financial analysis, including profitability analysis.

RESULTS AND DISCUSSION

The Fig. 1 shows the amount of electricity fed into the power grid and consumed by the surveyed household, together with the monthly balance between these values, from April 2019 to October 2021, in kilowatt-hours (kWh). For obvious reasons, the highest energy production (and the amount fed into the grid) is achieved in the summer months when there is the most sunshine, with relatively low production in the winter months. In the most favourable months, the amount of energy fed into the grid was 675–832 kWh, while in the winters it was only about 30 kWh. Throughout the entire



*period t1 = April 2019.

Fig. 1. Electricity fed into the power grid, electricity used in the analysed household, and balance between these values in the following months in the period April 2019–October 2021 in kWh

Source: Elaboration based on data collected by the authors.

period of study, the photovoltaic installation produced and fed into the power grid nearly 12 thousand kWh (almost 12 MWh). Electricity consumption in the household was also unevenly distributed in individual seasons – it was definitely the highest in the winter and relatively low in the summer, and was characterised by high fluctuations – the variance is nearly 15% higher than the amount of energy fed into the grid. In December 2019 and December 2020, the amount of energy consumed by the household was over 22 times greater than the amount produced by the photovoltaic panels. In turn, during the period June–August, in the three consecutive years, the household usually used only 16–30% of the energy generated by the panels.

In turn, Fig. 2 shows the distribution of the balance between the amount of electricity fed into the power grid and the amount of energy consumed in the household on a monthly basis from April 2019 to October 2021 in kWh. From the standpoint of economic profitability for the entire micro-installation, including changes in energy consumption, the most favourable balances were achieved in the summer months of 2019, and the weakest in 2020. During nine months of 2019 (from the start of data collection in April, through December) the balance was 1,143 kWh (data from 2019 did not include several winter months with very low values of electricity production from photovoltaic panels[2]). In 2020, the weather conditions were much less favourable, with less sunshine (peak sun hours). Throughout 2020, the balance between generated and consumed energy was negative, at a level of 155 kWh. In turn, in 2021 (until the end of October), there was a clear positive balance, exceeding 1,930 kWh. Generally speaking, over an entire year, less solar energy is generated in November and December. Therefore, a negative balance occurs in the months of November–January, the balance fluctuates around zero in February, March and October, and in the remaining months it is possible to generate a surplus. This means that using a photovoltaic micro-installation to generate solar energy can be seen not only as beneficial for environmental reasons, but also in economic terms.

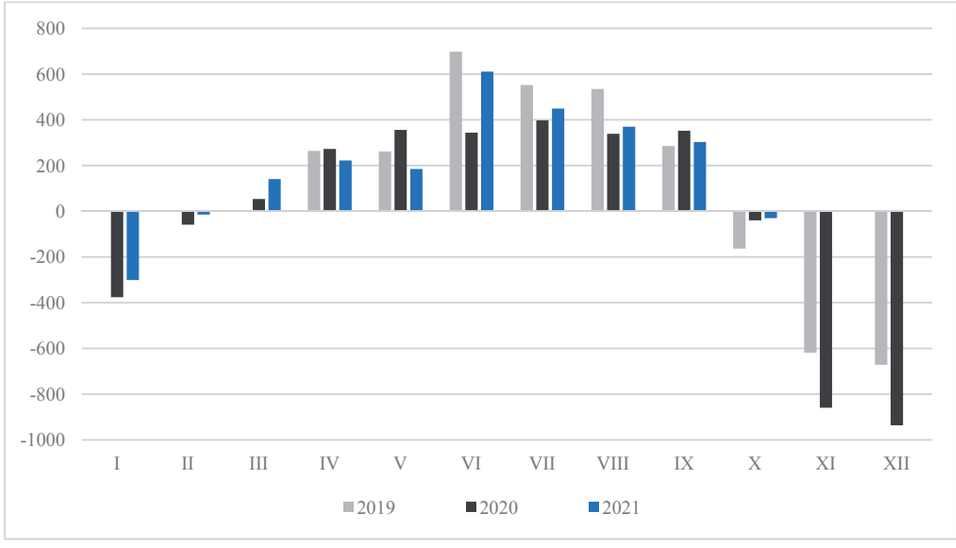


Fig. 2. Balance between electricity fed into the power grid and electricity used in a surveyed household in the following months, in 2019–2021, in kWh

Source: Elaboration based on data collected by the authors.

[2] The number of annual sunshine hours in Poland is estimated at 1,600, of which nearly 80% occur between April to September. Taking into account climate change, the annual number of sunny hours may even increase to 2,000 [Kruzel and Helbrych 2018].

Table 1 presents data on the amount of energy fed into the power grid, use and balance, as well as electricity prices for each year, along with the difference expressed in monetary units (PLN) and balance expressed in PLN and EUR. Such a summary allows us to see the current profitability of the analysed prosumer micro-installation. Taking into account the 31 months covered by the study (a relatively short period), the cumulative positive balance exceeds 2,900 kWh, which results in a surplus of over PLN 1,600 (EUR 360). The current cumulative return of investment (ROI) would be 16% (PLN 1,600/10,000), with the average value

Table 1. Electricity fed into the power grid, electricity use and balance in a household [in kWh], as well as electricity prices [in PLN] and balance [in PLN and EUR] in the following months of period April 2019–October 2021

Specification	Electricity fed into the power grid [kWh]	Electricity use [kWh]	Balance [kWh]	Price for 1 kWh [PLN]	Balance [PLN]	Balance [EUR]
04.2019	464.639	200.573	264.066		128.389	29.95
05.2019	483.225	221.154	262.071		127.419	29.66
06.2019	832.516	134.422	698.094		339.413	79.56
07.2019	678.516	126.193	552.323		268.539	63.04
08.2019	675.078	139.995	535.083		260.157	59.89
09.2019	470.3	184.897	285.403	0.4862	138.763	31.87
10.2019	281.525	445.19	–163.665		–79.574	–18.49
11.2019	72.812	691.653	–618.841		–300.880	–70.23
12.2019	30.594	701.916	–671.322		–326.397	–76.40
total 04–12.2019	**3,989.205**	**2,845.993**	**1,143.212**		**555.83**	128.84
01.2020	68.661	444.782	–376.121		–202.127	–47.55
02.2020	118.859	177.558	–58.699		–31.545	–7.37
03.2020	299.864	246.443	53.421		28.708	6.47
04.2020	479.644	206.877	272.767		146.585	32.25
05.2020	467.752	111.517	356.235		191.441	42.27
06.2020	428.663	84.579	344.084		184.911	41.60
07.2020	476.605	78.725	397.88	0.5374	213.821	48.02
08.2020	439.313	100.27	339.043		182.202	41.39
09.2020	522.393	170.363	352.03		189.181	42.28
10.2020	231.826	271.403	–39.577		–21.269	–4.68
11.2020	85.84	945.564	–859.724		–462.016	–102.62
12.2020	44.483	980.933	–936.45		–503.248	–112.42
total in 2020	**3,663.903**	**3,819.014**	**–155.111**		**–83.36**	–20.36
01.2021	51.348	352.463	–301.115		–178.862	–39.37
02.2021	225.356	239.96	–14.604		–8.675	–1.93
03.2021	380.466	239.836	140.63		83.534	18.16
04.2021	452.696	230.823	221.873		131.793	28.87
05.2021	424.911	239.708	185.203		110.011	24.28
06.2021	757.324	146.413	610.911	0.5940	362.881	80.61
07.2021	613.058	163.875	449.183		266.815	58.47
08.2021	533.642	163.613	370.029		219.797	48.10
09.2021	496.828	194.147	302.681		179.793	39.37
10.2021	376.822	406.898	–30.076		–17.865	–3.89
total 01–10.2021	**4,312.451**	**2,377.736**	**1,934.715**		**1,149.22**	252.68
Total in the entire period	**11,965.559**	**9,042.743**	**2,922.816**	–	**1,621.69**	361.16

*the values in EUR were calculated using monthly exchange rates published by the central bank of the Republic of Poland [NBP 2022].

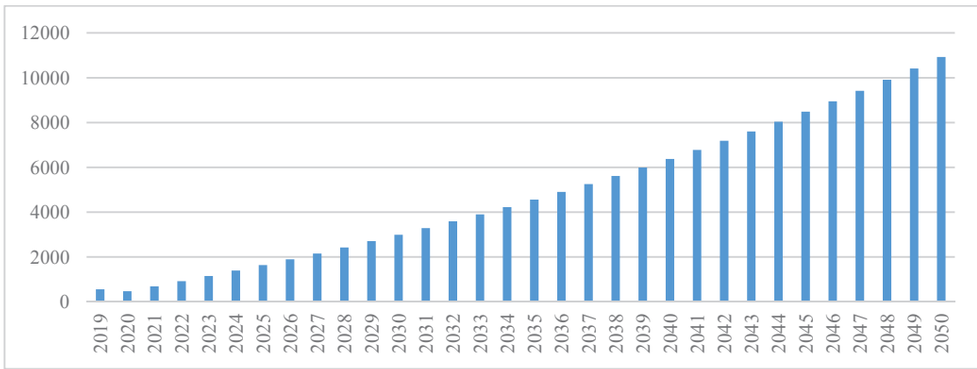
Source: Authors' own elaboration based on data from a household and [Urząd Regulacji Energetyki] (prices).

of 6.2% when annualised. However, it is important to note that data was collected for only 31 months, and excluded five less-sunny autumn and winter months from the 36 month period of years 2019–2021.

The profitability of the investment depends on several factors, including those already presented: the effectiveness of the installation, i.e. the amount of energy it will generate, which in turn depends on the level of solar radiation and the number of sunshine hours, as well as energy consumption and electricity prices. This data is presented in Fig. 3. According to manufacturing information as well as available data, photovoltaic panels should be efficient for about 25 years, with an annual degradation rate of 0.5–0.8% [National Renewable Energy Laboratory 2022]. Therefore, after this period their efficiency may decline to the level of 80–88%. However, the appropriate utilization and maintenance of panels could extend their functionality to 35 years.

As the analysed period does not cover three full years and is missing several particularly unfavourable winter months, it should be assumed that on average each year (starting from 2021) the installation will generate a production surplus of approx. 370 kWh, based on the available data. When calculating profitability in the long term, it has been assumed that electricity prices will increase at a rate of 3% annually. The data currently available shows that the installation generated an economic surplus of PLN 555.8 (EUR 128.8) in 2019, a loss of PLN 83.4 (EUR 20.4) in 2020, and it is estimated that the surplus will amount to approximately PLN 220 (about EUR 50) in 2021. In the context of the presented assumptions, the surplus will grow by approx. 3% annually in the coming years. In this situation, by 2050, the installation will pay back in full (the cumulative value of the surplus will amount to PLN 10,930), as shown in Fig. 3. However, at a higher annual rate of energy price growth, at which it would be possible to sell excess solar-generated energy to the power grid, e.g. 3.5 or 4%, then the cumulative value of the surplus will exceed PLN 10 thousand – 3 or 4 years earlier, respectively. This means that, looking at economic conditions only (including the annual degradation rate), a photovoltaic micro-installation is profitable in the long term, taking into account the co-financing for the installation of these panels through government subsidies, as mentioned earlier.

Kruzel and Helbrych [2018] showed that investments in photovoltaic panels in Poland are economically justified and that, from a financial point of view, they can pay off even in as few as twelve years. However, it should be noted that these authors, when calculating future values, assumed macroeconomic variables (PLN/EUR exchange rate, inflation rate or



*the current (February 2022) exchange rate is: 1 EUR = 4.5 PLN [NBP 2022].

Fig. 3. The cumulative economic surplus from the prosumer photovoltaic panels in the surveyed household in 2019–2050 in PLN

Source: Elaboration based on data collected by the authors.

electricity price growth rate) at levels that significantly differed from the actual rates at the end of 2021 (assumptions were made in the 2017–2018 year, but at the end of 2021 some of them were far from actual values). For this reason, these calculations should be slightly modified. Brodziński et al. [2021], analysing the economic efficiency of 22 photovoltaic farms of various sizes located in the north-eastern part of Poland, concluded that all of them were economically justified and profitable. At the same time, they indicated that the government support system was important in the context of actually getting investments to be implemented. Guaita-Pradas and Blasco-Ruiz [2020], in their analysis of the profitability of solar panels in Spain, emphasized the great importance of the initial investment costs as a factor that must be taken into account in long-term financial calculations. Sobczyk [2020] indicated that a prosumer micro-installation consisting of solar collectors in a household in Poland has a chance to pay for itself after a longer period, i.e. after a minimum of 20 years, assuming that it is an alternative to heating water with coal. In the case of heating water with other sources (e.g. electricity, heating oil), the investment could pay back much faster. Some authors even pointed out that photovoltaic installations can be economically viable even without a subsidy system, assuming the use of this solution in households with above-average electricity consumption [Chmieliński 2015] or favourable macroeconomic conditions [Kruzel and Helbrych 2018].

The authors of the present article are aware that a full financial analysis should take into account the cost of capital (loans, home equity or external capital), although it is now relatively low due to low interest rates. On the other hand – while facing high inflation rates, which the global economy is currently struggling with, including developed economies, like Poland [Eurostat], the decision to install such a prosumer installation is reasonable and it can be treated as an investment that protects against inflation and its consequences. In addition, aside from financial aspects of the installation, there are also economic issues that are difficult to calculate, and which are important in a holistic approach. From the household perspective, namely it is about independence and greater energy security as well as a lower risk of energy poverty. And finally, in the context of such an investment, it is worth pointing to the undeniable benefits for the natural environment resulting from the use of photovoltaic panels: significant reduction of carbon dioxide and other harmful substances that accompany the combustion of fossil fuels, renewable and inexhaustible nature of solar energy, no environmental degradation related to the extraction of mineral resources. If environmental benefits were to be valued under market conditions, the profitability of this micro-installation would certainly be higher.

CONCLUSIONS

The aim of the work was to present the profitability of investing in a photovoltaic micro-installation in a household in Poland during the period 2019–2021 (for 31 out of 36 months, over three calendar years). Therefore, the costs of the investment were presented, as well as the benefits, mainly in economic terms. Moreover, different calculations and estimations concerning return on the invested capital were made. Taking into account the entire period covered by the study, the cumulative amount of electricity generated by the panels reached almost 12 thousand kWh. This resulted in a positive balance above household energy consumption at a level of 2,900 kWh, i.e. an economic surplus of over PLN 1,600 (EUR 360). With careful and rational assumptions, the installation can bring savings of several hundred PLN a year, which means that it can fully pay for itself over 30 years. It should be noted that the purely financial profitability of an investment in the long term is influenced by several factors, including the technical efficiency of the installation, energy consumption and prices, as well as various external factors. However, it is worth viewing the use of photovoltaic panels also in non-financial terms. After all, their use provides undoubted benefits for the natural environment, as well as various economic arguments related to greater energy security and partial energy independence. Taking all these elements into account would make the overall calculation much more favourable.

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OPŁACALNOŚĆ INWESTYCJI W PANELE FOTOWOLTAICZNE W POLSCE NA PRZYKŁADZIE GOSPODARSTWA DOMOWEGO

STRESZCZENIE

Panele fotowoltaiczne są coraz częściej wykorzystywane do przetwarzania energii słonecznej na energię elektryczną w gospodarstwach domowych, także w Polsce. Rozwój tego rodzaju energii odnawialnej wynika z jednej strony z obowiązujących regulacji prawnych w obszarze polityki klimatyczno-energetycznej, z drugiej strony natomiast z licznych korzyści, które są związane ze stosowaniem tych paneli. Wśród nich należy wymienić zarówno argumenty ekonomiczne, jak i środowiskowe. Celem pracy była ocena opłacalności inwestycji w mikroinstalację fotowoltaiczną w gospodarstwie domowym w Polsce w latach 2019–2021. Omówiono więc koszty inwestycji, a także korzyści wynikające z jej podjęcia. Ponadto, dokonano różnych obliczeń i szacunków dotyczących zwrotu z zainwestowanego kapitału. Przez 31 miesięcy objętych badaniem skumulowany dodatni bilans energii elektrycznej wytworzonej ponad energią zużytą w gospodarstwie domowym przekroczył 2900 kWh, co skutkowało nadwyżką ekonomiczną w kwocie ponad 1600 PLN (ok. 360 EUR). Co więcej inwestycja przyczyniła się do ochrony środowiska naturalnego, co jest wartością dodaną fotowoltaiki.

Słowa kluczowe: panele fotowoltaiczne, energia elektryczna, odnawialne źródła, opłacalność, gospodarstwo domowe, Polska

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GLOBAL CRISES AND CYBERSECURITY ATACKS – AN ANALYSIS DURING THE COVID-19 PANDEMIC

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ABSTRACT

The COVID-19 pandemic has affected all nations in various ways, both economically and especially socially. The new normality, as social behavior dictated by the restrictions imposed, sustained online interaction, a factor that allowed an increase in cyberattacks. This paper intends to analyze the cyberattacks conducted during the COVID-19 pandemic, starting from a series of international events such as the crisis in Venezuela or Ukraine. A part of this study is a quantitative analysis of the results obtained from consulting the Scopus database. In this part, in addition to the most important authors and key words used, we aimed to find if the countries that are the main targets of cyberattacks are also involved in researching cybersecurity during pandemic. Cyberattacks are analyzed in terms of motivation and targets, aiming to identify possible solutions based on the *modus operandi* of attackers and what will be the next steps in the research.

Key words: cyberattacks, crises, coronavirus, COVID-19, cybercrime, hacktivism
JEL codes: F60, I30, L86

INTRODUCTION

Over time, humanity has faced events that have led to situations of instability or danger to individuals, groups or societies, known as crises [Bundy et al. 2017]. These have been marked by unexpected negative changes, with some authors considering them "processes of transformation of outdated systems that can no longer be managed" [Venette 2003].

The crises that humanity has faced and that continue to manifest themselves, can be framed in several typologies, the best known being the economic/ /financial, humanitarian, pandemic or military crises. In a broad sense, they fall into several types, depending on the mode of manifestation, the area of spread or their effects. These events had effects depending on the type of manifestation, the most common being the social ones such as loss of jobs, decreased quality of life or impaired physical integrity. In the process of eliminating the effects of crises and returning to normal, the focus is on maintaining activities and supporting efforts to minimize impact. Thus, there has been a decrease in interest and effort for security, whatever it may be, from physical security to cybersecurity.

The paper analyzes the existence of a correlation between recent crises, focusing on the pandemic and cyberattacks from the same period, respectively, their motivation, to support further research on cybersecurity risk management.

Thus, the paper seeks to provide conclusive answers to the following questions:

1. Was the COVID-19 pandemic a factor in increasing the number of cyberattacks?

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2. Is there a relationship between the rate of cyberattacks recorded and the ongoing crises?
3. Can the targets of future cyberattacks be predicted depending on the type of crisis?
4. What are the motivations and modus operandi of cyberattacks and how can they be countered?

To support research on cybersecurity risk management by identifying the correlation between crises and cyberattacks, the second part of the study will explain the research methodology that will allow, in the third part, a comparative analysis between recent crises and cyberattacks. And in the fourth part of the paper, a bibliometric analysis of research on studying cyberattacks during the COVID-19 pandemic will be performed. Thus, the data obtained, correlated with the analysis of the literature, will allow obtaining the answer to the three questions.

RESEARCH METHODOLOGY FOR ESTABLISHING A CORRELATION BETWEEN CRISES AND CYBERATTACKS

The methodological approach will involve the use of qualitative methods of research, which will analyze public sources of information and literature. Also, quantitative methods such as bibliometric analysis will be used.

In the qualitative approach, data will be obtained on the crises of the last decade that has affected various geographical areas, respectively, the cyberattacks conducted in times of crisis. These will be the subject of a cause-and-effect analysis on the association between the two types of events. The time frame chosen was primarily due to the low volume of data on cyberattacks that occurred before 2010. Additionally, some of these crises were echoes of the global financial crisis of 2007–2008, considered, by many economists, the most important crisis since the "Great Depression" of 1929–1930. Also, the same methodological approach will allow an analysis of the literature on cyberattacks during the pandemic, to identify whether there is a causal relationship between the context of the crisis and the motivation, respectively, their targets.

The quantitative methodological approach consists of a bibliometric analysis on the most relevant bibliographic sources that dealt with the cyberattacks during the COVID-19 pandemic. The search results, performed on the Scopus platform, included only scientific articles from journals and papers published in the volumes of specialized conferences. The analysis was performed using the VOSviewer software tool (version 1.16.16).

For comprehensive research on cyberattacks during the coronavirus pandemic, the Scopus database was queried in the title and summary of studies published in journals or conference volumes, using the following terms of reference: ("cyber attacks or "cyber-attacks" or "cyberattacks") and ("covid-19 or coronavirus"). One hundred twenty-three (123) results were obtained, containing research conducted between 2020 and 2021. The choice of key words aimed to obtain an overview of cybersecurity research from the perspective of identifying the motivation and targets of cyberattacks during the pandemic of COVID-19.

A REVIEW OF MOST KNOWN CRISES FROM THE LAST 10 YEARS

From economic crises to armed attacks on the population or the spread of pathogens, the world has always faced degenerative situations, capable of affecting one or more nations. In many cases, the manifestation of a crisis at the level of a nation has had effects outside it as well. The effects and the causes involved adjacent factors, some of which were cyberattacks conducted to or from the affected country.

Table 1 gives a brief overview of the main crises of the last decade. The crises listed are important for the following reasons:

– Although they have manifested themselves on the territory of a nation, their effects have spread beyond borders, having an extensive impact.
– Some of the governmental measures that favored the emergence of crises were generated by the global financial crisis from 2007–2008.

Table 2 shows a series of cyberattacks identified between 2013 and 2018 and which occurred because of the crises mentioned in Table 1. In addition to the factors that triggered and maintained these crises, nations have had to deal with numerous cyberattacks with major negative effects on electronic systems and

Table 1. The most publicly known crises from the last 10 years

Period	Naming	Observations
2010–2014	Portuguese financial crisis	– a financial crisis from 2001, exacerbated by the global crisis of 2007–2008; – many street protests; – a great damage to the socio-economic level.
2012–present	The socio-economic and political crisis in Venezuela	– the crisis began during the presidency of Hugo Chávez (2012); – very high inflation with great impact on purchasing power, health and law systems; – a massive emigration of population.
2013–2014	The Ukrainian crisis	– crisis during 2013–2014 on the several levels, known as Orange Revolution; – a lot of social protests related to EU or pro-Russian orientation.
2014– 2015	The financial crisis in the Russian Federation	– crisis was the result of the sharp devaluation of the Russian national currency [Viktorov and Abramov 2020]; – was caused by two major factors: the drop in oil prices by almost 50% in 2014 and the result of international economic sanctions imposed on Russia [Kitroeff 2014].
2015– 2016	The financial crisis in the People's Republic of China	– crisis was caused by the Chinese stock market turmoil that began on June 12, 2015, with the appearance of the stock market bubble and ended in early February 2016 [Riley and Yan 2015].
2018– present	The financial and economic crisis in Turkey	– crisis was due to the decline in the value of the Turkish lira, high inflation and rising borrowing costs; – was caused by the excessive current account deficit of the Turkish economy and the large amounts of private debt denominated in foreign currency [Borzou 2018, O'Brien 2018].

Source: The authors.

data. The attacks were mainly aimed to affect the systems of government institutions, their assignment being a difficult task due to the complexity, but also the misleading techniques used by attackers (e.g. the use of IP addresses from other geographical areas or the creation of variables in the source code, in a language other than the attackers' source language).

The analysis of the types of attacks exposed in Table 2 highlights the year 2014 as one of transition from ideologically motivated attacks to those motivated financially or supported by the state.

In order to verify the hypothesis regarding the trend of cyberattacks, all these events, made public in the period 2012–2020, were analyzed from the point of view of motivation. According to the data showed in the public environment (Fig. 1), for the period 2012–2014, the trends of cyberattacks were marked by the actions of ideologically motivated groups (Hacktivism) and those with financial motivation (Cyber Crime) [Passeri 2015].

Based on the comparison, it can be seen that the attacks with ideological motivation, between 2013 and 2014, decreased from 44% (2013) to 24.9% (2014), while the financially motivated ones registered a significant increase, from 47% (2013) to 62.3% (2014).

Since 2014, the phenomenon of hacktivism has been constantly declining, with significant percentages registering attacks with financial motivation. According to Fig. 1, from 2015 to 2016, the attacks conducted by cybercrime groups increased by 5%, and it is interesting that the attacks with an impact on the social environment (Cyber Warfare) increased from 2.4 to 4.3%.

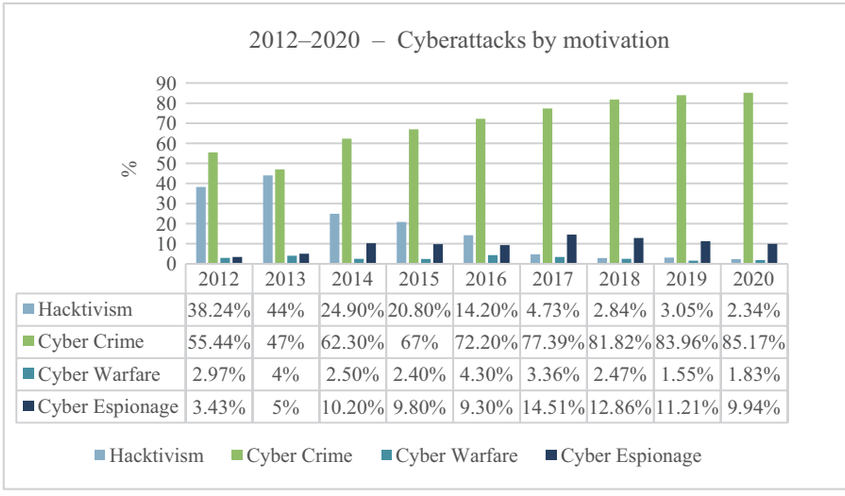
Between 2017 and 2020, the percentage of ideologically and financially motivated attacks continued on the same trend since 2014. Simultaneously, there is an increase in the volume and complexity of cyberattacks, given that organized crime groups have developed business models. profitable around phishing and ransomware attacks, the techniques and tools are marketed on the cybercrime-as-a-service platforms of DarkWeb. There is also an increase in state-sponsored attacks (Cyber Espionage), around 10%, which indicates an intensification in the race to obtain information.

Table 2. Cyberattacks during crises

Period	Cyberattacks	Cyberattacks targets
2013–2014	The hacktivism group „Anonymous" initiated the #OpPortugal operation which was intended to disrupt online government operations due to the violation of human rights [Pastebin 2014].	online government systems of the Portuguese government
2013	The group of hackers known as „r00ts3curity" or „# r00ts3c" carried out cyberattacks on sites in Ukraine, gaining access to data that was later made public. The attacks targeted web platforms of the Kharkiv Regional Scientific Library (www.library.kharkov.ua), Dentistry Of Sevastopol (www.vityaz.in. Ua) and the Center for the Receipt and Processing of Information and Specific Control (dzz. gov.ua) [Lee 2013].	online computer systems of Ukrainian government institutions
2014	Anonymous and Lulzsec groups launched the #OpVenezuela campaign, launching cyberattacks on government websites in Venezuela [Boone 2014]. During the operation, the members of Anonymous obtained and published a series of data on the governmental and presidential steps, which allowed the existence of this crisis [Support Anon Candanga 2019].	online computer systems of the Venezuelan government and presidency
May 2014	An unidentified group of hackers gained access to the Central Electoral Commission of Ukraine and deactivated parts of the network using advanced cyberespionage malware.	online computer systems of Ukrainian government institutions
May 2015	The German Bundestag computer network. BfV, Germany's internal intelligence service, was accessed unauthorized, with German investigators making public that the attacks were supported by the Russian Federation, and their goal was to obtain information about the functioning of the Bundestag, the German government and NATO [Winderm 2016].	online information systems of the German internal intelligence service
December 2015	Cyberattacks have taken place in the Russian Federation, compromising the IT infrastructure of three Ukrainian energy distribution companies and temporarily disrupting consumers' electricity supply [Zetter 2016].	industrial computer systems of Ukrainian energy suppliers
2015	The data of more than 21 million people has been compromised as a result of unauthorized access to the „US Office of Personnel Management" systems by a hacking group in China.	online computer systems of US government agencies
2015–2016	Cyberattacks by Chinese entities targeted Philippine government institutions, along with a medical center and smaller local government units, simultaneous with periods of heightened geopolitical tensions [Piiparinen 2016].	government computer systems in the Philippines
2016	Hackers in China have unauthorized access to workstations and servers of the Federal Deposit Insurance Corp., the US bank deposit insurance agency.	online computer systems of US government agencies
2018	Hackers of Turkish origin attacked at least 30 organizations, including government ministries, embassies and security services. According to British and American officials, the activity bears the marks of a state-backed cyberespionage operation carried out to promote Turkish interests [Stubbs 2020].	government information systems in Greece, Cyprus and Iraq

Source: The authors.

Starting from these data that reveal correlations between crises and cyberattacks, it is found that in the case of the events in Table 1, governmental systems were targeted, for ideological reasons, to subsequently target data and information that bring financial benefits to the attacker, by capitalizing on them in decisions with macroeconomic impact (cyber espionage campaigns). Given that the pandemic crisis has affected all nations, the next chapter will analyze whether the target and motivations of cyberattacks have experienced the same trend as in the case of the analyzed crises or have particularities.



	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hacktivism	38.24%	44%	24.90%	20.80%	14.20%	4.73%	2.84%	3.05%	2.34%
Cyber Crime	55.44%	47%	62.30%	67%	72.20%	77.39%	81.82%	83.96%	85.17%
Cyber Warfare	2.97%	4%	2.50%	2.40%	4.30%	3.36%	2.47%	1.55%	1.83%
Cyber Espionage	3.43%	5%	10.20%	9.80%	9.30%	14.51%	12.86%	11.21%	9.94%

Fig. 1. Cyberattacks by motivation, from 2012 to 2020

Source: The authors calculations using statistical data from [https://www.hackmageddon.com].

CYBERATTACKS DURING THE CORONAVIRUS PANDEMIC

Although the above-mentioned crises have affected several nations, the coronavirus pandemic (COVID--19) has had a considerable impact on the international economic and social life. In the second half of 2020, emerging markets were already in recession, followed by those of developed countries [Zumbrun 2020]. The recession has seen unusually large and rapid increases in unemployment in many countries. To all these effects, a major contribution was made by the consequences of the crises that nations such as Turkey or Venezuela have gone through or are still going through.

The variety of cyberattacks that occurred around the aforementioned events reveals that it is not surprising that they intensified during the COVID-19 pandemic. The crises have caused an international disruption, people having to adapt their daily routines to a new reality: work from home, lack of social interactions, physical activity and fear of not being prepared. [Lindseyh 2020]. Also, the sudden change of work contexts led companies to improvise new ways of doing business, which led to the vulnerability of IT infrastructures in the process of ensuring interoperability. Since the beginning of the pandemic crisis, there has been an intensification of attacks through malware or scams, those conducted through phishing campaigns increasing by about 600% [Fleming 2020].

In April 2020, Google blocked 18 million phishing emails daily using Machine Learning techniques [Kumaran 2020]. Such attacks are conducted for financial reasons, and are intended to exploit the recipient by creating a seemingly legitimate framework of the message source. Given this international framework, a bibliometric analysis of the most relevant bibliographic sources that dealt with the subject of cyberattacks during the COVID-19 pandemic would facilitate the finding of answers to our research questions.

Bibliometric analysis of results

The bibliometric analysis created an overview of the research of cyberattacks conducted during the pandemic and the application of the results to ensure cybersecurity. In this sense, it was considered to identify the key words of the studies in the field, respectively, of the main authors with a significant contribution. The level of involvement of the main countries that are the target of attacks in the process of supporting studies on improving the defense techniques of their own systems was also monitored.

Table 3. The most significant key words

Key word	Occurrences
Network security	55
Cyberattacks	38
Cyber security	32
COVID-19	25
Computer crime	23
Security of data	21
Crime	18
Cybersecurity	18
Internet of things	18
Malware	15

Source: Self representation using Scopus exported data.

Table 4. The most significant authors

Author	Documents	Citations
Bellekens X.	2	13
Gupta R.	2	9
Tanwar S.	2	9
Gupta D.	2	3
Khan R.A.	2	3
Konstantinou C.	2	3
Kumar S.	2	3
Renaud K.	2	2
Agrawal A.	2	1

Source: Self representation using Scopus exported data.

Table 3 contains the most used key words in the research and highlights, as we found earlier, that in the pandemic period, cyberattacks were financially motivated, being conducted through malware applications. They also targeted equipment in the Internet of things category, with research focused on ensuring network and data security. To identify the authors with the most important contributions, it was taken consider the number of citations. Thus, the most important authors are included in Table 4.

The analysis shows that their interest is focused on identifying new opportunities and technologies, such as artificial intelligence, to ensure cybersecurity, given the types of cyberattacks that occurred during the pandemic and their targets.

The results of the analysis showed that the main countries, according to the authors' affiliation, in which pandemic cyberattacks were studied and ways to counter them, are the United Kingdom, India, the United States, Saudi Arabia and China. Notably the list of countries includes countries such as Portugal, Turkey, Ukraine and the Russian Federation, which were involved in this research, possibly because of the events during the crises they faced. The data obtained show that the pandemic had and has an important impact on cybersecurity worldwide, being marked according to research, by financially motivated cyberattacks.

Literature review on cyberattacks during COVID-19 crisis

As COVID-19 has spread worldwide, it has also led to a significant threat to a technology-based society, manifested by campaigns of cyberattacks on both organizations/institutions and home users. Since the onset of the pandemic, numerous reports have highlighted the fraudulent use of the name of public authorities (e.g., WHO) and medical or pharmaceutical organizations [Bryan 2020, MalwareBytes 2020] in attacks targeting platforms involved [Krebs on Security 2020, Smithers 2020] in creating personal protective equipment [Europol 2020] and providing solutions against COVID-19 [Norton 2020, Paul 2020]. These attacks, also known as scams, targeted in particular the public, especially people who performed their professional activities at home. The changes that have taken place in the way of performed the professional activity, respectively at home, have caused a high level of cybersecurity problems and challenges that could not be previously estimated by the industry. Cybercriminals have used this opportunity to expand their attacks through traditional methods of fraud [Nurse 2019] using increased stress, anxiety and worries facing society. These negative aspects were complemented by the low level of training of software vendors, especially about the security of their products.

Cyberattacks related to the pandemic crisis have used, as a way of propagation, social engineering (SE), one of the main methods have produced negative effects, especially by targeting critical infrastructure, such as hospitals and medical services. In the current

situation, social engineering is one of the most significant security threats faced by various organizations in both the public and private sector [Abraham 2010]. Although data on the number of cyberattacks that used SE as the initial method of obtaining unauthorized access are not yet known, statistics for 2020 show that approximately 2,332 events have been reported to the Internet Crime Complaint Center (IC3), of which, approximately 39.9% were infecting computers with malware, and 15.4% of gaining unauthorized access to user accounts [Johnson 2021].

To further increase the success of cyberattacks, hacking entities have registered numerous of web domains containing words such as "covid" and "corona" [Check Point 2020]. Such domains are seemingly credible and therefore accessible, especially if they are associated with terms such as "WHO", "Centers for Disease Control and Prevention (CDC)" or key words (e.g. Corona-virusapps.com, anticovid19-pharmacy.com, etc.) [Brewster 2019, 2020]. The names of communication platforms have also been used to increase the credibility, such as Zoom, Microsoft or Google, both in emails and in domain names (e.g. http://log.microsoftonline.com- common-oauth2-eezylnrb.medyacam.com/common/oauth2/) [Check Point 2020]. This is all the more important as they are the main technologies used by millions of users around the world for educational, professional or social activities. The proportion of new malware used in COVID-19 attacks has increased by 15% [Nabe 2020]. The main malware applications identified in the attacks were updated versions of the already known ones, such as Metaljack, REMCOS, Emotet, LOKIBOT, SpyMax (disguised in the Corona live 1.1 application) FORMBOOK, Trickbot and Ginp. Some attacks even used a form of machine learning that allowed them to integrate into the environment and remain undetected [Lallie 2021].

Another form of attack related to the pandemic situation was the one carried out through ransomware applications, hackers managing to combine data exfiltration with their encryption, to have an advantage in determining the victims to make redemption payments. At the organizational level, ransomware attacks targeted in particular the institutions involved in combating the effects of the pandemic, this being a modus operandi specific to entities focused only on financial gains. Regarding ransomware applications, a notable threat was COVIDLock, an Android application (COVID-19 Tracker) that should provide an updated map of Covid cases, but which, encrypts the mobile device and asks the user for a payment for unlocking [Anderson 2020].

According to the data's from Statista platform, from 2011 to 2020, the amount of damage caused by reported cybercrime increased significantly, to USD 4.2 billion, from around USD 500 million in 2011.Thus, a correlation between statistical data on cyberattacks by motivation and their financial impact reveals a strong upward trend in financially motivated actions.

Basically, in times of crisis, institutions, companies and citizens need to pay more attention, even requiring additional training, information or warning about the risks they may be exposed to in terms of cybersecurity.

RESULTS AND CONCLUSIONS

The pandemic situation has had and has a major impact on the human condition, whether we are talking about health, economics or technology. In a period dominated by communication dependence and the need to ensure physical and mental integrity, cybercrime groups have identified the main target of cyberattacks: the individual. Its exploitation through various techniques related to fake-news campaigns, allowed groups, access to critical infrastructure and obtaining financial or image benefits, during the disruption of the functioning of information systems. Each crisis had a correspondent in the targets and motivations of the cyberattacks conducted, regardless of the geographical area. And the percentage of those known has been constantly growing, following the technological trend, this being one of the limits of research, respectively the insufficient sample size for statistical measurements of the amount of data on cyberattacks carried out during the mentioned crisis periods.

In response to the first question in the research, the COVID-19 pandemic and its impact on the individual were factors favoring not only cyberattacks but especially their success rate. In support of the answer are data published by organizations in the field of cybersecurity and highlighting features such as the emergence of false domains containing key words about

the pandemic or communication technologies. And the analysis of the attacks during other crises reveals that the rate of these events will not depend on the type of crisis, but on the level of use of technology in that period. As a result, the number of cyberattacks during the COVID-19 pandemic was significantly higher than in other periods, due in particular to the needs of the transition of some activities performed in the physical environment to the online one. This has caused a high level of cybersecurity issues and challenges that could not be previously estimated by the industry.

The analysis of the attacks identified during the crisis revealed that the main targets were the systems belonging to governmental and/or non-governmental organizations, involved in combating the state of crisis or considered responsible for its effects. In addition to the financial motivation, as highlighted by the statistical situation of cyberattacks, the attacks aimed to obtain data and information that support decisions with macroeconomic and geopolitical impact of countries of origin (cyberespionage campaigns). Thus, these data make it possible to estimate with a high degree of probability the targets targeted during a crisis.

In response to the motivations and modus operandi, in all situations related to periods of crisis, the human factor was the main lever for gaining access to platforms or applications that subsequently facilitated the operation of internal information systems. The attacks were identified as using social engineering as a way of propagation, domain names containing key words about the crisis, respectively, updated variants of some families of malware or ransomware. The highest percentage of attacks was recorded by those motivated financial, an aspect that supports the need for research identified in the bibliometric analysis. Counteracting them will be possible by ensuring the security of data and communication networks, with the support of new technologies such as artificial intelligence, an aspect highlighted by the work of researchers such as Bellekens or Tanwar.

The novelty of this study is to highlight the different manifestations of threats depending on the type of crisis and the nation affected. The factors that influence this dependence are: the existing political structures at the level of those nations, the degree of development of those states, respectively the digitalization of the nations. Also, the research showed that during the pandemic another important factor intervened: social distance and work from home, which led to an even greater exposure to cyberthreats, because it is more difficult to be sure that the information you have access to is real. The increase in fake news information, the impossibility of validating information from several sources, the exponential increase in the use of social media generates as many vulnerabilities in terms of cybersecurity. And the fact that people are vulnerable to social engineering, highlights the need to find new forms and means to protect and raise awareness in this regard. And in this sense, future research should focus on techniques in the field of Artificial Intelligence, by combining the models of Machine Learning for Domain Generation Algorithms, Botnet and Spam Detection, with those for User Behavior.

In conclusion, although the trend of cyberattacks is increasing, the involvement of the academic community will play a major role in creating an environment favorable to the development of techniques and methods necessary to ensure cybersecurity.

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GLOBALNE KRYZYSY I ATAKI NA CYBERBEZPIECZEŃSTWO – ANALIZA PODCZAS PANDEMII COVID-19

STRESZCZENIE

Pandemia COVID-19 dotknęła wszystkie narody w różnych wymiarach – zarówno gospodarczym, jak i społecznym. Nowa normalność jako zachowania społeczne podyktowane nałożonymi ograniczeniami podtrzymała interakcje online, co umożliwiło zwiększenie zakresu cyberataków. Artykuł ma na celu analizę cyberataków przeprowadzanych podczas pandemii COVID-19, począwszy od serii wydarzeń międzynarodowych, takich jak kryzys w Wenezueli czy na Ukrainie. Częścią tego badania jest ilościowa analiza wyników uzyskanych z przeglądu zasobów bazy Scopus. W tej części, oprócz najważniejszych autorów i użytych słów kluczowych, starano się ustalić, czy kraje będące głównymi celami cyberataków są również zaangażowane w badanie cyberbezpieczeństwa podczas pandemii. Cyberataki są analizowane pod kątem motywacji i celów atakujących. Wskazano również kolejne kierunki badań w tym zakresie.

Słowa kluczowe: cyberataki, kryzysy, koronawirus, COVID-19, cyberprzestępczość, haktywizm

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COHERENCE OF THE SPENDING OF EU FUNDS IN THE SZCZEBRZESZYN MUNICIPALITY IN POLAND IN 2014–2020: EXPECTATIONS OF INHABITANTS FOR LOCAL DEVELOPMENT AND IMPROVING THE QUALITY OF LIFE

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ABSTRACT

Local development, understood as a process of significant changes, is conditioned by both endogenous and exogenous resources, including EU subsidies. The main objective of the study is to identify the areas in which EU projects were implemented by the Szczebrzeszyn commune in Poland in 2014–2020. In addition, the study analyzes the opinions of the commune inhabitants on the legitimacy of investments implemented with EU funds, in the context of the socio-economic development of the commune and improvement of the quality of life. A CAWI survey was conducted among the inhabitants of the municipality, and the changes that have occurred due to the EU funding were analyzed. Most respondents noticed the development within the Szczebrzeszyn municipality in the last ten years. The use of EU funds allowed to increase the length of the sewage network and bicycle path, as well as to install solar collectors and photovoltaic panels. The respondents claimed that some of the projects positively impacted their quality of life.

Key words: EU funds, municipality, investment, local development, quality of life

JEL codes: I25, O12, R51

INTRODUCTION

The municipality (commune, in Polish – *gmina*), as the lowest level of local government in Poland (the EU LAU2 level), is closest to the citizens, therefore it is primarily responsible for creating local development aimed at raising the standard of living. The municipal authorities are active in sectors such as the protection of the environment, culture, energy, health and human capital to contribute to its development. It is obvious that development opportunities are to a large extent determined by the financial resources of a municipality. In a situation where it does not have its own funds necessary to shape development processes, funds from foreign sources, such as funds from the EU (EU funds), may prove helpful. The mere fact of obtaining subsidies from the EU budget does not guarantee the strengthening of local development; only in combination with entrepreneurship and the activity of the local community can subsidies significantly accelerate this development. However, for this to happen, the potential of the municipality must be properly managed [Kłodziński 2010], and the EU funds must be properly spent [Sawicka and Kurek 2004, Brăgaru 2011, Pomianek 2018, Rakowska 2019].

The effects of individual projects are characterized by a different time perspective. Taking into account the time of occurrence, one-off, long-term and

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potential effects should be distinguished. One-off effects concern, for example, the organization of cultural events. Long-term effects include the results of projects related to the construction or modernization of technical, social and educational infrastructure. In turn, the effects with a potential impact on development occur in the case of educational activities aimed at creating a low-emission economy or aimed at activating the unemployed. The effects of these measures are difficult to predict over time. In addition, some effects are easier to measure than others and can therefore be classified as measurable and unmeasurable. Measurable changes can be presented in quantitative terms, while non-measurable changes in qualitative terms [Rakowska 2019]. Therefore, it may be possible to determine whether a project has fulfilled its task and contributed to the improvement of certain aspects of society's life only after a certain period of time.

AIMS AND METHOD

Szczebrzeszyn is an urban-rural municipality located in the south-eastern part of Poland, in the Lubelskie Voivodeship (region). It was established in 1972 and covers an area of 124 km^2, 71% of which is arable land and 23% forests. There are very good conditions for agricultural production due to the high soil valuation index; however, agriculture is fragmented and thus low-effective [Urząd Miejski w Szczebrzeszynie 2017]. The Wieprz river flows through the territory of the municipality, as well as important road routes of international and national importance. In addition, there is a part of the buffer zone of the Roztoczański National Park and the Szczebrzeszyn Landscape Park within its area.

The aim of the study is to identify the areas in which EU projects were implemented by the Szczebrzeszyn commune in 2014–2020, as well as to find out the opinions of the commune inhabitants on the legitimacy of investments implemented with EU funds, in the context of the socio-economic development of the commune and improvement of the quality of life. The following research hypotheses were adopted in the study:

- Hypothesis 1 – the EU funds allowed to increase the use of renewable energy in the municipality in 2010–2019.
- Hypothesis 2 – due to the EU support, the percentage of the local population using the sewage network has increased.
- Hypothesis 3 – the spending of the EU funds influenced the development of bicycle infrastructure.
- Hypothesis 4 – the professional status of the surveyed inhabitants of Szczebrzeszyn municipality influences evaluation of the municipal authorities' activities.

The study used the following sources of secondary data: the Local Data Bank of the Central Statistical Office and financial reports of the Szczebrzeszyn municipality. A CAWI (Computer Assisted Web Interview) questionnaire survey was also conducted, in which 159 random people living in the Szczebrzeszyn municipality took part, including 96 women and 63 men. The chi-square (χ^2) test of independence was used to analyse the responses of residents collected during the study [Borkowski et al. 2004, Greenland et al. 2016], which makes it possible to examine whether there is a relationship between individual non-measurable variables. A direct interview was also conducted with a representative of the Szczebrzeszyn City Hall.

DIRECTIONS OF SPENDING EU FUNDS BY THE SZCZEBRZESZYN MUNICIPALITY IN 2014–2020

In the 2014–2020 financial perspective, Poland was the largest beneficiary of EU funds among all EU countries, and Polish local governments were given the opportunity to obtain huge funds. Due to this, local government authorities had the opportunity not only to overcome barriers resulting from the underdevelopment of the basic technical infrastructure, but also to opening up the possibility of accelerating development processes, thus increasing their competitiveness. The EU funds allow municipalities to develop faster than would be possible if only their own funds were used [Szara and Majka 2017].

Communes could apply for co-financing projects in various fields, including regeneration efforts, social inclusion and a low-carbon economy. However, not all territorial entities have been able to raise funds equally. In the ranking relating to investment expenditure made by local governments in 2014–2019, thanks to the acquisition of the EU funds, Podlaskie voivodship

(the EU NUTS-2 level) was in the lead with expenditure per capita amounting to PLN 1,480.81, while Lubelskie Voivodeship came third with a result of PLN 980.15. In the small town category, Szczebrzeszyn was ranked 230 out of 607 with per capita expenditure at the level of PLN 1,131.95 [Swianiewicz and Łukomska 2020].

In the years 2017–2020, the local authorities and community in Szczebrzeszyn municipality applied for funds from four programs, of which funding was obtained from three, i.e. ROP of the Lubelskie Voivodeship (ROP LV, in Polish: RPO Województwo Lubelskie), OP Digital Poland (OP DP, in Polish – PO Polska Cyfrowa) and OP Eastern Poland (OP EP, in Polish – PO Polska Wschodnia), with the first one being the most popular. As for the municipality as a local government unit, in the discussed period it submitted 15 applications for EU funding, of which 11 contracts were signed (almost all under the ROP LV – only one contract was signed within the Rural Development Programme 2014–2020 – RDP).

The direction of allocation of the EU funds in the Szczebrzeszyn municipality included the spheres of, inter alia, energy, water and sewage management, tourism, education and social integration. Projects that were implemented in the municipality in the past 2014–2020 perspective are listed in Table 1 (under the European Regional Development Fund, within the ROP LV) and Table 2 (under the European Social Fund and the European Agricultural Fund for Rural Areas). The projects with the highest EU funding in the municipality were thermal modernization of school and educational facilities in Szczebrzeszyn, construction of a sewage system and installation of solar collectors and photovoltaic panels – Stage II and III (Table 1).

The most aware group of inhabitants of the Szczebrzeszyn municipality in terms of investments financed from EU funds were inhabitants of the age 45–60. On the other hand, taking into account the structure of answers according to the area of residence, the knowledge of respondents from rural areas was at the level of about 57%, and of respondents from the municipality center – about 68%. This means that participants in the urban study were more aware of the activities carried out by municipal authorities regarding the EU projects.

According to the respondents, the most important source of information about investments in the Szczebrzeszyn commune is the Facebook page (33%), followed by information boards (24%) and the commune's website (21%). After analyzing the responses of the respondents, it was found that with age the importance of information provided directly by residents as a source of knowledge about the EU projects increases. On the other hand, the Facebook page shows the opposite tendency. It is more important for younger people.

On Fig. 1 shows the assessment of the importance of individual projects implemented in the commune from the 2014–2020 perspective, made by the respondents on a scale from 0 to 4, where 0 meant that a project was not important for them, and 4 – very important.

The most important for the respondents were projects related to the installation of solar collectors and photovoltaic panels (2.61) and the construction of a pedestrian and bicycle path (2.52). Projects related to the construction of a sewage system and thermomodernization of school buildings turned out to be a bit less important (both 2.47). The establishment of the Museum and Education Center (1.61) had the least value for the respondents in the commune. As can be read from Fig. 1, in the group of respondents, hard investments turned out to be more important than "soft" projects. The χ^2 test independence tests show the relationship between the professional status (broken down into working and non-working people) and the assessment of the importance of the project to build a pedestrian and bicycle path as well as the project on improving the competences of pupils from the Szczebrzeszyn municipality in the respondents' opinion.

Moreover, the participants of the study assessed the quality of the discussed projects on a scale of 0–4, where 0 meant poor quality of a project, and 4 – very good (Fig. 2). The respondents stated that thermal modernization (1.99) and sewage construction (1.94) were of the highest quality among all the projects. The largest limitations were observed in the "Be active" project (1.6). The evaluation of the quality of all projects was not too high, which may indicate some objections of the respondents as to the quality of these investments. It can be assumed that the projects did not meet their expectations appropriately.

Table 1. Projects co-financed by EU funds under the ERDF (ROP LV) implemented by the Szczebrzeszyn municipality in the 2014–2020 financial perspective

Project	Aim	Total project value [in PLN]	EU co-financing [in PLN]
Thermo-modernization of the building of the Primary School in Bodaczów	improving the quality of the natural environment through comprehensive thermal modernization of the public building	2,185,049.28	1,235,733.40
Thermo-modernization of school and educational facilities with the use of renewable energy in Szczebrzeszyn	improving the quality of the environment through comprehensive thermal modernization of utility buildings at the school in Szczebrzeszyn	4,907,933.08	2,332,161.99
Museum and Education Center with an amphitheater	using the internal potential of the area for economic development based on local resources	2,568,853.37	1,442,566.97
Construction of a sanitary sewage system in Szczebrzeszyn – Stage IV	increasing the availability and efficiency of the sewage system	6,465 206.49	3,018,969.34
Citizen-friendly digital office	a quick and simple way of dealing with official matters – a partnership project of 8 municipalities from the Lubelskie Voivodeship	7,190,248.99 (1,187,316.92)*	6,111,711.63 (1,009,219.30)*
Construction of a pedestrian and bicycle path along the Wieprz river with the organization of 2 nature observation points	support for economic growth through protection, promotion and development of natural tourist values	1,766,573.23	762,355.95
ECO Szczebrzeszyn warm in the rays of the sun – Stage II	increasing the use of renewable energy in the municipality	4,764,140.56	2,743,826.80
ECO Szczebrzeszyn warm in the rays of the sun – Stage III	increasing the use of renewable energy in the municipality	3,706,888.00	1,539,382.50

* – including Szczebrzeszyn municipality.

Source: Authors' elaboration based on [Mapa dotacji UE, Realizowane projekty].

Table 2. Projects co-financed from EU funds under the ESF and the EAFRD implemented in the Szczebrzeszyn municipality in the 2014–2020 financial perspective

Project	Aim	Total project value [in PLN]	EU co-financing [in PLN]
Development of competences of pupils from the Szczebrzeszyn municipality	raising the key competences of students, appropriate attitudes and skills necessary on the labour market, taking into account the needs of disabled people	987,715.91	932,975.91 (ESF – ROP LV)
Be active	increased socio-professional activity and improved access to the labour market for people excluded or at risk of poverty and exclusion	681,484.00	579,261.40 (ESF – ROP LV)
Tourist and recreation centre at Ogrodowa street	increasing general fitness and active rest by using the playground, outdoor gym or bicycle path	448 866.51	245,058.00 (EAFRD – RDP)

Source: Authors' elaboration based on [Mapa dotacji UE, Realizowane projekty].

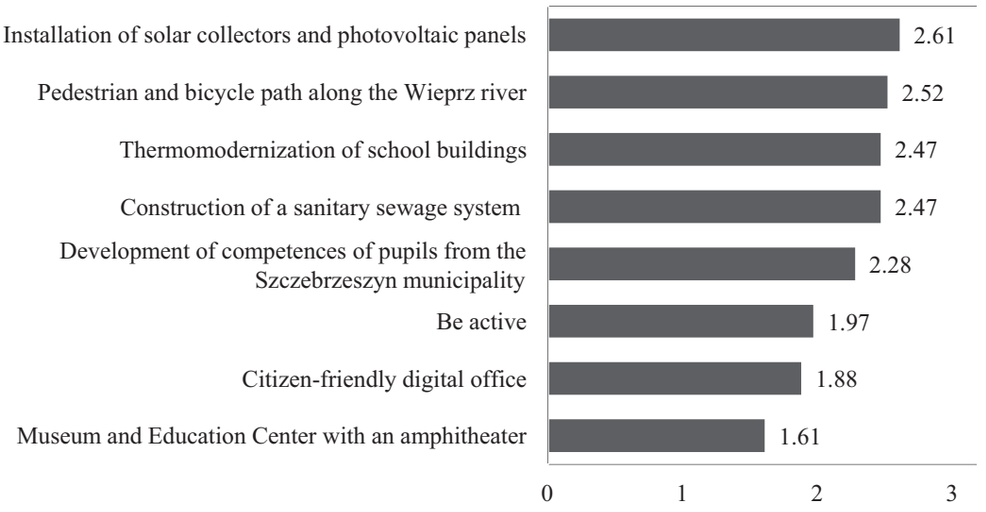

Fig. 1. Assessment of the importance of projects implemented by the municipality in the 2014–2020 perspective

Source: Authors' research.

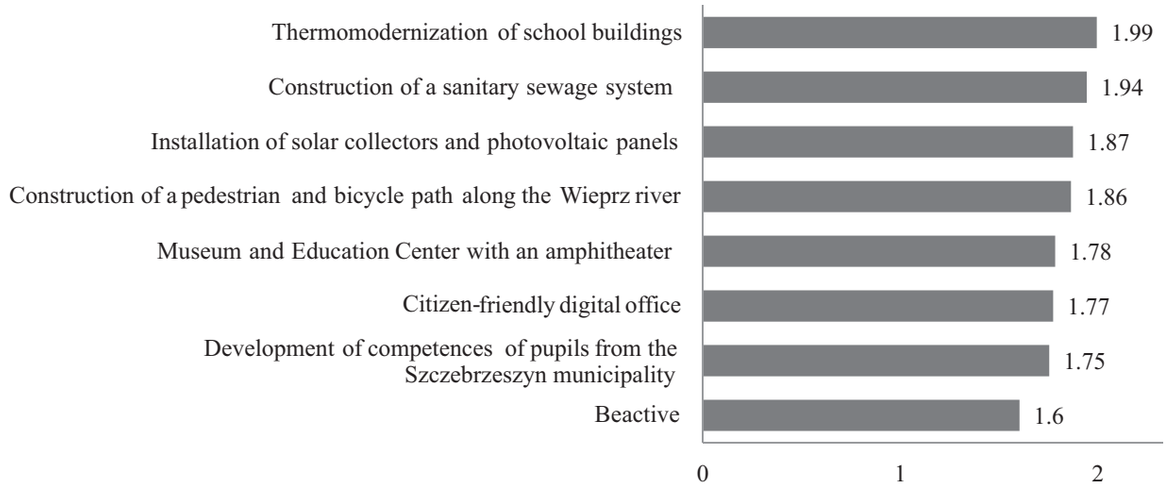

Fig. 2. Assessment of the quality of projects implemented by the municipality in the 2014–2020 perspective

Source: Authors' research.

The relationship was also examined in the case of project quality assessment. Using the χ^2 independence test, it was verified that there is a relationship between the professional status and the assessment of the quality of the "Be active" project, as well as the assessment of the quality of the construction project of the Museum and Educational Center. The working respondents assessed the quality of the projects much worse than the non-working participants. Moreover, the evaluation of the quality of the construction project of the Museum and Educational Center depended on the professional status. In this case also, the non-working respondents were more satisfied with the quality of the project.

Another issue raised in the survey included the areas which require funding according to the surveyed inhabitants of the Szczebrzeszyn municipality. Taking into account the data for all age groups in total, according to the respondents, the local government should put more emphasis on supporting tourism (34.6%), technical infrastructure (28.9%), and health protection (21.4%). Tourism as an area requiring funding was paid attention to mainly by younger people. It is also a local development factor [Boboli and Dashi Muça 2021] highlighted in the Local Development Strategy of Szczebrzeszyn Municipality [Strategia Rozwoju Gminy…]. However, as the age of the surveyed inhabitants increased, the importance of tourism decreased in favor of technical infrastructure and health protection. People under the age of 21 more often pointed to the need to develop culture and art, while older people looked for work and social integration. Regarding the gender structure, women selected health protection much more often than men.

Another issue raised in the study was whether the actions of the commune authorities are sufficient to improve the local quality of life. An overwhelming number of people participating in the survey (62%) assessed the activity of the municipal authorities as insufficient. The remaining respondents considered it to be sufficient (24%) and good (14%). Nobody rated them as very good. It can be assumed that the surveyed residents are not entirely satisfied with the functioning of the commune authorities and believe that a lot should be improved in this regard.

In order to examine the relationship between the evaluation of activities of the authorities of the Szczebrzeszyn municipality and such features as place of residence, professional status and gender, χ^2 tests were carried out and such relationships were found. The respondents from the town of Szczebrzeszyn assessed the behavior of the municipal authorities worse than the respondents from rural areas. The same question was also examined in terms of professional status. Another conclusion is that the professional status also affects the evaluation of the activities of the municipal authorities. The non-workers assessed the behavior of the authorities more positively than the working respondents. Moreover, there is also a relationship between the assessment of the activities of municipal authorities and gender. Women participating in the survey had many more objections about the functioning of the organs of the municipality than did men.

There is no doubt that the goal of EU investments is, inter alia, reducing development disproportions, increasing the standard of living of the local community and economic development of the municipality. However, this is not always achieved. The inhabitants of the Szczebrzeszyn commune who participated in the survey were asked to evaluate the individual benefits that may be the result of the EU support (Fig. 3).

The surveyed community of the Szczebrzeszyn municipality noticed benefits mainly in the improvement of the natural environment (61% of positive opinions), improvement of the aesthetics of the town (65%) and development of technical infrastructure (73%). On the other hand, according to 78% of respondents, no new jobs appeared. Almost the same number of people did not see the possibility of improving their qualifications (75%). The vast majority of respondents also believed that their income has not increased (70%), that there was no better level of education (61%), and that they did not experienced any improvement in their standard of living (57%). As can be seen, negative opinions prevailed. This means that, according to the surveyed residents, the EU funds did not significantly contribute to the development of the municipality. Moreover, using the χ^2 test, a correlation was found between the professional status and the assessment of the occurrence of benefits thanks to the EU funding in the form of new jobs. The unemployed saw this benefit more often than the employed. This may be due to the fact that non-working study participants, including pupils, students and retirees are not up-to-date with the labor market like working people. In turn, their skepticism may result from difficulties in finding employment in the past. The respondents were also asked about their satisfaction with the current socio-economic situation of the Szczebrzeszyn municipality. Negative responses prevailed – over 60% stated that they are not satisfied with the current socio-economic situation of the municipality. Only 25% of the respondents took the opposite position. The others were undecided.

The respondents' task was also to determine whether there had been any development in the social

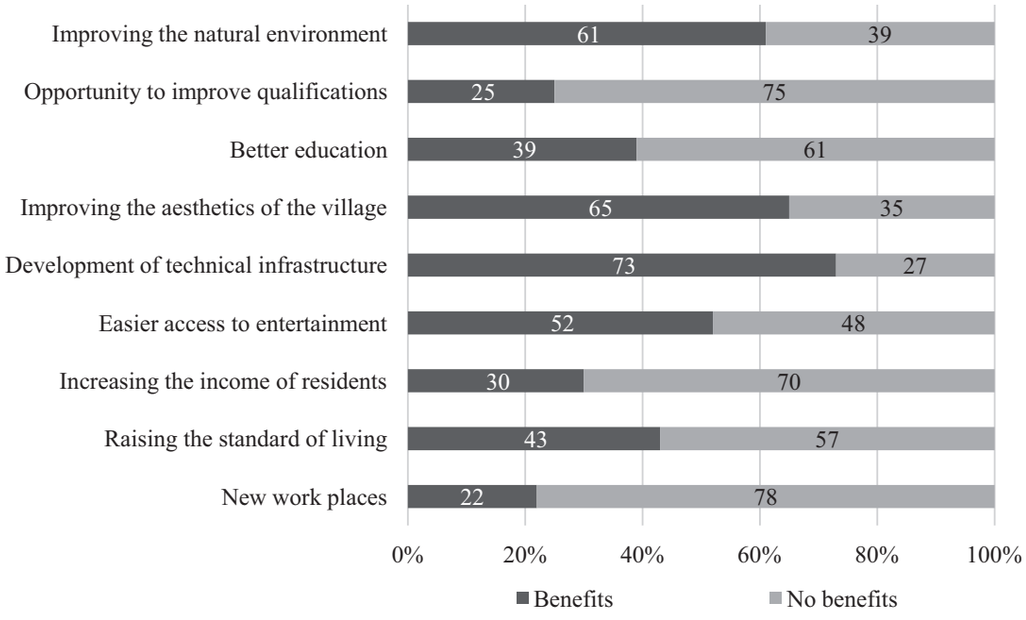

Fig. 3. Assessment of benefits for the municipality obtained due to EU funds according to respondents

Source: Authors' research.

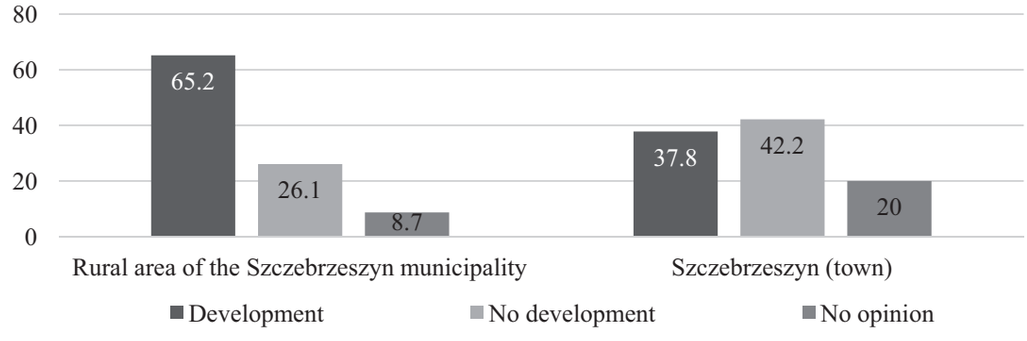

Fig. 4. Assessment of the development of the Szczebrzeszyn municipality over the last decade (2009–2019)

Source: Authors' research.

or economic spheres of the municipality in the last 10 years. Most of the respondents (almost 50%) were in favor that this process took place, while 35% were of the opposite opinion. The Fig. 4 presents opinions on the development of the municipality among the inhabitants participating in the survey, living in rural areas and the municipal center (Szczebrzeszyn town).

As can be seen from the data presented in Fig. 4, the surveyed town residents were much more critical when it comes to the evaluation of the Szczebrzeszyn development process, in contrast to the respondents from rural areas. Almost half of the respondents (42%) living in the Szczebrzeszyn town stated that in recent years there was no development of the

analyzed area. Almost 38% of the respondents had the opposite opinion. In turn, the situation in the rural area was completely different. There, the number of people claiming that development had taken place definitely prevailed (62%). Moreover, the study participants assessed the level of development of the Szczebrzeszyn municipality as similar compared to the neighboring municipalities. In order to find out which obstacles have the greatest impact on limiting and slowing down the development process, the respondents indicated the barriers which, in their opinion, are the most important (Fig. 5). Their task was to assign to each of the constraints a rating from 0 (indicating no impact on development) to 4 (meaning a very large impact on this process).

The most important barriers included in by survey participants were insufficient promotion of the municipality, insufficient use of natural values and poor decision-making efficiency of commune authorities (Fig. 5). The least impact on limiting the development of the Szczebrzeszyn municipality was noticed by the respondents in the low entrepreneurship of the local community.

The inability to obtain support in the form of external funds or difficulties with the implementation of EU projects also constitute a significant barrier to development. According to the person responsible for obtaining funds from the EU at the City Hall in Szczebrzeszyn, the greatest challenge in the past perspective, taking into account the implementation of the EU projects, was meeting the planned schedules and timely completion of projects. The reasons for this were related to the scale and complexity of project implementation, and in difficulties resulting mainly from conducting tender procedures, i.e. lack of offers or exceeding the funds planned for project implementation.

To sum up, the respondents considered the most important investments to be the installation of solar and photovoltaic panels and the construction of a pedestrian and bicycle path. However, they were not completely satisfied with quality of the projects. Due to the EU funds, the respondents noticed the benefits mainly in the improvement of the natural environment, improvement of the aesthetics of towns and the development of technical infrastructure. As to fields requiring support, they mentioned mainly tourism (34.6%), technical infrastructure (28.9%) and health protection (21.4%). Most of the respondents were not satisfied with the current socio-economic situation, and considered the actions of the commune authorities insufficient to improve their quality of life. It is optimistic that most of the survey participants noticed that the Szczebrzeszyn municipality has developed over the last ten years. They indicated a few barriers with a significant impact on the process of creating development: insufficient promotion of the commune, poor use of natural values and poor decision-making efficiency of commune authorities.

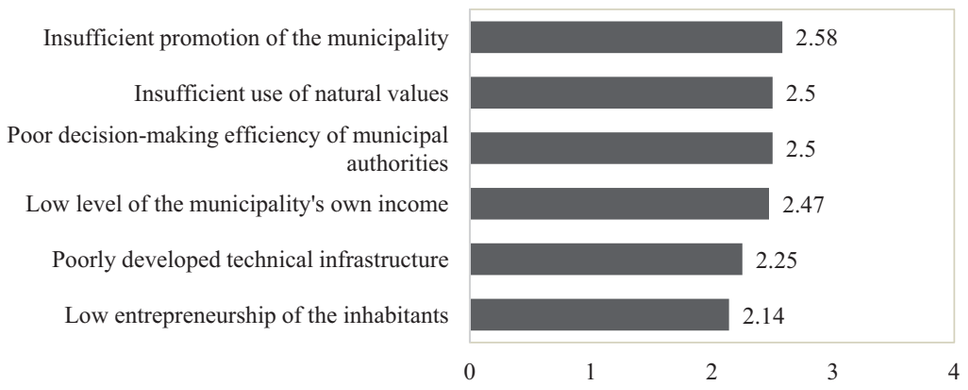

Fig. 5. Assessment of barriers influencing the development of the Szczebrzeszyn municipality

Source: Authors' research.

THE IMPORTANCE OF EU FUNDS IN THE DEVELOPMENT OF THE SZCZEBRZESZYN MUNICIPALITY

Obtaining EU funds is only the beginning of a path that should lead to economic and economic development. For this to happen, proper management at the lowest level of local government is important, and should be focused on constant development. However, this is not possible without investment. Government leaders should change the environment, contribute to the improvement or expansion of technical and social infrastructure, activate society and improve the aesthetics of public space, thus improving the comfort and shaping a better living environment for people. Therefore, the changes in individual spheres of life that took place in the Szczebrzeszyn municipality as a result of using funds under the 2014–2020 financial perspective were analyzed. Those that have taken place in selected items of technical infrastructure over the last six years are illustrated in Table 3.

The sewage system in the Szczebrzeszyn municipality has been underdeveloped over the years and little has changed in this area. As can be seen from the data presented in Table 3, in the years 2014–2018 the length of the active sewage network oscillated around 17 km. Only the town of Szczebrzeszyn and the town of Bodaczów were connected to the sewage network at that time. The total number of connections leading to residential and collective residence buildings in 2014 was 412, and in the following years it fluctuated. The situation changed only due to the acquisition of EU funds for the implementation of the project to build a sanitary sewage system. In 2019, the number of connections was 695, and the length of the active sewage network increased to 28.3 km. On the other hand, the percentage of people using the sewage network in cities over the last ten years increased from 56.5% in 2010 to 69.2% in 2019.

The greater number of connections to the sewage network provided better access to services, at the same time leveling the differences in access to the technical infrastructure. The project contributed to the improvement of the quality of the natural environment and economic development [Budowa… 2019].

Another investment that allowed for the development of technical infrastructure was a project aimed at developing the area in the Wieprz river valley. Its implementation resulted in the creation of 0.96 km of a pedestrian and bicycle path. The investment was intended not only for the inhabitants, but also to increase tourist traffic. Its main task was to provide a place to rest and spend free time [Mapa…]. In turn, the slight increase in the length of the bicycle path, which took place in 2019, was the result of the creation of a Tourist and Recreation Center with the help of RDP co-financing. So far, the largest investment aimed at creating bicycle paths in the municipality was the project "Bicycle Routes in Eastern Poland – Lubelskie Voivodeship" under the Operational Programme Development of Eastern Poland. Despite the fact that it was implemented in the previous financial perspective 2007–2013, it was also co-financed from the EU funds. It contributed to the creation of a total of 11.6 km of bicycle paths [Ministerstwo Rozwoju Regionalnego2012].

The development of technical infrastructure increases the attractiveness and competitiveness of the

Table 3. Changes in the technical infrastructure in the years 2014–2019 in Szczebrzeszyn municipality

Specification	Years					
	2014	2015	2016	2017	2018	2019
Length of the active sewage network [in km]	16.9	17.3	17.3	17.3	17.3	28.3
Number of connections to the sewage network [in pcs.]	412	450	384	410	399	695
Population using sewage treatment plants [number of people]	2,533	2,542	2,550	2,550	2,580	2,790
Length of the cycle path [in km]	1.2	11.6	11.6	11.6	11.6	11.7

Source: Authors' calculations based on [Local Data Bank, Statistics Poland].

area, which becomes a place encouraging people to settle, rest or locate business there [Sierak 2018].

The local government also conducted pro-ecological activities. Investing in renewable energy sources is an opportunity for better energy management. It involves the reduction of environmental pollution as a result of the reduction of air pollutant emissions in the field of, inter alia, emissions of dust, sulfur dioxide and carbon dioxide. Consequently, this may result in increasing tourist attractiveness of the municipality [Rakowska et. al 2020]. The Lubelskie Voivodeship has a very large potential when it comes to solar energy, which can be used, among others, in agriculture, heating and electricity. The introduction of solar collectors, which have the greatest development opportunities in the short term, would positively affect the reduction of fees for energy services, which will undoubtedly benefit the inhabitants of the municipality. However, not only will they be the beneficiaries of the activities carried out, the environment and the municipality will also benefit from it. In addition, it will be closer to meeting the requirements of energy production from renewable energy sources.

The Fig. 6 shows the number of solar collectors and photovoltaic panels installed under the last two financial perspectives. Investments aimed at introducing renewable energy sources into the commune were already initiated in the financial perspective for the years 2007–2013. At that time, 613 solar collectors were installed. In the 2014–2020 perspective, it was continued. The project "ECO Szczebrzeszyn Heat in the Rays of the Sun – Stage II and III" made it possible to install a total of 492 solar installations and 281 photovoltaic installations in residential buildings in the commune. It can be presumed that they contributed to the improvement of the economic situation of the inhabitants.

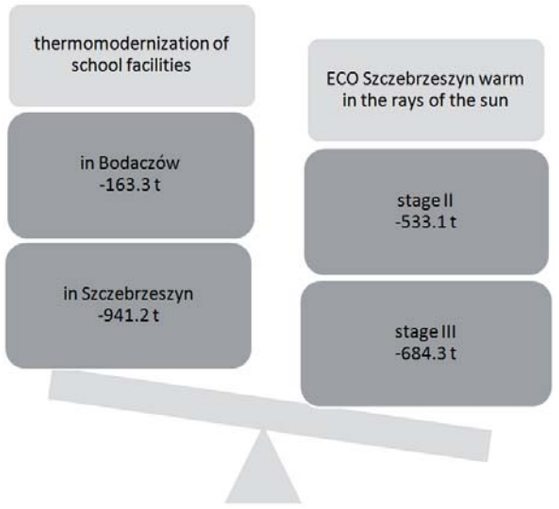

Fig. 6. Estimated annual decrease in greenhouse gas emissions from the projects [t CO_2/year]

Source: Authors' elaboration based on [Mapa dotacji UE, Realizowane projekty].

One of the main tasks that the Szczebrzeszyn municipality carried out in recent years was the modernization of educational institutions. The thermomodernization activities involved reduction of heat loss from buildings. They were aimed at improving the energy efficiency of these buildings, i.e. the use of energy from renewable sources and reducing the costs of lighting and heating. In the 2014–2020 perspective, projects were implemented regarding the thermal modernization of the building of the Primary School in Bodaczów and school and educational facilities in Szczebrzeszyn [Termomodernizacja…]. In the Primary School in Bodaczów, the coal-fired to gas-fired boiler room was rebuilt. In turn, in the Primary School in Szczebrzeszyn, for example, walls and roofs were insulated, windows and doors were replaced, and solar collectors were installed. Over time, the effects of thermo-modernization activities have a positive impact not only on the environment, but also human health and finances. The advantages of such activities include energy savings, improvement of the air condition and improved aesthetics. In addition, pupils (and teachers) have a chance to feel the increased comfort of using the buildings. Both thermo-modernization activities and those aimed at the use of renewable energy sources will result in reduction of greenhouse gas emissions [Strategia Rozwoju Gminy…].

CONCLUSIONS

The changes that took place in the local government in Poland were necessary to awaken the inactive potential at the local level. With the act of 1998, the municipality has become the basic and, at the same time, the smallest local government unit, which is also

characterized by the broadest range of competences and the strongest position. From that time on, the local government began to act as the landlord responsible for the economic development of the municipality [Parysek 2001]. In this process, however, it is not left to itself. It can count on support in the form of EU funds. However, obtaining these funds does not guarantee the rise of local development, as – if improperly spent – they can contribute to generating costs. Thus, it is important to take into account the needs of society and the financial situation of individuals.

For the respondents of the Szczebrzeszyn commune, more important than the "soft" projects were "hard" investments, which included construction of a sewage network and installation of solar and photovoltaic panels. The above-mentioned projects were also characterized by the highest value among all those implemented in the completed perspective. The commune community positively assesses the development changes in the last decade.

It was noticed that due to the EU funds, the municipality and its inhabitants achieved benefits mainly in the improvement of the natural environment, development of technical infrastructure and improvement of the aesthetics of the town. The first benefit may result from the implementation of the project "ECO Szczebrzeszyn Heat in the Rays of the Sun – Stage II and III", the first stage of which took place in the previous financial perspective. It enabled the installation of a total of 492 solar installations and 281 photovoltaic installations in residential buildings. According to the above, Hypothesis 1 was adopted, which reads as follows: "The EU funds allowed to increase the use of renewable energy in the municipality in 2010–2019".

The second benefit was the development of technical infrastructure. This is confirmed in practice, because with the aid of funding from the ROP LV, an investment was made to build a sewage network. As a result, its length in 2019 increased by almost 64% (from 17.3 to 28.3 km) compared to the previous year. In turn, the percentage of people using the sewage network in cities over the last ten years increased from 56.5% in 2010 to 69.2% in 2019. Therefore, Hypothesis 2 was adopted: "Due to the EU support, the percentage of the local population using the sewage network has increased".

Another project that influenced the development of the technical infrastructure in the municipality was the construction of a pedestrian and bicycle path along the Wieprz River. It was also co-financed by the ROP WL. At that time, an almost kilometer-long section of the path was built. In total, over 12 km of bicycle paths have been created thanks to EU funds in the last ten years. Thus, Hypothesis 3 was adopted: "The spending of the EU funds influenced the development of bicycle infrastructure".

On the other hand, the third benefit, i.e. the improvement of the aesthetics of the town, may partially result from the thermal modernization of buildings, the construction of the Museum and Educational Center, the construction of a pedestrian and bicycle path or the creation of a Tourist and Recreation Center for which funds from the ROP WL and RDP have been received. Undoubtedly, this benefit was due to many investments introduced over the years, not only from EU funds.

Most of the surveyed residents were not satisfied with the current socio-economic situation of the Szczebrzeszyn municipality, and they consider the actions of its authorities insufficient to improve their quality of life. Moreover, the assessment of the activities of the authorities of the unit in question depends on the place of residence, gender and professional status of the respondents. As for the first division, the inhabitants of the urban area were more critical in assessing the functioning of the organs of the unit. In the second category, women turned out to be more demanding, and broken down by professional status, the employed had more reservations about the activities of the municipality. In connection with the above, Hypothesis 4 was adopted: "The professional status of the surveyed inhabitants of Szczebrzeszyn municipality influences evaluation of the municipal authorities' activities".

Among the barriers limiting the creation of development to the greatest extent, the respondents most often indicated insufficient promotion of the commune and poor use of natural values. Perhaps it is in these areas that further projects should be implemented by the authorities of the Szczebrzeszyn commune. This picturesque town located in Roztocze region has many advantages that can attract tourists, such as: beautiful landscapes, monuments, parks, loess ravines as well

as hiking and biking trails. However, it does not use its full potential, which is noticed by the inhabitants of the municipality.

In the survey, the field that required support was mentioned primarily as tourism (34.6%). The need for its development was also highlighted in the Spatial Development Plan for the Lubelskie Voivodeship [Urząd Marszałkowski Województwa Lubelskiego w Lublinie 2015]. It stated, inter alia, that the commune has a good transportation location and should strive for the development of tourist infrastructure in order to take advantage of local cultural values. A similar opinion was included in the Development Strategy of the Lubelskie Voivodeship for 2014–2020 [Strategia Rozwoju Województwa…]. It defines the commune as an area with high natural, landscape and cultural values that should be used to create appropriate conditions for socio-economic growth. In addition, it was stated that the focus should be on the development of transport infrastructure, the improvement of social services and the support of human resources. The survey participants are of a similar opinion, pointing to the need to support the development of technical infrastructure (28.9% of respondents' votes) and health protection (21.4%).

The local government authorities in the Szczebrzeszyn municipality see the importance of financial support from the EU, because the municipality's own income is not a sufficient source of financing for investments and without a subsidy from the EU budget, numerous investments, such as the construction of a sewage system, would not be possible. In the 2021–2027 financial perspective, the Szczebrzeszyn municipality authorities have been planning investments in the areas of road construction and climate, including the construction of storage reservoirs, environmental protection and protection of cultural heritage.

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SPÓJNOŚĆ WYDATKOWANIA ŚRODKÓW UNIJNYCH W GMINIE SZCZEBRZESZYN W LATACH 2014–2020 Z OCZEKIWANIAMI MIESZKAŃCÓW W ZAKRESIE POPRAWY JAKOŚCI ŻYCIA I ROZWOJU LOKALNEGO

STRESZCZENIE

Rozwój lokalny rozumiany jako proces znaczących przemian uwarunkowany jest zarówno zasobami endogenicznymi, jak i egzogenicznymi, do których należy zaliczyć dotacje z UE. Głównym celem opracowania była identyfikacja obszarów, w których gmina Szczebrzeszyn realizowała projekty unijne w latach 2014–2020, a także poznanie opinii mieszkańców gminy na temat zasadności inwestycji realizowanych ze środków unijnych w kontekście rozwoju społeczno-gospodarczego gminy i poprawy jakości życia. W związku z tym przeprowadzono wśród mieszkańców gminy badanie CAWI oraz przeanalizowano zmiany, jakie zaszły dzięki dofinansowaniu z UE na jej terenie. Jak się okazało, większość respondentów dostrzegło rozwój gminy Szczebrzeszyn w ostatnich dziesięciu latach. Wykorzystanie środków unijnych pozwoliło na zwiększenie m.in. długości sieci kanalizacyjnej i ścieżki rowerowej, a także zainstalowanie kolektorów słonecznych oraz paneli fotowoltaicznych. Respondenci uznali, że niektóre projekty wpłynęły pozytywnie na jakość ich życia.

Słowa kluczowe: środki UE, gmina, inwestycja, rozwój lokalny, jakość życia

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A THEORETICAL AND EMPIRICAL APPROACH TO FOREIGN LABOUR MIGRATION AND EMPLOYMENT: THE CASE OF AGRI-FOOD MIGRANT WORKERS IN DEVELOPED ECONOMIES

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ABSTRACT

Most of the research on migration has focused on the scale and effects of people exodus from rural to urban areas rather than on rural areas as recipients of migrants, especially foreign migrants. This study aims to analyse employment of foreigners in agriculture and food processing sectors of selected developed countries, with particular emphasis on the time of the COVID-19 pandemic. It first reviews existing literature on ideas and theories about human migration through the history of economic and social thought. This theoretical background lies in the economic, social, health, demographic and integrated theories and concepts of migration that help understand the pull and push causes as well consequences of current international migration processes. Next, this article presents some facts about the employment of foreigners in agriculture and food processing in developed countries traditionally affected by severe labour shortages in these sectors, as well as the impact of the COVID-19 crisis on employers and workers. The results reveal that labour shortages and labour exploitation are amongst the most frequent and relatively consistent issues associated with immigrant workers in the agri-food industry. During COVID-19, these problems were exacerbated and complemented with the workers' health risk due to coronavirus clusters on farms and at food-processing plants.

Key words: migration theories, labour market, international migration, agriculture, food processing, foreign workers, COVID-19 pandemic

JEL codes: B00, F27, J43, J7, J61, J31, E26

INTRODUCTION

Human migration is a global phenomenon, spanning all epochs and encompassing many peoples [McNeill and Adams 1978]. It has increased considerably in recent years and is in a state of constant flux in terms of shape, form, direction, and content. International labour migration has sparked a political and academic discourse about its causes as well as economic and social consequences in both host and sending countries. Much of the recent research on labour migration is associated with rural-urban migration and from developing to developed countries. Less research is about migration from one country to rural areas of another country. In many developed economies, agriculture and the food industry with severe labour shortages have become increasingly dependent on a low-skilled and low-paid foreign labour force. These economies generate demand for jobs that are not attractive to domestic workers but are met by immigrants, and have policies that facilitate the recruitment of foreigners. However, they attract and hire people not only from

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poor economies but also from richer ones, as shown by intra-EU labour mobility.

The 'foreign worker problem' in the agri-food sector seems to be different than in some other sectors of the economy. Migrants hired here are much more exposed to dangerous, heavy, underpaid, informal, and illegal work.

The study aims to summarize the historically evolving economic ideas and concepts of labour mobility, especially cross-border migration, and to review the situation of foreign agri-food workers with particular reference to the COVID-19 period. We study the recent experience, in selected states, with inflow and hiring foreign labour migrants, mainly in the agriculture and food processing industry. Although we emphasize European countries, we also consider other developed countries.

We will investigate the following questions:

1. Is the farming and food-processing industry in developed countries able to exist without a foreign workforce, especially during global disturbances such as the COVID-19 crisis?
2. How are foreign workers treated and assessed in farms and food-processing plants?
3. What new problems for both employers and workers arose from the pandemic situation?

The article consists of five parts. Following this introduction, the second part looks at the theoretical background for the study of labour migration. The third part explains methodology and data collection. The fourth part presents findings. The fifth part consists of conclusions and suggestions for further studies.

MIGRATION – A THEORETICAL FRAMEWORK

Labour migration/mobility[1] relates to individuals whose general purpose in moving is to offer to sell their work capacity in the destination areas. Article 2.1. of the UN Migrant Workers' Convention defines a migrant worker as "a person who is to be engaged, is engaged or has been engaged in a remunerated activity in a State of which he or she is not a national", irrespective of his/her migratory legal status [UN OHCHR 1990].

It is well-known from the economic history of nations that their economic progress usually has been associated with the gradual but continuous transfer of people and economic entities from rural-based traditional agriculture to urban-oriented modern industry [Clark 1957]. To social scientists, migration is a social phenomenon, the examination of which sheds light on our understanding of human life. International workforce migration (which we are focusing on here) is a particular challenge to study because it has "nation" at its heart. It has the potential to change and enrich individuals and societies but also to exploit and bring about competition. It raises questions about social cohesion and social divisiveness.

There is no single universal, overall encompassing theory that could satisfactorily explain all aspects of migration, particularly the nature, reasons, and consequences of labour migration. The multifaceted migration phenomenon (including international migration) is often perceived as a multidimensional process that requires an interdisciplinary or multidisciplinary approach to its study. Economics, demography, sociology, political science, law, international relations, health studies, geography, anthropology, and public administration are the main disciplines involved in migration research. Table 1 outlines the selected theoretical contributions of scholars from various disciplines in the field of migration throughout the history of thought (with a predominance of economic theories).

Classical and neoclassical macroeconomic theories perceived the population movement as an effect of spatial imbalances in the distribution of production factors (labour, land, natural resources, and capital), and particularly differences in the supply of and demand for labour. The workforce moves from places where capital is scarce and where labour is plentiful to locations where capital is abundant and where labour is scarce, so wages are relatively high. These theories could explain the phenomenon covered by our study, i.e. the influx of foreign migrants to richer countries in search of jobs in the agriculture and food-processing sectors, which are struggling with the domestic labour shortage.

[1] In this article, we use the terms "migration" and "mobility" interchangeably. In an EU policy context, mobility refers to movement within the EU, and migration to movement from the EU to locations outside the EU.

Table 1. Points of view on migration – the literature review

	Contributors	Assumptions/arguments/drivers
Mercantilism	Reynell [1674] Court [1911]	People are considered the nation's most important economic resource. Emigration is this resource lost. It opposed emigration from the home country because it would weaken the national economy. Maintaining a large domestic working population is best for economic prosperity. The state should ease immigration laws. The markets (e.g. regional wage differentials) that each profession depends on are an important reason for migration.
Mercantilism	Child [1751, p. 146–147]	Emigration to colonial countries "is certainly a damage, except the employment of those people abroad, do cause the employment of so many more at home in their mother kingdoms, and that can never be, except the trade be restrained to their mother kingdoms".
Classical political economy	Smith [1979] [1776, Ch. X]	Support for free labour circulation from employment to employment as well as from place to place. Differences in labour supply and demand as well as wage differentials in different regions are the main factors stimulating migration. Strong migration motives lie in poverty and the wish of every person to provide for himself and his family.
	Say [1880]	Some exception to the free-market model when it comes to emigration.
	Ricardo [1817]	Theory of comparative advantage. The international mobility of goods under assumption that both capital and labour do not move internationally. Capital and workers would stay put in their home countries (with perfect domestic mobility).
Classical political economy Theory of population	Malthus [1798] Mill [1849]	Emigration (especially by colonization) would strengthen the home economy by opening new markets for its products and bringing relief from overpopulation and the unemployment burden. Export of population and capital may counteract the tendency of profits to fall to a minimum. "(…) a judiciously conducted emigration is a most important resource for suddenly lightening the pressure of population". "Self-supporting emigration – the Wakefield system, brought into effect on the voluntary principle and on a gigantic scale (the expenses of those who followed being paid from the earnings of those who went before) has, for the present, reduced the population down to the number for which the existing agricultural system can find employment and support". The children of the immigrants of the sending country receive the education of the receiving country and enter, more rapidly and completely than would have been possible in the country of their descent, into the benefits of a higher state of civilization (Mill).
Neo-classical economics Ravenstein's laws of migration'	Ravenstein [1885, 1889]	Migration is based primarily on privately rational economic calculations. The inhabitants of the area immediately surrounding a town of rapid growth flock into it; the gaps thus left in the rural population are filled by migrants from more remote districts (each migration produces movement in the opposite direction). Migrants proceeding long distances generally go by preference to one of the great seats of commerce or industry (centres of absorption). Favourable and unfavourable economic conditions serve to push and pull individuals in predictable directions. Migration increases with economic development. Migration is selective; migrants responding primarily to plus factors at the destination tend to be positively selected, those responding primarily to minus factors at the origin tend to be negatively selected.
Keynes theory of population	Keynes [1937]	An increasing population, apart from technical changes and standard of living, has a very important influence on the demand for capital and business expectations. A declining population would lead to a lower level of effective demand, lower aggregate savings, less capital accumulation, and a higher level of unemployment.
Neo-Keynesian economics	Hicks [1932, 1963]	International migration, like its internal counterpart, is caused by geographic differences in the supply of and demand for labour. "Differences in net economic advantages, chiefly differences in wages are the main causes of migration" (wage differential approach). "When a trade is in a flourishing condition, it draws immigrants to it, and the presence of these immigrants retards the rise in wages".
Neo-classical economics	Todaro [1969, 1980]	Migration determined by lifetime net income (earnings) maximisation choice made by individuals. People move (abroad) for the purpose of improving their economic and financial prospects. Rural-urban internal migration continues as long as expected urban income exceeds rural income.
Austrian School of Economics	Mises [2010, 1988] Hayek [1976, 1981] Rauhut [2021]	Humans seen as mobile factors liberated to seek their most efficient site of work throughout the world. Free mobility of labour will result in a more efficient allocation of the workforce compared to an administratively organized allocation. According to Hayek, unrestricted immigration would lead to a xenophobic reaction in the host country. Given the removal of institutional barriers to migration, migration will be determined by the interplay between market wages, standard wages, attachment component (fundamental freedoms as being quality-of-life aspects), and cost component (subjective consumption needs).
Dual economy theory	Boeke [1953] Jorgenson [1961]	Dual economy (in developing, underdeveloped or emerging economies) is the economic system divided into two sectors – the advanced or modern sector, which is called, somewhat inaccurately, the manufacturing sector, and the backward or traditional sector, which may be suggestively denoted as agriculture. If the food supply is more than sufficient there exists an agricultural surplus, and labour may be freed from the land for employment in manufacturing.
Dual (segmented) labour market theory	Doeringer and Piore [1970], Gordon [1972]	Immigration is linked to the structural requirements of modern industrial economies. The developed economy is dualistic: consists of the primary market (of high-skilled, well-remunerated, stable work) and secondary market (of low-skilled, low-remunerated work). Foreigners are required to fill job gaps in the secondary segment avoided by the natives.
New economics of (labour) migration	Piore [1979]	Migration is a household decision taken to minimize risks to family income or to overcome capital constraints on family production activities (micro-level decision). People migrate abroad to overcome market failures (deficiencies) in their home country. They intend to come only for limited periods of paid labour and save their money (generate remittances). Industry recruits foreign labour to do work not accepted by the natives.

Table 1. Continued

Contributors		Assumptions/arguments/drivers
Internal colonialism theories	Casanova [1965] Walton [1975] Hechter [1977]	Internal (domestic) colonialization is through forced, involuntary, or selected migration from one area to another (e.g. rural-urban). The movement of peripheral labour is determined largely by forces exogenous to the periphery. There is intra-national exploitation of culturally distinct groups, e.g., urban exploitation of the workforce of rural communities or colonies as well as a cultural division of labour.
Historical-structural perspective	Wood [1982]	Migration is an outcome of institutional, economic, social, and political forces both in sending and receiving countries. It is a macro-social rather than an individual process, determined historically (with an important role played by colonialism) and structurally (by the global economy.)
Structuration theory	Goss and Lindquist [1995]	Migration has been traditionally determined by the interrelated individual and historic-structural forces which are interacting with national and international institutions being able to connect potential employers and labour migrants in the entire world.
World-systems theory	Sassen [1988] Wallerstein [2011]	International migration is a by-product of global capitalism and the worldwide division of labour. The mobility of capital and the trans-nationalization of production have created new conditions for cross-border mobility of the labour force. Immigration is a natural consequence of economic globalization and market penetration across national borders.
Global capital accumulation theories	Sassen-Koob [1981] Petras and Veltmeyer [2001] Petras et al. [2016]	New transnational stage in the world capitalism evolution: the rise of transnational capital and the integration of every country into the new global production and financial system, appearance of a new transnational capitalist class grounded in new global rather than national markets and circuits of accumulation. The directions and flows of immigration are determined by global capital flows. The international labour migration process is a lever of capital accumulation in the formation of a global labour market. Emigration is generated not by backwardness and stagnation, but by capitalist penetration in the periphery.
Relative deprivation theory	Stark and Taylor [1989]	International migration decisions are influenced by relative as well as absolute income considerations. Sending abroad household members who hold promise for success as labour migrants can be an effective strategy to improve household income position relative to others in the reference group.
Human capital models	Schultz [1961, 1978] Becker [1962]	Migration costs are a form of human investment. Migration is a decision in which individuals calculate their present discounted value of expected returns on their investment in migration (earnings). The migration of individuals and families to adjust to changing job opportunities improves human capabilities. Workers with training specific to any industry, occupation, or country are less likely to leave these (via migration) than other workers.
Theory of (migrant) networks	Portes [1997] Portes and Walton [1981]	Migration can be conceptualized as a network-building process. Migration is a self-supporting process of diffusion and takes place in the context of social relations. Social networks play an important role in initiating and sustaining migratory flows.
Theory of cumulative social networks	Massey and España [1987] Massey [1990]	The greater the number of present or former migrants a person in a sending area knows, the greater the probability that he or she will also migrate. For each person in the sending area, if they were in contact with present or former migrants, they would also be more likely to migrate than others with identical characteristics.
The theory of circular cumulative causation	Myrdal [1957] Vietorisz and Harrison [1973] Massey [1990] Massey et al. [1993]	International and interregional economic relations involve unequal exchanges; the weak are always exploited by the strong, which means that migration has "backwash effects". Spread and backwash feedbacks (closed cycles of causation in complex systems whose parts are dynamically interrelated) between labour markets contributed to a divergence of technology levels, labour productivity, and wages in these markets. Migration is dynamic, a path-dependent process influenced at various (individual, family, community, etc.) levels by historical processes. Migration is determined by the expansion of migration networks, distribution of income, wealth and human capital, as well as desire to purchase assets to provide for old age.
Mobility transition hypothesis	Zelinsky [1971, p. 221]	A dramatic expansion of people's mobility was brought about by modernization. "There are definite, patterned regularities in the growth of personal mobility through space-time during recent history, and these regularities comprise an essential component of the modernization process".
"Healthy migrant" hypothesis"	Marmot et al. [1984] Rumbaut and Weeks [1996] Holz [2021]	The positive selection of migrants with respect to health. The healthiest individuals are most likely to out-migrate. They enjoy a health status that is superior to those who stay behind. The "healthy migrant" effect is marked by an observed health advantage for migrants compared to the host population, which declines with increasing years since migration.
"Unhealthy remigration' hypothesis" (salmon bias)	Abraído-Lanza et al. [1999] Puschmann et al. [2017]	Unhealthy migrants or migrants who experience deteriorating health have a greater tendency to return to their country of origin than healthier migrants. According to a salmon bias hypothesis, the so-called 'healthy migrant effect', referring to a situation in which migrants enjoy lower mortality risks than the native-born population, is caused by selective return-migration of the weak, sick, and elderly.

Source: Authors' own research based on the literature cited in the table and [Triandafyllidou 2015].

Likewise, the dual labour market theory, which depicts a labour market as divided into primary and secondary markets, suits well for explaining foreign employment in the mentioned sectors that generally offer poorly-paid jobs held by flexible workers.

The historical-structural approach deals with the origin of the costs and benefits confronted by the potential migrant. This approach appears in a variety of theoretical models, including internal colonialism and global capital accumulation. Documented evidence from the employment of foreigners in the agriculture and food industry of some developed countries suggests, and only suggests, the presence of elements of internal colonialism – economic and political domination of one populous over another within the boundaries of the state, which gives rise to economic exploitation and inequality.

Nowadays, most migration is voluntary and has a positive impact on individuals and societies but it can increase vulnerability to human trafficking and exploitation. It is true, however, that global investment liberalization, as well as free movement of capital within the EU, has been an important force for the spread of multinational corporations at all stages of the food chain which attracts the labour force. In the European region, citizens of Central and Eastern European states are especially tempted to move abroad to work in large food-processing companies, as indicated by job offers available, for example, on the Internet as well as many research results [Lever and Milbourne 2017].

The microeconomic perspective of migration focuses primarily on the rational calculus of the individuals (migrants seek employment opportunities that give them the greatest return). Migration flows are the cumulative result of individual decisions based on a rational assessment of the benefits (e.g., life-time income) to be achieved and the costs associated with moving. The migration social networks also play an important role [Bloch and McKay 2015].

In addition to economic, social, institutional, political, and historical factors migration and re-migration decisions can be also affected by individual health status. Unhealthy remigration hypothesis or selective return migration, for example, suggests that foreign migrants who face health problems are less capable of achieving high productivity in destination labour markets, which could result in a reduction of their earnings and standard of living, and finally lead to making the decision on returning or moving closer to home.

The motives that drive individual decisions to move internally or externally, generally seem to be the same today as they were almost 140 years ago when British geographer, Ernst G. Ravenstein, revealed migration patterns called the "laws of migration" [Ravenstein 1885, 1889]. Having recognized various motives for migration, he posited that employment and wage opportunities were its major determinants.

The reason that people move is determined by factors of attraction or repulsion (pull and push factors). Potential labour migrants analyse pull factors – attractive qualities in a specific destination, and push factors – deteriorating or negative conditions in the place of origin [Gmelch 1980, Kancs and Kielyte 2010]. This concept rests on neo-classical economics, namely individual cost-benefit analysis. The neo-classical approach views migration as a response to local/ /regional/national labour market disequilibrium.

Conventional economic explanations for migration from poorer to richer countries (or regions) are based on labour flows in response to differences in wages (or income) and job availability (see for example [Hicks 1963]). One of their implications is that the economic development of both the migrant-sending and migrant-receiving country (region) matters. However, according to Becker, "Earnings may differ greatly among firms, industries, and countries and yet there may be relatively little worker mobility". This may be due to the irrationality of the labour force and the enormous obstacles they would face in moving, but also to the perfectly rational behaviour of those with company, industry, or country-specific professions such as lawyers, and doctors [Becker 1962, p. 24].

MATERIAL AND METHODS

This paper uses the review of academic literature, scholarly discussions of labour migration, public statistics (Eurostat), content analysis of newspaper and magazine articles, media coverage and official reports on the foreign migrant workforce.

The research performs so-called topoi analysis based on the contents of a set of articles published mainly in the English-language and Polish-language scientific papers and newspapers that address aspects of foreign labour generally, and specifically in the agri-food sector. The topoi analysis seeks to identify distinct discursive models or schemes of argumentation and thoughts embedded in a given text. The Greek word "topos" is that which justifies a line of argument but requires less justification itself because it represents common-sense reasoning that relates to a body of collective knowledge that is shared among groups and communities. A topos is also more strongly tied to concepts than to words constituting a salient part of argumentation. The topoi are often assumed rather than mentioned explicitly in a text [Burroughs 2012, Wengeler 2012].

An analysis is generally done within the framework of positive economics, i.e. it is factual without formulating normative judgments or value judgments. So, we do not provide any recommendations or advice for policy.

RESULTS AND DISCUSSION

For some developed economies, external immigration has played a crucial role in the development of their labour market. In the EU member states, this current role can be illustrated, for example, by the contribution of foreign citizens to employment growth. Since 2013 in such countries as Malta, Austria, Luxembourg, and Germany foreign citizens contributed more than 50% to total employment growth between the second quarter of 2013 and the first quarter of 2019 [Nickel et al. 2019].

In higher-income countries, farming becomes increasingly unattractive for the domestic population, and agricultural workers become harder and harder to find. This farm labour shortage is often filled by foreign agricultural wage workers, especially in tasks that are difficult to automate, such as planting, pruning, and picking vegetables and fresh fruits.

Also in western European countries, agriculture and food manufacturing, especially meat processing, have for years been one of the industries with the greatest shortage of labour, which is successfully filled by immigrants, mainly from Central and Eastern Europe [Blanchflower et al. 2007, Zawojska 2009].

The EU enlargements from 2004, and the free movement of persons across Europe, brought a vast pool of people from Lithuania, Latvia, Poland, Hungary, Romania and Bulgaria, willing to migrate for work opportunities since in their home countries wages were lower, and the social security systems weaker. As the economies of some of these countries (e.g. Poland) improved, and the need for a replenishable source of the cheap workforce increased, the search has extended across the world to such countries as Ukraine, Belarus, Kazakhstan, Armenia, Vietnam, the Philippines, Timor-Leste, Georgia, India, and China [McSweeney and Young 2021].

In 2004, when the eight former communist states from Central and Eastern Europe – CEE (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia) joined the EU, only three of the existing EU members (the UK, Ireland, and Sweden) permitted citizens of new members unrestricted access to their labour markets. Although the UK, Ireland, and to a lesser degree Sweden were initially the preferred destination states for labour migrants originating from the CEE, including Poland, the other countries (e.g., Netherlands, Germany) also hosted them in relatively large numbers [Engbersen et al. 2013, Snel et al. 2015]. The labour-intensive economies of southern Europe (Italy, Spain, Portugal, and Greece) were also driven by migrants arriving from the new member states, although the rapid increase in migrant employment in agriculture in these countries began at the end of the 20th century [Kasimis 2005, Kasimis and Papadopoulos 2005].

Post-accession labour movements were in part a continuation of the migration paths that had already been established before 2004 [Garapich 2008], but also involved significant new migrant groups that did not follow in the footsteps of earlier labour migrants [Engbersen et al. 2013]. For instance, in UK's rural agribusiness, the economic migration channels of CEE citizens have evolved from labour providers who sourced workforce directly from the CEE region and delivered them to British employers, to suppliers or employers hiring migrants locally through family/

friend networks of people who have already lived in the UK [Findlay and McCollum 2013].

A key feature of the CEE post-accession migration to the UK labour markets was a greater orientation towards peripheral or rural areas ("rural bias") compared to previous migrations [Chappell et al. 2009, Knight et al. 2014, Stenning and Dawley 2009]. The most common reasons for such behaviour are unique opportunities for migrants created by the rurality, chiefly due to the nature of local labour markets, which can offer agricultural and food processing temporary/seasonal jobs and are limited in scope, as well as the job agencies' requirements to work in rural areas.

In commercial agriculture, much of the work is on a temporary – usually seasonal – basis, thus it is low-paid. Migrants from less advanced economies, irrespective of their education level and previous work experience, often work in the destination countries in semi-skilled or unskilled manual or agricultural occupations on a flexible basis [Canales 2003, Glorius et al. 2013, Nickell and Saleheen 2015, Snel et al. 2015]. Similarly, in EU states from the CEE region (e.g., Poland), foreigners from outside the EU, including Eastern Partnership countries[2], are mainly employed in low-skilled occupations in such sectors as agriculture, construction, manufacturing, and domestic services [Chmielewska 2020, Kahanec et al. 2013]. These immigrants have partially filled the gaps in rural areas and the food industry left by the outflow of domestic workers. Similarly, in the US food system, labour immigrants (of varying legal and citizenship statuses) occupy the majority of low-paid jobs [Flores 2020].

The wage differential theoretical approach does well, at least in the case of intra-EU and non-EU-EU migration for agricultural and food manufacturing jobs. Wage rates in western European economies compare favourably to those in eastern Europe (Fig. 1).

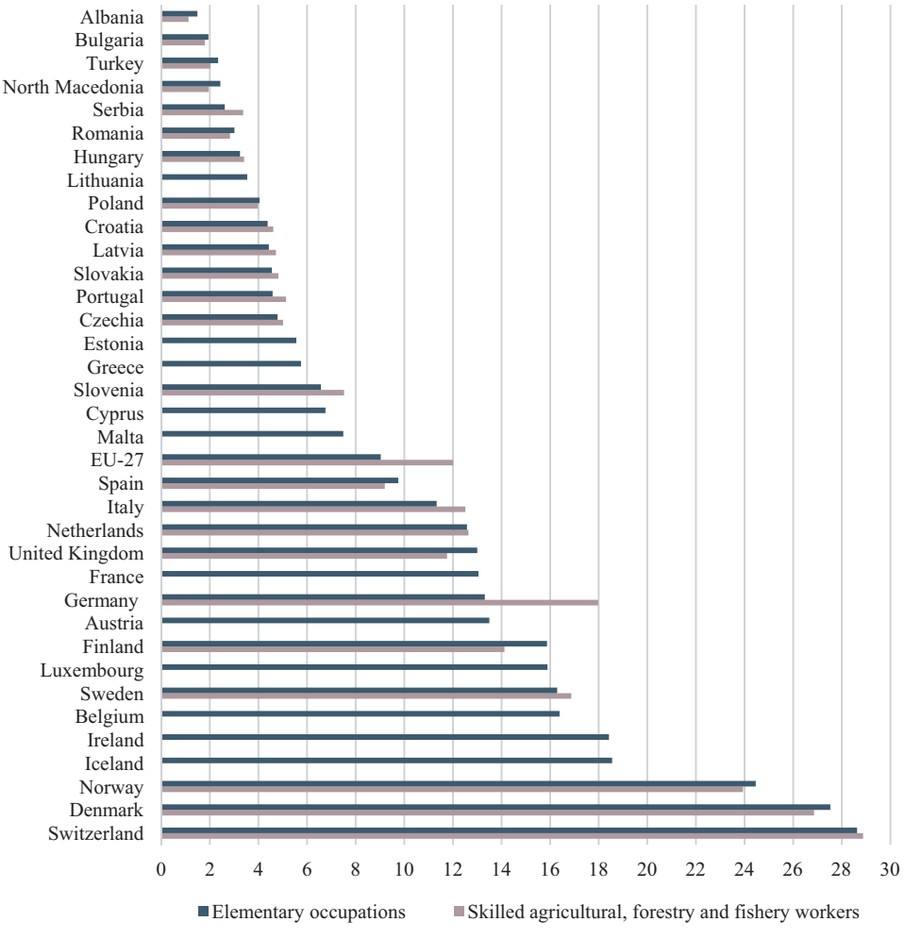
In the UK (except Northern Ireland), agricultural workers, including foreigners, must receive at least the national minimum or living wage (NMW, NLW), the hourly rate of which depends on their age. In 2021, its level ranged from GBP 4.62 to 8.91 (workers aged under 18 and 23 and over). Their counterparts in Northern Ireland were entitled to the Agricultural Minimum Wage rates, rather than the NMW or NLW, unless the NMW or NLW rate is higher. They fell within the range GBP 6.95–10.95 per hour depending on occupation grade [GOV.UK 2021, nidirect 2021]. In Germany, which only established a general statutory minimum wage on January 1, 2015, its 2021 rate was EUR 9.35 per hour[3]. Other western economies also applied hour wage floors at relatively high levels: France – EUR 10.48; the Netherlands – EUR 9.82 (employees aged 21 years and over). Spanish government-mandated minimum wage for domestic workers was EUR 7.04 per hour, while for contingent and temporary workers – EUR 44.99 per day (= ca EUR 5.62 per hour). In Norway, everyone over 18 years of age permanently employed unskilled within agriculture and horticulture had a statutory hourly wage of NOK 149.30 (ca EUR 15) per hour. Skilled workers were eligible for a minimum supplement of NOK 13 per hour. For seasonal (harvesting) workers this rate was generally lower (NOK 129.40–149.30) and conditioned on the period of employment [Norsk Arbeidsmandsforbund 2021]. For comparison, in CEE countries, the minimum hourly wage rates in 2021 amounted for: Poland PLN – 18.30 (ca GBP 3.65 or EUR 4.20); Romania – RON 13.58 (GBP 2.34, EUR 2.7); Bulgaria – BGN 3.92 (GBP 1.70; EUR 2.0); and Ukraine UAH 28.31 (GBP 0.8; EUR 0.9) [wageindicator.org 2020].

Presented numbers show that official wage differentials between western and eastern economies can be significant push and pull factors for labour migration decisions[4]. However, in various developed countries,

[2] Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.

[3] In Germany, until the end of 2017, wages below the statutory minimum wage were allowed in sectors covered by collective agreement such as meat processing, hairdressing, agriculture, temporary agency work, textiles and clothing and industrial laundries [Bruttel 2019].

[4] Earning income was not the sole pull factor of migrant seasonal agricultural workers to the UK. Other drivers behind their decisions included learning opportunities about modern agricultural techniques and British culture [Akay Bayraktar 2016]. The availability of affordable housing in rural areas also was an important determinant of labour supply for food processing and agriculture [Ruhs and Anderson 2010].



* elementary occupations involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort; they include: Cleaners and Helpers; Agricultural, Forestry and Fishery Labourers; Labourers in Mining, Construction, Manufacturing and Transport; Food Preparation Assistants; Street and Related Sales and Services Workers; Refuse Workers and Other Elementary Workers.

Fig. 1. Mean hourly earnings in 2018 [EUR]

Source: Authors' own compilation based on [Eurostat 2021].

the agri-food industry belongs to the economic sectors with a considerable large shadow economy with undeclared work [Binford 2013, Schneider 2014, GUS 2015, Flores 2020, Sawicka et al. 2021]. Thus, official wage rates can be generally higher than their actual levels in the shadow economy.

Informal recruitment in agriculture is common with regard to the immigrant workforce. Some newcomers may be more likely than domestic workers to enter the informal market because of their weaker position in the formal economy or, eventually, due to relatively larger net wages than in the registered economy. Some employers, in turn, may seek illegal labour migrants to fill in their vacancies quickly and cheaply as well as to minimise labour costs. Unfortunately, irregular migration status increases the risk of forced labour and labour exploitation [Amnesty International 2012] as it is easier to profit from immigrants' vulnerable condition.

According to the International Labour Organization (ILO), in 2016, out of the 24.9 million people employed in any form of forced labour, 16 million

were victims of forced labour exploitation in domestic work, construction, manufacturing, and agriculture – economic sectors with a large number of migrant workers. In agriculture and fishing sectors, 12% of identified forced labour exploitation cases occurred [International Labour Organization 2017].

A characteristic of irregular work is the existence of labour providers and recruitment agents, usually responsible for the payment and working conditions of the employed. Another characteristic is the gangmaster system that comprises people trafficking, health and safety violations, financial exploitation, housing abuse, lack of holiday and/or sickness benefits, daily dismissals, and other violations of labour and human rights [Strauss 2013].

Illegitimate job agents (gangmasters) have been documented to be widely responsible for the typical range of abuse such as late payment or non-payment of wages, restrictions on physical movement, debt-bondage, deception, violence, intimidation, threats, and excessive overtime.

To illustrate, recently, above 70% of all adults forced to work globally in agriculture, domestic work, and manufacturing were held in debt bondage (debt slavery) – their labour was demanded by employers or recruiting agencies as a means of loan repayment. Cases of these and other abuses in the agricultural sector have been extensively documented both in developing and developed countries [Lawrence 2016, International Labour Organization 2017].

In the EU, in general, and especially in its western and southern regions, the agri-food sector belongs to the main economic sectors receiving undocumented foreign migrant laborers. The gangsters who employ, recruit and organize groups of people to work on farms and at food factories play a particular role in providing such irregular workers. They exploited dozens of vulnerable people, controlling their wages and placing them in sub-standard accommodation [GLAA 2020a].

In the UK, for instance, in earlier years, gangmasters recruited flexible labour from the poorest rural areas of the former Soviet bloc, then Latvian, Lithuanian, and Russian citizens who were desperate enough to tolerate low pay and long working hours [Lawrence 2016], then Romanian and Bulgarian workers. In Italy, in 2018, of 2.66 million employees in irregular positions, 18.8% were in agriculture. The "Agromafie e caporalato report" reveals the 2018–2020 situation on the exploitation of Italian and overseas workers within the agri-food sector; misleading employment contracts, which significantly penalize a significant proportion of workers as well as frauds to the detriment of workers in all areas of production, which together form the value chain of the entire sector [Osservatorio Placido Rizzotto 2020]. Such worrying cases of exploitation, unsafe working, and squalid living conditions on farms and at factories in several countries refer not exclusively to illegal migrants but also those with legal status [Ethical Trading Initiative 2015, Austin 2016, Zawojska 2016].

As we present later in this section, there are a variety of answers to the questions posed in this article's introduction about the foreign agri-food workforce. Tables 2 to 4 summarize coverage of issues on migrants and their work in hosting countries overviewed in journals, newspapers, grey literature, and other sources.

The responses found in the different source contents toward the importance of foreign migrant labour in agriculture and food processing have been various and sometimes very polarized, but generally quite positive. The analysis of the key topoi in the quoted articles and documents shows that they contain elements of economic, social and humanitarian discourse. Labour migrations from less prosperous economies to richer ones and employment of foreigners are most often described as having the logic of economic rationality (following the theoretical foundations).

Although the topos of foreign labour as a threat to the competitiveness of domestic workers and technological progress is sometimes put forward in public discourse, generally the agri-food sector in the developed countries seems not to be a subject to such allegations. In the presence of labour shortages, a cheap, flexible, hard-working, and productive labour force from abroad is welcomed to match the needs and requirements of local employers and save the domestic farms and companies from losses and even bankruptcy.

In addition to the "labour shortage" topos, we identified the "labour exploitation" topos. The COVID-19 pandemic, more than ever, has exposed a crisis in the rights of agri-food workers ("modern slavery") across

Table 2. Is the farming and food-processing in developed countries able to exist without a foreign workforce, especially during the COVID-19 crisis?

Source	Country	
Chappell et al. [2009]	UK	In agriculture, the balance of evidence appears to suggest that in many sub-sectors (e.g. horticulture) the potential for replacing labour with technology has been exhausted. It seems unlikely that a UK-based labour supply, and possibly an EU-based supply, will be available in the medium term.
Findlay and McCollum [2013]	UK	Rural employers rely on migrant labour as they struggle to source labour regardless of prevailing conditions (boom or bust) in the wider economy. Eastern Europeans are essential to the functioning of the agricultural sector since it is not possible to source the labour locally.
Ruz and Steven [2016]	UK	Farmer opinion: UK agriculture cannot exist without foreign labour. We have not got enough staff of our own.
Green [2020]	UK	Immigration is not an optimal solution to farm labour shortages. Importing seasonal labour perpetuates low agricultural productivity and denies opportunities to British workers who are unemployed or seeking part-time jobs. To reduce the sector's dependence on migrants, the UK should aim to emulate the Dutch example by focusing on technological innovation. Many UK workers are keen and ready to take farming jobs provided they are paid enough and offered flexible and attractive working conditions. Pay a decent wage and you will attract domestic talent.
O'Carroll [2016]	UK	British Summer Fruits: "All first-world economies employ foreigners to pack and plant fruit. This is not unique. Canada, Australia even Spain employs migrants because their own citizens don't want to do the work". Britons "do not want to get up at 6am and work on their hands and knees all day."
Parliament UK [2020]	UK	The edible horticulture seasonal harvesting labour is almost entirely (99%) foreign labour, mostly from the eastern EU region. Undersupply of seasonal and temporary labour could lead to transferring agricultural and food processing production overseas. The National Farmers Union expresses "real concern amongst growers that they will not be able to secure the workforce they need for next years' harvest".
Sargent and Theresheva [2020]	Ireland	Fears for migrant workers who carry the load of the domestic horticulture boom.
Donaldson [2015]	France	Farmer opinion: "Without migrants, European agriculture will not survive".
Hampel et al. [2018]	Germany	Agriculture has economic importance for Brandenburg, therefore, securing a skilled labour supply is crucial. The agricultural sector is undergoing some degree of reorientation in terms of main products and consumers, coupled with significant forecasted labour shortages that have potentially already impacted the increasing incidence of seasonal work.
Corrado and Palumbo [2020]	EU	The restrictions on borders and mobility during the pandemic, which immobilized thousands of foreign seasonal workers from EU and non-EU countries, resulted in agricultural labour shortages and losses in production (Germany, Italy, Spain, Holland, Sweden).
Corrado and Palumbo [2020]	Italy	National farmers' organisations sounded the alarm on labour shortages due to border restrictions, especially of CEE workers (chiefly Romanians, Poles and Bulgarians). This has highlighted the dependence of the agri-food sector on cheap and flexible migrant labour.
ANSA [2021]	Italy	Foreign workers in agriculture have become important strategically. During the COVID-19 pandemic, the sector suffered because it lacked seasonal manpower.
Corrado and Palumbo [2020]	Holland	To address labour shortages in selected sectors as a result of the COVID-19 lockdowns, workers from Romania and Hungary were flown in, largely for employment in the asparagus and strawberry harvest.
Strzelecki [2016]	Poland	Due to cheaper workers from Ukraine the production costs can be reduced, which in turn allows Polish farmers to maintain or improve market competitiveness.
Rosenblatt [2021]	USA	In Pennsylvania, according to many farmers, local workers are not interested in taking on available jobs. Sourcing labour has become much more difficult since its shortages hit other industries as the COVID-19 pandemic shutdowns ease.
Haley et al. [2020]	Canada	Migrants are essential workers due to the central role they play in supporting farmers and the food supply. During COVID-19 they face greater vulnerabilities.
EMN [2020]	Poland	The COVID-19 pandemic revealed that Polish farmers lacking seasonal workers bear the costs and losses. Ukrainians, who are the vast majority of foreigners in Poland, left for their homeland, and some of them have never returned. This proves that the domestic agricultural sector is highly dependent on the supply of foreign workers.

Source: Authors' own research based on the literature cited in the table.

Table 3. How are foreign workers treated and assessed at farms and food-processing plants?

Source	Country	
EFFAT [2016]	Europe	Worrying cases of migrant agricultural workforce exploitation, lack of decent housing, working and living conditions.
McSweeney and Young [2021]	Europe	The European meat industry has been hiring thousands of workers through subcontractors, agencies, and bogus cooperatives for lower wages and worse conditions. It has become a global hotspot for flexible outsourced workers. Many of them have been foreigners earning 40–50% less than staff directly employed in the same factories.
Ruz and Steven [2016]	UK	The Bulgarian worker has always felt welcome on the farm. His employers have done a lot for him; they have paid for his agricultural courses and helped him move into a cottage nearby, along with other Bulgarians. But he does not think that many of the English workers like Bulgarian workers.
MAC [2014]	UK	Compared with local workers, migrants are more willing to work hard and wish to work many shifts and extra hours to earn as much as they can. They are more reliable and productive, and less likely to be trade union members.
Morris [2016]	UK	Polish seasonal migrant: "The money is good and I can see that the farm appreciates me coming. I feel a link with this area. I feel part of the business, part of the team. I feel a connection with the countryside here and with English people"
GLAA [2020b]	UK	About 200 Romanian and Bulgarian farm workers employed on a farm in Cambridgeshire during the COVID-19 pandemic, interviewed by officers from the Gangmasters and Labor Abuse Authority, expressed their satisfaction with the working conditions, training and proper treatment.
Sargent and Theresheva [2020]	Ireland	Long working hours, low rates of pay, poor working conditions, lack of suitable accommodation for foreign nationals working in the horticulture industry.
Chang et al. [2021]	USA	The US meat industry is an increasingly dangerous, low-paying industry employing a large number of immigrants. The precarious work conditions in meatpacking, and lack of labour protections, were decades in the making. This industry had worked to take bargaining power away from workers to create an industry treating workers as disposable parts of an assembly line.
NFWM [2021]	USA	Farm workers are some of the most oppressed workers in the US. In some cases, they are subject to physical and psychological abuse in the fields. In the worst and most extreme cases, they live in conditions constituting modern-day slavery.
Beaumont [2021]	Canada	Immigrant farmworkers are often brought with visas that are tied to specific employers, which creates a constant fear of being sent home for complaining about working conditions and mistreatment by employers. Because of this, they often endure dangerous conditions, with poor access to healthcare and little government oversight. And when COVID-19 brought sickness, panic, and lockdowns, a bad situation only became worse.
Dahm [2021]	Germany	Seasonal agricultural workers (the majority of whom came from Romania, Poland, Croatia, Ukraine, Bulgaria, and Georgia) are exposed to numerous violations of labour rights, inter alia, through incomplete wage payments and excessive wage deductions, a lack of social and health insurance, and inadequate housing.
Evans and O'Connor [2021]	UK	Workers on the Seasonal Workers Pilot, from 2021 the main way for migrant farmworkers to enter the UK, cannot change jobs freely. They can only change roles with the help of the same agencies that brought them over, and cannot seek work in other industries.
Evans and O'Connor [2021]	Scotland	The workers on the farm were on zero-hour contracts, which do not guarantee any work, and were paid for the amount of picked fruit. Under the law, pickers on this "piece rate" system must be "topped up" to hourly minimum wage of GBP 8.72 if they have not picked enough to earn this rate. Because of this, the supervisors would check everyone's work every two hours, and the workers who had not picked fast enough would be sent back for the rest of the day, unable to earn any more money.

Source: Authors' own research based on the literature cited in the table.

Table 4. What new problems for both employers and workers arose from the pandemic situation?

Source	Country	
colombi [2021]	EFFAT countries	As the COVID-19 pandemic continues to unfold, migrant workers, especially undocumented ones, are encountering many barriers in accessing vaccines, which reflects many other and broader obstacles in accessing health care and social protection.
Palumbo and Corrado [2021]	Italy	Since the outbreak of the COVID-19 crisis, it has been clear that essential economic sectors suffer from shortage of rights for workers.
Burcu [2021]	UK	The COVID-19 pandemic has made migrant (Bulgarian and Romanian) workers in the UK agri-food more vulnerable to labour exploitation (emotional abuse, threats, lack of payslips, work below the minimum wage, no allowance to take holiday, no holiday pay, wages withheld, physical abuse). Income reduction caused by COVID-19, through furlough or reduced working hours, forced many workers to borrow money to cover basic expenses. This added to the debts that many workers already had before coming to the UK. Too many employees in the workplace at once, not observing social distancing.
euromeat [2021]	Germany	In 2020, the Toennies – meat producer was embroiled in a nationwide scandal due to a huge coronavirus outbreak, when one of its meatpacking plants was ordered to shut after more than 1,500 workers tested positive for COVID-19. The outbreak, the country's biggest at the time, led to criticism of the company's use of low-paid contract workers from eastern Europe and claims that their working environment failed to prevent the spread of the coronavirus.
Dahm [2021]	Germany	COVID-19 measures were violated by employers, the state rarely inspected farms.
Galindo [2020]	Belgium	Hundreds of workers in a meatpacking plant in the Flemish Staden have been placed in quarantine after a coronavirus cluster was detected in the factory of the Westvlees company.
RTÉ [2020]	Denmark	Meat giant Danish Crown has closed a large slaughterhouse in Ringsted, after nearly 150 employees tested positive for the COVID-19. All the employees had to quarantine.
BHRRC [2021]	Italy	The situation for migrant farmhands working in the fields on the Gioia Tauro plain is desolate. Tent camps where workers live have become "shantytowns".
Mrzygłocka [2020]	Poland	In the Animex production plants, SARS-CoV-2 was confirmed among manpower working there but hired by an agency providing a work service for the meat plant. Virus transmission began in places where employees lived and worked together.
Haley et al. [2020]	Canada	While Canada tightened its borders and restricted entry of most foreign nationals, temporary migrant workers in the agricultural industry and food-processing were among those permitted entry.
Grant and Baum [2020]	Canada	The pandemic has exposed the poor working and living conditions that some migrants face as they support the Canadian food system. In Ontario alone, above 1,300 migrant farmworkers have been infected with COVID-19, and contracted the virus locally. Agriculture employers in several provinces were restricting the movement of foreign workers, not allowing them to leave the premises.
Hjalmarson [2021]	Canada	Undocumented people and many migrants, including farmworkers, who do not have social insurance numbers were excluded from the "Canada Emergency Response Benefit", which is to offer vital income support to those temporarily out of work as a result of COVID-19.
Chang et al. [2021]	USA	The Occupational Safety and Health Administration (OSHA) failed to adequately carry out its responsibility for enforcing worker safety laws at meatpacking plants across the country, resulting in preventable infections and deaths.

* EFFAT – the European Federation of Food, Agriculture, and Tourism Trade Unions.

Source: Authors' own research based on the literature cited in the table.

the globe, shedding more light on unsafe and exploitative working and employment conditions throughout the farming and meat industries (e.g., in abattoirs in Germany, the Netherlands, France, the USA); horrible living conditions (e.g., overcrowded accommodation for migrant workers often provided with employment); illegal subcontracting with puppet employment agencies, allowing actual employers to evade responsibility for working conditions and avoid paying social security contributions.

Another important topos is the "health risk" for workers related to the coronavirus outbreaks. As countries sought to reactivate their economies by sending people back to work, farm placements and food manufacturing plants emerged as breeding grounds for coronavirus clusters. Meat plants had to be shut down in the US, Germany, the UK, France, Spain, the Netherlands, and other countries after clusters of the coronavirus emerged, often soon after staff returned to work. The uncertainty caused by COVID-19 and the need to earn an income in the absence of health insurance, earnings protection, and welfare benefits may even have led some workers to hide symptoms of infection for fear of losing their jobs [ICMC 2020, Pitu and Schwartz 2020].

CONCLUSIONS

Based on the findings of the study, the following conclusions are drawn:

1. The present immigration of labour to developed countries from less prosperous ones is best explained by neoclassical economics, the new economics of labour migration, dual labour market theories, and world-systems theory. Differences in labour demand and large wage disparities, especially between national economies of western and eastern Europe, continue to be the main reason for the international movement of workers in search of jobs and income in agri-food.
2. Agri-food sector employers in developed countries generally prefer to employ foreign workers (particularly unskilled, seasonal and temporary) over domestic workers since the natives are less likely than incomers (or not likely at all) to accept low wages and bad working conditions, as well as less often meeting employer demands in terms of work ethics, motivation and mobility.
3. As agriculture and food-processing belong to the most hazardous industries and, in many cases (e.g. picking fruits and vegetables, piece manual work at factories), require from workers long hours of physical activity in hard and harsh (e.g. weather) conditions, "the healthy migrant" effect is possibly present among immigrants. On the other hand, in many developed countries, undocumented foreign migrants tend to be excluded from health services and expected to cover the costs of medical treatment on their own. Particularly during the present pandemic, when experiencing deteriorating health due to virus infection, COVID-19 disease or another, they can have a greater tendency to return to their country of origin than healthier migrants ("unhealthy remigration" hypothesis), provided they do not face restrictions on leaving the host country.
4. Much of the concern about the contemporary agri-food chain arises due to the illegal and shadow employment of foreigners, their forced labour, and exploitation both by gangmasters and employers. Because in most developed countries, low-skilled immigrants, including irregular ones, have a weak position both in the agri-food labour market and local communities, they are involved in unequal exchanges and are vulnerable to exploitation by the stronger (individual employers, large corporations) – as the theory of circular cumulative causation predicted.
5. Further research could look at country-specific policy responses to problems arising in the context of foreign labour supply and employment in agriculture and food processing in times of severe crises such as COVID-19.

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PODEJŚCIE TEORETYCZNE I EMPIRYCZNE DO MIGRACJI ZAROBKOWYCH I ZATRUDNIENIA CUDZOZIEMCÓW NA PRZYKŁADZIE MIGRANTÓW PRACUJĄCYCH W SEKTOZRE ROLNO-ŻYWNOŚCIOWYM W GOSPODARKACH ROZWINIĘTYCH

STRESZCZENIE

Większość dotychczasowych badań dotyczących migracji koncentrowała się na skali i skutkach *exodusu* ludzi z obszarów wiejskich do miast, a nie na obszarach wiejskich jako odbiorcach migrantów, zwłaszcza zagranicznych. Niniejszy artykuł ma na celu analizę zatrudnienia cudzoziemców w rolnictwie i przetwórstwie spożywczym wybranych krajów rozwiniętych, ze szczególnym uwzględnieniem czasu pandemii COVID-19. Na wstępie dokonano przeglądu literatury odnośnie idei, koncepcji i teorii dotyczących migracji ludności ewoluujących w historii myśli ekonomicznej i społecznej. Te teoretyczne podstawy zawierające ekonomiczne, społeczne, zdrowotne, demograficzne i zintegrowane teorie oraz koncepcje migracji pomagają zrozumieć czynniki przyciągające migrantów do kraju docelowego, oraz czynniki wypychające ich ze swoich rodzimych krajów, a także konsekwencje obecnych międzynarodowych procesów migracyjnych. Następnie przedstawiono wiele faktów dotyczących zatrudniania cudzoziemców w rolnictwie i przetwórstwie żywności w krajach rozwiniętych tradycyjnie dotkniętych dużymi niedoborami siły roboczej w tych sektorach, a także wpływ kryzysu pandemii COVID-19 na pracodawców i pracowników. Wyniki pokazują, że niedobory podaży siły roboczej i eksploatacja pracowników należą do najczęstszych i stosunkowo stałych dylematów związanych z imigrantami zatrudnionymi w sektorze rolno-żywnościowym. Podczas kryzysu COVID-19 problemy te zaostrzyły się i dodatkowo zostały uzupełnione zagrożeniem zdrowia pracowników z powodu ognisk koronawirusa w gospodarstwach rolnych i zakładach przetwórstwa spożywczego.

Słowa kluczowe: teorie migracji, rynek pracy, migracje zagraniczne, rolnictwo, przetwórstwo spożywcze, pracownicy zagraniczni, pandemia COVID-19

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INSTRUCTIONS TO AUTHORS

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