



Volume 113

2021

p-ISSN: 0209-3324

e-ISSN: 2450-1549

DOI: <https://doi.org/10.20858/sjsutst.2021.113.10>



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

Article citation information:

Macioszek, E. Analysis of the volume of passengers and cargo in rail and road transport in Poland in 2009-2019. *Scientific Journal of Silesian University of Technology. Series Transport*. 2021, **113**, 133-143. ISSN: 0209-3324.
DOI: <https://doi.org/10.20858/sjsutst.2021.113.10>.

Elżbieta MACIOSZEK¹

ANALYSIS OF THE VOLUME OF PASSENGERS AND CARGO IN RAIL AND ROAD TRANSPORT IN POLAND IN 2009-2019

Summary. Transport plays an important role in the economy of any country. Efficient and developed transport infrastructure of various modes of transport significantly affects the availability of transport services, and consequently, the well-being of citizens. This article presents an analysis of the volume of passengers and cargo transport using rail and road transport in Poland in 2009-2019. These analyses were carried out based on data obtained from the Central Statistical Office. All data concerns Polish entities that provide services in the field of passenger and freight transport in Poland and focuses on such information as the volume of passengers and cargo by individual means of transport, broken down into domestic and international transport. Further, the presented analyses concern the length of the available rail and road routes, tracks, the size of the rolling stock as well as the groups of transported loads.

Keywords: rail transport, road transport, passenger transport, freight transport

1. INTRODUCTION

In these times of modern economic globalisation, it is difficult to imagine an efficiently functioning state without an extensive transport system consisting of various modes of

¹ Faculty of Transport, The Silesian University of Technology, Krasińskiego 8 Street, 40-019 Katowice, Poland.
Email: elzbieta.macioszek@polsl.pl. ORCID: <https://orcid.org/0000-0002-1345-0022>

transport. Transport plays a pivotal role in the economy of any country. Efficient and developed transport infrastructure significantly affects the availability of transport services, and consequently, the well-being of citizens. Despite the role it plays in the economy, transport is also responsible for its negative impact on the natural environment. The energy that is needed for the functioning of transport comes mainly from petroleum products, and thus, contributes to high greenhouse gas emissions to the atmosphere and climate change. For many years, the European Union has been pursuing a transport policy aimed at reducing the negative impact of transport on the environment by introducing restrictions on greenhouse gas emissions. In addition, research is constantly being carried out to obtain solutions in the field of transport, which will be based on the use of the least-emission means of transport in everyday life while maintaining low prices of services, as well as the use of various forms of transport in terms of sustainable development of transport infrastructure [1-5]. Moreover, there are researches dedicated to the monitoring of landslide areas [6] and others aimed at analysing the influence of road transport on urban development or analysis of development transport corridors [7].

This article presents an analysis of the volume of passengers and cargo transported using rail and road transport in Poland in 2009-2019. These analyses were performed based on data obtained from the Central Statistical Office [8]. All data relates to Polish entities that provide services in the field of passenger and freight transport in Poland and focuses on such information as the volume of passengers and loads carried by individual means of transport, broken down into domestic and international transport. The presented analyses also concern the length of the available rail and road routes, tracks, the size of the rolling stock as well as the groups of transported loads.

2. SIZE OF PASSENGERS AND CARGO TRANSPORT BY RAIL

In Poland, in the years 2009-2019, a total of 8,842,47 million people and 16,393,83 million tonnes of cargo were transported by all modes of transport [8]. In Figure 1, the length of the operated railway lines in Poland in the years 2009-2019 is presented. Based on the presented data, it can be concluded that the length of railway lines in use is gradually decreasing. Comparing the entire analysed period, it can be concluded that the length of railway lines decreased by 4.5% to the value of 19,200 thousand km [9]. A significant reduction in the operated railway lines is visible at the turn of 2012-2013 (an annual decrease by as much as 3.8% to the value of 19,328 thousand km). The longest length of operated railway lines was recorded in 2011 and it was 20,360 km, and the shortest, in 2018, that is, 19,132 km [8].

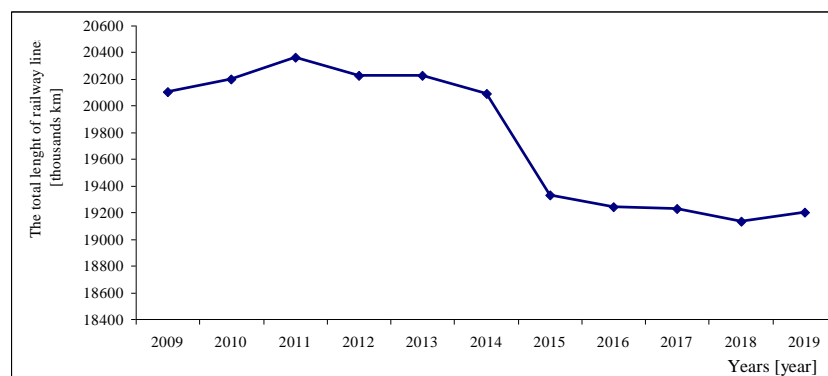


Fig. 1. Length of railway lines in use in Poland in 2009-2019
Source: Author's research based on data presented in [8]

In turn, Figure 2 shows the size of the rail rolling stock, that is, passenger wagons, freight wagons, locomotives and other rail rolling stock used for renovation, construction and rescue works used for passenger and freight transport in 2009-2019. Based on Figure 2, it can be concluded that the number of used rail rolling stock is gradually decreasing by the year. Annual declines fluctuate in the range of 2.0-6.5%, and the total decline in the period from 2009 to 2019 is as much as 20.3%. The largest resource of used rail rolling stock was in 2009, and it amounted to 118,953 units, and the lowest in 2019, amounted to 94,298 units. When analysing the rail rolling stock in Poland from 2009-2019, it can be concluded that freight wagons have the largest share (88%). In 2009, their number was 104.5 thousand units, while in 2019, it decreased by 26% to 87.7 thousand pieces. Passenger wagons constitute about 7% of the rail rolling stock, their number in 2009 was 8,227 thousand pieces. In 2019, the number of wagons used for passenger transport decreased by 14.2%, that is, 7,054,000 pieces. Locomotives account for approximately 4% of the total rail rolling stock, in 2009, the number of locomotives used for transport was 4,427,000 units, however, in 2019, their volume decreased by 14.1% to 3,800 thousand pieces. The remainder of the rail rolling stock (for example, devices and machines) was approximately 0.5%.

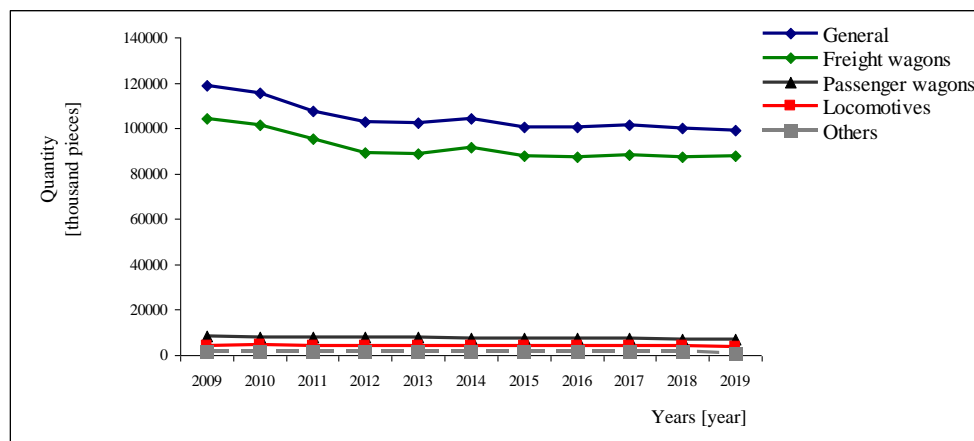


Fig. 2. Rail rolling stock in Poland in 2009-2019
Source: Author's research based on data presented in [8]

Figure 3 shows the total volume of passengers transported by rail and broken down into domestic and international transport in Poland in 2009-2019. Analysing the presented data, it can be concluded that in the initial period of the analysis, that is, in 2009-2008, an increase in the total number of transported passengers by 4.4% can be observed, from 279,657 to 291,892 million passengers. Then in the years 2010-2011, there was a decrease in the overall number of transported passengers by 3.2% from 291.892 million to 282,619 million transported passengers. The period of the greatest drops in passenger transport falls in 2012-2013. In 2019, 303,001 million passengers were transported by rail transport, which constitutes 9.9% of all transports in the analysed period. When analysing the number of passengers transported by domestic rail transport in 2009-2019, it can be stated that a total of 3,043,428 million people were transported in the analysed period, which constitutes 99.6% of all transports. In the analysed period, there are significant fluctuations in individual years in the number of transported passengers, with an upward trend in recent years. In the initial period of the analysis, that is, in 2009-2010, the number of passengers transported increased by 4.7% from 276,981 million to 289,901 million people. In the years 2010-2011, there was a slight decrease of 3% to the number of 281,086 million passengers. The largest decrease in the number of transported

passengers (7.7%) took place in 2011-2012. Then the number of transported passengers decreased from 281,086 million to 259,504 million. In the subsequent years of the analysis, that is, 2016-2019, an increase in the number of passengers transported by domestic transport can be observed.

On the other hand, in the case of passengers travelling by Polish international rail transport in 2009-2019, it can be stated that a total of 19,151 million passengers were transported in the analysed period, which constitutes 0.4% of all passengers. Based on the data presented in Figure 3, it can be stated that the number of passengers transported by international rail transport fluctuated, showing a downward trend. In the initial period of the analysis, that is, in 2009-2011, there are clear declines in the number of passengers travelling by international rail transport. The largest decrease in the number of passengers travelling by international rail transport is visible in 2010, from 2,676 million to 1,991 million passengers (25.6%). In the following year, another significant decrease in the number of passengers transported by international rail transport as much as 23% is visible. Thus, the number of passengers transported by international rail transport decreased to 1,533 million. Throughout the entire analysed period, the lowest number of passengers transported by international rail transport was recorded in 2017-2018. Most passengers used international rail transport in 2009, amounting to 2.676 million passengers, accounting for 14% of all international transport.

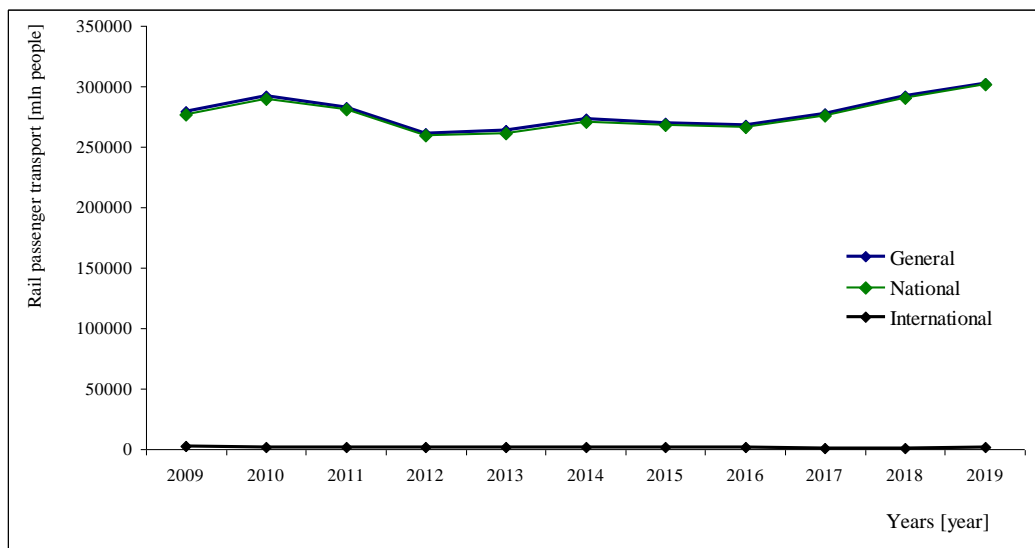


Fig. 3. Volume of rail passenger transport in Poland in 2009-2019 in total as well as in domestic and international transport

Source: Author's research based on data presented in [8]

Figure 4 shows the volume of transported goods by Polish rail transport in 2009-2019 in total and broken down into domestic and international transport. In the analysed period, the total volume of transported goods by rail transport was 2,538,027 million tonnes. When analysing the data presented in Figure 4, it can be seen that the total volume of transported goods varies yearly. In the years 2010-2011, there was the largest decrease, that is, 19% in transported cargo from 248,860 million tonnes to 200,820 million tonnes. The volume of transported goods in 2009 is the lowest in the entire analysed period and constitutes 7.9% of all transports. While the highest 14.5% increase in the entire analysed period was recorded in 2012-2013, the volume of transported goods increased then from 216,899 million to 248,606 million tonnes. In the years 2014-2018, a certain stabilisation of the volume of transported goods by

rail is visible, with fluctuations at the level of 0.8-2.0%. In the period 2018-2019, we observe a recovery in the freight transport market, the increase in volume of transported goods was then 7.6% which translates to 239.501 million tonnes. The highest number of 248,860 million tonnes of cargo was transported in 2008 and it constitutes 9.8% of all transports.

In the analysed period, a total of 1,784,469 million tonnes of cargo was transported by domestic rail transport. Based on the data presented in Figure 4, it can be concluded that the volume of cargo by domestic rail transport in the individual years of the analysis remains more or less at the same level. In 2009-2010, an increase in transport was observed by 4.8%, to the number of 176,367 million tonnes. In the following year, the highest decrease of 16% in the entire analysed period is visible, the volume of cargo decreased to 148,296 million tonnes. Comparing the year 2009 to the entire analysed period, it can be stated that the number of cargo that was transported in 2009 constitutes 8.3% of all transports. In the years 2009-2012, the least cargo were transported, the total number is 296,745 million tonnes and constitutes 16.6% of all transports. In turn, in the years 2014-2019, a stabilisation of the number of goods transported by the Polish rail transport can be observed with slight fluctuations within 1-3%. In the analysed period, a total of 753,558 million tonnes of cargo was transported by international rail transport. Based on Figure 4, it can be concluded that in the years 2012-2019, there was a stabilisation of the number of cargo transported by international rail transport with slight fluctuations at the level of 1-7%. The largest number of cargo, 76,682 million tonnes, was transported in 2009, accounting for 10.2% of all cargo in the analysed period.

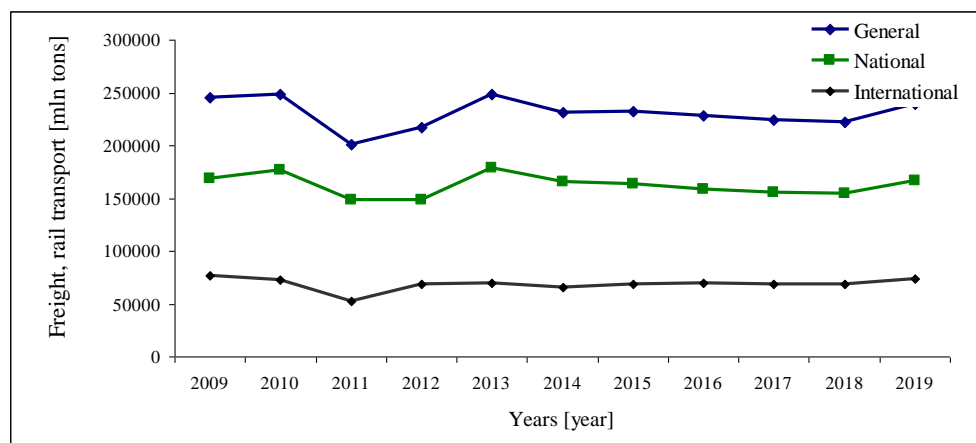


Fig. 4. Volume of transported goods by Polish rail transport in 2009-2019 in total and broken down into domestic and international transport
Source: Author's research based on data presented in [8]

Following, Figure 5 shows the share of transported cargo by rail transport according to the groups of cargo. Based on Figure 5, it can be concluded that fossil fuels have the largest share in the transport, including hard coal, lignite, crude oil, natural gas and other crude oil products (52%, that is, 1,327,441 million tonnes). The second largest group of cargo in terms of share in transport is metal ores and other mining and quarrying products (26%, that is, 659,989 million tonnes). The third largest group is the remaining cargo (10.2%, that is, 259,255 million tonnes), such as wood, waste, recyclable materials, machinery and transport equipment, empty containers, packaging. Chemicals follow as the next largest group, that is, chemical products, artificial fibres, rubber and plastic products (4.1%, that is, 104,584 million tonnes). Steel products (3.8%, that is, 98,456 million tonnes of cargo), cargoes classified as agricultural products, forestry, hunting and fishing products (2%, that is, 46,157 million tonnes) had

a smaller share in the transported cargo. The smallest share in rail transport had cargo from the group of non-metallic products and products, which include cement, gypsum, lime, construction materials (1.8%, that is, 42,145 million tonnes).

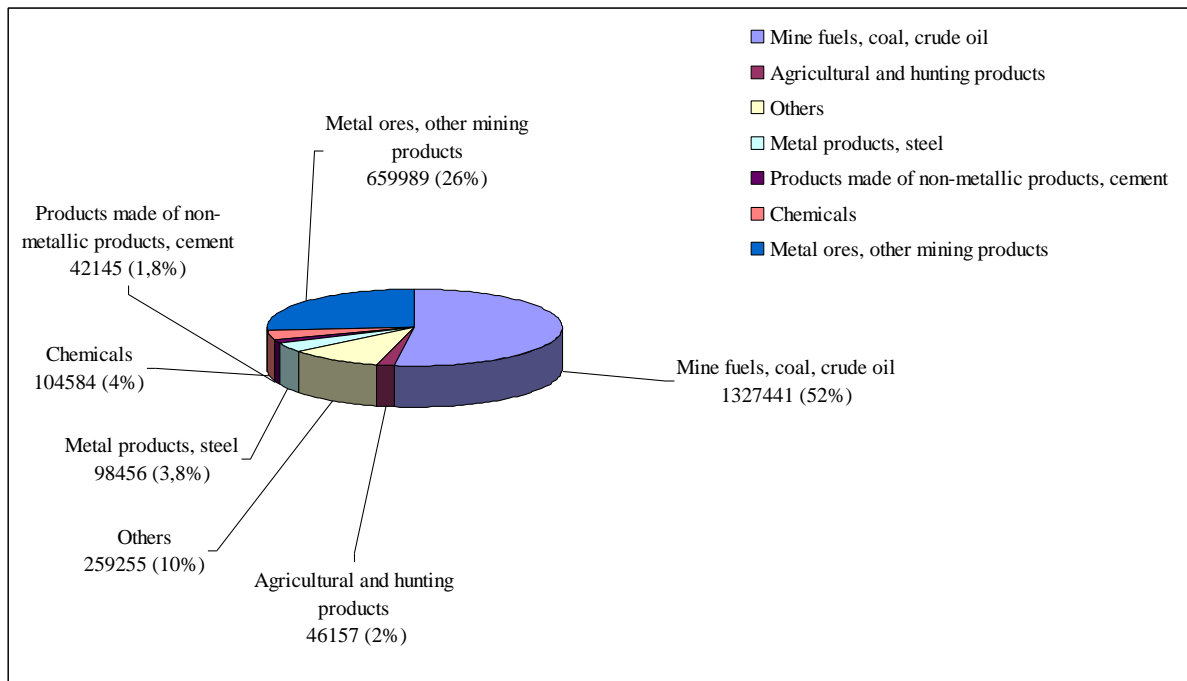


Fig. 5. Share of individual cargo groups transported by Polish rail transport in 2009-2019 in million tonnes

Source: Author's research based on data presented in [8]

3. ANALYSIS OF PASSENGERS AND CARGO TRANSPORT BY ROAD TRANSPORT

In Figure 6, the length of the road network in Poland in the years 2009-2019 in total and broken down into hard and unpaved surface roads were shown. Because of the conducted cattle works, the length of the road network in Poland systematically increased from 383,054 thousand km in 2009 (including 67.5% of roads with hard surface and 32.5% of roads with ground surface) to 422,300 thousand km in 2019 (including 70.9% of roads with hard surfaces and 29.1% of roads with unpaved surfaces).

In the analysed period, the length of the road network in Poland increased by a total of 10.2% (including the network of paved roads by 15.8%, while the length of the unpaved road network decreased). This phenomenon is very positive and desirable because efficient transport is based on extensive infrastructure, which undoubtedly translates into the country's economic growth.

In Figure 7, the length of the road network in Poland was shown, broken down into expressways and motorways in 2009-2019. Both networks of expressways and motorways in Poland are being expanded at a dynamic rate. In 2009, the length of expressways was 323 km, and motorways were 662 km, and in 2019, the length of expressways was 1,768 km, and motorways were 1,634 km. In most cases, the motorway network in Poland is a two-lane, two-way road cross-section. Only in sections near or through urban agglomerations, the number of lanes increases. Such a situation occurs, among others, on the A1 motorway in the Śląskie

Voivodeship, the A2 motorway on the Poznań ring road and the Pruszków - Konotopa section at the entrance to Warsaw, the A4 motorway at the passage through the Upper Silesian conurbation or part of the Kraków ring road, as well as on the A8 motorway constituting the Wrocław Motorway Ring Road.

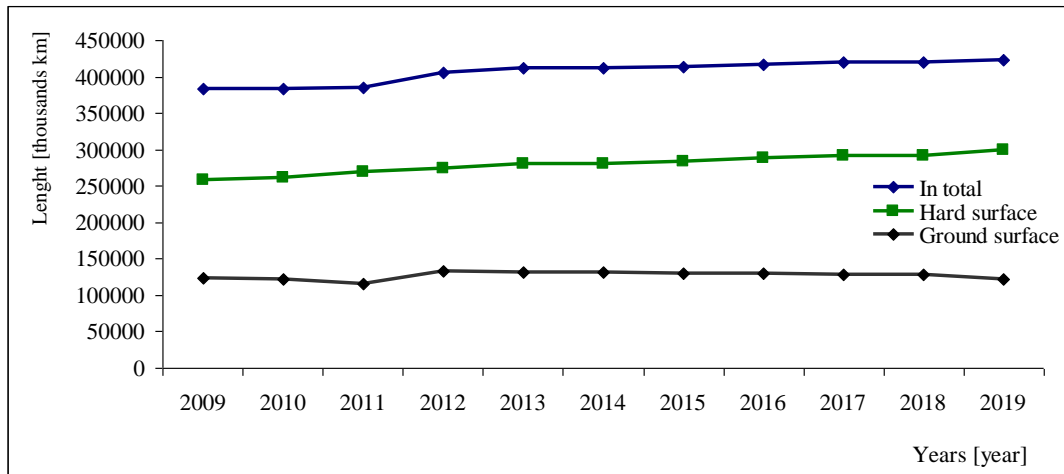


Fig. 6. Length of road network in Poland in 2009-2019, broken down into hard and ground surfaces

Source: Author's research based on data presented in [8]

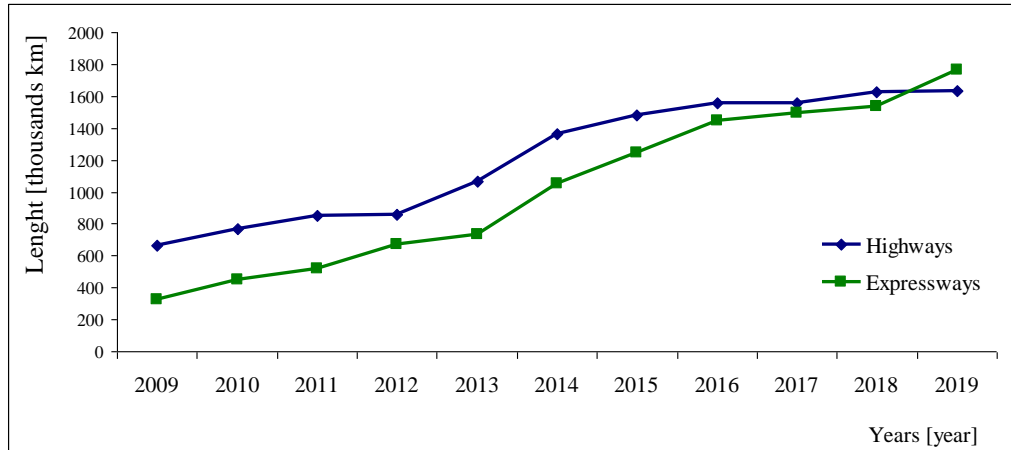


Fig. 7. Length of the road network in Poland in 2009-2019, broken down into motorways and expressways

Source: Author's research based on data presented in [8]

Figure 8 shows the volume of passengers transported by road passenger transport in Poland in 2009-2019 in total and broken down into domestic and international transport. During this period, the total number of transported passengers was 5,676,393 million. Analysing the data presented in Figure 8, it can be concluded that the overall number of passengers using road transport experienced a downward trend. Comparing the following years, a decrease of 3-8% annually is visible. In 2009, the number of transported passengers was 718,274 million, while in 2019, -378,610 million (a total decrease of 47.3%). In the analysed period, 5,643,180 million people were transported by domestic passenger road transport. The data presented in Figure 8

show a significant downward trend over the entire period considered (from 3-11% in individual years). The highest number of passengers was recorded in 2009 (715,186 million people), which constitutes 12.6% of all domestic transport in the analysed period. In addition, the lowest number of passengers transported (374,445 million people) can be observed in 2019. Comparing the number of passengers transported by domestic transport in 2009 to 2019, a decrease of 47.6% is visible. A total of 33,213 million people were transported by international road transport in Poland in 2009-2019. When analysing the data presented in Figure 8, it can be noticed that since 2012, the number of transported passengers has been showing an upward trend in international road transport after the decrease in the number of transported passengers in 2009.

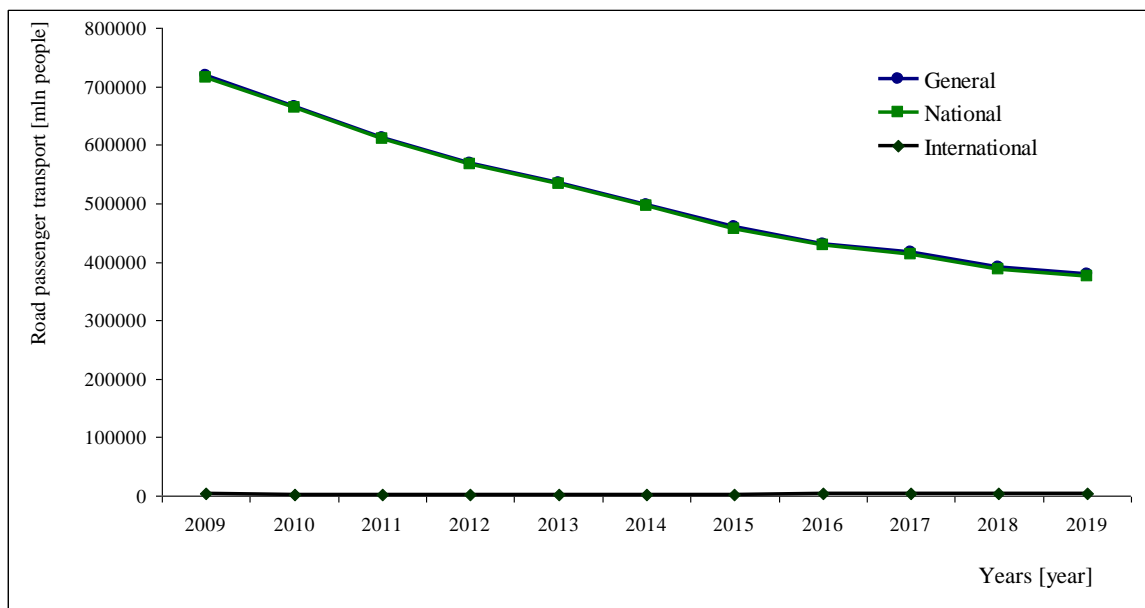


Fig. 8. Number of passengers transported by road transport in Poland in 2009-2019
Source: Author's research based on data presented in [8]

When analysing individual modes of transport, an increase in transport by all types of transport is visible, except for inland waterway transport. In terms of structure, in the case of cargo transport, road transport has dominated in Poland for years. This is illustrated by the data from the Central Statistical Office on cargo transport in individual years [8]. Figure 9 shows the volume of cargo transported by road in Poland in 2009-2019 in total and broken down into national and international transport. In the analysed period, the total number of transported cargo was 13769,257 million tonnes. Analysing the data, fluctuations can be observed in the size of transported cargo. The lowest total cargo was transported in 2009 (984,238 million tonnes).

The largest 14% increase in cargo transport can be observed in 2016-2019. It was then that the number of transported cargo increased from 1,313,657 million to 1,497,568 million tonnes. Comparing the total number of transported cargo in 2009 and 2019, it can be concluded that the number of transported cargo in 2019 is greater by 52.1%. In the analysed period, a total of 11,895,407 million tonnes of cargo was transported by domestic road transport. Analysing the data, it can be concluded that the volume of cargo transported by domestic road transport increased throughout the analysed period. The lowest number of 895,356 million tonnes was recorded in 2009. In 2009-2010, an increase in the volume of cargo transported by domestic

road transport of 1093,405 million tonnes (an increase by 11%) can be observed. The largest increase of 13% in the volume of cargo transported by domestic road transport occurred from 2018-2019, the number of transported cargo increased then to 1,209,782 million tonnes. Comparing the volumes of transported cargo in 2009 and 2019, it can be concluded that the number of transported cargo increased by 35.1%. In the analysed period, a total of 1,873,850 million tonnes of cargo were transported by international road transport. By analysing the data, an upward trend in the volume of transported cargo can be observed. Comparing the volume of goods transported by international road transport in 2009 to the data from 2019, it can be concluded that this number increased by as much as 226%.

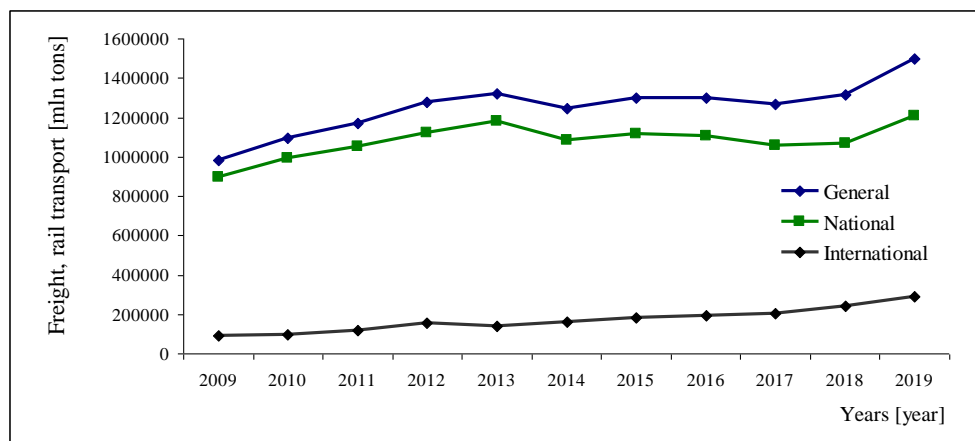


Fig. 9. Distribution of the cargo volume transported by road in Poland in 2009-2019
Source: Author's research based on data presented in [8]

In turn, Figure 10 shows the shares of cargo transport by road in Poland by cargo groups in 2009-2019. Based on the data presented in Figure 10, it can be concluded that road transport in Poland conveys most materials from the group of fossil fuels, metal ores, hard coal, brown coal, crude oil, natural gas, sand, gravel, stones and other mining products and mining. During the analysed period, a total of 4,935,520 million tonnes of this type of cargo were transported, which constitutes 36.8% of all transports. The second group, in terms of share in the transport, are chemicals and other products, metal products, machinery and transport equipment, clothing. During the analysed period, a total of 3003,661 million tonnes of this type of cargo was transported, which constitutes 21.85% of all transports in the analysed period. Another group includes products made of other non-metallic products, such as cement, lime, building materials. During the analysed period, a total of 1,850,239 million tonnes of this type of cargo was transported, which constitutes 13.4% of all transports in the analysed period. Food products (9.6%), waste and recycled products (7.7%), agricultural, hunting and fishing products (6.6%), wood, cork (5.0%) had a smaller share in road transport.

4. CONCLUSIONS

This article presents an analysis of the volume of passengers and cargo transported by rail and road in Poland from 2009-2019. The dominant share of transport in the analysed period was road transport, which provided over 64% of all passenger transport and 84% of cargo transport. The easy availability of this form of transport, flexibility, and the dynamic development and modernisation of the expressway and motorway network in Poland in recent

years have a significant impact on the popularity of road transport. This translates into increasing the competitiveness of this form of transport. Following road transport, the second kind of transport constituting the foundation in terms of transport in Poland is rail transport. In the analysed period, this form of transport was used for a total of 34% of passenger transport and over 15% of freight transport. Rail transport is giving way to road transport due to its unevenly distributed transport network, and often, poor condition of infrastructure, which has been largely neglected in recent years. An additional factor determining the use of railways in transport are the costs associated with rail services, which are higher in the case of small loads and services provided.

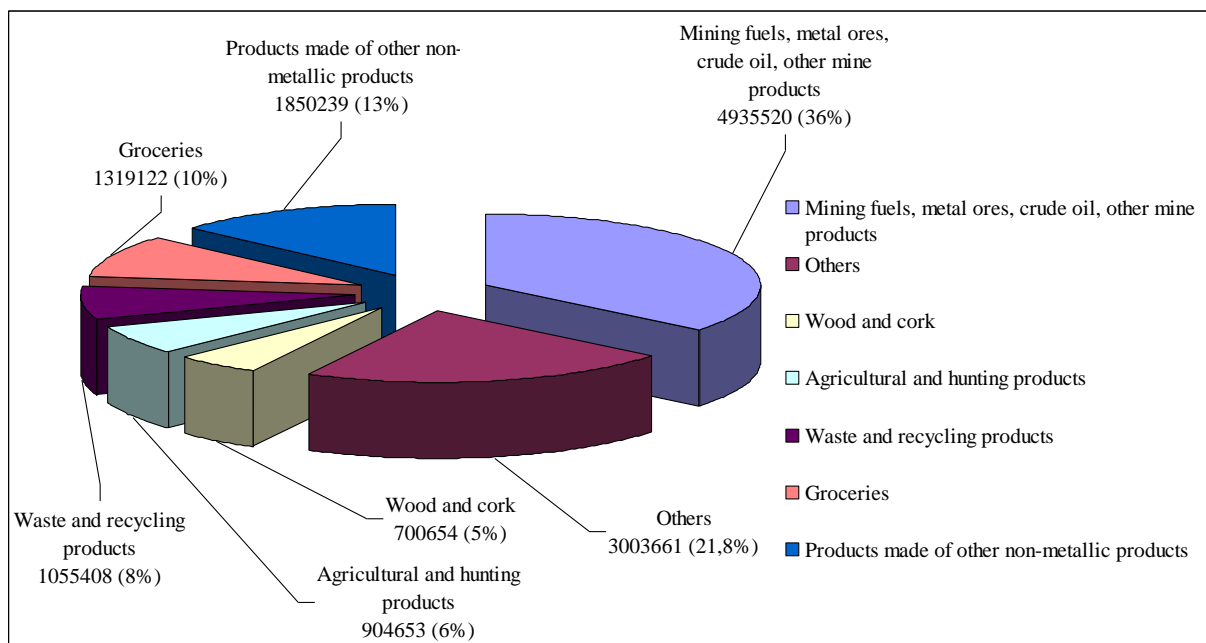


Fig. 10. Cargo transportation by road in Poland by cargo groups in 2009-2019 [million tonnes]

Source: Author's research based on data presented in [8]

References

1. Ambroziak Tomasz, Dariusz Pyza. 2011. "Problematyka wykorzystania różnych form transportu w aspekcie zrównoważonego rozwoju infrastruktury transportowej". *Logistyka* 4: 33-42. ISSN: 1231-5478. [In Polish: "Problems of using various forms of transport in the aspect of sustainable development of transport infrastructure"].
2. Jacyna Marianna. 2010. "Wybrane aspekty koncepcji modelu Systemu Logistycznego Polski ze względu na komodalność transportu". *Prace Naukowe Politechniki Warszawskiej. Transport* 75: 37-54. ISSN: 1230-9265. [In Polish: "Some Aspects of conceptual model of logistic system of Poland due to transport co-modality"].
3. Jacyna Marianna, Mariusz Wasiak, Roland Jachimowski, Piotr Gołębiowski, Piotr Klimek, Rostislav Vasek, Ilona Jacyna-Gołda, Mariusz Izdebski. 2019. "The concept of EPOS database of the transport infrastructure. In: *Proceedings of the International Conference Transport Means 2019*: 1250-1255.

4. Neider Janusz. 2012 *Transport Międzynarodowy*. Warsaw: Polish Economic Publisher. ISBN: 978-83-208-2191-8. [In Polish: *International Transport*].
5. Cieśla Maria, Aleksander Sobota, Marianna Jacyna. 2020. „Multi-criteria decision making process in metropolitan transport means selection based in the sharing mobility idea”. *Sustainability* 12(17)7231:1-21. ISSN: 2071-1050. DOI: <https://doi.org/10.3390/su12177231>.
6. Skrzypczak Izabela, Kogut Janusz, Kokoszka Wanda, Zientek Dawid. 2019. „Monitoring of landslide areas with the use of contemporary methods of measuring and mapping”. *Civil and Environmental Reports* 24(1): 69-82. ISSN: 2080-5187. DOI: 10.1515/ceer-2019-0005.
7. Śładkowski Aleksander, Maria Cieśla. 2018. “Analysis and development perspective scenarios of transport corridors supporting eurasian trade”. In: *Transport Systems and Delivery of Cargo on East-West Routes Studies in Systems, Decision and Control* 155: 71-119. Edited by Aleksander Śładkowski. Switzerland: Springer, Cham, Springer, Cham. ISBN: 978-3-319-78295-9.
8. Central Statistical Office. "Freight and Passenger Transport. Reports for the years 2009-2019". Available at: <https://stat.gov.pl/wyszukiwarka/szukaj.html>.

Received 02.09.2021; accepted in revised form 19.10.2021



Scientific Journal of Silesian University of Technology. Series Transport is licensed under a Creative Commons Attribution 4.0 International License