

Review article

## Assessment of road transport ecological security impact in Poland

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### ABSTRACT

Poland's location in the central part of Europe means international communications routes connecting north and south of the continent and east and west. Many Polish roads are transit routes that pass through environmentally valuable areas, run through forests and swamps, and cross migration routes of animals. A physical impact of transport on the environment is multipronged; it concerns, in particular, the quality of air, water, and soil, as well as disturbance of biodiversity, landscape planning, acoustic climate, the danger of vibrations and road security. Moreover, environmental resources are necessary for the efficient functioning of the transport system to generate energy, but on the other hand, to build infrastructure facilities.

Apart from sustainable development, ecological security is one of the approaches to understand and solve environmental problems. Simultaneously, compared to issues connected with economics, politics, social and military problems, attempts to securitize ecology and the environment have a relatively short story. The article aims to identify threats for ecological security and solutions connected with road transport functioning in Poland.

### KEYWORDS

ecological security, security, Poland, road transport



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## Introduction

Many years have passed since the consumerizing of motor transportation. Despite technological upgrading, which is observed in motorization, the preceding quality transformations are insufficient because of quantitative development. In the first stage of development, a distinguishing feature of effectiveness was carrying out the functions intended for transport – the passage of persons and goods. The most important feature for transport users was the maximum speed, power output, and reliability. As technologies advance, more and more criteria determine the quality of a vehicle and the whole transport system. The existing criteria started to include operating parameters of rolling stock (mileage, exhaust emission, noise level, speed, power, etc.). On the other hand, technical parameters of used road infrastructure (throughput, surface compositions, security level, durability, etc.). After the oil crisis, special attention was

devoted to fuel consumption parameters. Although the actions undertaken in this scope were dictated mainly by economic issues, they have significantly contributed to positive ecological aspects, such as reducing exhaust emissions and protecting natural resources. Environmental protection against adverse effects of motor transportation activities has started with the problem of air pollution. The first actions connected with it were undertaken in California in the United States of America. With time, the rules applying to this issue were transferred to other states (federal law) and other highly developed countries. In recent decades, the dynamic development of transport is a crucial factor in economic development and a significant source of arduousness and vital problems, especially in terms of local scale, particularly in big urban agglomerations. Considering that the adverse effects of transport affect the natural environment and society, this sector of the economy shapes and affects a level of ecological security.

Road transport is a vitally important element in the process of socio-economic development. Simultaneously, its negative effect on the environment exacts implementing changes in the entire transport system. The research subject is devoted to relations between the functioning of road transport and the quality of the environment and potential threats from road transport to ecological security in Poland. The article aims to identify threats for ecological security connected with the functioning of road transport in Poland. The research question of the article is the answer to how road transport in Poland influences the level of ecological security.

A systematic literature review and reports from the Chief Inspectorate of Environmental Protection, Statistics Poland (formerly the Central Statistical Office), and published materials of other institutions devoted to protecting the environment and ecological security were used to solve this problem.

## **1. Ecological security – theoretical aspect**

Apart from sustainable development, ecological security is one of the approaches to understand and solve environmental problems. Simultaneously, compared to issues connected to economics, politics, social, and military problems, attempts to securitize ecology and the environment have a relatively short story. The genesis of ecological security should be sought in increasing environmental threats, being a danger to the existence of societies and countries [1; 2, p. 107]. In many regions taking the form of challenges of existential nature, ecological problems had become a priority in the functioning of many entities at the end of the 1960s when the Secretary-General of the United Nations published the report *The problems of the human environment*. This document presented a delineation of the degraded environment and as the resulting consequences for human life. Considering the significance of the problem, the search for effective ways to protect the environment began. Three years after the U Thant report, the United Nations Conference on the Human Environment approved the Stockholm Declaration – the first document setting out the human right to the natural environment as one of the most important freedoms. Moreover, there were made important resolutions during this Conference, which increased the importance of environmental protection to the country's fundamental function. Thus, this activity has become the problem of domestic and external policy of the country. Many countries formed governmental structures and ministries dealing with this issue (the Polish government created the Ministry of Regional Economy and Environmental Protection in 1972, current name the Ministry of the Environment). Among the developed standards, frameworks, arrangements, and recommendations, there were appearing issues related to the securitization of this area increasingly often, and the correlations between the natural environment and civilization development began to be strongly linked [2].

The securitization process of the natural environment in the 1980s was pursued by J. Mathews, N. Myers, and A. Westing, who were expanding the scope of security in their works with new categories [3-5]. The work of R. Ullmann is also vitally important for the development of the theory of ecological security. He indicated in his attempts at redefining national security its multidimensional character, involving, among other things, problems connected with a hunger for natural resources or natural disasters. Although Ullmann had no doubts about including environmental issues in the scope of security, taking real actions by the public authority in the Cold War's military climate was difficult to achieve.

The Chernobyl disaster caused a spur to take up environmental issues to broaden the scope of security. After this accident, a conference on the ecological dimension of international security was organized on the Norwegian authorities' initiative. Participants of the conference analyzed cause and effect relationships between the natural environment and international security, pointing to a need for a comprehensive approach and taking into account the ecological basis of the nations' prosperity. On the other hand, in the early 1990s, Norwegian prime minister Gro Harlem Brundtland emphasized that the most critical challenge for humanity is the transition from the cold war era, through the Common Security Policy, to a concept of comprehensive security, involving social, economic and ecological aspects [6, p. 50].

After the end of the Cold War, the mainstream transition from military-political ground to its different spheres, including ecological security, could be observed [7, p. 6]. A relatively short story of this term on the ground of security theory and a wide range of relations between environmental issues and security causes many problems, including defining an ecological security scope. M. Pietraś, working on an explanation of the described term, distinguished a few principal currents. The first concentrates on relationships between humans and the natural environment, seeing the latter as a life-support system. R. Molvear also considered ecological security in this context. He believed that ecological security is *a security of the natural environment before such use and degradation that may endanger people and societies* [8, p. 175]. W. Michajłow similarly approaches the discussed issues. He treats ecological security *as elimination or reduction to a minimum of threats to human life and health, resulting from people habitat* [9, p. 182]. The above definitions indicate that the natural environment is a specifically protected value that decides about the quality and people living standards.

The second way to define ecological security is to associate this term with deliberate, conscious undertakings that aim at preventing ecological changes that are unfavorable for people. G. Prins discusses ecological security according to this current, pointing to a need to eliminate tendencies that deepen changes in the natural environment. O. Kołbasow, a representative of Russian literature, indicates in his studies on international environmental security that *it is a system of undertakings that eliminate the danger of mass extermination of human beings due to anthropogenically induced ecological changes that prevent people from being*. These definitions point to a threat aspect of existential nature, which results from the lack of awareness of specific actions rather than intentional ones [6].

The third current of defining environmental security, as noted by M. Pietraś, is less coherent and the most extensive because of terminological diversity. Its common distinctive feature is treating environmental and ecological problems as an essential element affecting broadly understood national and international security.

Seeing in ecological security such issues as the anthropogenic nature of threats, the possibility to counteract against them in the evolution of social behavior, the cooperation of various entities, and eliminating international tensions and conflicts on ecological background,

M. Pietraś proposes the following understanding of this term: *ecological security is such a state of social relations, including content, form, and way of organizing international relations, which not only limits and eliminate ecological threats, but also promotes positive actions, facilitating the realization of important values for the existence and development of nations and countries* [6, p. 89].

On the one hand, such an attitude towards the problem reduces the constructive protection of the environment and pursues avoiding all threats. On the other hand, it indicates that this process should participate with the participation of a country's domestic and external policy, collective ecological awareness of its community, and many component parts whose action should be focused and adapted to international cooperation [6, p. 13].

Ecological security is one of these categories, which is an essential part of social debate because of the multidimensionality of threats. In general, a threat to ecological security includes all kinds of pollutions and business products that drive to breaking immune barriers of ecosystems due to poisoning, pollution, damage, and organisms' paralysis. Processes occurring naturally with features of natural disasters whose nature is enormously destructive will also constitute a threat to this dimension of security. Such a situation is lowering the living standard for society, reducing economic activity, and general deterioration of wealth due to losses that need to be compensated. From a short-term perspective, it creates an unsafe situation for human life and health and its quality, whereas, from a long-term perspective, it has an existential impact.

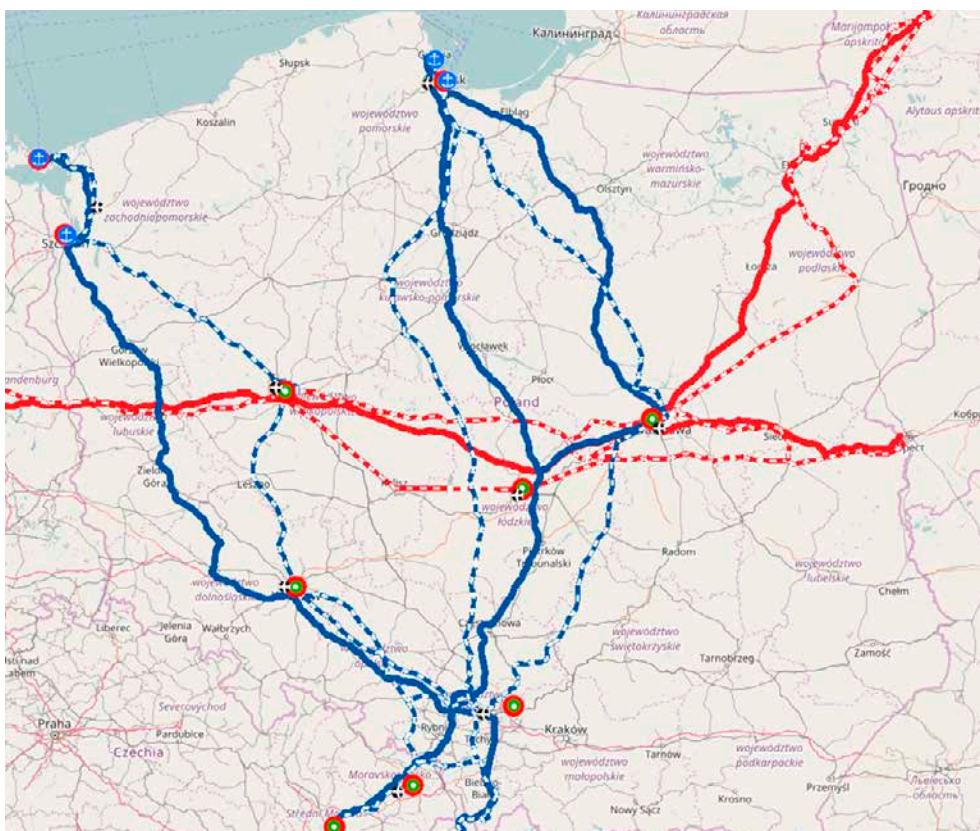
## **2. Transport and the environment**

Poland's location in the central part of Europe means that there are international communications routes connecting north and south of the continent, and east and west. On the one hand, the country's geopolitical location provides development opportunities, but on the other hand, it is a source of many threats. One of the most critical factors that positively affect Central and Eastern European countries' economic growth is the development of transport, most of all, motor transport.

Transport activity and other human activities are connected with interference in the natural environment and its strain. Many Polish roads are transit routes that pass through environmentally valuable areas, run through forests and swamps, cross migration routes of animals. It should be remembered that the level of transport impact on the natural environment depends on the pace of economic growth, traffic on the roads, level of advancement in modern transport technologies and the degree of their utilization, geographical position, and also the sensitivity of environmental elements. The impact of transport on the environment involves socio-economic issues, physical influence on the environment, and an impact on national heritage.

A physical impact of transport on the environment is multipronged; it concerns, in particular, the quality of air, water, and soil, as well as disturbance of biodiversity, landscape planning, acoustic climate, the danger of vibrations and road security. Moreover, environmental resources are necessary for the efficient functioning of the transport system to generate energy, but on the other hand, to build infrastructure facilities. The impact on national heritage manifests itself in the destruction of fauna and flora, visual changes of the landscape resulting in transforming places of particular importance and attractiveness that often have a historical meaning.

The adverse effects of transport development are increasing in time and space. They very often exceed the absorption possibilities of the environment. Many degradation phenomena



**Fig. 1.** Trans-European Network in Poland

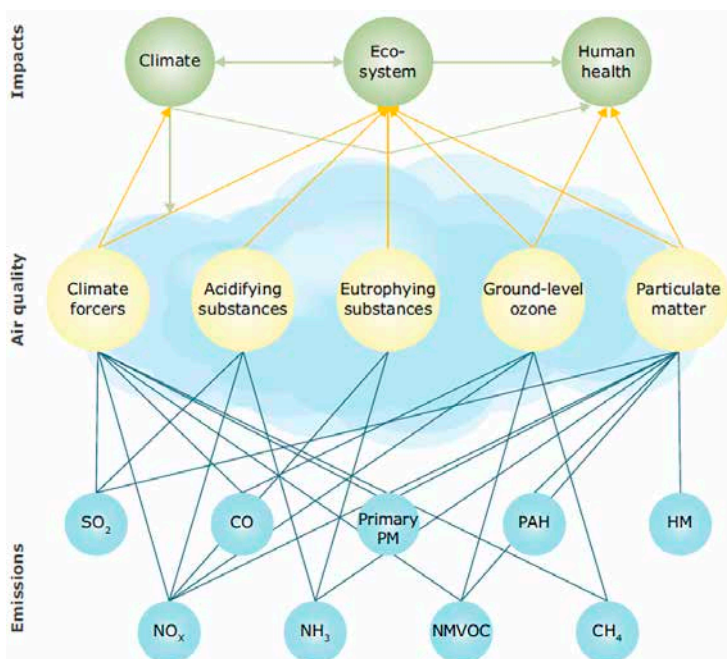
Source: [10].

in a local environment are manifested in worse living, working, and recreation conditions. In the long-term period, transport contributes to many phenomena of sub-regional and trans-national nature, such as acid rain, water pollution, etc.

Air pollution-related effects on human health have placed air pollution at the core of policy decision-making. In recent estimates, the World Health Organization (WHO) reports that approximately 7 million people died due to air pollution in 2012. Therefore, as emphasized by the WHO, air pollution is now the world's most considerable single environmental health risk (Fig. 1). Developed countries, particularly the European Union (EU) and the United States, have implemented strict regulations to improve air quality while weaker environmental regulations generally characterize developing countries [11].

According to a report of the Chief Inspectorate of Environmental Protection (GIOŚ), due to the negative impact of air pollution on one's health and the situation of the ecosystem, every year in Poland, an assessment of air quality is conducted with respect to the following: sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), carbon oxide (CO), benzene (C<sub>6</sub>H<sub>6</sub>), ozone (O<sub>3</sub>), particulate matter PM<sub>10</sub> and PM<sub>2.5</sub> pollution, and heavy metals determined in PM<sub>10</sub>: lead (Pb), arsenate (As), cadmium (Cd), nickel (Ni) and benzo(a)pyrene (B(a)P) [13].

The research on emission and exposure of many traffic participants to air pollution has been carried out since the end of the 20<sup>th</sup> century. There were 15 thousand chemical compounds



Note: From left to right the pollutants shown are as follows: sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), ammonia (NH<sub>3</sub>), particulate matter (PM), non-methane volatile organic compounds (NMVOC), polycyclic aromatic hydrocarbons (PAH), methane (CH<sub>4</sub>), heavy metals (HM).

**Fig. 2.** Major air pollutants in Europe, clustered according to impacts on human health, ecosystems and the climate

Source: [12].

identified in car fumes, but only a few of them are controlled as tracer substances. In OECD countries, motor vehicles are the most significant source of environmental contamination by C<sub>x</sub>H<sub>y</sub> (50%), NO<sub>x</sub> (50-70%), CO (80%). In addition, motor transport is an emitter of toxic chemicals not subjected to regulations by law. Research shows that these chemicals may cause cancer, prepone mortality, and disorders of the respiratory system [14].

Despite many actions for enhancing air quality, Poland's most critical problem remains: the too high concentration of tropospheric ozone in summer and exceeded concentration of particulate matter PM<sub>10</sub>, PM<sub>2.5</sub>, and benzopyrene in winter. According to the air assessment in Poland's five largest cities, the main reason for exceeding the limit values for PM<sub>10</sub>, PM<sub>2.5</sub> particles, and benzopyrene is surface emission (emission connected with household heating in household and welfare sector). The leading emitter of pollution in Warsaw is motor transport. Household and welfare emitters are situated on the fringe, not all over the city like in Kraków. The capital has a well-developed gas and heating network to which most of the infrastructure is connected. With this in mind, local air pollution in Warsaw is emitted by 60-80% by road transport. Also, in Wrocław, Poznań, and Łódź, high air pollution from particulate matter and benzopyrene remains the biggest problem. Warsaw, Kraków, and Wrocław present exceeded standards also for NO<sub>2</sub>. These standards are exceeded on roads in the center of cities where many pedestrians and drivers travel, therefore, the number of people being exposed to increased concentration of this compound may range from 5% to 15% of inhabitants of these cities.

It is challenging to isolate diseases caused by the emission of pollutants from motor transport in the overall pool of illnesses resulting from environmental contamination. Such research involves selecting a representative group of a given area and making measurements in a long-time perspective (around 30 years). However, parameters of environmental contamination and weather conditions should be registered concurrently. Besides, there is a massive problem of many other variables (environmental contamination from different sources, social and existential conditions, nutrition, way of life and type of work, etc.) influencing the reliability of obtained correlations.

Research conducted in a few European countries also has revealed that the number of fatalities for exhaust fumes enormously exceeds the number of accident victims. According to the World Health Organization (WHO) and the Italian National Agency for protection of the environment, exhaust fumes in Italy are the reason for 4.7% of disease/death among people above 30 years old and about 30% of respiratory diseases among children up to the age of 15. The impact of air pollution on public health in Switzerland, Austria, and France is estimated at around 6% of all deaths for people over 30 years old, which is more than 40 thousand deaths per year. Pollutants from motor transport cause almost half of the deaths, and motor transport in these countries are responsible for 25 thousand chronic bronchitis and 0.5 million asthma attacks [15]. For the sake of comparison, in 2012, there were 4.5 thousand people killed in traffic accidents in these three countries. In 2012, more than 3.5 thousand people died due to traffic accidents in Poland [16]. In Poland, no studies show the number of deaths caused by the harmful effects of exhaust fumes, but the ratio is undoubtedly comparable to those estimated in Western Europe.

One of the most important factors that negatively influence the natural environment is noise, which also adversely affects people. Noise is a name for vibrations propagating in the air in acoustic waves with varied strength and frequency, causing arduousness for people and the environment. The noise level means the sound pressure level, corrected to synchronize objective measurements with the subjective opinion of the sound estimated by the human ear [17, p. 8].

Noise belongs to specific kinds of pollution. It is understood as an imposed and irritating sound, causing arduousness and resentment. Such noise that we create by ourselves is felt remarkably less than that caused by others. It is also better to tolerate unavoidable noise, for example, traffic during work than noise during rest in the forest or at home, etc. The growth rate of this kind of pollution in the modern world is high, and each decade of the current century increases the noise level by 1 dB on a worldwide scale [18, p. 59].

The acoustic climate of the environment in Poland is mainly shaped by traffic noise. A fundamental threat in this category is road noise, which has a widespread influence because of its shared nature. This kind of noise varies over time, and it is emitted by vehicles crossing at varying frequencies and intensity. It occurs primarily at the tire-road interface and results from the propulsive features of the vehicle.

The road noise is a crucial environmental issue in Poland and the whole European Union. According to data presented by WHO, nearly 40% of the EU population (200 million) is exposed to road noise exceeding 55 dB per day, whence almost half of these people experience the noise exceeding 65 dB per day, whereas 150 million people are exposed to noise levels above 55 dB at night. Moreover, acoustic maps made under the Directive 2002/49/WE show that over 55 million people living in large agglomerations (more than 250 thousand people) are exposed to daily noise exceeding 55 dB, and 34 million people living in close vicinity of roads outside the housing area. Over 40 million inhabitants of agglomerations and more than

25 million people living in the vicinity of roads with traffic around 6 million vehicles per year are exposed to noise during the night, which exceeds 50 dB.

Under national law, operations connected with this issue have been set down in acts and executive acts. However, the basis in this matter is section V of the Environmental Protection Act. Pursuant to Article 112 of this Act, the protection against noise consists of ensuring the best acoustic environment, especially by reducing noise, maintaining the noise level below permissible noise, or at least at the permissible level [19, Art. 112]. The Act also describes the components of the ecological security system responsible for monitoring the acoustic climate. Following Article 25 of the Environmental Protection Act, observation of noise level is one of the State Environmental Monitoring tasks. The assessment of acoustic climate is mandatory in the case of cities with over 100 thousand inhabitants, roads, railway lines, airports, and areas for which the obligation to assess acoustic climate has been laid out in the district environmental program.

### **3. Solutions in transport for ecological security**

As the natural environment's state worsens, there has been reorientation on pro-ecological development in all human activities. A key message of such an approach is to ensure development without harming the natural environment because its quality determines future generations' development. By complexity of the issue and results that are possible to achieve, ecological security has remained in the center of interests for many environments for a long time [20, p. 167]. The functioning of the transport system under the principle of sustainable development and ecological security was presented for the first time during the OECD Conference in Berlin in 1991 [21, p. 201].

The dimension of the problems relevant to motor transport functioning points to a need to limit its effect not only on the level of road traffic security but especially on the natural human environment. The measures that are taken should be multirange. Rationalization of transport might be possible by a wide range of action, which includes:

- organizational and legal operations on rationalization of traffic,
- rational design and maintenance of roads,
- implementation of modern road traffic management systems and traffic control systems,
- ensuring a proper technical condition of motor vehicles that are used,
- training users of motor vehicles in the field of environmental protection.

The basis for the smooth functioning of the transport system in each region is public transport. It is one of the critical links stimulating transport behaviors. Public transport is an essential element in limiting threats from motor transport if it is well-managed. The advantage of public transport over individual transport is determined by its quality and possibility to ensure the same objectives implemented so far by the cars. It means that the system should include speed, reliability, security, and comfort, and it should guarantee door to door connections and low fares. A guarantee of high-quality public transport requires cyclical investments, ensuring high-level maintenance and exploitation of infrastructure and rolling stock. These funds could be provided, for example, from parking fees or reduced usage of individual transport. As a consequence, it can be expected that the number of transported passengers would be more significant. Mass communication is significantly safer for health, many times less accidental, and it also allows reducing the noise level [22].



Organizational and legal operations directed towards minimizing the negative impact of transport activity should be adjusted to the specificity of local threats and transport needs. These activities may reduce the impact of transport on the environment, but they will also ensure the rationalization of people and goods' movement in the transport system of urban areas. Universal solutions are, for example, no stopping sign, driving ban for trucks, permissible speed, or parking ban. A local level of environmental pollution is determined by congestion and structure of traffic, average speed, and traffic fluidity. Solutions in traffic organization and management enable the improvement of the transport system at much lower investment costs compared to the quantitative development of road infrastructure. One way to reduce heavy traffic and thereby affect ecological security in a positive manner is to move transit traffic out of urban areas. Another important factor from the perspective of ecological security is ensuring the maximum level of traffic fluidity. Generally, a requirement of traffic fluidity is fulfilled when the average moving speed in agglomerations amounts to 40-60 km/h, which is a massive problem in many European cities. For example, in Athens, the moving speed averages 3 km/h, in Paris 11 km/h, and in London 14 km/h [14]. This rate is not much better in Poland. In Warsaw, as indicated by data collected on weekdays by the Yanosik system, the cars move in the center with an average speed of 29 km/h [23]

Actions leading to traffic fluidity improvement in cities include using so-called *green waves*, allowing riding across a few crossroads. This solution has a positive impact on the environment, but it also reduces burning and improves fuel economy. A shift from the traditional control of particular junctions to more innovative methods, employing data about the structure and direction or volume of traffic, creates a much bigger possibility to adapt to a current situation on the road. Integrated traffic control systems have been created in Polish cities for many years. However, they do not function in any agglomeration in a sufficient area. For example, an Integrated Traffic Control System (ITCS) in Warsaw covers 268 junctions. It comprises of dozens of surveillance camera, measuring stations, and variable message boards [24].

Apart from technical and constructional possibilities to level the adverse effects of motor transportation, there are also solutions based on the human factor as each of us decides about the choice of transport. Reducing the role of passenger cars in traveling is extremely difficult to achieve mainly because of:

- drivers' tendency to fully exploit a throughput of road and street network until reaching the level of traffic congestion, despite taking remedial action,
- limited financial means, which could be designated to development of public transport due to its costs of development (underground systems, railroads, routes of the fast tram, purchase of rolling stock),
- ongoing changes in landscape planning and an outer zone of the city favoring the establishment of extensive development, which is challenging to serve with public transport and encouraging to make car journeys.

An adequate influence on most mobile people's decisions should be one of the critical issues undertaken under considers and limits in motor transport. The impact on communicational behavior has been present for a long time. However, earlier it concerned purely and merely the provision of high-quality use of individual motorization. Currently, they are influenced by parking fees, separating green zones, improving transport offers. However, these actions are too passive, addressed to the general public, without detailed knowledge of needs and expectations. It is essential to make each transport user aware and convince them to stop using the car in its current dimension. Possible changes in behavior may relate, for example, to:

- change of travel time (off-peak),
- change of means of transport,
- resignation from the travel in general,
- change of travel route.

The best idea from the above solutions is to change the mode of transport. It is necessary to establish the belief among the society that travel by bike, on foot, or by public transport equally meets or even exceeds the norms and demands reserved for individual transport. In countries and cities with a well-developed public transport system, there is noticeably a greater propensity to travel by this form of transport. For example, 75% of Helsinki residents travel to work with the use of public transport [25].

Many highly developed countries are making attempts and operations to completely abandon individual communication in the cities. One of the best examples, where it is forbidden to drive by your own car, is alpine Zermatt. This mountains village has been focusing on ecological transport since 1974. If combustion vehicles were allowed here, narrow streets would be blocked in every direction, and Zermatt would be hidden under the cloud of black smoke, the same as Zakopane as it is situated in the valley, 1600 m above the sea level [26].

Other western cities are also searching for similar solutions. Hamburg, the second-largest city in Germany, wants to eliminate the necessity to use cars in the city over the next 15-20 years. It is supposed to be more ecological, healthier, and more enjoyable to live. In terms of care about the state of the environment, this city is already one of the best places to live. Around 40% of its area is green areas (commons), sports facilities, parks, gardens, squares, and cemeteries. In addition, the municipality prepared the Green Network Plan – a plan of creating a green network and links between green areas with cycle and walking routes, which are friendly for people and the environment. The implementation of this plan aims to enable people commuting to work and tourists to get around the city without a need to use a car. The most important in the fruition of this idea is the high level of economic awareness of the residents and readiness the give up the car [27].

These should be complemented by building pro-ecological awareness among the operators of all vehicles. A common ecological awareness is shaped in everyday life, interests, economic activity, and shared values conveyed from generation to generation. It is a complex process directly related to the natural environment and its impact on people's quality of life. Significant factors in shaping ecological awareness include information and education. It is hard to change people's beliefs and habits, and therefore the exemplary solutions presented above cannot be implemented separately. A comprehensive pro-ecological policy should be conducted, combining specific measures in the integrated transport system. Only actions combining pro-ecological effects with increased attractiveness of offered solutions.

## Conclusion

Due to Poland's geopolitical location, the quantitative and qualitative development of infrastructure is essential to support a high transit traffic volume. For this purpose, besides the extension of railway infrastructure with high technical parameters, it is necessary to provide conditions that could guarantee to move the transit out of cities. It should also be noted that Poland's road transport system is an integral part of the entire transport system in the European Union, and both national and international market for the carriage of goods by road is one of the critical links of the economy. Therefore, the further development of this branch of

transport is logical in a short term perspective. At the same time, the growing importance of road transport will contribute to the increase in ecological threats, and consequently, there will be a necessity to develop forces and measures to combat the negative phenomena. It should also be borne in mind that the right to protection from the effects of the risk is one of the fundamental principles in democratic countries, and it is granted to all citizens regardless of their social status, faith, political views, etc. That is why it is appropriate to create and improve local, national, and international systems of ecological security to protect people. Elements of this system primarily include authorities, institutions, and legal acts equipped with necessary force and measures. In the case of counteracting ecological threats from transport, these systems may also include rail and point infrastructure elements. However, some solutions need to be viewed critically, for example, a paid parking system in city centers. It is often one of the sources of income for local governments rather than a mechanism that limits and discourages using individual transport. The introduction of fees for the use of motorways (apart from the prevailing rates) or limiting the availability of a given area is often perceived as an attack on motorists' interests.

Identifying presented threats and consequences resulting from them should raise social awareness of responsibility for the state in which we live. Reaching the main objective of the given work allows noticing that the quality of the services offered by the environment is mainly dependent on humans. The level of attractiveness of particular regions is determined primarily by the level of services: food provision (food, water, energy), regulating services (climate, occurring diseases, movement of food), cultural services (spiritual, aesthetical, recreational). Unfortunately, the current state of development of the Polish transport system is directed to the further development of motor transport, despite many declarations and assurances. Therefore, the only thing that can contribute to the reduction of threats from this mode of transport is the ecological awareness of people.

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### **Conflict of interests**

The author declared no conflict of interests.

### **Author contributions**

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

### **Ethical statement**

The research complies with all national and international ethical requirements.

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### **References**

1. Szewczyk Z. *Bezpieczeństwo ekologiczne – zrównoważony rozwój i wymiar ekonomiczny*. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu. 2017;19(3):295-300. DOI: 10.5604/01.3001.0010.3266.
2. Kukułka J. *Bezpieczeństwo międzynarodowe w Europie Środkowej po zimnej wojnie*. Warszawa: Scholar; 1994.

3. Myers N. *The Environmental Dimension to Security Issues*. The Environmentalist. 1986;6(4):251-7.
4. Mathews J. *Redefining Security*. Foreign Affairs. 1989;68(2):162-77.
5. Westing A. *An Expanded Concept of International Security*. In: Westing A (ed.). *Global Resources and International Conflict: Environmental Factors in Strategic Policy and Action*. Oxford: Oxford University Press; 1986, p. 183-200.
6. Pietraś M. *Bezpieczeństwo ekologiczne w Europie*. Lublin: The University Press; 1996.
7. Zięba R. *Kategoria bezpieczeństwa w nauce o stosunkach międzynarodowych*. In: Bobrow D, Halizak E, Zięba R (eds.). *Bezpieczeństwo narodowe i międzynarodowe u schyłku XX wieku*. Warszawa: Fundacja Studiów Międzynarodowych, Wydawnictwo Naukowe „Scholar”; 1997.
8. Molvear R. *Environmentally induced conflicts? A discussion based on studies from the Horn of Africa*. Bulletin of Peace Proposals. 1991;2:175-88. DOI: 10.1177/096701069102200204.
9. Michajłow W. *Problemy bezpieczeństwa ekologicznego świata i Polski*. In: Rotfeld AD (ed.). *Międzynarodowe czynniki bezpieczeństwa Polski*. Warszawa: PWN; 1986.
10. *Mobility and Transport*. TENtec Interactive Map Viewer, [online]. European Commission website. (n.d.). Available at: <https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html> [Accessed: 27 February 2020].
11. Bagayev I, Lochard J. *EU air pollution regulation: A breath of fresh air for Eastern European polluting industries?* Journal of Environmental Economics and Management. 2017;83:145-63. DOI: 10.1016/j.jeem.2016.12.003.
12. European Environment Agency. *Air quality in Europe. 2012 report*. Luxembourg: Publications Office of the European Union; 2012. DOI: 10.2800/55823.
13. *Stan środowiska w Polsce. Raport 2018*, [online]. Główny Inspektorat Ochrony Środowiska. (n.d.). Available at: <http://www.gios.gov.pl/pl/stan-srodowiska/raporty-o-stanie-srodowiska> [Accessed: 15 February 2020].
14. *Polityka rowerowa miasta Kielce*, [online]. Urząd Miasta Kielce. (n.d.). Available at: [http://www.um.kielce.pl/urbike/pub/polityka\\_rowerowa\\_miasta\\_kielce\\_pelna\\_wersja.pdf](http://www.um.kielce.pl/urbike/pub/polityka_rowerowa_miasta_kielce_pelna_wersja.pdf) [Accessed: 14 February 2020].
15. Krzyżanowski M, Kuna-Dibbert B, Schneider J. *Health effects of transport-related air pollution*. Copenhagen: World Health Organization Europe; 2005, [online]. World Health Organization Europe. Regional Office for Europe. (n.d.). Available at: [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0006/74715/E86650.pdf](http://www.euro.who.int/__data/assets/pdf_file/0006/74715/E86650.pdf) [Accessed: 20 February 2020].
16. *Bezpieczeństwo na drogach: drugi rok z rządu Europa jest na dobrej drodze do osiągnięcia celu*, [online]. Instytut Transportu Samochodowego. (n.d.). Available at: [http://www.its.waw.pl/Bezpieczenstwo\\_Na\\_Drogach\\_Drugi\\_Rok\\_Z\\_Rzedu\\_Europa\\_Jest\\_Na\\_Dobrej\\_Drodze\\_Do\\_Osiagniecia\\_Celu,0,3553,1.html](http://www.its.waw.pl/Bezpieczenstwo_Na_Drogach_Drugi_Rok_Z_Rzedu_Europa_Jest_Na_Dobrej_Drodze_Do_Osiagniecia_Celu,0,3553,1.html) [Accessed: 14 February 2020].
17. Ambroszko W, Miksiewicz K. *Analiza hałasu w ruchu drogowym w wybranej miejscowości i ocena jego wpływu na bezpieczeństwo ruchu*. Autobusy. 2018;12:43-8. DOI: 10.24136/atest.2018.351.
18. Gronowicz J. *Ochrona środowiska w transporcie lądowym*. Poznań–Radom: Instytut Technologii Eksploatacji; 2004.
19. Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska (Dz. U. 2001 Nr 62, poz. 627).
20. Przybyłowski A. *Pomiar zrównoważonego rozwoju transportu w polskich województwach*. Optimum Studia Ekonomiczne. 2014;3(69):184-94. DOI: 10.15290/ose.2014.03.69.12.
21. Ejdyś J. *Zrównoważony rozwój jako perspektywa funkcjonowania transportu miejskiego*. In: Kietczewski D, Dobrzyńska B (eds.). *Ekologiczne problemy zrównoważonego rozwoju*. Białystok: Wyższa Szkoła Ekonomiczna w Białymstoku; 2009.
22. *Transport lądowy*, [online]. Ziemiarnarozdrozu.pl. (n.d.). Available at: <http://ziemiarnarozdrozu.pl/encyklopedia/24/transport-ladowy> [Accessed: 2 March 2020].
23. *Korki w Warszawie – sprawdziliśmy średnią prędkość jazdy*, [online]. Oponeo.pl. 6 August 2019. Available at: <https://www.oponeo.pl/artukul/ranking-miast-przyjaznych-kierowcom-warszawa> [Accessed: 21 February 2020].

24. *Zintegrowany system zarządzania ruchem w al. Niepodległości*, [online]. Zarząd Dróg Miejskich. 13 September 2018. Available at: <https://zdm.waw.pl/aktualnosci/zintegrowany-systemu-zarzadzania-ruchem-czas-na-al-niepodleglosci/> [Accessed: 25 February 2020].
25. Brzeziński A. *Strefowanie ruchu – droga do poprawy jakości życia w Warszawie?*, [online]. TransEko. (n.d.). Available at: <http://www.transeko.pl/publik/Strefowanie%20ruchu.pdf> [Accessed: 26 February 2020].
26. *Miasto przyszłości: Melex*, [online]. Topgear.com.pl. (n.d.). Available at: <http://www.topgear.com.pl/miasto-przyszlosci-melex,garaz-top-gear,articles,332> [Accessed: 26 February 2020].
27. *Green Hamburg, Green Network*, [online]. Hamburg.com. (n.d.). Available at: <https://www.hamburg.com/residents/green/11836450/green-network/> [Accessed: 26 February 2020].

## Biographical note

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## Ocena wpływu transportu drogowego na bezpieczeństwo ekologiczne w Polsce

### STRESZCZENIE

Położenie Polski w centralnej części Europy sprawia, że przez jej terytorium prowadzą międzynarodowe szlaki komunikacyjne łączące północ z południem i wschód z zachodem kontynentu. Wiele dróg w Polsce, będących między innymi szlakami tranzytowymi, przechodzi przez tereny cenne przyrodniczo, biegnie przez lasy, mokradła, przecina szlaki migracji zwierząt. Fizyczny wpływ transportu na środowisko jest wieloaspektowy, dotyczy on przede wszystkim: stanu powietrza, stanu wód i gleb, zakłóceń bioróżnorodności, zagospodarowania przestrzennego, klimatu akustycznego, zagrożeń wibracjami i bezpieczeństwa w ruchu drogowym. Co więcej, do efektywnego funkcjonowania systemu transportowego niezbędne są zasoby środowiska potrzebne z jednej strony do pozyskiwania energii, z drugiej zaś do budowy obiektów infrastrukturalnych. Obecnie, obok koncepcji zrównoważonego rozwoju, bezpieczeństwo ekologiczne stanowi jedno z podejść do zrozumienia i rozwiązania problemów środowiskowych. Jednocześnie, w porównaniu z zagadnieniami związanymi z ekonomią, polityką, problemami społecznymi czy militarnymi, próby sekurytyzacji ekologii i środowiska naturalnego mają relatywnie krótką historię. Celem artykułu jest identyfikacja zagrożeń i dla bezpieczeństwa ekologicznego oraz możliwych rozwiązań związanych z funkcjonowaniem transportu samochodowego w Polsce.

**SŁOWA KLUCZOWE** bezpieczeństwo ekologiczne, bezpieczeństwo, Polska, transport samochodowy

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