

Review of public policy for reducing the transport environmental impact

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Received: 07.01.2021. Accepted 15.02.2021

The transport infrastructure influenced the wildlife and landscapes by the direct destruction of biotopes. The main impacts are paving the road or water canal, chemical pollution of the environment by vehicle engine emissions, petrol, oil and lubricant, flushing of contaminants and anti-ice chemicals with rainwater and dust forms of chemical compounds; isolation of individual parts of biotopes, populations, organisms or dividing ecosystems into parts (fragmentation); collisions of living organisms with vehicles; changing of landscapes, influencing the hydrological network; oppression of internal species. It is indicated that each mode of transport pollutes the environment, but a significant advantage – 85% of all the pollution is carried out by road transport. Accordingly, the main measures to prevent the negative impact of transport on the environment should be the following: improvement and implementation of the legal mechanism regulating the reduction of harmful effects of mobile sources on the air and effective public administration to reduce mobile sources' harmful effects air. This strategy should be focused on the basic principles of sustainable development. It is proved that satisfaction of transport needs should not conflict with environmental and health priorities and disrupt future generations' interests.

Keywords: transport infrastructure, the impact of transport, public policy, environmental priorities, sustainable development.

Introduction

Ukraine is located at the intersection of migratory routes of many types of wild animals. The main threat to biodiversity is human activities and the destruction of natural habitats of flora and fauna. Destruction of the natural environment occurs because of land plowing, deforestation with a subsequent change of land use, drainage or watering of territories, intensification of the transport and road complex, and fragmentation of landscapes, industrial, housing, and summer cottage construction. However, it is worth highlighting of transport system from limiting factors on wild animal populations.

Besides, our time is characterized by an unprecedented scale of transport. Transport serves industry and agriculture, most of it is involved in people serving. Accordingly, the damage is increasing because transport affects the environment. Roads, railways, and traffic disrupt environmental processes, increase mortality of animals and birds, and lead to ecosystem degradation and population isolation. Many wild animals are dying on the roads, which fall under cars' wheels or collide with them in flight.

It is necessary to pay attention to multiple studies on the impact of transport on the environment. Among such studies, it is advisable to distinguish the following authors' works: D. Albalate, G. Bel, G. Currie, A. Delbosc, S. Farber, A. Páez. However, the development of mechanisms of public policy improving transport impact on ecology remains insufficiently researched.

The work's analytical basis is the legislative of the state regulating transport impacts on the environment, scientific achievements of domestic and foreign researchers, and public authorities' statistical data.

Results

Today there are no useful developments in animal protection from motor transport in our country. Much attention is paid to these problems abroad. For example, in Central Arizona (USA), building underpasses and bridges for animals' passage is situated along highways of state significance, representing a high probability of collisions with wild animals. This practice is implemented in all countries that care about the conservation of wild fauna and safety movement since animals create not only dangerous situations on the roads but also are full-fledged components of natural ecosystems (Banister & Hall, 1981; Church et al., 2000; Geurs et al., 2006).

Transport infrastructure has the following impact on wildlife and landscapes:

- Direct destruction of biotopes when paving the road or water canal or conducting other construction;
- Chemical pollution of the environment by vehicle engine emissions, sources of petrol, oil, and lubricants;
- Flushing of contaminants and anti-ice chemicals with rainwater and dust forms of chemical compounds;
- Isolation of individual parts of biotopes, populations, organisms or dividing ecosystems into parts (fragmentation);
- Collisions of living organisms with vehicles;
- Changing of landscapes, influencing the hydrological network;
- Oppression of internal species (Cass et al., 2005; Albalate & Bel, 2010).

Significant influence occurs in space, causing fragmentation of landscapes and species habitats, fragmentation of individual areas up to such dimensions that lead to the disappearance of individual species or their communities.

Modern society cannot function not without transport. Now both freight and public vehicles are used, supplied with various types of energy to provide traffic. The following vehicles are currently in use in different parts of the world:

- Automobile ones (buses, cars, minibusses);
- Railway ones (metro, trains, electric trains);
- Water ones (boats, container vessels, tankers, ferries, cruise vessels);

- Air ones (aircraft, helicopters);
- Electric transport (trams, trolleybuses) (British Medical Association, 2009; Fyhri & Aasvang, 2010).

Even though transport allows accelerating the time of all movements of people on the surface of the Earth and by air and water, various vehicles impact the environment.

Each mode of transport pollutes the environment, but a significant advantage – 85 % of all the pollution is carried out by road transport, releasing exhaust gases. Cars, buses, and other vehicles of this type lead to various problems:

- Air pollution;
- Greenhouse effect;
- Noise pollution;
- Electromagnetic contamination;
- Deterioration of human and animal health (Lucas et al., 2001; Cass et al., 2005).

Features of air pollution caused by road vehicles are the following:

- Exhaust gases enter the lower surface layer atmosphere; the dispersal processes are slower than those of stationary sources;
- Emissions enter the breathing area of people;
- Emissions have a significant influence on the formation of sanitary and hygienic living conditions of people since natural air exchange and self-cleaning of air is limited due to dense residential development;
- Moto transport is a mobile source, i.e., the spread of pollution is possible over long distances (Banister & Hall, 1981; Schade, 2003).

Exhaust gases of cars with carburetor and injection engines, among the most toxic components, contain carbon monoxide, nitrogen oxides, hydrocarbons, and diesel gases – nitrogen oxides and hydrocarbons and carbon black and sulfur compounds. One car annually absorbs more than 4 tons of oxygen from the atmosphere, emitting exhaust gases of approximately 800 kg carbon monoxide, 40 kg nitrogen oxides, and almost 200 kg of different hydrocarbons. The primary attention is paid to reducing toxicity and neutralization of spent gases, and there are ongoing technical developments.

Crankcase gases contribute to air pollution — their number in engine increases as wear increases.

Also, it depends on the driving conditions and mode of operation of the engine. An idle crankcase gas ventilation system equipped with almost all modern engines works less efficiently, degrading cars' environmental performance.

Gasoline evaporations in the car occur when the engine is out of service. The gas tank's internal cavity is always in communication with the atmosphere to maintain the tank's pressure at the atmospheric level as gasoline is produced. This is necessary for the engine's entire power supply system's regular operation but simultaneously creates conditions for evaporation of light fractions of gasoline and air pollution.

A new harmful factor associated with motor vehicles is "traffic jams."

At this time, the car releases the maximum amount of poisonous substances, including the number of carbon monoxide. In the case of mass accumulations of cars, which work in idle mode, in the highway's zone of influence, these concentrations increase several times, causing poisoning symptoms.

Damage to health can be done not only to motorists but also to pedestrians at stops. The exposure of children to exhaust gases is hazardous because of the concentration of highly toxic substances in the surface layer.

Vehicles are also characterized by the presence of sources of pollution inextricably associated with the leading cause – car maintenance enterprises: gas stations, car shops, parking lots (Laird, Geurs & Nash, 2009; Ruban, 2018).

To improve the environment, it is necessary to:

- Increase uses of eco-friendly transport (trolleybuses, trams, electric vehicles, trains);
- Reduce damage from the operation of vehicles;
- Use neutralizers and hydrogen-oxygen additives;
- Converse to gas fuel (methane, propane);
- Use alternative types of fuel;
- Improve the quality of fuel and lubricants used;
- Do reconstruction of roads (British Medical Association, 2009; Currie & Delbosc, 2010).

Marine transport most pollutes the hydrosphere because dirty ballast water and water, which is washed by swimming boats, enter the reservoirs. Ship power plants pollute the air with various gases. If tankers transport petroleum products, there is a risk of water contamination by oil.

Aviation transport pollutes, first of all, the atmosphere. Their source is the gases of aircraft engines. Thanks to the work of air transport, carbon dioxide, and nitrogen oxides, water vapors, and sulfur oxides, carbon oxides, and solid particles enter the air.

Electric transport contributes to environmental pollution through electromagnetic radiation, noise, and vibrations. When it is maintained, various harmful substances enter the biosphere.

Thus, when operating a wide variety of vehicles, environmental pollution occurs. Harmful substances pollute water, soil, but most of all, pollutants enter the atmosphere. These are carbon monoxide, oxides, heavy compounds, and vaporous substances. As a result, the greenhouse effect occurs, but acid rains fall, the number of diseases increases and people's health deteriorates (Geurs et al., 2006; Mingardo, 2008).

The specific objective of public policy mechanisms improving concerning transport is to achieve a higher quality of atmospheric air, ensure environmentally safe living conditions of the population, reduce resource consumption, and improve the transport complex's efficiency and environmental safety.

The objective should be achieved through the following measures:

- Improvement and implementation of the legal mechanism regulating reduction of harmful effects of mobile sources on air;
- Effective public administration to reduce the harmful effects of mobile sources on air;
- Scientific and technical support for the rational use of natural resources and reduction of harmful effects of mobile sources on atmospheric air;
- Improvement of a system of responsibility and stimulation in the field of decrease of harmful effects of mobile sources on atmospheric air;
- Effective cooperation of specialists in the field of mechanical engineering, technical operation of vehicles, organization of transport, traffic, road construction, and urban transport planning;
- Improvement of a system of rationing of the impact of mobile sources on atmospheric air;
- Introduction of resource and energy-saving materials and technologies;

- Establishment of vehicles using new fuels;
- Implementation of modern innovative technologies of monitoring of the condition of atmospheric air near roads and objects of inclination of mobile emission sources;
- Improvement of a system of collecting, transfer, storage, and analysis of the relevant information.

Accordingly, it is necessary to develop a strategy to reduce the harmful effects of transport on the atmospheric air in Ukraine.

This strategy should be based on the basic principles of sustainable development. The satisfaction of transport needs should not conflict with environmental and health priorities and disrupt future generations' interests.

Decisions on the development of the transport system and regulation of transport activities should be evaluated in terms of economic efficiency and road safety, minimizing the impact of transport on air, and criteria are equivalent.

In regulating competitive relations between different modes of transport, the principle of phased switching of cargo and passenger flows to environmentally friendly modes of transport should be implemented. The focus should be on preventing environmental problems rather than addressing them.

The phased transition to the polluter–pays principle will reduce the share of economic and other actors with harmful environmental impacts.

Integrated transport planning, safety improvement, and reduction of the negative impact of transport on atmospheric air should be concentrated, first of all, concerning large cities, resort areas, and territories adjacent to international transport corridors for the subsequent dissemination of application of the most successful solutions in each of the areas.

Conclusion and recommendations

Accordingly, the priority measures for reducing mobile sources' harmful effects on atmospheric air should be the following.

1. Normative legal regulation in reducing of the harmful effects of transport on atmospheric air.

1.1. Development and implementation of regulatory legal and technical regulatory legal acts in the field of reducing the harmful effects of transport on atmospheric air, focused on:

- Improvement of a system of rationing of emissions of pollutants, the smoke of the fulfilled gases of vehicles and issue from aircraft on fuel;
- Rationing of carbon dioxide emissions from vehicles' exhaust gases;
- Restriction of entry and phasing out of vehicles and engines with the highest exhaust emissions;
- Promotion of production and operation of vehicles that fit modern environmental safety requirements;
- Implementation of international norms and standards of environmental safety requirements for vehicles;
- Promotion of production and use of motor fuels with improved environmental performance;
- Promotion of strategic assessment of the impact of transport complex and transport infrastructure on air;
- Introduction and implementation of new measures in the development of the transport sector and expected results.

2. Modernization and organization of new technologies of design and production of mobile equipment consider environmental safety.

2.1. Improving vehicle design, fuel efficiency, and environmental friendliness as follows:

- Improvement of the working process of internal combustion engines by optimization of supply of fuel, the formation of mixtures, combustion, using micro-processes;
- Introduction of low–toxic and economical methods of equipment adjustment;
- Development and implementation of exhaust gas neutralizers;
- Improving the strength characteristics of materials, use of substitute materials;
- Reduction of cars' weight;
- Structural reduction of aerodynamic drag of automobiles.

2.2. Development of vehicles equipped with unconventional engines: electric vehicles, hybrid systems, hydrogen engines.

3. Use of motor fuel with improved environmental performance.

3.1. Improving the environmental performance of fuel:

- Reduction of sulfur, benzene, and aromatic hydrocarbons in gasoline and diesel fuel;
- Increase of the cetane number of diesel fuel;
- Absence of metal-containing additives in gasoline and diesel fuel.

3.2. Partial replacement of petrol and diesel with non–petroleum energy sources.

4. Improving fuel economy and environmental safety of vehicles during operation.

4.1. Increase in vehicle productivity:

- Increase of vehicle utilization factor;
- Increase of vehicle mileage utilization;
- Optimization of transportation process planning and organization;
- Use of the specialized rolling stock corresponding to the transportation of different cargo types.

4.2 Improvement of road conditions, design parameters of roads, their technical condition.

4.3. Creation of optimal density of the road network, ensuring organization of transportation along rational routes.

4.4. Improving traffic management:

- Application of modern schemes, means, and technologies of organization of traffic;
- Introduction of the automated systems of monitoring and management of traffic flows;
- Increase of road capacity;
- Increase of the speed of vehicles;
- Reduction of traffic unevenness;

– Transport zoning of urban areas, use of the system of administrative and economic mechanisms to limit the use of personal vehicles in the busiest zones;

– Development of the car rental system, including parking spaces and electric car rental.

4.5. Implementation of efficient transport systems, improvement of transport infrastructure:

- Development of multimodal transport, ensuring the interaction of different modes of transport;
- Optimizing of the structure of urban buildings in order to reduce the transport needs of the population;
- Integrated consideration of transport factors in the development of architectural and planning solutions;

- Development of long-term urban and transport planning, taking into account projected traffic flows within settlements, as well as traffic, flows on non-urban roads adjacent to these settlements;
 - Use for Transportation of goods and passengers of vehicles which are characterized by lower specific emissions of pollutants and energy consumption;
 - Rationalization of transportation process using creation and functioning of the transport and logistic centers;
 - Complex accounting of ecological, territorial and spatial, economic and social aspects when planning transport infrastructure;
 - Organization of the safety bicycle movement, creation of conditions for parking of bicycles;
 - Organization in settlements with a population over 100 thousand people of pedestrian zones, the systems of parking off the road transport;
 - Organization of the intercepting parking on entries into settlements;
 - Construction of multi-level interchanges on highways;
 - Organization of pedestrian crossings under (over) the road;
 - Comprehensive, advanced development of public passenger transport systems as an alternative to the growth of the number of personal cars;
 - Modernization of passenger transport infrastructure;
 - Development of high-speed and off-street passenger transport systems;
 - Development of small aviation, including air taxi;
 - Development of a system of container rail freight;
 - Phased transition of public and communal transport to more environmentally friendly modes of transport;
 - Transfer to the use of biogas buses in settlements with more than 100 thousand people.
- 4.6. Technical modernization and updating of rolling stock: motor vehicles, traction, and motorcar rolling stock, aircraft.
- 4.7. Improvement of vehicle maintenance and repair system, introducing increased environmental requirements for public transport.
- 4.8. Introduction of modern, effective means and methods of diagnosing the technical condition of vehicles.
- 4.9. Improvement of professional skills of persons driving vehicles, their qualifications;
- Determining the quality and style of driving the vehicle, applying analytical control techniques that affect the efficiency of fuel use and emission of pollutants.

References

- Albalade, D. & Bel, G. (2010). Tourism and urban public transport: Holding demand pressure under supply constraints, *Tourism Management*, 31, 425–433.
- Banister, D. & Hall, P. (1981). *Transport and public policy planning*. London: Mansell.
- British Medical Association (2009). *Transport and Health: A briefing note from the BMA Board of Science*. London: British Medical Association.
- Cass, N., Shove, E. & Urry, J. (2005). Social exclusion, mobility and access. *Sociological Review*, (2005), pp. 539–555.
- Church, A., Frost, M. & Sullivan, K. (2000). Transport and social Exclusion in London, *Transport Policy*, 7, 195–205.
- Currie, G. & Delbosc, A. (2010). Modelling the social and psychological impacts of transport disadvantage, *Transportation*, 18, 31–41
- Farber, S. & Páez, A. (2009). My car, my friends, and me: a preliminary analysis of automobility and social activity participation, *Journal of Transport Geography*, 17 (3), 216–25.
- Fyhri, A. & Aasvang, G.M. (2010). Noise, sleep and poor health: Modelling the relationship between road traffic noise and cardiovascular problems. *Science of the Total Environment*, 408 (21), 4935–4942.
- Geurs, K., van Wee, B., & Rietveld, P. (2006). Accessibility appraisal of integrated land-use-transport strategies: Methodology and case study for the Netherlands Randstad area, *Environment and Planning B: Planning and Design*, 33(5), 639–660.
- Kropyvnytskyi, V.S., Maistro, S.V., Shvedun, V.O. & Stankevych, S.V. (2020). Prognosis of emergencies and their impact on population and territory of Ukraine, *Ukrainian Journal of Ecology*, 10(4), 218–224
- Laird, J., Geurs, K. & Nash, C. (2009). Option and non-use values and rail project appraisal, *Transport Policy*, 16, 173–182.
- Lucas, K., Grosvenor, T. & Simpson, R. (2001). *Transport, the Environment and Social Exclusion* York: Joseph Rowntree Foundation York Publishing Ltd.
- Mingardo, G. (2008). Cities and innovative urban transport policies, *Innovation: Management, Policy & Practice*, 10, 269–281
- Rajé, F., (2004). *Transport Demand Management and Social Inclusion: The Need for Ethnic Perspectives* Aldershot: Ashgate.
- Ruban, O. (2018). The conceptual bases of state regulation of the national security, *Authority and Society (History, Theory, Practice)*, 4(48), 166–167.
- Ruban A. & Shvedun, V. (2019). Research of state regulation indicators of national security condition of Ukraine, *Authority and Society (History, Theory, Practice)*, 1(49), 135–143.
- Schade, W. (2003). Transport noise: A challenge for sustainable mobility. *International Social Science Journal*, 55(176), 279–294.
- State Statistics Service of Ukraine. Available from: <http://www.ukrstat.gov.ua>
- Wright, C. & Curtis, B. (2002). Aesthetics and the urban road environment. *Proceedings of the Institution of Civil Engineers: Municipal Engineer*, 151(2), 145–150.

Citation:

Krykhtina, Yu.O., Dombrovska, S.M., Maistro, S.V., Stankevych, S.V. (2021). Review of public policy for reducing the transport environmental impact. *Ukrainian Journal of Ecology*, 11(2), Ecological Risk Assessment.



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