

THE ENVIRONMENTAL IMPACT OF TRANSPORTATION: AIR, RAIL, ROAD, AND WATER

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Keywords: transport, pollution, noise, rail, air, water

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1. Introduction

Our lives have become more and more dependent on transport and the growth of the world's economy is closely linked to the growth of freight transport. Transportation has been a fundamental element of modern society. Transportation systems offer great benefits like accessibility and mobility, but they also cause a very serious problem with regard to the growing impact on the environment. The most important environmental damage caused by transportation systems is pollution. Investigation shows there are more than 100 chemicals in emissions produced by the transport sector and they represent a large share of total human-made emissions. These chemicals make an important contribution to acidity, enhancement of the greenhouse effect and smog. Transport noise is another important environmental problem. Noise can reduce working efficiency and be a health hazard for both human beings and animals. Besides pollution and noise, other traffic-related environmental problems include the construction of transport facilities, which destroy natural and semi-natural habitats and threaten the very survival of many species of wild flora and fauna.

Generally, transport can be classified into four forms: road, rail, water and air, and different forms of transport result in different kinds of environmental problems. With the development of the worldwide economy, rapid growth of the transport system can be expected. It is therefore important to study these threats to the environment as completely as possible. In this chapter we will discuss the environmental impacts of

different forms of transport, in order to seek solutions for an efficient, less polluting and less disturbing transport system.

2. Road Transport

Road transport makes the most significant contribution to environmental damage: air pollution and traffic noise having the greatest impact. Other types of negative effects are accidents, congestion, waste products, physical inconvenience, bad smells, and soil and water pollution from spilled fuels and oil. Road construction can lead to decrease in size and fragmentation of natural habitats, threatening the very existence of many species of flora and fauna. Here we will concentrate on air pollution and traffic noise.

2.1. Road Transport and Air Pollution

Air pollution due to transport can cause danger to the environment and risks to public health. Investigation shows that the lead content of blood in traffic policemen is much higher than that of the average person, and its level coincides with the policemen's length of service. A similar condition occurs in dust and surface soil adjacent to highways, especially on the downwind side of busy roads due to petrol-engines in motor vehicles using leaded fuel. The main pollutants emitted from transport activities are hydrocarbons, Pb, CO, particulates, SO₂, NO_x, and CO₂. Table 1 shows the contribution of traffic-related emissions to total emissions.

	HC	Particulates	SO ₂	NO _x	CO
Contribution of transport to total pollution (EC, 1980 approximation)	27	14	3	49	79
Contribution of transport to total pollution (The Federal Republic of Germany, 1987)	53	30	-	62	75
Contribution of freight transport to total pollution by road transport (Netherlands, 1986)	24	63	69	43	13

Source: Federal Environmental office 1990(revised) (7), OECD and Central Bureau of Statistics CBS (Netherlands) (1).

Table 1. Air pollution from the transport sector

The share of traffic to total emissions is considerable. In the European Commission and the Federal Republic of Germany the major components of total emissions are carbon monoxide (CO), followed by nitrogen oxides NO_x, hydrocarbons, particulates and SO₂. Table 1 also shows that particulates and SO₂ are the major components of pollution by freight transport in the Netherlands, with emissions of CO, lead, hydrocarbons and NO_x being modest. Investigation shows high concentrations of these air pollutants are found mainly in urban areas, near busy motorways and inside motor vehicles. Table 2 shows the emissions from different forms of transport.

	Emissions in grams per ton km					
	CO ₂	CO	HC	NO _x	Aer	SO ₂
Road transport	211	0.90	0.68	2.97	0.39	0.20
Inland waterway	33	0.11	0.05	0.26	0.02	0.04
Railway	102	0.02	0.01	1.01	0.01	0.07

Source: CBS (revised)

Table 2. Emissions per tonne km of different forms, 1985

It is obvious that the emissions per tonne kilometer of road transport are much higher than other transport forms. All of these emissions are threatening to human health and the environment. For example, hydrocarbons can cause cancer as well as other diseases. Lead (Pb) can damage organs such as the liver, and may affect the nervous system. Carbon monoxide (CO) interferes with absorption of oxygen by red blood cells and may affect the nervous system. Particulates and fibers are toxic and have an unfavorable effect on infant mortality. Sulfur dioxide (SO₂) and NO_x (nitrogen oxides) lead to respiratory system disease and are contributors to smog and acid rain. In warm sunny weather, solar radiation acts on nitrogen oxides and volatile hydrocarbons to produce ozone, which leads to an increased health risk in some people, such as those with respiratory disorders and those engaged in heavy physical exertion outdoors. During a winter smog-period, excessive concentrations of sulfur dioxide and black smoke have serious effects on health. Unlike the summer smog situation, where the largest risk group consists of mostly healthy persons doing heavy physical exercise outdoors, the group at risk during winter smog comprises persons who are especially susceptible to the acid winter smog mixture and stay mainly indoors. These include cardiac patients, persons with chronic lung disease and elderly people in very poor physical condition. Winter smog can result in hospitalization and even increase the risk of death. A study carried by the National Institute of Public Health and Environment Protection in the Netherlands (RIVM) has shown that measures designed to curb traffic on very busy streets during these periods may reduce the health risk by approximately 30%.

Furthermore, carbon dioxide emitted by combustion engines is not as toxic as SO₂, but it can exacerbate climate warming. When the atmospheric concentrations of trace gases, which include CO₂, increase, less heat radiating from the surface of the earth can escape into space; the result of this is a warming of the lower layers of the atmosphere, causing the climate to change and the sea level to rise. It is estimated that CO₂ is responsible for half of the anthropogenic enhancement of the greenhouse effect. Traffic accounts for about 20% of the CO₂ emission in the Netherlands.

2.2. Road Transport and Noise

Noise may be defined as the effects on human beings of exposure to (unwanted) levels of sound. It affects almost all kinds of human behavior, such as disturbance of living, sleeping, working and recreational activities. In opinion polls held in 1989 the population had no doubt that traffic noise is the dominant source of nuisance: close to 70% of the West German population feel that traffic noise in the streets is a nuisance, and 24% even call it a grave nuisance. Compared to other transportation noises, people

are most disturbed by road traffic. According to a study in Germany, the main “annoying” source of noise is road traffic, followed by aircraft.

Table 3 shows the exposure to high noise levels (65dBA) of road transport for some countries. In Japan, for instance, 31% of the population are exposed to high noise levels between 06.00 and 22.00. Thirty percent of the Greek population are exposed to high noise levels day and night.

Average between 6 and 22h								
Country	Netherlands	Belgium	France	Germany	United Kingdom	Spain	Switzerland	Japan
%	6	12	13	8	11	23	11	31
Average 24 h								
Country	Denmark	Norway	Sweden	Greece	United States			
%	12	5	11	20	7			

Source: OECD (see Ref. 1).

Table 3. National population exposure to high road transport noise, selected countries, early 1980s

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Biographical Sketch

Huang Mei was born in March 1968 at the city of Guiyang, P. R. China. She received her bachelor's degree from Nanjing Institute of Meteorology in 1988, with a major in synoptic meteorology. After graduation, Huang Mei was employed as an assistant to the chief engineer of Guizhou Meteorological Bureau from 1988 to 1993. In 1996, she earned her Master's degree from the Institute of Geography, Chinese Academy of Sciences, with a major in Climatology. She is currently employed as an assistant to the professor of the Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, where she is now a Ph.D. candidate. Huang Mei's research field specialty is the study of climatic change.