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URBAN TRANSPORT ECOLOGY FACTORS, ECOLOGICAL PROJECTS, AND THEIR IMPACTS ON THE ECOLOGICAL SITUATION IN LATVIA

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Transport and industry are among the most important factors influencing the contemporary ecological situation. The analysis of this influence is impossible without monitoring the conditions of change in the environment. In different countries, measures of ecological regulation have been undertaken. These require significant expenditure. One of the most interesting projects concerning ecological regulation and the comparative analysis of ecological risk is 'The Californian project'. In this project, proposals on the economic criteria for evaluating the measures of risk reduction have been developed.
Attention is drawn to different programs used to monitor the ecological situation in Latvia. In the research the analysis of 10-12 years of statistical data is carried out. Data analysis suggests a tendency towards an improvement in the ecological situation. In Latvia, the mechanisms for financing ecological programs, which are aimed at decreasing the levels of harmful pollution in the atmosphere, are based on the experience of the USA and European countries. This research evaluates the relationship between the financing of ecological programs and the ecological situation in Latvia.

Keywords: ecology, environment pollution, ecological laws, ecological statistics for Latvia, analysis of statistics

The research of Academician Vernadsky has shown that life on Earth is concentrated in a thin layer of biosphere within which all components are connected into a single global system. A leading thinker at the end of the 19th century wrote: “Let's not flatter ourselves too much with our victories over nature. It revenges every victory.” Mankind has had to find a way out different ecological situations at different stages of development. For example, extermination of many species of mammals as a result of hunting more than 25 thousand years ago made people turn to farming and cattle breeding. Nowadays the essential factors of influence on the ecological situation are transport and industry.

1. The Influence of Transport and Industry

The negative consequences of transport and industry development (use of resources, up to their exhaustion) can be considered in the three aspects [1, 2, 3] shown in Table 1.

Table 1.

Consumed resources	Ecological factors	Social factors
Energy. Material. Land. Water. Air.	Construction of new projects: pollution of land, water, atmosphere, changes to the existing ecosystem, destruction of natural habitats, reduction in living space, threats to biodiversity. Transport streams: noise and vibration, exhaust fumes, expense, road accidents	Death, serious injury and poisoning of people and other living organisms. Increased levels of stress experienced by road users Occupational illnesses of drivers. Increased taxation and expenditure related to transport, including effects on the family budget. Hypodynamia.

According to the United Nations, transport and industry produce approximately equal amounts of environmental pollution. The percentage produced by transport is presented in Table 2 [3].

Table 2.

Factors	Transport percentage, %
Consumption of natural resources	20-32
Pollution of atmosphere	50
Water pollution	5
Use of land	30
Noise	60-80
Accidental deaths	46

91.3% of this air pollution results from road transport activities, 3.7 % from railways, 2.7 % from maritime transport, 0.9 % from river transport and 1.4 % from air transport. According to USA data, road transport produces 60.6 % of air pollution, industryproduces16.2 %, heating produces5.6 %, waste incineration produces 3.5 %, power stations produce 14.1 %.

The impact of CO on the human organism is shown in Figure 1.

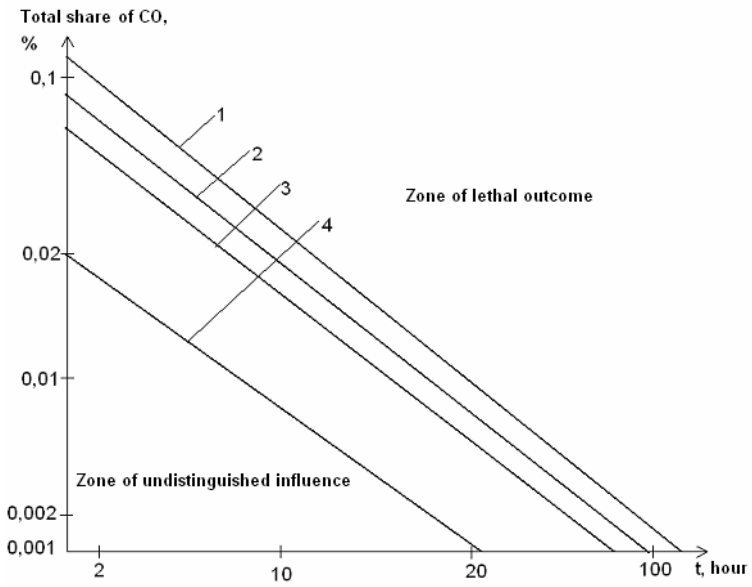

Figure 1. CO Impact on a human organism:
1 – deadly danger; 2 – headache, nausea; 3 – the beginning of toxic effects; 4 – noticeable effect.

It is noticed that the careful regulation of traffic, for example in tunnels, leads to a decrease in levels of CO (as overtaking is often forbidden and speeds are lowered). The concentration of CO in pedestrian tunnels, as a rule, is several times less than in adjoining streets (this difference is greater when a tunnel is well-ventilated). On a 900 km journey a car uses as much oxygen as a person does in a year.

Many hazardous substances connected with transport activities can dissipate into the atmosphere. For example, nitrogen oxide is transferred over 10 km in 1 hour, and carbon dioxide can travel over 100 km in 48 hours. The effects of lead, iron, copper, zinc can be seen on plants. Growth is slowed down, and leaves develop yellowness and can die off.

Noise has been called an invisible poison. It leads to emotional disorders, gastric diseases, loss of hearing and other illnesses. Transport produces 45 % of city noise, aircraft produce up to 2 %, industry produces up to 30 %.

Electromagnetic radiation is produced by various devices and equipment that may be installed in a road vehicle. At the present time electromagnetic radiation is not regulated. The electrostatic potential of a body and the intensity of an electromagnetic field in a vehicle should be subject to regulation.

The manufacture of vehicles requires large quantities of materials, which leads to a large consumption of natural resources. It is necessary to implement energy-saving technologies and technologies which do not produce waste, and also secondary raw materials processing technologies. It is very important to monitor how the environment changes. All of this requires expenditure.

2. Ecological Risk and 'The Californian Project'

Expenditure on environmental protection is significant. For example, in the USA the passing of basic ecological legislation at federal level has put into place the basis of a rigorous system of regulation. No state is permitted to pass any legislation which is less rigid than the federal measures [4]. The Environment Protection Agency (EPA) is responsible for implementing environmental legislation. In the USA there is an assumption that if businesses are better informed about ecological regulation measures, the costs they will incur in realizing the main objectives of ecological policy will be lower. A local general plan of nature use usually serves as the basis for managing the ecological conditions in regions (municipalities). The financing of ecological programs through special taxes has become widespread over recent years. Some states have undertaken more detailed projects to produce comparative analyses of ecological risk. The largest project is known as the Californian [4].

The Californian project was an attempt to answer some questions of national value. One key issue concerned disagreement over the policies of the EPA regarding the use of risk estimations in determining regulation priorities. The opinion was expressed that the risk estimation itself should not dominate the decision-making process. Attention focusing on quantitative aspects of risk does not give sufficient information on qualitative aspects, which can be very important. For example, questions concerning whether the risk is voluntary is or not, whether it is distributed uniformly or if it mostly concerns certain groups of the population cannot be described within quantitative parameters. Moreover, risk estimation is not an 'exact science' in the strict sense, as it inevitably includes some assumptions and expert estimations. In addition there is a high degree of uncertainty in risk assessment and it is considered that comparative analysis of risk often ignores social values and the role of society.

Due to discussions at a national level, the Californian project paid particular attention to these questions. For example, equality was one of the criteria that were used for ranging. Questions of 'flashpoints'; places where the most vulnerable groups in the population were exposed to the greatest risk, were considered. The critical analysis of risk estimation models included the analysis of factors which influence or should influence the extent of risk and decision-making on environmental issues.

Special attention in the project has been paid to the questions of the participation of the community in decision making. One of the most efficient methods to ensure this occurs is to assign adequate technical assistance to the inhabitants at the local level. For example, the EPA provides grants so that the local residents would have the means to hire a consultant or to conduct a study. Many states follow this policy. Grants are assigned also to assist the conduct of negotiations concerning the solution of conflict situations.

One of the most important aspects of the Californian project is the development of proposals which concern taking economic factors into account when seeking solutions to ecological problems. Practically for the first time in this type of project there are not only carefully formulated parameters, but also attempts to put the ideas into practice. From the point of view of economic analysis, the ideal selection is making the kind of decision which ensures the greatest risk reduction under a given level of expenditure. Within the framework of the project, four economic criteria for evaluating the measures of risk reduction have been developed: 1) the economic effectiveness (it assumes that the expenditure must bring the greatest benefit); 2) the distribution of expenditure and benefits; 3) the uncertainty (results depend not only on decisions taken concerning the environment, but also on many other variable factors); 4) factors of time (in terms of risk reduction this means deciding to take immediate action, or waiting until the necessary information has been acquired.

The elements of the Californian project can be used for the solution of the problems of ecology in the field of transportation and the analysis of ecological statistics.

3. Data analysis relating to hazardous pollution in Latvia

In Latvia, taking into consideration measures in the EU countries and the USA, steps have been taken to improve the ecological situation nationally, in regions and in cities.

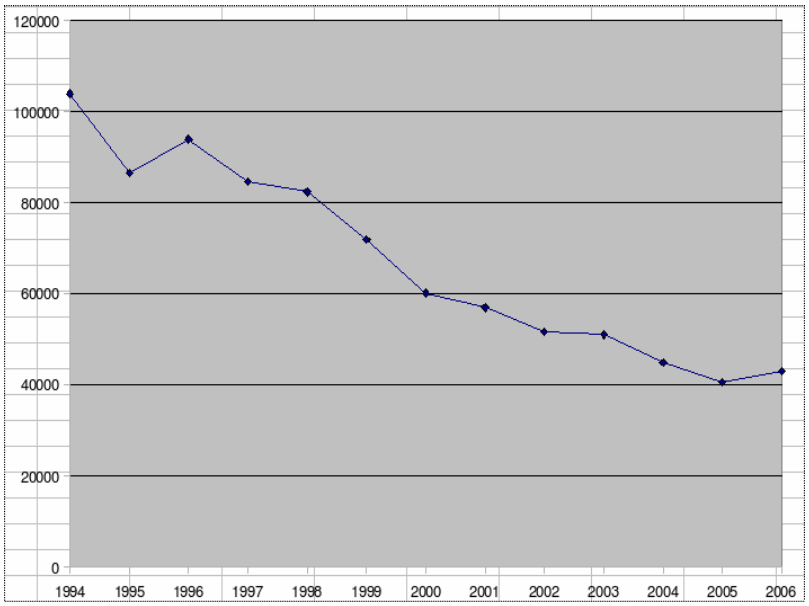

Figure 2. Level of hazardous pollution in tonnes by year

The realization of measures concerning environment protection, ecological regulation and the performance of corresponding programs demands considerable material inputs. In the article, a large volume of data received from the Statistical Bureau of the Republic of Latvia has been analysed [5]. These data contain information on the financing of programs and the volumes of different kinds of pollution.

In order to understand the relationship between the financing of ecological programs and the ecological situation in Latvia, a correlation analysis is used in the study [6].

In Latvia different programs concerning the ecological situation have been developed. Statistical data are accumulated and published annually [3-14]. As a result of the variety of measures taken in the last 10-12 years, the ecological situation has gradually improved. This trend is shown in Figure 2. It displays the volume of hazardous pollution in the atmosphere between 1994 and 2006.

Table 3 displays statistical data concerning the levels of different hazardous pollutants in tonnes between 1994 and 2006.

Table 3. (In tonnes)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
NOx	10281,1	7913,2	8654,3	9513,5	9288,7	8203,8	8314,7	8808,8	9273,2	10285,2	8920,9	9743,2	10561,1
SO2	51598,6	38074,7	44930	33821	31735,9	23352,2	12038,1	8866,6	7773,1	5886,8	4534	3214,2	2078,7
CO	24723,9	23425,2	23768,4	23950,9	25375,3	25290	24897,8	24902,7	21609,6	22633,5	18766,9	15176,5	16608,6
GOS	1771,5	1689,1	1750,1	2136,7	2490	3607,8	3929,2	4263,6	4607,3	4516	4496,3	5101,3	4202,5
other	13178,9	12465,4	11829,8	12320,7	11123	9999,2	9500,2	8553,8	4343,4	4140,9	6263	5481	5951,5
misc.	2289,9	2866,8	2856	2757,9	2279,2	1330,3	1220,8	1487,6	3932,5	3466,3	1785,4	1781	3517,2
Total	103849,9	86434,4	93788,6	84600,7	82292,1	71783,3	60000,8	56883,1	51539,1	50928,7	44766,5	40497,2	42919,6

Figure 3 displays the reduction in levels of different hazardous pollutants (in tonnes) by year. The displayed levels of the different pollutants show a downward trend, although this is not the case with NO_2.

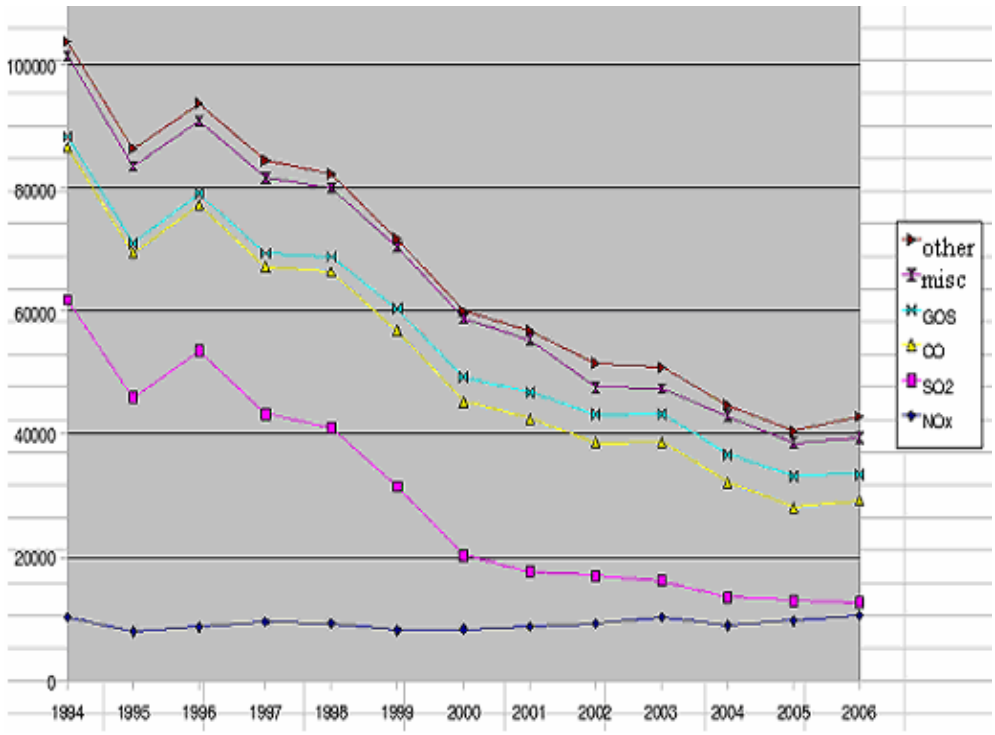

Figure 3. Levels of different hazardous pollutants in tonnes between 1994 and 2006

Figure 4 displays the proportions of the different hazardous substances for each year between 1994 and 2006. There is a clear reduction in the level of SO_2 although the levels of NO_x, CO and GOS increase significantly over the period. There is no significant change in the levels of the other substances.

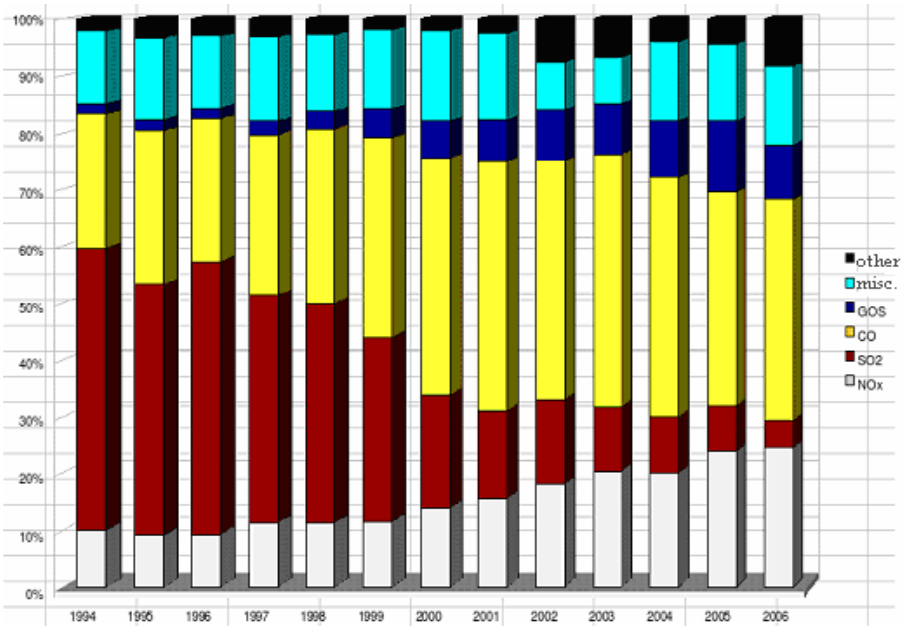

Figure 4. Levels of different pollutants expressed as a percentage of the total for each year between 1994 and 2006

Table 4 shows the level of atmospheric pollution in Riga compared with the total from other cities in Latvia (in tonnes) between 1996 and 2006.

Table 4.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Riga	15106,2	12920,7	11376,3	8900,4	9372,4	8869,9	6991,9	6843,4	5190,2	6437,1	7286
Others	78682,4	71580	70915,8	62882,9	50628,4	48013,2	44547,2	44085,3	39576,3	34060,1	35633,6
Total	93788,6	84500,7	82292,1	71783,3	60000,8	56883,1	51539,1	50928,7	44766,5	40497,2	42919,6

Figure 5 shows that the levels of hazardous pollutants in Riga comprise between 12% and 18% of the totals of these substances in Latvia these pollutions in Latvia (depending on the calendar time).

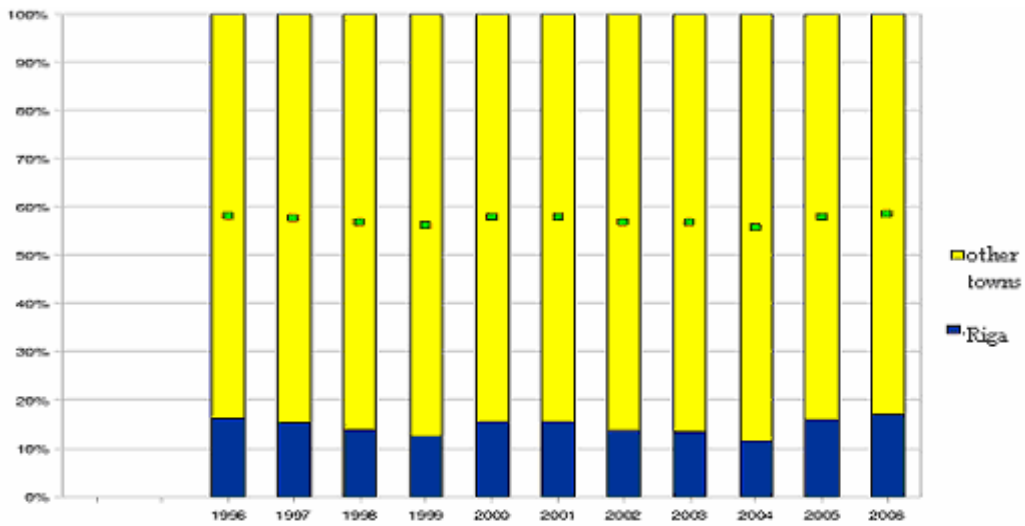

Figure 5. Pollution in the city of Riga as a proportion of the total for Latvia

Figure 6 shows the reduction in the levels of hazardous pollutants between 1996 and 2006. The proportion of these substances in Riga is smaller than 10 years ago.

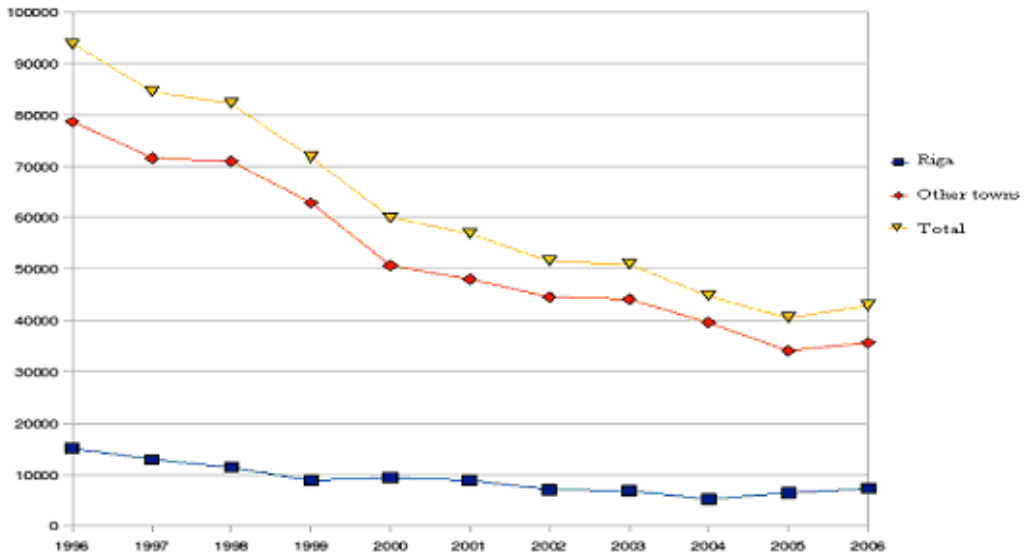

Figure 6. Volume of hazardous pollutants in Riga, other Latvian cities, and the total for Latvia between 1996 and 2006.

4. Directions in the financing of ecological programs in Latvia

Based on the experience of the USA and other European countries, there are mechanisms for financing ecological programs to reduce the levels of harmful substances in the atmosphere in Latvia. As in similar programs in other countries, the distribution of funds is directed first of all towards those cities and regions which are most exposed to the pollution. This principally applies to the city of Riga. Table 5 shows the trend in the dedicated financing of anti-pollution measures. The increase in this funding can be clearly seen.

Table 5.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Riga			368,9	350,1	298,2	188,1	117,7	239,7	1604,7	2423,2	1182,4	3090,9	5873,1
Other	1216,3	2078,6	815,2	2044,2	3518,8	1661,6	1017,8	2525,6	4190,9	3095,7	3642,6	4263	5356,1
Total	**1216,3**	**2078,6**	**1184,1**	**2394,3**	**3817**	**1849,7**	**1135,5**	**2765,3**	**5795,6**	**5518,9**	**4825**	**7353,9**	**11229,2**

If years in which there were reduced levels of finding of air pollution reduction measures are not taken into account, the overall trend shows an increase in funding. It is evident that the level of funding in Riga has increased, as it has in Latvia as a whole. (Figure 8).

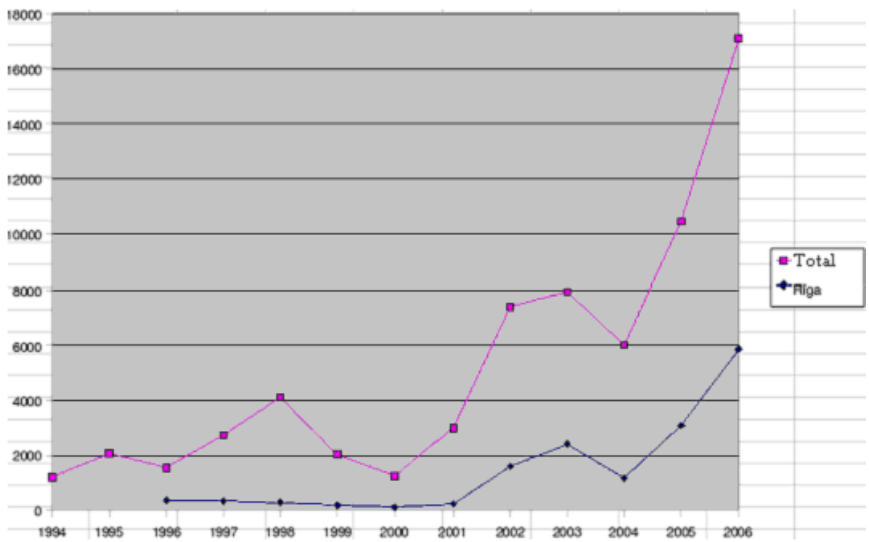

Figure 7. Financing of ecological programs between 1994 and 2006.

Figure 8 shows the share of ecological program funding spent in Riga, and the combined share spent in the other main towns in Latvia between 1994 and 2006 in

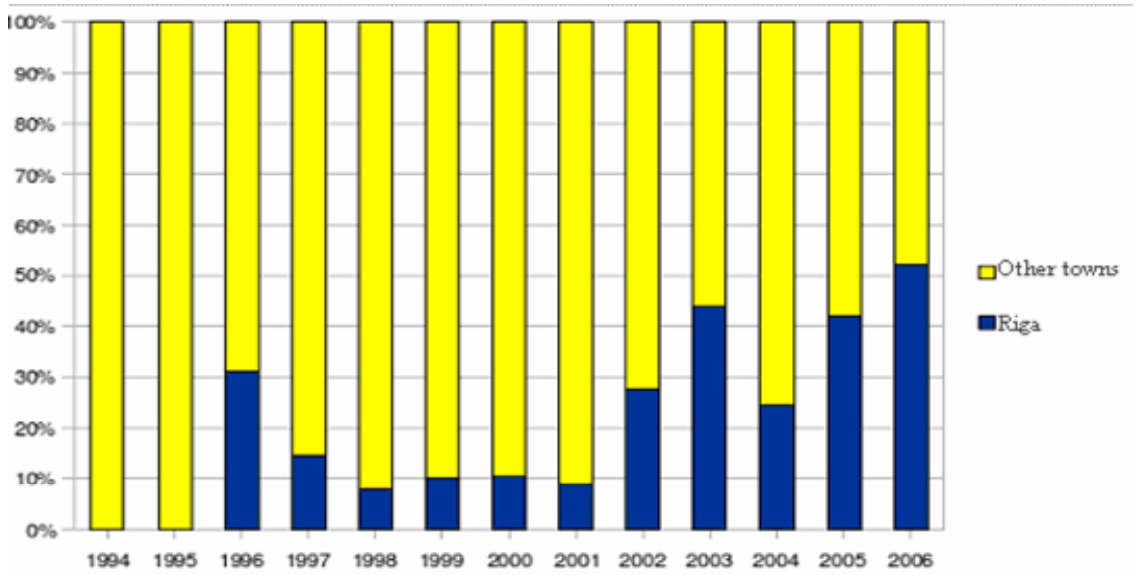

Figure 8. Share of ecological program funding in Riga and the rest of Latvia

5. Evaluation of the relationship between the financing of ecological programs and the ecological situation in Latvia

In order to evaluate the relationship between the financing of ecological programs and the ecological situation in Latvia it is expedient to use a correlation analysis. Using statistical data it is possible to calculate that the selective paired correlation coefficient, which characterizes the tightness of the relationship between values x and y is $\rho(x, y) = -0.73$. Since it is negative and close to -1, it means that there is a close inverse relationship between the ecological situation and the expenditures connected with the ecological programs. An increase in the level of funding for ecological programs tends to lead to a decrease in the levels of hazardous substances. A notable feature of the financing of ecological programs in Latvia (1994-2006) is the fact that they are targeted at decreasing the impact of stationary sources of pollution. It is not assumed that they are targeted at mobile sources of pollution such as transport.

On the basis of the regression estimators, the degree of influence of the enclosed resources (funds) on the ecological programs can be determined. For this purpose it is necessary to use an estimation of the regression equations [4]. The result of the calculations (according to all the available statistical data) is as follows:

$$\hat{y} = -0{,}008754 + 4521{,}6 \cdot x .$$

From the equation (5) it is seen that with each increase of one thousand LVL in the financing of the ecological the level of air pollution in Latvia reduces by 4521.6 tones.

Calculating the elasticity coefficient (defined under the formula $e_1 = b_1 \frac{\bar{x}}{\bar{y}}$), shows that e_1=-0.15. It shows that with a 1% increase in financing, pollution levels fall by 0, 15 %.

6. Conclusions

Transport and industry are among the most important factors which influence the contemporary ecological situation. The analysis of this influence is impossible without monitoring the conditions of change in the environment. In different countries measures of ecological regulation have being undertaken in recent years. These require significant expenditure. One of the most interesting projects

concerning ecological regulation and the comparative analysis of ecological risk is "The Californian Project". In this project proposals on the economic criteria for evaluating the measures of risk reduction have been developed.

Attention is drawn to different programs used to monitor the ecological situation in Latvia. In theses programs the analysis of 10-12 years of statistical data is carried out. Data analysis suggests a tendency towards an improvement in the ecological situation improvement. In Latvia the mechanisms for financing ecological programs, which are aimed at decreasing the levels of hazardous pollution in the atmosphere are based on the experience of the USA and European countries. This research evaluates the relationship between the financing of ecological programs and the ecological situation in Latvia.

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