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PROBLEMS OF TRANSPORT ECOLOGY AND ANALYSIS OF ECOLOGICAL STATISTICS OF LATVIA

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Researches of Academician Vernadsky showed that life on Earth is concentrated in a thin layer of biosphere wherein all components are connected into united planetary system. One of the middle and the end of 19th century thinkers wrote: "Lets 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 thousands years ago made people turn to farming and cattle breeding. Nowadays the essential factor of influence on an ecological situation is transport and industry.

1. About Transport and Industry Influence

Negative consequences of transport and industry development (consumption of resources, up to their full disappearance) can be considered in three aspects [1, 2, 3] as it is shown in Table 1.

Table 1.

Consumed resources	Ecological factor	Social factor
1	2	3
Energy. Material. Land. Water. Air.	Construction of the enterprises: Pollution of the territory, water, atmosphere, infringement of natural connections, reduction of vital space, reduction of biological productiveness. Transport streams: noise and vibration, fuel exhaust and expense, road accidents.	Death, mutilation and poisoning of people and live organisms. Intensification of stressful loadings of the participants of the traffic. Occupational diseases of drivers. Growth of taxes and expenses for transport (changes in the family budget). Hypodynamia.

According to the United Nations, transport and industry approximately equally pollute environment. The transport percentage is presented in Table 2 [3].

Table 2.

Factors	Transport percentage, %
Consumption of natural resources	20-32
Pollution of atmosphere	50
Water pollution	5
Occupation of terrene	30
Noise	60-80
Dead in a wreck	46

91.3 % of air pollutions result from automobile transport work, 3.7 % – railway, 2.7 % – sea, 0.9 % – river and 1.4 % – air. According to the USA automobile transport produces 60.6 % of air pollutions, industry – 16.2 %, heating – 5.6 %, dust burning – 3.5 %, power stations – 14.1 %. CO impact on the human organism is showed on Figure 1.

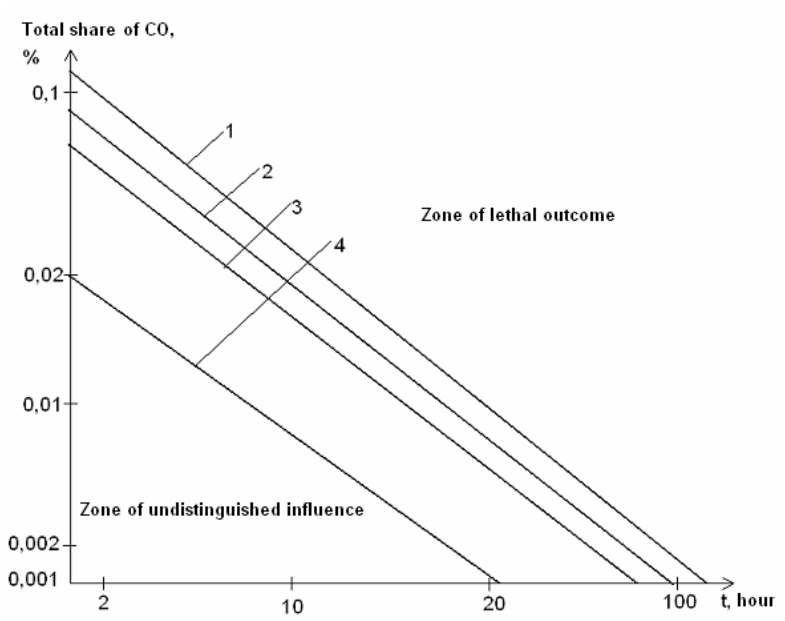

Figure 1. CO Impact on a human organism:
1 – deadly danger; 2 – a headache, a nausea; 3 – the beginning of toxic impact; 4 – distinguished influence.

It is noticed that the ordered traffic, for example, in tunnels leads to decrease of CO (overtaking there is forbidden and speed is lowered). The concentration of CO in pedestrian tunnels, as a rule, is several times less than in adjoining streets (this positive factor reinforces in the presence of a good ventilating system). On 900 km stretch a car uses as much air as a person in a year.

Many hazardous substances connected with an action of transport are able to dissipate in the air. For example, nitrogen oxide is transferred over 10 km in 1 hour, carbon dioxide – 100 km in 48 hours. Influence of lead, iron, copper, zinc also affects plants, slowing down their growth, leads to yellowness and dying off of leaves.

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

Electromagnetic radiations arise from various devices and equipment that are installed in a vehicle salon. At the present time electromagnetic radiations are not regulated. The electrostatic potential of a body and the intensity of an electromagnetic field in a vehicle salon should be under regulations.

Vehicles' manufacturing requires a large quantity of materials so it leads to a large consumption of the natural resources. It is necessary to implement energy-saving technologies and technologies without waste, and also technologies of secondary raw materials processing. It is very important to monitor the condition of the environment change. All of this requires expenses.

2. Ecological Risk and "The Californian Project"

Expenses on environment protection are significant, for example, in the USA where adoption of the basic ecological laws at federal level has put a strong base of system whereby any state cannot establish less rigid rules in comparison with national [4]. In the USA the basic volume of regulation inventing activity is carried out through Environment Protection Agency (EPA). In the USA they fairly believe that the more fully business is informed about the measures of the ecological regulation, the smaller costs it will take to realize the main objectives of the ecological policy. The local general plan of nature use usually serves as a management basis of ecological conditions in regions (municipalities). The financing of the ecological programs at the expense of the implement of special taxes has gained a wide enough development during the last years. After EPA some states have undertaken more detailed projects under the comparative analysis of ecological risk. The largest project is known as Californian [4].

In the Californian project an attempt to answer some questions which have national value was made. The matter is that EPA offers on the use of risk estimations for determination of regulation priorities have caused an ambiguous reaction. The opinion was expressed that the risk estimation itself cannot dominate in decision-making process. Attention focusing on quantitative aspects of risk does not give the sufficient information on qualitative aspects which can be very important. For example,

questions whether the risk is voluntary is or not, whether it is distributed uniformly or its major part falls at certain groups of the population cannot be described in quantitative parameters. Besides, the risk estimation is not an "exact science" in the strict sense as it inevitably includes some assumptions, expert estimations, etc., and also is connected to a big share of uncertainty. At last, it is considered that comparative analysis of risk often ignores social values and society role.

Due to national discussion the Californian project has paid particular attention to these questions. For example, among the criteria whereby ranging was made equality is included. Questions of "flashpoints" - places which are connected to the greatest risk and exposure to risk of the most vulnerable groups of population have been considered. The critical analysis of risk estimation models included the analysis of factors which influence or should influence risk ranging and decision-making on environmental issues.

Special attention in the project has been paid to the questions of the participation of community in decision making. One of the most efficient methods to ensure this is assigning an adequate technical assistance to the inhabitants at the local level. For example, EPA practices grants' assignment so that the local residents would have had means to hire a consultant or to conduct an examination. Along this way go many states. Grants are assigned also for conducting the negotiations for the purpose of the solution of conflict situations.

One of the most important sums of the Californian project is development of proposals on taking into account economic factors along with solution of ecological problems. Practically for the first time in this type of projects there are not only parameters which should be allowed formulated, but also approaches in the way it is possible to make. From the point of view of economic analysis, ideal selection is making the kind of decision which ensures the greatest risk reduction under given level of expenditures. 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 expenditures must bring the greatest benefit); 2) the distribution of expenditures and benefits; 3) the uncertainty (results depend not only on rendered decisions on environment, but also on many other variable factors); 4) factor of time (in measures of risk reduction the estimation of immediate actions or after the accumulation of the necessary information is required).

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

3. Data Analysis on the Hazardous Pollutions in Latvia

In Latvia with the account of experience of the EU countries and the USA are conducted works which are directed on improvement of an ecological situation in the country, in cities and regions.

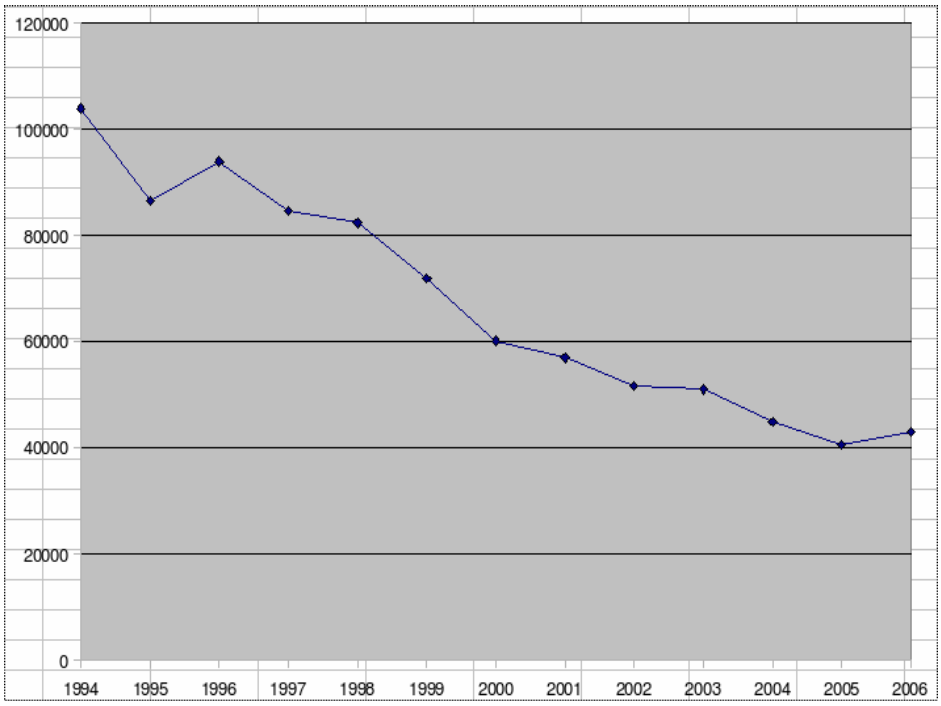

Figure 2. Dependence of hazardous pollutions in tones depending on the calendar time

Realization of measures on environment protection, ecological regulation and on performance of corresponding programs demands considerable material inputs. In the article a great volume of information received from Statistical Bureau of the Republic of Latvia has been analysed [5]. This data contains data on programs' financing and volumes of pollutions (by various kinds).

For the communication estimation between financing of ecological programs and an ecological situation in Latvia the correlation analysis is used in the study [6].

In Latvia there are different programs on ecological situation monitoring developed. Statistical data are accumulated and represented in annual books [3-14]. As a result of the complex of measures of the ecological situation improvement in the last 10-12 years, it has gradually improved. This tendency is shown in Figure 2. It displays the graphic dependence of the volume of hazardous pollutions to the atmosphere depending on the calendar time (from 1994 till 2006 year).

Table 3 displays statistical data on different hazardous pollutions' components (in tones) by years.

Table 3. (In tones)

	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	24997,8	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	103848,9	86434,4	93788,6	84500,7	82292,1	71783,3	60000,8	56883,1	51539,1	50928,7	44766,5	40497,2	42919,6

Figure 3 displays the general tendency of hazardous pollutions' reduction depending on a year in tones. The displayed dependences of the differentiated components of pollutions on the calendar time demonstrate a tendency toward their decrease, but in this case there is no tendency toward a decrease on the component NO_2.

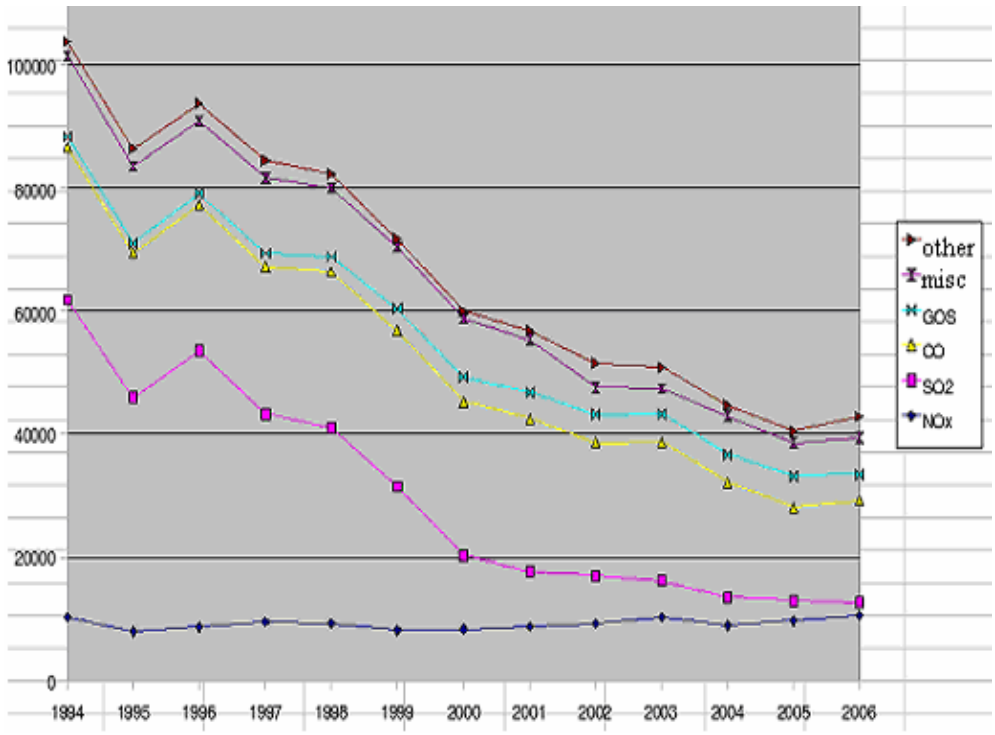

Figure 3. Dependence of different hazardous components (pollutions) in tones on the calendar time.

Figure 4 displays the shares of the distribution of hazardous substances in the specific calendar time. SO_2 apparently has a clear tendency toward a decrease, but hereby NO_x, CO and GOS shares significantly increase, but other hazardous substances' shares change insignificantly.

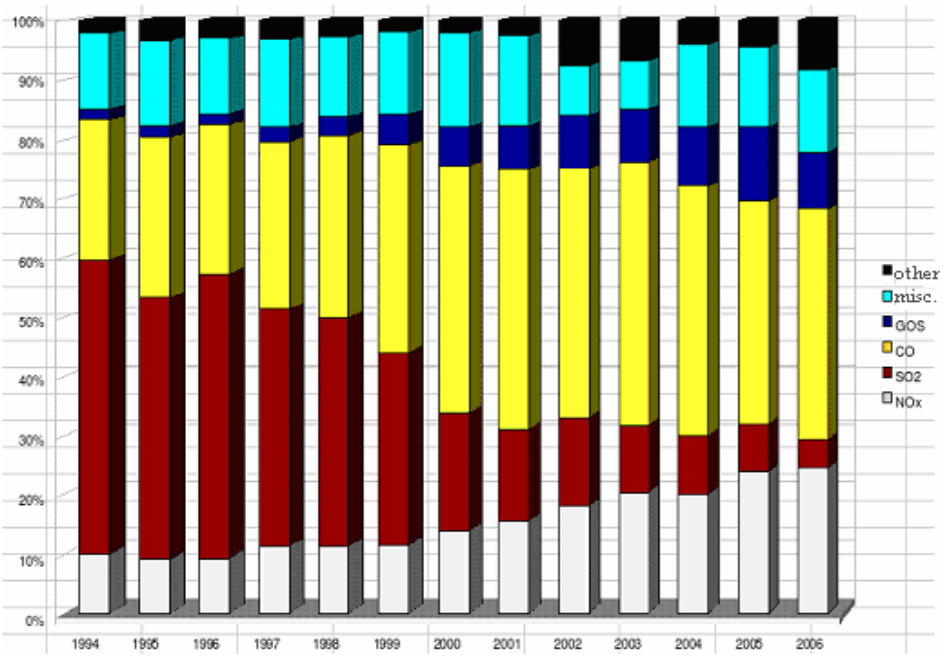

Figure 4. Pollutions components share dependence in percents on the calendar time

Table 4 characterizes the overall share of pollution in the atmosphere of the city of Riga in comparison with other cities of Latvia depending on the calendar time (1996-2006). Pollutions in the tones in Riga and summary pollutions in other cities are displayed.

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 displays that the pollutions of hazardous substances in Riga range from 12% to 18% of these pollutions in Latvia (depending on the calendar time).

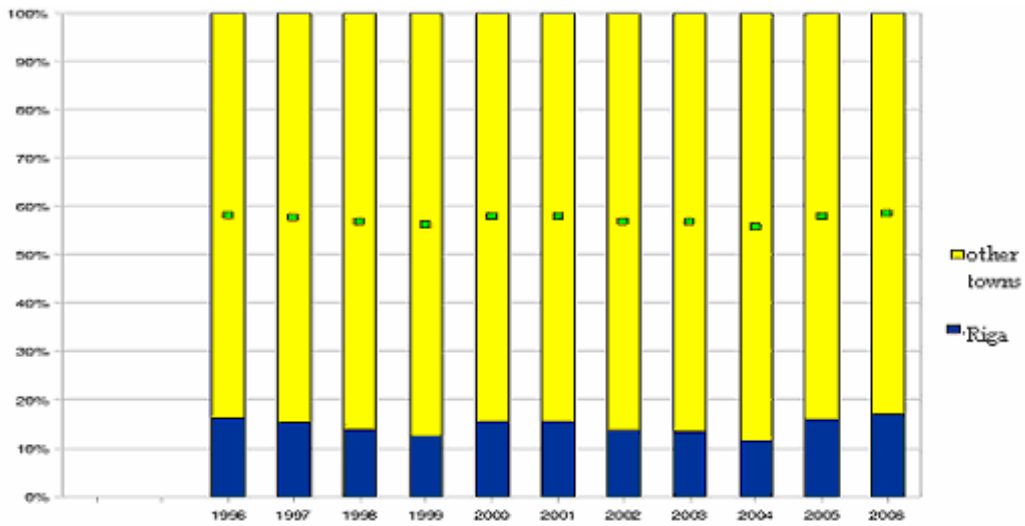

Figure 5. The city of Riga pollutions proportion in total pollutions in Latvia

Tendency toward the reduction of the total volumes of the pollutions of hazardous substances in the dependence on the calendar years is traced in Figure 6. The share of pollutions in Riga is smaller in 2006 than this share was 10 years ago.

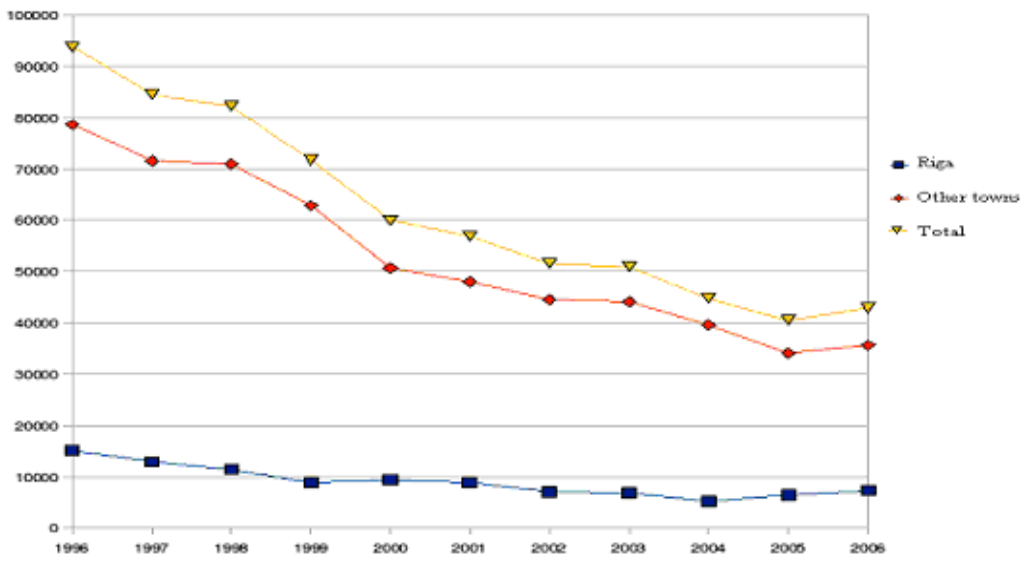

Figure 6. Dependence diagram of the total volume of pollutions with hazardous substances from the calendar years in Riga, other cities and generally in Latvia

4. Tendencies of Financing of Ecological Programs in Latvia

Being based on the experience of the USA and European countries, in Latvia there are mechanisms of financing of ecological programs for the purpose of the decrease of harmful influence on the atmosphere of Latvia. As in similar programs of other countries, the distribution of funds is directed, first of all, toward those cities and regions which are most exposed to the pollution. First of all, this is true for the city of Riga. Tendencies of purposeful financing are displayed in Table 5 of which it is evident that funds devoted to the control of air pollution in Latvia constantly increase.

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 we do not take into account some years wherein to the control of air pollution smaller funds were devoted, then an increase in the financing is characteristic. This is evident (Figure 7) not only in Latvia and in Riga, i.e., the volumes of financing have been increasing. Moreover the share of the funds devoted to the city of Riga has been increasing (Figure 8).

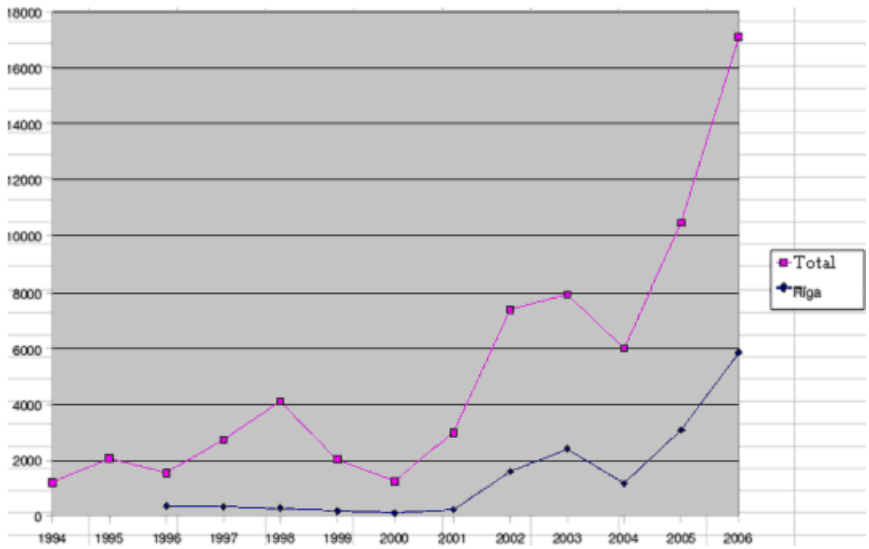

Figure 7. Financing of ecological programs depending on the calendar years.

Proportion of financing of ecological programs in Riga and summarily in other cities in the specific calendar year characterizes Figure 8.

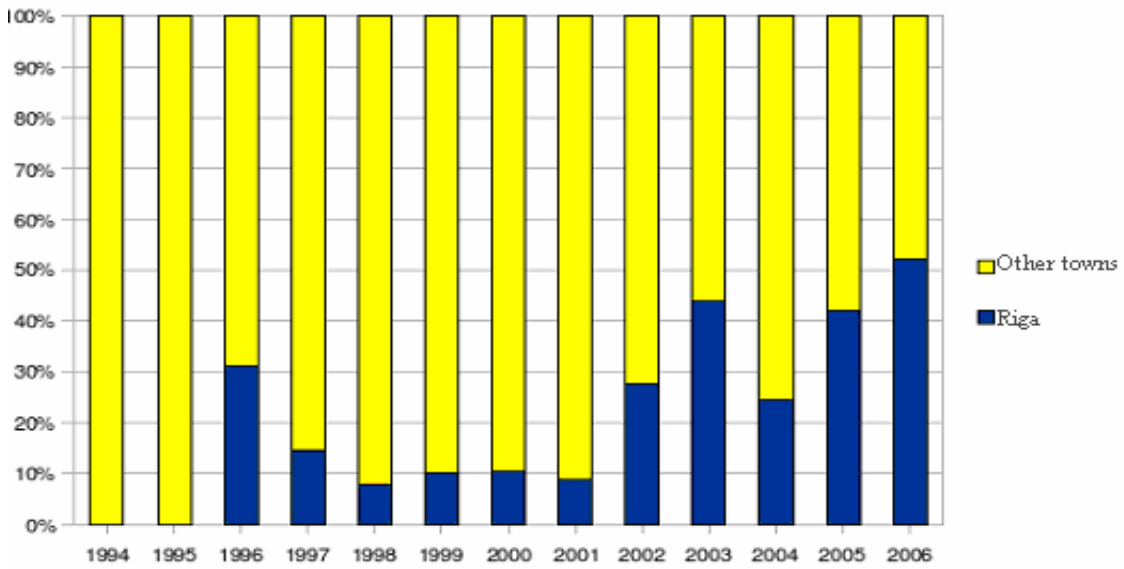

Figure 8. Financing share of ecological programs in Riga and Latvia

5. Evaluation of the Relationship between Financing of Ecological Programs and Ecological Situation in Latvia

In order to evaluate the relationship between financing of ecological programs and ecological situation in Latvia it is expedient to use a correlation analysis. Calculation with the use of data of statistics [3] makes it possible to determine 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 between the ecological situation and the expenditures connected with the ecological programs there is a close inverse relationship. Consequently, with an increase of the volumes of financing the levels of the content of hazardous substances have a steady tendency toward a decrease. The special feature of financing of ecological programs in Latvia (1994-2006) is the fact that they are devoted toward the decrease of the influence of the stationary sources of pollution, but suppression of such kind of mobile sources of pollution influence as transport there is not assumed.

On the basis of the regression estimators, the dependence 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:

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

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

Calculating the elasticity coefficient (it is defined under the formula $e_1 = b_1 \frac{\bar{x}}{\bar{y}}$), we have received that e_1 =-0.15. It shows that with the financing increase at 1 % pollution level falls by 0,15 %.

Conclusions

Transport and industry are one of the most important factors of influence on the contemporary ecological situation. The analysis of this influence is impossible without monitoring the condition of a change of the environment. In different countries measures of ecological regulation have being undertaken in recent years. They require significant expenditures. One of the most interesting projects

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

Attention is drawn to different programs on the monitoring the ecological situation in Latvia. In the research the analysis of 10-12 years period statistical data is carried out. Data analysis indicates the tendency of the ecological situation improvement. In Latvia the mechanisms of financing of the ecological programs, which are devoted toward the decrease of hazardous pollutions to the atmosphere, are created on the basis of the experience of the USA and European countries. Research gives the evaluation of the relationship between financing of ecological programs and ecological situation in Latvia.

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