

Green building as a factor of reducing technogenic risks

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Abstract. Technological risks act today as one of global challenges which the mankind faces. Growth of scales of anthropogenic and natural emergency situations involves not only a huge number of losses various, but also threatens the possibility of existence of a human situation. An exit from this situation at the global level is connected with concepts of sustainable development, inclusive development, green economy and green construction. Without opposing itself to the nature, and acting as her part, "fitting" into natural processes, the mankind gets chance of survival. Green construction acts as one of real tools of it. The interrelation of Green Construction and technological, natural risks is considered in the research. The correlation-regression and trend analysis acts as the main tool of a research. In the research the trend analysis of technogenic and natural disasters is based on the statistical database of Emercom of Russia, the correlation-regression model of numerous of housing which is putting into operation is developed, communication between characteristics of construction and level of technological risks is investigated, the interrelation between standards of Green Construction and the concept of sustainable development is considered.

1. Introduction

At present, disasters and emergencies have become an inherent characteristic of the development of modern society. Risks associated with natural fluctuations of the natural environment and climate only increase over time, and in turn are reflected in the modern world. It is worth noting that every year the scale of natural and man-made emergencies, such as a landslide, flood, abrasion, is increasing more than 15 times in the last 50 years. According to the statistics of the Ministry of Emergency Situations of Russia, the number of victims from natural and man-made disasters each year is tens of thousands of people [1].

Rapidly developing industry and technological progress are reflected in the world ecological situation. This is typical for each country, regardless of how modern and highly organized would be its industrial sphere, which is one of the components of this problem. And the second important aspect is the urbanization of the population and the gradual construction of territories for the construction of housing, residential complexes and the construction of industrial facilities [2-5].

More than 1 billion buildings in the world have a negative impact on the environment:

- Seizure of 17% of all fresh water;
- Use of 25% of all cut wood;
- 33% of all carbon dioxide emissions;
- Consumption of 40% of all materials and energy [3,6].



In conditions when the population, as well as the cost and complexity of the infrastructure are in constant growth, and the area of areas suitable for resettlement and construction is steadily decreasing, the forecast of occurrence of extreme and, the more technogenic catastrophic incidents is an extremely important task.

2. Methods

The study uses the following methods of information analysis:

At the first stage, data were collected on the number of man-caused and natural accidents in the period 2009-2016 based on the data of the Ministry of Emergencies of Russia, which are presented in the diagrams [5, 7-13].

The second stage is the analysis based on the trend model, with the purpose of determining the trend, that is, the main trends in the dynamics of indicators, as well as a summary of the data for the analyzed period.

For the third stage, a selection of factors influencing the commissioning of residential houses of the Russian Federation was carried out.

At the fourth stage, based on the results of the correlation, the factor having the greatest impact on the commissioning of residential buildings in the territory of the Russian Federation was identified.

What determines the amount of housing commissioned recently? We perform the correlation-regression analysis. We will carry out the selection of factors:

Y - Commissioning of residential buildings in the Russian Federation, millions of square meters of the total area of residential premises.

X1 - Population, mln.

X2 - Education, use, neutralization and disposal of production and consumption wastes in the Russian Federation, mln.

X3 - Costs for environmental protection in the Russian Federation, million rubles.

X4 - The number of administrative buildings, units.

We will perform the correlation check. Based on the results, we can eliminate the factor X4, as the number of administrative buildings depends on the formation, use, disposal and disposal of production and consumption waste (Table 1).

Table 1. The correlation analysis.

	X1	X2	X3	X4
X1	1			
X2	0,620072	1		
X3	0,872314	0,895213	1	
X4	0,528325	0,922757	0,861497	1

As a result of regression analysis we obtain the equation: $y = 0,00027 * X3 + 728,418$.

Thus, the amount of housing directly depends on the cost of the environment. This is directly related to the preservation or improvement of the quality of buildings and the comfort of their internal and external environment. One of the main ways to achieve this goal - the introduction of green construction [1,2,11,12,14].

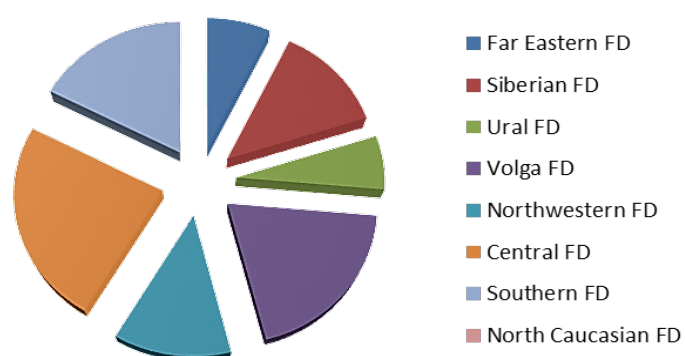
The main goal of green construction is to reduce global risks, increase the safety of the world population and preserve the environment.

Recently, the number of dangerous natural disasters and major technogenic accidents on the territory of the Russian Federation continues to grow. Let us consider the statistics of the Ministry of Emergencies of Russia for technogenic and natural emergencies in the districts (Table 2) [10,15].

Table 2. Statistics of technogenic accidents in the Federal Districts.

Technogenic situations in the districts:										
	FE FD	Siberian FD	UFD	VFD	NFD	CFD	SFD	NC FD	RF Tech. Risks	ES of all kinds
2009	19	34	17	52	33	64	46	0	265	425
2010	14	35	19	23	20	38	17	12	178	339
2011	13	27	16	28	19	36	19	27	185	292
2012	19	28	22	44	18	41	33	23	228	432
2013	14	26	10	38	13	25	28	12	166	325
2014	15	19	14	31	19	44	28	15	185	262
2015	17	29	22	30	10	26	22	14	170	257
2016	9	28	14	30	11	38	25	23	178	299
Total	120	226	134	276	143	312	218	126	1555	2631

Let's imagine the data graphically (Figure 1).

**Figure 1.** Technogenic situation in the districts.

As we can see on the diagram, the Central, Southern and Volga federal districts have one of the most negative technogenic situations. However, in recent years there has been a tendency to reduce their number (Figure 2, Table 3).

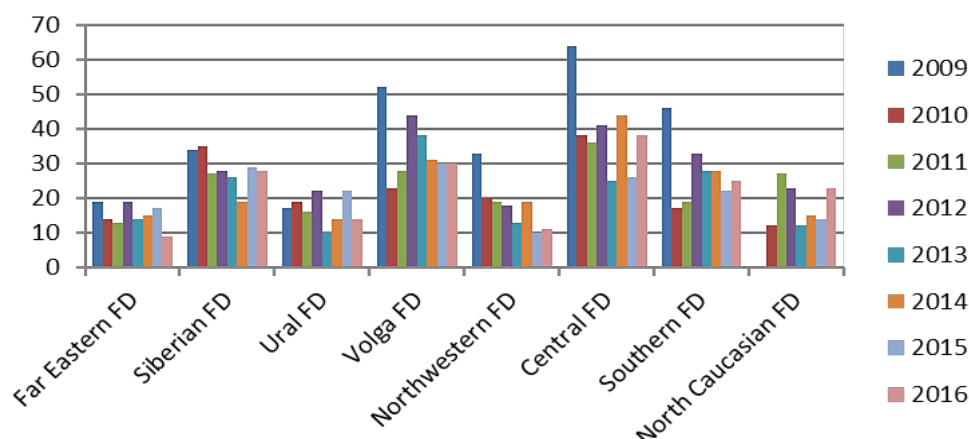
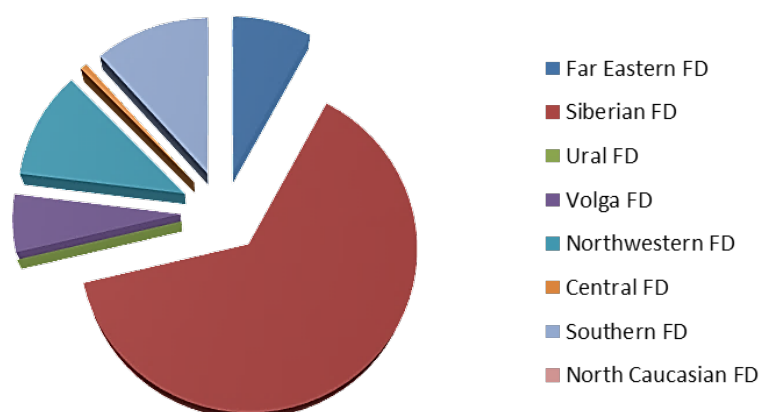
**Figure 2.** Dynamics of technogenic situations in the districts.

Table 3. Statistics of natural disasters by FD.

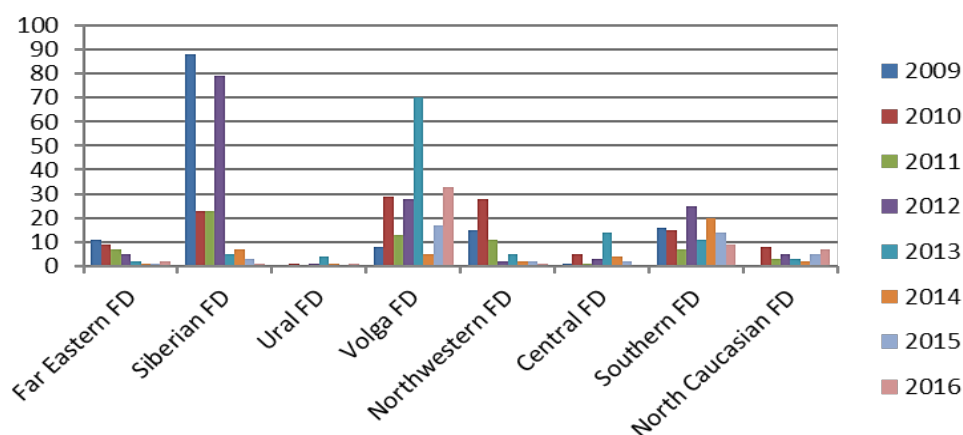
Natural emergencies:										
	FE FD	Siberian FD	UFD	VFD	NFD	CFD	SFD	NC FD	RF Tech. Risks	ES of all kinds
2009	11	88	0	8	15	1	16	0	139	425
2010	9	23	1	29	28	5	15	8	118	339
2011	7	23	0	13	11	1	7	3	65	292
2012	5	79	1	28	2	3	25	5	148	432
2013	2	5	4	70	5	14	11	3	114	325
2014	1	7	1	5	2	4	20	2	42	262
2015	1	3	0	17	2	2	14	5	44	257
2016	2	1	1	33	1	0	9	7	54	299
Total	38	229	8	203	66	30	117	33	724	2631

We will construct the diagram on the basis of available statistical data (Figure 3).

**Figure 3.** Dynamics of natural emergencies in the districts.

The largest share of natural emergencies is in the Siberian District.

As in the case of man-made emergencies, there is a tendency to reduce them (Figure 4).

**Figure 4.** Dynamics of natural situations in the districts.

3. Results

Analyzing the statistics, we can say that the Central District is most exposed to technogenic risks. For the analyzed period (from 2009 to 2016) the total indicator reaches 312 catastrophes. In the total share of emergencies for the period under review, technogenic risks amounted to 59.1%. The least number of technogenic accidents is observed in the North Caucasus and the Far Eastern Districts.

Consider the statistics of natural disasters in the Federal Districts. The greatest number of natural disasters is observed in the Siberian District, their number is 229 disasters in the period from 2009 to 2016, just worth noting and the Volga District, where the indicator reaches 203 disasters. In 2009 and 2012 in the Siberian Crane, the peak values of natural disasters, and for the year are 88 and 79. The share of natural disasters in the analyzed period is 27%. The greatest number of fluctuations in the natural environment and climate is observed in 2012 [7].

We will carry out a correlation analysis of emergency situations of anthropogenic and natural character in the Urals Federal District.

We use the following factors:

U - natural disaster;

X1 - Population, people;

X2 - Volume of investments, thousand rubles;

X3 - The total area of residential houses has been put into operation.

As a result of the correlation analysis, we obtain the following results (Table 4):

Table 4. The correlation analysis.

	X1	X2	X3
X1	1		
X2	0,636844	1	
X3	0,435805	0,90845	1

The number of residential buildings commissioned directly affects the increase in emergency situations of anthropogenic and natural character in the Urals District. We perform the elimination of factor X3. By the result of the regression analysis we obtain the following equations:

- for emergency situations of a technogenic nature:

$$Y = (-6,4E-06) * X1 + (-2,7E-10) * X2 + 95,57$$

- for a natural disaster:

$$V = 80.7 + (-6.6E-06) * X1 + (7.7E-10) * X2$$

4. Conclusions

A trend analysis in time has been shown that there is a gradual decrease in the number of emergencies. This is due to the increase in investment, the adoption of a number of measures to prevent emergencies, etc. Thus, the reduction in the probability (frequency) of emergencies, types and magnitude of the consequences of emergencies. A set of measures aimed at reducing individual and social risks, taking into account possible economic and special factors. The economic mechanism, which forms the regulatory and legal framework for financial support for activities to manage man-made and natural risks.

In the Ural Federal District there is a tendency to increase housing growth with a reduction in man-made and natural risks. This is due to the introduction of new standards of green building and the concept of sustainable development.

At present, we are studying the relationship between these factors on the example of other Federal Districts of the Russian Federation.

This analysis is necessary for the redistribution of the state budget and the application of emergency prevention measures by various federal districts of Russia.

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Acknowledgments

The work was supported by Act 211 Government of the Russian Federation, contract No. 02.A03.21.0011.