

**POLLUTION OF LANDS
IN RUSSIA**

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At present time the increasing of anthropogenic load on the ecosystem is a real fact. The control of all natural media is the aim of ecological monitoring.

Monitoring is the system of regular environmental observation that allows to receive the information about the state of environment and to give the assessment of the modern, past its state and changing in future of those environmental parameters, that are important for humanity.

The initial activity in the field of nature protection in Russia can be dated by the 30-th – 40-th years of the last century, and it was the composition of surface water and air. But ecological service was absent at that time in Russia.

The ecological service in Russia and in the world has appeared after the famous International Conferences of UNESCO in 1968 year in Paris and later in 1972 year in Stockholm.

The National State Ecological Committee in Russia was organized in 1978 year.

There is the legal base for soil ecological monitoring that provides the activity of this service.

THE LEGAL BASE FOR THE MONITORING OF LANDS IN RUSSIA

Constitution of RF: The protection of nature is a national problem in RF (1993)

The Laws of Russian Federation: «The earth code» (1991), «About Entrails of the Earth» (1992), « About the environment protection» (1992), « About the ecological expert evaluation»(1995), «About the soil melioration» (1996), «About the unified state system of prevent and liquidation of extraordinary situations » (1996), «About the especially protected natural reservations» (1996).

The International laws about Environment: « About trans boundary transfer of pollutants with air and water flowers» (since 1991)

Decisions of the Government of Russia: limits of the inputs of pollutants into air (1981), soil monitoring (1982), standardization of the pollutants throwing into to atmosphere (1981) and to environment (1992), the order of the polluted soils conservation (1992), lands cadastre (1992), the order of ecological expertise carrying out (1993), the order of the polluted soils conservation (1992), monitoring of the environment (1994), about of lands melioration, taking down, keeping and using of fertile soil layers (1994), the assessment of technogenic loads on the environment (1994), providing of the ecological safety under activities of Armed Forced of Russia (1996).

Decisions of Ecological Committee

There are some organizations in RF that control the ecological state of soils in the country: Committee of Hydrometeorology, Ministry of Agriculture, Ministry of Health, Ministry of Natural Resources.

The availability of environmental information for the organizations and for population is provided by the annual publication of “National report of the ecological state of RF”. The present report includes some materials from the these journals of the last years (2004-2008)

Table 1. THE STRUCTURE OF LAND FUND IN RUSSIA

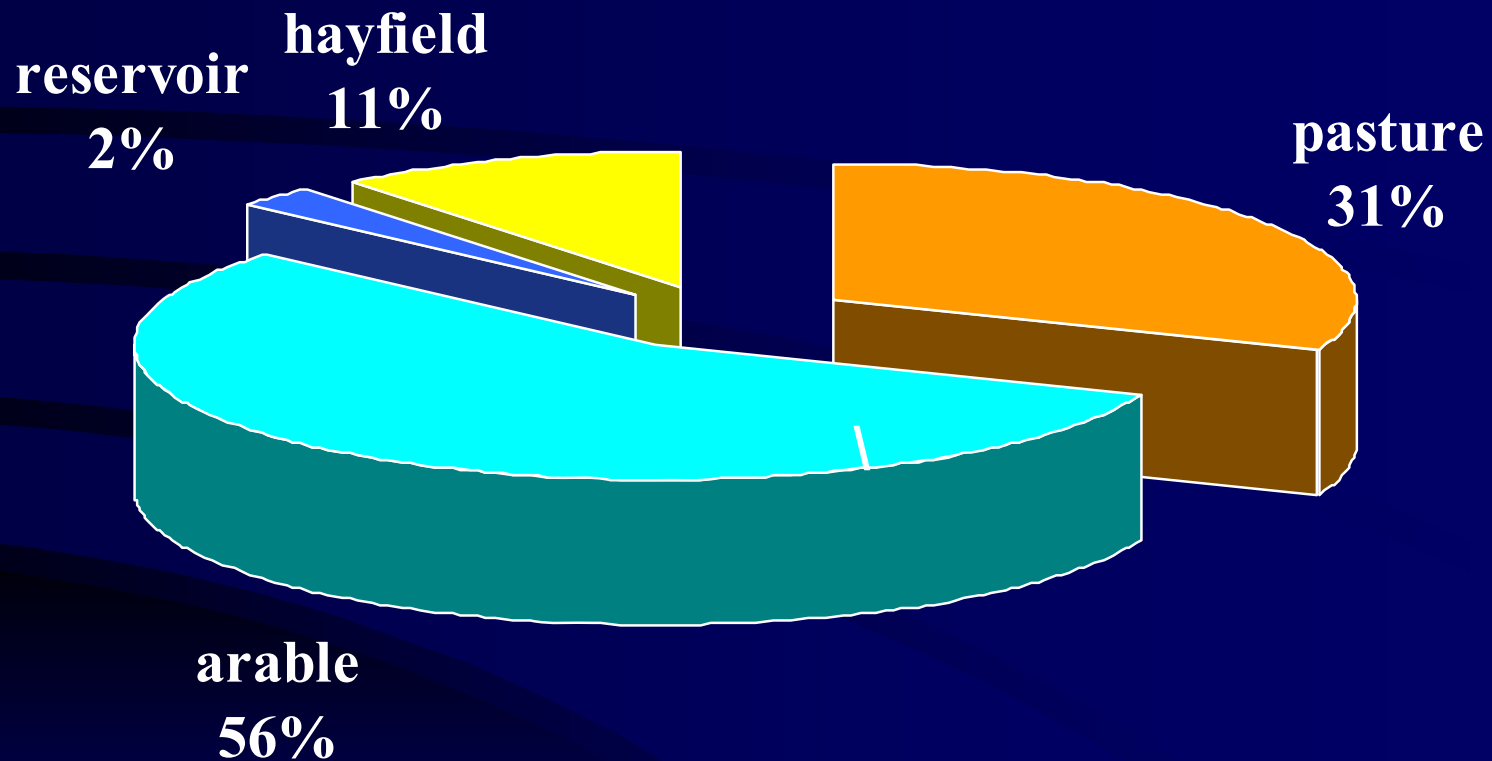
(The National report on the land state and land use in Russia, 2007).

Types of land use	Area	
	million ha	(% of total lands)
- agricultural lands	220,6	12,9
(arable lands)	121,6	7,1
- forest and bushes	784,7	64,3
- marshes	108,2	6,3
- submarine	71,8	1,6
- pasture of deer's	328,0	18,9
-population puncts	13,4	1,1
- plants	181,9	1,0
Total	1709,8	100,0

One can see that the most part of the territory in country is occupied by forests , the area of inhabited localities (near 1,1%) is small but the most part of the population is living there.

The agricultural lands are used for different purpose: the area of the arable lands consists of near half of the total area of the agricultural lands.

Using of agricultural lands in RF (% from the area of agricultural lands)



pasture arable reservoir hayfield

The soils of different types of using are under the ecological monitoring. Different types of soil degradation have been estimated in Russia. The main reasons of agricultural lands degradation are water and wind erosion, salinization, waterlogging and marshes.

Table 2. The share of the degraded lands
(% from the agricultural lands area)

Type of degradation	% from the area of agricultural lands of country
water erosion	17,8
wind erosion	8,4
salinization	20,1
waterlogging and marshes	12,3

Water and wind erosion prevail under other types of soil degradation. Nevertheless soil pollution is considered the most dangerous for humanity. It is because of following :

a) pollutants can directly influence on health and life of people;

b) soils are connected with environment by flows of substances and they are polluted at any case of environmental pollution;

c) pollutants can long or for ever keep in soils (organic pollutants are decomposed for a long time, nonorganic pollutants are not decomposed);

d) polluted soils can be the sources of secondary pollution of environment after the stopping of primary pollution.

That is why the control of land pollution in Russia is the most important direction of environment protection.

**FACTORS THAT ARE RESPONSIBLE FOR THE
ACCUMULATION OF POLLUTANTS IN SOILS**

1) TECHNOLOGICAL FACTORS-

**EMISSION OF POLLUTANTS INTO THE
ENVIRONMENT;**

**2) CLIMATIC AND PHYSICAL -GEOGRAPHICAL
FACTORS-**

**DISTRIBUTION OF POLLUTANTS IN THE
ENVIRONMENT;**

**3) PROPERTIES OF SOILS AND PROPERTIES OF
SUBSTANCES - ACCUMULATION OF POLLUTANTS IN
SOILS .**

Pollutants input into soils by different ways:

- 1) in solid state with solid wastes from different sources on the soil surface or when burring of these substances;**
- 2) from the polluted atmosphere;**
- 3) from the polluted surface water.**

**The main sources of solid wastes
production and consumption are the
following types of activity**

“Mining” (71%)

“Manufacturing” (6%)

“Trade, repair (7%)

«Operation with property 8%

The main sources of pollutants to the atmosphere are the following types of activity:

“Mining” (30%)

“Manufacturing” (34%)

“Production and distribution of electricity, gas and water” (20%)

The main sources of pollutants to the surface water are the following types of activity:

“Production and distribution of electricity, gas and water” (53%),

“Manufacturing” (19%),

“Mining” (6%),

“Agriculture, hunting, forestry” (6 %),

“Public utilities and others social service” (12%)”

38-46% of pollutants, generated every year, are regularly used and disposed in RF, the most part of them are keeping in environment.

There is the classification of chemical elements with different dangerous for the environment. It is worked out on the base their toxicity, ability for migration in landscape and accumulation in products.

**CLASSIFICATION OF CHEMICAL ELEMENTS
FOR THE CONTROL OF POLLUTION**
(State Standard 17.4.02-83. Moscow, Russia, 1983).

Categories of pollutants	Chemical elements
1. High-dangerous	As, Cd, Hg, Se, Pb, F, Zn,
2. Moderately-dangerous	B, Co, Vi, Mo, Cu, Sb, Cr
3. Little-dangerous	Ba, V, W, Mn, Sr

The list of pollutants which content in soils is under the control of the ecological monitoring:

1) Pollutants of industrial genesis:

a) V, Fe, Cd, Co, Mn, Mo, Ni, Sn, Pb, Hg, Cr, Zn (the total content, the species, that can be extracted by diluted acids);

b) fluorine,

c) sulphates, nitrates,

d) oil and oil products,

2) The additional pollutants of agricultural lands :

a) pesticides;

There is the document that is called “Methodical recommendation for revealing of the degraded and polluted lands” (1995)” that has the description of all the actions for the determination of the level of soil pollution and its assessment.

These stages include:

- 1) The revealing of the pollutants sources (plants of metallurgy, electricity, transport and so on)**
- 2) selection of soil samples in field (the procedure differ for the lands of different using: arable, industrial area, area of recreation in city and so on),**
- 3) the choosing of the pollutants which content in soils samples will be determined,**
- 4) analyzes of soil samples (determination of the total content of pollutants and their extractable species (for heavy metals).**
- 5) the assessment of the level of soil pollution on the base of their critical levels .**

The problem of critical levels of pollutants in soils is very important.

First critical levels of chemical elements for soils have appeared in Russia on 1984 years.

Now there are in Russia four types of critical levels of chemical elements in soils.

First: hygienic levels - it is such permissible levels of chemical elements in soils that provide the safety of these substances for living organisms in water, air and food (that had contacts with the soil).

These levels have been established in the model laboratory experiment according to the principle- doze- effect, taking into account not only toxicity of elements, but the relation of soils with plants, water, air. Their number now is near 2 hundreds, organic substances prevail among them. The number of nonorganic substances, including metals and nonmetals, is rather low among them.

Hygienic critical levels of chemical elements in soils

Element	Critical level	Indicators of toxicity		
		Sanitary	Translocation	Water Migration
Total content of chemical elements (mg/kg)				
Mn	1500	1500	3500	1500
V	150	150	170	350
Pb	32	32	35	260
Sb	4,5	4,5	4,5	4,5
Hg	2,1	5	2,1	10
Available species of chemical elements(mg/kg)				
F	2	-	2	-
Cu	3	3	3-5	72
Ni	4	4	4	14
Zn	23	37	93	200
Co	5	5	25	1000

Such approach to the estimating of the critical limits of chemical elements in soils is unique.

The other feature of these parameters – the presence of the critical levels for the available (mobile) species of metals and nonmetals in soils. These species are the most important for the ecosystem.

The merits of this methodology- its ecological base. The drawback of this methodology- the critical levels were worked out without taking into account the different sensitivity of soils with different properties to pollution

This situation was corrected by the working out of oriented ecological critical levels of chemicals in soils (such is the second type of critical levels of chemicals in soils).

For this purpose the soils of Russia were divided on three groups on the base of their texture and their reaction.

THE ORIENTED CRITICAL LEVELS OF NONORGANIC POLLUTANTS IN SOILS (Russia, 1994)

Groups of soils	Ni	Cu	Zn	As	Cd	Pb
a) sand and loamy sand	20	33	55	2	0,5	32
b) loamy and silt soils with acid reaction (pH KCl <5,5)	40	66	110	5	1,0	65
c) loamy and silt soils with near neutral reaction (pH KCl >5,5)	80	120	220	10	2,0	130

The third type of approaches to the determination of critical level of substances in soils of different regions- the background content of these substances in soils of these regions, that it exceeded on three standard deviation from the average level.

THE AVERAGE CONTENT OF HEAVY METALS IN THE MAIN GROUPS OF SOILS IN RUSSIA

Soils	Zn	Cd	Pb	Hg	Cu	Co	Ni	As
Soddy-podzolic sand and loamy sand soils	28	0,05	6	0.05	8	3	6	2,5
Soddy-podzolic loamy clay soils	45	0,12	15	0,10	15	10	30	4,5
Gray forest soils	60	0.20	16	0,15	18	12	35	5,5
Chernozem	68	0,24	20	0,20	25	15	45	7,0
Chestnut soils	54	0,16	16	0,15	20	12	35	6,0

CRITICAL LEVELS OF POLLUTANTS IN SOILS ACCORDING DIFFERENT INVESTIGATORS (mg/kg)

Elemen	El-Bassam, Tietien, 1977	Linzon 1978	KabataP Pendias 1979	Kloke, 1979	Kitagishi, Yamane, 1981	Russia, 1988
As	50	8	30	10	15	-
B	100	25	100	25	-	-
Cd	5	75	5	3	-	-
Co	50	10025	50	50	50	-
Cr	100	-	100	100	-	-
Cu	100		100	100	125	-
F	500	2	1000	200	-	2,1
Hg	5	0,3	5	2	-	-
Mo	10	2	10	5	-	35
Ni	100	200	100	100	100	30
Pb	100	200	100	100	400	-
Se	10	5	10	10	-	150
V	-	60	100	50	-	85
Zn	300	400	300	300	250	

**CRITICAL LEVELS OF CHEMICAL ELEMENTS,
USED IN DIFFERENT COUNTRIES
(total content, mg/kg)**

Elements	England	France	Germany	Russia
Mn	-	-	-	1500
Cr	600	150	100	-
F	-	-	200	-
V	-	-	50	150
Zn	500	300	300	-
Ni	70	50	50	-
Cu	280	100	100	-
Pb	550	100	100	32
Co	-	-	50	-
As	10	-	20	-
Cd	3,2	5	3,0	-
Hg	1,0	1,0	2,0	2,1

The fourth criteria of soil contamination is used for the soils contaminated by several chemical elements (Z). It reflects the combined effect of these elements (n). Such situation is rather distributed. It is the relative parameter and it is calculated as the sum of the ratio of all controlled elements content in the investigated soils (Ci) to the critical level (CL) of these elements (hygienic or oriented or background):

$$Z = (\sum C_i / CL) - (n - 1)$$

THE CATEGORIES OF SOIL POLLUTION ON THE BASE OF COMBINED INDEX OF SOIL CONTAMINATION

Categories of soil contamination	Z
Allowable	1-8
Weak	8-16
Middle	16-32
High	32-64
Very High	64-128

The experience of the using of above named critical levels of chemicals in soils has shown the significance of some positions:

- a) the critical levels of chemicals in soils should be estimated on the base of their connection with their toxicity and influence on the quality of environment;**
- b) the critical levels of chemical in soils should be differentiated for soil with different properties;**
- c) background level of chemicals content in soils are informative for the assessment of soil pollution;**
- d) the critical levels of available (mobile) species of chemicals in soils are effective parameters for soil ecological monitoring (no only the total content of chemicals in soils);**
- e) the combined index of soil pollution is informative for the assessment of the polluted soils state.**

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What are the results of soil monitoring in Russia?

The most important for the regular control of the ecological state of soils are the following objects:

- 1) soils of the vicinity of great plants;**
- 2) soils of big city;**
- 3) soils of agricultural area.**

The soils in the vicinity of different big plants (where atmosphere has high pollution) are polluted in the most measure. The level of soil pollution depends on their distance from the plant. On the distance 0,5-2 km the content of pollutants in these soils can exceed the critical levels on some orders.

THE PROPERTIES OF NATURAL AND TECHNOGENIC SOILS OF MIDDLE URAL

Deep, cm	pH	Humus, %	Cu total	Cu availabl
Technogenic area				
0-10	3,48	1,82	1200	810
10-22	4,24	0,74	450	370
22-62	5,49	0,58	180	114
Background area				
0-15	5,10	4,16	22	0,4
15-20	5,04	0,70	23	0,3
20-35	5,67	0,80	20	0,3

HEAVY METALS CONTENT IN THE NATURAL AND TECHNOGENIC SOILS OF FAR EAST OF RUSSIA (total content, mg/kg)

Deep, cm	Zn	Pb	Cd	Cu
Technogenic area				
0-6	788	11000	19	377
6-20	426	6700	19	225
20-32	100		1	7
Background area				
0-10	83	16	1,1	47
10-25	78	14	0,1	50
25-40	75	14	0,1	46

Cu and Ni CONTENT IN THE SOILS OF KOLA PENINSULA

Deep, cm	Cu content, mg/kg		Ni content, mg/kg	
	total	available	total	available
Technogenic area				
0-2	806	462	1992	240
2-4	16	9	124	7
4-8	21	28	137	19
8-22	35	7	149	10
Background territories				
0-7	30	2	137	3
7-15	6	1	19	1
15-23	7	1	30	1
23-38	10	1	32	1

THE CONTENT OF METALS IN SOILS OF DIFFERENT AREAS OF ST-PETERBURG

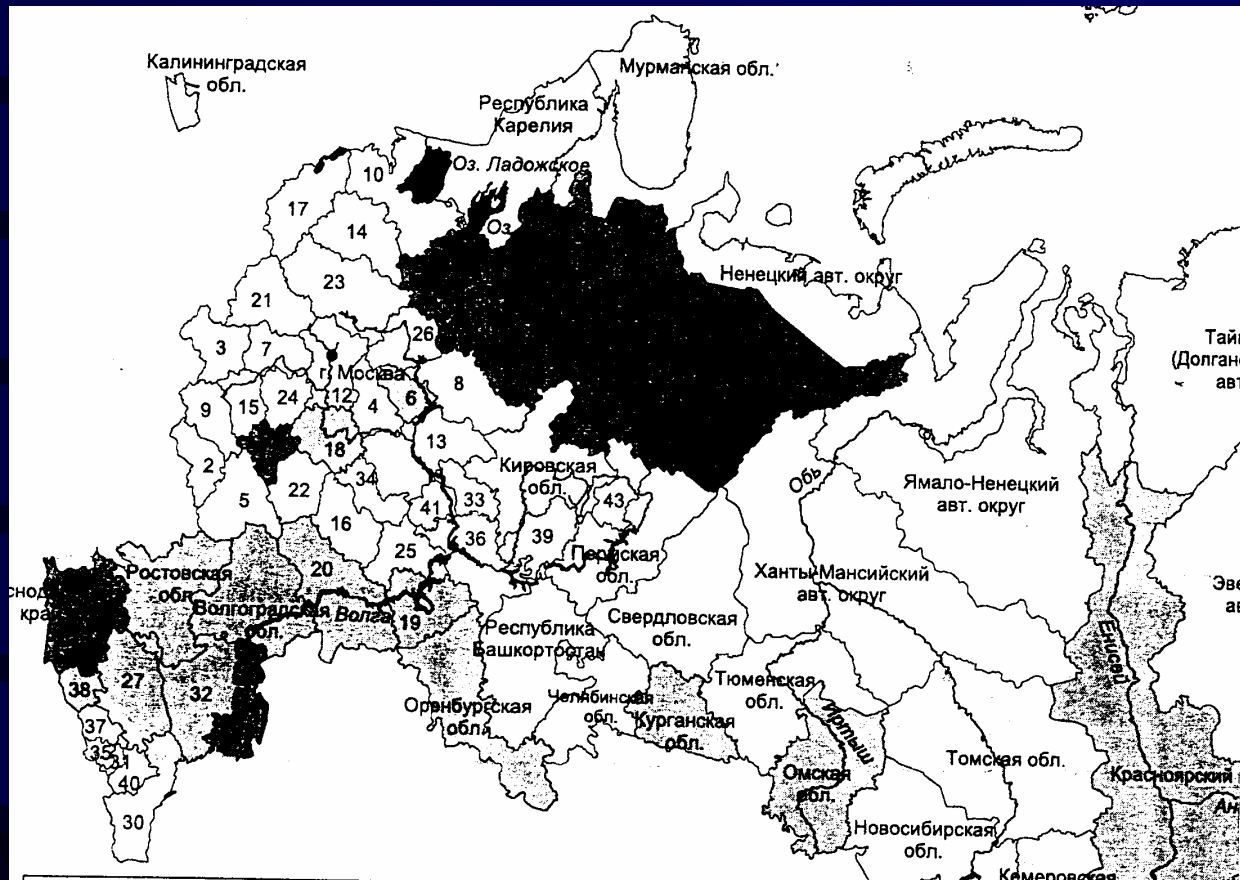
Elements	Recreation zone		Habitable zone		Technogenic zone	
	C,mg/kg	C/CL	C,mg/kg	C/CL	C,mg/kg	C/CL
Ni	30	1,5	30	1,5	53	2,6
Co	9	0,2	8	0,2	10	0,2
Cr	27	0,3	37	0,3	109	1,2
Cu	54	1,6	58	1,8	139	4,2
Zn	230	4,2	474	8,6	684	12,4
Hg	0,3	0,2	0,3	0,1	0,3	0,2
Pb	96	3	114	4	177	6
As	4	2	4	2	4	2
Cd	0,5	1	14	1	1	2

HEAVY METALS CONTENT IN THE AGRICULTURAL SOILS OF MOSCOW DISTRICT (total content, mg/kg)

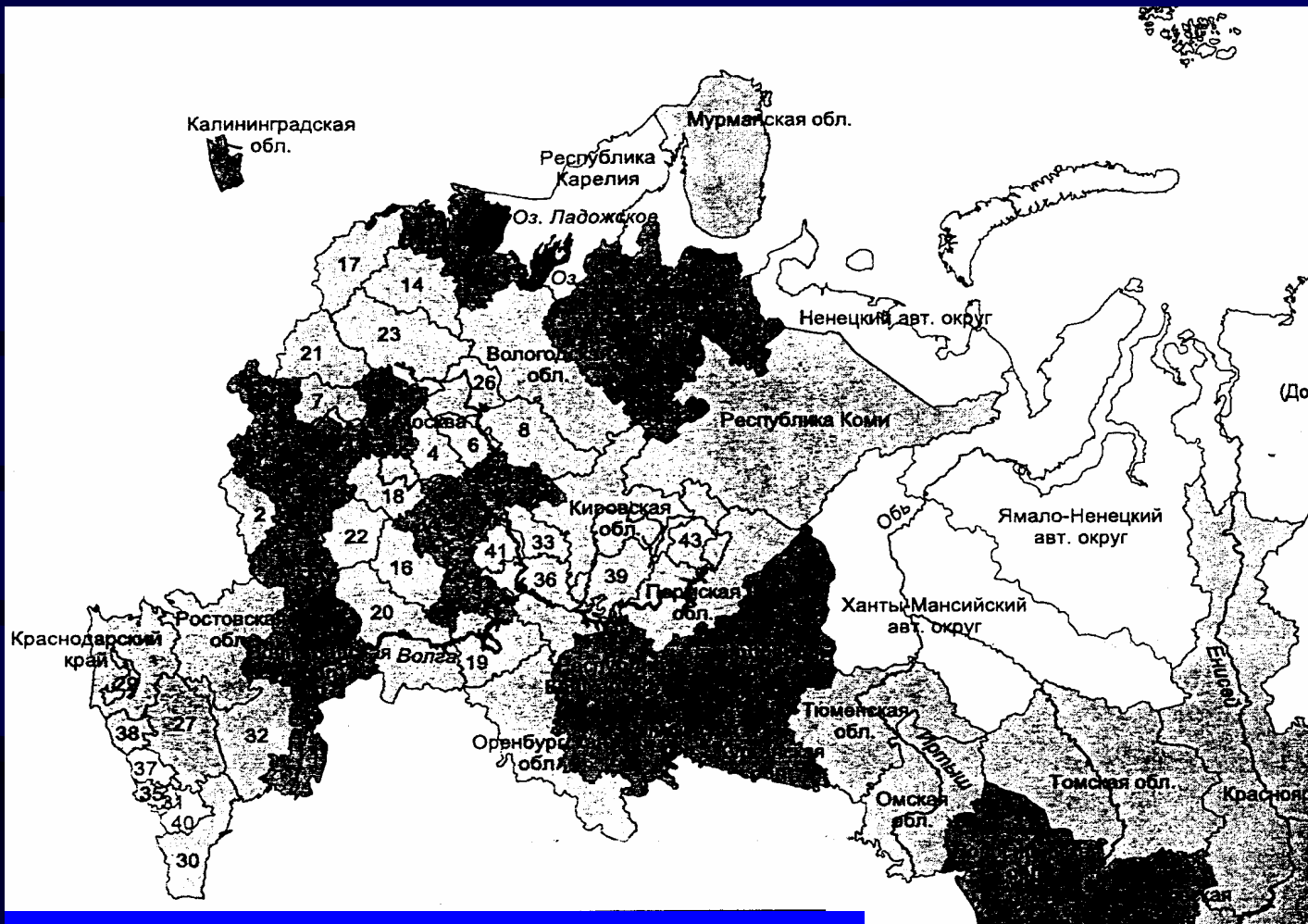
element	Level of contamination (C_{me}/CL)	% of lands
Pb	2CL	0,3
Zn	0,5-1 CL	1,2
Cu	3CL	0,1
Ni	3CL	0,01
Hg	0,1-1 CL	0,3
Cd	2CL	0,3
F	3CL	0,1

**BALANCE OF HEAVY METALS IN THE ARABLE
LANDS of MOSCOW DISTRICT, 1980-1999
(tons/ha year)**

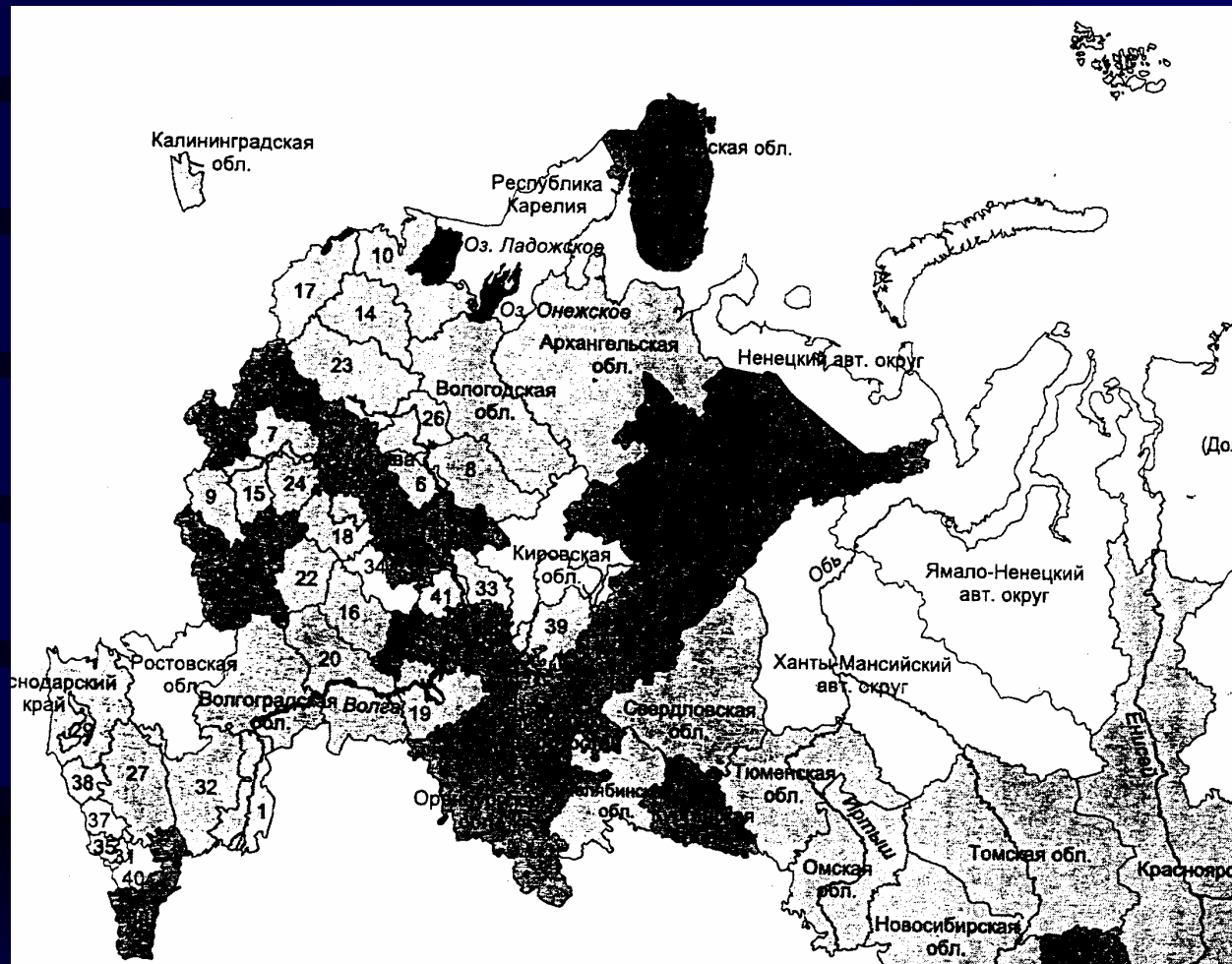
Part of balance	Heavy metals (g/ha)					
	Pb	Zn	Cu	Cd	Ni	Cr
with mineral fertility	5	6	4	1	5	2
rock phosphates	3	6	3	<1	5	3
lime	52	30	8	8	42	51
with organic fertility	29	120	24	11	86	92
with aerosols	34	80	10	4	15	H.O.
total	123	240	49	24	154	148
total carrying out from soil	20	150	24	23	144	141
balance	103	91	26	2	10	7



As in the arable soils of European part of Russia



Pb in the arable soils of European part of Russia



Cd in the arable soils of European part of Russia

There is the experience of the excavation of the polluted soils in Russia. It is concerns predominantly the soils polluted with organic substances at the territories of oil extraction and transport of oil and oil products and soils of industry territories polluted with heavy metals. The materials of the excavated polluted soils are buried on the special polygons. The materials of the excavated soils are placed often between the layers of the buried solid living wastes. Such polygons are most of all are placed near great cities and industrial centers

The grasses, trees and shrubs are grown on the territories where the excavated polluted soils have been buried for organizing of comfortable landscapes there. The monitoring of these soils is provided on the base of criteria's that are usually used for the identification of the polluted soils. They are named above.

What are the recommendation for these soils:

- a) the assessment of the pollutants content in soils on the base of the above named documents;**
- b) the mapping of the territories on the base of the pollutants content in soils (1:10000, 1:50000).**
- c) the regular (every 10-15 years) determination of the pollutants content in soils;**

The risk assessment of the polluted soil burry is provided on the base of the monitoring of the ground water of these territories. The content of the pollutants in ground water should not exceed their permissible level for ground water.

The territories with excavated buried polluted soils are not used for agricultural purpose. Some simple ameliorants such as lime, clays, mineral fertilizers can be used on these territories.

There are no special procedures for the secondary using of the polluted soils that are excluded from using.

CONCLUSION

1. The degree of soil pollution should be estimated by using the total content of pollutants and the content of mobile species of pollutants in soil.
2. Critical levels of the pollutants content should be differ for soils with different properties that provide the sustainability of soils to pollution.
3. The main sources of soil pollution are the aerosols wastes of different plants, especially mining and metallurgy.
4. Soils in great city are polluted predominantly by the wastes of transport.
5. The chemicals, used in agriculture, are not the serious sources of soil pollution.
6. Near 20% of the arable lands in Russia are polluted , but the content of nonorganic pollutants predominantly exceeds the critical level 1,5-2 times.
7. The complex environmental- medical monitoring should be recommended that can provide the simultaneous control of the environmental state and health of people.

DEAR COLLEAGUES,

THANK YOU VERY MUCH FOR YOUR ATTENTION

