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TRANSFORMATION OF ENVIRONMENTAL PROBLEMS IN MOSCOW: SOCIOLOGICAL DIMENSION

ABSTRACT. The paper assesses transformation of environmental situation in Moscow and citizens' attitude toward those changes. It analyzes a mass poll of 800 Moscovites conducted in June–July 2015. The research was aimed at identifying the correlation between subjective perception of residents and objective spatial and environmental differentiation in Moscow as well as assessing the potential of Moscovites' involvement in solution of environmental problems. Air pollution caused by production enterprises and cars, solid household waste and waste incineration plants were given special consideration. The article analyzes how Moscovites perceive problems of the whole city and of their own districts.

KEY WORDS: environmental sociology, environmental situation in Moscow, state of environment, public opinion, spatial differentiation, modernization of public environmental consciousness.

INTRODUCTION

With 12197 thousand residents, Moscow is the largest Russian city [Demographic Yearbook of Russia, 2015]. After city borders were moved in 2012, its area became 2511 sq.km (the research reviews the area of old Moscow, which accounts for approximately one-third of that value). Moscow is administratively divided into 12 districts which include 125 municipalities.

Among all Russian cities, Moscow is the 7th based on the integral index of human impact, the 2nd based on emissions, the 1st based on water consumption and waste waters, and the 16th based on reduced volume of waste given their toxicity [Bituykova, 2015]. The air is polluted, average annual concentration of nitrogen dioxide (NO₂), nitrogen oxide (NO) and formaldehyde (CH₂O) are above allowed sanitary standards and growing in 2010–2014 [Yearbook..., 2015]. In other words,

objective deterioration of the environment on specific indicators or its aggregated value exceeds self-purification capacity of natural constituents. According to sociologists, there is also a subjective criterion of unfavorable environmental situation (ES), when a person (segment, group, territorial community, etc.) considers it to be a real threat to his/her interests and quality of life [Sosunova, 2005].

In terms of municipal administration and self-administration, subjective assessment of environmental situation in a city often turns out to be more important than objective assessment. Public opinion, environmental maturity of public consciousness, and preference of active or passive environment protection measures may create an information field and intensify nature conservation activities in districts or in the city. The way residents perceive the state of the environment (SE) in different districts influences their perception of the quality of

urban environment as well as development of housing market in the city.

First sociological research on how Russians perceive SE was carried out in Moscow in the 1990s. Moscovites noted environmental problems, on the one hand, objectively due to an always complex environmental situation (large scale, rapid development of transport, and inherited industrial facilities ensured Moscow's top place in a country-wide ranking), and, on the other hand, subjectively due to a high level of education.

1993–1999 saw the number of Moscovites, who were primarily concerned with «the dirt and environmental situation», decreased from 26 to 17 %, but environmental problems remained at the 3rd place after elevating crime level and high cost of living up until 1997 when a greater number of Moscovites mentioned non-payment of salary [Yakovlev, 1999]. Citizens invariably consider air pollution to be the main environmental problem and cars to be the main polluter, while paying almost no attention to noise pollution. However, as for industrial areas, 50 % of respondents mentioned closing them as a high-priority measure; however, as for cars, 47 % proposed new environmentally safe public transport and new roads and thought that the least benefits could be achieved through underground crosswalks and increased taxes on old cars as those problems were not widely discussed by mass media. «Lack of administrative attention toward environmental problems» was the second among reasons for unfavorable SE in 1993 and the seventh, the last, in 1999 [Fomichev, 1999].

The poll of 2015 when respondents could choose top three problems revealed that 67.5 % of Moscovites blame transport, 51.2 % – environmental situation and 51.1 % – healthcare. 62 % of respondents consider ES in Moscow to be rather unfavorable or nearly catastrophic. According to them, main polluters are cars (59 %), industrial and energy facilities (27 %), now they also include

household waste and waste incineration plants (17 %).

Main purpose of the research is to define correlation between subjective perception of environmental situation and actual spatial differentiation in Moscow in 2015, factors influencing SE in various districts, and Moscovites' attitude toward environmental changes after the collapse of the USSR.

OVERVIEW OF STUDIES

Publications pursue one of three directions. Research based on anthropological approaches and aimed at studying attitudes toward the environment, in particular, waste and garbage, in different communities. "Rubbish Theory: The Creation and Destruction of Value" by M. Thompson, focused on conceptual study of waste, was one of the earliest works in this group [Thompson, 1979]. A monograph by M. Douglas, first published in 1966 and classics already, studies various pollution concepts and taboos in different communities [Douglas, 2001]. The majority of publications are dedicated to specific environmental and waste issues in cities [Melosi, 2005] and attitudes toward pollution in public discussions [Bickerstaff, 2003].

The second direction represents a systemic approach to study correlation between society and environment, functioning of ecosystems, and applied dimensions of solutions for sustainable development of ecosystems [McGinnes, Ostrom, Ostrom, 2009, Plieninger, etc.].

The third direction may be referred to as critical sociology or radical approach in studying society and environment. Those publications study and criticize consumer society that damages the environment. J. Bennet's publication on philosophical issues in political ecology was among the first ones in this group [Bennet, 2010].

O.N. Yanitsky, A.S. Ahiezer, A.V. Baranov, L.B. Kogan are eminent Russian scholars who

have laid foundations for a discipline that later became known as environmental sociology [Ahiezer, 1969, Baranov, 1984, Kogan, 1967, Kogan, Listengurt, 1975, Yanitsky, 1998]. In the 1990s, there have been a number of research projects in Moscow related to Moscovites' attitude toward environmental situation in the city and changes in pollution [Bityukova V., Sokolova, 2008, Fomichev, 1999, Yakovlev, 1999].

DATA AND METHODS

There were two stages of research: objective assessment and community study.

Transformations in spatial structure of industrial pollution were assessed based on integral indices of human impact for industrial areas (IA) in Moscow, including amount of emissions (according to statistical accounting of industrial emissions), emission density, pollution areas, and structural complexity of emitted aerosol and its toxicity.

Intensity and structure of traffic in Moscow were measured and subsequently used in order to analyze pollution from cars. Impact areas of streets were calculated based on OND-86 method [Tischenko, 1991]; amount and density of pollution in the areas – based on running exhaust emission.

A mass poll was conducted in June-July, 2015 in order to understand how Moscovites perceive environmental problems. Six municipal districts of Moscow have been selected for polling: Novokosino, Perovo, Sokolinaya Gora, Mozhaisky, Krylatskoye, and Novo-Peredelkino. The selection was based on the following: it had to include districts with different levels of environmental pollution, districts located in semi-peripheral and peripheral parts of the city, approximately equally remote from the center. Within the districts, respondents were selected based on quota sampling consistent with sex-age structure of each district.

Central districts were excluded from the research as there are totally different reasons for choosing the city center as a place of

residence (prestige, high quality of housing, including new housing). Residents do not take environmental situation into account.

Therefore, resulting sample structure is similar to sex-age structure (SES) of district population. Overall, there were 800 respondents, from 103 in Novokosino to 170 in Perovo. The questionnaire consisted of the following parts: assessment of changes in the environmental situation in Moscow and in the district; ranking of polluters in the city and in the district; questions about environmental behavior of Moscovites and others.

RESULTS AND DISCUSSION

Changes in environmental situation in Moscow and in the districts.

More than half of respondents (53.5 %) believe that environmental situation has deteriorated over the past five years. Another 26 % think that it has not changed. Most likely they are more interested in municipal improvement than in environmental problems. Respondents mention the following specific manifestations of deteriorating environment: air pollution (84 %), deterioration of health and parks (38 %), dirty ponds (32.5 %), and disappearing green belts (32.5 %); only 1 % mention increasing noise pollution (Fig. 1).

However, there is no objective proof: industrial and car emissions have not grown in Moscow, average annual concentrations have decreased or remained stable, within allowances: CO – 0.2 daily average threshold limit value (TLV); particulate matter pollution that was 10 microns in diameter or less (PM10) – 0.9; NO average annual TLV – 0.7; NO₂ – 1.3.

Assessment of changes in industrial pollution.

Two main trends are currently typical of environmental situation in Moscow: *deindustrialization and decreasing industrial pollution and growing car pollution*. Air pollution from stationary sources has declined

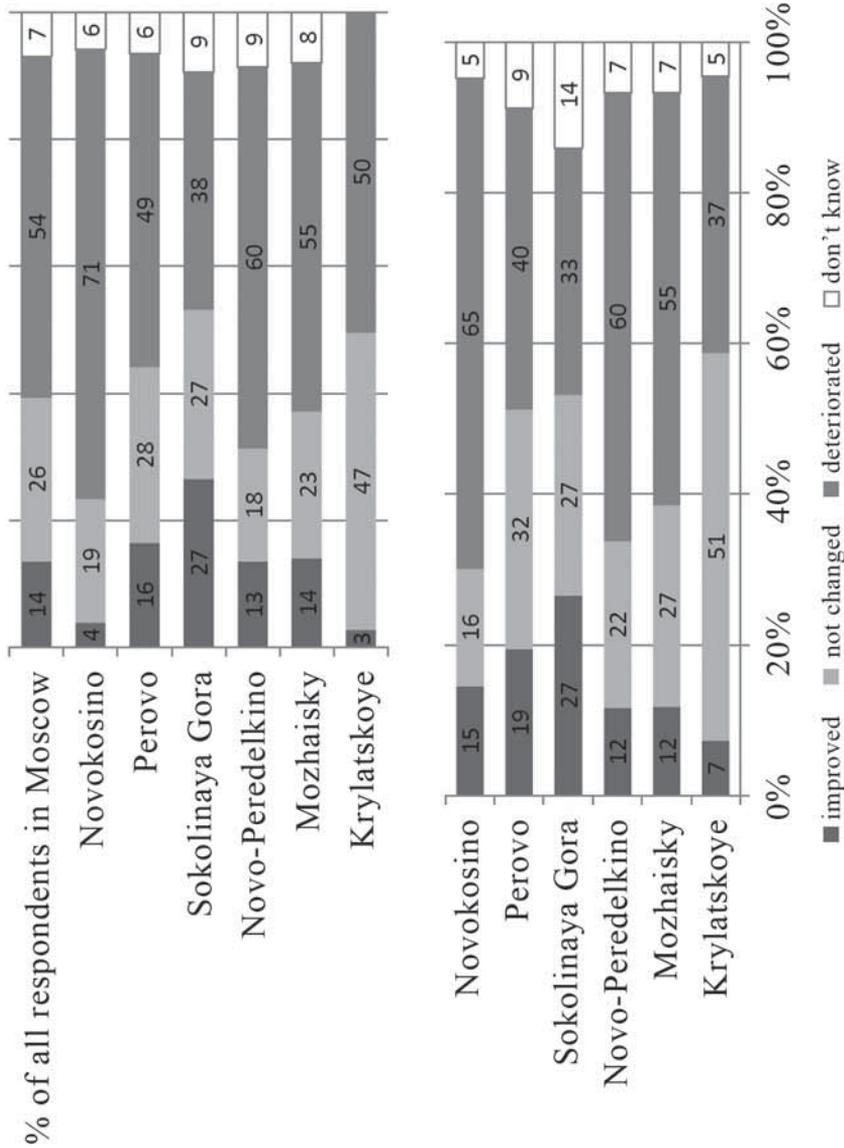


Fig. 1. Distribution of answers to the question: Has environmental situation changed in Moscow (upper) and in your district (lower) in the past five years? (Per cent of respondents from the district)

from 26–27 % in the early 1990s to 10 % by 2000 and to 6 % by 2014. Industrial pollution has undergone the maximum reduction. In the early 1990s, Moscow was the 15th–16th top polluted Russian city based on the total pollution from stationary sources, which could be compared to Nizhny Tagil, Angarsk and Krasnoyarsk and exceeded pollution in Ufa, Yaroslavl, and Chelyabinsk. In 2001 Moscow moved to the 20th place and until now is only in the top thirty.

Moscow, similarly to the majority of large cities, has an even reduction in pollution from stationary sources after 1990. Overall production in 1999 accounted for 40 % of the 1990 level, which ensured an adequate emission reduction of 38.6 % (from 367 to 141.3 thousand tons/year (1998)). Later Moscow saw mostly chaotic closure of production enterprises. However, the default resulted in compensating rise of industry: overall production grew by 2.5 % in 1998, 8.9 % in 1999, 7 % in 2001. At the same time, unlike the majority of Russia's cities where production growth was accompanied by increasing emissions, total pollution from stationary sources in Moscow was still declining – up to 105 thousand tons and 50 thousand tons in 2001 and 2009, respectively, – as the result of changes in industry structure in general and of specific enterprises due to

environmental policy and reconstruction. But the growth after the 2008–2009 crisis still caused increase in emissions by 71–68 thousand tons in 2012–2014 (Fig. 2).

Stationary sources and their emissions are distributed unevenly. As main industrial polluters are oil refinery in Kapotnya and combined heat and powers facilities (CHPs) the majority of analyzed districts have a manifold smaller share of stationary sources. Only in Perovo and Sokolinaya Gora it is 1.5 times greater than the average Moscow value. While the overall emissions from stationary sources tended to decline in 2008–2014 (average annual reduction of 15 %), Krylatskoye, Novo-Peredelkino, and Novokosino saw pollution decreased by 90 %, Mozhaisky and Perovo – by 55 %, and Sokolinaya Gora – only by 10 %. Emissions decreased both in industry and in housing and utilities due to equipment modernization of boilers or transition to gas fuel.

Industrial areas experienced an uneven reduction of emissions in 1992–2014. Emissions considerably decreased by the early 2000s, mainly at the expense of well-developed industrial areas in the middle belt of Moscow which specialized in mechanic engineering and heavy industry. As the result,

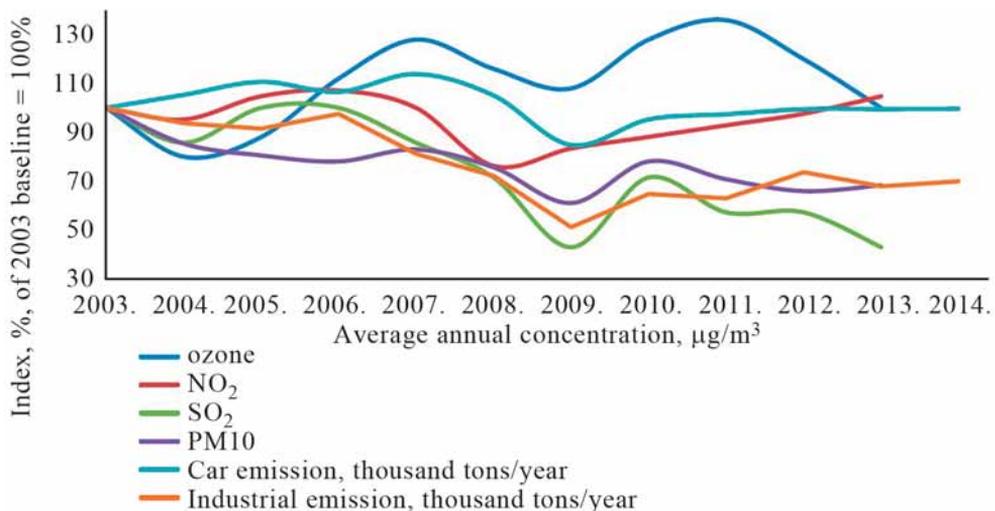


Fig. 2. Average annual concentrations of pollutants in Moscow

an age-long gap in Moscow's industry, with a traditionally more developed east, is gradually closing due to a more intense reduction in large enterprises. Krylatskoye, Mozhaisky, and Novo-Peredelkino do not include any industrial areas (IA); separate polluters are located along the periphery. Mozhaisky district shares a southern border with Ochakovo IA, with a CHP at the core, which partially affects the district, and a northern border with Kuntsevo IA, specializing in mechanic engineering (Elektroschit, JSC), that has no significant impact (Table 1).

Perovo municipal district is the most environmentally unfavorable district in the Eastern Administrative District. However, Perovo IA sees a rapid replacement of industrial functions with housing and public ones. The impact has most significantly decreased after Kuskovo chemical plant, JSC was closed and an apartment complex was built in its place. Sokolinaya Gora municipal district has experienced minimum reduction, as Sokolinaya Gora IA in the south has a strong impact. Woodwork is on the rise there, the emitted aerosol has a more complex structure now, though its density and toxicity have slightly decreased. Small industrial areas, Semenovskaya and Kirpichnyeulitsy, have almost no impact, but still have not been

reconstructed. Neighboring districts also have minimum impact: Khapilovskaya IA has no serious polluters; serious polluters in SerpiMolot IA have been eliminated. Energy facilities are down to a small Ufaev CHP-11 in Sokolinaya Gora IA, emitting less than 800 tons.

Environmental situation in Novokosino changed in 2003, when Moscow Waste Incineration Plant 4 was built in Rudnevo IA. Saltykovsky forest separates it from residential areas; there are six cleaning steps of exhaust gas and a thermal station using alternative fuel – solid household waste. And still it affects Novokosino – residents complain about it. According to the number of complaints, Kosino-Uhtomskoye and Novokosino are the most unfavorable Moscow districts [Report... , 2014].

Industry remains a crucial factor of toxicity due to specific emissions. Production enterprises were combined into special areas for two main reasons: to minimize chemical, noise, and other impact on residential areas and to boost efficiency due to large production complexes on limited territories. But gradually houses approached industrial areas despite urban development standards. Thus, in terms of urban development programs it is important to assess whether residents understand that industrial areas are a hazard.

Table 1.

Municipal district	Industrial areas in the district (main enterprise)	1992	2002	2014
Krylatskoye	No			
Mozhaisky	<i>Kuntsevo</i> (All-Russian Institute of Light Alloys JSC)	Strong	Moderate	
Novo-Peredelkino	No			
Perovo	<i>Projector</i> (Moscow Electrode Plant)	Strong	Moderate	
	<i>Sokolinaya Gora</i> (Nefteprodukt Moscow Plant (Rosneft), Ufaev CHP-11)	Strong		
Sokolinaya Gora	<i>Semenovskaya</i> (SalutGaz-Turbine Engineering Research and Production Center)	Moderate	Insignificant	
	<i>Kirpichnye ulitsy</i> (AREMZ-1 First Automotive Equipment Maintenance Plant, JSC)	Moderate	No impact	
	<i>Sokolinaya Gora</i> (Vperyod Moscow Automotive Equipment Maintenance Plant)	Strong		
Novokosino	No	No impact		

Residents' assessment of industrial pollution

The results of the poll were rather unexpected. Eighty two and a half percent of respondents in Novokosino consider industry to be the main environmental problem in Moscow (as compared to the average Russian value of 40 % [Abramov, 2014]), almost 40 % believe that waste incineration plant is the key environmental threat in the district. Residents of Mozhaisky and Sokolinaya Gora placed industry on the 2nd place and residents of Krylatskoye, Novoperedelkino and Perovo – on the 3rd. Only 35 % of residents in Perovo and 40 % in Sokolinaya Gora mentioned industry as the main polluter in their districts.

Therefore, in general, residents understand the role of industry and its impact on environmental situation in Moscow (slightly more) and in their districts. However, when it comes to purchasing residential property, Moscovites stop seeing the problem both for objective and subjective reasons [Popov and others, 2016]. Their subjective attitude toward environmental situation depends less on lack of information and environmental illiteracy in the housing market and more on difficulties in interpreting ecological information for an ordinary person, and impossibility to assess the potential threat.

Assessment of changes in car pollution

Car pollution has grown only by 14 % since 1990 (932.2 thousand tons in 2014), despite a sevenfold increase in the number of cars. The early 1990s saw the maximum annual increase in the number of cars (19.1 %), later the situation stabilized, and 1996 saw a radical change – the growth of the number of cars started to decline. Recently the growth of the number of cars has slowed down to average annual 5 % (2.7 % in 2013), which clearly demonstrates that the market is saturated.

Growing number of cars is accompanied by active fleet renovation with cars of a higher environmental class (approximately by 2–3 % a year); decreasing number of trucks

(nearly twice during 1991–2006) improves environmental situation. According to the experts, data on vehicle age show that in the past decade, the share of cars of environmental class above 4 (Euro-4) has grown from 0 to 50 %, for trucks – to 30 %, and for buses – to 16 % by early 2014.

Fuels below Euro-4 class (running exhaust emission (g/km) is twice lower than for Euro-3 and thrice lower than for Euro-2) have been prohibited in Moscow since 2013, fuels below Euro-5 – since January 2016. Replacement of fuel class 3 with fuel class 4 resulted in SO₂ emissions decreased by 79 %, benzpyrene by 22.7 %, solid emissions by 13.5 %, NO and CO₂ – each by 4 %. Fifty percent of motor fuels used in Moscow corresponded to class 5 already in 2014. [Report. ..., 2015].

Though the target has been achieved, there almost no reserves left to reduce emissions by improving the quality of motor fuels. Better gasoline and new structure of vehicle fleet, first of all in large cities, helped decrease total and specific car pollution. Running exhaust emissions have decreased by four times. Those changes have annihilated the dependency of emissions on the number of cars. Since 2007 the rapidly growing number of cars in Moscow has not led to more emissions.

Remarkably, the past fifteen years have seen a more equally distributed car pollution that is moving from working to residential areas. Implementation of construction projects and road reconstruction decrease the number of areas with maximum pollution (Table 2).

Areas with the average emission density of 1000–2000 tons/sq.km/year were relatively stable during 2002–2014. Other groups saw a significant redistribution. About half of the areas remained unchanged in the groups of 3000–5000, 500–1000, and 100–500. At that, the majority of areas, formerly belonging to the group of 500–1000, experienced an increase in polluters' density. The opposite is true for the group of 3000–5000. Car emission density has averaged, i.e., human impact is

Table 2. Groups of areas based on emission density, share of the total area of Moscow

Emission density (tons/sq.km/year)	1992		2002		2014	
	Number of areas	Share of total area of Moscow, %	Number of areas	Share of total area of Moscow, %	Number of areas	Share of total area of Moscow, %
Less than 500	27	17	37	26 (+9 %)	35	34 (+8 %)
500–1000	27	19	43	23 (+4 %)	39	32 (+9 %)
1000–3000	71	38	70	43 (+5 %)	94	28 (–15 %)
3000–5000	42	22	20	5 (–17 %)	18	5
More than 5000	11	4	8	3 (–1 %)	4	1 (–2 %)

now distributed more evenly. This could have been a positive trend, but growing pollution in peripheral areas compensated for declining peaks (primarily, at the intersection of radial motorways and the Garden Ring). Moreover, the number of areas with low density has decreased as well.

Therefore, selected districts have car emissions proportional to the population size but for Mozhaisky district (Western Administrative District) where the share of emissions is larger due to Kutuzovsky Avenue that is daily used by up to 250 thousand cars.

Model districts have different structure of car pollution in the affected areas along main motorways (Fig. 3):

- Perovo and Sokolinaya Gora have the majority of car emission areas with the density of 1000–1300 tons/sq.km, with certain areas near industrial zones of 3000–3500, and certain areas of up to 4000 tons/sq.km. Novokosino is dominated by areas with the density of 1000–1300 tons/sq.km, but has no local highly dense areas.
- Krylatskoye and Mozhaisky have the majority of car emissions areas with the density of 1500–2000 tons/sq.km along the streets. Novo-Peredelkino has the same density along the roads, but has less internal pollution areas of 500–1000 tons/sq.km.

Therefore, cars are a background factor of the quality of the environment; its pollution and noise are rather homogeneously distributed across the city.

Cars are the main polluter in all districts: 90 % of overall emissions in Perovo and Sokolinaya Gora and 98 % in other districts. From Moscovites' perception, the role of cars is less significant. In terms of their districts, the majority of respondents consider cars to be the main reason for environmental degradation: from 48 % in Perovo and Sokolinaya Gora to 78 % in Krylatskoye. But in terms of Moscow, 20–30 % plus, on average, consider cars to be the main polluter.

What is more important, despite the fact that it was the transition to Euro-5 fuel that ensured better quality of the air, Moscovites have little understanding of its environmental advantages. In 2014, only 18 % of the respondents said that they had heard of Euro-5 environmental standard and 44 % knew nothing about planned ban on fuels below Euro-5. Only 40 % agreed that Moscow oil refinery exclusive production of Euro-5 fuel since 2013 ensured less air pollution in Moscow and only 26 % suggest prohibiting sale of fuel below this standard. At that no more than 66 % feel positive effect of the implementation of this standard, and 21 % are for closing Moscow roads for old cars. This attitude is likely to reflect growing fuel prices.

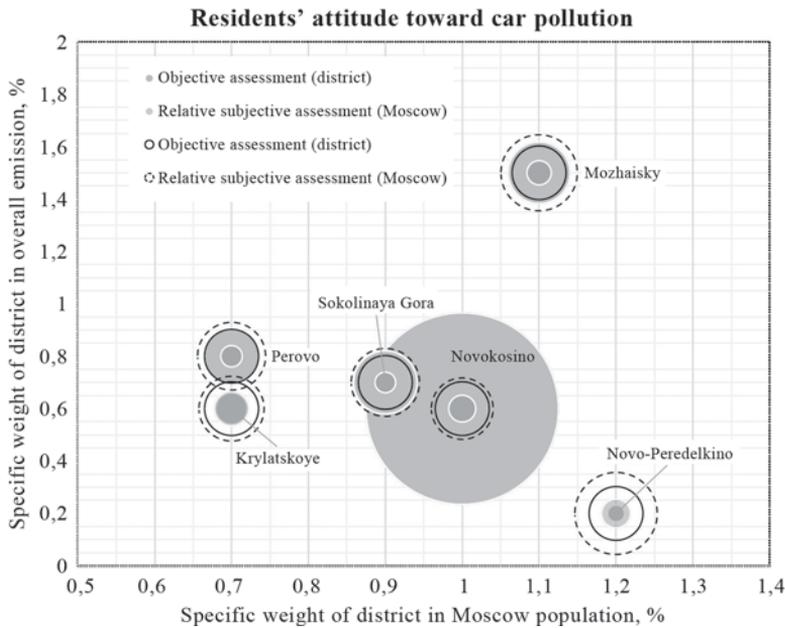


Fig. 3. Correlation between the share of respondents, who call cars the main polluter, and the level of auto air pollution.

Moscovites are hardly ready for steps to reduce car load: only 47.8 % believe that it is very important to use public transport and environmentally safe transports (bicycle, electric cars) and 34 % believe that it is rather important; only 23 % are ready to act.

Residents' assessment of solid household waste

Moscow annually produces more than 3 million tons of solid household waste. Only recent years have seen a reduction from 3.2 in 2012 to 2.5 million tons in 2014. Household waste and dumping sites are a pressing problem for modern cities, yet it has not cemented in citizens' consciousness.

The poll respondents have placed household waste and dumping sites on the 3rd place both for their districts and for Moscow. The number of respondents who call solid household waste the leading problem for the city is approximately three times higher than for their districts: 62 % in Krylatskoye, 59 % in Perovo, 54 % in Novo-Peredelkino, and 47 % in Mozhaisky.

Ten to seventeen percent consider household waste to be the main polluter in their own districts. Not only Moscovites underrate the size of the problem, try to move it away, and do not see the consequences, but they are against waste incineration plants. The residents of Novokosino, where the waste incineration plant is located, are most responsive to this problem (74 % of respondents in the district). The district regularly witnesses protests against this enterprise. The residents also mention the impact of Kuchinsky solid waste landfill that deteriorates underground and open waters.

Involvement in solution of environmental problems

Moscow undergoes a more rapid social and demographic modernization than other Russian regions, including greater environmental responsibility of residents. Some questions were aimed at defining specific features of modernization of public environmental consciousness of Moscovites. Key features of modernization of environmental consciousness

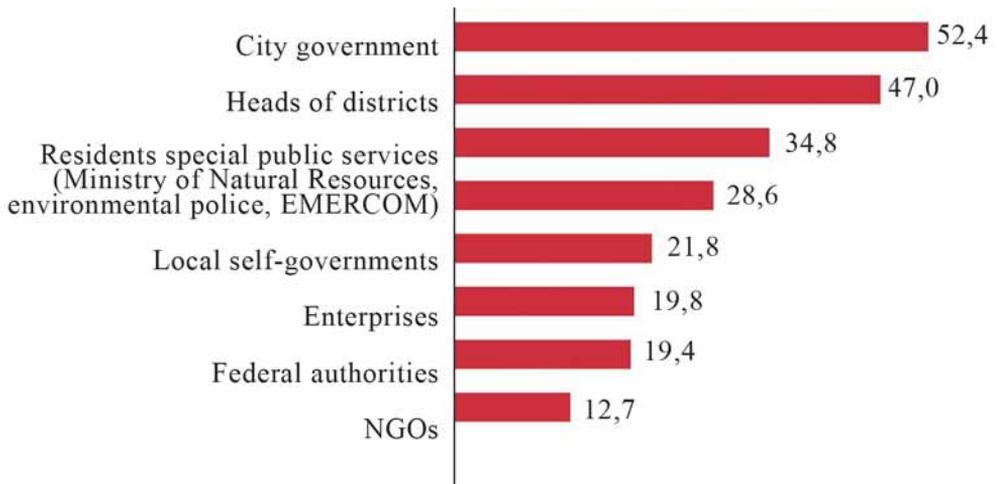


Fig. 4. Answers to the question: Who do you think should be responsible for environmental situation in your district? % of respondents, N = 800

and readiness for environmentally responsible behavior are: vigorous interest in solving environmental problems, involvement in environment protection measures, awareness of the environmental situation and main polluters and pollution indicators, and personal responsibility for the environment.

The analysis of this part of the questionnaire should take into account the large number of university-educated respondents that influences the number of respondents interested in environment protection.

The majority of respondents rest responsibility upon municipal authorities. However, a good sign is that 34.8 % believe that residents themselves are responsible for the environment. They could form a proactive group of citizens concerned with the environment (Fig. 4).

CONCLUSIONS

Comparative analysis of ES indicators and sociological research revealed that the main objective factors for difference between the actual situation and the residents' attitude are as follows:

– Environmental situation improves or remains stable while residents, on the contrary, pay more attention to it as the result of less social tension. During the transition period, this factor had much less impact due to existential threats that caused declining interest toward environmental values.

– Recent years have seen leveling of urban pollution as the result of breakthroughs in the industry and transport. The west-east differentiation has become less obvious. This confirms that environmental requirements are, to a great extent, programmed, i.e., people either got used to (or accepted) conditions they live in, or took them into account when moving to a given district.

– Environmental situation in Moscow is characterized by a substantially decreasing role of factors that could be influenced by large investment aimed at technological production modernization, i.e., an increasing role of waste that Moscovites do not consider to be an obvious environmental factor; this problem demands involvement of citizens. However, according to the research, citizens do not perceive it locally.

Subjective factors include:

- lack of knowledge and environmental illiteracy, difficulties in interpreting ecological information for an ordinary person, and impossibility to assess potential threat of polluters;
- absence of accurate and objective criteria of environmental conditions that results in divergence of visually-based perception of environmental situation in separate districts from actual situation.
- latent nature of environmental factors in residents' consciousness and, as the result, underestimation of environmental threats and consequences of current actions. Social studies call this phenomenon the shift of future plans in human preferences. Sometimes, human behavior is irrational; the results we choose now do not always match the outcomes we want later [Medvedev, Aladsheva, 2001].
- despite the dominant role of car pollution among environmental problems, ease of travel largely compensates for the harm in residents' opinion.
- assessments of environmental situation in the districts are usually based on comparisons. That is why transit districts

are underrated. Life of the majority of residents is limited to the center and the middle belt; residents of remote districts see a broader picture, as they daily travel across all the belts. That is why dynamics of assessments requires special attention.

Public opinion, environmental maturity of public consciousness, and preference of active or passive environment protection measures may create an information field and intensify nature conservation activities in the districts or in the city. The majority of environment protection measures are not initiated by residents but are organized by the government. Until now, despite a more dynamic interaction between the population and authorities in management, cultural, and even urban development spheres, potential of environmental consciousness as an important resource for territorial development and better urban environment remains unclaimed and is not used by municipal administration or environmental NGOs.

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