

COMPLEX APPROACH TO THE ASSESSMENT OF LIFE QUALITY IN URBAN ENVIRONMENT: CASE STUDY OF MAHILIOU IN BELARUS

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Abstract

World is getting urbanized, therefore quality of life at the cities is topical problem of global importance. Plenty of recently published methodologies have approached to the assessment of urban environment, however they are lacking complex view on the problem. We understand life quality as a complex indicator comprised of the factors of outdoor and indoor environments (threat of environmental pollution, factors of natural environment), welfare (income level, structure of expenditures, employment rate, criminal violence), professional environment (employment hazard), and services availability and quality (education, leisure, public health, public transportation, municipal services). Above data has been collected and analyzed in terms of spatial dynamics over the last decade for Mahiliou – a typical Belarusian municipality. The spatial distribution of all indexes has been compared with health statistic (total sickness rates and separate deceases) and scaled according to it, i.e. health hazard-oriented assessment numbers have been obtained for each factor of life quality. The assessment numbers have been mapped and integrated, and than obtained sum has been verified by confrontation with spatial morbidity rates. The spatial analysis has been made using ArcView 3.2 GIS software. The obtained integrative map has been applied to the city zoning regarding to the conditions of social ecology.

Introduction

Cities are considered to be the areas of the most powerful human impacts on the environment. Scholars from the variety of backgrounds all over the world are deeply involved into the urban environmental studies. This interest may be explained by the weaker environmental performance of the cities compared to non-urbanized areas, and therefore by the unsatisfactory public health indexes. The term quality of life has been in use from the mid of the 60th in the USA. At that time the term had included all the range of the issues (purposes of the humankind's existence, hygienic conditions in the cities and etc.). Belarussian scientists had used the term "living standard" and only from the beginning of the 90th Belarussian sociologists began to use the term "quality of life" in their research. Nowadays, scholars from the various fields employ the term "life quality" (James R. Dumm, 2000; Riccardo Abbate, 2000). Definition of this term doesn't exist. Various studies understand this term from the different perspectives such as economic and social. Thus, the quality of life can be explored as the ratio between demand and supply of the all the conditions and services the municipal residents might need. We understand life quality as a complex indicator comprised of the factors of outdoor and indoor environments (threat of environmental pollution, factors of natural environment), welfare (income level, structure of expenditures, employment rate, criminal violence), professional environment (employment hazard), and services availability and quality (education, leisure, public health, public transportation, municipal services). This paper offers the analysis of the factors of the quality of life in the city, exploring them as the system of links between outdoor and indoor environments, welfare, professional environment, services availability and quality and health status. Five sections compose our work. After the short introduction, in the next section the data and methods allowing to evaluate the quality of life are described. At the end, study's results are analyzed.

Methods

The research has been carried out in the city of Mahiliou – one of the biggest industrial center in the Republic of Belarus with 360,6 thousand citizens. Mahiliou has the highest in Belarus indexes of environmental pollution, and features many social problems, associated with the collapsed National economy, and dramatically decreasing level of social security.

The data used in this paper have been obtained from interviews, Mahiliou's municipal agencies for environmental protection, public health, statistic, and urban planning. The section of environmental assessment is based on the data from the field surveys carried out during 2001-2002. All the factors describing quality of life in the city were aggregated into four groups, as follows: *factors of outdoor and indoor environments, welfare, professional environment, and services quality and availability.*

The factors of outdoor environment were analyzed within such sections as: environmental pollution, and natural (biophysical) conditions. The calculations for the spatial distribution of environmental pollution have been based on the data for air pollution, soil pollutions, and traffic noise. Data for air pollution has been converted to the number of times the official thresholds for the certain ingredient had been exceeded. The most common pollutants, such as FENOL, CO, NH₃ have been selected and included to the integrative index of the air pollution (I.Z.A.). Data for soils' pollution have been involved, since they are long-term indicators of air pollution (Natural complex, 2000) and they act as a factor of human health. 200 soil samples have been taken from the various land-cover/use patches in Mahiliou municipality. The atomic-absorptive analysis has been employed to define concentrations of heavy metals in the soil samples. Maps for concentrations of Fe, Cd, Co, Cr, Sr, Cu, Zn, Mn, Pb, Ni, and summary map of the heavy metals' concentrations have been made. The map of the traffic noise based on the data for the level of traffic noise at the main roads in the city of Mahiliou has been used in the assessment of the city acoustic environment.

The following factors have been included to the assessment of natural (biophysical) conditions: relief accessibility, weather indexes, and geochemistry of landscapes. Relief accessibility is understood as area's suitability for transportation and pedestrians, and calculated as a function of slope's steepness and availability of bridge links in valleys and other depressions. The weather index describes influence of climatic factors on human health, and has been calculated according to the formula (1) (Vitchenko, 2000):

$$I_m = I_t + I_h + I_v + i_{\Delta p} + i_{\Delta t} \quad (1)$$

, where I_t – function for temperature's impact on human health, I_h function of humidity, i_v – function of wind's impact, $i_{\Delta p}$ - function of variations of atmospheric pressure, $i_{\Delta t}$ - function of temperature variations.

The landscape geochemistry has been used in the study for it describes migration of chemical elements (including pollutants) within the units natural of landcover, thus indicating their ability of accumulating/transition in soils and living organisms. The map of geochemical landscapes has been based on the scheme of urban watersheds (geochemical arenas), delineated into the elementary landscapes (according to the type of migration, i.e. autonomous (eluvia), heteronymous (transeluvial-accumulative, super-equal, equal)).

Data about dwelling satisfaction (interior design, space, sunlight and etc.) and the dwellings age has been integrated to the assessment of the quality of housing conditions. Indicators of the quality of drinking water have been used as well (the per cent water's samples, which are not corresponding to hygienic standards.

An income is sensitive issue of the welfare due to the instability of price, inflation, the increase in the supply and variety of consume goods (Illner, 1998). We have been used such indicators as income per worker, the income per employee.

To characterize social indicators of the quality of life we have used indicators of the market of the goods and services: the volume of the sails of the main commercial services; the indicators of the structure of the services consumed by the city residents; the volume of the sails of the common type of the services; the structure of the services consumed by the city residents.

High unemployment rate is an important factor of the social tensions in the city of Mahilou. To describe the unemployment in the city we have used such indicators, as the total number of the unemployed residents; distribution of the unemployment regarding the sex, age, duration of unemployment.

Hazards in the occupational environment are major cause of injury, ill health (Environmental Health, 1999). We used indicators of the chemical and physical pollution of the workplaces, number of reported cases of occupational injure per 100 working people in the year and also the average duration, structure and total number of reported cases of occupational injure on the enterprises.

Education and cultural activities have been characterized by such indicators as number of nursery schools and secondary schools, number of pupils and teachers in the secondary schools, number of

universities in the city, number of the students in the city, number of museum, theatres, cinemas visitors per residence, number of libraries per capita. We also involved data on the special density of shops, markets, post offices, stadiums, and bathhouses.

Indicators of the public health were aggregated into two groups: 1) social-demographic (age structure of population, life expectancy at birth (male and female), density of population, birth rate, death rate); 2) morbidity rate (the total illness, the indicators of the separate diseases and the age). The morbidity of the children is the more representative indicator of the overall quality of health conditions, because in many respects children are more vulnerable group to adverse effects of the environment health. We used indicators of the mortality regarding the age and sex, for all the causes.

In order to make evaluation of public transportation in terms of social ecology, we took into consideration the following indexes: availability of public transportation and capacity of the public transportation.

In the recent past the concepts of the life quality have been based upon subjective opinions of city residents. In order to clarify spatial distribution of the life quality indexes we have studied public perception of urban environment. The sociological poll, including 200 inquiries, shows the correspondence of actual conditions to the perceived.

The spatial analysis has been based on GIS ArcView 3.2. We have made the GIS in collaboration with Mahilou center hygiene and epidemiology. The extensions Spatial Analyst, 3D- Analyst were used to make maps.

The study includes four steps. First, data were compiled for factors of outdoor and indoor environments, welfare, professional environment, and services availability and quality. The second step, indicators characterizing spatial distribution of the factors of the quality of life and describing the quality of life in the whole on the city were chosen. The available statistic data don't allow making conclusions about spatial distribution of them and they are quantity and quality characteristics of the city as a whole. On the third step we have made maps of the separate factors of the quality of life and complex map of the quality of life. Fourth, we compared map of the quality of life with the indicators of the illness and the morbidity. The different methods were used in this study: statistic, geochemical, mathematic, compare-describe, map and interview.

Results

The different weighting coefficients have been used for every group of the life quality factors: social factors - 0,7; factors of the outdoor environment - 0,2; factors of the indoor environment - 0,1. The highest rate of the weighting coefficient of the social factors is caused by their significant influence on shaping of human health and well-being. We made zoning of the city according to the integral map of the quality of life in Mahilou (illustration 1).

As the result, the life quality for the residents of the most part of city area has been assessed as unsatisfactory.

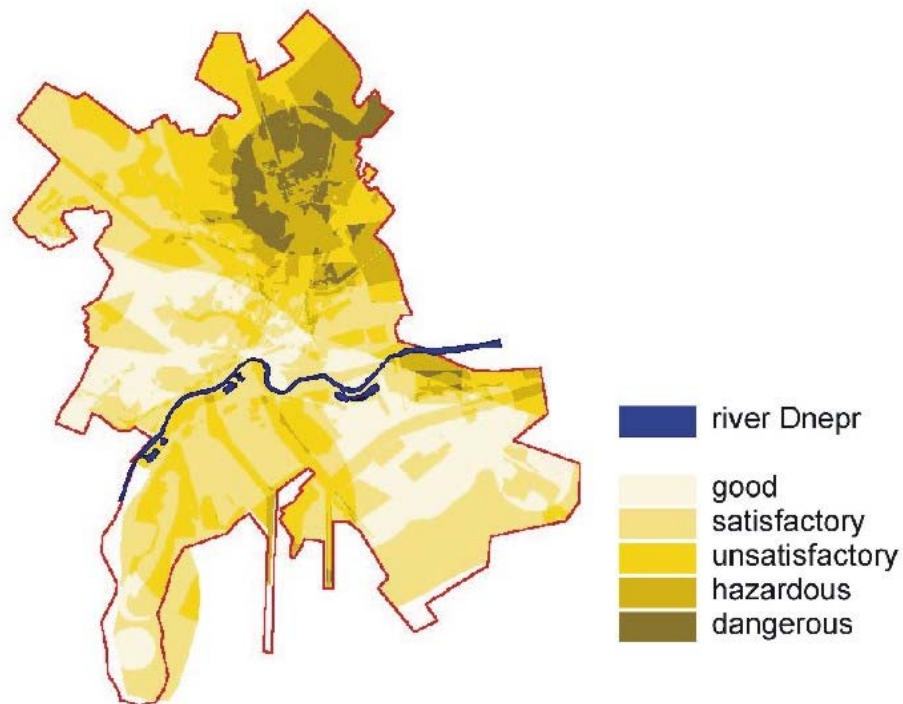
The life quality conditions in the northeast of the city are characterized as dangerous. Such anomaly is explained by an influence of the biggest enterprises, railway station and railway depot situated in this part of the city. The situation is getting weaker because of the prevalence of the southern and southwestern winds transferred the pollutants to the northeastern part from all the territory of Mahilou.

Hazardous conditions in the districts of the MIR-2 and East industrial center are caused by big auto and railways and the irritating of the weather conditions

The territories with unsatisfactory life quality conditions (46%) occupied the significant areas in the city have been aggregated into five zones. The first zone locates in the Kazimirovka district on the northwest of the city. This zone is characterized by weather discomfort and the highest integrative index of air pollution. The lowest level of air quality could be explained by the complex of unfavorable factors linked with locating within the river valleys. Since the area is crossed by the one of the most important of national highways (Mahilou - Minsk) the life quality conditions on the areas along the road could be reviewed as a hazardous.

Unsatisfactory conditions of the life quality in the Jubileynii district are explained by an influence of the industrial enterprises situated on the fringe of this zone. The areas with "unsatisfactory" life quality"

Illustration 1. The distribution index of life quality on the territory of the Mahiliou



index are characterized by the very high level of the environmental pollution and unsatisfactory biophysical conditions: weather discomfort, potential dangerous geochemical conditions of the landscapes.

The zones with satisfactory index of life quality locate in the central and southern parts of the city. Comparatively high level of air and soil pollution within the city center is caused by significant influence of transport. The same situation in the south of the city could be explained by the transfer of pollution from the south industrial zone that concentrated the most significant sources of industrial pollution and intensive influence of the transport caused by allocation of the main roads along the zone.

Good conditions of the quality of life in the central part of the city are explained by the high level of social development. The low level of the chemical pollution causes favorable situation in the southeastern part of the city.

Discussion

Public health is one of the most important indicators of the quality of life. We have tried to find out the relationships between the state of human health and the following factors: outdoor and indoor environment, welfare, professional environment, services availability.

Natural indicators have an auxiliary role in the quality of life compared with environmental pollution that causes the most anomalies. Local spatial structures could be primarily linked with the natural factors. The research shows the links between the main meteorological indicators and public health in the city of Mahiliou.

As it was noted by the World Health Organization, environmental conditions cause about 13-20% state of public health. The level of the total children illness such as respiratory disease, inborn anomalies within the districts in the region of the Factory of the Artificial Fiber is considerably higher than on the other regions of the city. The risk of the chronic affect within the residential zone adjoining to the railway station, the part of the Solominka districts and Eastern industrial center is evaluated as the most dangerous (50-59%). The risk of the chronic affect on the territory of the part of the Solominka district, Eastern and Western industrial centers and MIR-2 districts is evaluated as the dangerous (17-30%). The children living in the residential areas around the railway station, Western

and Eastern industrial centers, MIR-2 and Solominka districts are exposed by the highest risk (Data about, 2001).

According to the data of the World Health Organization the value of the social factors in public health is about 70%. The link is established between the level of the social development of the city districts and the total illness of the children (the center of the city). Nevertheless, when integrated with all factors of the life quality assessment, the value of social factors lost its significance.

The correlation between integrative index of the life quality and public health has been established for the most of the city districts. The highest level of mortality is registered in the northeast and east of the city, thus the low level of the quality of life characterizes these parts of the city. The high level of the mortality in the MIR-2 district is caused by hazardous conditions of the quality of life. The established link between the quality of life and public health does not register for the same territories of the city.

Conclusion

Despite of the fact that according to the official statistics the input of environmental pollution in the range of the factors effected on human health is about 13-20%, the research comes to conclusion that namely the influence of environmental factors plays a main role in the forming of spatial distribution of life quality indexes in such a big city as Mahiliou.

Natural conditions have an auxiliary role within the quality of life. Nevertheless, some of the authors point out the high level of air pollution within the river valleys, a number of the landscape-geochemical studies concludes about the high level of oncological diseases linked with allocation within a valley. Usual, contemporary research do not include the natural factors in life quality assessment that could be possibly explained by low value of the natural factors in the integrative index of life quality.

The research shows that the social factors have no significant importance for the spatial distribution of life quality indexes that could be confirmed on the example of the East industrial center of the city. Service quality indicators and public health are slightly correlated. Possibly the increasing of the accuracy of the research especially further development of the databases and spatial distribution of the data will allow achieving the better results.

The results of the research display the lack of the statistically significant correlation between the quality of life and public health. As a conclusion all the indicators have been corrected in accordance with the density of the population.

The research is for the cities of the different scales. The methods are easy and comfortable for the municipal services using. The research is of interests of the policy-makers.

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