

POPULATION 'HABITATION COMFORT' INDICATORS FOR AREAL COMPARISON IN CENTRAL RUSSIA

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Abstract: This paper reports on research to develop local indicators of 'habitation comfort' that are relevant for population health in the Vladimir region, located in Central Russia. We present a conceptual model based on the literature which led us to include three groups of factors for assessing population habitation comfort: natural-anthropogenic, social and medical-ecological. To assess and display a 'comfort map' of socio-economic conditions, a single database has been developed. Higher comfort level is associated with better social-economic conditions, and also with proximity to major economically developed regions like Moscow and Nizhny Novgorod. The lowest comfort level index was detected in the regions with the worst natural-anthropogenic and social-economic conditions. In further analysis, demographic conditions in the Vladimir region were evaluated by administrative region, and medical-ecological zoning was carried out based on principal causes of diseases affecting the population.

Key words: Health, Population, Pollution, Questionnaire, Modelling.

Article Info: Manuscript Received: September 10, 2012; Revised: November 26, 2012; Accepted: November 28, 2012; Online: November 30, 2012.

Introduction

Nowadays many researchers deal with these diverse aspects of habitation conditions assessment in various regions. For instance, in medical geography the reasons of endemic diseases origin, connected with natural peculiarities (Folasade Iyun *et al.*, 1995, Akhtar, 1991, Barrett, 1999, Avtsin, 1972, Voronov, 1961, Malkhazova, 2011), climatic parameters are studied to assess the favorable climatic conditions (Boksha *et al.*, 1980, Bochorishvili *et al.*, 2005, Gorbatovsky *et al.*, 1985). Considerable attention is given to the research of habitation social features in various regions (Davidov, 1995, Kostovskaya *et al.*, 2010, Sazhin *et al.*, 2008). It should be mentioned that lately even greater attention has been paid to the nutrition behaviour research etc.

However, in real conditions the population is integrally dependant on the all of the aforementioned factors. That is why an integral assessment of various

populations' habitation conditions or habitation comfort has become a very important issue. For instance, by comparing habitation comfort levels alongside health indices, it is possible to view an integrated criterion to describe the situation in the region as a whole. The environmental factors important in heterogeneity and spatial distribution create the need to develop a method of integrated criteria for habitation comfort comparative assessment in the region by applying the modern geo-informational technologies.

Our research aim is to develop principles for the multiple-factor assessment of environmental comfort, and the ecological and medical-demographic conditions for adaptation and population habitation in different regions.

Study area

The research area is the Vladimir region which is located in the central part of the Russian Fed (RF). The Vladimir region is situated on the Smolensk-Moscow upland stretching into the Vladimir Opolye (which has a height of up to 236 m) and the Meshchera lowland in the south. The river system

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belongs to the Volga basin and includes the Oka and the Klyazma rivers. The climate is moderately continental with average temperatures in January at 11° C and 17° C in July. Precipitation is about 500 mm a year and vegetation is represented as the mixed forests of southern taiga.

The Vladimir region is one of the most urbanized, the most economically and industrially developed and the most comfortable region of Russia. Despite the lack of resources and raw materials, the Vladimir region is distinguished by its highly qualified labour force. The overabundance of industrial military enterprises and light industry hampers prevents the ability to adapt quickly in a competitive market and economic environment. The migrant influx and population mobility increase define the importance of determining the environmental comfort rate for population habitation.

Methods applied

In this research we consider *population habitation comfort* as the optimum environment conditions for an individual and the population and investigate individual ability, to adapt to certain habitation conditions using the least amount of additional expenses whilst still preserving intellectual and social activity.

We aim to assess population habitation comfort for the regional level by applying geo-informational technologies. To calculate the comfort level we have created an integrated database of the Vladimir region and we have organised the assessment of habitation comfort according to three groups of factors: nature-anthropogenic, social and medical-ecological (Figure 1).

1. Natural properties; recreational and aesthetic conditions and anthropogenic impact.
2. Social-economic conditions for habitation.
3. Medical-demographic and ecological conditions.

The ecological conditions of the researched area are assessed according to various environmental characteristics, for example; air, soil and water pollution from various sources, radiation level. The medical-demographic situation is estimated by combining the vital rate, populace structure changes and morbidity of basic nosology groups. We have assessed habitation comfort for an individual by applying various characteristics, and assessing general comfort based on data received from a respondent survey. Over 300 respondents from both genders and a range of age groups took part in thirty questionnaires per each gender and age group.

The survey was based on gender character and various age groups. 270 respondents participated in the research (30 respondents per each group). As part

of the questionnaire objective respondents estimated priority factors of all the suggested conditions of population habitation comfort according to the 5-ball system. The survey results were processed applying mathematic statistics methods including Microsoft Excel and 'Statistica' software.

Statistics from the Medical information-analytical center, Regional State Federal Statistics Department of Vladimir region, Hydrometeocenter, Nature Management Department of Vladimir region administration have been used in the research. The population survey method for defining index priority of nature-anthropogenic, social-economic and medical-ecologic conditions has been applied. The statistics were processed according to the following parameters: vicinity to water bodies, forests, centers of population, climatic comfort, average salary, availability of medical care service, pollution of air and water, basic nosologies, morbidity rate etc. (83 characteristics in total). Area zoning was carried out according to all characteristics.

Natural-anthropogenic along with social and medical-ecological can be conditions for population habitation assessment. To evaluate natural-anthropogenic conditions at the local level we identified fourteen parameters: proximity to the rivers, water bodies, forests, swamps, peat bogs, wildlife preserves and other objects, and also climatic comfort. (It is suggested that to assess the proximity of objects influencing area's recreational condition depends on the remoteness rate). Additionally, climate comfort has been assessed according to the weather pathogenicity index, calculated with the help of hydro-meteorological databases. We also considered the factors which can negatively influence a human body.

For our region the most comfortable districts from the point of view of their natural-anthropogenic conditions are the areas located along the Klyazma River. As for climatic comfort the most comfortable districts are situated in the west and east of the region, and the least comfortable is in the central part. To assess the social conditions we used 24 characteristics which characterize the population living standards such as average wage, official unemployment rate, shops, pharmacies, public services availability, dwelling areas per an average single resident.

It is suggested that in order to assess the medical-ecological conditions as a part of population comfort habitation two groups need to be established: regional environmental conditions or ecologic situation and medical-demographic situation in the region. Among the indices characterizing the ecologic situation there are the characteristics which negatively affecting on the population habitation comfort:

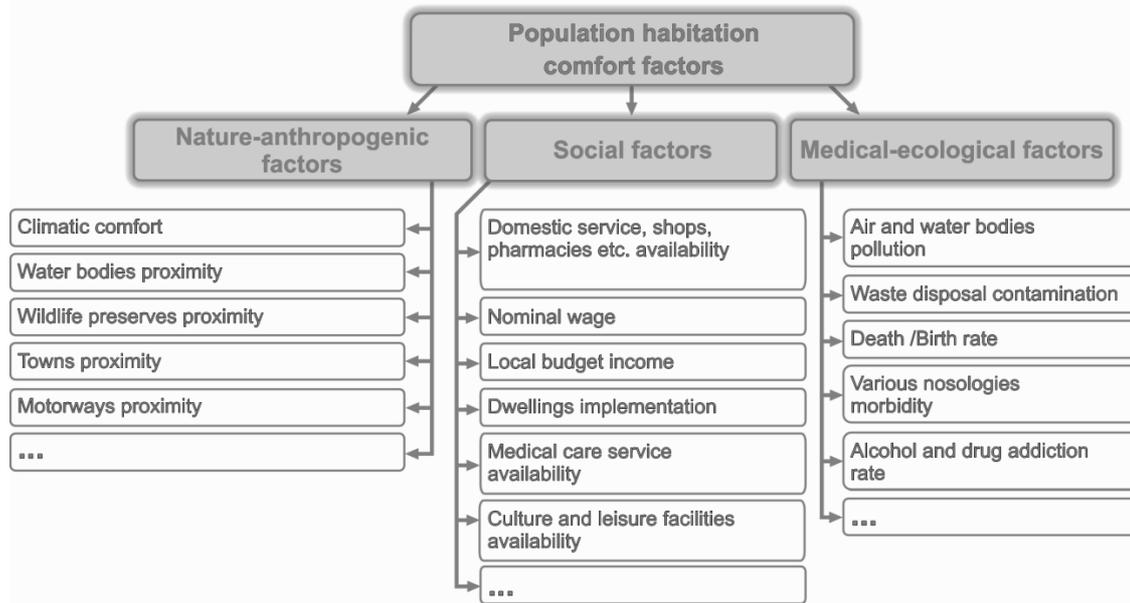


Figure 1. Identification of principle factors and parameters, influencing populace habitation comfort

- air pollution from permanent sources;
- air pollution from automobile transport;
- water bodies pollution;
- waste disposal in the research area;
- waste landfills location an types.

To assess the medical-demographic environment 40 indices have been identified; they are characterized by the basic nosologies morbidity rate, death and birth rates, which have been transformed into a 5-ball system for further comfort evaluation. According to the general sickness rate it can be stated that the 1st place belongs to respiratory diseases (23.5 %) 2nd place is blood circulation disorders (15.4 %) and 3rd place is digestive apparatus disorders (8.6 %). Among the adult population blood circulation disorders prevails (20.2 %) in the structure of general sickness rate and among children and teens respiratory diseases prevail (53.2 % and 36.4 % correspondingly).

The general assessment of population habitation comfort has been calculated using a geo-information system procedure and the following formula:

$$K = F_1 * p_1 + F_2 * p_2 + F_3 * p_3$$

where:

F – Ball according to the comfort factors;
p – Priority of the population habitation comfort, the indexes are: nature-anthropogenic (1), social (2) and medical-ecological factors (3).

After calculating this formula the general comfort condition can be then normalized according to this formula:

$$Ball = ((a - min)/(max - min)) * 5$$

where:

a – Value of an indicator; *min* – Minimum of indicators, *max* – maximum of indicators.

For further evaluation of the received results on self-descriptiveness, demographic conditions of the Vladimir region have been assessed using the demographic tension index (DTI), which includes the most common characteristics in the formula:

$$DTI = U * \lg \rho * (0,1 * Z - 2 * P + C) * C_d^2 * V$$

with

- U* – urbanization of the area;
- ρ* – population density (people/km²);
- Z* – total annual morbidity (per 1000 people);
- P* – general birth rate index (per 1000 people);
- C* – general mortality (per 1000 people);
- C_d* – children (infant) mortality (per 1000 people);
- V* – corrective factor for Vladimir region.

Results

Judging by the survey results the nature-anthropogenic conditions are more preferable for the younger population (less than 18 years of age) and older generation (above the 55 years of age). At the same time social conditions are important among the able-bodied population between the ages of 18 and 55 and the medical-ecological conditions are dominated by children, males between the ages of 18 and 30 years old and the retired population.

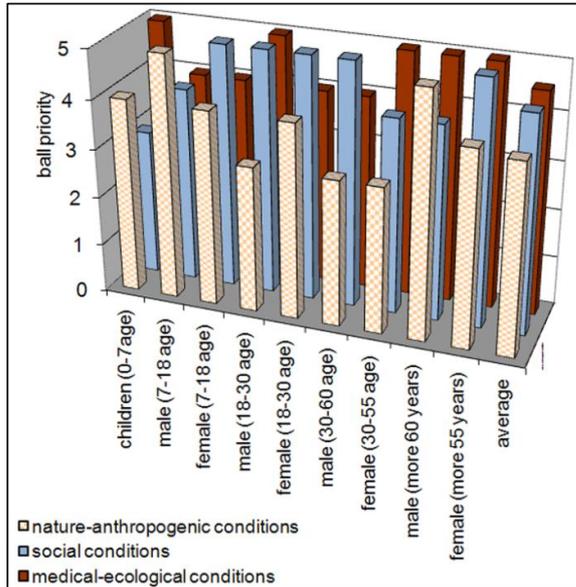


Figure 2. The priority of the population habitation comfort factors (averaged by survey results)

The diagram demonstrates individual levels of adaptation ability according to the environmental factors of people of various gender and ages (Figure 2).

In this paper we illustrate the characteristics of the habitation comfort rate for children under seven and women aged between 18 and 30 as an example (Figure 3, 4). The diagram shows, that according to comfort priority factors, the medical-ecological conditions are the most significant for children, the

second rate factors are the nature-anthropogenic ones and the social factors are not so important for them.

Regarding population habitation comfort in the Vladimir region for women aged between 18 and 30, the following areas are the most favourable; Alexandrov, Kolchugino, Gorokhovets to name but a few. The least favorable areas are situated in the Gus-Khrustalny and Kovrov districts. The diagram shows that for women aged 18-30 the most significant factors are the social conditions, but the nature-anthropogenic and medical-ecological are of less importance. In compiling the map of comfort habitation integral levels for the researched area, summation of all indices in geo-informational environment have been applied using weighting coefficients of gender-age structure (Figure 5). The DTI has been calculated for separate districts of the Vladimir region using the data from the Nature Management Department of the Vladimir region administration statistics (Figure 6, Table 1).

One of the DTI parameters is *birth rate*, which has been lower than average in Russia for the last several years. The present birth rate in the region is considerably lower than required even for simple reproduction. The drop in birth rate is dependent on unfavourable changes in the population age structure, but for the last two years the situation has slowly been changing for the better.

At the same time the *general death rate* in the Vladimir region exceeds the average mortality rate in Russia. Blood circulation disorders rank in first place (38.8 %), accidents and poisoning rank in second

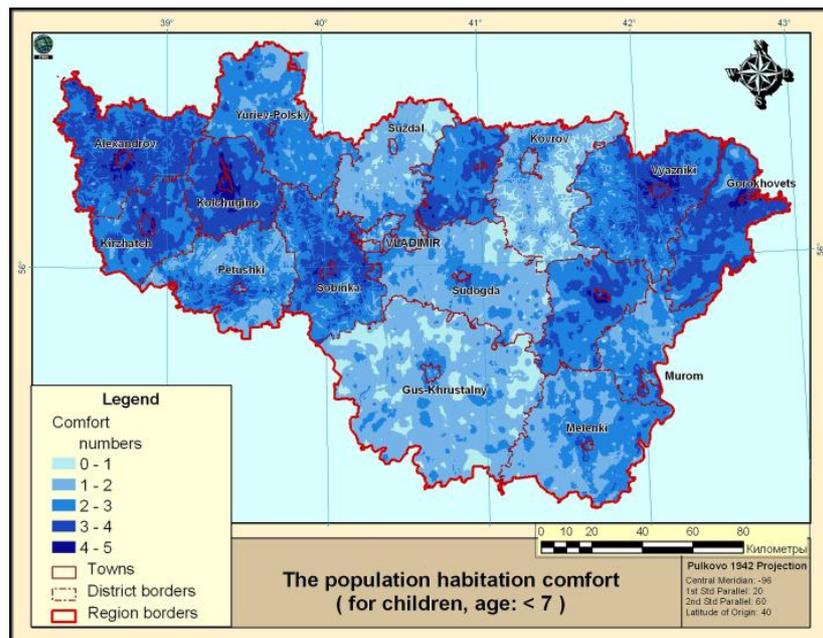


Figure 3. The population habitation comfort (for children)

place (28.3 %) and these are followed by neoplasms (11.3 %), digestive apparatus disorders (7.3 %), respiratory organs diseases (4.3 %), infectious diseases (3.3 %), others (6.7%).

Infant mortality, mortality among infants younger than 1 year old, is of great significance for

demography. The infant mortality index (IMI) is a criterion of general well-being and ill-being and in the Vladimir region is on average consistently lower in comparison to Russian as a whole. Besides it has decreased considerably lately and the reasons have the same pathology as in the country in general. In terms of perinatal pathology, in the first place there is innate abnormality, in the second place, respiratory disorders, in the third place, infections and parasitic diseases in fourth place.

The demographic tension index map, demonstrates a different situation, using the index for the Vladimir region districts has been compiled. The highest DTI values were registered in Vladimir, Melenki, Kovrov, Kameshkovo, Vyazniki, Alexandrov, Selivanovo and Murom districts. Such high index values are caused by children and general population mortality, general disease incidence and population density, except for Melenki and Selivanovo districts with low population density, but high rate of children and general death rate. The DTI decrease has been identified both in the Vladimir region, as a whole, and in the separate districts of the region as well.

Table 1. Demographic tension index (Vladimir region)

Districts	Population density (person/km ²)	Demographic tension index
Alexandrov	69.5	0.165
Vyazniki	44.9	0.57
Gorokhovets	18.9	0.32
Gus-Khrustalny	31.2	0.19
Kameshkovo	36.4	0.67
Kirzhatch	42.5	0.25
Kovrov	104.7	0.95
Kolchugino	53.7	0.04
Melenki	20.2	0.085
Murom	162.1	0.04
Petushki	44.1	0.085
Selivanovo	16.9	0.026
Sobinka	42.3	0.9
Sudogda	20.3	0.1
Suzdal	235	0.17
Yuriev-Polsky	21.8	0.045
Sum		0.91

Discussion and conclusions

Comparing comfort habitation maps and the DTI it can be stated that comfort maps possess much higher self-descriptiveness. Obviously a high DTI does not always correlate with a low habitation comfort value. Such regions might have advantages in other vital parameters for various population groups, which are part of comfort indices.

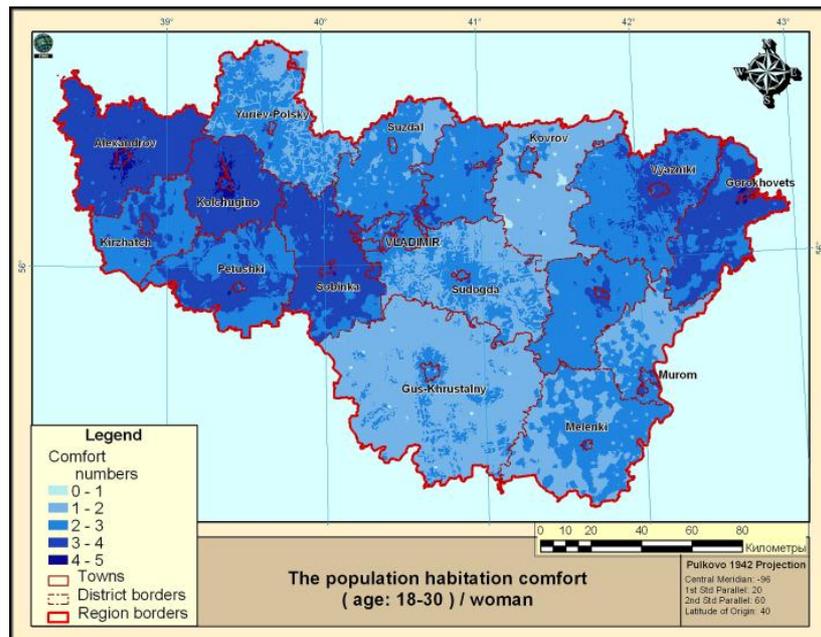


Figure 4. The population habitation comfort (for women)

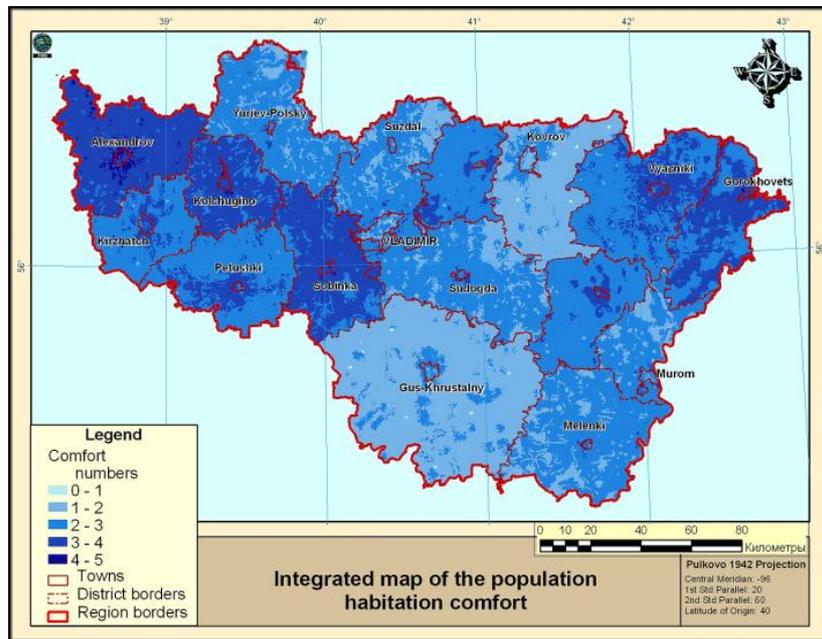


Figure 5. Integrated map of the population habitation comfort



Figure 6. Demographic tension index (2005-2007)

For instance, the Alexandrov and Kolchugino districts, despite their high DTI, are distinguished by a high comfort rate which is explained by more favourable social-economic and medical-ecologic conditions determined by the proximity of Moscow, a major economically developed region. On the contrary the low DTI of the Gus-Khrustalny district does not provide a high habitation comfort level, it is connected with worse natural-anthropogenic and social-economic conditions compared to other districts of the region.

Research results can be used to assess population habitation comfort by Municipal departments with

the aim of making more optimal decisions. The comfort rate evaluation might also be useful for migration departments and real estate agencies when choosing the best place of residence.

The most scientifically approved approach for multi-factor population habitation comfort assessment in the region has been suggested. The parameters complex which determines the optimal adaptation ability of an individual and the various resident populations under the conditions of a certain nature-regional complex has been revealed.

The geo-informational systems including developed software modules and applying up-to-date

object-oriented programming languages, has been created and an integrated habitation comfort database for Vladimir region has been developed. Applying the geo-informational environment, habitation comfort maps have been compiled according to various gender and age groups. The computer calculation for the possibility of habitation comfort for an individual has been created as well.

Integral indices for population habitation comfort rate are considered as individual characteristics; on the one hand, as multi-dimensional integrated population and adaptation characteristics of environmental factors impact on the other hand.

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