Title: The volume of generated waste, population density and road network density : anthropogenic pressure index

Author: Damian Absalon, Barbara Ślesak

Citation style: Absalon Damian, Ślesak Barbara. (2011). The volume of generated waste, population density and road network density : anthropogenic pressure index. "Procedia Environmental Sciences" (Vol. 3, (2011), s. 136-140), doi 10.1016/j.proenv.2011.02.024

Available online at www.sciencedirect.com

ScienceDirect

Procedia Environmental Sciences 3 (2011) 136–140

Procedia Environmental Sciences

Spatial Statistics 2011 – Mapping Global Change

The volume of generated waste, population density and road network density - anthropogenic pressure index

Damian Absalon[a], Barbara Ślesak[b]

[a]*Faculty of Earth Sciences, University of Silesia, Będzinska 60, 41-200 Sosnowiec, Poland*

[b]*Upper Silesian Child Health Center, Medykow 16, 40-752 Katowice, Poland*

Abstract

The study attempt to define an anthropogenic pressure index (I_A) on the basis of the data, available for Upper Silesian Metropolitan Union districts. The volume of generated waste, population density and road network density, were taken into account to determine this parameter. Each of these factors was given the same level of importance in assessing the degree of its contribution to deterioration of the natural environment. The data were related to the mean of each factor for all districts. This index uses values of $I_A<100\%<I_A$, where value $I_A< 100\%$ represents an area with the lower than mean of concentration the negative factors degree, and $I_A >100\%$ represents an area subjected to the greatest anthropogenic pressure (more than a mean of the negative factors degree). The importance of individual factors was set as 1, assuming that each factor had an equal impact on the environment. In the Upper Silesian Metropolitan Union districts, the estimated values of the anthropogenization index range from 3.1 to 14.9 (for Silesia region), and from 13.8 to 78.2 (for Poland). The graphic representation of data, was possible owing to GIS-supported analyses. Visual presentations are shown against the background of Silesian region and Poland maps.

Selection and/or peer-review under responsibility of [name organizer]

Keywords: harmful factors; antropogenic index; environmental exposure; gis-based analysis

doi:10.1016/j.proenv.2011.02.024

1. Study area Introduction.

The area of research is the Upper Silesian Metropolitan Union (GZM) which is covered with 14 cities, which are both, autonomous administrative units. The goal of the union is better management, the ability to raise funds and thus the greater development of each individual. Such policy has a direct bearing on the possibilities of influencing and shaping the environment of human life. Especially, it should be noted that the specificity of place, where for several years developing the mining industry, which is burdensome for the environment. Currently, despite the inhibition of the industry, this area became the Silesian center of business, communication and culture [1].

Fig. 1. The Upper Silesian Metropolitan Union (GZM) against the background Poland and Central Europe. The Silesian Province The Upper Silesian Metropolitan Union is divided into 14 districts administratively and the number 1-14 has been assigned as district number for each district: 1-Gliwice; 2-Zabrze; 3-Bytom;4-Piekary Ślaskie; 5-Swietochlowice; 6-Siemianowice; 7-Ruda Śląska; 8-Chorzów; 9-Katowice; 10-Tychy; 11-Mysłowice; 12-Sosnowiec; 13-Jaworzno; 14-Dąbrowa Górnicza.

According to the Statistical Yearbook of provinces [2], at the Silesian province, there is contained approximately 1.4 per year t/km^2 gaseous and 2.8 / km^2 dust in the air (the most dangerous form). Such impurities can easily get into the human body. Harmful effects of dust depends on the type, grain size, concentration and exposure time. In the air, in addition to natural dust - is the dust of anthropogenic origin. The sources of air emissions are industrial plants, areas of low buildings or farms, main roads, or communication lines (the main source of lead in air). The air pollution is also affected by the transit coming from outside the province [3].

Another factor influencing the concentration of air pollutants, is the direction of prevailing winds. Predominate (45% of the days of the year) westerly winds that bring much of the pollution from western Europe (Kaminski, 1987). In Silesia, the measurement of the concentration of particulate matter, selected heavy metals and compounds in the air leads Provincial Environmental Protection Inspectorate in Katowice, with 16 automatic stations located in specific parts of the province. With daily data, monthly and yearly clear that, at least in the near Katowice standards for particulate matter are repeatedly exceeded. Especially in the winter months, when it is due to increased heating of individual households.

Previous studies indicate a parallel between air quality and health quality of life [3, 4]. This is also reflected in the state of health of the region, which is reflected in the subsequent statistics. They show a more frequent occurrence than in other regions of allergies, respiratory diseases, skin diseases, and diseases of the central nervous system or cancer [5, 6].

Region has a population of 4.6 million, representing 12.2% of the Polish population. Silesian region is the most urbanized region in Poland, 78.4% of the population is an urban population, the country has the highest population density (510 persons / km²), the national average is 122 persons per km². These facts have consequences later in the assessment of quality of life in GZM [7]

One factor, that contributed significantly to environmental degradation is greatly expanded the road network. In this condition influenced the nature of the region, its urban-industrial function, where it was needed the movement and transport of goods. This network is systematically developed and improved. According to data of Central Statistical Office, the density of road network in GZM in 2007 amounted to 323.9 km2/100km2 (the national average in Poland) [8].

Due to the mineral resources, which have been intensively exploited for many decades, typical for the region, is the use of land, which is largely subject to anthropogenic influences. Due to the industrial and residential buildings, the test area is strongly and consistently being transformed under the influence of unfavorable factors. This allows you to request a significant impact on quality of life of the population and is reflected in the state of health of residents.

1.Aim and methods work.

The aim of this study was to identify the designation and the designation of the most potentially toxic impact on the health impacts of human activity, demonstrating the degree of damage. The ultimate result is a collection of various anthropogenic factors and to provide a single common anthropogenic index. For this purpose there was used a statistical calculation using the formula:

$$I_A = [a_1/b_1 + a_2/b_2 + a_3/b_{3\ldots}]/\sum [c_1 + c_2 + c_3]$$

where $a_{1,2,3\ldots}$ are values of consecutive factors in the study district; $b_{1,2,3\ldots}$ are values of mean value of factors in all districts of Silesia region, and Poland, and c represents the importance of the studied factor. The importance of individual factors was set as 1, assuming that each factor had an equal impact on the environment.

This was achieved by using data on population density, road network density and the amount of waste produced in the site, these data are presented for the following counties GZM in relation to the average of the data for the province of Silesia, and Polish. Gathered the value allowed for the preparation of the image of anthropogenic pressure in GZM.

2.Results.

The results clearly show the great influence of human activities to environment. These are all the more important results that show the extent of damage in relation to the average in the province of Silesia, where it must be observed not only higher rates but very large dispersion of results from slightly more than 2 to almost 14-fold difference compared to the region (Fig. 2) . As expected the greatest rates are noted in the districts of central and western part of Upper Silesian Metropolitan Union. Districts with the highest values are Chorzów (8) and Ruda Śląska (7), (Fig. 2).

Even higher ratios are formed in relation to the average measured on Polish territory from 8.5 to more than 78 percent difference (Fig. 2.2). The highest rates are noted in the district of Ruda Śląska (7) and Katowice (9), (Fig. 2.2).

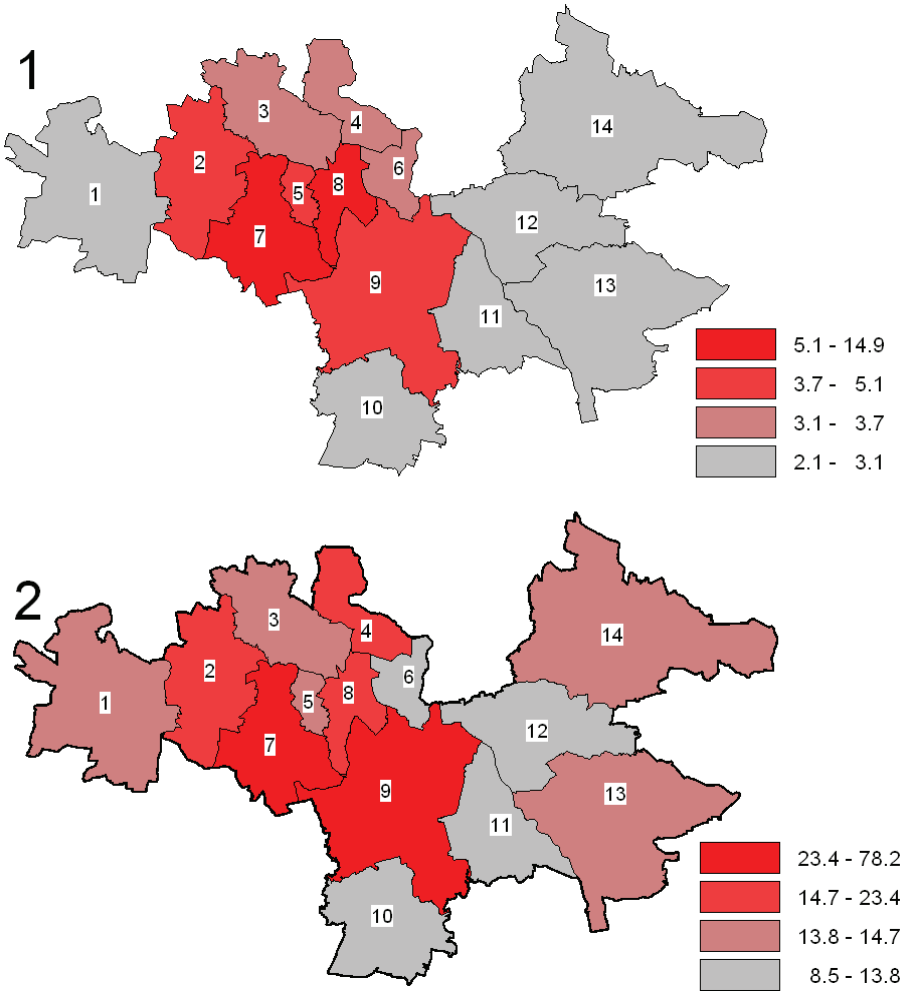

Fig. 2. Indicators of anthropogenic index (%) in various districts of GZM in relation to the Silesia region (2.1) and Poland (2.2). The numbers in the polygons indicate the district number, in accordance with Fig. 1.

The Study suggests that GZM is a region with a particularly high rate of anthropogenic changes, thus represents a major potential danger to human health.

3. References

[1] Dulias R., Hibszer A. red., 2008: Górnośląski Związek Metropolitalny. Zarys Geograficzny. Polskie Towarzystwo Geograficzne, Sosnowiec, 304s.
[2] Rocznik statystyczny województw Głównego Urzędu Statystycznego, 2006, Warszawa.
[3] Kagawa J., 2002: Health effects of diesel exhaust emissions – a mixture of air pollutants of worldwide concern, Toxicology, 349-353.
[4] Au W.W., 2002: Susceptibility of children to environmental toxic substances, International Journal of Hygiene and Environmental Health, 501-503.
[5] Mosavi-Jarrahi A., Moini M., Mohagheghi M.A., Alebouyeh M., Yazdizadeh B., Shahabian A., Nahvijo A., Alizadeh R., 2007: Clustering of childhood cancer in inner city of Teheran metropolita area: a GIS-based analysis, International Journal of Hygiene and Environmatal Health, 113-119.
[6] Wu K., Huo X., Zhu G., relationship between esophageal cancer and spatial environment factors by using Geographical Information System, Science of the Total Environment, 219-225.
[7] Stan środowiska w województwie śląskim w 2006 roku, 2007: Wojewoda Śląski, Wojewódzki Inspektorat Ochrony Środowiska, Katowice, ss. 174.
[8] www.gus.gov.pl