

The Impact of Urban Spatial Structure Scenarios on Air Pollution (A Case Study of Tehran)

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Extended Abstract

1. Introduction

The specialization of occupations, diversity in land use, alteration of land application patterns, and spatial dispersion of activities as well as the increase in the number of daily trips have affected the range of trips or various applications' sphere of influence; in such a situation, individuals need to travel long distances, particularly via personal automobiles (Ghadami, 2012). Studies by urban planners in this regard show the impact of urban development structure and pattern on exacerbating dependency on vehicles such as automobiles. In other words, any spatial shape or structure could support different transportation pattern in cities.

Either directly through fossil fuel consumption or indirectly through the production of other types of energies, the transportation sector produces various greenhouse gases; subsequently, transportation is considered as one of the main causes of air pollution. Therefore, the identification and design of a spatial structure with the capability of adapting to the present and future conditions while remaining sustainable is, today, one of the vital necessities in the area of urban planning (Bertaud, 2002).

Meanwhile, despite the escalation of numerous issues caused by the expansion of urbanization, the evolution of urban spatial structure is mainly overlooked (Bertaud, 2002). As a result, significant shortcomings due to weak spatial structures are mostly

neglected, to the extent to which the time for any sort of action is lost (Bertaud, 2003). Considering the relation between these two important components, in other words, the spatial structure and air pollution, the major purpose of the present study is to examine the impact of spatial structure on the extent of air pollution.

2. Methodology

The present descriptive, analytical study seeks to provide answers to this question: Do different scenarios of urban spatial structures have different impacts on the extent of the emission of pollutants? Secondary and official information published by the Iranian statistics institution and organizations related to Tehran municipality and the environment protection agency are used in this research.

Network Analysis in ArcGIS software was used to calculate the distances and a possible model for limited attractions and the pollution indices of vehicles in Iran were the main tools and models used in this study.

The three scenarios in the study include 30% of changes in the city's spatial structure within frameworks including the continuation of the current urban spatial structure pattern, scattered urban growth, and centralization of spatial structure.

3. Results

The results of Shannon's entropy model demonstrate an outward, random and decentralized growth of Tehran. Given the

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results of Gi (getis-ord) statistics and hot-spot clustering in 1996, the city of Tehran involved 2 concentrated areas in 4 regions including regions 14-18 with a population of 6493700, 450160, 264300, and 298600 people, respectively. In 2006 however, the concentrated clusters of Tehran grew to 4 areas in 8 regions including regions 4, 7, 10, 11, 14, 15, 17, and 18 with populations of 813238, 305240, 315173, 275241, 475520, 64329, 255864, and 249786 people, respectively.

To estimate the extent of air pollution in this study, first, the number of trips taken between regions were approximated. According to the information by the comprehensive traffic plan of Tehran, the most used means of transportation are cars. In the next step, various factors of pollutant emission for different vehicles were employed.

In “Scenario A,” air pollution was investigated considering a 30% increase in population and attractive applications across 22 regions of Tehran in compliance with the current pattern. In this study, the concentrations of pollutants separated by vehicles along with the extent of pollutants separated by their types and the entire pollutants in scenarios were calculated. According to the results, in the situation of 30% increase in the current spatial structure pattern, the highest and lowest shares in air pollution are caused by carbon dioxide and lead, respectively.

In the next scenario with a 30% increase in the number of attractive applications and population in outside regions of Tehran including regions 1, 2, 4, 5, 8, 13, 14, 15, 18, 19, 21, and 22, the sum of all pollutants in

this scenario is 5565 tons, which compared to the similar scenario (30% of the status quo), an increased extent of pollutants is implied.

In the centralization scenario (C) the 30% spatial structure is added to the extent of attractive applications and population across the central regions of Tehran, namely, regions 2, 6, 7, 10, 11, and 12.

A comparative examination among scenarios A, B, and C of the spatial structure in relation to air pollution separated by pollutants (tons) shows that the highest potential for air pollution among scenarios is the first one (Scenario A) with more than 5738 tons. Moreover, the lowest potential for air pollution is related to the centralization of spatial structure scenarios with 5192 tons.

4. Conclusion

Given what was expressed, it can be concluded that the two scenarios involving the continuation of the status quo and scattered growth (through population growth and activities in outer regions of Tehran) both involve the highest potentials for increasing pollution. These scenarios are of a stronger relationship with the current pattern of Tehran’s spatial structure. This shows that the subject of balancing Tehran’s pollution would remain, regardless of the spatial structure of the city; in case substantial changes in the current structure are overlooked, a more severe increase in Tehran’s pollution is expected.

Keywords: Spatial structure, Air pollution, Scenarios, Tehran

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