

Case study of environmental pollution at Sajjad Boulevard of Mashhad municipality

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ABSTRACT:

Due to the rapid growth of cities in Iran, the increasing number of vehicles and the urge for moving to meet the daily needs, the cities cause pollution at the local and medium-sized level. Today's urbanization must be based on sustainable development. This case study, based on the information and evidence of the current situation, has been created to deal with the effect of street parking on creating traffic and as a result, environmental pollution in the Sajjad Boulevard local district 1 of the municipality of Mashhad. For this purpose, after analyzing the current status of the parking lots on the street and the amount of the traffic at the intersections, the study of the amount of air pollution in Sajjad Boulevard, local district 1 of Mashhad, has been investigated. This research was descriptive-analytical and data collection was done in two types of documentation and survey methods. The final results indicated that the fuel consumption and pollution resulting from the occupancy of the street road surface on street parking lots was rising considerably, endangering the health of citizens.

Keywords:

Street parking, Air pollution, Traffic, Mashhad municipality.

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Large cities is one of the most important sources of air pollution. Traffic, as one of the most important criteria for development and planning in transportation, currently has a significant share in the cost of household's portfolio of expenses. In addition, the traffic causes irreparable damage and contributes to the pollution of the urban environment and the deterioration of physical and mental health status. In Iran, as one of the developing countries, and especially in its metropolitan areas, the increasing number of vehicles and the demand for traffic has exacerbated this problem (Briggs *et al.*, 2000) and has created wheeze problems in children (Briggs *et al.*, 2000).

The city of Mashhad with over 3,057,679 inhabitants and 25 million pilgrims and travelers in 2016, as well as about 6 million trips per day, saw heavy traffic problems caused by the inappropriate use of communication routes. The excessive use of personal vehicles, lack of electric and electric-transportation vehicles the excessive growth of inappropriate traffic (such as business places at the edge of the city) and increasing demand along with the growing population.

1. Population of Mashhad regions based on 2016 census

Area	Population (according to the census of 2016)	Area (ha)
Mashhad city	3057679	35147
District 1	167013	1477
District 2	513365	3844
District 3	417950	3307
District 4	262184	1342
District 5	175603	1438
District 6	232616	1869
District 7	253236	4742
District 8	92543	1930
District 9	327061	4473
District 10	296823	2333

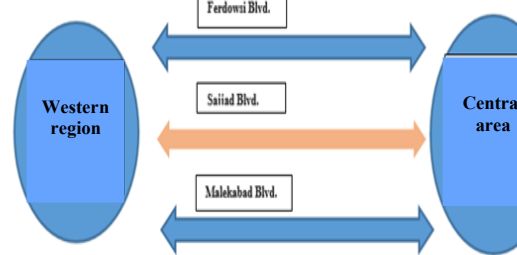


Figure 1. Location of Sajjad Boulevard and its relationship between the center and west of Mashhad city

The location and the vastness of the city of Mashhad has exacerbated and intensified the needs and problems of transportation and traffic of the city and its citizens. From another perspective, the phenomenon of traffic-based pollutants is considered as a spatial-temporal truth that affects the volume of real factors and parameters (Zanjirani *et al.*, 2010). This issue is closely linked to factors such as increasing vehicle volume, passenger travel, inland and outward travel, facilities and public services, public transportation infrastructure and geometric shapes of the road network (Sanjay and Ravi, 2007). Therefore, it is important to study the role of each of these factors in the air pollution control and it is very important in the field of urban management and decision making (Marshall *et al.*, 2008).

The spatial information system GIS (Geographic Information System), as a comprehensive system for analyzing and deciding spatial factors, can use a large amount of real-world facts in digital form (Badard and Fournier, 2001). Therefore, it is inevitable to collect effective data and parameters such as the volume of pollutants released into the urban environment, the number of trips, the geometric shape of the road network and the distribution of traffic in order to design and model the traffic and the management of the city.

Area	based on census of 2005	in the year 2026	Total area (
Part 1 (Sajjad neighborhoods, Malekabad)	26846	28879	3091283
Part 2 (Neighborhoods of Feles-tine, Middle East, Abkhoo)	29605	29876	2264808
Part 3(Goharshad, Hejrat, neigh- borhood)	30814	33610	2779599
Part 4 (Majd neighborhoods, Motahari 2, Ghaem, Sanabad)	44301	50496	3067512
Part 5 (Ahmadabad neighbor- hood)	26799	28360	2595961

one of the most effective methods for calculating traffic air pollution concentration centers. In this regard, such as: spatial and descriptive data related to traffic, mobile and user in urban space, distribution patterns and densities were considered as the basis of estimation methods. Accordingly, sources related to nitrogen oxides, carbon dioxide (CO₂), carbon monoxide (CO), Volatile Organic Components (VOCs), sulphur dioxide (SO₂), nitric hydro carbonates and suspended particles were investigated. In the study area of Montreal, Canada, with implementation of same statistical analysis, it was found that 50% of the pollution of nitrogen oxides and 43% of the volatile organic components originate from urban transport (Lefebvre *et al.*, 2001). Other studies have also been carried out and the results of the spatial relationship with the implemented GIS showed that other factors related to the problem are an important indicator in measuring and estimating traffic pollution (Poorhammad and Ahmad, 2007).

In the sequel, by simulating three-dimensional and two-dimensional NO₂ spatial variations and analyzing how vehicles concentrate and releases it in the atmosphere using GIS, the GIS parameter has an important role in maintaining and improving the health of the community and the urban environment (Hoek *et al.*, 2001). However, one of the most

challenges in the field of traffic pollution from urban traffic (Mulebeke and Zheng, 2010). In this way, despite the importance of this factor, this factor has not been considered and has not played an active role in the final results. Determination of different parameters such as different pollutant sources, the effect of each source, the integration of factors and parameters, the implementation of spatial and temporal analyzes on parameters for predicting future status in the GIS can be easily accomplished (Rebolj and Sturm, 1999). This case study was conducted to examine the space occupied by vehicles in the parking lot, which causes traffic due to the reduction of street width, and the amount of stopping time and air pollution at the crossings of Sajjad Boulevard (Blvd.) in Mashhad municipality district 1 to identify the dimensions of the problem by describing and explaining the serious consequences caused by traffic to human health and the environment.

MATERIALS AND METHODS

Area of study

The study area of Sajjad Boulevard is in Mashhad municipality district 1 (as shown in Figures 2 and 3). As shown in Tables 1 and 2, the population is about 100000. This area consists of five parts and about 28000 inhabitants in part 1 of district 1 Mashhad city (including the neighborhoods of Sajjad, Malekabad, Feleshtine, Middle East, Abkhoo, Goharshad, Hejrat, Majd, Motahari 2, Ghaem, Sanabad, Ahmadabad).

The Neighbourhood	Ppopulation	Attract travel	Parking required	Number of parking spaces on the street and outside the street	Available parking space	The proportion of parking in the neighborhood	Average parking rate in the area	Cond
Sajad	1,868	33,512	37235	1,150	1278	0.03	0.03	Short
Malek Abad	12,484	3,724	409	128		0.03		Short
Felestin	13,075	4,332	43321	409		0.09		Short
Rahnamaee	12,873	25,993		1,635	2725	0.06	0.07	Short
Abkooh	10,947	12,996		681		0.05		Short
Goharshad	17,650	23,206	33151	1,348	1925	0.06	0.06	Short
Hejrat	15,583	9,945		578		0.06		Short
Majd	19,597	12,661	36173	403		0.03		Short
Motahari2	16,633	18,087		350	1751	0.02	0.08	Short
Ghem and anabad	15,195	5,426	45228	998		0.18		Short
Ahmad Abad	31,108	45,228		2,321	2321	0.05	0.05	Short
				167,013	195,108	195,108	10,000	Total

interconnection of two urban areas, the traffic area a due to the location of a number of administrative o banks, commercial complexes and educational cente trans-regional performance the traffic becomes heav by day.

The Sajjad Boulevard of Mashhad Munic of Iran was analyzed for the extent of environment lution due to defective parking system in ope Mashhad is considered to be an industrial and co cial center. Every car owner would wish to park th as closely as possible to his destination so as to mi his walking. High volume of traffic consisting o fast and slow-moving vehicles is plying through th Significant traffic generators are located in the stu ea, such as commercial centres, shopping centres, rants, banks, residential flats, government offices, tals, city bus stops, near railway stations, etc. In t sence of ample off-street parking facilities, cars ar hazardly parked along the curb, creating traffic o tion and hazards. No parking bay is labelled; thus, park their vehicles on the street. The problem of p has taken on severe proportions with the rising vehicle population. A comprehensive analysis of p characteristics, demand, behaviour preference and latory steps that are possible for regulating is o benefit to a traffic engineers as well as town plann aim of the parking survey and questionnaire surve provide all these kinds of data (Herin and Jisha, 20

Parking characteristics There are certain o teristic which have full impact on parking deman as:

Parking accumulation: It is defined as the num parked vehicle at a specified time is called Parking mulation. Normally his is expressed by accum

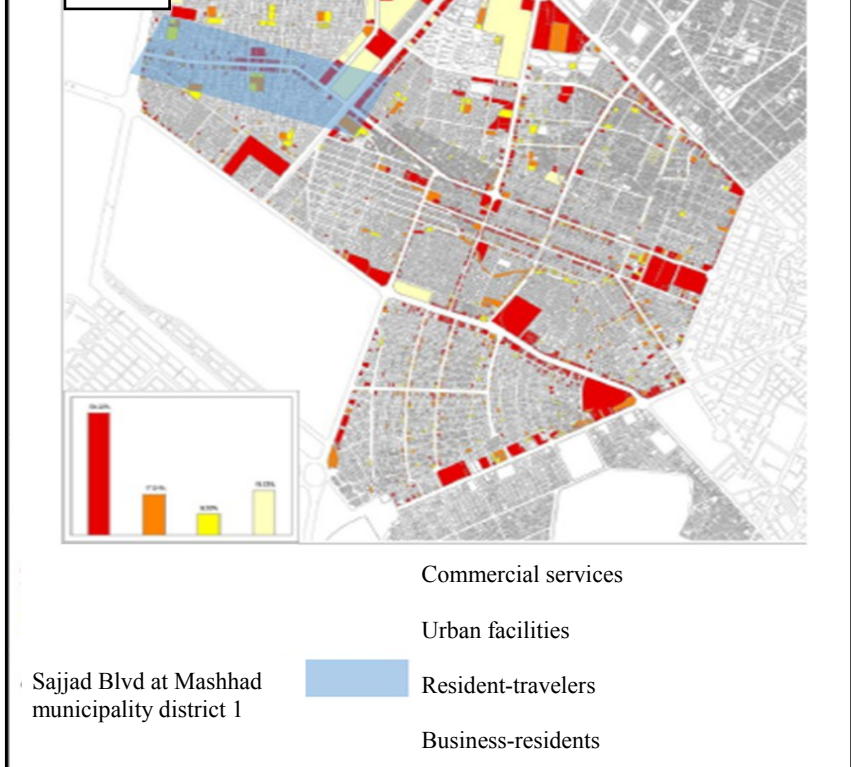


Figure 2. Functional scale of applications in district 1 of Mashhad municipality

of time for which vehicle uses the facility.

Parking volume: Parking volume means number of vehicles involved in parking activity is called parking volume.

Facility occupancy: It is defined as the ratio of number of vehicles using parking facility to the number of parking facilities available at a specified time

Average Time loss: The time loss due to the break of traffic passage that is mainly effected due to ineffective traffic.

Carbon emissions: The more traffic disturbance leads to the more emission of hydrocarbon, carbon dioxide, carbon monoxide etc.

Fuel consumption: More traffic problems lead to more fuel consumption which in turn increases the demand for fuels.

time is then counted. The number of vehicle that use the parking lot is also taken. The final occupancy of the parking lot is also taken. We also collected data regarding the time duration of a vehicle using the parking lot. Parking duration and turnover are also obtained. We did not estimate the parking fare from this survey (Sajjad and Arjita, 2018).

RESULTS AND DISCUSSION

Descriptive findings

After analyzing the data of Mashhad municipality from the statistics center as well as Mashhad municipality organization and according to the municipality data regarding district 1 of Mashhad, the number of travel attraction in district 1 has been calculated and according to Table 1, the condition of parking supply is now about 3%. The

Thursday, 18 April 2013

Approach 1, Detectors: 2-4

	00:	01:	02:	03:	04:	05:	06:	07:	08:	09:	10:	11:
:15	202	109	53	15	2	11	59	286	409	485	475	426
:30	207	139	33	21	6	5	91	318	390	424	505	462
:45	151	94	23	10	17	18	170	326	421	425	469	446
:60	129	67	21	11	11	55	269	354	380	474	475	455

Hourly Total	689	409	130	57	36	89	589	1284	1600	1808	1924	1789
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AM Total: 10404 AM peak 1924 10:00 - 11:00

	12:	13:	14:	15:	16:	17:	18:	19:	20:	21:	22:	23:
:15	456	401	262	323	344	414	458	502	353	432	384	322
:30	425	371	290	312	351	491	503	413	393	390	380	298
:45	414	401	289	348	348	429	477	482	470	429	336	285
:60	395	325	317	386	446	341	436	391	419	324	343	-

Hourly Total	1690	1498	1158	1369	1489	1675	1874	1788	1635	1575	1443	905
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PM Total: 18099 PM peak 1918 18:15 - 19:15

Daily Total 28503

me and also speeds at least three intersections to the
 The saturation of the car has become impossible and
 ly impossible to control with guidance lights, and the
 ce of police and locals after a long time cause traffic
 tion.

The consumption of gasoline and diesel fuel in
 ad according to the statistics of Mashhad Environ-
 Organization in 2016 was calculated as given in Table
 Mashhad, daily consumption of gasoline is 3060 thou-
 sants and gas oil is 2395 thousand liters. The consump-
 tion at peak hours also exceeds 1.12.

30 * 1.12 = 3427200 liters (Daily gasoline consump-

tion in the Mashhad region).

- 3427.2 * 365 = 1250928000 liters (Gasoline consumption in 2016).
- 2395 * 1.12 = 2682400 liters (Daily gas consumption in the Mashhad region).
- 2682.4 * 365 = 979076000 liters. (Gas consumption in 2016).

Analytical Findings

Given the descriptive findings and the lack of
 ing conditions in this area from Mashhad, each of the
 sections of Sajjad Boulevard, with regard to the traf-

Table 8. Average time lost from street parking for each car

of parts district 1 Mashhad city	Intersection position	Number of parking spaces in Sajjad Boulevard (Half way between two intersections)	The level of occupation of the street by the parking lots on the margin of Sajjad Boulevard (10 square meters per car)	Number of traffic on Sajjad Boulevard (at peak hours)	At least an increase in the stopping time for each car at each intersection due to the reduction of street width due to parking (min)
1	Golriz	74	740	1880	3

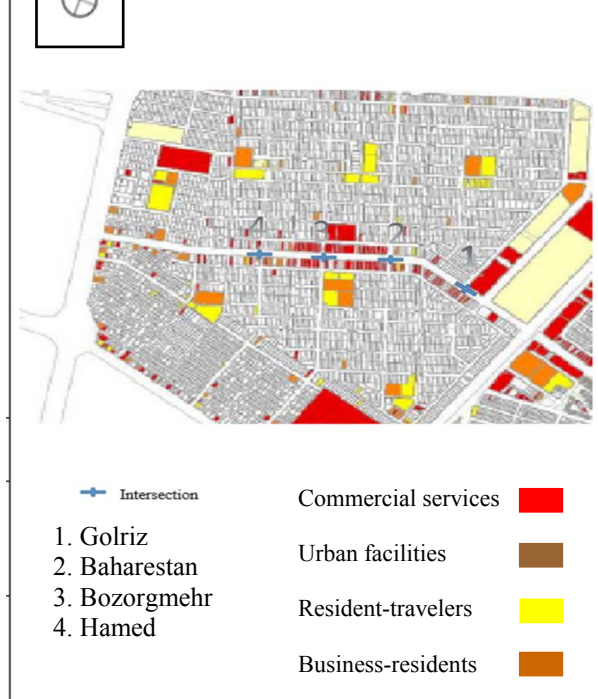
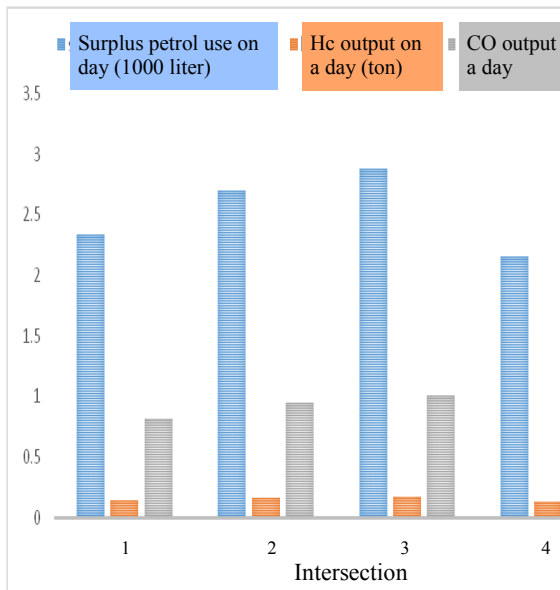
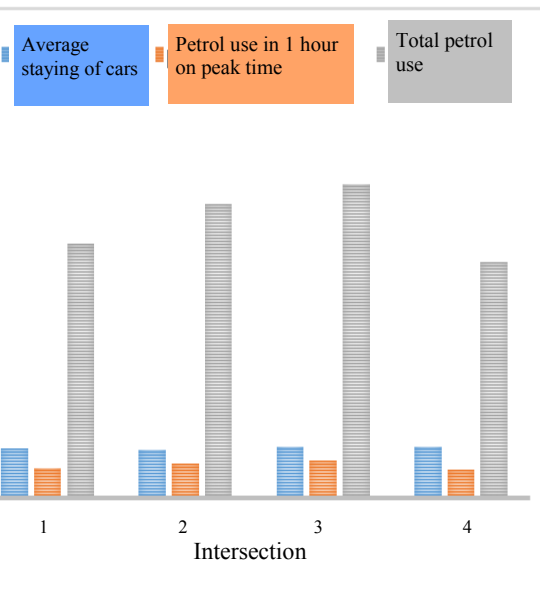


Figure 3. Sajjad Boulevard and its intersections (Ghorbanian and Farhad, 2018)

of vehicles in peak hours, were calculated and evaluated. In this stage, traffic organization data of Mashhad municipality has been examined as shown in Tables 5, 6 and 7. Due to the lack of access to traffic information in the

Golriz cross, it increases the traffic scenario and the organization of this intersection has been carried out. Finally, using SPSS software, the number of parking lots that have been identified on the street edge which reduce the street width and



Intersection position	Average number of vehicles whose stopping time is more than standard at Sajjad Boulevard (at peak hours)						
	Increase in the stopping time for each car at each intersection due to the reduction of street width by street margin parking (min)			Total amount of gasoline consumed at each intersection at Sajjad Boulevard (at peak time), (liters)			
	Total stopping time at each intersection at Sajjad Boulevard (at peak hours), (hour)			The total amount of gasoline consumed at each intersection at Sajjad Boulevard (4 hours peak), (liters)		The total amount of gasoline consumed at each intersection at Sajjad Boulevard (14 hours non-peak), (liters)	
	Total amount of gasoline surplus per day (liters)						
Golriz	470	3	23.5	285.5	1142	1199	2341
Marrestan	450	4	30	330	1320	1386	2706
Orgmehr	481	4	32	352	1408	1479	2887
Shamed	480	3	24	264	1056	1109	2165
Total					4926	5173	10099

Ghorbanian and Farhad (2018)

average increase in stopping time for each vehicle at intersection was calculated by reducing the street width by on street parking according to Table 8.

Increased stopping time and gasoline consumption at intersections

At this stage, according to the average stopping time of each vehicle at the intersection, the total time of

Table 10. Approximate amount of pollutants from gasoline and diesel engines (in grams per liter of fuel consumption)

Engine	Pollutants	Nitrogen oxides	Hydrocarbons	Carbon oxides	Aldehydes
	Petrol engine	13.50	63.00	350.00	0.50
	Diesel engine	27.00	22.00	7.20	1.20
	Pollutant	Organic acids	Benzoalpa pyrene	Particle	-

calculated. Fuel consumption in passenger cars was estimated at an average of 11 liters per hour.

Increase in the pollutants at intersections

As per the Organization of Environment of Mashhad, the approximate amount of pollutants from the fuel of gasoline engines are presented in Table 10. After calculating the amount of pollutants from automobile fuel in Mashhad in 2016 by the author, these contaminations are relatively high.

Typically, 438 thousand tons of carbon monoxide were emitted in 2016, its amount is 1.2 thousand tons per day. As well as the amount of hydrocarbons produced in 2016, was 78 thousand tons and daily 0.21 thousand tons (equivalent to 21 ten-ton trucks). In Sajjad Boulevard according to Table 11 and Figure 5, 4.18 tons of hydrocarbons and carbon monoxide contaminants were calculated per day.

Traffic-induced air pollution has always been a major concern for urban managers and planners. This issue plays a significant role in protecting the health of citizens and creating a clean and healthy environment in all urban corridors (Bellander *et al.* 2001). Mashhad is a traffic-intensive city due to the movement of many vehicles (including Mashhad residents and travelers). Therefore, the pollution caused by traffic in this city is notable, which should be considered seriously. After investigating the Sajjad Boulevard in Mashhad 1 district, it was found that the increase in vehicle stops at the intersections of this Boulevard

Part of district	Intersection	The amount of gasoline surplus in traffic due to the reduction in street width at the peak hour (liters)	The amount of gasoline surplus in traffic due to the decrease in street width per day (liters)	The amount of hydrocarbons produced in one day (tons)	The amount of carbon dioxide produced per day (tons)
1	Golriz	285.5	2341	0.15	0.8
2	Baharestan	330	2706	0.17	0.9
3	Bozorgmehr	352	2887	0.18	1.0
4	Hamed	264	2165	0.14	0.7
5	Total (tons)			0.64	3.5
Total hydrocarbons and carbon monoxide in one day (tons)					4.18

Source: Ghorbanian and Farhad (2018)

able role in the dissemination of traffic-induced pollution due to the decreased street width due to street parking.

CONCLUSION

A brief review of four intersections at Sajjad Boulevard revealed that the reduction of the width of the streets and the geometric state of the streets play an important role in the formation of various pollutants, so that in this Boulevard 10099 liters of additional gas is burned daily and 4.18 tons of pollutants associated with it was only due to traffic congestion caused by the car parking on the edge of the street. This urban area has a lot of civil constructions and commercial traffic. Regarding the focus of administrative and commercial use, along with the lack of attention to the parking spaces (which is itself an important factor of the geometric state of the road network), in order to solve this problem in addition to building parking in suitable locations, the more appropriate distribution of applications and considering the development of transport infrastructure, one can use the following solutions:

1- Smart city development and strengthening of internet capabilities to reduce the use of vehicles.

2- Development of public transport, rail and gas vehicles,

- Management and reduction of travel demand.
- Speed up the process of disposing of a worn out vehicle.
- The use of a catalytic converter to convert carbon monoxide and unburnt hydrocarbons to carbon dioxide.
- Perform regular technical inspections and engine maintenance and timely service of the vehicle in a determined manner.

DATA AVAILABILITY

Some data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions (e.g. anonymous data).

REFERENCES

Badard T and Richard D. 2001. Using XML for the change of updating information between geographical information systems. *Computers, Environment and Systems*, 25(1): 17-31.

Bellander T, Berglind N, Gustavsson P, Jonsson Nyberg F, Pershagen G and Lars Järup 2001. Using geographical information systems to assess individual historical exposure to air pollution from traffic and houses.

method for mapping traffic-related air pollution: application and testing in four contrasting urban environments. *Science of the Total Environment*, 253(1-3): 151-159.

Armond J. 1988. Trends in GIS and comments. *Computational Environment and Urban Systems*, 12(3): 137-159.

Armanian and Farhad. 2018. The role of parking in urban development plans. Doctoral Thesis, Mashhad Azad University.

Arora KJ and Jisha A. 2019. Study of on-street and off-street parking choice behaviour. *International Journal of Advanced Research in Computer and Communication Engineering*, 8(1): 79-84.

Arora G, Fischer P, Van den Brandt P, Goldbohm S and Kerkreef B. 2001. Estimation of long-term average exposure to outdoor air pollution for a cohort study on mortality. *International Journal of Exposure Analysis and Environmental Epidemiology*, 11(6): 459-469.

Arora S, Sharma Sanjay and Shankar Ravi. 2007. Selection of service provider: An Analytic Network Process approach., *The International Journal of Management Science*, 35(3): 274-289.

Arora S, Small JD, Nethery E and Brauer M. 2008. Within-city spatial variability in ambient air pollution: comparison of estimation methods. *Atmospheric Environment*, 42(6): 1359-1370.

Arora S, Beke JAW and Li Zheng. 2006. Analytical network process for software selection in product development: a case study. *Journal of Engineering and Technology Management*, 23(4): 337-352.

Arora S, Rajat B and Arjita PB. 2018. Analysis of the parking management system in campus of MIT. *International Research Journal of Engineering and Technology*, 5(5): 912-921.

Arora S, Rebolj D and Sturm PJ. 1999. A GIS based computer oriented integrated system for estimation visualization and analysis of road traffic air pollution. *Environmental Modelling and Software*, 14(6): 531-539.

Arora S, Sener BK, Mehmet Lutfi Süzen and Vedat Dogan. 2005. Landfill site selection by using geographic information systems. *Environmental Geology*, 49(3): 376-384.

Arora S, Venn A, Lewis S, Cooper M, Hubbard R, Hill I, Hill R, Bell M and Britton J. 2000. Local road traffic pollution and the prevalence, severity and persistence of wheezing in school children: combined cross sectional and longitudinal study. *Occupational Environmental Medicine*, 57(3): 151-158.

Arora S, Zanjirani FR, Rezapour Sh and Fatemeh Shariati. 2010. Fuzzy AHP to determine the relative weights of evaluation criteria and fuzzy TOPSIS to rank the alternatives. *Applied Soft Computing*, 10(2): 520-528.

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