

EVALUATION OF NOISE POLLUTION IN ILAM CITY IN 2018

Javad Hatamzadi¹, Amirreza Talaiekhosani^{1, 2*}, Gholam Reza Ziaee³

¹ Department of Safety, Health and Environment, Najafabad Branch, Islamic Azad University, Najafabad, Iran

² Department of Civil Engineering, Jami Institute of Technology, Isfahan, Iran

³ Department of Accounting, Jami Institute of Technology, Isfahan, Iran

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CORRESPONDING AUTHOR:

atalaie@jami.ac.ir

Tel: (+98 31) 52636319

Fax: (+98 31) 52636320

ABSTRACT:

Introduction: High level of noise can be harmful for human mental and physical health. Therefore, it is important to study the noise pollution in cities. The aim of this study is to investigate the situation of noise pollution in Ilam, Iran.

Materials and methods: 18 locations of Ilam city were selected to measure the noise level. The noise was measured in four different times including 9 AM, 12 PM, 6 PM and 9 PM in all week days. Then, the collected data was analyzed by standard statistical tests. Finally, the map of noise pollution for Ilam was prepared by ArcView GIS.

Results: The results showed that the highest noise level was measured in the areas of Saadi market, Imam Khomeini street and nearby Mostafa Khomeini hospital. The highest noise pollution in Ilam was measured on Saturday and Tuesday (about 61 dB). The noise pollution was slightly reduced to 60 dB on Wednesday and Thursday. The noise pollution was sharply reduced to 55.8 dB on Friday.

Conclusions: The noise pollution in the most areas of Ilam, was more than the maximum permissible level. Therefore, this city needs to develop a plan for noise management.

INTRODUCTION

Nowadays, many pollutants are released into the environment with the risk for human health. Noise pollution is one of the various anthropogenic pollutants. Moving hundreds of thousands of cars, industrial activities and constructions in large cities can be main sources of noise pollution [1]. When people are exposed to sound waves excessively, their health are endanger [2]. In the last three decades, with the identification of noise pollution dangers for human health, this

type of pollution has become more interesting for researchers [3]. Various studies have shown that short - term and long - term exposure to noise not only can reduce human hearing, but also increase blood pressure, cardiovascular disease, anxiety and insomnia [4]. Exposure to noise can increase the rate of visiting physicians and increases drug use in the community [5]. It has been reported that the noise caused by urban traffic could lead to an increase in ischemic heart disease [6]. Also, another study reported that increasing noise pol-

lution could increase the pain in patients hospitalized in hospitals [7]. The level of stress in people exposed to noise pollution has been reported to increase sharply [8]. In many parts of the world, noise pollution maps are provided annually. These maps are used as the necessary infrastructure for managing noise pollution in cities [3, 9, 10]. Noise pollution maps for Tehran, New Delhi, Tokyo and Rome show that in high traffic areas, the amount of noise pollution exceeds from maximum permissible limit (70 dB) [3, 11, 12]. The study of noise pollution in various cities such as Qazvin [13], Kashan [14], Hamedan [15], Khorramabad [16] and Tabriz [13] indicates that noise pollution in these cities is also a serious problem. In the city of Fukuyama in Japan, a map of the noise pollution of the streets was prepared for identification of the noise pollution dispersion in the city [17]. Such a study was also carried out in the Swedish scan city and its noise pollution map was determined [18].

Providing a noise pollution map that shows the amount of noise in various times and locations of Ilam was necessary to reduce the noise pollution in this city. Therefore, the aim of this study was to provide many maps of noise pollution in Ilam during hours of 9 AM, 12 AM, 18 PM and 21 PM. For this plan, the rate of noise pollution was measured at 18 locations in Ilam during a week. Finally, the results were converted into maps using the ArcView GIS.

MATERIALS AND METHODS

In this study, 18 locations in the city of Ilam were selected. These locations were Arghan square, Hijrat alley, Fatehan Mimak square, Shahdaha square, Northern Kamarbandi road, Haft Tir street, Saadi market, Imam Khomeini street, Shadabad region, Nooruzabad region, Mostafa Khomeini hospital, Besharat avenue, Chaloosa region, Chalimar region, Student Blvd, Repairs, Razmandegan region and Shahid Beheshti street. Selected locations included commercial and residential areas. Selected regions were distributed somewhat homogeneously throughout the city to study noise pollution. The DSM8930 General tools sound meter was used to measure the sound level. Based on sound measurement standards, the microphone distance of the sound meter from reflective surfaces such as walls and cars

was chosen at least 1 m and a minimum of 1.5 m from the ground. The sound meter was also at least as much as an arm length far from the operator's body [19]. In this study, LA_{eq} was measured. Based on the standards, LA_{eq} must be measured in a particular time period (15 min). In this study, some other parameters were used to describe noise pollution of Ilam city. These parameters are defined below. LA_{10} is the level exceeded for 10 % of the time and as such can be regarded as the 'average maximum level. LA_{90} is the 'average minimum level and is often used to describe the background noise. Traffic noise index (TNI) is an indicator that is calculated by combining LA_{10} and LA_{90} . TNI was obtained from Eq. (1).

$$TNI = 4 \times (LA_{10} - LA_{90}) + LA_{90} - 30 \quad (1)$$

Another indicator that used in this study was noise pollution level (NPL). NPL is provided by the U.S. Department of Housing and Urban Development (DHUD) for environmental noises. Based on DHUD, the annoyance resulting from noise exposure depends on the average sound level and the sound source variability. NPL was calculated from Eq. (2).

$$NPL = LA_{eq} + (LA_{10} - LA_{90}) \quad (2)$$

In this study, all statistical analyzes were performed using SPSS.

RESULTS AND DISCUSSION

Ilam with an area of 212804 ha has been located in western parts of Iran and is the capital of Ilam province, with GPS coordinates of 33° 38' N and 46° 26' E. Ilam city is located in the cold mountainous region at a height of 1319 m above mean sea level. In this study noise measurement stations were somewhat homogeneously distributed in Ilam city. The tests of noise measurement were performed during the period from 9 February 2018 to 10 June 2018. The minimum measured noise level in different areas of the Ilam city is shown in Fig. 1. Fig. 2 and Fig. 3 show the maximum and average noise level in different areas of Ilam city. Fig. 3 shows the average noise level (LA_{50}) in different areas of Ilam city for four different hours of 9 AM, 12 PM, 18 PM and 21 PM. Based on these figures, the highest noise level

is observed in the areas of Saadi market, Imam Khomeini street and nearby Mostafa Khomeini hospital. The highest level of noise was observed near the Mostafa Khomeini hospital at 69.8 dB at 18 PM.

Since the noise pollution was studied in different days, it was also possible to compare the noise pollution on different days of a week (Fig. 4). The results showed that on Saturday and Tuesday, the

highest noise pollution was measured in different parts of the city (about 61 dB). The noise pollution was slightly reduced to 60 dB on Wednesday and Thursday. The noise pollution was sharply reduced to 55.8 dB on Friday. The level of TNI and NPL in different areas of Ilam city are shown in Table 3. According to this table, Arghan square at 18 PM has the highest TNI.

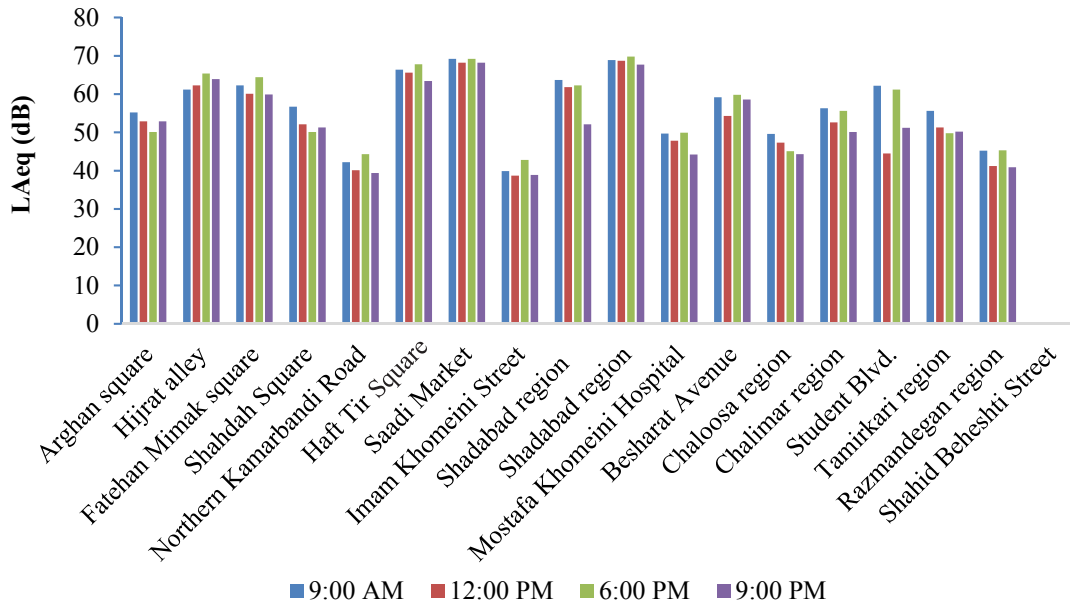


Fig. 1. The minimum of LA_{eq} during a week in different parts of Ilam city for four studied hours

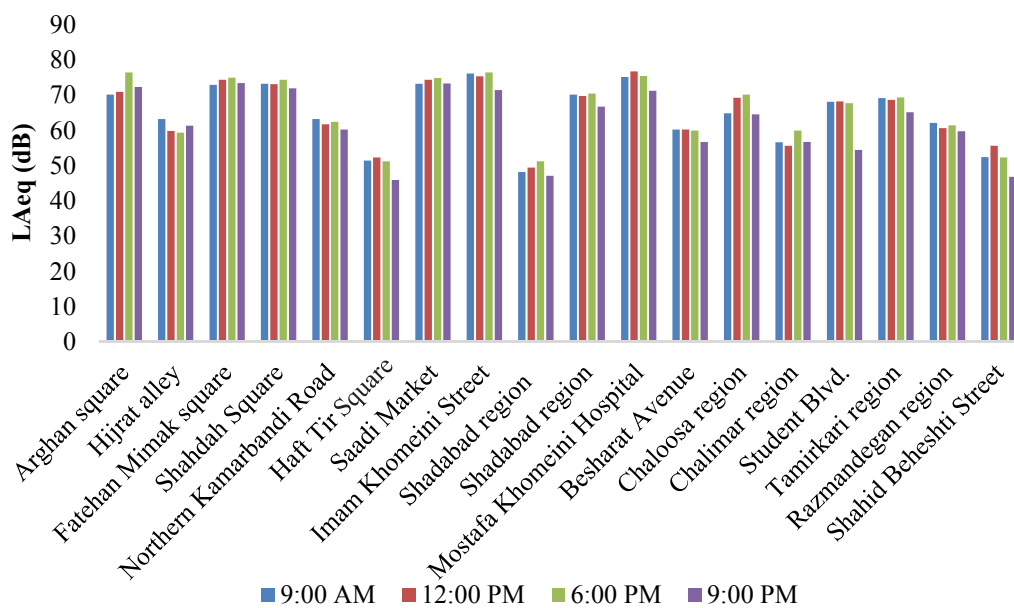


Fig. 2. The maximum of LA_{eq} during a week in different parts of Ilam city for four studied hours

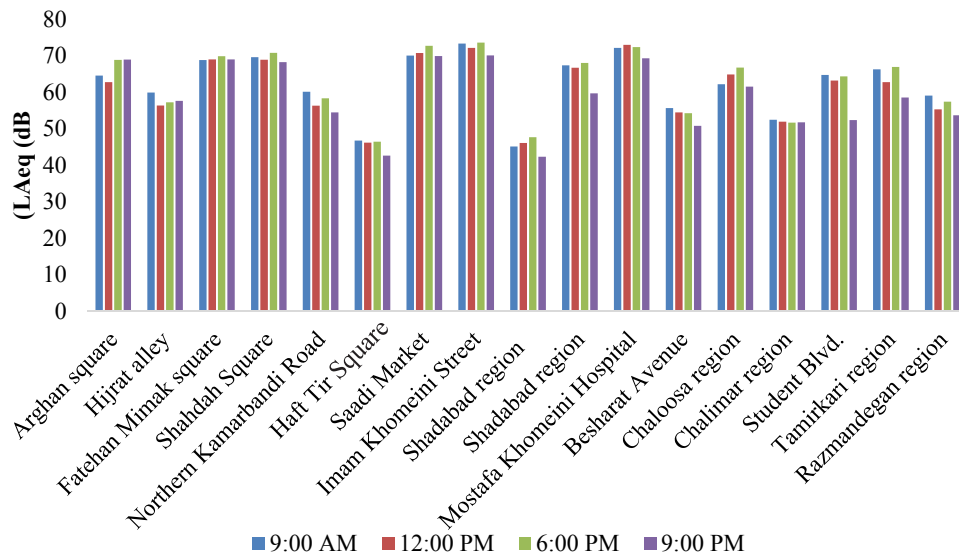


Fig. 3. The LA50 in different parts of Ilam city for four studied hours

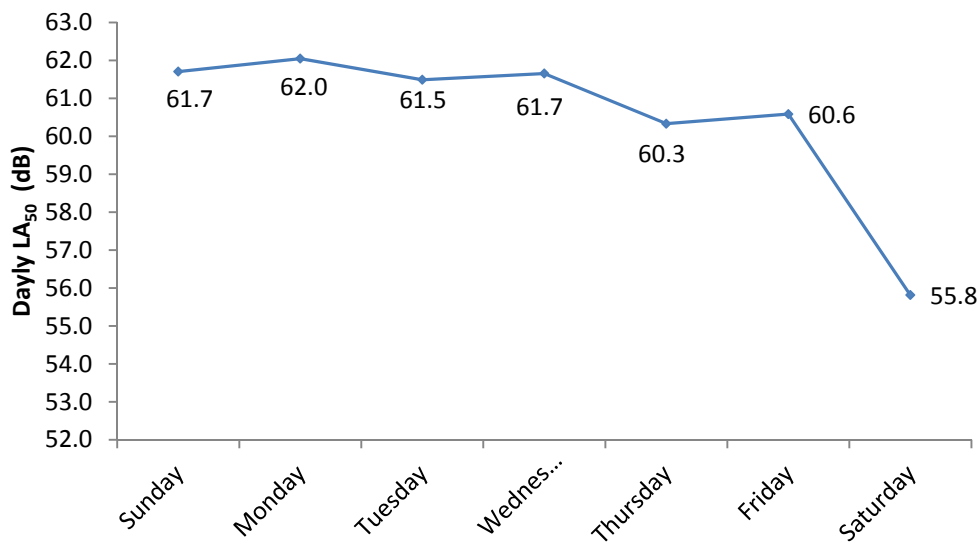


Fig. 4. Average of noise level (LA_{50}) in Ilam city during a week days

The average, minimum and maximum levels of noise in various parts of Ilam city are shown in Table 1. Also, in this table the amount of probability value (P_{value}) is shown to find whether there is significance statistical difference and this issue was checked by ANOVA test. In every comparison in which the amount of P_{value} was under 0.05 (level of test) the difference was statistically significant among various hours. The results of ANOVA test were reliable, because the normality assumption was checked in each group indepen-

dently. It should be noted that in every ANOVA test in which the statistical probability is under 0.05, the statistical difference was reported significant while in the rest of comparisons in which the statistical probability is higher than 0.05, the difference reported non - significance. But despite of non - significance differences there are some visible source of differences that undoubtedly are not deniable and the intensity of them was not so high to make the whole test significance. In this study the ANOVA test was shown statistically

significance in some parts of Ilam such as: Kamarbandi Shomali road, Emamkhomeini street, Shadabad region, Nourouzabad region, Mostafa Khomeini hospital, Chalehsara region, Tamirkari region and Razmandegan region. The maximum

permissible levels of noise in ambient air for different areas are illustrated in Table 2. Based on this table the amount of noise in most parts of Ilam were higher than the permissible level.

Table 1. Weekly average, maximum and minimum of noise level in different areas of Ilam city for four studied hours

Areas	Minimum (dB)				Maximum (dB)				Average (dB)				P _{Value}
	9 AM	12 AM	6 PM	9 PM	9 AM	12 AM	6 PM	9 PM	9 AM	12 AM	6 PM	9 PM	
Arghan square	55.9	52.1	56.9	63.2	70.1	70.9	76.4	72.3	64.6	62.8	68.9	69.0	0.125
Hijrat alley	55.2	52.9	50.1	52.9	63.2	59.8	59.3	61.3	59.9	56.4	57.3	57.6	0.165
Fatehan Mimak square	61.2	62.3	65.4	63.9	72.9	74.3	74.9	73.4	68.8	69.0	69.9	69.0	0.947
Shahdah square	62.3	60.1	64.4	59.9	73.2	73.1	74.3	71.9	69.6	68.9	70.8	68.2	0.675
Northern Kamarbandi road	56.7	52.1	50.1	51.3	63.2	61.7	62.4	60.2	60.1	56.3	58.4	54.5	0.019*
Haft Tir square	42.2	40.1	44.3	39.4	51.4	52.3	51.2	45.9	46.7	46.2	46.5	42.6	0.095
Saadi market	66.4	65.6	67.8	63.4	73.2	74.3	74.8	73.3	70.1	70.8	72.7	69.9	0.253
Imam Khomeini street	69.2	68.2	69.2	68.2	76.1	75.3	76.4	71.4	73.4	72.2	73.6	70.1	0.023*
Shadabad region	39.9	38.7	42.8	38.9	48.2	49.4	51.2	47.1	45.1	46.1	47.7	42.3	0.030*
Shadabad region	63.7	61.8	62.3	52.1	70.1	69.7	70.4	66.7	67.4	66.7	68.0	59.7	0.000*
Mostafa Khomeini hospital	68.9	68.7	69.8	67.7	75.1	76.7	75.4	71.2	72.2	73.0	72.4	69.3	0.019*
Besharat avenue	49.7	47.8	49.9	44.2	60.2	60.2	59.9	56.7	55.6	54.5	54.2	50.8	0.232
Chaloosa region	59.2	54.3	59.8	58.6	64.8	69.2	70.1	64.5	62.2	64.9	66.8	61.6	0.036*
Chalimar region	49.6	47.3	45.1	44.3	56.6	55.6	59.9	56.7	52.5	51.9	51.7	51.8	0.981
Daneshjoo Blvd.	56.3	52.6	55.6	50.1	68.1	68.2	67.7	54.4	64.7	63.2	64.3	52.4	0.000
Tamirkari region	62.2	44.5	61.2	51.2	69.1	68.6	69.3	65.1	66.3	62.8	66.9	58.6	0.021*
Razmandegan region	55.6	51.3	49.8	50.2	62.1	60.6	61.4	59.7	59.1	55.3	57.4	53.7	0.023*
Shahid Beheshti street	45.2	41.2	45.3	40.9	52.4	55.6	52.3	46.8	47.7	47.4	47.5	43.9	0.113

The sign of * means that there is a significant difference with 95 % confidence.

Table 2. The maximum permissible level of noise in ambient air of Iran20]

Type of area	Day (7 AM to 10 PM) LA _{eq} (30 min) dB(A)	Night (10 PM to 7 AM) LA _{eq} (30 min) dB(A)
Residential areas	55	45
Residential and commercial areas	60	50
Commercial areas	65	55
Residential and industrial areas	70	60
Industrial areas	75	65

Table 3. The level of NPL and TNI in different areas of Ilam city

Area	TNI				NPL			
	9 AM	12 AM	6 PM	9 PM	9 AM	12 AM	6 PM	9 PM
Arghan square	82.7	97.3	104.9	69.6	78.8	81.6	88.4	78.1
Hijrat alley	57.2	50.5	56.9	56.5	67.9	63.3	66.5	66.0
Fatehan Mimak square	78	80.3	73.4	71.9	80.5	81.0	79.4	78.5
Shahdah square	75.9	82.1	74	77.9	80.5	81.9	80.7	80.2
Northern Kamarbandi road	52.7	60.5	69.3	56.9	66.6	65.9	70.7	63.4
Haft Tir square	49	58.9	41.9	35.4	55.9	58.4	53.4	49.1
Saadi market	63.6	70.4	65.8	73	76.9	79.5	79.7	79.8
Imam Khomeini street	66.8	66.6	68	51	80.3	79.3	80.8	73.3
Shadabad region	43.1	51.5	46.4	41.7	53.4	56.8	56.1	50.5
Shadabad region	59.3	63.4	64.7	80.5	73.8	74.6	76.1	74.3
Mostafa Khomeini hospital	63.7	70.7	62.2	51.7	78.4	81.0	78.0	72.8
Besharat avenue	61.7	67.4	59.9	64.2	66.1	66.9	64.2	63.3
Chaloosa region	51.6	83.9	71	52.2	67.8	79.8	77.1	67.5
Chalimar region	47.6	50.5	74.3	63.9	59.5	60.2	66.5	64.2
Daneshjoo Blvd.	73.5	85	74	37.3	76.5	78.8	76.4	56.7
Tamirkari region	59.8	110.9	63.6	76.8	73.2	86.9	75.0	72.5
Razmandegan region	51.6	58.5	66.2	58.2	65.6	64.6	69.0	63.2
Shahid Beheshti Street	44	68.8	43.3	34.5	54.9	61.8	54.5	49.8

Ilam's noise pollution maps for different times are illustrated in Fig. 5 to Fig. 8. Based on these maps, the eastern parts of the city have had the highest noise pollution. The reason for the high level of noise pollution in the eastern parts of the city can be related to a large number of stores and vehicles that are in this part of city.

CONCLUSION

The noise pollution in Ilam city was investigated in this study. The eastern areas of Ilam city had the highest noise pollution due to a large number of vehicles that were traveled through the streets. The highest noise pollution in Ilam city was measured on Saturday and Tuesday (about 61 dB). The noise pollution was slightly reduced to 60 dB On Wednesday and Thursday and it was sharply reduced to 55.8 dB on Friday. In the most areas

of Ilam city the noise pollution was more than maximum permissible level. Therefore, this city needs to develop a plan for noise management.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest that would prejudice the impartiality of this scientific work.

AUTHOR CONTRIBUTION

It is certified that all of the authors have made the same contribution in the experiments and manuscript writing.

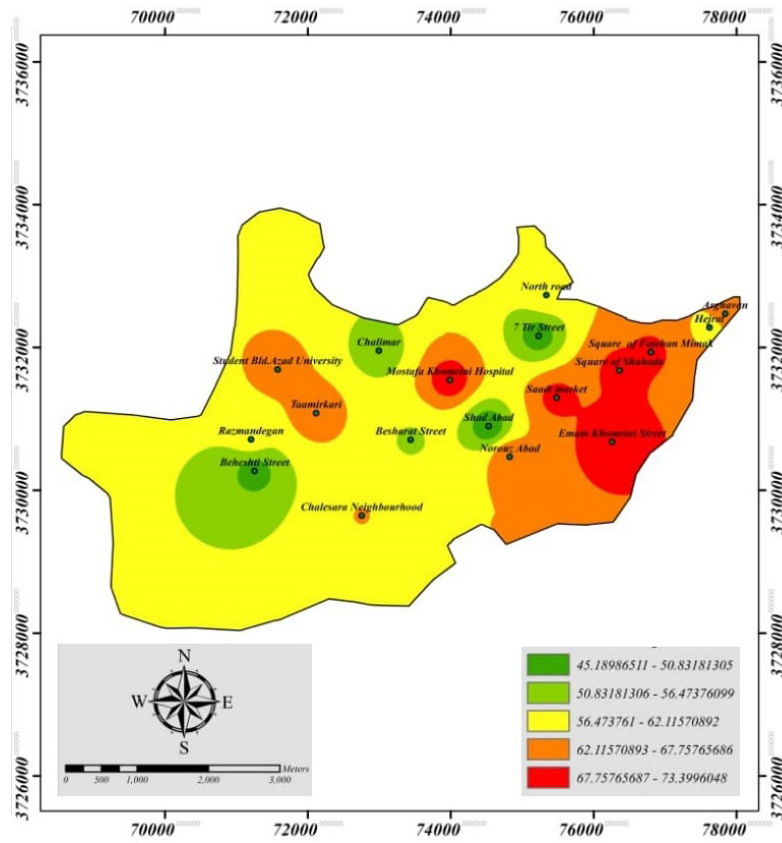


Fig. 5. The map of Ilam noise pollution for 9 AM

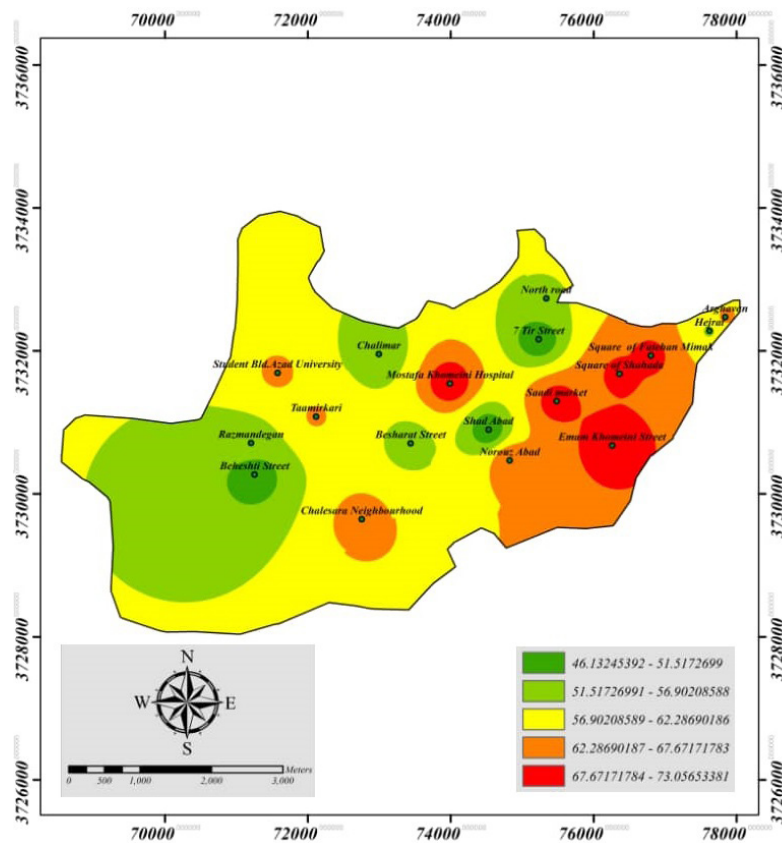


Fig. 6. The map of Ilam noise pollution for 12 PM

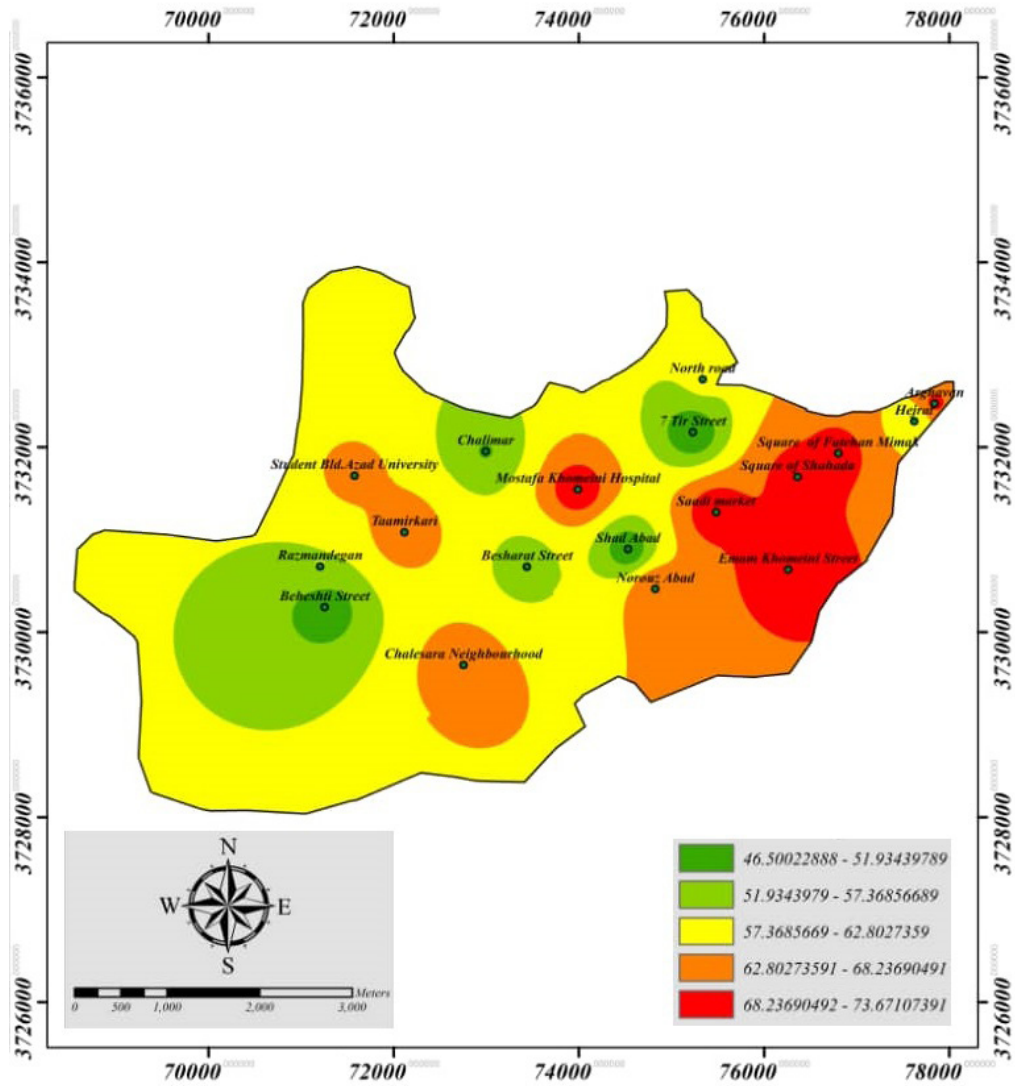


Fig. 7. The map of Ilam noise pollution for 6 PM

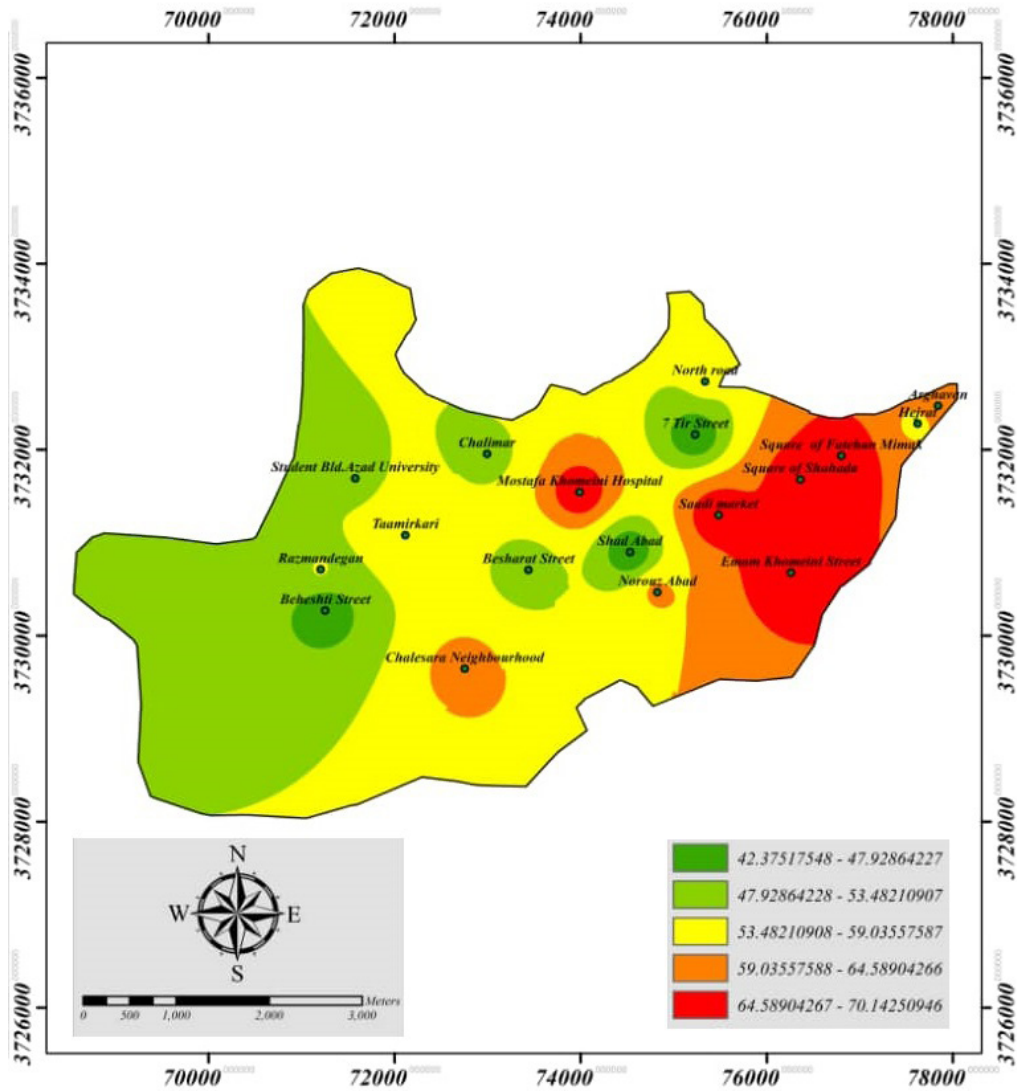


Fig. 8. The map of Ilam noise pollution for 9 PM

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ETHICAL CONSIDERATIONS

Authors are aware of, and have complied with, best practices in ethics, specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, com-

peting interests and compliance with policies on research ethics. Authors adhere to publication requirements that the submitted work is original and has not been published elsewhere in any language.

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