Int. J. Environ. Res., 2(2): 133-138, Spring 2008
ISSN: 1735-6865

Ecological Impact Assessment of Highways on National Parks: Tehran - Pardis Highway (Iran)

Monavari, M.[1*] and Mirsaeed, Sh.G.[2]

[1] Graduate School of Environment and Energy, IAU, Iran
[2] Environment Science, Science and Research Campus, Ahvaz, IAU, Iran

Received 26 Aug. 2006; Revised 20 August 2007; Accepted 7 Oct. 2007

ABSTRACT: Population growth and urbanization increase the demand for developing new roads. Heavy traffic of the east of Tehran imposes high pressure on transportation. Network of this city and old road of Tehran-Rudehen does not meet this need. Therefore, constructing the new highway (Tehran – Pardis) in the east of Tehran would be needed. But the new highway passes through protected area of Jajrood and next to Khojir National Park. These areas include ecologic values as well as national importance. Therefore, constructing the new highway next to or inside these regions, have potential impacts. In this study, parameters such as noise and air pollutions in 10 stations were measured. Also, for anticipating the effects, simple Matrix & Pastakia matrix methods, were used. The results of the research show that noise and air pollutions have no effect on mammals and birds of Khojir National Park. It is assessed that constructing of new highway has less environmental impacts when compared with the option of widening the present road.

Key words: Environmental Impact, Highway, Khojir, National Park, Ecological, Habitat

INTRODUCTION

Located in the east of Tehran extending to Pardis New Township, Tehran-Pardis highway begins from the end of Shahid Babai highway to this township. This highway crosses some parts of Khojir National Park and Jajrood Protected Area resulting some potential environmental negative impacts.Pollutants impact on biota include noise , light , sound ,dust ,metals such as Pb ,Cd, Ni , and Zn , and gases such as CO and NOx. The extents to which emissions and disturbances extend from a road have been researched by some authors (Schonewald-Cox & Buechner, 1992). Construction and operation of highways may have some potential impacts including air, noise, soil, surface water and potential impacts of transportation of hazardous wastes (Monavari, 2001a). Also they can cause aesthetic and landscape impacts as well as destruction of local communities due to population dislocation (Reed , 2001).

*Corresponding author: Email-monavarism@yahoo.com

Moreover, amongst the most important major impacts of highways one can be point out to direct impacts like road accidents (mortality), destruction of habitats and life cycles, behavioral changes, separation of population, consequences of noise pollution on behavioral changes, reproduction and migration of species and indirect impacts like more accessibility of people to habitats of different species (Clevenger, 2002). On the other hand, development of roads is an indispensable need of different countries for more effective and safe transportation system as well as time saving purposes (Spellerberg, 1998). Consequently, development and expansion of highways and expressways is inevitable. For attaining sustainable development, it is necessary to integrate environmental concerns in development of policies, programs, planning and projects. This study is a method for showing beneficial and adverse impacts in both construction and operation phases giving rise to some mitigation measures for reduction and mitigation of adverse impacts.

MATERIALS & METHODS

For recognition of existing status and the most important consequences of proposed project the following measures have been adopted:

- Selection of 10 monitoring stations in the study area for measurement of air and noise pollution and determining geographical characteristics using GPS (Table 1).
- Sound level in 4 different seasons and in each station in 5 points with 5, 10, 50 and 100 meters distances from the limits of new highway were determined. Also CO, NO_2 and SO_2 were measured.
- GIS mapping of fauna habitats.
- Calculation of obtained SPLs from noise measurements and its rate to the closest animal habitat :

$10\log_{10}(R/r)$ = Reduction of noise pressure based on dB (Abbaspour, 1998)

R: Distance of the habitat to limit of the highway

r: Meters from the limits of the highway (selected as 5, 10, 50, and 100 m.).

- Selection of 2 alternatives for the project, i.e. Tehran-Pardis highway (alternative 1) and widening of existing Tehran-Roodehen Road (alternative 2).
- Making use of Pastakia (Rapid Impact Assessment) Method (Monavari, 2001b) for assessing the impacts in both alternatives.

RESULTS & DISCUSSION

The results of noise measurement, which was carried out 4 times at each station and in 5 points of 5,10, 50 and 100 meters from the limits of the highway , is giren Table 2.

Table 1. Geographical Characteristics of Sampling Stations

Station	Longitude			Latitude		
Station 1	E51°	41′	42.6″	N 35°	44′	29.5″
Station 2	E51°	42′	5.9″	N 35°	44′	36″
Station 3	E51°	42′	24.6″	N 35°	44′	41.8″
Station 4	E51°	42′	42.1″	N 35°	44′	51.6″
Station 5	E51°	43′	20″	N 35°	44′	51.2″
Station 6	E51°	43′	58.6″	N 35°	44′	51.5″
Station 7	E51°	44′	22.4″	N 35°	44′	55.9″
Station 8	E51°	42′	3.4″	N 35°	45′	35.1″
Station 9	E51°	42′	3.8″	N 35°	45′	25.8″
Station 10	E51°	43′	7.2″	N 35°	44′	55.9″

Table 2. Result of noise measurement in station 1(dB)

Station		Leq		Lmax		SPL	
Autumn 2004	At edge of the highway	76.9	75	105.2	102.8	72.62	70.1
Winter 2004			77.4		102		71.4
Spring 2005			77.3		107.5		74.2
Summer 2004			77.9		108.6		74.8
Autumn 2004	5 m far from the highway	74.6	74.5	104.2	101.8	67.95	68.2
Winter 2004			74.8		101.9		66.9
Spring 2005			74.3		106.9		68.5
Summer 2005			74.8		107.9		68.2
Autumn 2004	10 m far from the highway	74.5	77.8	101.9	100.7	65.4	65.1
Winter 2004			73.8		99.9		63.5
Spring 2005			74.1		103.2		66.2
Summer 2005			78.3		103.7		66.8
Autumn 2004	50 m far from the highway	67.9	71.5	90.7	92.9	58.67	58.3
Winter 2004			73.1		58.1		58.1
Spring 2005			65.3		91.7		58.3
Summer 2005			61.8		93.1		60
Autumn 2004	100 m far from the highway	58.9	59.5	77.5	79.3	54.8	55
Winter 2004			61.9		77.9		55.3
Spring 2005			58.1		76.9		53
Summer 2005			55.9		75.9		56.2

By comparing obtained average Legs on the highway limits (the closest point to the highway) and in 100 meters from the highway (the most far point to the highway) and comparing them with noise standard in the ambient environment (Majnoonian, 2001) for residential, commercial and industrial areas indicate that in the stations No. 1, 2, 3,4,5,6 and 7, average Leg rate is higher than noise level standard in Iran. But in stations 8, 9 and 10 it is below the standard (Fig.1).

Locations of major mammals' habitats in Khojir National Park as well the distribution map of partridge and dull-yellow, as the most populated and important species of the park were mapped. Moreover, the closest distance of each species' habitat from the highway has been specified in the Table 3. Resultantly, in view of the fact that sound level in different stations in the region is not much higher than admissible standard, and regarding the distance of major habitats from the highway, that are far enough, it is understood that these noises can't be harmful for the species in the region.

The rate of SPL (Sound Pressure Level) shows that this rate decreases considerably without imposing any harm to related habitats. As soon as these SPLs approach the closest habitats of these species, their quantity fluctuate between 24/21dB to 38/81 dB that is low enough not to harm them.The results of air pollution sampling that have been carried out 4 times in each station and at 2 points adjacent to highway and also 100 meters from the highway are giren in Table 4.

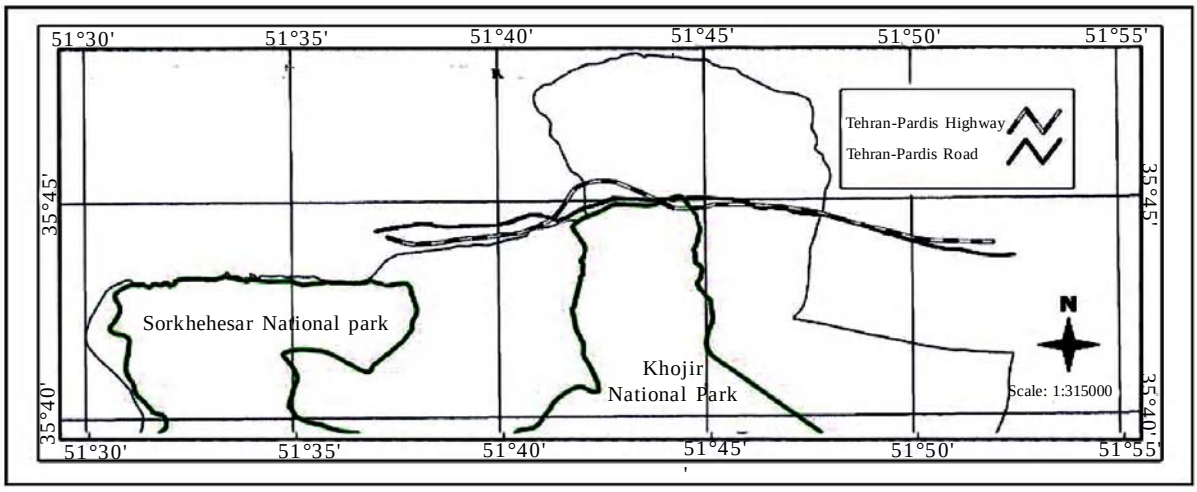

Fig. 1. Location of Tehran-Pardis Highway

Table 4. Results of measured Air Pollutants

Station 1	At edge of the proposed highway		100 m away from the proposed highway	
	CO	7 ppm	CO	4.8 ppm
Autumn 2004	NO_2	0.05 ppm	NO_2	0.03 ppm
	SO_2	0.05 ppm	SO_2	0.03 ppm
	CO	7.8 ppm	CO	4.6 ppm
Winter 2004	NO_2	0.05 ppm	NO_2	0.03 ppm
	SO_2	0.05 ppm	SO_2	0.02 Ppm
	CO	2 ppm	CO	4.9 ppm
Spring 2005	NO_2	0.05 ppm	NO_2	0.02 ppm
	SO_2	0.06 ppm	SO_2	0.03 ppm
	CO	8 ppm	CO	4.6 ppm
Summer 2005	NO_2	0.06 ppm	NO_2	0.03 ppm
	SO_2	0.06 ppm	SO_2	0.03 ppm

According to results and their comparison with ambient air standards, it is found that the rate of CO in all sampling stations including in 100 meters ones do not exceed the standards. The rate of NO_2 is not also above both primary and secondary standards in all stations. It is the same for SO_2 in all stations. Consequently, there is not any harm to habitats of the region.

For studying the impacts of implementation of Tehran-Pardis highway Project, 2 alternatives were selected as were formerly described. The first alternative is widening of present Tehran-Roodehen road and the other is construction of a new highway. In both alternatives the impacts of construction and operation phases are dealt with as follows:

- Beneficial and adverse impacts of construction phase of proposed highway

Beneficial:
Employment, Financial facilities, safety fencing, access roads development, closing of construction workshops
Adverse:
Explosion, destruction of vegetation, mountain cutting, construction of bridge, herbicide utilization, drilling, asphalting, tunnel construction, residential buildings and restaurant, sand dune exploitation, demolition of buildings, cutting and filling, concrete making, stone cutting, transportation of construction machinery and materials, dyeing and insulation.

- Environmental impacts arising from construction phase

Beneficial
Population Density, employment (new job opportunities) , transportation, industry and mining
Adverse
Aquatic ecosystems, quality of surface water, food chains, soil stability, drainage, noise, air, soil structure, traffic, landscape, soil erosion, sedimentation, aesthetics and views, tourism, hygienic indexes, land use, land ecosystem, groundwater quality and surface water utilization.

- Beneficial and adverse impacts arising from operation phase

Beneficial
Employment development, snow removing, repair and maintenance, toll pay, traffic, parking areas and gas stations
Adverse
Hazardous wastes transportation, warehousing, restaurants, salt scattering and hazards & accidents

- Environmental impacts from operation of the highway

Beneficial
Future development plans, health facilities and services, public participation, leisure time, resettlement, biological diversity, employment development, increase of property price, migration, expansion of recreational areas, safety and security, income and expenses, welfare, industry and mine,
Adverse
Noise, surface water quality, agriculture, health indexes, solid waste disposal, climate, micro-climate, traffic, groundwater quality, flora habitats.

The results of comparing 2 alternatives are as follows:

- The impacts of construction phase for 2 alternatives(1,construction of new highway and 2 idening of existing road)

Total of Construction Phase	**Number of Impacts**	**No. of Beneficial Impacts**	**No. of Adverse impacts**	**Ratio of Beneficial to Total**	**Algebraic Sum**	**Average**
Alternative 1	289	80	209	0.27	-129	-0.44
Alternative 2	183	32	147	0.17	-112	-0.61

- Impacts of Operation Phase of Alternatives (1:Construction the proposed highway,2 : Widening existing road)

Total of Construction Phase	Number of Impacts	No. of Beneficial Impacts	No. of Adverse impacts	Ratio of Beneficial to Total	Algebraic Sum	Average
Alternative 1	133	83	50	0.62	+33	-0.24
Alternative 2	104	38	66	0.36	-27	-0.25

- General Comparison of Alternatives Both in Construction and Operation Phases

Alternative	Number of Impacts	No. of Beneficial Impacts	No. of Adverse impacts	Ratio of Beneficial to Total	Algebraic Sum	Average
Alternative 1	422	163	259	0.38	-96	-0.22
Alternative 2	287	70	213	0.24	-143	-0.49

Therefore, alternative 1 (construction of highway) is preferred. It should be pointed out that Pastakia method is less time consuming. Also the results can be easily presented in a more meaningful graphic pattern (Monavari, 2001a). These results are given in Tables 5 to 8.

Table 5. Summery points in construction phase of proposed highway (Tehran –Pardis)

Extend of effects / Component	-E	-D	-C	-B	-A	N	+A	+B	+C	+D	+E
Physical –Chemical	0	0	0	1	11	0	3	0	0	0	0
Biological - Ecological	0	0	2	1	2	2	0	0	0	0	0
Sociological –Cultural	0	0	0	1	1	0	2	0	0	0	0
Economic- Operational	0	0	1	1	1	0	1	1	0	0	0
Total	0	0	3	4	15	2	6	1	0	0	0

Table 6. Summery points in operation phase of proposed highway (Tehran –Pardis)

Extend of effects / Component	-E	-D	-C	-B	-A	N	+A	+B	+C	+D	+E
Physical –Chemical	0	0	0	2	2	0	1	4	0	0	0
Biological - Ecological	0	0	0	1	2	0	1	2	0	0	0
Sociological –Cultural	0	0	1	0	1	0	0	2	0	4	0
Economic- Operational	0	0	0	0	0	0	0	1	0	2	2
Total	0	0	1	3	5	0	2	9	0	6	2

Table 7. Summery of points in construction phase for widening of existing road (Tehran-Roodehen)

Extend of effects / Component	-E	-D	-C	-B	-A	N	+A	+B	+C	+D	+E
Physical –Chemical	0	0	0	1	11	0	3	0	0	0	0
Biological - Ecological	0	0	1	0	2	4	0	0	0	0	0
Sociological –Cultural	0	0	2	1	7	0	0	0	0	0	0
Economic- Operational	0	1	1	3	0	0	0	0	0	0	0
Total	0	1	4	5	14	4	3	0	0	0	0

Table 8. Summery in operation phase for widening of existing road (Tehran-Roodehen)

Extend of effects / Component	-E	-D	-C	-B	-A	N	+A	+B	+C	+D	+E
Physical –Chemical	0	0	0	2	2	0	1	4	0	0	0
Biological - Ecological	0	0	0	1	2	9	1	2	0	0	0
Sociological –Cultural	0	1	1	1	1	0	0	1	1	2	0
Economic- Operational	0	0	0	0	0	1	0	0	0	3	1
Total	0	1	1	4	5	1	2	7	1	5	1

In this method construction of Tehran-Pardis highway is also approved compared with widening of existing road.

CONCLUSION

The main conclusion of the present investigation is that the construction of new highway has many advantages over widening the present one. It is also concluded that Pasticcio method is a simple and effective tool for environmental assessment. Besides these conclusions, we should point out to the followings:

- Prevention of sedimentation of materials arising from construction activities like mountain cutting. Natural drains should be protected by embankments or straw or putting limitation on soil excavations in dry periods.
- For prevention of soil erosion, plantation of young trees or shrubs in endangered areas is necessary. It can be also done by spraying mulch on sensitive soils especially those that are close to the surface water of the region namely Jajrood River.
- For preventing any environmental and social disturbance, site selection for construction workshops should be made carefully enjoying a sound management.
- For preventing any landslide or stone falling in soil exploitation activities, such activities should be limited in potentially sensitive and unstable areas and fixing the exploited areas with construction suitable walls with good materials.
- For prevention any kind of decreasing water quality of Jajrood River due to increase of suspended materials arising from erosion, vegetation enhancement programs should be implemented in these areas. Sedimentation pounds may also be constructed for sediment control in these areas.
- The best time for explosion activities is late summer and during daytime to prevent any harm to pregnant animals of the region.
- For preventing any damage to landscape and scenery of the region due to grading, some sloping limitations should be set forth in this regard.
- For prevention of traffic dust and its impact on health of the residents as well as vegetation, water spraying is recommended.
- For preventing any kind of harm on habitats of wildlife, the course of new highway should pass through less sensitive areas.
- For controlling unauthorized hunting due to new access roads, new Environmental Guard Stations should be established in these areas.
- Construction of over and under crossings and passageways for passing of wildlife through the highway is necessary. Moreover, putting fences and other obstacles for preventing wildlife from crossing the road is inevitable.
- Compiling a solid waste management program for controlling these materials in the region is necessary (for sound collection and disposal).
- For prevention of horning by drivers and its potential impacts on wildlife, biologically and behaviorally, a control program for awareness of drivers by putting related signs is necessary.
- Exploitation of sand dunes from the bed of the river should be controlled for preventing any erosion of the walls of the river.
- Establishment of any gas station and repair shops close to the river should be prohibited for preventing any probable disperse of oil materials to the river and using dispersants for collecting them.
- Trying to absorb native people for different phases of the project for promoting public participation and using local investments.
- Compensate the loss of those people who have lost their lands or their land-use has been changed.
- Prohibit construction of any gas station, tourist guest house, parking and other buildings close to Khojir National Park limits.

REFERENCES

Abbaspour, M., (1998) Environmental Engineering, Azad University Publication, **2**, 589.

Clevenger, A. P., (2002). Effects of highways and other linear development on wildlife populations, literature collection, www.office@cmiae.org.

Majnoonian, H., (2000). Protected areas of Tehran. Internal Report No.123, Department of Environment ; Tehran , Iran, 123-149.

Monavari, S.M., (2001a). A Guide to environmental impact assessment of highways. Joint publication of Iran DoE & UNDP; 40.

Monavari, S. M., (2001b). Application of rapid assessment in development project. The first International Seminar on EIA in Iran; Joint publication of Iran DoE & UNDP; 54-66.

Reed, N. (2001). The ecological effects of roads, managing roads for wildlife; 7-25.

Schonewald – Cox , C. and Buechner, M., (1992). Park protection and public roads.Conservation Biology- the theory and practice of nature conservation, preservation and management (eds. P.L. Fieldler and S. K. Jain), 373-395; Chapman Hall , New York.

Spellerberg, I. A., (1998). Ecological effects of roads and traffic: a literature review, Global Ecology and Biogeography Letters; Blackwell Science Ltd., **7**, 317-333.