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Health Impact Assessment for the Construction of Ring Rad Southern Loop in Lahore, Pakistan

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Abstract

Health Impact Assessment of general public is carried for the construction of southern loop of ring Road in Lahore, Pakistan. The methodologies adopted for conducting the assessment were survey, baseline information, interviews using questionnaires, evaluation in the Environmental Impact Matrix and measurements of various health parameter, drinking water quality assessment and air quality assessment. To carry out the assessment 300 people from the project area were randomly selected and were interviewed. Water quality monitoring and air quality monitoring was conducted by collecting water and air samples. The parameters were compared with the World Health Organization (WHO) guidelines for the drinking water and United States Environmental Protection Agency (USEPA) for the ambient air quality. Results of health status assessment showed that common diseases in the area were hepatitis, skin allergy, stomach problems, high blood pressure, diabetes, fever, flu and respiratory problems. The results of ground water quality showed that total Coli forms, fecal coli forms and fecal entero cocci were found to be high as compared to WHO Guidelines. Chemical parameters were well within the permissible limits except Total Dissolve Solids (TDS). Analysis of wastewater showed that samples were having a very high COD content of 263 mg/l in comparison to the prescribed limits of 150 mg/l, while all other parameters are well within the permissible limits of NEQS. In case of ambient air quality the results showed that PM10 was found to be 426 µg/m3 which was substantially high as compared with USEPA standard value of 150µg/m3. However, the CO, NO2 and SO2 were well within limit. Prediction and evaluation of impacts of the project revealed that construction of road will pose some temporary health issues during the construction phase of the project implementation but those problems were of mild nature and temporary, and ended with the completion of construction of the project.

Keywords: Health impact assessment (HIA), drinking water quality monitoring, air quality monitoring, world health organization (WHO), united states environmental protection agency (USEPA).

Introduction

Roads and highway construction projects are civil construction developments to improve transportation system essential to connect places, provide employment and evidently affect economic progression[1]. Transportation system in urban areas is one of the environmental issues presenting threat to sustainable development because of the transport sector's energy consumption patterns and green house gases emissions at the global scale. It is estimated that by the year 2025, the transport sector's energy consumption will be doubled and much more people will become dependent on private automobiles[2]. Environmental implications of this rapidly growing and poorly regulated motorization needs proper planning of future transportation system for the sustainable development[3].

Environmental Impact Assessment (EIA) is a systematic procedure to assess social, environmental, and economic consequences of a project before its construction and implementation[4]. Major transportation, civil construction projects must undergo Environmental Impact Assessment to minimize negative effects on social environment. Along with considerable environmental impacts, land use developmental projects largely affect public health, thus emphasizing the need of considering health impacts within Environmental Impact Assessment. It is well recognized that a wide range of projects affect public health[5].

Most of the Environmental Impact Assessment programs around the world require considering impact assessment of the developmental projects on human health. Comprehensive measures are required to effectively integrate health outcomes in Environmental Impact Assessment procedures with meaningful participation of local community[6]. Health Impact Assessment is the procedure that influences decision making of policies and projects to improve population health or at least does not damage the population health. Urban and city planning projects shape land use, housing, transportation, job opportunities and social services. The quality of urban environment and opportunities of public participation in decision making is regarded as powerful determinant of population health[7].

Transportation projects have positive impacts for economic development but may also have significant negative environmental impacts on nearby communities and the natural environment. Property and People are often directly affected by

the road works. Health Impacts like high levels of noise during construction and production of air pollutants during construction and implementation phase are major significant problems related to such type of projects. Impacts may also include soil erosion, changes to streams and underground water and sometimes affecting sensitive environments and lifestyle of indigenous people[8]. In order to carryout effective environmental and health assessment of road construction the contractors must understand the assessment process and should coordinate it during design and construction activities[9]. Road construction projects require impact identification, public participation and formulation of effective mitigation for reduction of health impacts on workers and general public[10]. Road construction and improvement projects inevitably require Health Impact Assessment to be conducted in order to minimize and mitigate negative health impacts to road users, nearby community and on road construction workers[11].

Objectives of the study were to: i. Observe the baseline socioeconomic and health conditions of the residents of the Project area. ii. Predict the adverse and beneficial impacts of the Project on socioeconomic and health states of community through environmental impact matrix. iii. Suggest appropriate mitigation measures and propose an Environmental Management Plan.

Material and Methods

Study Area: Government of Punjab, Pakistan initiated the project of Lahore Ring Road (LRR). The project is aimed at providing a high capacity and an efficient road facility at the fringes of the city to cater for inter suburban travel demand and city by passable traffic to help relieve the city road network from the congestion and pressure of extraneous traffic. LRR is also required to help spread and distribute the traffic volumes on the city roads more evenly for efficient traffic management. Health Impact Assessment of the residents, stakeholders and general public is carried for the construction of Ring Road in Lahore, Pakistan. Figure 1 is showing the map of project area. Study was conducted for the period of six months in 2011.

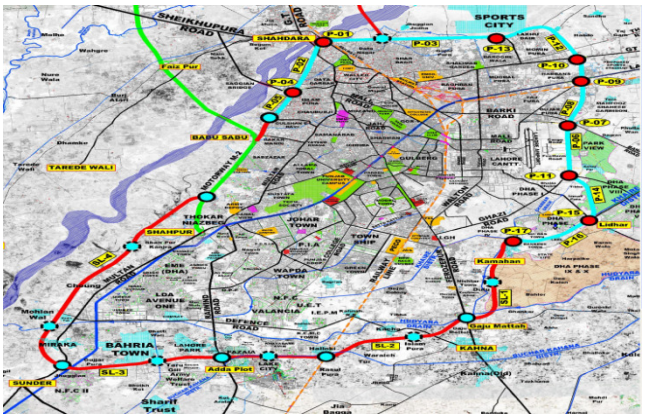

Figure-1
Map of Project Area

Survey: For collecting the baseline information a detailed survey of the project area was carried out. The survey was carried out to have an idea about the living conditions like sanitation of the surrounding environment, basic health and environmental conditions of the project area.

Interview using Questionnaire: More than 300 community inhabitants of the project area were interviewed by using questionnaire for the health assessment. The questionnaire was specially designed to know the status of health in project area by asking about the common diseases, reason of diseases, height, weight, blood pressure, food type, physical activities, availability of medical facilities for prevention and control. Data was analyzed for the selected parameters for the health assessment of the community members.

Measurement of health parameters: Height: To measure the height measuring scale was made on the wall with the help of measuring tape and height was recorded in foots and inches.

Weight: The weight was measured with the help of weighing machine (TANTINA, Model 1535). The weight was measured in Kilograms.

Body Mass Index (BMI): The relationship between weight and height was used for the BMI calculation. BMI was calculated in kilogram/meter square with the help of following formula

BMI = Weight in kg / Height in meter squares

Drinking water quality assessment: For drinking water quality assessment, groundwater samples were collected from the hand pump at a depth of 80 feet for analysis of both microbiological and chemical parameters. The instrument used for the drinking water analysis parameters are Hach pH meter, USA, Hach COD Reactor, USA, Hach Conductivity meter, USA, Hach Spectrometer DR/2000.

Wastewater quality: The waste water sample was collected and preserved in accordance with the standard method for collection of wastewater samples from the project area. The collected samples were analyzed for all the parameters of NEQS including pH, chemical oxygen demand (COD), total dissolved solids (TDS), chloride, fluoride and sulphate except pesticides, herbicides and fungicides.

Ambient air quality assessment: The ambient air quality was monitored in the project area. The ambient air quality was monitored for priority pollutants such as CO_2, NO_2, SO_2 and PM. The period was 24 hours at each sampling point. Figure 5 shows a view of Ambient air monitoring in Project area.

Noise level: Noise level was monitored for 24 hours with the interval of 1 second and hourly average data was recorded. The sound level was monitored from 7.5 meters from the edge of the

road. The sound level was monitored with the help of a portable digital sound meter.

Data analysis: After designing the questionnaire, interviews were taken during the survey and about 300 questionnaires were filled and these questionnaires were entered in Microsoft excel work sheet and percentages were taken then graphs are drawn on the Microsoft excel worksheets. Parameters like Carbon, Hydrogen, Sulphur and Iron were analyzed and values of these parameters were compared with minimum international standards by drawing the graphs and Standard deviation was used as a tool of Statistical analysis.

Evaluation of project impacts using matrix: The methodology selected for environmental impact prediction was matrix. It was based on the assessment of environmental impacts due to project during constructional and operational phase, health aspects or issues are listed along one axis and impacted environmental characteristics or conditions along the other.

The following scale has been used for the evaluation of impacts: LA = Low Adverse (low/short-term damage to the environment), MA = Medium Adverse (moderate damage to the environment), HA = High Adverse (severe damage to the environment), LB = Low Beneficial (less beneficial to the environment), MB = Medium Beneficial (moderate beneficial to the environment), HB = High Beneficial (highly beneficial to the environment), N/A = Not Applicable, O = Insignificant / No Impact.

Results and Discussion

Body Mass Index: The Body Mass Index (BMI) was calculated of community members as a health assessment parameter during the survey. Figure-2 is showing that mostly people were in range of normal (55 percent), 20 percent were underweight, 17 percent people were found to be overweight while 8 percent were obese.

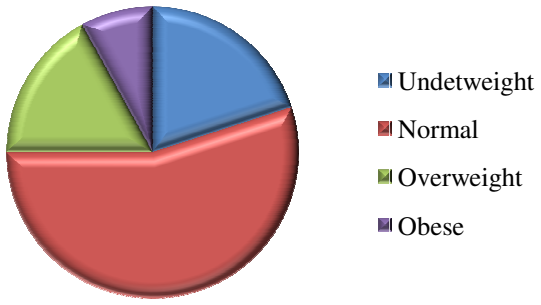

Figure-2
Graph showing percentages of underweight, normal, Overweight and obese people interviewed during survey

Diseases: When community members were asked about the specific diseases of the area they were of view that the area specific diseases are seasonal which includes viral and infectious diseases and also some have genetic diseases like heart diseases and diabetes. The results of the data collected to assess the health status of the community members showed that mostly people were healthy (69 percent) and some people were having common diseases shown in figure-3.

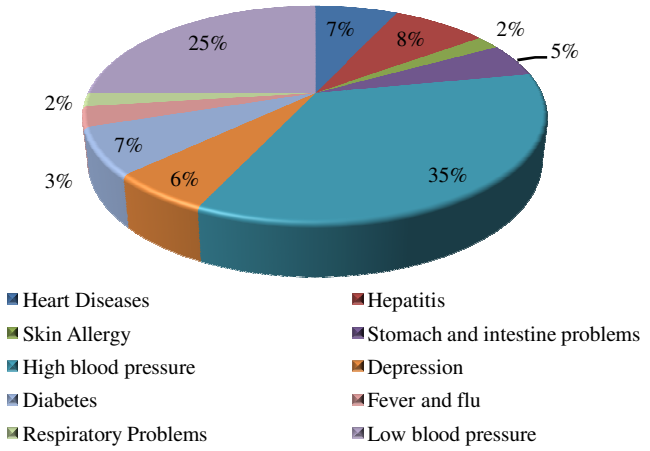

Figure-3
Graph showing percentages of common diseases among people in project area

Drinking Water: Most of the people in the area were using ground water for drinking purpose. Generally underground water is of good quality. For establishing baseline conditions, groundwater samples were collected from hand pump at a depth of 80 feet for analysis of both microbiological and chemical parameters. The results of the ground water quality are presented in figure 4, 5, 6, 7, 8 , 9 and 10. The ground water results for microbiological analysis depicts that the values of Total *Coli forms,* fecal *coli forms* and fecal *entero cocci* are higher as compared to WHO Guidelines, which shows that the water was unhygienic and unsafe to be used for drinking purposes. While the results for chemical analysis show that the value of pH is towards the basic side and all other values were well within the permissible limits except total dissolve solids (TDS).

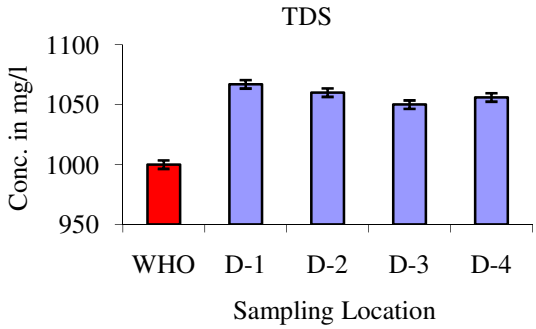

Figure-4
Graph showing the Total Dissolved Solids in different locations of project area

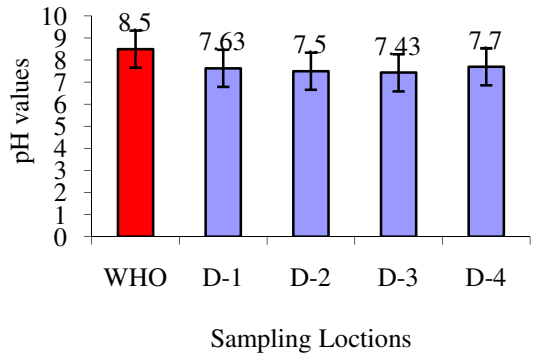

Figure-5
Graph showing the pH values of water in different locations of project area

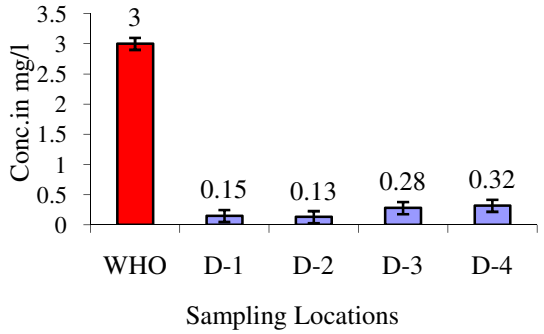

Figure- 6
Graph showing the concentration of Nitrites in different locations of project area

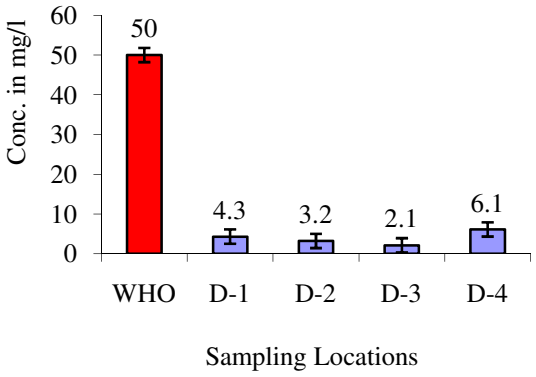

Figure-7
Graph showing the concentration of Nitrates in different locations of project area

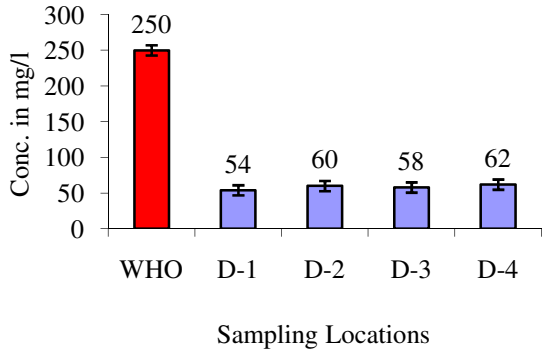

Figure-8
Graph showing the concentration of Chloride in different locations of project area

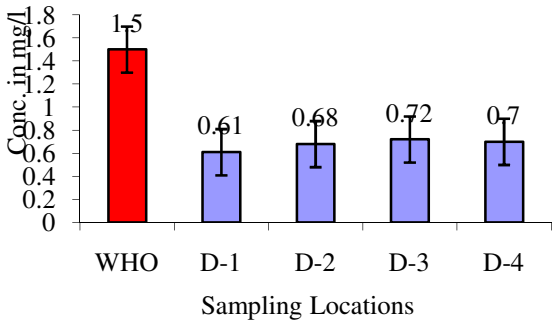

Figure-9
Graph showing the concentration of Fluorides in different locations of project area

Wastewater Analysis: The wastewater samples were collected from Hudyara drain in the Project area. The samples were collected and preserved in accordance with the Standard Method for collection of wastewater samples. The collected samples were analyzed for all the parameters of NEQS, Pakistan except pesticides, herbicides and fungicides. The results obtained were compared with the NEQS and have been shown in figure- 11. The results showed that the samples were having a very high COD content of 263 mg/l in comparison to the prescribed limits of 150 mg/l, while all other parameters are well within the permissible limits of NEQS.

Ambient air quality: The ambient air quality was monitored in the Project area. The ambient air quality was monitored for priority pollutants such as CO, NO_2, SO_2 and PM 10. The monitoring period was 24 hours at each sampling point. The results of the ambient air quality monitoring at the project site are shown in figure- 12, 13, 14 and 15. The result shows that highest value of PM10 was 426 µg/m3 which was found to be substantially high as compared to the USEPA standard value of 150µg/m3. However, the CO, NO_2 and SO_2 were well within limit.

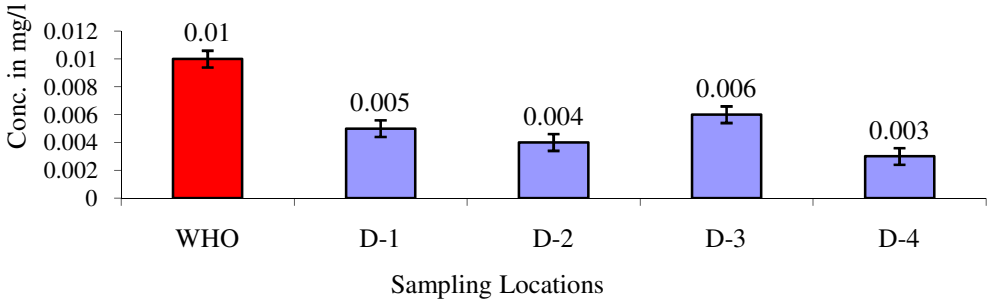

Figure-10
Graph showing the concentration of Arsenic in different locations of project area compared with WHO value and Standard deviation from the Standard

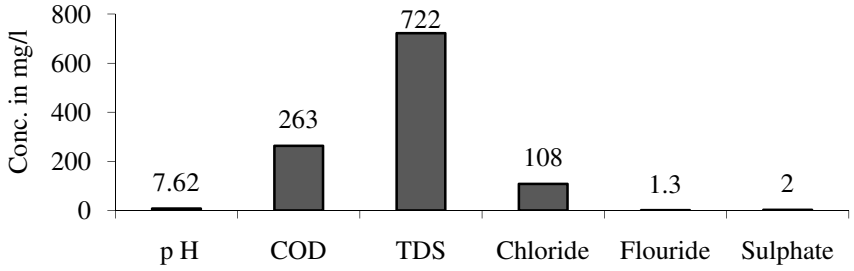

Figure-11
Graph showing the concentration of different parameters in wastewater samples collected from the project area

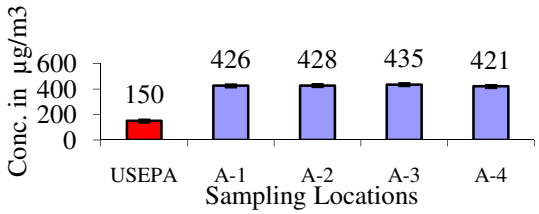

Figure-12
Graph showing the concentration of Particulate Matter in different locations of Project area

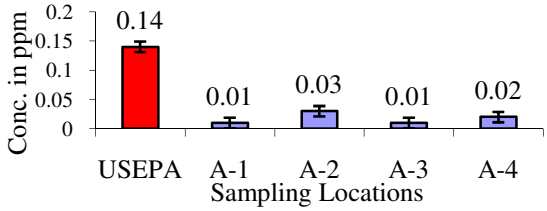

Figure-14
Graph showing the concentration of Sulphur Dioxide in different location of project area

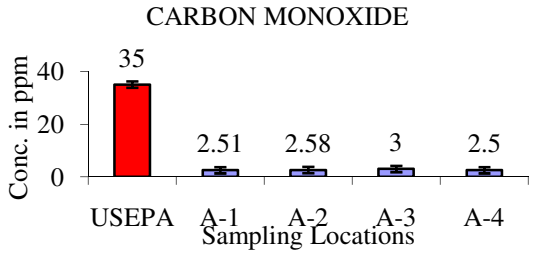

Figure-13
Graph showing the concentration of Carbon Monoxide in different location of project area

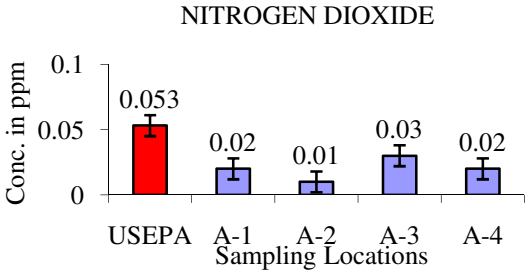

Figure-15
Graph showing the concentration of Nitrogen Dioxide in different location of project area

Noise level: Noise levels were found to be quite high due to be movement of traffic. The maximum one hour average value recorded was 93.1 dB (A) and the minimum value recorded was 68.3 dB (A). Noise level was monitored for 24 hours and average data was recorded. The results are presented in figure-16.

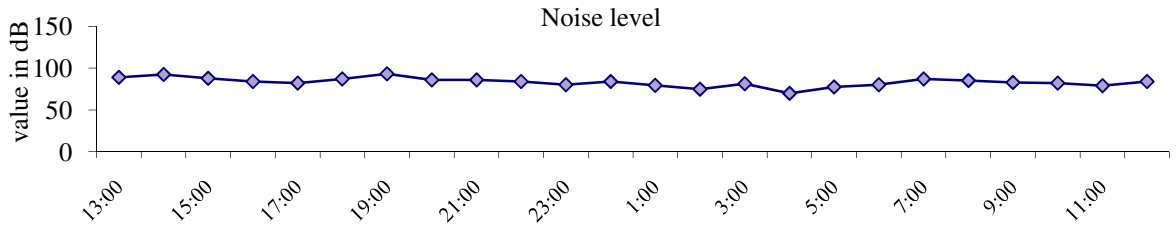

Figure-16
Graph showing the maximum and minimum noise level monitoring with interval of one hour near project area

	Socioeconomic Environment										Health			
Environmental Components / Project Activities	Public Health & Safety	Occupational Health & Safety	Disruption of Public Utilities	Employment	Land Acquisition & Compensation	Social Disorder	Cultural/Religion Values	Noise & Vibration	Local Economy	Traffic Management	Water Quality	Dust	Diseases	Waste Generation
Vegetation Clearing	LA	LA	LA	MB	LA	O	O	LA	O	LA	LA	HA	LB	LA
Construction camps. Workshops etc	LA	LA	O	LB	O	LA	O	LA	O	O	MA	MA	LA	HA
Excavation operations at burrow & quarry areas	LA	MA	O	MB	LA	LA	O	MA	LB	O	MA	HA	O	HA
Transportation of construction materials	MA	LA	O	LB	O	LA	O	MA	LB	LA	O	MA	O	LA
Use of construction materials etc	LA	LA	O	LB	O	O	O	LA	LB	LA	MA	HA	MA	HA
Earthwork operations	MA	HA	MA	MB	O	O	O	HA	MA	HA	LA	HA	O	MA
Operation of concrete batching plants	MA	L A	O	MB	LA	O	O	MA	LA	LA	LA	LA	LA	MA
Operation of asphalt plants	MA	LA	O	MB	O	LA	O	MA	LA	LA	O	O	LA	LA
Crushing operations	MA	LA	O	MB	LA	O	O	HA	LB	O	LA	HA	MA	MA
Waste Management	LA	LA	O	LB	O	LA	O	O	O	O	MB	MB	MB	HB
Storage of oils/diesel	LA	MA	O	LB	O	O	O	O	O	O	MB	O	LB	LB

Legend: O- Insignificant / no impact, MA-Medium Adverse, NA-Not Applicable, MB-Medium Beneficial, LA- Low Adverse, HA- High Adverse, LB- Low Beneficial, HB-High Beneficial

Figure-17
Environmental Impacts Matrix for the Construction Phase

Sr. No.		Socioeconomic Environment								Health			
	Environmental Components / Project Activities	Road Safety	Land Use	Employment	Community Development	Economic Activity	Noise & Vibration	Economic Benefits to Community	Communication System	Water Quality	Dust	Diseases	Waste generation
1	Movement of vehicular traffic	MB	NA	MB	MB	MB	LB	LB	HB	O	HA	O	O
2	Transportation of goods/ Passengers	MB	O	MB	HB	HB	LB	MB	HB	O	HA	LA	O
3	Commercial / industrial development	LB	MA	MB	LB	HB	LB	LB	MB	LA	MA	LA	O
4	Road maintenance	LB	O	LB	LB	LB	LB	LB	MB	O	HA	O	MA
5	Maintenance of Road Machinery	O	O	O	LB	O	LB	LB	LB	O	MA	O	MA

Legend: O- Insignificant / no impact, MA-Medium Adverse, NA-Not Applicable, MB-Medium Beneficial, LA- Low Adverse, HA-High Adverse, LB- Low Beneficial, HB-High Beneficial

Figure-18
Environmental Impact Matrix for the Operational Phase

Evaluation of Project Impacts using Matrix: Health impacts were predicted and evaluated with the help of environmental matrix shown in figure-17 and 18. Potential issues addressed in matrix are disruption of public utilities, employment, traffic management, social disorder, land acquisition and compensation, public health and safety, noise and vibration, water quality, dust, waste generation and diseases during Design/ Construction phase. Road safety, land use, community development, noise and vibration and diseases during operational phase.

Discussion: The study was conducted to assess the impacts of Lahore Ring Road Southern Loop Project on the health status of public. The Lahore Ring Road Project is basically meant to meet the speedy communication needs of the Lahore City. The construction of the Southern Loop is inevitable to complete the overall loop of the ring road and will interlink the traffic coming from various parts of the city with the Package 17 of the main ring road. Socioeconomic and health status are interlinked. The proposed project, not only will help to provide support in terms of economic uplift but also help in improving the health status of the inhabitants of the project area. Key influences on health in the economic dimension of the environment include employment and income distribution. Although there is clear agreement that income is related to health, health improves with increasing civil service status all the way to the highest occupation levels. The results of the study show that mostly community inhabitants were healthy but some common diseases like heart diseases, hepatitis, skin allergy, stomach and intestine problems, high blood pressure, diabetes, fever, flu and respiratory problems because of pollution, unhealthy conditions, viral/bacterial infections and some because of genetically disorders. Major determinants on the social side of the environment include education and literacy, employment, and working conditions and the levels of social support[12]. Literacy rate of the inhabitants was not satisfactory. Lower levels of education are linked with poor health and higher levels of education are associated with better health. Education facilities were inadequate in the communities of the study area. In term of environmental exposures, person with less education are compelled to select for more hazardous jobs because of financial condition, to live in area where they are exposed to variety of toxins ad pathogens and suffer with more health problems then a well educated person[13].

The socioeconomic environment is crucial in influencing individual lifestyles. Living conditions in the study area reflect the low economic and social condition status of inhabitants as most of the area for construction of project comes under rural areas. Although they are provided with the electricity, gas facility, water but sanitation and drainage system is not proper. The poor sanitation results in all kinds of stomach and intestine infections, hepatitis, skin problems and diarrhea. Most of the infectious diseases in the area are related to poor hygiene conditions, the situation demands for earlier measures in this regard. Personal hygiene is essential both for improving health and for sustaining the benefits of interventions. The results of the survey done illustrates that the majority of the local people were living in poor condition lacking the basic facilities of life. The waste management system was improper heaps of solid

waste were found on the road sides of the area which is damaging the aesthetic beauty and deteriorating the environmental quality. Another problem is the present condition of the access roads is one of the major issues of the area as they are in very poor condition due to lack of maintenance. This causes inconvenience to the locals residing in the nearby localities. These deteriorated access roads cause problems to the students, patients etc. The main critical control points of this project are lack of education, Unemployment, Lack of health facilities, Cutting of trees/bushes falling within the proposed corridor, Disturbance to the public movement during construction, Air and Noise pollution due to the operating of construction machinery during construction phase of project, Solid waste generation during construction, Land acquisition and resettlement, Relocation of public utilities.

On the positive side, the proposed construction of the road is expected to generate considerable economic activity as new opportunities for skilled/unskilled manpower will be available. This is besides the positive impacts of general uplift of economy due to rapid movement of traffic between various cities lying on the way of road and its surroundings. On the adverse side, cutting of trees, handling and disposal of construction waste, contamination of surface and ground water, disruption of traffic, deterioration of air quality, increase in noise level, impacts on existing utilities, safety of workers and public are some of the perceived negative impacts during the construction phase which will require necessary mitigation measures. At the operational phase, road safety, deterioration of air quality, increases in noise level and a check on surface water contamination, traffic problems are the significant negative impacts. Mitigation measures against the negative impacts, as suggested in the Environmental Management Plan (EMP) shall be strictly enforced, for which an Environmental Committee should be constituted to oversee the implementation of the proposed mitigation measures during construction and operational phases.

Conclusion

The proposed construction of the Lahore Ring Road Southern Loop will have both positive and negative impacts during the construction and operational phases, for which proper mitigation measures are necessary. During the field survey, significant efforts were made to identify the main social, health and environmental issues related to the construction of the proposed road. Various government departments and agencies were also contacted for obtaining salient information along with area resident. Improved communication infrastructure will promote new business opportunities. In addition such an activity will also increase the land value that will benefit the local residents. This impact will be permanent and major positive in nature. In conclusion, it can be said that in general the project will have positive impacts on the social, economic and health status of community inhabitants.

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