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Physical Impact Assessment (Air and Noise Component) of Waste Water Treatment Plant for Mehmood Booti/Salamat Pura, Shadbagh and North Site, Lahore, Pakistan

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Abstract

Environmentally sound development is possible only if potential environmental impacts are known before the project is initiated. The present study is focused on Air quality impact assessment for North Waste Water Treatment Plant (WWTP). Baseline study was conducted and data on topography, hydrogeology, soil, climate and meteorology, wind velocities and direction etc. was collected through secondary sources like published literature, metrological department and geology department. Ambient air quality assessment was done to find out the existing air conditions of the area where the project is proposed. Selected parameters for ambient air quality assessments were oxides of carbon (CO), nitrogen (N_2O), sulphur (S_2O) and particulate matter. Collection of environmental data on physical parameters and field survey was based on site visits. Future impacts of the project on air environment were predicted and evaluated using matrix methodology. The exponential population growth and urbanization is responsible for the increasing pollution load in the River Ravi. Waste water from industrial and municipal sources is directly discharged in it without proper treatment. Proposed project of installation of waste water treatment plant aims to treat waste water discharged from various sources in the areas; Mehmood Booti, Salamat pura, Shadbagh and North sites, in order to minimize the River Ravi pollution. Results of all parameters of ambient air quality analysis were within the permissible limits except Nitrogen dioxide and Particulate matter due to dust and vehicular emissions. Impact prediction and assessment revealed that air quality of the area will only be affected in the construction phase of project. Operation of the treatment plant will not have negative impacts on ambient air quality. Further studies should be carried out and more advanced mitigatory measures should be adopted to improve existing air quality of the project area.

Keywords: Physical impact assessment (PIA), air quality monitoring, noise level monitoring, prediction, construction phase.

Introduction

In upcoming years, climate will change drastically, resulting in many global shifts, some of which can be seen now. Entire world will be affected through climate change resulting from increased global warming and rising sea levels[1]. The warming rate of the world is 0.128 (+ 0.026) °C for every year since past 59 years. As a result of global warming, our country is experiencing climate change, principally, in the temperature which is increasing considerably[2]. Lahore faces a hot steppe climate accompanied with prolonged extreme warm summers, arid and humid winters.

Clean Air Act (amended in 1990) necessitates EPA to set National Ambient Air Quality Standards for pollutants that are injurious to public health and the environment. Two types of national ambient air quality standards have been identified by the Clean Air Act i.e. primary standards and secondary standards[3].

The planned 2012 Amendments of area selected for State ambient Air Quality Standards became effective on April 1, 2013, when approval by the workplace of jurisprudence. Standards of ambient air quality were established by Air Resources Board (ARB) to spot outside waste level thought-about secure for the general community[4]. National Environmental Quality Standards (July 1996) provide protection of close air quality in Pakistan.

Outdoor noise also referred to as environmental noise has many sources like machines and transportation systems, motor vehicles, aircrafts, and trains. The impact of noise on humans depends not solely on its magnitude however conjointly on its frequency content as a result of the ear isn't equally sensitive to noise in the least frequencies within the perceptible vary of 16-20,000 Hz. however this vary is reduced with age and alternative subjective factors[5].

EIA of planned project is obligatory in keeping with the Environmental Protection Act of Pakistan. PEPA-1997 [Section 12 (1)] states that: "No proponent of a project shall begin construction or operation unless he has filed with the office Associate initial environmental examination

or, wherever the project is probably going to cause adverse environmental impact, an environmental impact assessment, and has obtained from the office approval in respect thereof" [6].

The objectives of the study are to: i. Collect baseline information related to the air environment through field survey and analysis of air quality parameters, ii. Compare the results of analysis with standards in order to check the compliance. iii. Environmental impact recognition of the project by preparing the matrix. iv. Suggest appropriate recommendations to minimize adverse impacts on the air quality arising from the construction of project. v. Preparation of an environmental management plan.

Material and Methods

Study area: The present study focus on the environmental impact with reference to physical aspects particularly air carried out on a waste water treatment plant. The proposed project site for waste water treatment plant is located in the east of River Ravi and north of the Lahore Ring Road. The proposed site is surrounded by residential areas including Jhuggian Jodha village, Karol, Ainu Bhatti, Jabbo, and Madinabad. The proposed project lies in the city of Lahore in Punjab Province.

In the methodology for carrying out the air quality impact assessment of WWTP three main studies were carried out i.e. i. Baseline conditions, ii. Impact prediction and evaluation.

Ambient air quality assessment: This ambient air quality impact assessment was conducted to address the potential air quality impacts resulting from the construction of project of North WWTP. Air pollutants emitted from each of the activities under consideration are identified. Analysis of physical parameters was done to find out the baseline environmental condition. The presented study was conducted for the assessment of four parameters of ambient air quality included CO, SO_2, NO_2, PM_{10}. National Environmental Quality Standards are used and values are compared with the NEQS. The sampling was conducted for 24 hours period. Locations were selected as follows: i. A-1, near Karol village, ii. A-2, near Jhuggian Jodha village, iii. A-3, near Ainu Bhatti, iv. A-4, near Madinabad.

Testo 317-3 CO analyzer was used to analyze CO, whereas SO_2 and NO_2 were analyzed in accordance with the SOP (Standard Operation Procedure) on the basis of ISO 6767 and ISO 6788 methods of USEPA.

Noise intensity monitoring: Monitoring of noise was done at the locations where air quality was monitored. Noise level was measured at day time and night time. Five (5) readings were taken at day and five (5) readings at night time for each location and compared with NEQS. Noise level was monitored with the help of TES 1350 Sound Level Meter at the project site.

Evaluation of project impacts using matrix: The methodology selected for environmental impact identification studies was matrix. It is based on the assessment of environmental impacts due to project site and design in which air and soil aspects are listed at one axis while impacted environmental conditions at the other end. The criteria of impact evaluation used are given below: O = Negligible/ No impact, LA = Low Adverse, MA = Medium Adverse, HA = High Adverse, B = Beneficial.

Results and Discussion

Ambient air quality: The results indicate that all the parameters at the selected points are within the NEQS except NO_2 and PM_{10}. Dust and vehicular emissions contribute to the elevated concentrations of NO_2 and PM_{10} at the selected monitoring points.

Noise level: The results indicate that the noise level is within the permissible limits of NEQS during both day and night at all selected locations.

Evaluation of project impacts using matrix: To evaluate the impacts, environmental impacts matrix is used for construction stages. The matrix identifies the potential issues, stressor and receptor during construction phase. The evaluation of impacts on air quality are done for the existing activities as well as prediction of impacts for the proposed WWTP project also assessed and enumerated by matrix.

Discussion: In the study of Wastewater Treatment Plant Impacts for the ambient air quality analysis four types of air pollutants are of major concern. These include CO, SO_2, NO_2 and PM_{10}. Fossil fuel combustion is the primary source contributing to CO emissions. Other sources of CO emissions include exhaust from internal combustion engines and partial burning of fuels[7]. SO_2, an industrial pollutant, is also emitted through fossil fuel burning if not removed before burning. It exists on earth in very small concentrations[8]. Concentration of CO and SO_2 are well within the permissible limits as prescribed by NEQS.

The concentration of NO_2 exceeds the limit as prescribed by NEQS. The primary sources of NO_2 are combustion processes and vehicular emissions. The monitoring was done near the road side surrounded by an open area without any vegetation thus the higher concentration of NO_2 may be the because of vehicular emissions. Nitrogen dioxide emissions are related with the combustion temperature; as increasing temperature increases nitrogen dioxide level[9]. The higher concentration of PM_{10} may be due to the dust produced from the movement of agricultural machinery on the unpaved surroundings. The analysis of ambient air of the selected locations revealed that the existing air quality is fair to some extent. Nitrogen dioxide (NO_2) and particulate matter (PM_{10}) level is already high on these locations and WWTP construction can cause elevated levels of emissions and dust which need special consideration to be controlled according to the Standards.

The noise level was within the permissible limits of NEQS. There was not much difference of noise level between day and night. During day, the traffic volume is very high at River Ravi Bridge often leading to traffic jams resulting in continuous horns, thus contributing to noise pollution. During night, although the traffic volume is not as high as at day time but the heavy vehicles like trucks, loaders and containers passing nearby contribute to noise pollution. Inspite of this the noise level remained within the limits prescribed by NEQS.

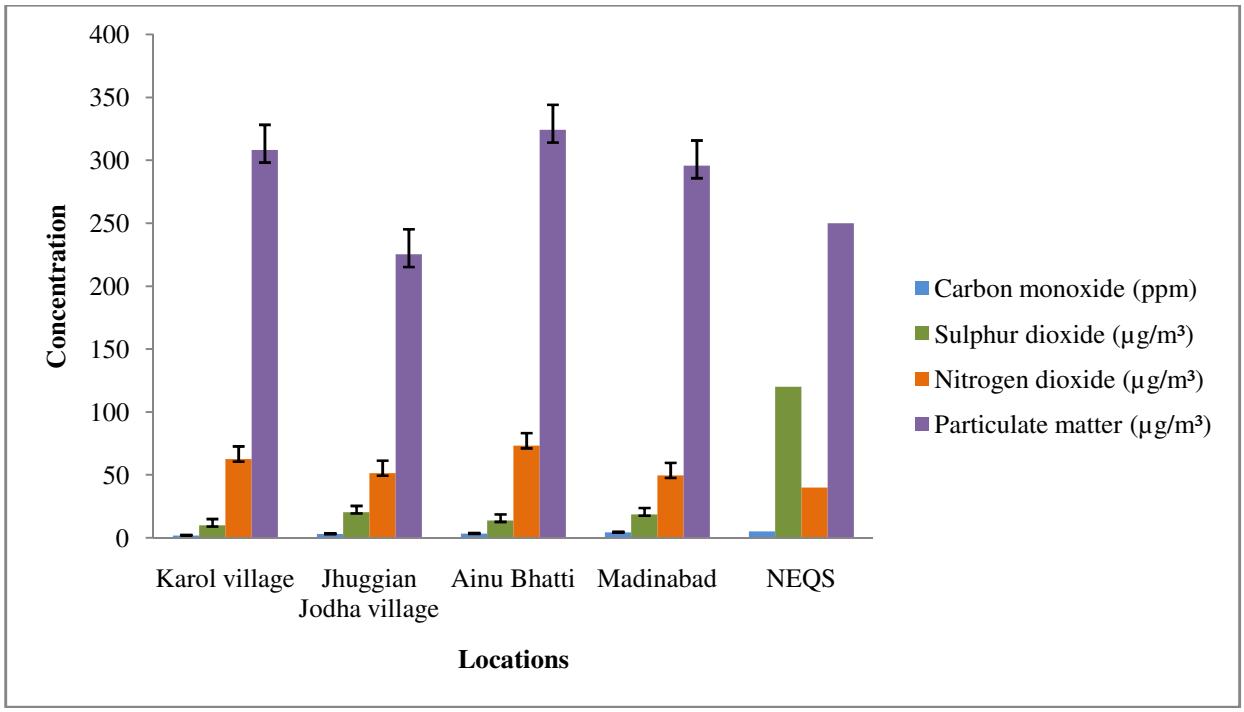

Figure-1
Graph showing comparison of four week samples of air quality parameters at four different locations

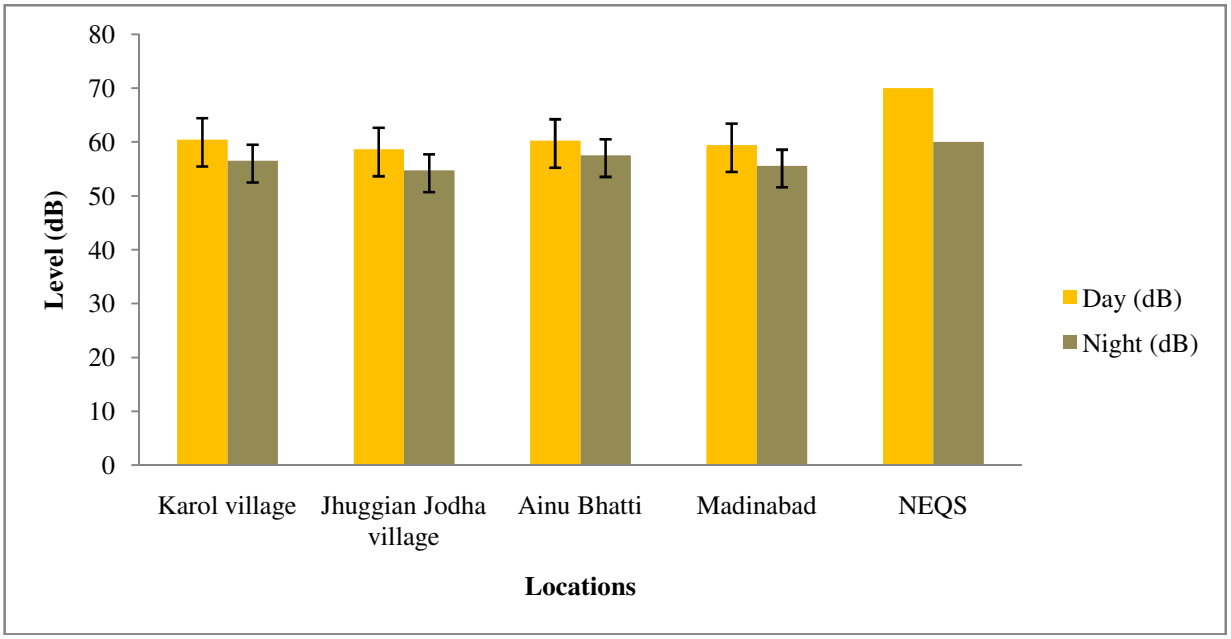

Figure-2
Graph showing comparison of noise level during day and night at four different locations along with NEQS values

Table-1
Air quality Impact Prediction and Evaluation matrix for the construction phase of North Wastewater Treatment Plant (WWTP), Lahore

Sr. No.	Project Activities	Stressor	Receptor	Evaluation criteria					Remarks
				LA	MA	HA	B	O	
1	Vegetation clearing	Authority	Community, air and soil quality	Y	N	N	N	N	Land is acquired by Government and not used for cultivation or residential purposes. Wind erosion is the major dust emission source due to vegetation clearing.
2	Construction camps and workshops	Working force	Air quality and Noise	N	Y	N	N	N	Due to proposed camp sites, loss of vegetation and assets on the selected land and dissatisfaction of rehabilitation measures during construction may occur. Temporary visual intrusion may occur.
3	Excavation operations	Working force	Community and air Quality	N	Y	N	N	N	Major impact during activity is dust nuisance. Spraying the area with water will minimize this impact.
4	Use of construction material etc.	Dust and other material	Air quality	Y	N	N	N	N	Blowing of dust from usage of construction materials like cement, sand etc should be avoided by shielding them from exterior, e.g. using polythene curtains or raising a fence of corrugated sheets around areas of active construction.
5	Operation of concrete batching plants	Working force and construction machinery	Air quality and Nuisance	N	N	Y	N	N	SO_2 and NO_2 will be emitted from the diesel powered mechanical equipment.
6	Solid Waste Management (disposal of excavated material)	Authority	Community	Y	N	N	N	N	Worker garbage shall be properly Disposed at site. Open burning of solid waste should be strictly banned.
7	Use of generators	Authority	Air quality and Noise	N	N	Y	N	N	Emissions from generators at the site can be maintained to reduce these emissions.
8	Earthwork operations	Workforce	Air quality	Y	N	N	N	N	Experts will help to manage the effects of earthworks in a well-organized manner.
9	Transportation of construction material	Authority	Community	Y	N	N	N	N	The load carried by the vehicle should be enclosed by sheeting to prevent seeping through the vehicle.
10	Asphalt plant operation	Machinery	Community health	N	Y	N	N	N	Asphalt plants release pollutants which causes toxicity.

11	Fuel, oil and lubricant from construction equipment and their storage	Vehicles	Community health	Y	N	N	N	N	Oil and fuel evaporation and leakages during their use and storage. Only good quality oils, petroleum products, additives and spares should be used.
12	Construction of embankments	Working Force and construction process	Surface water	Y	N	N	N	U	Embankments are mound of earth or stone build to hold back water so preventive measure against dust should be adopted for in-situ mixing and unloading materials.
13	Open storage of construction material	Authority	Surface water	Y	N	N	N	N	Blowing of dust and particulate matter from stockpiled loose material (e.g. sand, soil) should be avoided either by sheeting them with tarpaulin or plastic sheets or by sprinkling them with light shower of water.
14	Exhaust from machinery	Equipments and Working force	Air quality	N	N	Y	N	N	Exhausts from fossil fuel burning in the construction machinery will deteriorates local air quality.
15	Noise and Dust problems	Authority and machinery	Air quality	Y	N	N	N	N	Release of dust and noise production as a result of machinery operation deteriorates the local air quality and causes disturbance for the community.

Legend: i. O: Insignificant/ no impacts, ii. LA: Low Adverse Impacts, iii. MA: Medium Adverse Impacts, iv. HA: High Adverse Impacts, v. B: Beneficial, **N: no, Y: yes, U: uncertain**

Conclusion

Due to urban sprawl and exponential increase in population the consumption of water and wastewater generation rate has increased significantly. Currently, the wastewater generated is either disposed off to the River Ravi or reused for irrigation purposes without any treatment which in turns deteriorates the water quality of River Ravi and poses risk to public health. WASA and GOP have planned to provide facilities to treat the wastewater before its final disposal or any other intended reuse. For this purpose the establishment of North Waste Water Treatment Plant has been planned. During the field survey, considerable efforts were made to recognize the main impacts on the quality of air related to construction of proposed project. Hence concluded that Nitrogen dioxide and Particulate matter is very high which is harmful for the public health. Construction of North WWTP will affect the air quality so mitigation measures should be adopted. Although the air quality of the project area is not good and construction activity will worsen it more. But the design of WWTP is such that its operation will not affect the air quality thus the project should be installed because its benefits are more than its drawbacks. The treatment plant will help in decreasing the hazards associated with the use/disposal of untreated waste water in Lahore city. EMP is formulated for effective mitigation. According to the discussion, it is recommended to approve the project. Environmental Management Plan should be followed for the mitigation of air quality impacts due to the construction of this project.

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