Environmental Quality for EIA

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Abstract*: Now a day, Environmental degradation is a global level issue and very serious threat to eco-system. Hence analyzing the environmental quality becomes mandatory to overcome the various types of environmental pollution. Hence, EIA becomes compulsory in almost more than 29 countries to execute any of the proposed activities like the construction of dam structures, mining works, construction and execution of industries etc. Analyzing the existing environmental condition of the proposed study area is very important as a part of EIA. The current study have been conducted for analyzing the air quality at a Industrial City in South India due to the Huge human settlements, the subsequent development of Urbanization through Deforestation, Colonization, Industrialization and Transportation, and in turn, to ascertain the increase in pollution level. The emissions through Area sources were identified and the environmental quality has been determined through a specific technology transfer – Environmental Evaluation System (EES) with the assigned parameter importance units.

***Keywords* : Area source, EIA, Emission factors, Emission Inventory, Parameter Importance Unit**

I. INTRODUCTION

Environmental degradation through urbanization through deforestation, industrialization and transportation highly poses threat to the eco-system, damages the property, and causes healthy risks for the human being and live stocks. In order to carry out screening analysis of impact assessment, there is a need for a reliable, usable and simple method / tool for the planners, evaluators and technical operators [1]. Environmental Impact Assessment (EIA) is a basic tool for the proponents, interveners, stakeholders, and for the internal auditors of any the organizations / industries / enterprises etc. The prediction of both positive and negative impacts upon the proposed activity could be easily done by following the EIA procedure / methods. EIA is mandatory for the site selection (matching with the salient features and site selection criteria), for the selection of suitable raw materials not posing threat to the environment, for the process modifications, the technology transfer, equipment modifications, fixing the effective stack height, the customer advice, and for the production of environmental friendly products and thus to safeguard the society. Emission inventory is the indispensable tool of collecting the relevant environmental data, is a valuable activity to ascertain the environmental quality [2, 6]. To promote the better understanding of the existing pollution level, and to raise the awareness of policy-makers, the decision- makers and the general public, the quantitative measurement of emission concentration is essential. The opportunity for the proponents, the interveners, the stakeholders, the internal auditing team and the decision makers etc to predict the impacts, for the technology transfer, for the mitigate measures, or also to boost the potential environmental, health, and social consequences of a proposed development activity of any proposed activity, knowing the existing environmental quality is of prime importance. Emission inventory is a method for the identification of the concentration of various pollutants through line, point and area sources. The data could be collected for all the major sources through the direct observation, interview, questionnaire and data base. To develop an emission inventory for an area, one must list out the types of sources for the area, line and point such as automobiles…; need to determine the type of air pollutant emission from from each of the listed sources, such as PM, SO_2, NO_2…; find out the valid emission factors for each of the pollutants in accordance with the central or state pollution control boards; through an actual count, or by means of some estimating technique, determine the number and size of specific source in the area; and multiply the appropriate numbers from and to obtain the total emissions and then sum the similar emissions to obtain the total for the area. The types and quantity of raw materials used by the households, restaurants, café, wedding halls, small scale industries, large scale industries etc are to be identified for the area source of emissions. Additionally, the bus stations, railway stations, and ports are the major areas where the emission concentration will be more must be considered.

Emission factor (EF) is a statistical activity data helps to determine the total emission concentration. Total emission = Fuel consumption x Emission factor For the evaluation and assessment of environmental impacts, a number of methodologies have been developed. But the computer – based modeling techniques are very strong in predicting and quantifying the impacts. The emission concentrations of various gaseous pollutants can be further weighed using the weighted check lists. Battelle Environmental Evaluation System (BEES) helps to determine the environmental quality upon the characteristics of air. EES shows the parameter importance unit (PIU) for the various gaseous pollutants like CO, HC, SO_x, NOx, SPM, photochemical oxidants, and others.

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The parametric estimates must be converted into an environmental quality (EQ) scale that ranges between 0 and 1. If the value of EQ equal to 0 indicates the environmental quality is extremely bad and the value of EQ equal to 1 indicates the environmental quality is very good. The parameter importance unit (PIU) will vary with the weightage of the individual parameters. The total PIU assigned compiling all the individual parameters is equal to 1000 PIU.

II. METHODOLOGY

A. Preliminary survey

For the current study, the base boundary map of the study area was collected from the city municipality and digitized. The preliminary survey was conducted in the study area, and most of the data were collected from the local municipality authorities which includes the total number of wards in a town, total number of houses, restaurants, wedding halls, schools, colleges, café (tea shops) etc in each ward.

B. Identification of sources

The total area sources (both mobile and stationary sources) of emissions were considered for the study. For the stationary sources of an area, the various industries, modern rice mills, open burning etc were considered as shown in "Fig. 1".

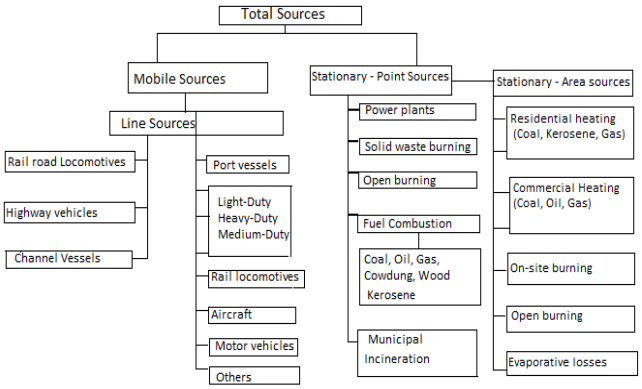

Fig.1. Emission Source Categories

C. Identification of Area sources

For the estimation of emission concentration from the area sources, the residential fuel usage per day, commercial fuel usage per day, the number of vehicles being operated from the bus station, the number of vessels being operated from the port, the revolution per minute (rpm) of railway locomotives in the railway stations were under the consideration.

D. Emission factors used for estimation

The emission factors (EF) for area sources were collected from Office of Tamilnadu Pollution Control Board (TPCB) in the study area. The emission concentration of various gaseous pollutants and the particulate matters were estimated based on the emission factors prescribed by them as shown in Table-1.

Table- I: Emission factors for Area sources

	Emission factor			
Pollutant	***Coal (Tone per ton.)***	***Kerosene (kg / 1000 lit.)***	***Wood (kg / ton.)***	***LPG (kg / 1000 lit.)***
CO	0.025	0.6	1.0	0.23
HC	0.02	0.35	1.0	0.081
SPM	0.027	1.2	15.0	0.22
NO_x	0.0002	1.5	5.0	0.72
SO_2	1.84*S	17.0*S	1.5	0.005*S

Source: CPCB, India

E. Preparation of Thematic Maps

Geographical information system (GIS) tool was used to prepare the thematic maps showing the emission level in each ward. Arc GIS version 10.3 was used for this purpose.

F. Technology Transfer

Battelle Environmental Evaluation System (BEES), a scientific technology was implemented to ascertain the environmental quality of the study area based on the total emission concentration of CO, HC, SPM, NO_x and SO_2 [8, 9]. According to BEES, USA, the assigned parameter importance units for the various gaseous pollutants were shown in Table-2.

Table- II. Assigned PIU's for Gaseous Pollutants

Pollutants	Assigned PIU
Carbon Monoxide (CO)	5
Hydrocarbon (HC)	5
Particulate Matters (PM)	12
Nitrogen Oxides (NO_x)	10
Sulphur Oxides (SO_x)	10
Photo-chemical Oxidants	5
Others	5

Source: BEES, USA lab

III. RESULTS AND DISCUSSION

The ward-wise distribution of dwelling units and the other commercial units were collected from the local municipality as shown in Table-3. The area sources like houses, theatres, hotels, tea shops, Noon meal centers, educational institutions for all the 24 wards of a city were considered for the current study. The emission concentration of various gases were calculated for area sources based on the amount of fuels(Kerosene, LPG, Wood) used in each units like residential, hotels, Tea shops, Noon meal centers, Bus depot and Railway stations shown in Table-4. Referring the assigned PIU's as per Battelle Lab, USA, shown in Table-2, the environmental quality (EQ) was estimated for the various pollutants. Based on the various components responsible for air pollution, the environmental quality was calculated.

EQ = [1000 – (P x Q)] / 1000

Where P: the measured value of any component; Q: the assigned PIU of that component

For example, as shown in Table- 4, the total kerosene usage in Ward-1 of the study area was found to be 72,420 litres/year. Referring Table-1, the 0.6 kg of CO will be released by the usage of 1000 litres of Kerosene. Then from 72,420 litres of Kerosene usage, the amount of CO release is equal to 43.45 kg/year. Thus, the Environmental quality score for this attribute, EQS = {1000– (43.45 x 5)} / 1000 = 0.78, classified as "good". Likewise, all the attributes will be examined and the environmental quality will be ascertained based on it. Geographical Information System (GIS) was used as a tool for the preparation of the thematic maps [3, 4, 5, 7] showing the various level of emission concentration in the study area. The variations in the concentration of CO, HC, SPM, NOx and SO_2 through area sources in each ward were shown in Figure-2, 3, 4, and 5 below using the GIS based thematic maps. The concentration of the emission of CO, HC,SPM and NOx were classified as very high, high and Moderate and were shaded with Red, Green and Brown colours respectively in the thematic maps.

Fig.2. Variations in CO level

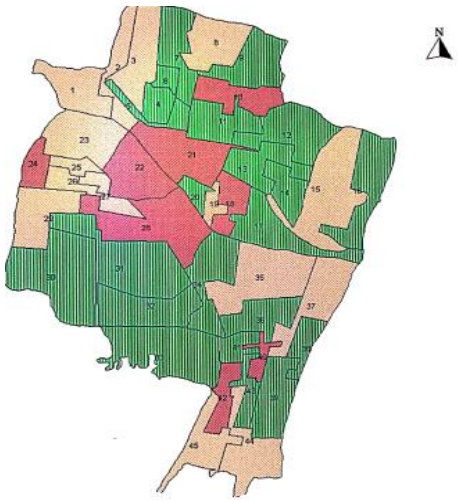

Fig.3. Variations in HC level

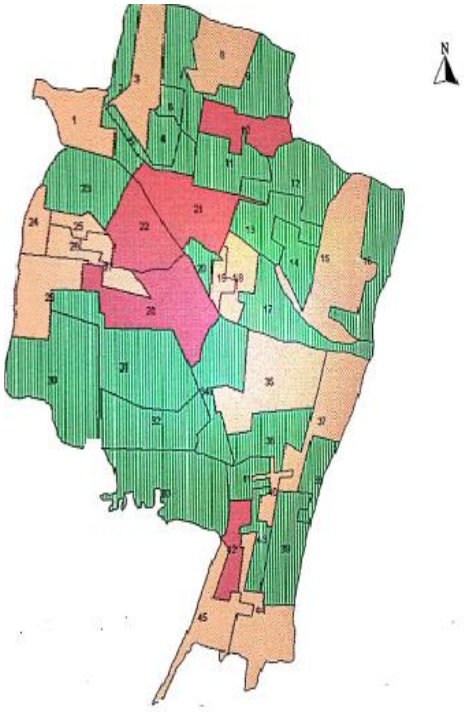

Fig.4. Variations in SPM level

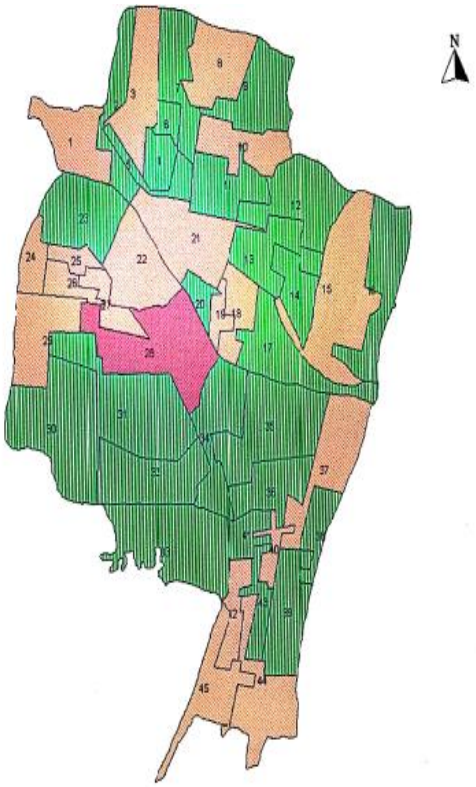

Fig.5. Variations in NOx level

Table- III: Ward-wise Distribution of Various Units

Ward	Dwell	Hotel	Tea	Wedd	NMC	Bus	Bus	Railw	ports
1	518	2	4	-	1	-	-	-	-
2	243	1	5	-	-	-	-	-	-
3	592	2	6	-	-	-	-	-	-
4	476	-	4	1	-	-	-	-	-
5	605	-	6	-	-	-	-	-	-
6	315	-	2	-	1	-	-	-	-
7	447	-	7	-	-	-	-	-	-
8	391	3	6	-	-	-	-	-	-
9	196	-	3	2	1	-	-	-	-
10	618	6	10	5	1	-	-	-	-
11	588	-	4	-	-	-	-	-	-
12	548	-	2	1	-	-	-	-	-
13	368	-	2	-	-	-	-	-	-
14	683	-	5	-	-	-	-	-	-
15	172	2	-	-	1	-	-	-	-
16	45	-	4	-	-	-	-	-	-
17	643	-	-	-	1	-	-	-	-
18	495	3	7	-	-	-	-	-	-
19	423	3	4	2	-	-	-	-	-
20	250	-	5	2	1	-	-	-	-
21	620	4	10	2	1	-	-	-	-
22	821	7	12	-	-	-	-	-	-
23	602	-	7	-	1	-	-	-	-
24	255	4	-	3	-	-	-	-	-
25	428	2	8	6	-	-	-	-	-
26	728	2	10	3	1	-	-	-	-
27	555	2	12	-	-	-	-	-	-
28	735	7	15	1	1	1	1	1	-
29	729	2	6	4	1	-	-	-	-
30	228	-	2	-	-	-	-	-	-
31	404	-	4	-	1	-	-	-	-
32	138	-	3	-	1	-	-	-	-
33	266	-	-	-	1	-	-	-	-
34	491	-	-	-	1	-	-	-	-
35	193	2	2	-	-	-	-	-	-
36	326	-	4	-	-	-	-	-	-
37	302	3	4	3	-	-	-	-	-
38	114	-	2	-	1	-	-	-	-
39	291	-	2	-	-	-	-	-	1
40	479	4	6	3	1	-	-	-	-
41	578	2	5	1	1	-	-	-	-
42	330	4	13	-	1	-	-	1	-
43	561	-	4	2	1	-	-	-	-
44	434	2	4	-	-	-	-	-	-
45	576	2	5	1	1	-	-	-	-

Table- IV: Concentration of Emissions in Kg/year due to wardwise kerosene usage

W. no.	Kerosene used Lit. / yr	Conc. of emissions (kg/year)				
		CO	HC	SPM	NO_x	SO_2
1	72,420	43.45	25.34	87.00	108.63	1.53
2	41,700	25.02	14.60	50.04	62.55	0.90
3	56,040	33.62	19.61	67.24	84.10	1.20
4	93,720	56.23	32.80	112.5	140.60	2.00
5	34,440	20.67	12.05	41.32	51.70	0.73

Table- V: Ward-wise Overall Emission Concentration from Area Sources (Kg/Year)

Ward no.	CO	HC	SPM	NO_x	SO_2
1	397	299.	3600	1625.	340.
2	30052	1960	2755.	21200	1671
3	328.3	238.	2580.	1352.	220.
4	222.1	106.	291.4	691.7	6.35
5	95400	5573	755.9	76820	6609
6	263.2	195.	2501.	987.6	229.
7	629.0	549.	7546.	2872.	755.
8	361.8	279.	3387.	1495.	424.
9	218.6	83.0	570.8	600.2	67.9
1	932.8	809.	9154.	3659.	798.
1	147.3	78.6	198.0	491.2	5.60
1	364.0	279.	2123.	1348.	199.
1	156.5	74.6	176.0	405.3	4.30
1	286.3	96.6	327.3	652.1	3.70
1	292.3	320.	2999.	1552.	342.
1	167.0	97.8	289.0	408.9	22.7
1	175.6	105.	776.0	587.9	54.4
1	528.9	406.	4510.	2706.	426.
1	363.7	392.	3458.	1814.	327.
2	176.6	90.6	563.0	546.1	37.9
2	86887	6868	9093.	38834	4606
2	26232	2033	10095	16375	2002
2	334.5	166.	991.6	927.0	79.9
2	407.6	385.	4877.	1959.	436.
2	332.6	238.	2415.	1330.	297.
2	478.3	356.	2950.	1582.	362.
2	408.7	314.	2470.	1303.	327.
2	11800	7479	17287	92751	8593
2	300.7	279.	3175.	1434.	6793
3	182.1	176.	1616.	711.7	371.
3	177.2	97.4	599.5	517.8	209.
3	153	105.	657.4	504.3	46.7
3	302.4	308.	709.3	777.8	58.9
3	11312	7694	6177.	64355	76.1
3	331.5	192.	2300	1000	6010
3	98.12	71.0	32.20	348.9	317.
3	392.5	281.	3400	1400.	3.5
3	162.5	99.6	694.9	562.6	425.
3	70.70	36.7	120.5	188.6	47.6
4	469.1	381.	4958.	2036.	1.80
4	180.5	77.5	234.0	528.0	478.
4	521.5	404.	5029.	2187.	23.4
4	120.0	66.2	490.1	396.6	548.
4	420.1	344.	4492.	1825.	58.6
4	335.6	245.	2763.	1313.	281.

IV. CONCLUSION

Environmental Evaluation System (EES) is a fundamental management tool for the identification of the level of impacts upon any attributes. EES focus with the systematic process planning and to reduce the potentially deleterious effects upon the proposed projects. The application of EES is more useful for the prediction of the environmental quality in term of air, water, soil etc.

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