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Assessment of Air Pollution and Its Impacts near Municipal Solid Waste Dumping Site Kammiyampet, Cuddalore, India

B.Abraham Lingan[1], G. Poyyamoli[2] and U.Jagadeesh Chandira Boss[3]

Ph.D, Research scholar, Department of Ecology and Environmental Sciences, Pondicherry University, Pondicherry, India[1]

Associate professor, Department of Ecology and Environmental Sciences, Pondicherry University, Pondicherry, India[2]

Research associate, Vector Control Research Centre (VCRC), Pondicherry, India[3]

Abstract : The generation of municipal solid waste (MSW) in Indian cities has resulted in severe environmental and health problems due to improper management. Air Pollution is one of the major environmental concerns in India due open disposal and burning of MSW. In the present study, suspended particulate matter (SPM), respirable suspended particulate matter (RSPM), sulphur dioxide (SO_2), oxides of nitrogen(NO_X) and carbon monoxide (CO) were investigated in four sites around Kammiampet open dumping ground and a control site in Cuddalore, India. The result was indicated that the concentration of SPM and RSPM in all the study area were higher than NAAQS (CPCB, 2009) and there is an urgent need to regulate and monitor the ambient air quality in Cuddalore, especially around the dumping sites. The Air Quality Index (AQI) calculated for all study sites shows that moderately polluted which is a cause of acute health impacts to the habitants.

Keywords: Air pollutants, Ambient Air, Municipal Solid Waste, Dumping Site, Impact, Environment, Human Health.

I.INTRODUCTION

The problem of municipal solid waste management (MSWM) has become a global challenge from a local/regional/national issue, due to the rapid population growth, urbanization and industrialization. The problem has acquired an alarming dimension and increasing day by day especially in the developing countries during the last few decades which results into a direct threat to the environmental and public health [1]. MSWM is one of the major challenging issues in urban cities, the generation of huge quantities of solid waste culminates in a serious environmental pollution problem, threats to human health, which is a hindrance to the sustainable development of the urban areas [2,3]. Inadequate management of MSW in most cities of developing countries leads to problems that impair human and animal health and ultimately result in economic, environmental and biological losses [3]. The present carried out ambient air quality assessment around Kammiyampet open lendfill site in Cuddalore.

II.STUDY AREA DESCRIPTION

Cuddalore town is the headquarters of the Cuddalore taluk and the Cuddalore district. It is located at the estuary of rivers Gadilam and Pennayar on Bay of Bengal. The town is at a distance of 200 Kms from south of Chennai, 23

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Km south of Puducherry and 45 Kms north of Chidambaram. The latitude and longitude are 11.75°N and 79.75°E respectively. As per 2011 censes the town had population of 173,361 and floating Population of about 20,000. The Cuddalore town covers a total area of 27.69 km^2 and is divided in to 8 sanitary division and 45 political wards. The urbanization and industrialization has made rapid changes and expanding residential areas. The lack of adequate collection and treatment of MSW by Cuddalore Municipality Corporation (CMC) has created greater challenges for waste management in the rapidly expanding town.

III.METHODOLOGY

The present study was conducted to around Kammiyampet dumping area during 2010-2011. In order to understand ambient air quality status around dumping ground, 4 ambient air samples (Table.1) were taken in the vicinity of Kammiyampet dumping ground. The parameters were assessed including suspended particulate matter (SPM), respirable particulate matter (RSPM), sulphur dioxide (SO_2) and nitrogen oxides (NOx).

Table 1 Sample locations of ambient air sample

S.No	Location	Distance from dumping site (km)
1	Kammiyampet	0.30
2	Navanitha Nagar	1.2
3	Meenakshi Nagar	2.1
4	Gadillam Nagar	3
5	Contorl site	10

For SPM and RPM analysis, the high volume air sampler (HVAS) 1700 (Zenith Eng.) was used. The concentration was measured using quantitative analysis with glass fiber filter paper (Whatman GF/A) PM10 range – 100 to 0.1 µg. The SO_2 (sulphur dioxide) concentration was measured using iodine as absorbent and titrated with sodium thiosulphate, indicator-starch, and the NOx (oxides of nitrogen) concentration was measured as follows. Nitrite ion produced during sampling was determined colorimetrically (DR-2000), with a range of 20–740 µg/m^3.

IV.AIR QUALITY INDEX (AQI)

The Air Quality Index (AQI) was defined as a scheme to transforms the values of individual air pollutant into single number. AQI was calculated using the method suggested by Tiwari and Ali [4] and improved by Kaushik et al., [5]. The concentration of each pollutant was used to calculate the following formula:

$$Q = 100\ \frac{V}{Vs}$$

where, Q represents of quality rating, V is the observed value of pollutant and and Vs represents the recommended values of National Ambient Air Quality Standards (NAAQS) (CPCB, 2009). If total 'n' no of pollutants were considered for air monitoring, then geometric mean of these 'n' number of quality ratings was calculated in the following way:

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$$g = antl\log\{(loga + \log b + \log c + \cdots + logx)/n\}$$

Where g is geometric mean, while a, b, c, and x represent different pollutant values of quality rating, and n is the number of values of quality rating.

V.RESULT AND DISCUSSION

Air pollution is a major threat to human health and environment, especially pollution from unscientific disposal sites creates acute health problems to the surroundings habitants [6]. The continues inhalation of particulate matters consists of dust, fumes, mist and smoke cause lung damage and respiratory problems [7]. In this study, the concentration of pollutants like SPM, RSPM, SO_2, NOx and CO was carried out in four selected sites around Kammiyampet landfill (Fig.1) and a control site.

V.I SPM Scenario

The SPM concentrations were found to be exceeding at all locations in both the season except the control site (Table.2) At Kammiyampet area, the highest concentrations of SPM were found to be 474.7µg/m³ in pre monsoon (May) and 429.4µg/m³ in post monsoon (November) season, whereas in control site the lowest level of SPM was found to range from 198.5 and 156.6 µg/m³ respectively by pre and post monsoon seasons respectively. Except control site, the level of SPM had exceeded in all other sites than the recommended standard by NAAQS. The SPM values in both seasons were in decreasing order from Kammiyampet > Navanitha Nagar > Meenakshi Nagar > Gadillam Nagar.

Table 2. Status of ambient air quality during pre & post monsoon

Sites	SPM		RSPM		SO_2		NOx		CO		AQI		Status	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Kammiyampet	474.7	429.4	134.3	117.5	21.51	19.16	32.58	30.34	0-1.2	0-1.1	73.15	66.08	Moderately polluted	Moderately polluted
Navanitha Nagar	390.7	314.2	143.6	108.8	18.15	16.8	28.61	23.83	0.1.1	0.1.1	65.99	56.74	Moderately polluted	Moderately polluted
Meenakshi Nagar	346	233	127.3	103.3	11.56	9.45	24.04	13.76	0.2.1	0.2.0	63.15	47.61	Moderately polluted	Fairly clean
Gadillam Nagar	378.21	290.5	198.4	112.8	15.38	12.56	21.5	21.89	0-1.5	0-1.1	68	52.19	Moderately polluted	Moderately polluted
Contorl site-KN Palayam	198.5	156.6	76	58.5	10.5	8.67	13.6	10.54	0.06	0.05	19.27	13.92	Clean	Clean

(Except AQI, all values are expressed in µg/m³).

V.II RSPM Scenario

The concentrations of RSPM in the study area ranged from 134.3-198.4 µg/m³ in pre monsoon and 117.5-112.8µg/m³ in the post monsoon. The highest concentration was observed at Kammiyampet sample site in 134.3-117.5 µg/m³ respectably by pre and post monsoon season, whereas the lowest concentration was found in control

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site ranging between 76-58.5 µg/m³ in pre and post monsoon seasons respectively. The concentration level of RSPM has exceeded at all the study sites except control site than the recommended standard (100µg/m³) by NAAQS. The RSPM values in both seasons were in decreasing order from Kammiyampet > Navanitha Nagar > Meenakshi Nagar > Gadillam Nagar.

V.III Gaseous pollutants

The measured concentrations of gaseous pollutants such as SO_2, NOx and CO around the landfill are comparatively low in both the seasons compared with the recommended standard by NAAQS. The highest SO_2 concentrations were observed at Kammiyampet sample site on 21.51µg/m³ in pre monsoon and 19.16µg/m³ in post monsoon season. The NOx levels ranged from 21.5-32.58µg/m³ and 30.34-10.54µg/m³ respectively by pre and post monsoon seasons. The highest level NOx was observed at Kammiampet sample site that ranged from 32.58-30.34µg/m³ in pre and post monsoon seasons. In the present study, the concentrations of SO_2, NOx and CO were found to be below permissible limit (80µg/m³ for SO_2/NOx and 02µg/m³/CO) as recommended by NAAQS [8] in all the sites for both the seasons.

(a) (b)

Fig. 1 Kammiyampet dump site photos. (a) Open burning at Kammiyampet dumping site, Cuddalore (b) Residential houses near the Kammiyampet dumping site, Cuddalore.

V.IV Health risk

At elevated levels, all the air pollutants will have adverse effects on human and environment. The accumulation of pollutants in the human body through inhalation of air is an important route [9]. The results of the present study revealed higher levels of SPM and RSPM. The dust released from various sources can produce a spectrum of diseases ranging from a simple cold to deadly diseases like cancer as reported by Bency *et al* [10]. The higher concentration of particulate matter causes acute and chronic respiratory disorders and lung damage in humans [11]. Population residing in the vicinity of polluted region by high suspended particulate matter was reported to have a higher risk of cardiovascular diseases [12]. The high amount of RSPM are either in polluted or moderately polluted category and might be due to the harmful effect of the RSPM dwelling in the area[9].

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V.V Air quality index (AQI)

The Air Quality Index is developed to provide the information about air quality, which is an indicator or determine of some circumstance or property [13]. The observed concentration of air pollutants was calculated into the AQI using by standard formulae which was presented in Table.2 and Table 3 shows the categories of AQI.

It was found that the entire study site was ranked as moderately polluted except control site in pre monsoon season. The study sites such as Kammiyampet, Navanitha Nagar and Gadillam Nagar were remain found to be as moderately polluted status in post monsoon season, and rest of study area including Meenakshi Nagar and control site respectively were ranked as fairly clean and clean.

Table 3. Air quality categories based on AQI

Category	AQI of ambient air	Description of ambient air quality
I	Below 10	Very clean
II	Between 10- 25	Clean
III	Between 25- 50	Fairly clean
IV	Between 50-75	Moderately polluted
V	Between 75-100	Polluted
VI	Between 100-125	Heavily polluted
VII	Above125	Severely polluted

VI.CONCLUSION

The study reveals that the high concentration particulate matter and other pollutants were observed higher level in pre monsoon season compare post monsoon season. The reason is due to the calm or light winds velocity during the pre monsoon season [14]. The concentration of SPM and RSPM are found to be major air pollutants in all area except control site in Cuddalore. The gaseous pollutants like SO_2, NOx and CO has considerably low. The particulate matters pose health risks either alone, or in combination with other pollutants [13]. Hence, the high concentration of SPM and RSPM are the most important concern of habitants who living surrounding of dumping site and there is an urgent need to regulate and monitor the ambient air quality in Cuddalore, especially around the dumping sites.

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