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Analysis of Water and Air Quality in and Around HIMSWM Treatment Plant- Hyderabad

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Abstract: *In recent days the emission of air pollutants in to the environment has grown very quickly. The air pollution is caused due to the smoke emitted by vehicles, industries and other sources. Hyderabad is the largest and capital city of Telangana. It occupies 650km^2 on the Deccan Plateau along the banks of the Musiriver, in the northern part of south India. According to the 2011 Census of India, Hyderabad is the fourth-most populous city in India with a population of 6.9 million residents within the city limits, and has a population of 9.7 million residents in the metropolitan region, making it the sixth-most populous metropolitan area in India. With an output of US$74 billion, Hyderabad has the fifth-largest urban economy in India. In India air pollution is monitored by Central Pollution Control Board(CPCB) along with State Pollution Control Boards (SPCBs) and the National Environmental Engineering Research Institute (NEERI) in Nagpur. The National Air Quality Monitoring Programme (NAMP) was started in 1984 with seven sensor stations 248 towns and cities have the air quality network of 591 air quality monitoring stations upto 2015, it is reported that in India 2022 added 180 manual air quality monitoring stations, increasing the number to 883 to achieve the goal of 1500 by 2024. For our study because of some practical difficulties and analysis of the air quality. Air Pollutants has been collected from the CPCB. The dataset contains City, Date, Time, $PM_{2.5}$,PM_{10}, NO_2, SO_2, CO, O_3, Benzene, Toulene, Xylene, Air Quality Index (AQI). Hyderabad was divided into six zones, air quality monitoring sensors are located at 14 places in and around six zones. For our study we selected one sensor that is Secunderabad, which covers the surrounding areas including Jawahar Nagar treatment plant. To analysis the maximum concentration of air pollutants such as $PM_{2.5}$,PM_{10},SO_2,NO_2,CO,O_3over the time period of three months (Jan to Mar 2023).Most physio-chemical properties, including as pH, EC, Alkalinity, Chlorides, Cu, Mn, Pb, and Cr, exceeded their acceptable limits at more than three sample sites, according to this study. The water sources were determined to be unsafe for drinking, agricultural, and irrigation uses due to elevated toxicity levels.It was observed that PM2.5,ranges 218 - 403µg/m3 is very poor causes respiratory illness, PM10 range 112 - 360µg/m3 is moderately polluted causes breathing discomfort (Asthma, lungs), NO2 range 10 – 12ppm is satisfied causes minor breathing discomfort to sensitive people ,O3 range 20 – 35ppm is good causes minor effect, SO2 is 12 – 22ppm is satisfied causes minor breathing discomfort to sensitive people ,CO 109 – 119ppm is severe effects on healthy people and serious impact for those with existing diseases, so continuous air quality monitoring is necessary to protect environment and human health.*

Keywords: Municipal Solid Waste, Hyderabad Integrated Municipal Solid Waste Management (HIMSWM), landfills, Greater Hyderabad Municipal Cooperation (GHMC), Municipal Solid Waste(MSW)

I. INTRODUCTION

1.1 Municipal Solid Waste & Sources

One of the significant sources of environmental problems originating from industrial is incorrect collecting and disposing of municipal solid waste in urban areas. The waste streams commercial solid waste sources are different from the hazardous substances in household waste. In our day- to- day life we generate so many different types of wastes. In those solid waste is one of the types and solid waste is highly generated waste. In India there are nearly 1.4 billion population and everyone generates waste, nearly some metric tons of waste is generated. All the wastes generated should be treated properly in particular methods like landfills and incineration. Especially in the city like Hyderabad, due to its over population it generates large amount of waste. By treating these wastes generated produce a lot of pollution into the environment and this leads to dangerous health hazards. Recently several studies has been carried out for the better understanding of the effects of landfill pollution on human health as well on the environment. Toxic gas emissions from landfills like Methane, NOx, SO_2, VOC'S, CO_2, PM, HC, O_3, CO, pose a serious threat to both the

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environment and human health. Some studies has shown that the toxic gases released from landfill sites are even responsible for the lung and heart diseases in humans. Landfills also generate a toxic soup known as Leachate, formed when the waste is subjected to biological and physiochemical transformation process and it is highly toxic and causes land and ground water pollution. As solid waste management is a critical aspect of environmental hygiene, it must be incorporated into environmental planning. There are many treatment plants in Hyderabad, which treat the wastes generated. One of them is Jawahar Nagar treatment plant, it is a city of Municipal Corporation located in Medchal-Malkajgiri district in Telangana.The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for six principal pollutants ("criteria" air pollutants) which can be harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

II. OBJECTIVE OF THE STUDY

- To collect the data about the quantity of solid waste generation & detail process of HIMSWM in Hyderabad.
- To collect data aboutdifferent zones &air quality monitoring sensor station which covers HIMSWM treatment plant at Jawahar Nagar in Hyderabad .
- To collect water as per standard APHA method around HIMSWM treatment plant
- To collect the air pollutant concentration level in selected site from CPCB data base
- To analyse water quality as per standard methods
- To assess the air pollutant variations level of daily, weekly and monthly during January to March 2023 around the Nacharam sensor station.
- To Compare the water quality with BIS &air quality with NAAQS(National Ambient Air Quality Standard)
- Impact assessment of water & air on environment and human around the HIMSWM treatment plant.

III. MATERIALS AND METHODS

3.1 Detail information about HIMSWM:

Hyderabad is the capital and largest city of the Indian state of Telangana and the de jure capital of Andhra Pradesh. It occupies 650 km2 (250 sq mi) on the Deccan Plateau along the banks of the Musi River, in the northern part of Southern India. With an average altitude of 542 m (1,778 ft), much of Hyderabad is situated on hilly terrain around artificial lakes, including the Hussain Sagar lake, predating the city's founding, in the north of the city centre. According to the 2011 Census of India, Hyderabad is the fourth-most populous city in India with a population of 6.9 million residents within the city limits, and has a population of 9.7 million residents in the metropolitan region, making it the sixth-most populous metropolitan area in India. With an output of US$74 billion, Hyderabad has the fifth-largest urban economy in India.TheQutb Shahi dynasty's Muhammad QuliQutb Shah established Hyderabad in 1591 to extend the capital beyond the fortified Golconda.In 1687, the city was annexed by the Mughals. In 1724, Asaf Jah I, the Mughal viceroy, declared his sovereignty and founded the Asaf Jahi dynasty, also known as the Nizams. Hyderabad served as the imperial capital of the Asaf Jahi's from 1769 to 1948. As capital of the princely state of Hyderabad, the city housed the British Residency and cantonment until Indian independence in 1947.Hyderabad City is divided into 6 zonesCharminar,LB Nagar, Khairtabad, Secunderabad, Serilingampally, Kukatpally.

Each zone is further divided into a total of 30 circles. In addition, the circle will be divided into 150 stations. In 2020 each district will have 40,000- 50,000 people. Jawahar Nagar comes under the zone of Serilingampally, West zone. The coordinates of Serilingampally 17.48370 N, 78.31580 E The flow chart for the Study of water& Air Quality around is shown in Fig: 1for our study we selected the Secunderabad zone is located at North zone of Hyderabad,Air sensor station located at Secunderabad zone consists of areas such as Qutbullapur, Gjularamaram, Alwal, Malkajgiri(jawaharnagar), Secunderabad, Begumpet.

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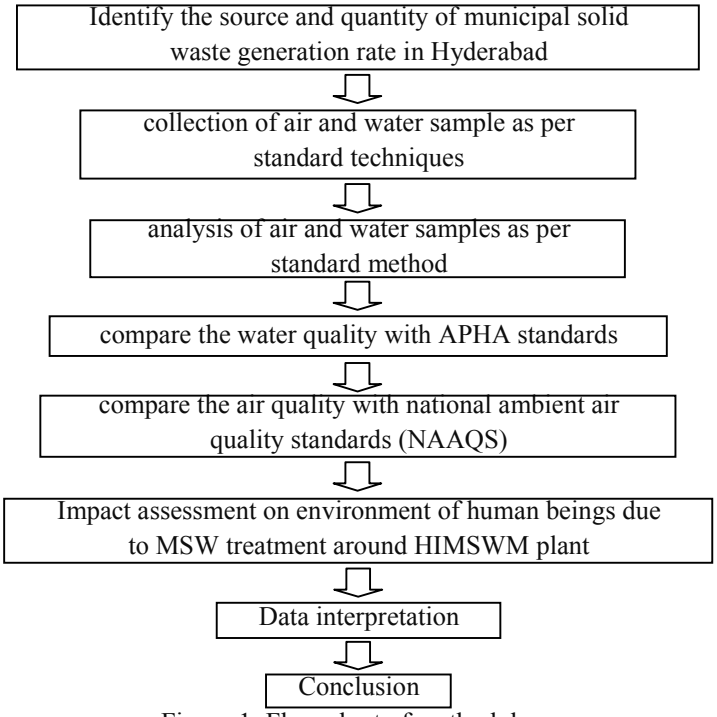

Fig no-1: Flow chart of methodology

3.2 Location & collection of water & air samples

For our study 6 watersampling stations located around the HIMSWM treatment plant are designated as (S1 to S6).Grab sampling and composite sampling are two approaches that can be used for sampling. Grab sampling is the collecting of all of the tested material at once. It solely reflects performance at the moment in time when the samples were taken. Composite sampling consists of a collection of several discrete samples taken at regular intervals over some time.For the water and sample analyses, the grab sampling method was used. The water was collected in plastic bottles with a capacity of 1-2 liters. Six samples were taken in all, one from surface water and five from bore wells. To avoid obtaining non representative samples of stagnant or contaminated water, samples were taken from the bore well only after it had been pumped for some time. Water quality is assesd as per APHA methods.

Table 1 Location& Collection of Water samples

Sampling Stations	Sample Area	Locations of site			Distance (M)	Source of Water
		Description	Latitude	Longitude		
S1	Shanthi nagar	Beside treatment plant	17°31’22.68”N	78°35'4.3296"E	100	Ground water
S2	Ambedkar Nagar	In-front of treatment plant	17°31'38.618" N	78°35'17.124"E	50	Ground water
S3	Kedareshwari colony.	Near army college of dental	17°31'22.468" N	78°34'46.664"E	200	Surface Water
S4	CPRF public school	Hakimpet.	17°31'43.042" N	78°35'35.548”E	40	Ground water
S5	Karmikanagar	Beside Bethestha Gospel Church	17°30'47.613" N	78°35'25.616" E	250	Ground water
S6	Near Govt. High school	Dammaiguda	17°30'14.832" N	78°35'27.848" E	700	Ground water

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Air Pollutantshas been collected from the CPCB.The dataset contains City, Date, Time, $PM_{2.5}$,PM_{10}, NO_2, SO_2, CO, O_3, Benzene, Toulene, Xylene, Air Quality Index (AQI). Water quality analysis report is presented in Table 2.

TABLE 2. Water Quality Analysis Report

S.NO	PARAMETERS	S1	S2	S3	S4	S5	S6
1	Colour	No colour	No colour	Yellowish	No colour	No colour	Dark Brown
2	Temperature (°C)	25	25	25	25	25	25
3	pH	8.1	8.97	6.80	9.23	7.04	8.71
4	EC (µs/cm)	510	1270	9470	3510	3240	32,800
5	Acidity (mg/l)	3	20	38	19	27	<0.1
6	Alkalinity (mg/l)	160	920	470	800	390	4200
7	Chlorides (mg/l)	430	1200	2365	6790	528	7,246
8	D0 (mg/l)	5.8	5.6	3.4	5.1	5.2	<1
9	BOD (mg/l)	<2	<2	6	<2	<2	234
10	COD (mg/l)	<4	6	30	<4	6	640
11	TDS (mg/l)	328	816	6100	2260	2080	20,900
12	Copper (mg/l)	1.5	5.9	0.02	9.1	0.05	0.09
13	Manganese (mg/l)	<0.02	20.02	1.43	13.1	<0.02	0.19
14	Lead (mg/l)	<0.01	0.5	0.9	1.5	<0.05	<0.01
15	Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Chromium (mg/l)	<0.02	<0.02	<0.04	0.02	0.02	0.07

Water Quality

An investigation has been made to find the suitability of water resources for various activities by collecting samples from 6 different locations around HIMSW which were analyzed for their physio-chemical characteristics compared with BIS[10500-1991] standards Most physio-chemical properties, including as pH, EC, Alkalinity, Chlorides, Cu, Mn, Pb, and Cr, exceeded their acceptable limits at more than three sample sites, according to this study. The water sources were determined to be unsafe for drinking, agricultural, and irrigation uses due to elevated toxicity levels. As a result, immediate treatment strategies, such as those outlined in section 4.2, are critical in this endeavour to protect the delicate environment.Water quality analysis compared with BIS is presented in Table 3.

Table 3. Comparison of water quality with BIS standards

S. NO	Parameters	S1	S2	S3	S4	S5	S6	BIS 10500	Remarks
1	Colour	No colour	No colour	Yello wish	No colour	No colour	Dark Brown	-	
2	Temperature (°C)	25	25	25	25	25	25	-	
3	pH	8.1	8.97	6.80	9.23	7.04	8.71	6.5-8.5	S4 & S6 exceeds the limit
4	EC (µs/cm)	510	1270	9470	3510	3240	32,800	400	All sites exceeded the limit
5	Acidity (mg/l)	3	20	38	19	27	<0.1	-	
6	Alkalinity (mg/l)	160	920	470	800	390	4200	200-600	S2,S4&S6 exceeds the limit

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7	Chlorides (mg/l)	430	1200	2365	6790	528	7,246	250-1000	S2,S3,S4&S6 exceeds the limit
8	D0 (mg/l)	5.8	5.6	3.4	5.1	5.2	<1	-	
9	BOD (mg/l)	<2	<2	6	<2	<2	234	-	
10	COD (mg/l)	<4	6	30	<4	6	640	-	
11	TDS (mg/l)	328	816	6100	2260	2080	20,900	500-2000	S3,S4,S5&S6 exceeds the limit
12	Copper (mg/l)	1.5	5.9	0.02	9.1	0.05	0.09	0.05-1.5	S2 & S4 exceeds the limit
13	Manganese (mg/l)	<0.02	20.02	1.43	13.1	<0.02	0.19	0.1-0.3	S2,S3,S4&S6 exceeds the limit
14	Lead (mg/l)	<0.01	0.5	0.9	1.5	<0.05	<0.01	0.01	S2,S3 & S4 exceeds the limit
15	Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	In the limit
16	Chromium (mg/l)	<0.02	<0.02	<0.04	0.02	0.02	0.07	0.05	S6 exceeded the limit

AIR QUALITY

Pollutants emitted at Nacharam sensor area from jan to mar is presented from table 4 to 6.In the month of January 2023 at Nacharam sensor area the pollutants emitted are $PM_{2.5,}$ $PM_{10,}$$NO_{2,}$ $O_{3,}$ $SO_{2,}$ CO(morning, afternoon, evening).$PM_{2.5}$ emitted highest in 3rd week is 328 µg/m3.PM_{10} emitted highest in 4th week is 182 µg/m3. NO_2 emitted highest in 1st week is 11ppm. O_3emitted highest in 1st and last week is 20ppm. SO_2 emitted is 12ppm in 2nd,3rd,4th weeks. In the month of Febrauary 2023 at Nacharam sensor area the pollutants emitted are $PM_{2.5,}$$PM_{10,}$ $NO_{2,}$ $O_{3,}$ $SO_{2,}$CO(morning, afternoon, evening). $PM_{2.5}$emitted is 403µg/m3 in the 1st week. PM_{10} emitted is 360µg/m3 in 1st week. NO_2 emitted is 11ppm in 1st and 2nd weeks. O_3 emitted is 22ppm in 2nd and last week. SO_2 emitted is 16ppm in the 4th week. CO emitted is 118ppm in the 3rd week.In the month of March 2023 atNacharam senor area the pollutants emitted are $PM_{2.5,}$$PM_{10,}$ NO_2, O_3, $SO_{2,}$CO(morning, afternoon, evening).$PM_{2.5}$ highest emission is 218µg/m3 in the 3rd week. PM_{10} emitted is 112µg/m3 in 4th week. NO_2highest emission is 12ppm in the 1st week. O_3 emitted is 35ppm in 1st week. SO_2highest emission is 22ppm in 4th week. CO emitted is 109ppm in 1st week.

Table 4: Pollutants emitted atNacharam sensor in January month 2023

Morning							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	307	121	11	19	8	57
2	2ND	325	172	10	18	12	111
3	3RD	328	149	10	18	9	111
4	4TH	136	133	10	18	9	54
5	5TH	168	141	10	18	9	114
Afternoon							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	262	109	10	18	8	50
2	2ND	325	173	8	19	12	111
3	3RD	328	149	10	19	12	111
4	4TH	136	133	10	19	12	111

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5	5TH	108	186	8	20	10	114
Evening							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	266	109	10	20	11	50
2	2ND	325	173	8	19	12	111
3	3RD	328	149	10	19	12	111
4	4TH	136	133	10	19	12	111
5	5TH	98	157	10	19	8	114

Table 5: Pollutants emitted at Nacharam sensor in Febrauary month 2023

Morning							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	403	360	11	20	11	110
2	2ND	48	119	11	22	11	118
3	3RD	77	116	10	20	12	106
4	4TH	62	116	10	10	11	107
5	5TH	55	112	8	22	16	33
Afternoon							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	403	360	11	20	11	110
2	2ND	48	119	11	22	12	118
3	3RD	77	106	8	13	10	73
4	4TH	45	116	11	19	11	107
5	5TH	55	112	8	22	16	33
Evening							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	403	360	11	10	9	110
2	2ND	48	119	11	22	12	118
3	3RD	73	105	8	15	10	60
4	4TH	45	99	10	14	8	69
5	5TH	59	110	8	22	16	29

Table 6: Pollutants emitted at Nacharam sensor in March 2023

Morning							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	72	109	12	35	13	109
2	2ND	78	110	11	21	13	103
3	3RD	218	109	10	22	12	38
4	4TH	146	98	9	20	11	38
5	5TH	55	112	8	22	16	33
Afternoon							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1ST	72	109	7	35	13	109
2	2ND	83	110	11	21	11	103
3	3RD	83	110	11	21	11	103
4	4TH	146	98	8	20	22	38
5	5TH	55	112	8	22	16	33

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Evening							
S.no	Weeks	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1	1^{ST}	72	109	10	34	13	109
2	2^{ND}	85	108	11	19	11	103
3	3^{RD}	69	107	11	22	12	38
4	4^{TH}	60	90	7	20	11	38
5	5^{TH}	59	110	8	22	16	29

IV RESULTS AND DISCUSSIONS

4.1Nacharam Sensor Station

The data includes the various types of pollutants present in the air around Secunderabad area. The data collected is from January 2023 -March 2023.The sensor station is located at Nacharam .The data is presented in table – 4.1, 4.2, 4.3.

Table No-7:Pollutant level at Nacharam sensor area during January 2023 month

S.No	Duration	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1.	Morning	328	172	11	19	12	114
2.	Afternoon	328	186	10	20	12	114
3.	Evening	328	173	10	20	12	114

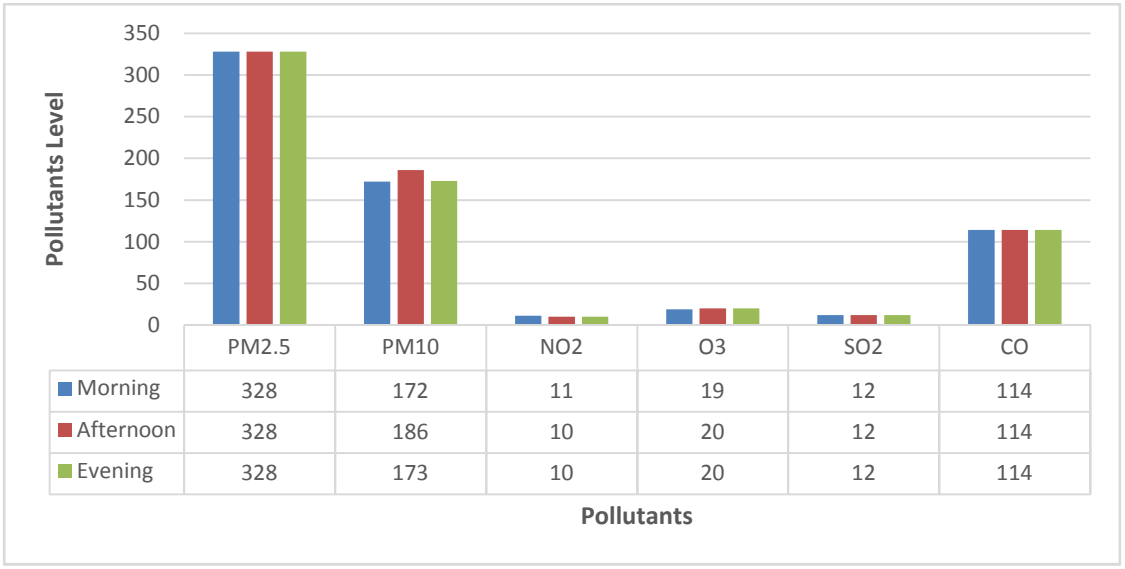

Fig 2: Pollutants level in the month of January 2023

In Nacharam sensor area during January we have observed $PM_{2.5}$ is at the peak when compared to all other pollutants which is 328µg/m3, PM_{10} value is 186µg/m3, NO_2value is 11ppm, O_3 value is 20ppm, SO_2 value is 12ppm and CO value is 114ppm.

Table-No:8 Pollutants level at Nacharam sensor area during February month 2023

S. No	Duration	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1.	Morning	403	360	11	22	16	118
2.	Afternoon	403	360	11	22	16	118
3.	Evening	403	360	11	22	16	118

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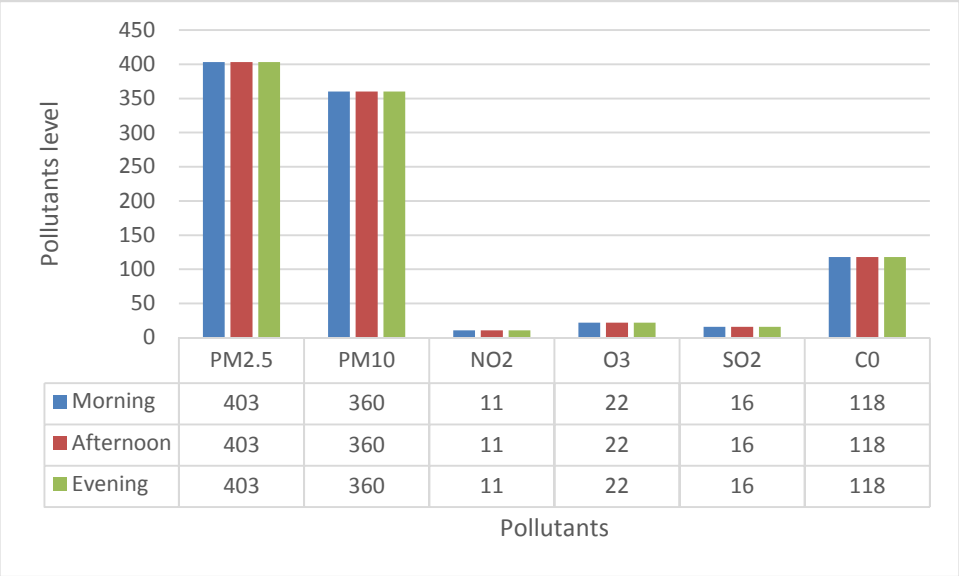

Fig 3: Pollutants level in the month of February2023

InNacharam sensor area during February we have observed $PM_{2.5}$ is at peak when compared to other pollutants which is 403µg/m3,PM_{10} value is 360µg/m3 it is the second highest pollutant,NO_2 value is 11ppm, O_3 value is 22ppm, SO_2 value is 16ppm, NO_2 value is 118ppm.

Table-No:9 Pollutants level atNacharam sensor area during March month 2023

S.No	Duration	$PM_{2.5}$	PM_{10}	NO_2	O_3	SO_2	CO
1.	Morning	218	112	12	35	16	119
2.	Afternoon	146	112	11	35	22	119
3.	Evening	85	110	11	34	16	119

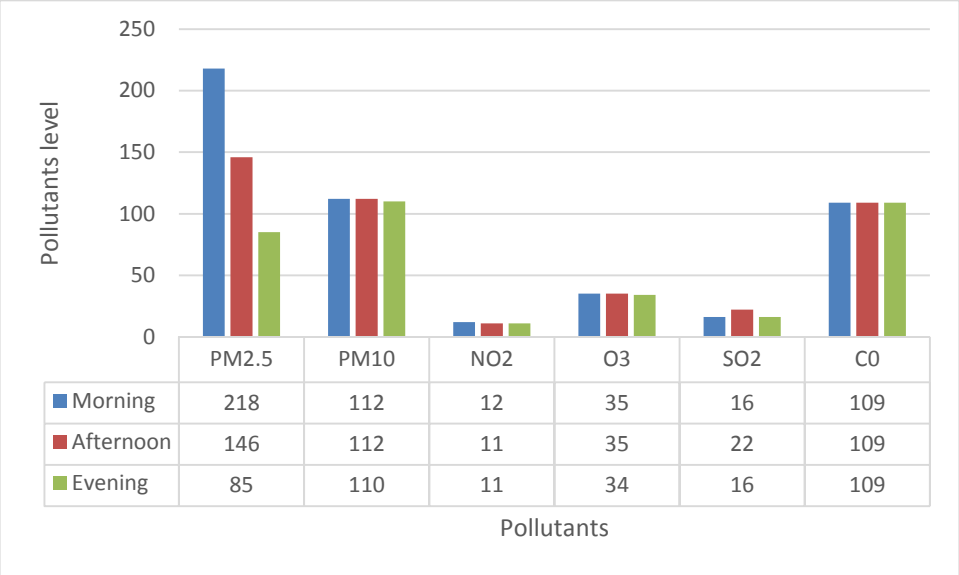

Fig 4: Pollutants level in the month of March 2023

InNacharam sensor area during March we have observed $PM_{2.5}$ is high compared to other pollutants which is 218 µg/m3, PM_{10} value is 112 µg/m3, NO_2 value is 12ppm, O_3 value is 35ppm, SO_2 value is 22ppm, CO value is 109ppm.From our Study it was observed that most of the pollutant exceeds the AQI. Air quality level was observed and compared with AQI, the results obtained and their impact on human is presented from selected site $PM_{2.5}$,ranges 218 - 403µg/m3 is very poor causes respiratory illness, PM_{10} range 112 - 360µg/m3 is moderately polluted causes breathing

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discomfort (Asthma, lungs), NO_2 range 10 – 12ppm is satisfied causes minor breathing discomfort to sensitive people ,O_3 range 20 – 35ppm is good causes minor effect, SO_2 is 12 – 22ppm is satisfied causes minor breathing discomfort to sensitive people ,CO 109 – 119ppm is severe effects on healthy people and serious impact for those with existing diseases, so continuous air quality monitoring is necessary to protect environment and human health.

V. CONCLUSION

Most physio-chemical properties, including as pH, EC, Alkalinity, Chlorides, Cu, Mn, Pb, and Cr, exceeded their acceptable limits at more than three sample sites, according to this study. The water sources were determined to be unsafe for drinking, agricultural, and irrigation uses due to elevated toxicity levels.Air quality level was observed and compared with AQI, the results obtained and their impact on human is presented from selected site $PM_{2.5}$,ranges 218 - 403µg/m3 is very poor causes respiratory illness, PM_{10} range 112 - 360µg/m3 is moderately polluted causes breathing discomfort (Asthma, lungs), NO_2 range 10 – 12ppm is satisfied causes minor breathing discomfort to sensitive people ,O_3 range 20 – 35ppm is good causes minor effect, SO_2 is 12 – 22ppm is satisfied causes minor breathing discomfort to sensitive people ,CO 109 – 119ppm is severe effects on healthy people and serious impact for those with existing diseases, so continuous air quality monitoring is necessary to protect environment and human healthIn Nacharam sensor area the concentration of air pollutant $PM_{2.5}$ is 316.3µg/m^3 is very poor for that human faces respiratory illness on prolonged exposure, PM_{10} is 219.3µg/m^3 poor polluted for this human faces problems like breathing discomfort to the people on prolonged exposure. NO_2 is 11.3ppm good, O_3 is 25.7ppm good. So_2 is 16.7ppm good for this human faces minimum impactas per AQI concentration range. CO is 11.7ppm moderate so human faces breathing discomfort to the people with lungs ,asthma and heart diseasesas per AQI concentration range.

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