Advances in Bioresearch
Adv. Biores., Vol 12 (5) September 2021: 219-228
©2021 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.12.5.219228

Advances in Bioresearch

ORIGINAL ARTICLE

Huge Increase in Particulate Matter during Harvesting of Paddy in Winter in Rural Area: A Special Reference to Murulia Village, West Bengal, India

Dibyendu Saha[1], Jai Prakash Keshri [2] and Nimai Chandra Saha [3*]
1 Research Scholar, Department of Botany, The University of Burdwan, West Bengal, India, 713104, email: dsbotbu79@gmail.com
2 Professor, Department of Botany, The University of Burdwan, West Bengal, India, 713104, email: keshrijp@gmail.com
*3 Vice Chancellor, The University of Burdwan, West Bengal, India, 713104, email: saha.buruniv@gmail.com
*Corresponding author

ABSTRACT
The study was carried out on the monsoon wise ambient air status in respect of respirable suspended particulate matter (RSPM or PM)in a very rural and agricultural area of Katwa sub-division in Purbo Bardhaman district, West Bengal, India named Murulia village from 2018 to 2020. Particulate matter (PM) is a key factor of air pollution that comes into the air from natural resources or from anthropogenic. Agricultural activity is one of the important resources of anthropogenic cause of particulate matter to air contamination in rural area. Particulate matter can travel over long distances and suspend over a long time in the air and can significantly cause a vast range of diseases. The status of ambient air contamination contributing to particulate matter in the study area was evaluated through Temtop M2000C Air Quality Monitor.It was noticed that during the study period the ambient air quality remarkably deteriorated in winter due to paddy harvesting and emission from field during burning of its residue. The average PM2.5, PM10, Particles were in pre-monsoon 46.51ug/m^3, 65.9 ug/m^3, 6693per/L, monsoon 22.78 ug/m^3, 55.88 ug/m^3, 2449.66 per/L whereas in winter much more i.e. 170.3 ug/m^3, 247.14 ug/m^3, 19975.66 per/L respectively in the said village. Therefore biennial average ambient air status yardstick of Air Quality Guideline Levels laid down by the WHOis much negatively altered.

Key Words: *Agricultural activity, Ambient air, Anthropogenic, Harvesting, Respirable suspended particulate matter (RSPM or PM), winter.*

Received 06.06.2021 Revised 21.07.2021 Accepted 06.09.2021

How to cite this article:
D Saha, J P Keshri and N C Saha .Huge Increase in Particulate Matter during Harvesting of Paddy in Winter in Rural Area: A Special Reference to Murulia Village, West Bengal, India. Adv. Biores. Vol 12 [5] September 2021. 219-228

INTRODUCTION

Rice as cereal is taken as principal food for the large part of the global human population, chiefly in Asia and Africa. It is an agricultural product with the 3rd highest comprehensive production [6, 7]. India is one of the world's highest yielders of rice, including brown and white paddy, cultivated mostly in the eastern and southern parts of the country [12]. In the Purbo Bardhaman district, West Bengal,paddy is the chief crop, on an average near about 58% of the total population possesses the agricultural population [1]. But in Indo-Himalayan Range (IHR), Bay of Bengal (BoB) and other remote areas the decline in air quality has been noticed during winters particularly. The pollutants undergo long-range transportation from their source regions contaminating their atmospheric conditions [11. Concentration levels of PM10 and PM2.5 are higher during the post-monsoon season as compared to those in the pre-monsoon months. It's increased with a decrease in temperature at post-monsoon. As well as emission from field during burning of agricultural crop residue is a common environmental threat, the levels increased up to 60-70% during paddy harvesting in the winter season [2]. Respirable suspended particulate matter (RSPM) is a heterogeneous mixture of particles with an assemblage of chemical components and physical features

that perform as a potential risk to human health. RSPM studies indicate that ultrafine particles (>1 μm) cause most of the observed health effects and can lead to acute dangerous respiratory infections in children and chronic bronchitis in adults, cardiovascular problems, lungs cancer, reduced lungs function, asthma and severe case mortality [2, 5, 10]. Another study revealed that the continuous association of increased cardiovascular mortality with suspended particulate matter [6].

The present study was conducted monsoon wise over a period from 2018 to 2020 to assess the air pollutant concentrations that deteriorated the ambient air during harvesting of paddy in winter in respect of PM2.5, PM10 and particles i.e. respirable suspended particulate matter (RSPM) of Murulia village, Purbo Bardhaman district, West Bengal state in India.

Study Area

The present study site Murulia villageis situated in Kaichar-I gram panchayat, Mangolkote Block, Katwa sub-division, Purbo Bardhanman district, West Bengal state, India and geographically around 23.545205°N Lat and 88.056809°E Long. It is a medium size village with total 261 families residing, has population of 1048 of which 540 are male while 508 are female as per Population Census 2011.

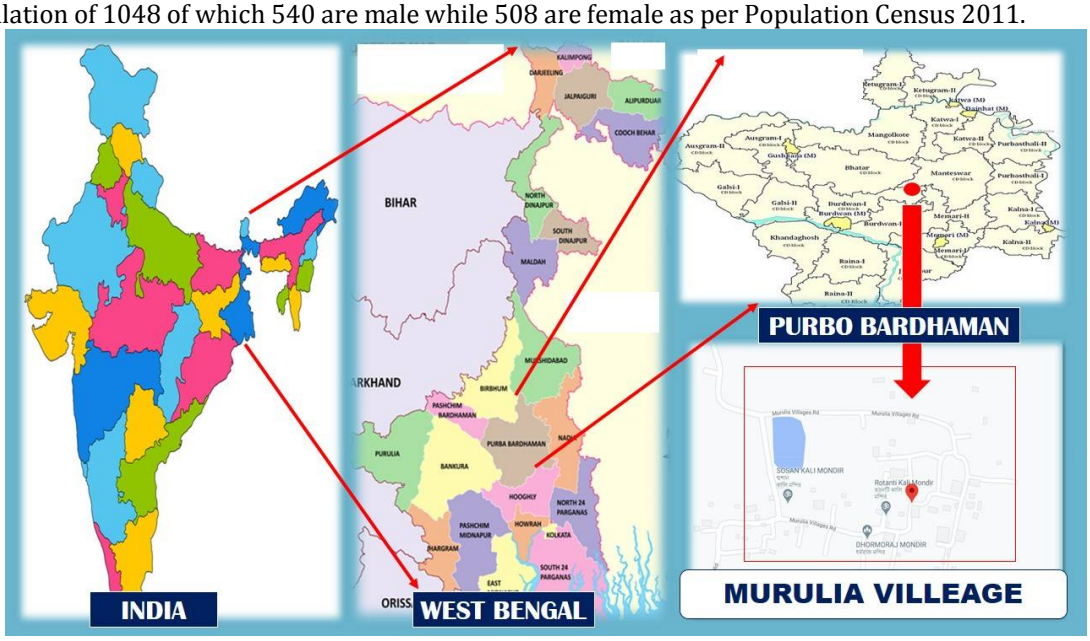


Figure 1. Geographical location of Murulia village, Purbo Bardhaman, West Bengal

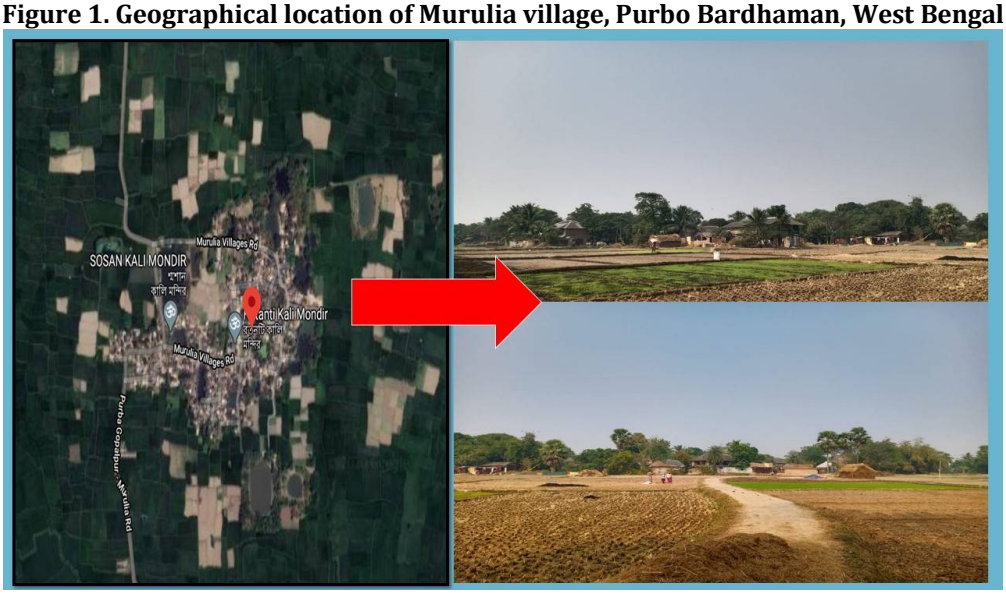


Figure 2. Satellite view of Murulia village

6 spots were considered for measuring the ambient air quality in respect of monsoon wise Particulate Matters (PM). Out of the 6 spots 3 spots were located in the surroundings and 3 spots were inside Murulia village, Purbo Bardhaman, West Bengal.

Figure 3. 6 selected points, where the ambient air quality in respect of Particulate Matters (PM) of Murulia village was measured

MATERIAL AND METHODS

The ambient air quality with respect to Particulate Matters (PM) in the said village was measured at 6 different spots through Temtop M2000C Air Quality Monitor. Data on PM2.5, PM10 & Particles with Temperature & Humidity of these spots were taken into consideration for the analysis from 2018 to 2020. Monsoon wise 10 readings were taken from each spot at a distance of 10 meters apart and the mean values were considered for statistical analyses.

Figure 4. Ambient air quality in respect of Particulate Matters (PM) of Murulia village was measured through Temtop M2000C Air Quality Monitor

RESULTS AND DISCUSSION

In context of presence of particulate matter, the present study has been done to assess the ambient air status deterioration during the winter season. The source of air pollutants was recognized which was responsible for deteriorating the ambient air status in the said rural site (Table 1; Figure 5, 6, 7). Among these dust particles i.e., PM 10, PM 2.5, particles were considered monsoon wise. During the study period i.e. from 2018 to 2020 monsoon wise atmospheric temperature and humidity were also recorded (Figure 8, 9). In the present study, air pollution was evaluated through Temtop M2000C Monitor at 6 different spots, out of these 3 spots were in the vicinity and 3 spots were inside the study village (Figure 3). The biennial study period was divided on the basis of monsoon i.e. pre-monsoon (summer, March-May), monsoon (rainy, June-September) and post-Monsoon (winter, October-February) and 10 readings were taken from each spot at a distance of 10 meters apart and the mean values were considered for statistical analyses. The data of particulate matter for almost all measuring spots were the highest in winter or post-monsoon season (Table 1, 3; Figure 5, 6, 7 &10) by reason of paddy harvesting and emission from field during burning of its residue by village inhabitants. Whereas during the monsoon PM concentration was the lowest (Table 1, 3; Figure 5, 6, 7 &10) because relative humidity and rainfall largely commanded the daily variations of PM2.5–10, indicating the high abundance of soil dust in this fraction [9].

Table 1. Status of monsoon wise average ambient air quality from 2018 to 2020 in respect of PM 2.5, PM 10, Particles, Temperature and Humidity at 6 spots of Murulia village

	Pre-monsoon					Monsoon					Post-monsoon				
	PM2.5 ug/m³	PM10 ug/m³	PAR. per/L	Temp. (0C)	Hum. (%)	PM2.5 ug/m³	PM10 ug/m³	PAR. per/L	Temp. (0C)	Hum. (%)	PM2.5 ug/m³	PM10 ug/m³	PAR. per/L	Temp. (0C)	Hum. (%)
Spot 1	46.2	68.9	7024	38.2	47	31.5	57	3200	32.2	98	185.7	282.2	22976	23.2	44.2
Spot 2	48	67.3	6099	37.2	46.8	25.3	58.2	2987	34	90.3	168	205.6	19857	24.2	46
Spot 3	49.2	67.9	8598	34.5	51.8	26.9	52.1	2201	33.5	101	202.3	303.9	24057	23.9	47
Spot 4	47.3	65	6225	35.4	52	25.9	58	2110	32.4	98	205.8	311.4	25714	25.2	49
Spot 5	45	68	5498	36.2	49.1	30.1	55.2	2198	33	108	135	185	12035	25.2	49.6
Spot 6	43.4	58.3	6714	34	49.2	27	54.8	2002	34	109	125	195	15215	24.8	48.9

PM= Particulate matter, PAR. = Particles,Temp. = Temperature

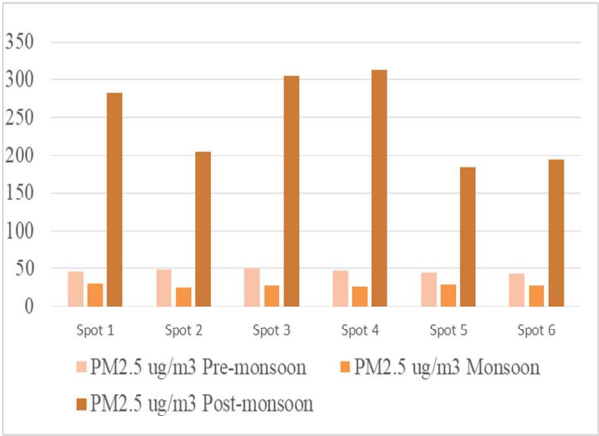


Figure 5.

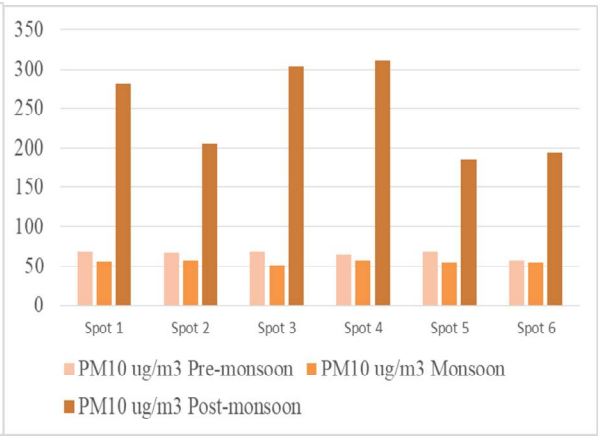


Figure 6.

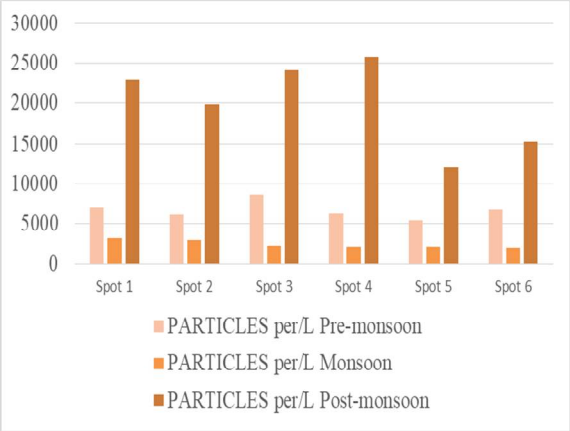


Figure 7.

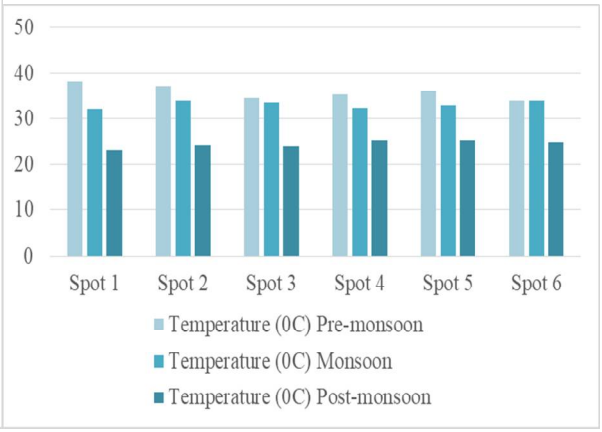


Figure 8.

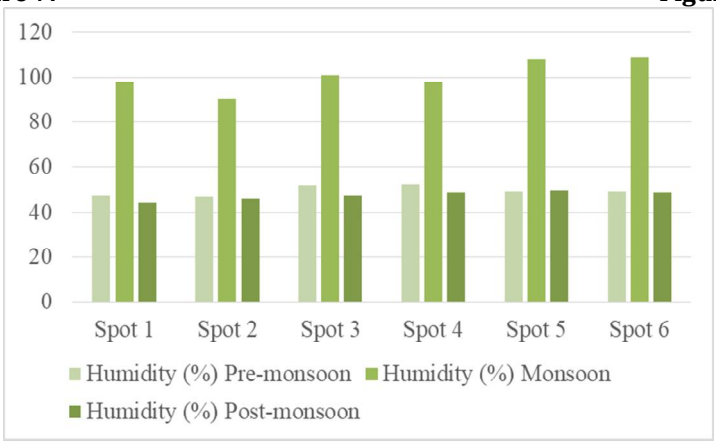


Figure 9.

Figures 5, 6, 7, 8 & 9. Monsoon wise bar graphs of PM 2.5, PM10, Particles, Temperature and Humidity respectively in ambient air quality ofMurulia village from 2018 to 2020

Table 2. ANOVA: Two-Factor without Replication shows the monsoon wise (2018 to 2020) ambient air status in respect of, PM 2.5, PM 10,Particles Temperature, and Humidity at 6 spots of Murulia village

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	12393260.57	4	3098315.143	1.26491472	0.295641809	2.549762972
Columns	1820168251	13	140012942.4	57.16152929	4.4755E-26	1.913455016
Error	127370157.8	52	2449426.111			
Total	**1959931669**	**69**				

Notes: SS = Sum of Squares, df = Degree of Freedom, MS = Mean Sum of Squares, Fobs = statistical F, P- value = Probability, Fcrit = Critical F.

Table shows Two-Factor ANOVA or factorial analysis of annual (November 2018 to October 2019) air quality status in respect of PM 2.5, PM10, Particles Temperature, and Humidity at 6 spots of Murlia village. Here F > F crit, rejected the null hypothesis. The means ofbiennial air quality status of the said village at the selected 6 spots are not all equal, there is a significant statistical difference.

Table 3. From 2018 to 2020 monsoon wise ambient air status in respect of average PM 2.5, PM 10, Particles,Temperature and Humidity of Murulia village

	Pre-monsoon	Monsoon	Post-monsoon
PM2.5 ug/m3	46.51	27.78	170.3
PM10 ug/m3	65.9	55.88	247.18
PARTICLES per/L	6693	2449.66	19975.66
Temperature (0C)	35.91	33.18	24.41
Humidity (%)	49.31	100.71	47.45

Table shows the monsoon wise biennial average ambient air quality status in respect of PM 2.5, PM 10, Particles Temperature and Humidity of Murulia village.

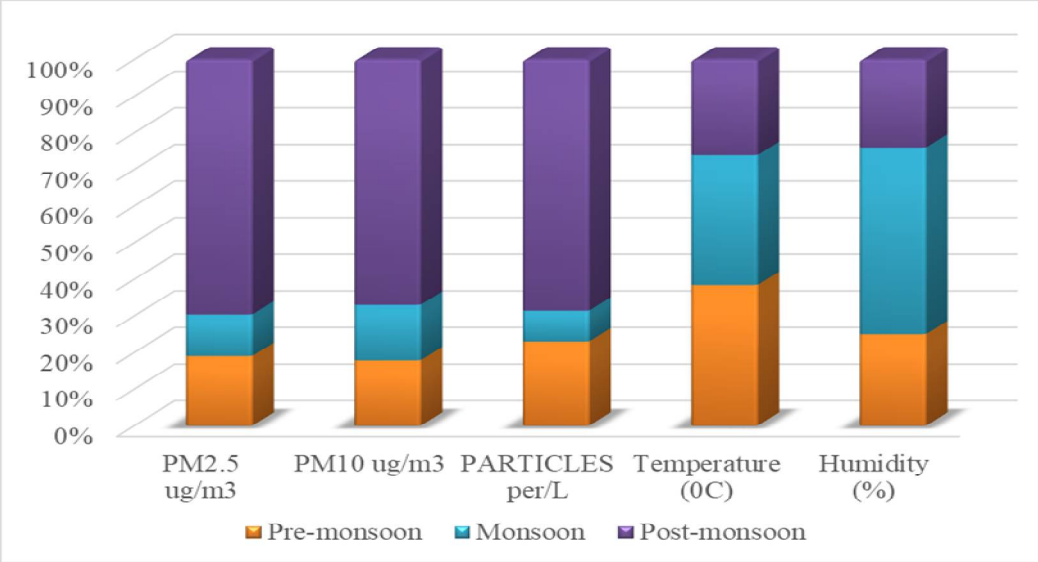


Figure 10. From 2018 to 2020 monsoon wise ambient air status in respect of average PM 2.5, PM 10, Particles, Temperature and Humidity of Murulia village

Murulia village possess an array of human settlement or community i.e. town let with a population ranging from 800 to 1000.As per the Election Commission's published voter list2020 male 431 female 424 voters are present in this small village. Katwa and Bardhaman are the urban neighborhoods of this village. Nearest railway station Bankapasi and bus stand Bankapasi chatti about 1.6km and 1.8km respectively away from the said village. A major chunk of the people earn their living by means of the agriculture. Paddy is the chief crop. Besides, some of them are engaged in 100 days Government job. Only a few of them are employed in Government or other private sectors.

Figure 11.Source of particulate matter during harvesting related activities

Figure 12. Pollution in respect of particulate matter during post threshing activities

Figure 13.Air pollution by particulate matter during harvesting, threshing and post threshing activities

Figure 14. Ambient air is polluted by particulate matter owing to transportation and burning of paddy residuals

PM10 concentrations in the surface layer of the ambient air was noticed 2-3 times higher in post-monsoon than in monsoon and pre-monsoon seasons [3]. It is more noticeable in January and February than in June and July. In winter maximum are mainly at the time intervals of 9-11am and 7-9 pm, whereas minimum are in 4-5am and 3-5pm in winter. In winter, the daily disparity of PM2.5 is close to the daily

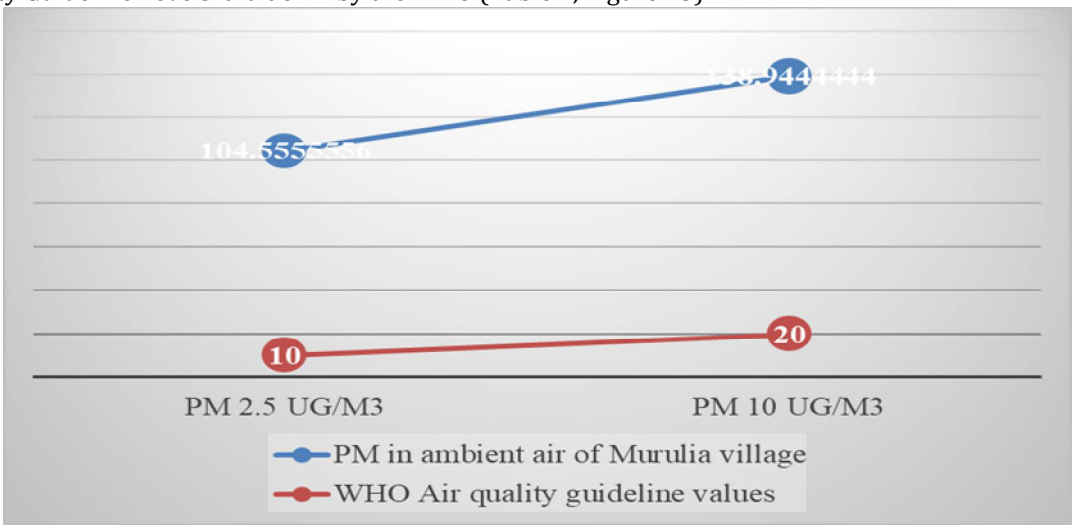
variation of PM10. In contrast the concentration of PM2.5 increases to values that are remarkably superior in the evening than in the afternoon [14].

Table 4. From 2018 to 2020 average PM 2.5 and PM 10 of ambient air is compared to WHO Air quality of Murulia village

Parameters	PM in ambient air of Murulia village	WHO Air quality guideline values
PM 2.5 ug/m3	104.556	10
PM 10 ug/m3	138.944	20

Table shows the PM2.5 and PM10 in the said village air were much more than WHO Air quality guideline values.

From the above observation, it is very much clear that the village ambient air status due to suspended particulate matter of the said site has been much negatively altered. It was judged by the yardstick of Air Quality Guideline Levels laid down by the WHO (Table 4, Figure 15).



.Figure 15. Graph shows of PM 2.5 and PM 10 of ambient air as compared to WHO Air Quality Guideline Levels of Murulia village

Figure 16. Some glimpses of village and village activity of study site

It is reported that respirable particulate matter has both acute and chronic effects on a number of different systems and organs as well as a great impact on human health. It varies from slight upper respiratory irritation to chronic respiratory and cardiac vascular disease, chronic bronchitis in adults, aggravating pre-existing heart and lung disease, asthmatic attacks, and acute respiratory infections in children. The carcinogenic respiratory disorder is also reported [13, 10].

CONCLUSION

Murulia a village in Purbo Bardhaman, West Bengal, India is beset with a plethora of trees and greeneries having an idyllic charm of its own. It is an agriculture dependent village enriched with many water bodies. It is by and large free from pollution. But agricultural activities like paddy harvesting and emission from the field at the time of the burning of residues and anthropogenic activity create a serious air contamination problem especially particulate matter in like Murulia village that are agriculture-dependent. Work zone and ambient air quality status data from 2018 to 2020 were collected, analysed and it is revealed that dust particles i.e., PM 10, PM 2.5, particles are contamination potential which is the highest in winter, than summer but it is the lowest during the rainy season in the village. So a well-through allied plan is the needed of the hour to ensure a judicious balance between agriculture and activities on one hand and maintaining the environment, especially human health on the other. For doing so authors' suggestions are as follows:

First, well-defined planning for proper management of paddy residue and to convert the same into biomass. Second, crop rotation system should be introduced. Third, use of improved and sophisticated tools and machineries that are potentially pollution resistant, especially particulate matter. Forth, Governmental may take initiatives for organising medical camps at regular intervals to get first-hand information of the physical and mental health of the villagers. Fifth & last but not least, awareness camps are to be organised to make the inhabitants of the village aware of the perils as well as risks of pollution regarding the particulate matter and also the preventive measures to counteract it.

ACKNOWLEDGEMENT

The authors are grateful to Head of the Department, Botany, The University of Burdwan, West Bengal for laboratory facilities.

REFERENCES

1. Agricultural information, Bardhaman (2020). National Informatics Centre, Burdwan District Unit, Ministry of Communications and Information Technology, www.bardhaman.nic.in.
2. Ali M. U., Liu G., Yousaf B., Ullah H., Abbas Q. and Munir M. A. M. (2019). A systematic review on global pollution status of particulate matter-associated potential toxic elements and health perspectives in urban environment, Environmental geochemistry and health, 41(3), 131-1162.
3. Arif M., Kumar R., Kumar R., Eric Z. and Gourav P. (2018). Ambient black carbon, PM2. 5 and PM10 at Patna: Influence of anthropogenic emissions and brick kilns. Science of the total environment, 624, 387-1400.
4. Awasthi A., Agarwal R., Mittal S.K., Singh N., Singh K. and Gupta P. K. (2011). Study of size and mass distribution of particulate matter due to crop residue burning with seasonal variation in rural area of Punjab, India. Journal of Environmental Monitoring, 13(4), 1073-1081.
5. Beamish L. A., Vargas A.R.O. and Wine E. (2011). Air pollution: An environmental factor contributing to intestinal disease, J. Crohn's Colitis, 5, 279–286
6. Brook R.D., Rajagopalan S. and Pope C. A. (2010). Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association, Circulation, 121, 2331–2378.
7. Food and Agriculture Organizationof the United Nations Corporate Statistical Database (FAOSTAT) (2020). http://www.fao.org/faostat/en/#data.
8. Godfray H. C. J., Beddington J. R., Crute I. R., Haddad L., Lawrence D., Muir J. F., Pretty J., Robinson S., Thomas S. M. and Toulmin C. (2010). Food security: the challenge of feeding 9 billion people, science, 327(5967), 812-818.
9. Hien P. D., Bac V. T., Tham H. C., Nhan D. D. and Vinh L.D. (2002). Influence of meteorological conditions on PM2. 5 and PM2. 5– 10 concentrations during the monsoon season in Hanoi, Vietnam. Atmospheric Environment, 36(21), 3473-3484.
10. Kampa M. and Castanas E. (2008). Human health effects of air pollution, Environmental pollution, 151(2), 362-367.
11. Sen A., Abdelmaksoud A. S., Ahammed Y. N., Banerjee T., Bhat M. A., Chatterjee A., Choudhuri A. K., Das T., Dhir A., Dhyani P. P. and Gadi R. (2017). Variations in particulate matter over Indo-Gangetic Plains and Indo-Himalayan Range during four field campaigns in winter monsoon and summer monsoon: role of pollution pathways, Atmospheric environment, 154, 200-224.
12. Worden, Robert L. (1996).India: a country study,Washington, D.C.: Federal Research Division, Library of Congress: For sale by the Supt. of Docs., U.S. G.P.O,l (ii), 850,https://lccn.loc.gov/96019266.

13. World Health Organization (2002). World health report-2002. World Health Organization, Geneva.
14. Zavorueva E. N., Zavoruev V.V. and Lipovka Y. L. (2018). December. The daily variation of the concentration of suspended particles in the surface layer of the atmosphere of the village Berezovka, Krasnoyarsk region,in 24th International Symposium on Atmospheric and Ocean Optics: Atmospheric Physics, International Society for Optics and Photonics 10833, 108336K.