

DUST CONTAMINATION SITUATIONS AT DHAKA METROPOLITAN CITY: SOURCES, HAZARDS, MANAGEMENT AND AWARENESS

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1. ABSTRACT

The article “Dust contamination situations at Dhaka Metropolitan city : sources, hazards, management and awareness” is an excellent contribution covering on more than 60 sources of dust contaminations at Dhaka Metropolitan city. Dusts, clay colloids, colloidal dusts, nano particles or particulate matters work as air pollutants containing hazardous and toxic chemicals and different heavy metals. From November 2024 to March 2025 there was no rainfall but plants of all categories were covered with 30-100% dust layers where transpiration was totally absent (blocked). Because of the huge dusts, Dhaka faced many days as one of the major air-polluted cities in the world. High air pollution caused various health hazards like cough, fever, mental disorders, heat diseases, allergy, headache, vomiting or vomiting tendency, pneumonia, diarrhea, skin diseases, sleepless nights, problems of visions, various eye diseases, running of nose-flow, asthma, diabetes, blood pressures, cancer and even to death. Heavy metals also create a lot of diseases particularly As, Pb, Cr, Ni, Hg etc. Dust contaminations were found to be variable on the basis of 20 factors of varieties of land producing and movement of dust to the air. Through wide study and previous 3-4 related articles, a large number of air pollution management guidelines were established and also 30 basic new awareness universal slogans were developed for proper solving the air pollution and minimizing health hazards at Dhaka urban environment.

Key words: Air pollution, contamination, sources, heavy meal pollution, health hazards, management, awareness.

2. Introduction

Clay (diameter size <0.002mm) minor, micro or nano soil particles like natural fine, grain dust particles or colloids which develop plasticity in presence of limited water. Clay contains a higher amount of Mg, Si, Fe and smaller amount of Ca, Na, and K. There is no demarcation line between clay and colloidal clay but soil particles less than 0.0002mm in diameter is called as colloidal clay or dust clay, nano or micro clay particles. Four main constituents like Si, Al, Fe and water make up of 90-98% of the colloidal clays. If clay colloidal are examined under high power microscope, electron microscope or an x-ray then crystalline structure can be observed. The finer the clay the greater the moisture percentage on it. Such clay colloids or micro, nano particles carry a lot of contaminants in air as particulate matters ($2.5\mu\text{g}$, $10\mu\text{g}/\text{m}^3$ move to human body as respiratory air and create minor, moderate, major to severe health hazards on the basis of carrying capacity (variety) of the colloidal pollutants (CO_2 , CO, NO, NO_2 , SO_2 , NH_3 gases and heavy metals like As, Ni, Pb, Cr, Hg etc.). Some of the properties of clay minerals are highlighted here: i) Clay colloids are negatively charged anions and attracts large number of positively charged cations; ii) The colloidal particles due to minor sizes tend to remain in suspension where settling velocity under force of gravity is very low; iii) The clay colloids from different soils differ in their properties. The finer the particle sizes of clay, the greater the intensity of colloidal properties; iv) Clay colloids form black soils are rich in S; and low in Fe and Al but red soils colloids are low in Si and high in Al and Fe; v) Clay never resists as single mineral i.e. it is a mixture of several minerals where one is prominent; vi) Red lateritic soils the Kaolinite type of clay minerals and black soils are rich in montmorillonite type of clays; vii) Clay minerals exist with 4 characteristics like size and chemical composition, shape, surface area, electromagnatic charge and adsorbed cations; viii) If clay colloids are examined under high power microscope, electron microscope

or x-ray, their crystalline structure can be observed (Fig. 1); ix) The common clay minerals or clay colloids are kaolinite, montmorillonite, illite, vermiculite, chlorite, saponite, sesquioxides and amorphous, and they are called as silicate clays as shown in Fig. 1 (Sattar, 2022) and x) The 18 properties of three clay minerals like Kaolinite, montmorillonite and illite are described here in Table 1.

Table 1. Eighteen properties of 3 clay minerals like Kaolinite, montmorillonite and illite (Sattar, 2022; Das, 2015)

Sl.	Properties	Kaolinite	Montmorillonite	Illite
1.	Structure	1:1 lattice (Fig. 1A)	2:1 lattice (Fig. 1B)	2:1 lattice (Fig. 1C)
2.	Substitution	No substitution	Substitution in silica layer by aluminium	Substitution in aluminium sheet by Mg or Fe
3.	Non-exchangeable cations	None	Mg	K
4.	Cation base exchange capacity me/100mg	3-15	80-100	15-40
5.	Anion exchange capacity	High	Low	Medium
6.	Cohesion and plasticity	Practically no cohesion and plasticity	Highly plastic and cohesive	Medium in cohesion and plasticity
7.	Porosity and permeability	Porus and permeable	Low in porosity and permeability	Medium in porosity and permeability
8.	Size	Coarser particle size	Fine particle size	Medium in particle size
9.	Structural formula	(OH) ₈ , Al ₄ , Si ₄ , O ₁₆ (Fig. 1A)	(OH) ₄ , Al ₄ , Si ₈ , O ₂₀ , XH ₂₀ (Fig. 1 B)	(OH) ₄ , Ky (Al ₄ , Fe ₄ , Mg ₄ , Mg ₆) (Si ₈ -yAl _y)O ₂₀ (Fig. 1C)
10.	Water entry into sheets	Water cannot enter between the sheets	Water can enter between the sheets easily	Water cannot penetrate
11.	Relative swelling when wetted	Almost none	High	Moderate
12.	Relative stickiness	Slight	High	Low
13.	Environment where clay is dominant (zone)	Moist, warm to hot subhumid and tropics, humid leached soils	Arid to humid soils limited leaching	Subhumid and cool areas, parent rock containing micas
14.	Drained conditions	None/low slight mostly pottery work require several thousand yrs. for well drained	No slightly leached zones	Slightly leached areas/zones
15.	Soil types	Acidic parent materials/acid soils	Alkaline parent material	Acid/neutral parent material
16.	Prominent element presence	O, Al, Fe	O, Si, Al, K	O, Si, Al, Mg
17.	Parent materials	Acidic	Acidic/neutral	Alkaline
18.	Arrangements	The unit arrangement is as 1 layer of Al ₂ O ₃ and 1-layer of SiO ₂ (Fig. 1A)	Two silicate sheets and enclosing an alumina sheet (Fig. 1B)	The unit consists of 1-layer of SiO ₂ and 1-layer of Al ₂ O ₃ and another of Si ₂ O (Fig. 1C)

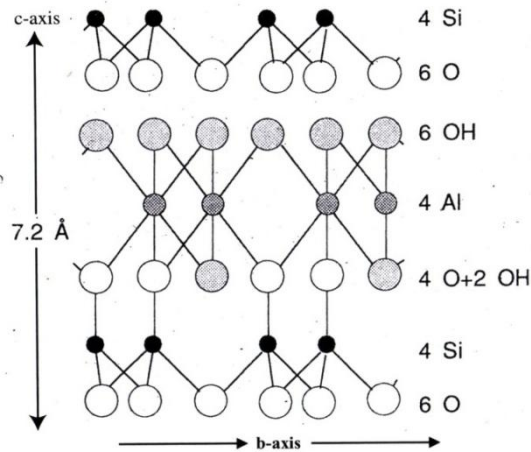


Fig. 1A. Structure of kaolinite (clay mineral (1:1 layer silicate))

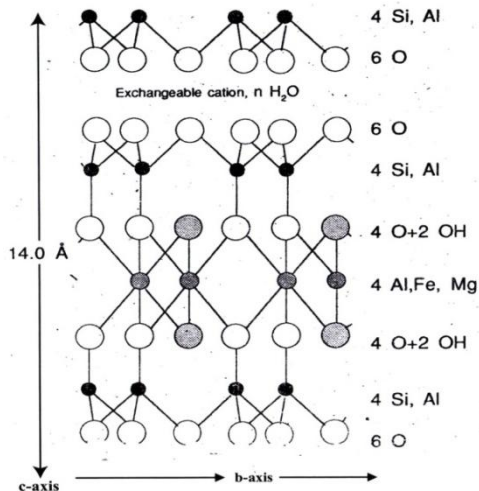


Fig. 1B. Structure of montmorillonite (2:1 layer silicate) clay minerals

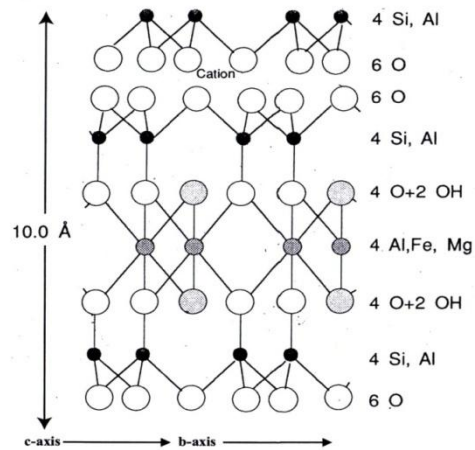


Fig. 1C. Structure of Illite (2:1 non-expanding type) clay minerals

Fig. 1. Structures of Kaolinite (1A), montmorillonite (1B) and illite (1C) clay minerals (Sattar, 2022; Das 2015)

3. Sources of dust contamination at Dhaka Metropolitan city

The detailed dust contamination sources are listed here and the major sources and cycles of soil contaminations related to health hazards are outlined in Fig. 2 where 10-15 major air pollution (dust contamination) causes and 10-12 related diseases are listed (Sattar, 2003).

1. Roadside plain land.
2. Road island fellow, grass or plainland.
3. Road dust covering entire or part of the road.
4. Roadside dust or loose soils.
5. Soils/dust of roads staying on boundary walls/road walls.
6. Around or here and there of the flyover.

7. Land/soils or loose dusts below the flyovers.
8. Dusts/loose soils around or entire city parks here and there.
9. Footpath dusts.
10. Drain soils-dry soils in drains or sides of the drains around the city.
11. Clearing and saving or keeping of drain soils around.
12. Thousands of plants, bushes, minor trees covering leaves of those plants.
13. Unprotected urban graveyard here and there around the city.
14. Movement and tyres of thousands of small and large vehicles.
15. Dusts from car washing or repairing areas.
16. Wind carrying dusts throughout the year.
17. Millions of various qualities (large to small) posters around the city.
18. Dusts from lakes, ponds or river banks.
19. Dusts/sands carrying by thousands of trucks around the city roads.
20. Soils carrying from one place to another particularly to the construction sides.
21. Thousands of new building construction works and rough utilizes the soil bodies.
22. Soils from corridors, corridor plants and roof gardening soils.
23. Dusts/loose soils from hundreds of playground here and there around the city.
24. Soils from various boring sites for different places.
25. Vehicle parking sites-hundreds of locations or parking zones.
26. Shoe dusts of millions of people everyday movement.
27. Dusts/soils from walking streets/footpaths.
28. Dusts from areas of water spraying/around zones.
29. Everyday indoor floor dusts of millions of urban houses.
30. Dusts from millions of house-floor carpets in the urban regions.
31. Dusts from thousands of gas stations areas.
32. Dusts adsorbed on outside walls near the roads.
33. Dusts, loose soils from botanical gardens and small nursery gardens/areas.
34. Dusts, loose soils from small and large zoos.
35. Dusts coming around keeps inside the vehicles.
36. Dusts releases from large gathering.
37. Dusts from hospital floors-corridors and hundreds of rooms.
38. Dusts from city shops/floor and goods.
39. Dusts/loose soils from road side grasses, bushes etc.
40. Factory solid wastes/soils around the factories.
41. Kalbaishakhi winds and dusts movement.
42. Shops of selling of soils, bricks, stones of the soil dusts coming from them.
43. Dusts/loose soils from slum zone areas.
44. Cutting of soils from high land or minor sloppy or hilly areas at different zones.
45. Stores or go down keeping for various purposes.
46. Repairing or reconstruction sites of old/new housing areas.
47. High speed running of vehicles-carrying or moving of dusts.
48. Closed/opened market ground/fields.
49. Removal of dusts from clothes after working/moving outside zones.
50. Dusts removal from window glasses from houses of all kinds.
51. Road cutting areas/sites.
52. Making of holes at various areas of road for postering or other purposes.
53. Fellow land here and there distributes dusts around the regions.
54. Washing of clothes through moving/remove of dusts.
55. Tin shade houses at different zones of the city.
56. Various stalls of furniture shops.
57. Cover of outside of the buildings for cleaning for using of new colouring.

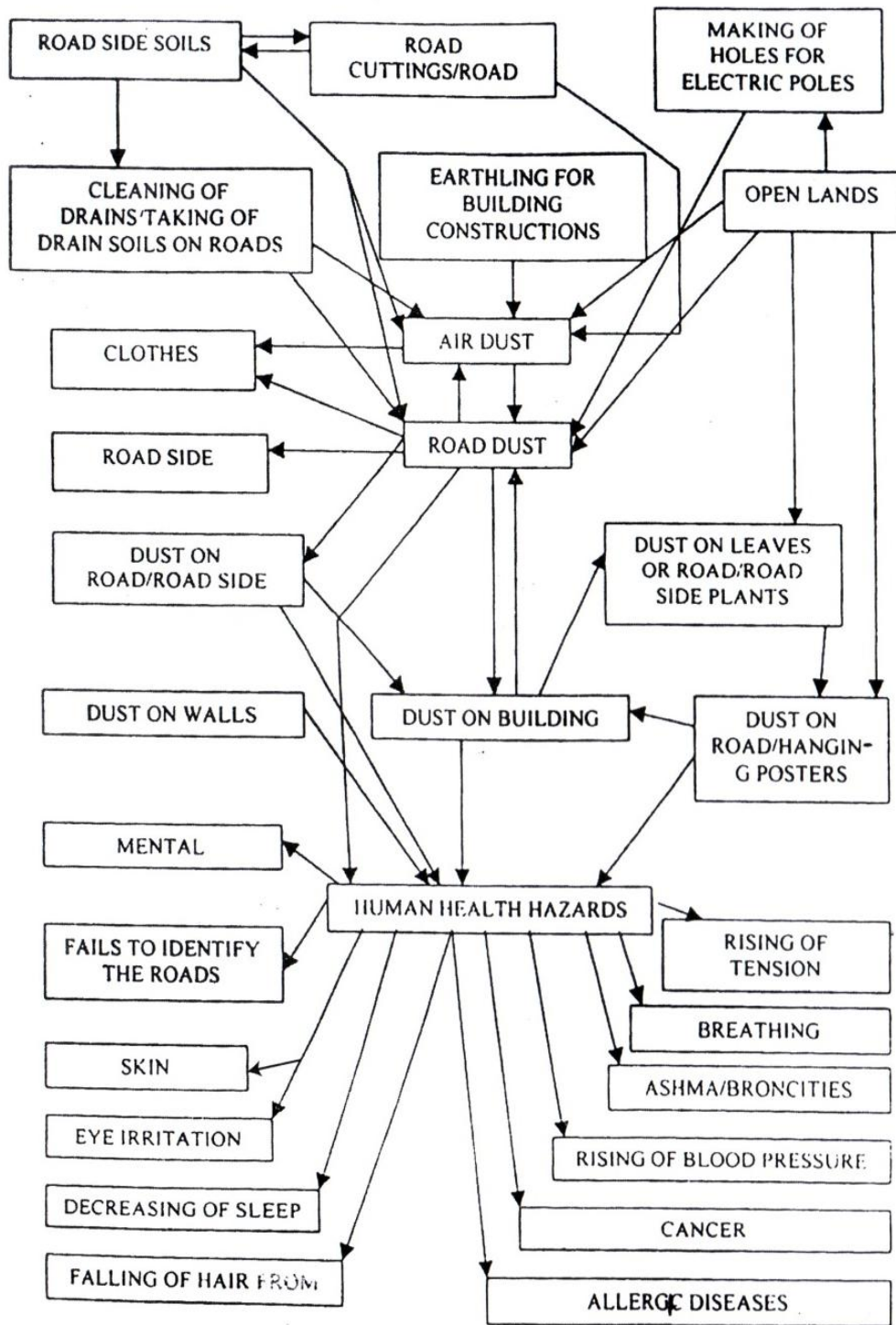


Fig. 2. Sources of dust deposition and dynamics of dust hazards to human health at metropolitan cities of Bangladesh (Sattar, 2003).

58. Collection, grinding, sieving and storing and analysis of soils.
59. Dust from eye-glasses-millions of them.
60. Road degradation around the city.
61. Dust after cleaning of millions of floors of the urban houses-residents, hotels, shops, offices, stores, industries etc.

4. Other air pollution and contamination sources at Dhaka Metropolitan City

1. Fumes of all kind of vehicles.
2. Fumes of various industries.
3. Fumes of burning or cookings.
4. Fumes of burning the wastes of the urban areas.
5. Fumes of burning of the hospital wastes.
6. Fumes of burning of plant leaves of roads, papers, tissues or old cloths-someone throws on roads.
7. Fumes of accidental firing.
8. Fumes of brick fields from plants/wood burnings.
9. Burning of kerosine oils for various purposes like cooking, lighting etc.
10. Gas burning for various purposes through producing of fumes.
11. Fumes producing at various restaurants poor to rich types.
12. Fumes producing through burning of dead bodies of hindu people including woods.
13. Coal burning works for various purposes.
14. Fumes from peach burning for road carpeting.
15. Fumes from burning of hospital wastes, different useless office papers or very old scripts at the univ. campuses.

5. Newspaper reports on air pollution at Dhaka Metropolitan City

The widely accepted air standard data can be used as follows: (1) 0-50 score treated as fresh, good or safe air, (2) 51-100 also be treated as acceptable data, (3) 101-150 can be counted as alarming one, (4) 151-200 can be used as unhealthy or unhygienic one, (5) 201-300 can be counted as very unhealthy, unsafe or unhygienic one, and (6) >300 severe or strongly harmful for the health. The air standard data were measured at Dhaka Metropolitan city on Feb 2023 were 225, Feb 2024 to 258 and Feb 2025 to 262 and Nov. 2024 to Feb 2025 produced higher records than those of last 9 years (Prathom Alo: March, 2025). According to IQ air record of PM_{2.5} (particulate matters) of 2024 air quality recorded to Chad (91.8), Bangladesh (78), Pakistan (73.7), Congo (58.2), India (50.6), Tajakistan (46.3), Nepal (42.8), Uganda (41.0), Ruyanda (40.8), Bermuda (40.3), (Bangladesh Pratidin: 12March, 2025).

On Jan/2025 IQ Air measured to 518 in the morning and the day 622 at Dhaka city where entire January showed severe air contaminations. Data of 2017-2024 recorded to 255 scores at January 2025 to 318, January 2024 to 302 and last 2 weeks of January/2025 was recorded to 300 to > 300 scores i.e. widely unhealthy and hazardous (Prathom Alo, 9 Feb. 2025). A report from Prathom Alo on 10 December 2024 the air quality records from different cities measured to Narayangonj 205; Dhaka-195; Gazipur-191; Rajshahi-179; Mymensingh-167; Rangpur-186 on November 2024. Again, Prathm Alo report on December 10, 2024 showed the picture like air quality of 2016-2023 was 176 at Dhaka in 2024 to 195; 5 December/24 at Dhaka to 341 and 9 December/24 300 scores produced unhealthy or unsafe air. In 2023 air contamination CRIA value of PM_{2.5} recorded to 79.9 µg although national standard covers on 35 µg air pollution centre (Caps) reports (Bangladesh Prathidin 19, Jan 2025). Again, IQ Air quality Inter. Report stated that out of 124 cities of the world the pollution of Dhaka recorded to 3rd position (AQI) score of Dhaka was 244 although recorded near to USA Embassy to 451 scores i.e. PM_{2.5} recorded to 301 and at Eastern housing area 406, Savar 358, Kalyanpur 358, Gulshan lake to 316 (AQI score) (Bangladesh Pratidin, 22 Jan 2025). Out of 100 cities air contamination situations readed to 4th position at Dhaka city where IQ air quality recorded to 165 at 10pm and at that time score recorded to Katmandu 194 (highest polluted city then), Nompan took 3rd position with 172 score on 7 April 2024 score Dhaka city recorded to 144 at 10am (Prathom Alo, 8 April 2024) (IQ Air,

Switzerland organization). On 6 April 2024 the IQA score of Dhaka air was 159 at 9pm and 4-5 April the score recorded to 122 at 10 am where Changmai took highest position at 10pm (7 April 2024 Prathom Alo). On 29 April 2025 Dhaka occupied 2nd position regarding air pollution where recorded score was 171 i.e. unhealthy air environment. In the evening the score recorded to 135. That was 5th position in the world. Regarding air pollution Dhaka always existed 1-7th position in the world that was covered by IQ air standard of Switzerland by air measuring instrument. The recorded data showed $60\mu\text{gm}^{-3}$ concentration of the pollutants (normal $5\mu\text{gm}^{-3}$). The highest score recorded from Lahore to 186, and Delhi to 156 score covering 3rd position. On the basis of the scores the air-contaminants from some countries recorded to scores of Vietnam (139), Quet (118), Katmandu of Nepal (114), (Bangladesh Pratidin, 30 April, 2025).

6 . Road dust (Clay/clay colloids) contaminations on leaves of plants: case study of 4 areas at Dhaka Metropolitan city

From November 2024 to March 2025, i.e. during the last 5-6 months there was no rainfall in the country when most of the day Dhaka Metropolitan city occupied within 1st to 5th position regarding the global air pollution (IQAir quality). During this time millions of plants of Dhaka urban region including house plants, roof top garden plants covered with minor to major dust layers. The dust depositions were severe on road side plants, road side flowing plants. In this study, dust contaminations on roads, road side plants, road island plants, bushes, minor/medium level trees, flowering plants of the roads/road sides were studied at 4 locations like (1) Abdullahpur to Kamarpara, Uttara sector-10 (Fig. 3), (2) House building site to sector 12, mosque, Uttara Sector-12 (Fig. 4), (3) Around the Park, and Park zone of the Shamoli children park (Fig. 5) and (4) Starting point from the metroraill zone to Mirpur area (Fig. 6), and from these four sites 400-500 photographs were taken covering minor to high levels of dust contaminations i.e. 80-99% areas of the leaves were covered with dusts and they looked like leaves of white colours. From these study, it proved that the plants of Dhaka city were look like white colour leaves. It was estimated that these plants were not the natural plants of Bangladesh rather they were the leaves from other globes. Everywhere in the Dhaka urban zone, the leaves were observed as white leaves nothing more than that. Practically, 100% leaves were shown to be polluted where in 2008, Sattar observed 15-16 heavy from leaf-dusts of Dhaka Metropolitan city (Sattar, 2008). Through five models and schemes it was widely discovered the movement of dust contaminations through indoor, outdoor and poster dust contaminations and health hazards related to dust contamination/air pollution (Sattar and Shahriar, 2024).

Observation regarding leaf dust contaminations as shown in Fig. 3-6.

- (1) Leaves of all plants, trees, herbs, and bushes carry a layer of dust.
- (2) On the basis of fineness of leaves (new, medium or old leaves) the thickness of dust layers varied traces to major (light or thick layer of dusts).
- (3) The more the open soils/dusts on main road the more thickness the dust layers on leaves.
- (4) On the basis of sources the dust layers varied in colour like white, red, brown, black etc.
- (5) New and fresh leaf zones were mostly free from dusts.
- (6) Black soil zone/areas showed black powered or tiny grains on leaves.
- (7) The leaves were fine and no breakings of layers were observed to 90-95% leaves.
- (8) In all cases covering of all 4 sites (Fig. 3-6) dust soils/soil layers were so fine 100 passed through 10-mesh since, 80-90% passed through 20-mesh sieve, and even they are directly ready for lab. Analytical tests as studied for heavy metals in 2005 (Sattar *et al.* 2005).
- (9) Usually leaf-dust soil particles are texturally clay (colloidal clay/clay colloids, nano soil particles, particulate matters etc.), clay loam, silty clay, silty caly loam and with traces of sandy clay soils.
- (10) The leaves received dusts on the basis of smoothness/fineness of the surface area like as very rough < rough < medium rough < poorly smooth<smooth/fine< very smooth<extremely fine surface zone. Mango-jackfruit plants received large amount of dusts where as new banana leaves, flowering plants received traces amount of dusts in the leaf-surfaces.



Fig. 3. Dust contaminations on leaves of different plants at Abdullahpur to Kamarpara roadside (Ashulya road side directions; November 2024-March 2025)



Fig. 4. Dust contaminations on leaves of different plants at road sides and road islands from Housebuilding to Mosque of Sector-12 (November 2024-March 2025).



Fig. 5. Dust contaminations on leaves of different plants at around the parkzone of Shemoli Shesu Park (November 2024-March 2025).



Fig. 6. Dust contaminations on leaves of different plants under the metrorail zone from Diabari to Mirpur zone (November 2024 to March 2025).

7. Heavy metal contaminations in air, dusts nano-soil particle and particulate matters

On the basis of soil (land) ground utilizations, dust movement and/or soil contaminations are variable from place to place or site to site minor (traces) to major (severe) levels like trace, medium low, medium, medium high, high, severe or extreme because of the presence of various contaminant/pollutants in air like CO₂, CO, NO, SO₂, CH₄, NO_x and different heavy metals like Zn, Cu, Mn, Mo, Pb, Ni, Hg, As, An, Se, Va, Cr etc. including the radioactive materials like Cr, Tr (Fir. 4) (Sattar 2010; 2022).

On the basis of human life styles, nature, environment, road situations, management practices, local foundations, constructions, business purposes Dhaka Metropolitan City can be divided into 25-30 sites i.e. Dhaka Metropolitan city Urban land utilizations covers (1) residential area, (2) market zone, (3) construction sites, (4) park/play ground zone, (5) forest zone (if any), (6) industrial zone, (7) airport sites, (8) tourist sites, (9) fellow land, if any, (10) bus stations zone, (11) gas-station area, (12) riverbank sites/areas, (13) hospital sites, (14) pond/lake zone regions, (15) large and small shopping mall zones, (16) brickfield zone (if any), (19) slum zone, (20) various office zones, (21) different institutional campus zones, (22) football ground and play ground regions, (23) Children parks, zones, (24) Railway stations, where dust contaminants/particulate matters pollutions might be variable.

Table 2. Global emission of heavy metals in air, water and soil (in 1000 metric tones/year) (Nigaru, 1988)

Element	Air	Water	Soil
Zn	132	226	1372
Cu	35	112	954
Mn	38	262	1670
Mo	3.3	11	88
Cd	7.6	9.4	22
Pb	332	138	796
Ni	56	113	325
Hg	3.6	4.6	8.3
As	18.8	41	82
An	3.5	18	26
Se	3.8	41	41
Va	86	12	132

Table 3. Maximum allowable limits (MAL) of heavy metals in soils at different countries (mg kg⁻¹) (Kabata-Pendias, 1995)

Element	Austria	Canada	Poland	Japan	Britain	Germany
Cd	5	8	3	-	3	2
Co	50	25	50	50	-	-
Cr	100	75	100	-	50	200
Cu	100	100	100	125	100	50
Ni	100	100	100	100	50	100
Pb	100	200	100	400	100	500
Zn	300	400	300	250	300	300

Table 4. Maximum allowable limits (MAL) of trace element is soil (mg kg⁻¹) (Pendias and Pendias, 2001)

Element	Austria 1977	Poland 1993	Germany 1992	European communities 1986	USA 1993
Cd	5	1-3	1.5	1-3	20
Cr	100	50-80	100	100	150
Pb	100	70-150	100	50-300	150
Ni	75	50-80	80	75	75

When there is soil there must be the dust and without dust soil can never be recognized as soil. Similarly, where there is soil there must be traces to major amount of 12-25 heavy metals, so where there is the dust there must be existence of traces to major amount of different heavy metals where they are responsible for creating health hazards through dust movement in air as dusts, dust colloids clay colloids, nano particles, colloidal particles, or particulate matters ($PM_{2.5}$, PM_{10}). Most environmental scientists showed emphasis on air pollution here where they tried to explain the responsibility of Particulate matter ($PM_{2.5}$, PM_{10}) in relation to health hazards ignoring the total air pollution (different gases, heavy metals, particulate matters, other nano particles etc.). Air particulate matters include soil dusts, dust colloids, clay colloids, dusts, nano soil particles, (those $<0.000mm$ in diameter), including all gaseous substances treated as pollutants and through inhalation move to human body, work as slow poison and produces minor to severe diseases even cancer to death.

Sattar published more than 50 articles in relation to soils, dusts, foods, road dusts, bus station soils, airport soils, road island soils, leaf dusts, farm soils, drain soils, park soils, home garden soils, car parking place, lake and pond sediments where the following heavy metals were detected-Na, Mg, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Mo, Cd, Sb, Ba, Hg, Pb and U (Sattar and Blume, 1998; Sattar, 2001; Ahmed *et al.* 2002). Sattar *et al.* (2005) also largely studied the heavy metal contaminations of the 4 metropolitan (Dhaka, Chittagong, Khulna and Rajshahi) cities of Bangladesh covering all aspects (12-15 zones) of soils, and the detected heavy metals were Pb, Al, Ti, Cr, Mn, Fe, Co, Ni, Cu, As, Zn, Cd, Sn, Sb, Ba and Hg. Niragu established the global emissions of Zn, Cu, Mn, Mo, Cd, Pb, Ni, Hg, As, An, Se, and U in soil, air and water samples and confirmed the wide existence of heavy metals in air as health hazard-pollutants (Table 2). The maximum allowable limits of heavy metals (Cd, Co, Cr, Cu, Ni,) at different countries are shown in Table 3 and different years (Table 4) where the result of Bangladesh soils proved as highly contaminated than those Bangladesh Metropolitan soils as observed by Sattar *et al.* (2005).The leaf-dust contaminations 4-sites at different locations of Dhaka Metropolitan city are listed in Fig. 3-6.

8. Toxicity to crops and health hazards of air pollution: The toxicity of heavy metals to crops are listed in Table 5. Sattar largely described the heavy metal contaminations, pollutions, toxicity to crops, health hazards, cycle covering 40 pages in his book (Sattar, 2022; P. 483-521) in relation to soils, clays, dusts clay-colloids nano-soil particles.

Air pollution is directly related to health hazards. In Bangladesh more than 2 lakh people are died as a result of air pollution. Children and elderly people widely suffer due to air pollution-(toxic chemicals and gases, heavy metals, particulate matters). During an Olympic game in 1980 a reporter asked to a Finnish Olympic runner for their long lives and best result of Marathon run where he replied because of the fresh air and pollution free environment. Air pollution is severe at Dhaka urban zone where people are badly suffer or affected with cough, cold, fever, running of nose flow, various skin and eye diseases, diabetes, ashma, blood pressures, diarrhea, headache, vomiting, disfunctions of head (moving), mental disorders, strokes, heart diseases, abnormal life styles, allergy, pneumonia, cancer and even to death. At Dhaka Metropolitan city thousands of people use musk during movement because of the health hazards and safety of life against air pollution. On the basis of sources the hazards/health related diseases are variable from place to place and person to persons.

Sattar (2022a) established 21 air pollution related health hazards, and they are again listed here- (1) Eye irritation, (2) Various skin diseses, (3) Mental disorders, (4) Falling of hairs, (5) Decreasing of sleep, (6) Rising of tensions, (7) Breathing troubles, (8) Various health, lung or kidney diseases, (9) Ashma/broncities, (10) Increasing of blood pressures, (11) Different cancers or other chronic diseases, (12) Allergic diseases, (13) Vomiting tendency, (14) Depression or loss of interest, (15) Brain/kidney damages, (16) Diabetes, (17) Arises of blindness, (18) Loss of appetites, (19) Hormonal disorders, (20) Headache, drowniness, confussion, convulsion etc., (21) Diarrhea, burning of mouth and/or throat. Even the heavy metals like Pb, Ni, Cr, Hg, Br, Zn, As and various gases moved or released from coal fire power plans and widely polluted the air (Fig. 7) where they largely responsible for occurring of various health hazardous (Sattar, 2010).

Table 5. Toxicity symptoms of heavy metals to crops/plants

Sl. No.	Heavy metals	Toxicity symptoms on leaves/stems
1.	Cu	1. bluish leaves
2.	Zn	1. yellow leaves, 2. brown patches, 3. pale green stripes on leaves
3.	Mo	Not well identified
4.	B	1. Yellow leaves, 2. brown stripes on leaves
5.	Ni	1. White longitudinal stripes, 2. brown patches on leaves
6.	Pb	Not well detected
7.	As	1. Red stems, 2. yellow leaves
8.	Cd	1. red brown patches on leaves, 2. stunted growth (stems)
9.	Cr	1. Longitudinal palegreen colour stripes on leaves, 2. yellow leaves
10.	Hg	1. Yellow leaves, 2. red stems
11.	Co	1. Pale longitudinal stripes on leaves, 2. Pale green on leaves
12.	V	1. Pale green longitudinal stripes on leaves
13.	Be	1. Yellow leaves, 2. Stunted stems
14.	Ti	1. Yellow leaves
15.	Zr	1. Red stems
16.	Ag	1. Red brown patches on leaves, 2. red stems
17.	Se	1. Red stems
18.	Sn	1. Red stems
19.	Mn	Not known
20.	Ba	Not known

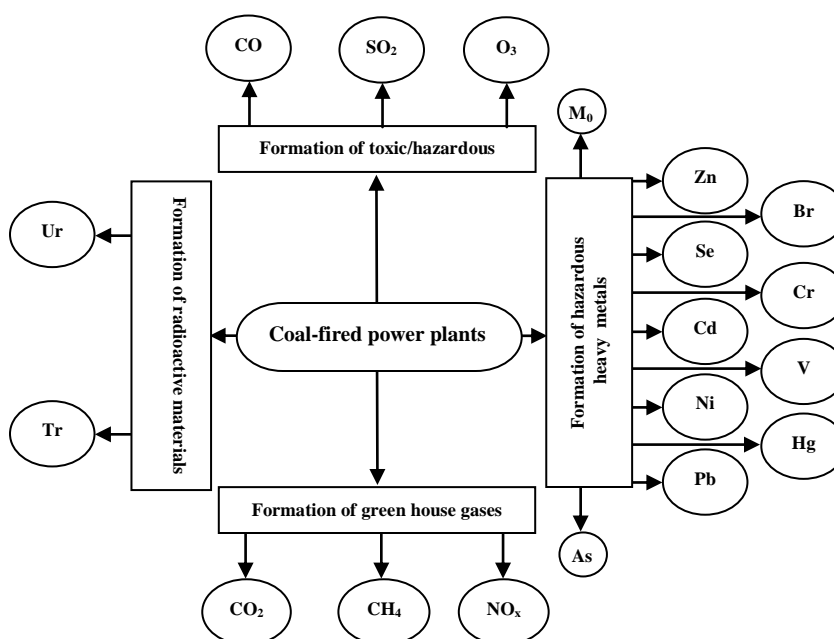


Fig. 7. Formation of various gases (hazardous and green house) and toxic/harmful heavy metals to air from coal-fired power plants (Sattar 2010).

9. Control and minimizing of dust contaminations for sound air quality management at Dhaka Metropolitan City

1. 1-2 times watering in the main roads particularly in the severe dust zones/dust moving sites.
2. On the basis of availability of water road, side zones (one or two sides on the basis of dust depositions/movement in air) can also be used under regular watering for weaken the dusts.
3. Plants on road divider-zones can also be washed at least once in a month in case of long absence of rainfall in the region.
4. Trucks carrying sands and/or soils must be strongly covered with plastic sheets.
5. Slowly roads should be improved according to developed countries where road carpeting must be covered the main part and 2-side areas too. Thus road dust production should be entirely minimized.
6. Usually, road construction/repairing works should be done at nights and here these should be followed.
7. Road repairing works should be done within a short time.
8. Road constructions and repairing works should be done for at least 100 years sustain.
9. All housing construction work sites should be regularly washed with watering during winter months for minimizing soil dusts.
10. All urban drains should be cleaned in each year before the rainy season. Again they should be cleaned 1-2 times more in a year in case high sedimentation or waste deposits.
11. Drain soils, sediment etc. should be quickly removed after cleaning where longtime storage add huge dust contaminations to air.
12. Urban plantation to road sides and road islands are important and they should be managed properly.
13. Road cleaning should be done every day before sunrise i.e. early in the morning.
14. All urban parkings should be properly maintained against dust movement from the park.
15. Any brick field around the city should be strickly banned because those cause severe air pollution.
16. Urban road cutting system should be checked and again cutting without long time failure of repairing largely create large dust contaminations.
17. Old vehicles and those vehicles produce black fumes should be rejected as out of orders.
18. All fish markets should be cleaned everyday where floor, roads and drains should be sand or clay free zone.
19. Urban industries must have pollution management cell so that each industry can easily minimize its own quality against soil and air pollution.
20. Never allow soils, sands, wastes or hospital materials on roads, road sides or road islands.
21. Open car, bus, truck i.e. vehicle parking zones on pumping stations should be regularly cleaned through removing of soil, sand or dust particles.
22. Urban wastes should be properly removed far away from the city zones.
23. Urban/hospital wastes, should never be burned around the city and they should be scientifically burned through minimizing fumes.
24. All car/vehicle repairing zones are poorly managed where sound management should be done.
25. City lake repairing works should be done properly through minimizing movement of soils or dusts of the zones particularly covering of two sides of the lakes.
26. Open burning of papers, washes, leaves of plants, old clothes, hospital plastics etc. should be restricted where urban central burning house should be developed.

10. Awareness slogans against Dhaka Metropolitan City dust contaminations

Here 30 slogans were given for proper management of dust contaminations of Dhaka Metropolitan city. These can also be applied to any cities of Bangladesh and/or other countries too. They work/show as proverb, so proper English meaning may not come and that's why side by side Bangla slogans are also applied:

English meaning	Bangla slogans
1. Dhaka city to be free from air pollution, Reduce vehicle emissions, brother.	১. ঢাকা শহরের বায়ু দূষণমুক্ত চাই, যানবাহনের ধূঁয়া কমান ভাই।
2. Clay colloids causes dust pollution, Sprinkle water during house construction.	২. ধূলোবালি ডাস্ট দূষণ ঘটায়, বাড়ীঘর নির্মাণে পানি ছিটান।
3. Road dusts looks good, Spray water morning and evening-that's good.	৩. রাস্তার ডাস্ট ভয়াবহ সাজ, সকাল বিকেল পানি ছিটান-তবেই বাছ।
4. Take care on cutting and repairing of roads, Do this at night	৪. রাস্তাকাটা মেরামতে সতর্ক হোক, রাতে রাতে কাজ সারুন।
5. Improve the carpeting of the roads, Make it in both sides.	৫. রাস্তার কার্পেটিং উন্নত হোক, দু'পাশ বাড়াতে যেন ভুল না হয়।
6. Require lab tests to control air pollution, Alternate use of routine test.	৬. বায়ুর দূষণ নিয়ন্ত্রণে ল্যাব পরীক্ষা চাই, রুটিন পরীক্ষার বিকল্প নেই।
7. The inside of vehicle must be kept clean, Stay focused on daily tasks.	৭. যানবাহনের ভিতর পরিষ্কার রাখতে হবে, প্রতিদিনের কাজে মনোযোগী হবে।
8. Clay colloid are not enough causing dust pollution, Numerous chemicals work there in the place.	৮. ডাস্ট দূষণে কঁাদা কলোয়েড কণা যথেষ্ট নয়, অসংখ্য রাসায়নিক পদার্থও এ খেলায় অংশীদারী রয়।
9. Air pollution varies by area and source, Health risks increase or decrease such way.	৯. এলাকা ও উৎস ভিত্তিক বায়ু দূষণে তারতম্য ঘটে, স্বাস্থ্য ঝুঁকি এভাবেই বাড়ে কমে।
10. Pollution control the matter of industry owners, Every industry must have own control cell.	১০. শিল্প কারখানার দূষণ নিয়ন্ত্রণ মালিকের কাজ, প্রতি শিল্পে নিয়ন্ত্রণ সেলের আবশ্যিকতা হতে হবে ঠাই।
11. Markets should be kept clean, The owner should take care every-day's work.	১১. হাটবাজার পরিষ্কার পরিচ্ছন্ন রাখতে হবে, মালিক পক্ষে প্রতিদিনই এ কাজে যেন খেয়াল রাখে।
12. Dhaka air pollution shaking the world, Research publication awareness remain weak.	১২. ঢাকার বায়ু দূষণ বিশ্ব কাঁপায়, গবেষণা প্রকাশনা সচেতনতা দুর্বল রয়।
13. Air pollution increases health hazards everyday, No options against that.	১৩. বায়ু দূষণে স্বাস্থ্য ঝুঁকি বাড়াচ্ছে প্রতিদিন, সাবধানতার বিকল্প নেই।
14. Traffic services produce good results, Keep vehicle emission under control.	১৪. ট্রাফিক সেবা উত্তম ফল দিতে পারে, ধূঁয়া ছাড়ার যানবাহন যেন নিয়ন্ত্রনে রাখে।
15. Air pollution peaks in winter, Dhaka city suffers without rain.	১৫. শীতকালে বায়ু দূষণ তুঙ্গে উটে, বৃষ্টিপাতহীন ঢাকা শহর কেঁদে মরে।
16. Dhaka-the city of large population, Air pollution situation not improving still today.	১৬. সুবিশাল জনসংখ্যার শহর ঢাকা বটে, বায়ুর দূষণমুক্ততায় হাল আজো না ধরে।
17. Political democracy runs day and night. Nature environment and air pollution not coming to the point.	১৭. রাজনীতি গণতন্ত্র বলে দিনরাত মাঠে থাকে, প্রকৃতি পরিবেশ বায়ুর দূষণ উচ্চারণে না ভাসে।

English meaning	Bangla slogans
18. Department of Environment requires air pollution monitoring cell, Expert researchers must be there in the field.	১৮. বায়ুর দূষণ মনিটরিং এ পরিবেশ অধিদপ্তর সেল থাকা চাই, বিশেষজ্ঞ গবেষক যেন মাঠে ঘাটে সচেতনতায় বসে।
19. TV news covers researchers on air pollution, No data, only story there in the talk.	১৯. টিভিতে বায়ুর দূষণে দুচারজনের গবেষণার কথা ভাসে, কাজ নেই গল্পের কথায় দিনপাড় করে হেসে।
20. Dhaka residents must be vocal against air pollution. The lives of generations may be threatened then.	২০. দূষণমুক্ততায় কাজকর্ম সচেতনতায় ঢাকাবাসী সোচার হোন, তা না হলে প্রজন্মের জীবন হুমকীতে হবে ঠাই।
21. Less work less research on Dhaka air pollution, Published visible data not there in the field.	২১. ঢাকায় বায়ু দূষণের তুলনায় কাজকর্ম গবেষণা কম, ডাটা প্রকাশনার দেখা নেই-কোথাও ভাই।
22. The smell of municipal smoke and mosquito coil burning fumes rises air pollution, Life is threatened then by the smelling of strong fumes.	২২. পৌরসভার মশার ধূঁয়া গন্ধ দূষণ বাড়ে বায়ুতে, জীবনযাত্রা হুমকীতে আসে ঐ ধূঁয়ার বিষাক্ত গন্ধে।
23. Drain cleaning should be done at least once a year, The pollution levels still comes as alarming.	২৩. বৎসরে ড্রেন পরিষ্কার কমপক্ষে একবার যেন হয়, এখানেও দূষণের মাত্রা ভয়াবহ আকৃতি রয়।
24. Someone is running for medals through talking of Dhaka's air pollution, Practical research and publications not there in the matter.	২৪. ঢাকার বায়ু দূষণের কথা বলে পদকের জন্য দৌড়াচ্ছে কেহ, আসলে গবেষণা প্রকাশনা সচেতনতায় দেখা যায় না কবু।
25. CO ₂ , CO, SO ₂ , NO, NO ₂ , NH ₃ and heavy metals cause air pollution, Research, publications and wide awareness must be added there.	২৫. CO ₂ , CO, SO ₂ , NO, NH ₃ এবং হেভি মেটাল বায়ু দূষণে বড় অংশীদার বটে, গবেষণা প্রকাশনা সাবধানতা যেন এ স্তরে বাড়ে।
26. Air pollution increases, colds, coughs, sneezing, watery eyes, Better to avoided such polluting sites.	২৬. বায়ু দূষণে সর্দিকাশি হাঁচি চোখে জল বাড়ে, চলাফেরায় সাবধান ঐ এলাকা বর্জন করাই ভাল।
27. Excessive air pollution causes serious diseases including bronchitis and cancer, Proceeds carefully without negligence.	২৭. বায়ুর অতি দূষণে ব্রনকাইটিস, ক্যানসারসহ জটিল রোগ ধরে, অবহেলা না করে সাবধানে যেন পথ চলে।
28. Better to wear a mask during severe air pollution, Avoid mask in other times for good health.	২৮. অতি দূষণ বাড়লে পরে মাস্ক পড়া উত্তম, অন্য সময় বর্জন স্বাস্থ্য সুরক্ষায় ভাল।
29. Proper govt. research data on air pollution is important, scientists, researchers and physicians then must manage for proper protection. Only then scientists, researchers and doctors find a way to control pollution.	২৯. বায়ু দূষণ গবেষণার সরকারী সঠিক ডাটা যেন থাকে মাঠে, বিজ্ঞানী গবেষক চিকিৎসক সত্যিকার দূষণ নিয়ন্ত্রনে তবেই পথ পাবে।
30. There are very limited trees in Dhaka city, Everyone should come for plantation.	৩০. ঢাকা শহরে গাছপালা বড়ই কম, বাড়ানোর কাজে যেন সবার হাত পাই।

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