

Role of plants in mitigating pollution: A case study

Dipu Samanta^{1*} and Samadrita Deb²

^{1*}Department of Botany, Dr. Kanailal Bhattacharyya College, Howrah-711104 (India)

²Ex student, Department of Botany, University of Calcutta, Kolkata-700073 (India)

*For correspondence dipusamanta2010@gmail.com

Abstract

Now a day, pollution is the serious threat or issue for the environment. Human activities, deforestation, civilization, mining, industrial wastes, burning of fossil fuels, use of chemicals in agricultural purposes, arbitrary use of plastics are some main reasons for pollution. All these environmental pollutions are divided into several categories such as air pollution, water pollution, soil pollution, noise pollution, radioactive and thermal pollution. It has detrimental effects on the environment, including the life of all living beings. Plants are the bio-mitigator of environmental pollution. Green plants are the lungs of the earth. They absorb carbon dioxide from the air and release oxygen for their own photosynthetic purposes which in turn is paramount for the survival of living beings. Not only known as natural oxygen generating factories, plants can also absorb dust, radiation and purify the air. *Aloe vera*, English ivy, *Areca* palm, Spider plant and bamboo palm are good air purifiers. *Eichhornia crassipes* has the bio absorption capacity to clean industrial wastewater. Many plant species have the potential to absorb heavy metals from soil and water. Scientists call sunflower plants as hyperaccumulators which can absorb radioactive waste through roots and store in stems and roots. Trees and shrubs are able to mitigate noise pollution. Tree belts of *Pinus brutia* have the largest capacity of reducing noise pollution. Plants improve soil fertility and water quality, reduce soil erosion, purify and clean air. Planting trees is the ultimate way to get rid of pollution naturally from the Earth. A small case study has been incorporated to establish the fact in general.

Plants play an important role in life on Earth. We get several things from the plants. They have immense importance to the environment. They act as producers of ecosystem services. Not only that, but they are the main controllers of all types of environmental pollution. Several pollutions such

as air pollution, water pollution, noise pollution, soil pollution, thermal and radioactive pollution have harmful effects on our surrounding environment. Pollutions harm human and animal health also. Climate change is taking place due to pollution and temperature is increasing rapidly. Storms, cyclones, droughts,

heatwaves, unseasonal rains, tidal surges, floods, landslides, dense fogs are causing an unbalanced environment. Some plant species act as the indicator of several types of pollution¹. *Populus alba* L., *Morus alba* L. indicates marble waste ecosystem pollution¹.

Air is mainly polluted by harmful substances due to emission of toxic chemicals from the factories, excessive burning of fossil fuels. Plant improves air quality by absorbing carbon dioxide and releasing oxygen in the air through photosynthesis. Conifers such as pines, cypresses purify air naturally. *Sphagnum cymbifolium* reduces the concentration of suspended particulate matters (SPM) in the indoor environment²⁰. There are several indoor plants such as *Aloe vera*, English ivy, *Areca* palm, Spider plant and bamboo palm have air purifier properties and also have medicinal values⁹.

Noise pollution is unpleasant or unwanted sounds which are not comfortable for human beings. Major causes of noise pollution are using of loudspeakers, horns of vehicles, usage of fireworks, industrial and construction noise and so on. Noise pollution is dangerous for health because it can cause hearth related problems, hearing loss, hypertension, sleeping disorder. Reduction of noise pollution through vegetation is called sound attenuation. Different plant parts such as branches and mainly leaves absorb and then dissipate the noise energy. Sometimes trees deflect sound waves and transform into the other energy forms. Broadleaved trees are better sound waves absorber than needle leaf trees²². A dense vegetation (15-30 m wide)

has the capability to reduce sound levels upto 6-10dB (5;6). 1.5 – 4.0 m tall young and 4-10 m tall middle aged tree belts are the best for noise reduction¹¹. Trees and shrubs are act as “noise buffer”. Recent research result showed that the tree belt of *Pinus brutia* have the largest capacity of noise reduction¹⁹.

Soil pollution is a manmade global problem. It is the risk to the health of all living beings and ecosystem also. It is the part of land degradation. Use of insecticides, pesticides for agricultural purposes decrease the soil fertility and change the soil structure. Presence of excessive chemicals, heavy metals increase alkalinity and acidity of the soil which in turn decrease soil quality. Moreover, polluted soil contaminates groundwater. Phytoremediation technique is used to remove toxic pollutants from the soil⁴. Phytoextraction is the ultimate solution of phytoremediation for removal of heavy metals and metalloids from soil permanently³. *Azadirachta indica* has the high potential to accumulate cadmium, chromium, manganese, Iron, copper, lead and zinc¹³. Metal tolerant plant species are used through phytostabilization process to decrease heavy metals availability to the soil and therefore reduce the chance of entering toxic metals in the food chain^{15,26}. *Trifolium alexandrinum*, Egyptian clover is used in phytoextraction of Cd, Pb, Zn and Cu². Recent study reveals that more than 450 plant species including 45 angiosperms are act as hyperaccumulators²¹ *Sedum alfredii*, a perennial herb has the potential to hyperaccumulate more than two elements such as Cd, Pb and Zn⁸. Plants under brassicaceae family such as *Brassica juncea* has the ability to take up toxic pollutants from soil and covert them less toxic volatile forms²³

through phytovolatilization. Moreover, plants prevent soil erosion through their root system.

Water is polluted by contamination of heavy metals, toxic wastes, plastic wastes, chemicals from factories and industries, oil leakage, eutrophication. This contaminated water is responsible for various severe diseases such as diarrhoea, typhoid, hepatitis A, cholera, dysentery and jaundice. Water pollution adversely affects health of human, plants, animals and overall surrounding ecosystem. Water hyacinth is used to treat wastewater¹⁷. Recent study shows that *Pistia stratiotes* L. has the potential to remove heavy metals from polluted water⁶. Macrophytes are used to control water pollution and as well as assimilate and store nutrients such as phosphorus, nitrogen. They inhibit excessive algal growth on water and some aquatic plants have ability to accumulate heavy metals. Some higher aquatic plants such as *Scirpus validus*, *Typha latifolia*, *Phragmites communis* play major role in treatment of wastewater. Among them, bulrush and common reed has ability to remove ammonia and nitrogen⁷. A study showed that a wastewater lagoon improved by some vascular aquatic plants such as water hyacinth, *Lemna* and *Spirodela*²⁵. *Lemna minor*, *Elodea canadensis* and *Cabomba aquatica*—these three aquatic plants have capacity to uptake pesticides such as copper sulphate, flazasulfuron, and dimethomorph¹⁶.

Hydroponic technique is used to treat water contamination. Some terrestrial plants are capable of accumulate heavy metals through their long and hairy rooting systems. This process is called rhizofiltration (phytofiltration). Indian mustard and sunflower are the good example²⁴.

Radioactive pollution is the environmental threat due to the emission of radiation of alpha, beta, gamma rays. Use of radioisotope, mining sector, nuclear accident from nuclear plant and spillage of radioactive waste are the main source of nuclear pollution. Radiation causes severe damage to body such as skin burns, acute radiation syndrome, cancer, cardiovascular disease. Sometimes it causes permanent mutations which leads to difficulties in human bodies. Parathyroid adenoma, myeloma, tumor in brain and central nervous system are the result of nuclear contamination. Not only in humans, radiation can damage the stomata of plants and reduce the growth at any developmental stages. It also can damage DNA and affects in reproduction such as sterility, reduction of reproduction rate, reduction in viability of offspring, and seed germination. Exposure of Alpha particles on *Arabidopsis thaliana* led to decrease the working power of photosynthesis and carbon assimilation⁵. Still plant has the ability in mitigating radioactive pollution. Say for example, *Helianthus annuus*, known as hyperaccumulator has the potential to pull and store radioactive elements in their root and stem. After Chernobyl nuclear disaster, sunflower plants were planted in affected areas to clean up waste of nuclear radiation. Radioactive phosphorus was absorbed by mycorrhizal root of pine seedlings¹². Here *Pinus taeda* L. and *Pinus resinosa* were used for research purpose. Several plant species such as *Gingko biloba*, *Ocimum sanctum*, *Centella asiatica*, *Tinospora cordifolia*, *Phyllanthus amarus*, *Zingiber officinale*, *Podophyllum hexandrum*, *Mentha piperita*, *Amaranthus paniculatus* have the protection ability against radiation induced damages¹⁰.

Some indoor plants help to absorb harmful radiation. These are Stone Lotus flower, spider plant, *Aloe vera*, Cactus and rubber plants.

Area under case study:

In the present case study, Salt Lake Sector- 1 and Kalna, Purba Burdwan area were taken into account for random collection of data. Data were collected in the month of March, 2021.



Fig. 1 Tree plantation for air purification at Salt lake area.



Fig. 2 Tree provides shade Kalna, Burdwan, W.B.

A case study was performed in which responses were collected from randomly selected people of the Salt Lake sector- 1 area and Kalna, Purba Burdwan area. This work was done with the help of using GPS, mobile camera and others (notebook, pen, pencil). We had randomly sampled from two different areas. People's responses were collected in the form of question-answer method. The question was 'How important the tree is'?

People from different walk of life answered from their own point of view. But everyone's answer had the same meaning. From their answers, it is clear that the importance of plants in the environment and everyone's life is a lot. Not only for the environment, plants are very useful to every human being.

After listening to everyone's answer, it can be concluded that the importance of trees is immense. Planting trees is important not only for the environment, but also for all living beings. Responses are given in Table-1.

Environmental pollution is one the serious problem in the world. This is the curse of our living beings. Plants have role in protecting the environment from pollution is paramount. Plants are the bio-mitigator of different types of environmental pollution. Photosynthetic plants are the lungs of the earth. Phytoremediation process is used to clean water. Plants improve soil fertility and water quality, reduce soil erosion, purify and clean air. Green plants are able to mitigate noise pollution also. So, planting trees is the ultimate way to get rid of pollution naturally from the earth.

Table-1. Case study on people to know the on role of plants on environment

People's occupation	Location	Response
School student	Salt Lake	Trees are very important to us. We stand under the shade of trees in summer and wait for our school bus.
Tea seller	Salt Lake	I rest in the shade of a tree.
School teacher	Salt Lake	Trees are needed to protect environment as well as resistant of air pollution. I stand under the tree to protect myself from the scorching heat of the sun in the hot season and from the rain in the rainy season.
Rickshaw puller	Salt Lake	Cool air is available under the tree.
Shopkeeper	Salt Lake	For the shade of the trees, my little shop made by tin does not gets hot in the summer.
Daily passenger	Kalna	This is a peacock flower tree. In every summer, the tree blooms red and it looks so beautiful.
Bus driver	Kalna	It is better to have trees on both sides of the road. Otherwise, roads become very hot and sometimes pitch road melts and it becomes difficult to drive.
Banker	Kalna	At least we are protected from dust for the trees.
Local people	Kalna	Actually, tree is the home of many birds. Two squirrels are there. Sometimes monkeys come and rest on this tree.
Farmer	Kalna	For us, plants are main the source of our income. I am basically a paddy farmer. I also earn money by cultivating cauliflower, cabbage in winter. The tree is the main source for our survival.

From the above table it is interpreted that the role of plants in everything is undeniable.

References :

- Ahmad, Z., A.M. Khan, M.I. Ali, N. Fatima and S. Ali (2019). *Journal of Cleaner Production*, 236.
- Ali, H., M. Naseer and M.A. Sajad (2012). *Int. J. Environ. Sci*, 2: 1459–1469.
- Ali, H., E. Khan and M.A. Sajad (2013). *Chemosphere*, 91: 869–881.
- Berti, W.R. and S.D. Cunningham (2000) "Phytostabilization of metals," in *Phytoremediation of Toxic Metals: Using Plants*
- Biermans, G., N. Horemans, Vanhoudt, N., Vandenhove, H., Saenen, E., and Van Hees, M., *et al.* (2015). *J. Environ. Radioact*, 149: 51–63.
- Galal, T.M., E.M. Eid, M.A. Dakhil and L.M. Hassan (2018). *International journal of phytoremediation*, 20(5): 440-447.
- Gersberg, R.M., B.V. Elkins, S.R. Lyon and C.R. Goldman (1986). *Water research*, 20(3): 363-368.

to Clean-up the Environment, eds I.

- Raskin and B. D. Ensley (New York, NY: John Wiley & Sons, Inc.), 71–88.
8. He, B., X. Yang, W. Ni, Y. Wei, X. Long and Z. Ye (2002). *J. Integr. Plant Biol*, 44: 1365–1370.
 9. Inbathamizh L. (2020). *International Journal of Green Pharmacy*, 14(2): 130–137.
 10. Jagetia G.C. (2007). *Journal of clinical biochemistry and nutrition*, 40(2): 74–81.
 11. Kellomäki, S., A. Haapenen and H. Salonen (1976). *Silva Fennica*, 10: 237–256.
 12. Kramer, P.J. and K.M. Wilbur (1949). *Science*, 110: 8–9.
 13. Labe, T. E. and S.I.N. Agera (2017). *Journal of Research in Forestry, Wildlife & Environment*, 9(2): 92–101.
 14. Leonard, R.E. and S.B. Parr (1970). *Journal of Forestry*, 20: 282–283.
 15. Marques, A.P., A.O. Rangel and P.M. Castro (2009). *Crit. Rev. Env. Sci. Technol*, 39: 622–654.
 16. Olette, R., M. Couderchet, S. Bjagianti, and P. Fullaffoy (2008). *Chemosphere*, 70(8): 1414–1421.
 17. Reddy, K.R. and T.A. Debusk (1987). *Water science and technology*, 19(10): 61–79.
 18. Reethof, G. (1973). *Journal of the Air Pollution Control Association*, 23: 185–189.
 19. Samara, T. and T. Tsitsoni (2010). *Noise Control Engineering Journal*, 59(1): 68–74.
 20. Sirohi, S., S. Kumar, C. Yadav, D. Banerjee and P. Yadav (2020). *Journal of Environmental Engineering and Science*, 15(4): 208–215.
 21. Suman, J., O. Uhlik, J. Viktorova, and T. Macek (2018). *Front Plant Sci*, <https://doi.org/10.3389/fpls.2018.01476>
 22. Tanaka, K., S. Ikeda, R. Kimura and K. Simazawa (1979). *Bulletin Tottori University Forests*, 11: 77–102.
 23. Terry, N., C. Carlson, T. Raab and A.M. Zayed (1992). *J. Environ. Qual*, 21: 341–344.
 24. Tomé, F.V., P.B. Rodríguez and J. Lozano (2008). *Sci. Total Environ*, 393: 351–357.
 25. Wolverton, B.C. and R.C. Mc Donald (1979). *Journal (Water Pollution Control Federation)*, 51(2): 305–313.
 26. Wong, M. H. (2003). *Chemosphere* 50: 775–780.