Current Journal of Applied Science and Technology

40(11): 43-46, 2021; Article no.CJAST.67695
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Air Quality effects Along with Potential Agricultural Solution to Amid COVID-19

Hanuman Singh Jatav[1*], Kailash Chandra[1], Udit Nandan Mishra[2], Subhash Chand[3], Champa Lal Khatik[1], Mudasser Ahmed Khan[1], Sanjay Kumar Attar[1], Shish Ram Dhaka[1], Ramu Meena[1], Ompraksh[1], Shaantanu Dabi[4], Mukesh Nitharwal[1], Subhita Kumawat[1] and Jhumar lal[1]

[1]Sri Karan Narendra Agriculture University, Jobner-303329, Jaipur, India.
[2]Biochemistry and Plant Physiology, Centurion University of Technology and Management, Paralakhemundi, Gajpati-761211, Odisha, India.
[3]ICAR- Indian Grassland and Fodder Research Institute, Jhansi-284003, India.
[4]Government Lohia College, Churu-331001, Rajasthan, India.

Authors' contributions

This work was carried out in collaboration among all authors. Authors KC, UNM, HSJ and SC designed the study, authors CLK, MAH,SKA,SRD and RM performed the statistical analysis authors OP, SD, MN, SK and JL wrote the protocol, authors KC and SC wrote the first draft of the manuscript. Authors HSJ and 'KC managed the analyses of the study. Author SC managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2021/v40i1131369
Editor(s):
(1) Dr. Yahya Elshimali, Charles Drew University of Medicine and Science, USA.
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Complete Peer review History: http://www.sdiarticle4.com/review-history/67695

Mini-review Article

Received 24 February 2021
Accepted 29 April 2021
Published 25 May 2021

ABSTRACT

Life forms and their health status are highly dependent on the surrounding environment especially on the air quality as air and its constituents are the basic requirements for life sustenance on earth. Booming population and their dependency on machineries *such as* vehicles for their mass transportation has tortured the mother earth with polluted environment. This has affected the quality of air that we breathe and in turn affects our health status. Some of the notable air pollutants ($PM_{10,}$

**Corresponding author: E-mail: hanumaniasbhu@gmail.com, hsjatav.soils@sknau.ac.in;*

$PM_{2.5,}$ CO, NO, $SO_{2,}$ O_3 NH_3 and Pb) serve as the means to determine the air quality index. This article outlines the impact of air quality on humans and plants as well as the effect of lockdown due to novel *Corona virus* (COVID-19) on air quality globally. In order to intervene the communal spread of COVID-19 governments across different continents have imposed restrictions on public movement and gathering which has reduced the mass transportation and usage of vehicles. This has benefited the air quality by reducing the pollutants in atmosphere and it is needless to say this is a blessing in disguise amid COVID-19 pandemic.

Keywords: Air quality index; air pollutants; lockdown; COVID-19.

1. INTRODUCTION

Major gaseous air pollutants are ground level ozone (derived by photochemical reaction between nitrogen oxides and volatile organic compounds, and sunlight, particularly in high temperature situation such as summer), nitrogen oxides *such as* nitrogen dioxide (derived by reaction between nitric oxide, promptly generated from combustion of fossil fuel, and ozone gas), sulphur oxides such as sulphur dioxides (main source of emission is industrial processing and energy production systems) [1]. Carbon monoxide (CO) and Ozone gas (O_3) are the most studied gaseous air pollutants and have adverse human health impact such as mortality and morbidity [2].

1.1 Hazardous Impact on Human Health Due to Poor Air Quality

Air pollution is one of the pioneer environmental factors associated with adverse effect on human health. Based on aerodynamic diameter and place of its deposition after inhalation, PM is broadly categorised as Coarse PM (2.5-10µm diameter), fine PM (0.1-2.5 µm), ultrafine PM (<0.1µm). PM_{10} includes coarse PM, fine PM and ultrafine PM. Ambient exposure of $PM_{2.5}$ tends to premature mortality in India and more than 3 million individual dies per year.Impact of COVID-19 lockdown on air quality and stages of life has been depicted in Fig. 1.

Deng et al. [3] studied particle deposition in human lung from different sources and concluded coarse particles (>2.5µm) was mostly in tracheobronchial region through impaction, while fine particles (<2.5µm) deposited in Pulmonary region through sedimentation and diffusion process. PM particles are also carrier of immunogenic substances *such as* pollen, fungal spores and bacteria, which are independently associated with development of asthma. Major gaseous air pollutants are ground level ozone (derived by photochemical reaction between nitrogen oxides and volatile organic compounds, and sunlight, particularly in high temperature situation such as summer), nitrogen oxides such as nitrogen dioxide (derived by reaction between nitric oxide, promptly generated from combustion of fossil fuel, and ozone gas), sulphur oxides such as sulphur dioxides (main source of emission is industrial processing and energy production systems). Ozone gas is highly reactive, due to oxidative in nature, and has adverse human health impact such as mortality and morbidity. CO, SO_2, NO_2 are positively associated with the mortality due to stroke due to reduced oxygen carrying capacity of haemoglobin in blood.

1.2 Hazardous Impact on Plants Due to Poor Air Quality

Air pollution does not only adversely affect the human health, but also plant health and behaviour. Particulate matter affects both human health and environment. Air pollutants such as PM, NO, O_3, SO_2 have negative impact on plant morphology and physiology. Ozone, a phytotoxic agent, also affects plant morphology and actively participates in reactive oxygen species (ROS) formation due to its reactive nature [4]. Deviation from normal environmental condition (0-50 AQI) due to particulate matter [5] is one of the most health hazardous form of air pollutants, impose to morphological (leaf number, leaf area, stomata size and structure, plant growth and reproduction), physiological (relative water content and pH), biochemical (type of pigments and their concentration, sugar, protein, ascorbic acid and enzymes), and behavioural changes (flowering time and duration) of plants. Effect of COVID-19 on the socioeconomic livelihood on the farmers made an impact which troubles the farmers to carry out farm activities [6].

1.3 Eco-Friendly (Agricultural) Solution for Improving Air Quality

Planting of those plant species which consist more wax on their leaf surface may be a vital

remittance to reduce air pollution particularly PM [6]. Researchers found positive correlation between amount of wax and PM of diameter 2.5-10µm. however, there was no positive association between total amount of PM of any size and amount of wax deposition. Right vegetation selection and green roof usage can not only improve air quality but also sustain biodiversity for long term. Green roof with extensive vegetation remove air pollutants at large extent.

Plantation of pine tree species such as *Pinus strobus, P. pumila*are will act as green roof to capture PM (grammar). Plants such as Japanese maple-for reducing O_3 and Magnolias- for NO_2 tolerance as in roof tops and reduce air pollutants. Green infrastructure (GI) approaches, which includes green roofs, green walls, trees, shrubs, herbs and hedges, provides various services such as microclimate regulation, flood risk mitigation, carbon sequestration, and abatement of air pollutants, improved human health and ultimately eco-sustainability. Development of parks called as '*lungs of city*' with dense foliage, plantation across the road and street canyon environments are some solutions to mitigate air pollution in the urban area [7] has also extensively studied the effect of plantation on air pollution mitigation in open road and street canyon environment and found air quality will be deteriorated under tree plantation (high level vegetation canopy) while shrub (low green infrastructure) plantation improves the air quality. Tall vegetation with low and wide porosity on open road condition improves the air quality by reducing pollutants while gaps and high porosity tend to deteriorate air quality [8,9]. However In urban scenario, plantation of tall vegetation or denser canopy becomes a challenge due to two reasons:

1) The roads are not wider to support growth of big trees.

2) Pavement of footpath i.e., asphalted path designed in cities get easily destructed by the big trees that are planted. Thus, the policy makers do not promote the idea. Infrastructure like smog towers, convenient yet efficient air filters/purifiers should be taken as an alternative [10].

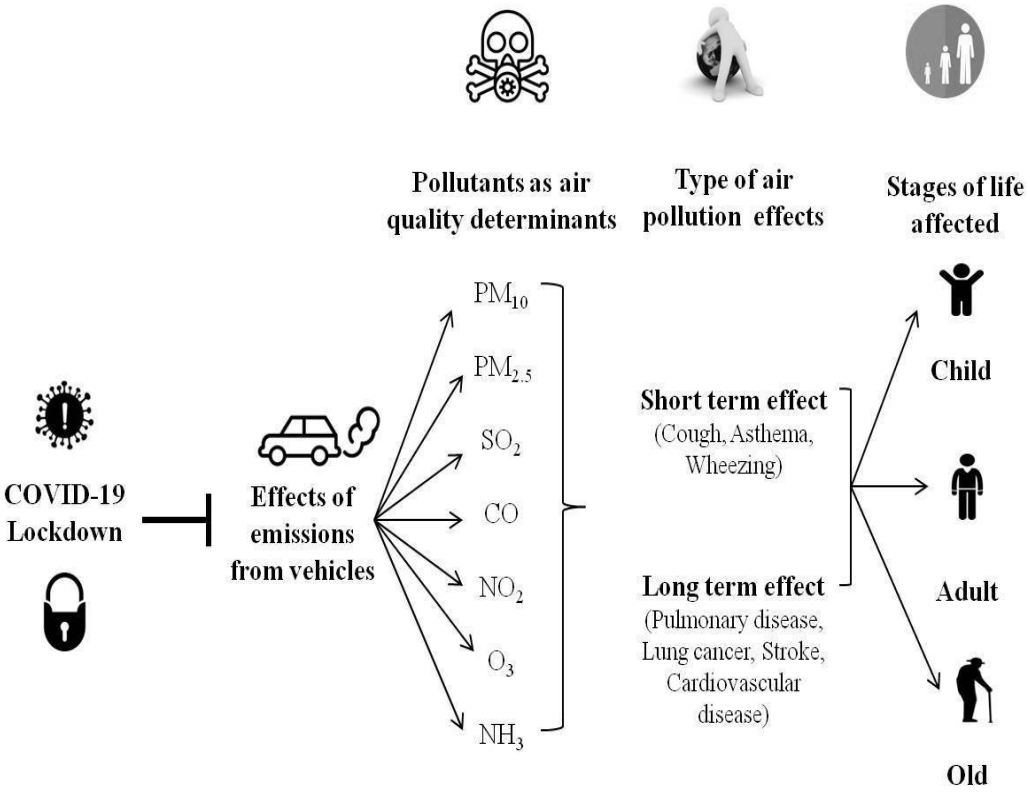

Fig. 1. Impact of COVID-19 lockdown on air quality and stages of life

2. CONCLUSION

The outbreak of novel infectious corona virus disease (COVID 19) was reported from Wuhan city, an initial epicentre of pandemic, of China in the month of December, 2019 and spread globally with different mortality rate. During COVID-19 '*Pandemic Lockdown*', shutting down of educational, recreational, cultural, commercial activities with simultaneous switching to 'e-working' (*work from home*) as a result of governmental intervention policies showed an immediate impact on the air quality due to restricted mass movement and vehicle circulations. Reduced use of vehicle and mass movement has provided a brain storming impact on the society and its residents to reconsider mobility in long term. In this regard, transport interventions played a key role in reducing the concentration of air pollutants amid COVID-19 which is indeed a rare opportunity to change lifestyles to more sustainable alternatives. In fact, WHO has also recommended cycling and walking as alternatives of fossil fueled vehicles. It can be said that lockdown due to COVID-19 has served as a blessing in disguise for having positive impact on air pollution levels both for short and long term.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/67695