Impact of Covid-19 Pandemic on Biotic and Abiotic Factors of the Environment

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Abstract

As the transmission of Covid-19 increased exponentially, the nation recognized a lockdown, i.e., 'a stay home order,' as the most prominent measure to slow down the spread of the pandemic. With people restricted inside their homes and restrictions in daily outdoor activities, the environment got an immense opportunity to heal itself. The conclusions of the present investigation are based on the analysis of responses to an online survey of people of the National Capital Region (mainly New Delhi, Delhi, Gurugram, Faridabad, Noida, and Ghaziabad region). With people confined inside, many changes in parameters like air pollution, noise pollution, the behavior of animals and humans, etc. were observed. An overall positive effect on Delhi's environment was observed. The outcome of this study highlights the adverse effects of careless human activities on the ruin of the environment and its health.

Keywords: *Covid-19, Environment, Health, Delhi NCR.*

Introduction

Covid-19 was first reported in December 2019 in the city of Wuhan, China. A large number of people were reported to suffer from pneumonia-like symptoms. Investigations found that the disease was caused by a novel coronavirus SARS COV2. On 11th March 2020, WHO declared the COVID-19 outbreak as a global pandemic. A pandemic refers to the worldwide spread of disease. The Covid-19 spreads through bodily fluid droplets of the infected person. The coronavirus can enter a healthy person's body through the eyes, nose, or mouth. It is a single-stranded RNA virus enveloped by a proteinaceous cover. The Latin name for the crown is Corona, which refers to the crown-like structure of the proteinaceous covering, thus gives this virus the name "Coronavirus" *(World Health Organization 2020)*. The virus infected person develops symptoms usually in 5 to 6 days, but sometimes it may take even up to 14 days. Even though 80% of the infected people eventually recover, the disease may be fatal for the higher age groups (World Health Organization 2020). The non-availability of medications and vaccines for the disease so far makes prevention the only way to combat the outspread of this disease. One of the major preventive measures is the longstanding method of Quarantine. This method was designed in the 17th century during the Black Death (Bubonic plague), which was caused by Yersinia pestis bacteria. It travels from person to person through the air, and the bite of infected fleas and rats. Quarantine or physical distancing involves avoiding contact with other people to reduce the spread of the virus. To curb the spread of the virus, governments of various countries, including India, announced a lockdown *(The Hindu 2020)*, confining people in their houses.

After imposing an initial 14-hour public curfew on 22 March *(The Hindu 2020)*, a national lockdown was announced on 24th March for three weeks, which was later extended even further for the subsequent eight weeks. This lockdown had a trans-disciplinary

impact on domains like the economy, health care, interpersonal relationships, and also the environment.

This study mainly focuses on the impacts of Covid-19 lockdown on the environment. The Environment is an asset of a city, and in areas like Delhi-NCR, which are a hub of social, political, economic, and other national and international affairs, the significance of a clean and pleasing environment becomes more vital. The air pollution level in Delhi has always been strikingly high. Major contributors to this pollution include vehicles, crop burning, diesel generators, etc. The polluted, hazy, and smoggy sky makes it extremely difficult to perform astronomical observations. Such a high level of pollution has various impacts on health, including many respiratory diseases (Singh et al. 2015).

In the past few years, rampant construction activities, industrial sources, and anthropogenic pressure, etc. have aggravated the water pollution in Delhi and NCR region. Studies have revealed that river water in Delhi is severely polluted (Upadhyay et al. 2011). The necessity to ponder upon the changes in the water bodies becomes even more important due to the increasing levels of pollution.

There are menacing consequences of noise pollution. High noise levels interfere with speech and communication, hamper sleep, weaken memory and concentration ability, cause hypertension, etc. (Centre for Science and Environment 2011). Lockdown witnessed less vehicular traffic, shutting of industries, low construction activities, closed religious places, and low public gatherings, thereby decreasing noise pollution. A 2015 study conducted by the Central Pollution Control Board (CPCB) across 60 major Indian cities estimated that these cities were generating around 4,059 tons of plastic waste on a daily basis. Delhi topped the list with 690 tons of day-to-day plastic waste (Thakur ,2019); therefore, we chose to focus

on the impact of COVID-19 on plastic waste generation. In a healthy environment, both plants and animals play a vital role in the ecosystem; therefore, we also emphasized observing changes in plant growth, animal growth, and their behavioral patterns during the lockdown period. The sudden proclamation of nationwide lockdown was expected to cause several changes in interpersonal relations and behavior. Though some individuals got stranded in isolation away from their homes, others spent a blissful time with their families. Several responses from the survey aim at bringing out the details about the impact which lockdown made on interpersonal relationships.

In a nutshell, this study was to scrutinize the effect of the COVID-19 pandemic on Delhi's environment. Both biotic and abiotic factors of the environment were taken into consideration, such as human health, interpersonal relationship, and the effect on the number and behavior of birds and animals, the impact on air quality, noise levels, and the use of plastic.

Methodology

Our project's survey was designed to determine the effect of lockdown due to the COVID-19 pandemic on the environment. The survey was web-based, and it was conducted via Google forms in the form of a questionnaire that had 26 questions about health, interpersonal relations, and the environment. The questionnaire consisted of 3 main thematic sections, the first section focused mainly on the socio-demographic characteristics, the second section focused solely on the effect of lockdown due to the COVID-19 pandemic on health and interpersonal relations, and the third section of the questionnaire consisted of questions based on the effect of lockdown due to COVID-19 pandemic on the environment.

The questionnaire consisted of some open-ended questions and some multiple-choice questions that had predefined answers, offering respondents the option to choose among various options. The survey was disseminated through various social media platforms. This medium was particularly chosen due to the reason that people use social media often, and more people could be reached out. The open part of the survey was of great importance as it provided additional information that helped in the improved interpretation of the overall results, and similarly, our results also provided a more in-depth understanding of respondents' perceptions. Out of the total of 477 responses received from the survey, the majority of the respondents were from Delhi and NCR (Faridabad, Gurugram, Noida, Ghaziabad).

Data analysis of the survey primarily consisted of percentages as well as frequency counts that were examined using Microsoft Excel Software. Graphs were also used for the analysis and compilations of survey results.

Results and Discussion:

1.1Socio-demographic Characteristics of Respondents (Table 1)

S. No.	AREA		OCCUPATION				FAMILY	
Category	**Delhi & NCR**	**Others**	**Govern-ment employee**	**Self-employed**	**Private sector**	**Student**	**Attached nuclear family**	**Detached nuclear family**
Number of responses (Out of 477)	340	137	69	35	72	301	293	184
Percentage	71.3%	28.7%	14.5%	7.3%	15.1%	63.1%	61.4%	38.6%

Table 1: Number and percentage of Socio-demographic characteristics of Respondents

1.2 Impact of lockdown on health and interpersonal relationships

Our study aimed at unraveling the links between the type of family relationships, the impact of lockdown on family relationships, and various adverse mental health outcomes that people have experienced due to the lockdown. Various lifestyle modifications that people have made during the lockdown (workout and meditation routines or healthy eating habits, etc.) had also been put into the area of our study.

The analysis of the survey displayed that the majority of the respondents (63.3%)had a positive impact on family relations. Getting a break from exhausting and anxiety-ridden daily routine allowed people to get together and strengthen stronger bonds within their families. Contrastingly, 9% of people had deteriorating family relations, as they couldn't get along well with their family. They were lonely and harmed their mental health. The remaining 27.7%of people experienced no such substantial change in their interpersonal interactions (Figure 1).

Respondents also experienced changes in health conditions. Some believed that the lockdown had a positive impact on their overall health, while others believed that it deteriorated their health. Of course, these varying opinions arise as a result of various factors such as the kind of job one was in, the availability of resources required, and the psychological make-up of that individual.

The majority of our respondents (86.1%) revealed that they engaged in physical activity and healthy eating habits. They adapted either of the two or both as their lifestyle modifications during the lockdown and experienced a tremendous positive change in their overall health. Having more free time than before, they focused more on fitness and self-improvement; therefore, they engaged themselves

in yoga and meditation. People revealed that they then had less work pressure, and their traveling time was also saved. They experienced fewer respiratory problems as the air pollution levels also dropped during the lockdown. People enjoyed nature and bird watching. Contrastingly, a few (23%) of them struggled with both physical and mental health issues during the lockdown like weight gain, increased stress, anxiety, laziness, sleeplessness, depression, and lack of concentration leading to headaches and reduced work output. Obstruction in the curriculum of studies and uncertainties in the evaluation process left students in turmoil. Eyesight related issues were observed due to prolonged use of computer screens. Others simply fell prey to laziness and boredom during the lockdown. In all, our study aims to highlight both the positive and negative aspects of the lockdown objectively.

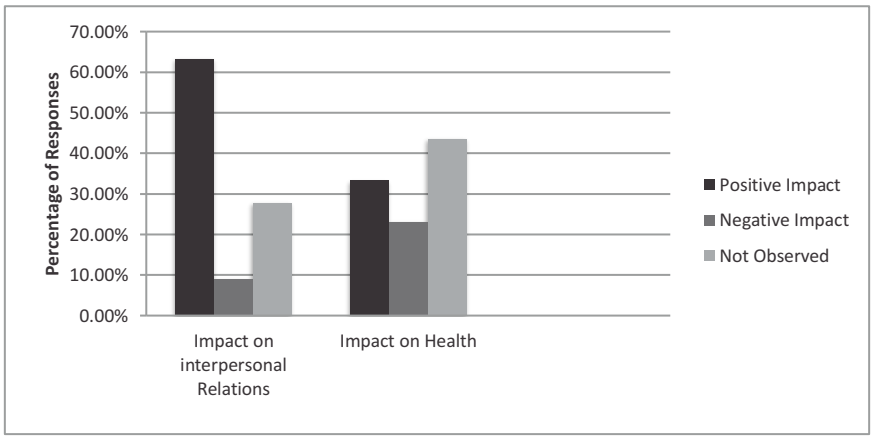

Figure 1: Graph depicting the Impact of lockdown on Health and Interpersonal relationships

3.3 Impact on Air Pollution

According to a study carried out by the World Health Organization (WHO), Delhi was reported to have the most polluted air among1600

major cities in the world (Times of India, 2020a). Concentrations of PM10 in Delhi have been found to be considerably high and the PM2.5 concentrations are also far beyond the tolerable limits. It is now common knowledge that air pollution has a deleterious effect on human health, poor air quality completely damages the lungs. It is estimated to kill 1.5 million people every year (Times of India, 2020b). Many respiratory diseases such as hypertension, heart attack, cognitive and mental illness are already triggered by air pollution. The only difference is that those diseases may not be as immediately lethal as COVID-19 and not transmitted by person to person. It has been established that before COVID-19, the emission of CO^2 was raised by 1% per year over the previous decade (Jackson et al. 2019). The positive effect of lockdown is to decrease the CO^2 emission by −17% (−11 to −25%) by 7th April 2020 (Quere et al., 2020) with respect to the mean level of emission in 2019. Due to high air pollution, the Delhi sky mostly appears hazy and smoggy.

High air pollution in the city is mainly a result of vehicular emissions (Rizwan et al., 2013). Increased emissions from the industrial sources, intense crop residue burning in North India (mainly in Haryana) also contribute to increased air pollution in the NCR region (Raman and Mukherjee, 2019).

Soon after four days of the commencement of lockdown about 40% to 50% improvement in air quality was perceived. There was a tremendous decrease in the values of air pollutants like PM10 (Particulate material), $PM^{2.5}$, NO^2 (−52.68%) and CO (−30.35%) during the lockdown phase (Mahato et al., 2020). Air quality index (AQI) was found to decrease across all the parts of the nation, the maximum decrease by 44%was observed in the north, 33% in the

south, 29% in the east, 15% in central, and 32% in western India. Central and Eastern Delhi has experienced a maximum improvement in air quality (Sharma et al., 2020).

These repercussions are obvious to expect as there was a sharp dip in vehicular emissions, i.e. major contributor of air pollution. The results obtained from our survey also revealed that the use of cycling and walking increased by 24% (as also stated by CSE). Various other studies reveal that during lockdown due to the COVID-19 pandemic, about 60% improvement of air quality in transport and industrial areas was observed (Mahato et al., 2020). A study conducted by CSE (Centre for Science and Environment) confirmed that there had been a "97 % reduction in overall traffic and 91% reduction in trucks and commercial vehicles entering the capital during April, as compared to the pre-lockdown months of December-January" (Shrangi and Pillai, 2020).

Our survey also aimed at finding out the changes in air pollution levels observed by the people of Delhi and NCR, majorly due to lockdown in the country. The graph (Figure 2.) below depicts the changes in air quality our respondents had observed.

The responses revealed that the air quality improved significantly in the city due to the lockdown. It was also found out that air pollution had gone down by 79% during the initial phase of lockdown. According to the research study conducted by CSE in six cities (including Delhi) on the levels of PM2.5, Delhi has shown the steepest drop in the levels of PM2.5 (Shrangi and Pillai, 2020).

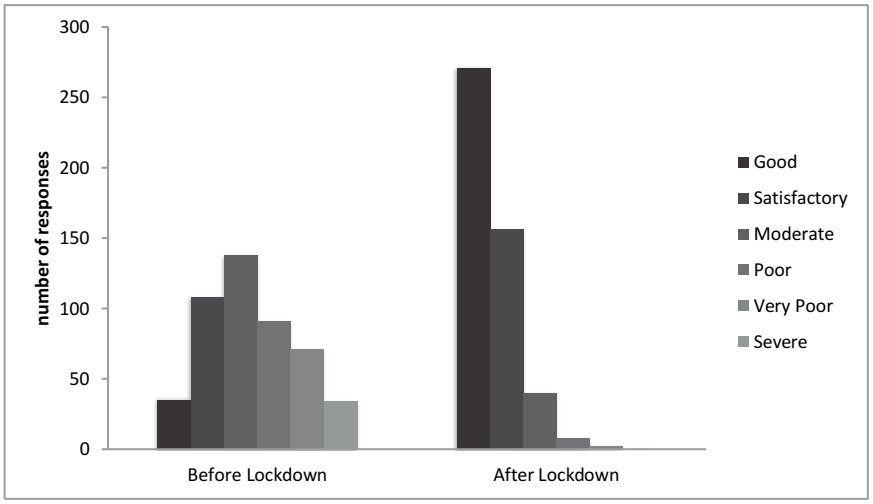

Figure 2: Graph depicting the varying level of air quality observed by people before and after lockdown.

Studies carried out in Delhi reflect the correlation between air pollution and health impacts. Responses from our survey reveal that various people have seen improvement in their respiratory health. Asthma patients felt relieved during the lockdown period as air quality had improved significantly. As a consequence of reduced air pollution during the lockdown, the sky had also become clearer than before. The data from our survey reveals that about 85% of respondents observed clear sky during the lockdown; around 84% believe that smog had reduced in their regions. The visibility of stars also increased by 52.83%. Various other reports also confirm the prominent visibility of stars during the lockdown (Gandhiok, 2020). Also, there had been more instances of a bright rainbow appearing during the lockdown due to the COVID-19 pandemic, as revealed by our respondents. It is rare event to observe rainbows in Delhi due to pollution. But there was the frequent appearance of rainbows in Delhi during lockdown as the pollution levels dropped (Harin 2020).

3.4 Impact on Water Bodies

Delhi depends on the river Yamuna and partially on river Ganga for its share of raw water and over 86% of Delhi's total water supply is contributed by surface water and the remaining of it is contributed by groundwater supply. Pollution load in the river Yamuna is added from various sources such as industries, domestic waste, and long dry season in the National Capital and all of it has eventually converted the river Yamuna into a Nala. Najafgarh drain along with its 70 sub drains is the biggest polluter of the river. (Singh Et Al. 2015).

A distinctive positive impact on water bodies was observed on local as well as regional levels during the lockdown period. The majority of respondents acknowledged that they observed clearer and less polluted water bodies during the lockdown (Figure 3.). These alterations were attributed to the reduction in industrial discharges, lesser vehicular emissions, and a pull-over in domestic waste (Frontiersin.Org 2020) during the lockdown.

Reports from The Delhi Pollution Control Committee (DPCC) also state that the absence of industrial effluents and reduced human activities has improved the water quality of the river Yamuna (Times of India 2020c). These changes would not have been possible without extreme measures that were taken due to the COVID-19 pandemic.

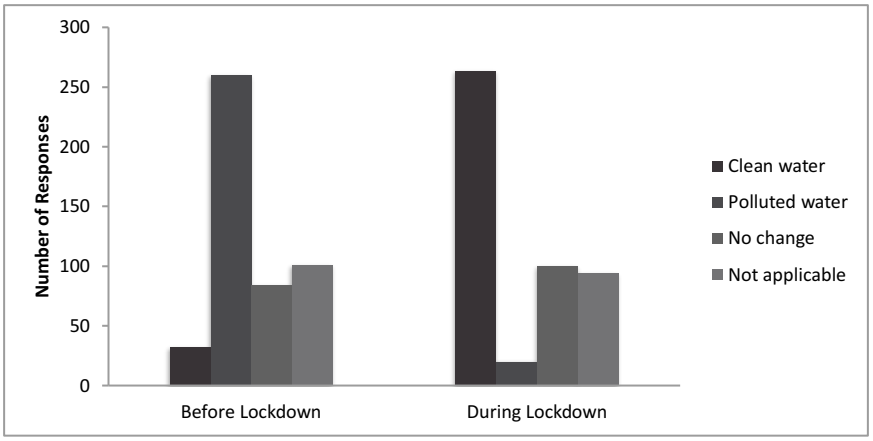

Figure 3: Graph showing the changes observed in water bodies before and during the lockdown.

3.5 Impact on Noise Pollution

Delhi has been classified as the second most affected city by noise pollution. Major contributors include vehicles, loud noise, industries, and construction activities. According to the study conducted by CSE (Centre for Science and Environment), noise from vehicles has been detected as the foremost reason for noise pollution (Ismail and Ahmed 2018). Construction activities and stone crushing also contribute to noise levels as high as 90 dB during the daytime and therefore are considered hazardous for living beings (Mandal and Pal 2020).

According to the Central Pollution Control Board (CPCB), New Delhi, India, the noise level in Delhi was found out to be 80dB, which is considerably beyond the safe levels set by the organization, i.e., 55 dB (Centre for Science and Environment 2011).

Out of the total 477 responses, the majority of respondents (86.8%) mentioned that they had observed a far-reaching decrease in the noise emission during the lockdown (Figure 4). These results also

align with a news report from the Times of India, which mentioned that most uptowns of Delhi experienced noise under permissible sound levels, and there was a reduction in the noise level of the entire Delhi state by 35% to 68% during the day time (Times of India 2020d).

This was primarily caused by the decrease in the number of vehicles, which are the chief contributors to noise pollution. The lockdown tremendously decreased the intensity of noise from construction activities, especially the loud noises produced in the stone crushing areas. In the lockdown phase, the entire study units fell under the noise level < 65dBA, which is normal, as defined by CPCB (Mandal and Pal 2020). Intermission in the loud, sharp sound of machinery, suspension in thudding from industries, and absence of noises of the general public in the surrounding further outstripped noise pollution.

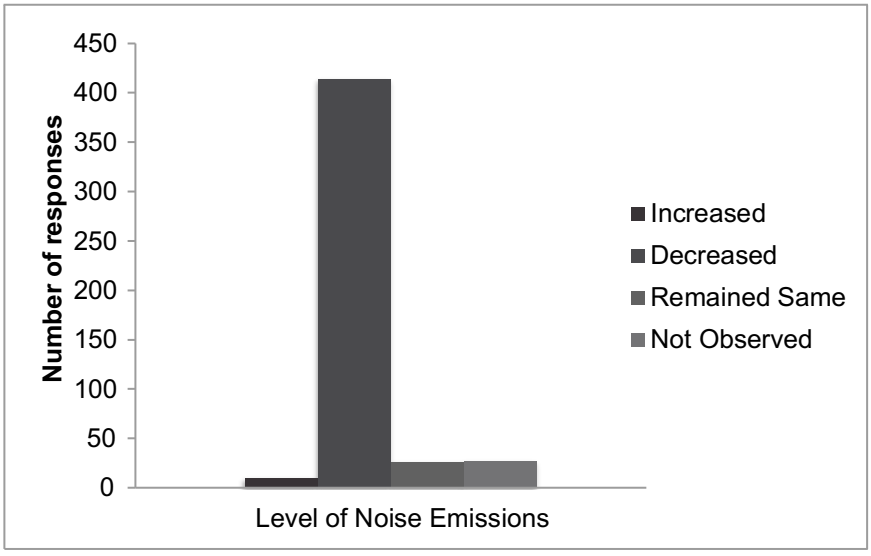

Figure 4: Graph depicting the change in the levels of Noise emissions experienced by people during the lockdown.

3.6 Impact on Plastic Waste

Responses obtained from this survey indicated that 99.1% of respondents used one or the other type of mask (either reusable or single-use disposable mask) during the lockdown period to mitigate the pestilence. The responses reveal that out of those 99.1% respondents, 76.7% of respondents used either single-use disposable masks or readymade reusable masks (Figure 5). A dramatic increase in the demand for personal protective equipment (PPE) like masks and gloves, which are mostly plastic items, led to a steep increase in plastic use. A face mask is typically polypropylene (PP), polyurethane (PUR), or polyacrylonitrile (PAN) article (Earth.org 2020). Also, with an upturn in the number of patients, there was an upsurge in demand for non-biodegradable, polyvinylchloride (PVC), and PP derived sterile one-use items like blood bags, pill casings, disposal syringes, and catheters (Earth.org 2020).

Another important factor which further contributed to the surge in plastic waste was an escalation in online food ordering and online grocery shopping during the lockdown period. Having no option to dine in, and an increased number of restaurants offering food delivery, customers saw online food ordering as the only substitute to enjoy palatable restaurant food (Businesswire 2020). A minimum of 64.3% of respondents in our survey revealed that they have either shifted or are deciding to shift to online grocery shopping during the lockdown. Various other reports have also revealed that owing to this new normal, an increase in plastic use was observed as per order a minimum of 3-4 plastic wrappers, and meal boxes are used for packaging, which are also microplastics, polypropylene(PP), or polystyrene (PS) derived products. According to the studies, these microplastics (like polypropylene, polyurethane, polyacrylonitrile, and polystyrene) produced worldwide enter the marine ecosystem leading to deleterious effects on marine wildlife. Thus COVID-19

lockdown further expedited the menacing effect of microplastics on the environment (Earth.org, 2020).

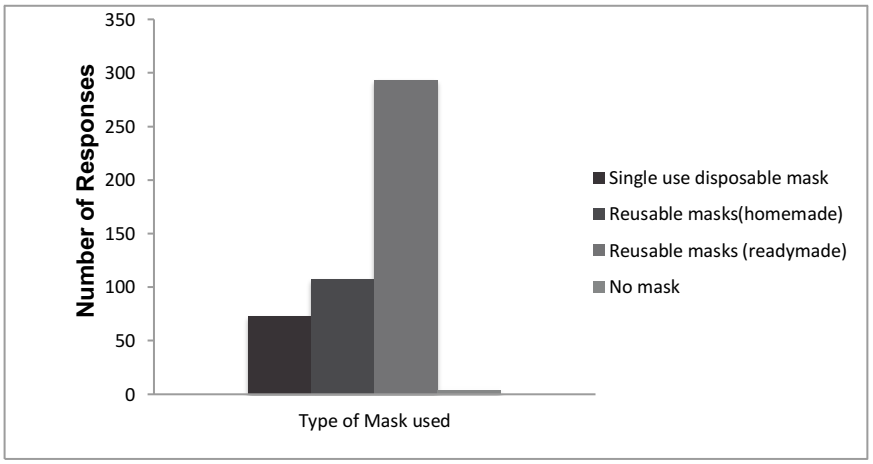

Figure 5: Graph depicting the types of masks used by people due to COVID-19 outbreak.

3.7 Impact on Animals

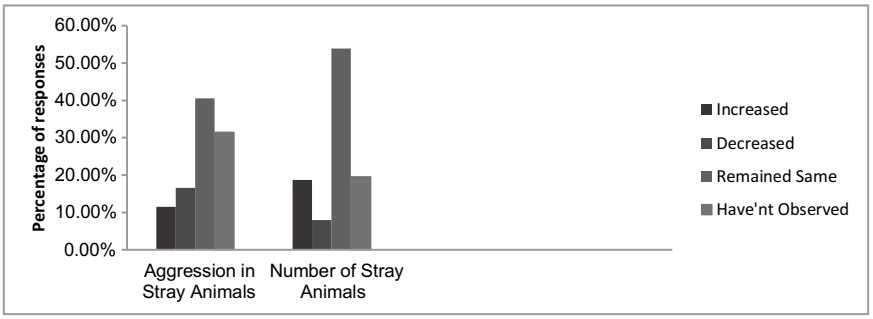

Figure 6: Graph depicting changes observed in animals during the lockdown.

According to data received, a majority of respondents (40.5%) observed no change in the animals' behavior, 16.6% of the respondents believed that animals had become less aggressive than before, whereas 11.5% of respondents stated that they had become

more aggressive during the lockdown period. At the same time, 31.4% of the respondents didn't observe anything related to this (Figure 6).

These varying responses to the behavior of animals could be attributed to differences in the degree of the change in the environment of areas from where the responses were collected.

Some animals experienced a more peaceful environment due to less human intervention and a halt in the city's commotion; consequently, they felt more independent, free, and less aggressive than they used to be before lockdown (Scroll.in 2020).

A large number of stray animals, like cats, dogs, cows in India, depend on food and waste from households, restaurants, and grocery shops (Outlook 2020). But reduced human activity during lockdown led to food scarcity and competition, thereby leading to their aggressive and annoying behavior. So, in contrast, it was a challenging time for the dogs and cows, which were used to human attention, care, and sympathy (Deccanherald 2020).

Still, in many localities, animals were able to feed themselves as they were doing before and didn't experience much change in their surroundings; thus, they were behaving in the same way as before the lockdown.

Besides a change in behavior, a change in the number of animals was also observed. A spike was observed by 18.7% of the respondents (Figure 6). Possibly the number of animals didn't increase, but they were being noticed more because of less traffic, less crowded streets, rarer episodes of people's brawl on roads, and perhaps more time to heed outside. Animals could then roam around safely and, therefore, fearlessly, without bothering much about

speedy cars or callous human activities *(Scroll.in 2020)*.

Many reports verify that animals like Sambar in Chandigarh, Nilgai in Delhi, Elephants in Haridwar, and the small Indian civet in Kerala, native to those regions, were being observed more by people in a significant number *(Scroll.in 2020)*.

But due to the shifting of animals to other places because of the unavailability of food at the original place where they inhabited, respondents (8%) observed a decrease in the number of animals as compared to their number before the lockdown period *(Deccanherald 2020)*.

The majority of the respondents (53.9%) presume that the number of animals remained the same. But 19.5% of respondents didn't observe anything related to this.

3.7 Impact on birds

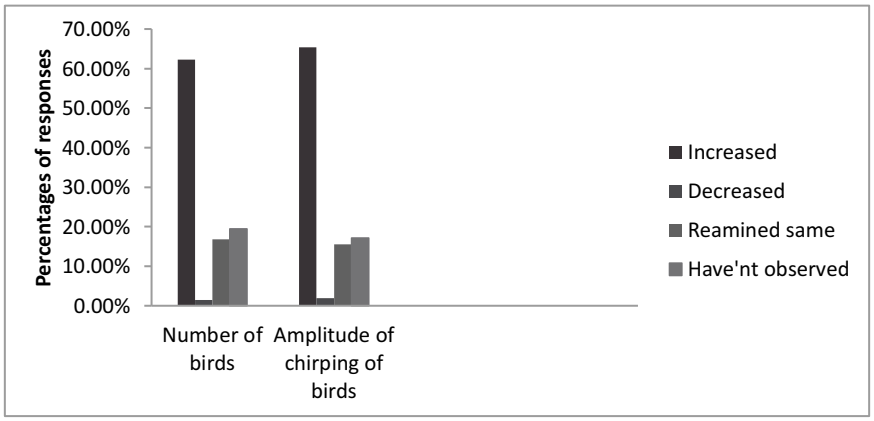

Figure 7: Graph depicting changes observed in birds during the lockdown.

The majority of the respondents (62.3%)were of the opinion that they had observed an increase in the number of birds (Figure 7). Some of the birds that were reported by people during the lockdown period are-Sparrow, Peacock, Parrot, Eagle, Koel, Woodpecker, Mainah, Hummingbird, Bulbul, Kingfisher, Cuckoo, Kites, Owls, Black drongo, etc.

It was observed that due to the reduction in noise pollution, bird mating calls were being easily understood by their mates. As a result, they were breeding more than before, and hence there was an increase in their numbers (Outlook 2020). Conversely, few studies explain that birds are coming into the public eye not because they were multiplying, but because of being more noticed by now less occupied people (Scroll.in 2020). In contrast, 1.4%of total respondents reckon that there was a decrease in the number of birds. This was due to the same reason, as we mentioned for animals. 16.8% of respondents were of the opinion that the number of birds remained the same. And 19.5% of respondents didn't observe any changes.

The majority of respondents (65.4%) acknowledged an increase in the amplitude of birds (Figure 7.). This was primarily due to significantly reduced noise levels; people who were indoors during the lockdown could also distinctly listen to their sounds with much greater clarity than before.

3.8 Impact on Plants

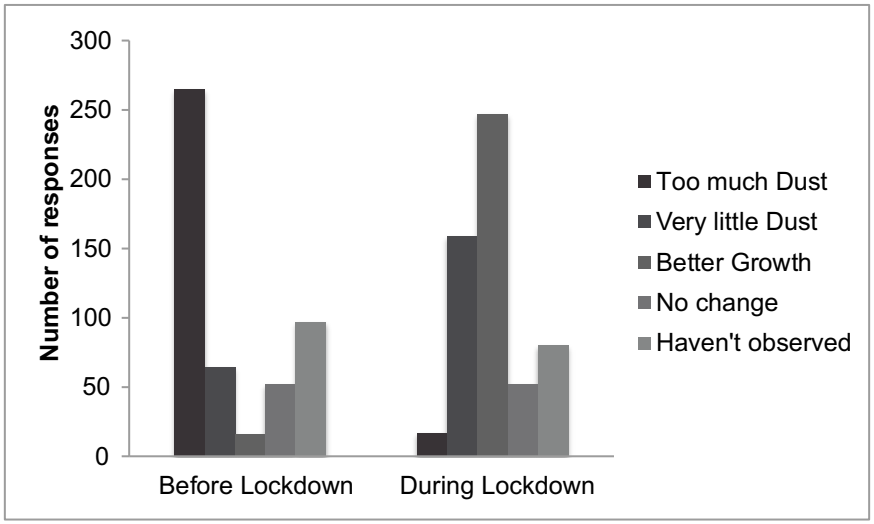

Figure 8: Graph depicting the level of changes observed in plants before and during the

Statistical analysis of the data from the respondents revealed that there had been a dramatic decrease in the amount of dust on the plants (Figure 8), certainly because of the halt in activities like construction, manufacturing industries, vehicular movement, etc. The majority of the respondents saw better growth in plants, an increase in the number of pollinators; cleaner air and water, good soil health because of less pollution, and also the increased spirit of people to nurture the plants during lockdown were probable reasons for the same (Credit-Agricole 2020).

Conclusion

COVID-19, which originated in Wuhan, China, has infected millions of people worldwide, and the situation is still not controlled as no proven cure for the virus has been discovered. Social distancing is the

only preventive step that the entire nation is following, and for the same, a nationwide lockdown was also imposed. As human activities got restricted during the lockdown, mother-nature found its way to heal itself. As almost everything was put on halt (factories, industries, transport services, social gatherings, construction activities, etc.). Our survey efforts conclude that remarkable improvement in the quality of air and water during the lockdown. At the same time, due to the restricted vehicular movement, construction activities, and social gatherings, significant improvement in noise quality was also observed in Delhi and NCR regions. On the other hand, a tremendous surge in plastic pollution is expected in the future, keeping in mind the present trends of high plastic usage in the country. It could also be concluded that the lockdown due to the COVID-19 pandemic has proven out to be both beneficial as well as challenging for the people as far as the health and interpersonal relationships are concerned. After visualizing the changes in the environment due to the lockdown, we uphold the fact that recovery of mother-nature is not irreversible; with the lockdown, we assume that nature got the 'recovery time' and it healed itself to some extent. A significant drop in the dust on plants was observed along with improved growth. After reviewing various reports as cited earlier, the probable causes for the above observations were reduced pollution and its outcomes on the ecology. Also, we deduce that no discernible changes were observed in animal behavior and their numbers as such. The number of birds and their amplitude of chirping undoubtedly increased during the lockdown period, and the probable reasons were examined using various reports. But still, lockdown cannot be concluded as the sustainable means to curb the situation as it turned out to be an extremely challenging time for several people. People experienced depraved mental and bad physical health and few got stranded from their families and their interpersonal relationship was awfully

affected. Apart from this, a tremendous surge in plastic pollution is expected and unusual animal behavior was also observed.

So overall comprehension of our survey results is that the early and strict imposition of lockdown helped nature to replenish itself to some noticeable extent but at the same time, there is a chance that environmental pollution can be back with more pace once the 'new normal' is established. There is an immediate need to diligently study the effect of such lockdowns so that the potential benefits we observed are not lost in time and also reaped in the future. It is the human effort that leaves an everlasting effect on the environment and therefore we must realize that lockdowns are not the only sustainable means to curb the situation.

Acknowledgment

We sincerely appreciate and acknowledge the contributions of all those who have helped us in this research work. However, the group would like to express their deep appreciation and indebtedness, particularly to the Department of Botany, Gargi College, the University of Delhi, for its endless support and understanding spirit. We thank all for their unwavering support, and we hope that this paper proves to be helpful for studying the impact of lockdowns on biotic as well as abiotic factors of the environment.

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