

## **Impact of Covid-19 lockdown on urban Sky glow: A review on Kolkata**

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**Abstract:** Excessive, misdirected, or obtrusive artificial (usually outdoor) light- known as light pollution (LP), can have serious environmental issues for humans, wildlife, and our climate. Light pollution is a side effect of industrial civilization, which is one of the most rapidly increasing types of environmental degradation that are faced by urban and non urban areas of the World. This research article specially focused on to investigate the impact of the lockdown caused by the COVID-19 pandemic on the urban environment (Sky glow & Ecology) of Kolkata, India, Compared with night sky brightness and Suspended particles matter in the atmosphere which is the main cause of artificial night-time light emissions. During the investigation through statistical data, satellite imagery and astrophysical telescope imagery analysis, it has been proved a clear decreasing rate of light pollution due to reduced of anthropogenic aerosol content in the atmosphere which resulted in less artificial sky glow being scattered. With this fallen emissional rate of LP urban ecological and sky line environmental condition have been improved, it's an opportunity to reset urban environmental sustainability.

**Key words:** Covid-19, Light pollution, Astrophotography, Radiance Scale, Suspended Particles Matter (PM 2.5), Telescope image.

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### **I. Introduction**

World human civilization in recent decades are facing new pandemic diseases, SARS-CoV-2 in 2019, WHO has declared the Novel Corona Virus Disease (COVID-19) as a global pandemic, Corona viruses are a group of related viruses that cause diseases in mammals and birds. In humans, corona viruses cause respiratory tract infections that can be mild, such as some cases of the common cold (among other possible causes, predominantly rhinoviruses), and others that can be lethal, such as SARS, MERS, and COVID-19. Caronavirus diseases, covid-19, highly infection daises, was first found in Whan, China on December, 2019. Recently almost all the country and all the territories of the World are affected by this deadly infectious virus. West Bengal was affected firstly on 17 March'2020. The COVID-19 pandemic has caused dramatic changes in human habits and activities across much of the world.

By reviewing the available scientific literatures we can see, the global outbreak of COVID-19 is affecting human lives and environment also. The measures taken to control the spread of the virus and the lockdown procedures have significant effects on the environment. Due to pandemic situation absence of heavy economic activity significantly improves different environmental Parameters quality in different cities across the world. Covid-19 is a infections virus disease, that's why several national and international authorities and government suggested that prevent measure like wear musk, maintain physical distancing etc. Beside that to control the spread rate and infection rate many government restrict the movement of people and announced for lockdown. World Economic Forum reported, nearly 3 billion people are faced with some form of lockdown globally, and movement is being restricted by respective governments to control the COVID-19 infection (WEF, 2020). Due to movement restriction and a significant slowdown of social and economic activities, world economy faces a destructive situation but the environment are benefited through this, different environmental parameter quality have been improved and surprisingly, shows a clear trend to decrease the light pollution rate due both to decrease in light emissions from the city of Kolkata. In this paper determine the impacts of a COVID-19 lockdown on artificial night-time light emissions, for an exemplar, the city of Kolkata, India.

## II. Objectives

The objectives of the study are to analyse the Changing scenario of urban night Sky brightness (**Sky glow**) and its impacts on Kolkata's urban skyline and ecology, due to outbreak of covid-19, which are highly significance from the viewpoint of both environmental and socio-economical.

## III. Methodology

The nature of the present research work is explorative and the whole work has been done by descriptive as well as analytical methods. In this study, **PM 2.5** aerosols data, both of natural and anthropogenic origins have been considered to evaluate the brightness of the night sky of pre and after lockdown situation. Aerosols emission data have been collected from Central pollution control board (**CPCB**), India. Light pollution map have been collected from the International Dark Sky Association (**IDA**). The sources of telescope imagery are the American astronomical society (**AAS**). Moreover, **LANDSAT 8 OLI** Image of the United States Geological society (**USGS**), Google earth Image have been used to making different aerosols emission map through different digital map making software like: **QGIS**, **Erdas imagine**(2014).

## IV. Study Area

A global light pollution map developed by a group of researchers of International Dark Sky association (IDA) has ranked New Delhi, Kolkata and Bangalore as the three cities with the highest light pollution in India. Kolkata is the most urbanized growing city, where the brightness from outdoor lights is on a steady rise in various parts of the study area, which were already experiencing high levels of outdoor brightness.

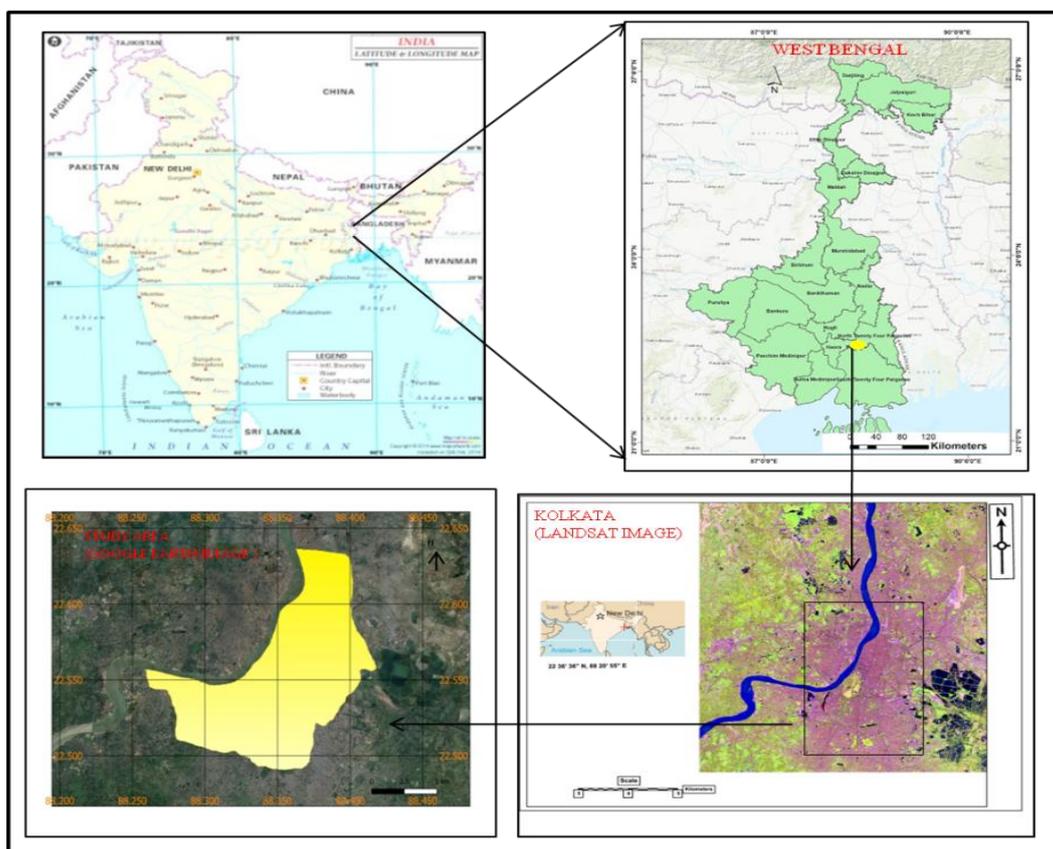


Fig: 1 Study area map

## V. Light Pollution

Light pollution is the presence of anthropogenic and artificial light in the night environment. It is only very recently that the multiple negative effects of artificial lighting on ecology, human health, and social well-being. It's also known as "photo pollution" or "luminous pollution" is excessive, misdirected, artificial light. Light pollution not only keeping the lights at night but by shining excessive light or using "bad" light fixtures. Bad light spread rays to upwards, wasting light, energy, money. Light pollution is a side effect of modern civilization it's very harmful for not only animal & environment but also human life, that is the presence of artificial light in otherwise dark conditions.

The term is most commonly used in relation to in the outdoor environment, but is also used to refer to artificial light indoors. Adverse consequences are multiple; some of them may not be known yet. Light pollution competes with starlight in the night sky for urban residents, interferes with astronomical observatories, and, like any other form of pollution, disrupts ecosystems, artificial light at night has negative impacts on insects and has adverse health effects. Specific categories of light pollution include light trespass, over-Illumination, Glare, Light Clutter, and Sky glow (**Rajkhowa**).

Artificial sky glow is the brightening of the night sky that originates from in cause of atmospheric constituents like particulate matter (**T. Ścieżor, M. Kubala**), atmospheric aerosols that scattered artificial lighting back towards Earth within the atmosphere this is the primary source of anthropogenic sky glow and another components like vehicle and residential lighting that contribute to sky glow. This sky glow especially indirectly effected personal computers, communication satellites, mobile phones, Global Positioning Systems (**GPS**), solar panels, and Magnetic Resonance (**MRI**) scanners. Today, Sky glow is a prime problem for astronomers, because it reduces contrast in the night sky to the extent where it may become impossible to see all but the brightest stars (**Luginbuhl, Walker, Wainscoat, 2009**). Modern astronomy helps us determine the Sun's effect on Earth's climate, and identify any potential threats to Earth from space. Sky glow, and more generally light pollution, has various negative effects: from aesthetic diminishment of the beauty of a star-filled sky, through energy and resources wasted in the production of excessive or uncontrolled lighting, to impacts on birds and other biological systems, including human (**Rich & Longcore**). Research on insects, turtles, birds, fish, reptiles, and other wildlife species shows that photo pollution can alter their behaviours, foraging areas, and breeding cycles, (**Longcore & Rich Catherine**) and not just in urban centres but in rural areas as well. Due to this luminous pollution the modern civilization are missing the opportunity to enjoy of night sky beauty, that's why in modern decades people in most of the world's large urban centres, stargazing to build a planetarium.

## VI. Detail Analysis

Light Pollution = Wasted Energy, Wasted Money, and Untoward Modifications of Earth's Surface & Atmosphere



Fig: 2 Sky Glow image of Kolkata



Fig: 3 Semi cut off artificial Street light image of Kolkata

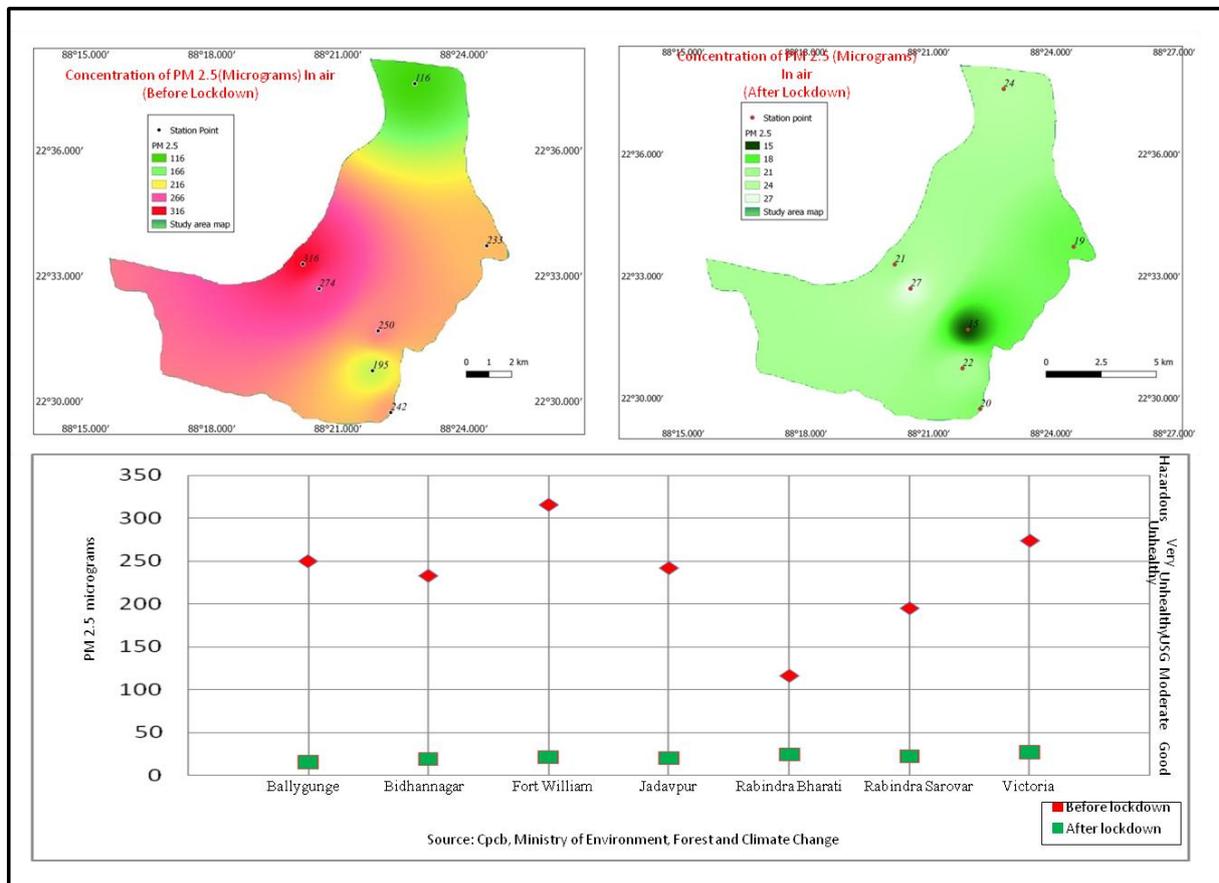


Fig: 4 PM 2.5 (micrograms) concentration map of Kolkata

Figure 4 shows a comparison of GIS imagery of Kolkata on PM 2.5 concentration in air, before lockdown and after lockdown periods. Analysis indicates that the intensity of PM 2.5 aerosols emission before lockdown periods the level is much higher, which are mainly very unhealthy and hazardous. Surprisingly, the Graphical representation (Fig: 4) of average 2.5 emission data of 7 station shows a gradual declining trend after the lockdown period. It is important to note that during the lockdown period, different type of anthropogenic and industrial activities such as vehicles, mini industries, restaurants, and street vendors were closed, that's why the PM2.5 Concentration in atmosphere is much lower in that time.

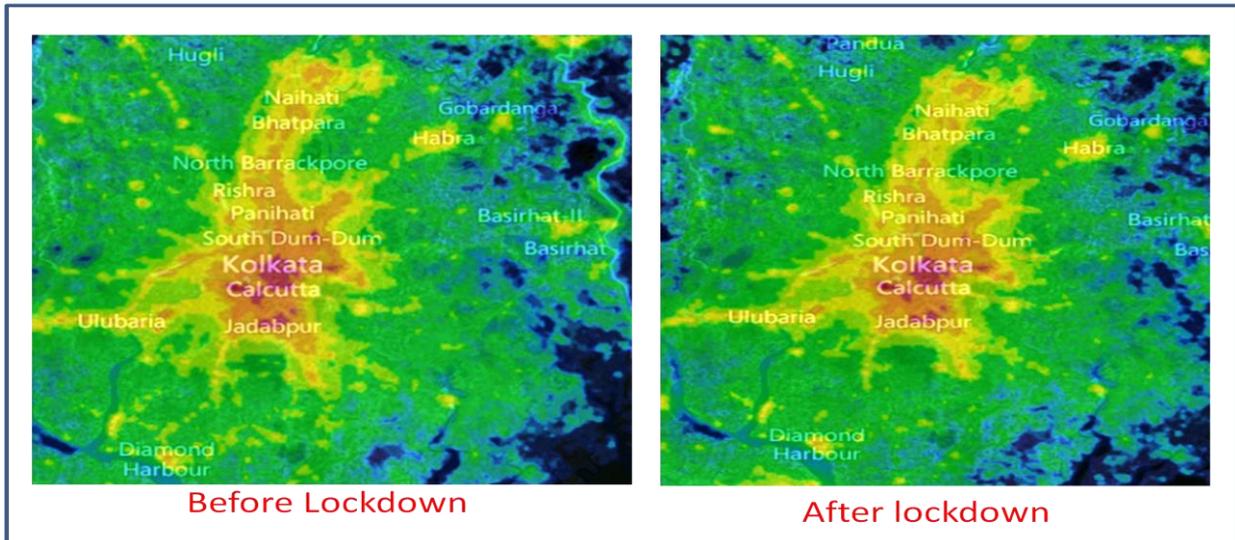


Fig: 5 Light pollution map of Kolkata (Source: International dark sky association)

Location	Latitude(N)	Longitude(E)	Radiance(2019)	Radiance (2020)	Elevation
Near Bablutala	22.63355	88.45429	36.73	34.88	0 mt.
Near Ballygunge Circular Road	22.53638	88.34579	51.79	50.90	8 mt.
Near Rabindra sadan Metro	22.54146	88.36831	57.49	54.48	10 mt.
Near Park Circus	22.54082	88.40010	69.16	66.86	10 mt.
Near Subhas sarovar	22.57032	88.40010	57.12	52.39	4 mt.
Near Rabindra Bharati University	22.62711	88.37883	44.28	42.40	8 mt.
Near Moulali	22.55204	88.37135	59.12	57.73	9 mt.

Table: 1 Radiance chart (Source: Light Radiance Trends)



Fig: 6 Radiance Scale

Fig: 5 shows light pollution imagery changes map of Kolkata after and before lockdown. There is a strong linear correlation between sky brightness and pm 2.5 concentration. During these lockdowns, private and social life as well as industrial and commercial activities were reduced to a minimum to break the exponential increase in the infection rate of the, as a results due to this the pm 2.5 concentration in the air has also been reduced. The comparative study of fig: 3 clearly indicting the decaling trend of aerosols concentration after

lockdown. As a result in Fig: 4 images the light pollution map have been changed. By this image (Fig: 5) analysis and Table: 1 radiance data of different places on Kolkata during after and before lockdown period clearly indicates the radiance changes, this two type of analysis it has been proven, decrease in scattered light due to the presence of fewer anthropogenic aerosols during the lockdown and as a results after lockdown the light pollution map have also been improved.

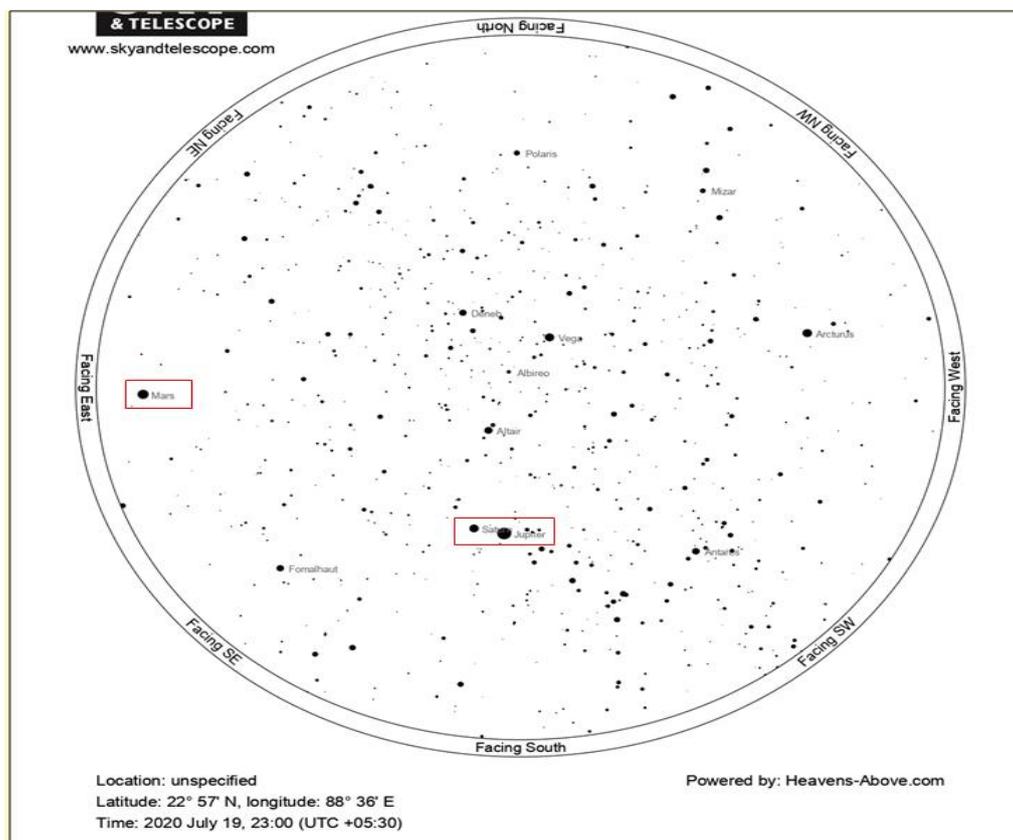


Fig: 7 Telescope image of Kolkata (19 July, 2020),  
Source: American astronomical society.

Fig: 5 show the telescope imagery of Kolkata after lockdown, which represents an improvement scenario of sky visibility. The different planets and crescent moon will simultaneously visible to the naked eye on Sunday, July 19, (According to Dr. Jeffrey, Astronomer) during lockdown the dramatically changes of atmospheric aerosols concentration are affected the planet visibility also.

Lower amount of suspended particles in the air has lead to better visibility too. This is giving photographers and stargazers a much clear view of Kolkata's night sky line. The stars at Kolkata's sky are much brighter due to clear sky (According to Kasutav Chowdhury, Secretary, and Astronomy Centre Kolkata) (TOI, 2020)

Different flying insects are attracted by artificial lights at night (like butterfly), at the same time, they are removed from ecosystems, die. Which are indirectly impacted the natural ecosystem. But during lockdown, due to clear environment they are come back to the city. The numbers of butterfly are significantly higher than previously (according to Somenath Pal das, Specialist Butterfly Garden and breeding) (TOI, 2020)

Birds that migrate or hunt at night navigate by moonlight and starlight. Artificial lights can cause them to wander off course towards dangerous nighttime landscapes of cities. But during lockdown lower pollution level are attracting different migratory birds to the cities.

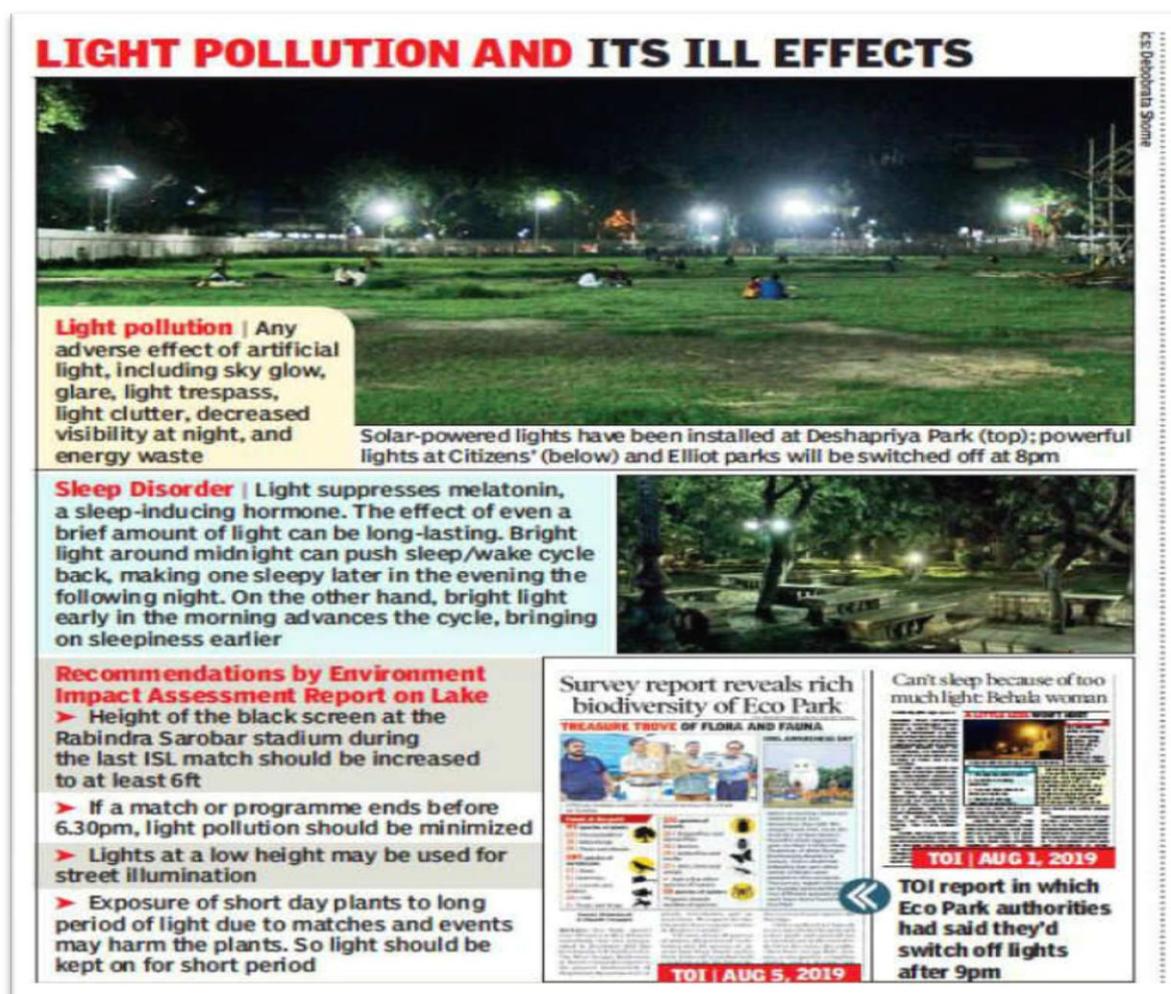


Fig: 8 Light pollution and Kolkata (Source: TOI, AUG, 2019)

## VII. Conclusion

The investigation of this study finds a clear decrease of light pollution (as measured in terms of sky brightness) within the city of Kolkata after the lockdown. Also, the sky glow of this city have been changed. Firstly, this was because of a decrease in scattered light due to the presence of fewer anthropogenic aerosols during the lockdown. In this regard, a positive correlation is found between sky brightness and PM 2.5 particle concentration in the atmosphere. Second reason for the reduction of light pollution comes from a decrease in the net amount of light emitted by the city probably due to a decrease in private lighting of buildings, vehicle lights, Industrial lighting and lighting of private areas. The variety of environmental conditions is important because it contributes to the segregation of resources and greater biodiversity. Various natural processes can only happen during the night. Examples are resting, repairing, celestial navigation, predating or charging of systems. For this reason, darkness has the equal and amendatory functional importance as daylight. It is much important for the healthy functioning of organisms and whole ecosystems. Due to this lower light emission rate the not only the urban sky, even entire environment have been shifted to a sustainable condition. The important effect of COVID-19, the short-term reduction in aerosols emissions and environmental quality parameter improvement is not a permanent solution for cities, but its influence on national commitment to action and also a better opportunity for major investments in emissions reduction efforts and environment management procedure to future engagement in the global pollution mitigation.

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