LIGHT POLLUTION: A Serious Threat to the Living Being

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Abstract— Artificial Light is the commodity used in day-to-day life for easy and simple living. As far as pollution is concerned Light Pollution is one of the most ignorant and non-specific pollution. There are several countries that have made strict laws after observing the increment in the effect of Light Pollution. On the other hand, India is still suffering from the very basic which is awareness among people. For living, artificial light cannot be made to be fully suspended from the lives of the people. But excessive usage of artificial light throughout the day is causing Light Pollution should be controlled with proper laws, regulations, and awareness. Light Pollution is a threat to the environment. More quality researches are also required in the field of the Light Pollution in the future for a better understanding of the topic.

***Keywords*- Light Pollution, Non-Specific Pollution, Effect of Light Pollution, Artificial Light, Quality Research**

I. INTRODUCTION

Light pollution is modification of daytime light in the dark surrounding created by initiation of artificial light. Awareness on the effect of light pollution started in the second half of the 19th century, but efforts to address the effects of the light pollution began in 1950s. In 1980s the International Dark-Sky Association (IDA) founded. Due to constant increment of night time artificial lighting, Light pollution issue is progressively discussed and many places have made laws to compel the excessive deprivation of light in the sky and environment. Everything we make is lit at night. Artificial lighting has become an essential to ease in human activity at dark time contribute in light pollution. When light pollution causes the visibility of the sky in the night is degraded and redundant, aggregate of energy is wasted. Pollution of light is the most rapidly growing environmental problem. Exposure to bright light in the morning and during the day is beneficial. It is also beneficial to avoid artificial light at night. Artificial light holds you awake at night, causing you to sleep and wake up later. When city dwellers go camping, they are more likely to feel tired, go to bed earlier, and wake up earlier. Shades or a face mask are used for people who can't sleep because street light shines into their bedroom. This is not a healthy solution because it keeps you from being awakened by sunlight. In Lucknow, light pollution was observed as moderate in May, 2021 by numbeo.com. In Uttar Pradesh is was observed that a rise in the intensity of light pollution form 1993-2013 (Kumar P et al., 2019). In 2017 it was observed as the light pollution at night is increasing at the rate of three present faster than the overall global average.

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II. DIFFERENT SOURCES OF ARTIFICIAL LIGHT

Every light has its own advantages and disadvantages. The more the power a lamp will consume the more money will be required to be spent. They may also have different effects on different organism. The different lamps used as sources for lighting, wavelength and typical life of source as per Bureau of Energy Efficiency and Europian Comission-2011 and Claudia Rieswijk, 2014.

Table 1: Types of Light, Efficiency and typical life of different light sources used (source: Bureau of Energy Efficiency and Europian Comission-2011 and Claudia Rieswijk, 2014)

s.no	Types of light	Efficiency (lumens/ watt)	Typical Life (hours)
1.	Metal Halide	75-140	18000
2.	High Pressure Sodium Lamps	50-130	6000-12000
3.	Low Pressure Sodium Lamps	100-203	6000-12000
4.	Halogen Lamps	16-29	6000-12000
5.	Compact Fluorescent Lamps	50-85	8000-10000
6.	High Pressure Mercury Lamps	35-60	5000
7.	Fluorescent Lamps	480-570	5000
8.	Incandescent Lamps	5-27	1000

III. DIFFERENT TYPES OF LIGHT POLLUTION

1. Clutter- Excessive clusters of lights are referred to as clutter. Light clusters can cause confusion, divert attention away from barriers, and even create injury
2. Excessive Illumination- Excessive usage of light is known as over-illumination. According to the same US Department of Energy source, the industrial, residential sectors and commercial consume over 30% of total energy.
3. Glare- Intemperate dissimilarity between bright and dark areas in the line of vision can cause glare. Glare can be caused by looking straight at the filament of an unshielded or poorly shielded light.

4. Light Trespass- When unwelcome light penetrates one's property, such as by beaming through a neighbour's fence, it is known as light trespass.
5. Sky Glow- The "glow" effect that can be seen over crowded places is referred to as sky glow. There are two types of sky glow “direct” and “indirect” sky glow.

IV. RADIANCE IN INDIA

Radiance obtained from VIIRS in Light pollution map for India indicates that the radiance per 1000 population shows continuation increment from 2013-2020.

Year	Pixel count	Sum	Rad. / 1000 pop.	Mean
2013	16,114,361	7,567,308	5.6	0.5144
2014	16,114,359	8,007,079	5.9	0.5443
2015	16,114,294	8,367,076	6.2	0.5688
2016	16,114,299	8,775,342	6.5	0.5965
2017	16,114,293	8,856,374	6.6	0.6020
2018	16,114,229	9,406,141	7.0	0.6394
2019	16,114,225	9,718,560	7.2	0.6607
2020	16,114,297	9,806,078	7.3	0.6666

Figure 1: Radiance per 1000 population

SOURCE:
https://www.lightpollutionmap.info/LP_Stats/country.html?country=India

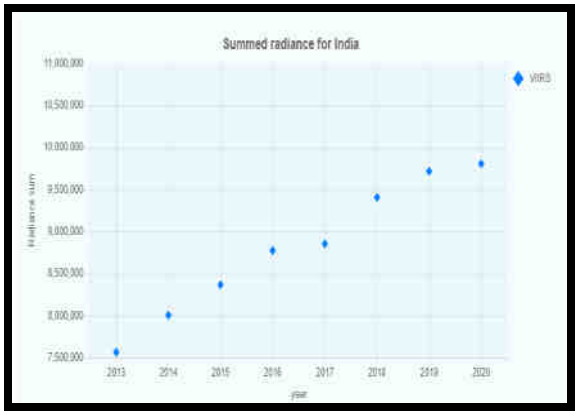

Figure 2: YEAR VS RADIANCE

SOURCE:
https://www.lightpollutionmap.info/LP_Stats/country.html?country=India

Light Pollution has a direct impact on the energy consumed. Due to sky glow it is difficult to observe the night sky. Clearly the graphs for radiance is indicating an alarming situation. So, to limit the effect of the Light Pollution we need to keep tracking the Radiance and through awareness among people.

V. EFFECT OF LIGHT POLLUTION

From the years it has been clearly observed that the impact of light pollution is chronic.

Table 2: The use of light by organisms (source: Gaston et al., 2013) (Ref. Claudia Rieswijk, 2014)

	Function	
Light as a resource	Photosynthesis	Absorption of light by chlorophylls and carotenoids to convert into carbon-based products
	Partitioning of activity between day and night	Organisms are active during specific periods of the day and have adapted their physiological characteristics to the light intensity of these periods. The intensity of light regulates their timing of activity and is therefore the driver for specific patterns of behaviour.
	Dark repair and recovery	The absence of light provides organisms to repair and recover their DNA from damage caused by harmful light, such as solar UV-B radiation.
Light as an information source	Circadian clocks and photoperiodism	The circadian clock refers to the internal physiological system, controlled by cues, which regulates activity and associated physiological patterns in a 24 hour cycle. Photoperiodism is the physiological reaction of organisms to the length of day and night, seasons, as well as the monthly lunar cycle. Organisms use the length of day and night to anticipate their activity patterns on the changing environment, by altering physiological processes like hormonal cycles and the functioning of the immune system. So-called ‘zeitgebers’ are cues that are recognized by organisms and regulate these patterns.
	Visual perception	Organisms use light to perceive their environment. The intensity and wavelengths used by organisms are different among species.
	Spatial orientation and light environment	Light is used by many organisms for directional movement. The moon, for example, is used by many nocturnal organisms as a tool for navigation. Also, light-avoiding movements exist among several species.

- **Effects on Animals**- Light pollution can alter the development, migration, circadian cycle, predator prey relationship, reproduction in animals. In India many animals were dropping into the endangered category due Light Pollution or due to loss in habitat. Bird’s uses horizon as direction for their homes but light pollution can interfere in the process. Sea turtle Hatchlings consider horizon as orientation for the direction to enter in the sea. Light pollution misleads many hatchlings in the opposite direction to the sea which becomes the cause for death for many hatchlings and they die due to dehydration, or by becoming prey for predators. Bats becomes active after the dusk. Their ability to see in low intensity lights make them sensitive towards high intensity lights. Artificial light can cause increment in the reproduction rate which will ultimately leads to higher mortality rate because

every environmental condition is not feasible for surviving baby bats. To differentiate the different activities of day and night, bats and insect depends upon light. Artificial light can affect the photoperiodism by shorting the hibernation period. Insects mating behaviour can also get effected due to the artificial light which can cause decrement in there population.

- **Effect on Humans**- Excessive exposure in the light pollution leads to numerous human health issues. . Researchers of the NCI (National Cancer Institute) and the National Institute of Environmental Health have concluded that artificial light at night may represent a risk factor for breast cancer. Increased headache incidence, worker tiredness, medically defined stress, decreased sexual function, and increased anxiety are all possible health effects of Light Pollution. Also the increased exposure can lead to disrupt circadian rhythm and can also disrupt in the temperature of body.
- **Effect on plants**- Trees provide entire ecosystems for a variety of animal species. Light pollution has a negative impact on them. Artificial light makes it difficult for trees to react to seasonal changes: light pollution prevents many trees from shedding their leaves. This has ramifications for creatures who rely on trees as a habitat. Short-day plants necessitate lengthy nights. If a plant is suddenly lit for a long night, its flowering and growth rhythms may be completely disrupted.

VI. Measures to Control Light Pollution

1. Turn off the light when not needed.
2. Avoid direct exposure in the sun.
3. Motion sensors can be used for outdoor lightings.
4. Using proper light source.
5. Public awareness for healthy lighting system.
6. Proper laws and regulations are needed in India.

Conclusion

Light Pollution is gradually increasing in India. The paper suggest the increment of Light pollution with the effect on whole environment mainly in India. All day exposure of artificial light is quite damaging for the whole environment. Proper guideline with the awareness among the people is the need for present time. The time needs research in both the qualitative and quantitative research on the light pollution. Proper and effective management policy is needed for the reduction in light pollution in India. As light pollution is quite ignorant and there is no data available in this field.

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