International Journal of Leading Research Publication (IJLRP)

E-ISSN: 2582-8010 ● Website: www.ijlrp.com ● Email: editor@ijlrp.com

An Empirical Assessment of Light Pollution in India and its Varied Forms

Mr. Ranveer Singh Whala[1], Ms. Nidhi Jain[2], Dr. Momina Zahan[3]

[1]Teaching Assistant, School of Business and Law, Navrachana University, Vadodara, Gujarat.
[2]PhD Research Scholar, Faculty of Law, Banasthali Vidyapith, Banasthali, Rajasthan.
[3]Assistant Professor, Faculty of Law, Banasthali Vidyapith, Banasthali, Rajasthan.

Abstract:
Light pollution, an often overlooked yet rapidly growing environmental issue, poses significant challenges to human health, ecosystems, and the visibility of the night sky. This paper introduces the concept of light pollution and categorizes its major types, including glare, skyglow, light trespass, and clutter, highlighting their distinct impacts on society and the environment at large. The research adopts a dual empirical approach, quantitative and qualitative, to examine the extent and perception of the problem in India. Qualitative and Quantitative surveys assess parameters such as public awareness, attitudes, impact analysis, personal experiences, sources, behavioural patterns of Light pollution and future-ready solutions. The findings reveal a pressing need for integrated policy interventions, improved lighting design, and removing awareness crisis to balance developmental needs with sustainability goals. The paper concludes with specific suggestions, emphasizing regulatory frameworks, adaptive planning cycles, community participation, and the promotion of energy-efficient, dark-sky-compliant technologies to mitigate the adverse effects of light pollution and safeguard the integrity of the nocturnal environment.

Keywords: Light pollution, Empirical Survey, Dark sky, Ecosystem, Night Sky, Sustainability.

1. INTRODUCTION

The phenomenon of excessive artificial light at night being used where they are considered unwanted or intrusive is called Light Pollution. Beyond an environmental concern, Light Pollution is also a concern for ecological and Human well-being. It can affect the natural circadian rhythms, leading to sleep disorders, stress(Falchi et al., 2011) and in some cases even breast cancer(Chepesiuk, 2009). When Light Pollution increases to an extent that it starts to deteriorate a human's health in any possible manner, the Right to Life of such person, guaranteed under Article 21(Constitution of India, 1950) of Part 2 of the Indian Constitution, so affected by any of the effects of Light Pollution can be said to be hampered. The Constitution guarantees protection of life and personal liberty, it states that *'No person shall be deprived of his life or personal liberty except according to procedure established by law'*(Constitution of India, 1950). The right to a healthy environment is a vital aspect of the right to life(Hashim, 2013) and deprivation of life and liberty of a person cannot be done except according to the procedure established by law. In the landmark judgements of Maneka Gandhi(*Maneka Gandhi vs Union Of India*, 1978) and Francis Coralie(*Francis Coralie Mullin vs The Administrator, Union Territory of Delhi and Ors.*, 1981) the Hon'ble Supreme Court of India held that *'no one shall be deprived of his life or personal liberty except by procedure established by law and this procedure must be reasonable, fair and just and not arbitrary, whimsical or fanciful'.*

There are many judicial actions taken to protect the environment which also includes the dark starry sky. A few instances where an individual's Right to Life was violated due to light pollution were recorded in South Mumbai, where an individual namely Nilesh Desai(Chatterjee, 2017). A local gym used to keep its light on until late at night or sometimes even early morning, it took years of hard work and multiple

complaints to the authorities by Nilesh to get notices issued by the police and the district collector to the local gym for turning off their lights by 10:00 PM. Another instance from Mumbai in the year 2023, showed that advertising billboards were using very bright lights in order to ensure that their billboards became eye-catching. Many NGOs came together and addressed the issue to Chief Minister Eknath Shinde warning them about the consequences of these Billboards and their 'Killer Light Pollution', as many accidents were taking place due to these Billboard's extraordinarily powerful lights directly hitting a driver's eye(Singh, 2023). Such instances shall not be repeated as they are not only violative of Article 21 but also life-threatening.

METHODOLOGY

The methodology for this research paper is based on primary as well as secondary sources of data. Under the primary sources, apart from the statutes and legal frameworks, the researchers have incorporated an empirical study consisting of both qualitative and quantitative approaches. For quantitative, a structured survey with a sample size of 100 respondents was conducted, gathering their insights and understanding. Stakeholders who are either key contributors to or significantly impacted through Light Pollution, including Event Planners, Environmentalists, Government Officials, Nighttime staff, People associated with Complexes, Employees or Owners of Factories, and People associated with Billboards. Whereas, for the qualitative aspect, in-depth interviews were carried out with two distinguished experts: Mr. Dorje Angchuk, Engineer at the Indian Astronomical Observatory and Member of the International Astronomical Union representing India, and Mr. Kesang Dorjey, an Amateur Astronomer working at Hanley Observatory.

2. TYPES OF LIGHT POLLUTION

Light Pollution is misdirected and unwanted artificial light at night that leads to many of its ill effects. The Light Pollution can be further categorized as:

2.1 Light Trespass

Light trespass is unwanted artificial light on a person, property or area of concern,(Alberta Dark Sky Association, n.d.). A common light trespass occurs when strong lights from outside enter the house of a person through their window(s), causing various problems, the most common being sleep deprivation.(Rajkhowa, 2014) Over the years, the issue of light trespass has increased immensely for residential areas and so have its complaints.(Ntoutsos et al., 2021) Curbing Light Pollution has become super challenging, especially in India. In many instances, the authorities deny taking action on any application or complaint filed in regard to light trespass.(Chatterjee, 2017) On one hand, India along with the rest of the world has to do something to mitigate Light Pollution, whereas, on the other hand, India aims to light up the backward areas by giving them more light.("Energy Efficiency & Renewable Energy Management Centre Government of NCT of Delhi," n.d.) All ordinances to reduce the effect of light trespassing have immensely failed due to them either being too unrealistic or, being vague to the extent that people abuse them without facing consequences.(Rajkhowa, 2014) There can be numerous reasons or sources to Light Pollution via light trespass, however, this phenomenon usually occurs due to street lights in compact cities(Chao et al., n.d.) or due to a neighbour's installation of new light fixtures on their property(Liebel, 2024) that unintentionally or unknowingly enters into another person's household leading to Light Pollution by light trespass. A study conducted in Taiwan with respect to Light Pollution by night lamps and advertising lightboxes indicates that a night lamp can raise illuminance by 6 lux, whereas, a lightbox may increase luminance up to 17 lux in situations where the bedroom was on the first floor.(Chao et al., n.d.) It was found that advertising lightboxes and night lamps were both responsible for light trespass, however, lightboxes had a much dominating effect with light trespass for Light Pollution.

2.2 Glare

Glare refers to excessive light that causes discomfort(*What Is Light Pollution?*, 2024) in other words,

when the eyes have been exposed to light that is bright, it causes the effect called glare.(Kaushik et al., 2022a) Glare produces a level of brightness that is so high that the eye can no longer hold it in its field of view, limiting the person's ability to differentiate or identify objects(*Glare Light | What Is Glare, Forms, Types, Pollution, Prevention*, 2020) When light from another vehicle enters into the eye of the driver, it creates a difference in contrast of light and dark in the eye.(Hills, 1980) This effect may lead to temporary impairment in the driver's eye that may take up to 1 hour after exposure for complete recovery.(Rajkhowa, 2014) Glare is considered one of the most destructive types of Light Pollution(Lystrup, 2017) as it hampers with one of the most fragile and crucial parts of the human body. Glare can be further categorised into 4 types which are:

A. Distracting glare: when light reflects from or within the lens.(Kaushik et al., 2022a)

B. Discomforting glare: a uniform brightness/luminous veil being drawn over the retina. This veil reduces the apparent contrast in the visual scene to impair visibility.(*Glare Light | What Is Glare, Forms, Types, Pollution, Prevention*, 2020)

C. Disabling glare: it is a more intense version of the discomforting glare and causes greater discomfort which might not be bearable for all.(Rajkhowa, 2014)

D. Blinding glare: usually comes from smooth surfaces and compromises one's ability to see.(Kaushik et al., 2022a)

Then there is one of the famous scales for measuring glare called the De Boer (1967) scale, this scale has a nine-point scale value where 1 (one) is the most effective and destructive glare, whereas 9 (nine) is the least effective glare.(Bullough et al., 2008) The sale has the following equivalencies:

1 Unbearable
2
3 Disturbing
4
5 Just permissible
6
7 Satisfactory
8
9 Just noticeable(Bullough et al., 2008)

There are various other scales for bifurcating glare types, in a study conducted in Nebraska, it was found that the discomfort glare is higher when the background luminance is lesser.(Tyukhova, 2015) Therefore, discomfort glare increases when background luminance decreases. The study's analysis showed that the discomforting glare increased with the increase in the luminance and size of the source and a decrease in the angle between the glare source and fixation point and background luminance.(Tyukhova, 2015)

2.3 Skyglow

Skyglow is one of those types of Light Pollution that occurs alongside the other types, the effect of skyglow can be considered to be in action when the night sky is brightened above places inhabited.(Achuthan, 2021) A big bright dome/sheet of light that covers the night sky due to excess artificial light at night.(*Skyglow*, 2023) Skyglow occurs when the light coming out of the source is either directly aimed towards the sky or, when the light is reflected from the ground towards the sky and is scattered in the atmosphere(Duriscoe, 2013) by particles of dust.(Lystrup, 2017) It is considered under the main 3 types of Light Pollution alongside light trespass and glare.(*Light Pollution - Globe At Night*, n.d.) Skyglow can have a negative impact over a large area of the environment, affecting that area with its harmful effects.(Du et al., 2018) The streetlights and façade lights majorly contribute to skyglow as these lights are usually kept on for the whole night no matter whether or not there is any person to use such lights.(Du et al., 2018)10/10/2025 3:51:00 PM However, unlike light trespass and glare, the impact of skyglow cannot have individual responsibility, therefore, there can be no individual liability or

accountability.(Lystrup, 2017) In case of light trespass and glare, a person can be held liable for claiming civil damages, the same is not possible in the case of skyglow.(Lystrup, 2017) Therefore, a victim has no safeguarding authority to protect or compensate them for the damages they receive due to skyglow.(Lystrup, 2017) The Light Pollution and skyglow, both increase side by side and the impact they have, relies on how lighting is controlled in a particular area of study. Therefore people are finding out methods to measure Light Pollution(Rabaza et al., 2014) in order to protect the environment as well as life on earth. The creation of Dark Sky Preserves is not sufficient enough for those areas to be completely safeguarded, additional measures are required within the preserves and in the vicinity of those preserves to maintain the quality of those areas.(Lima et al., 2016) In theory, such a task shall not be challenging, considering the fact that the effects of skyglow are instantaneous and reversible.(Lima et al., 2016) It is crucial to understand that the manner in which LEDs are installed (as LEDs are the most common form of light used today) is responsible for either mitigating or exacerbating the skyglow effect(Bierman, 2012)

2.4 Clutter of Lights

Clutter refers to excessively grouped and concentrated lights in a habitat,(Achuthan, 2021) it is a condition where an excess of items or their arrangement degrades performance at a given task.(Rosenholtz et al., 2007) Excess or poorly organised display items would result into masking,(Legge & Foley, 1980) reduced ability in the object's recognition, visual search efficiency(Wolfe, 2018) and crowding.(Stuart & Burian, 1962) In some situations, the more the number of items, the better the performance benefits, especially when items are low entropy. However, clutter is quite the opposite, it is a condition where excessive items(Ho et al., 2001) lead to degradation in the performance.(Rosenholtz et al., 2007) Other than confusion,(Crawford, 1991) headaches, irritability and sleep deprivation, clutter may also lead to short-term memory,(Miller, 1994) however, it may not happen solely on the basis of the number of items but would also depend on various other features such as colour, size, shape, orientation, brightness etc.(Alvarez & Cavanagh, 2004) Studies have also found background clutter responsible for reducing the visibility of an object or, its conspicuity in cities at night,(Davoudian, 2017) it is also one of the major contributors to the overall increase in Light Pollution, which according to Globe at Night(*Home - Globe At Night*, n.d.) is increasing by 10% every year.(Gough & Today, n.d.)

3. QUANTITATIVE STUDY

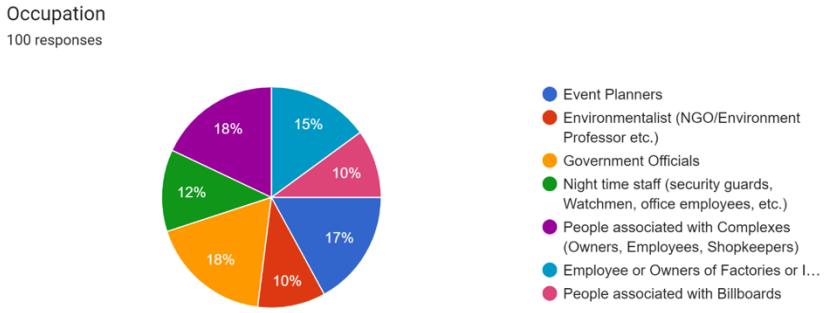

Fig. 1 - Occupation of Respondents

The pie chart shows the occupational distribution of 100 survey respondents who were divided into 7 categories being the major stakeholders of Light Pollution

- Event Planners (17%): These individuals are involved in organizing day and night events so majorly participate in the creation of Light Pollution. It was necessary to take their insight regarding Light Pollution.
- Environmentalists (10%): The group includes those working for NGOs or professors teaching environmental Laws to know their views regarding the impact of Light Pollution on the environment.

- Government Officials (18%): Policymakers and administrative authorities can play a vital role in regulating and managing Light Pollution. This group included individuals working in several Municipal Councils, State Pollution Control Boards, and other government officials.
- Nighttime Staff (12%): It included watchmen, security guards, Corporate Employees working during night shifts, and direct stakeholders of Light Pollution.
- People associated with Complexes (18%): It covers the owners, the employees working in the complexes, and the shopkeepers within the complexes, who are possibly aware of the impact of Light Pollution created by the fully flooded lights of the complexes.
- Employees or the Owners of the factories or Industries (15%): This section might include the contributors and the sufferers of Light Pollution. So, it becomes important to take their insight.
- People Associated with Billboards (10%): This section includes the authorities associated with advertising through the Billboards including Lighted and non-Lighted Billboards as nowadays Billboards play one of the major roles as a source of Light Pollution.

Interpretation:

Government Officials**:** As the regulatory and policy framework is the major focus of the research, the category of Government Officials is included as the respondent. The researcher approached the government officials from different parts of India working in this field including the executive bodies and administrative authorities. These people can help regulate light pollution through policy formulation and implementation.

Balanced Representation: The authors tried to maintain a balanced representation of several stakeholders including night-time workers, commercial complexes, and industries. Respondents of these categories include the stakeholders who might have an impression that the regulation of Light Pollution can result in negative economic implications in the future for their Business or employment. It is important to take their view and suggestions. It indicates a comprehensive approach to understanding light pollution in depth.

Special Interest Groups**:** It covers environmentalists and people associated with Billboards, though smaller in number, it represents the concerns and insights of this special interest group regarding the effect of Light Pollution.

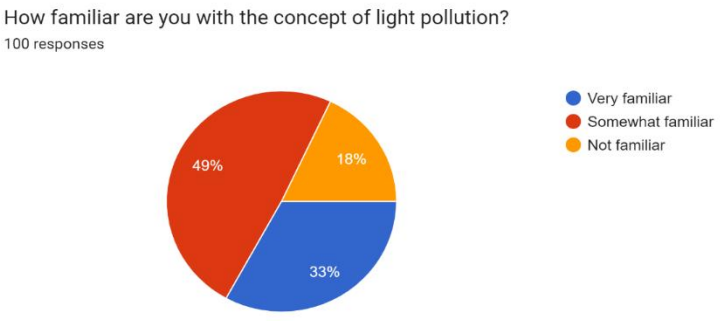

Fig. 2 - Level of Respondent's familiarity with Light Pollution

This question seeks to identify the percentage of people who are aware or, at least have an idea regarding the term 'Light Pollution', the data collected from respondents illustrate that the majority of the respondents are either very familiar or, somewhat familiar with the concept of Light Pollution, their percentage adds up to 82%. There is also a smaller portion of the population (18%) with no knowledge and awareness regarding Light Pollution at all. More than eight-tenths of the population knows Light Pollution, this majority itself implies that there is an issue of Light Pollution that needs to be addressed. However, this majority may not be definite as there can be the presence of 'Social Desirability bias(Kaushik et al., 2022b). The survey was conducted online, and the respondents are likely to look up Light Pollution before actually answering it, or just say that they know about it considering it to test their knowledge.

A considerable number of respondents i.e., 49% contemplate that they are somewhat familiar with and do not have complete knowledge regarding Light Pollution. Also, 18% of respondents mentioned that they have completely no idea of what Light Pollution is. Basic educational information could be shared with the population who are not familiar with the concept of Light Pollution by various means such as awareness programs, community events, workshops, seminars, media coverage, etc. Slightly more detailed information can be promoted to people who are somewhat familiar with Light Pollution through guest lectures, blogs, research articles, educational institutions, webinars, etc.

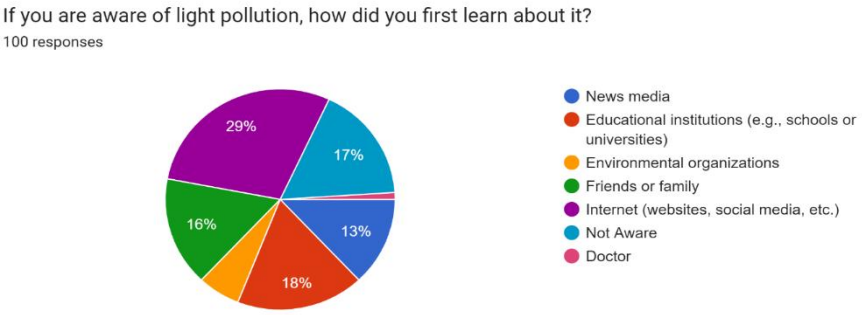

Fig. 3 - Source of initial knowledge on Light Pollution

This question was aimed to determine which of the following mediums majorly contributes to spreading awareness regarding Light Pollution. As per the data, a large number of the respondents (29%) have stated that they first learned about Light Pollution via the 'internet', i.e., through websites, articles, social media, etc. This shows the importance of digital content and digital awareness. The second-most medium for awareness of Light Pollution as per the data collected (18%) is 'educational institutions', emphasizing the vital role of environmental education in society. Other mediums were responsible for creating awareness about Light Pollution, such as 'friends and family' (16%), 'news media' (13%), 'environmental organizations (6%), and 'doctors' (1%).

Despite being the most influential medium in India, News media has fallen short in addressing the Light Pollution concerns to the public. Also, doctors and environmentalists, being expert bodies, have been even less effective in educating patients about the detrimental effects of light pollution on the human body and the environment.

With the increasing Light Pollution, mainstream media must cover this topic and inform about its detrimental effects. Also, doctors should educate their patients regarding the impact of Light Pollution on the human body which causes irritability, uneasiness, dementia, headache, etc. Environmentalists need to handle this issue in a much more sensitive manner.

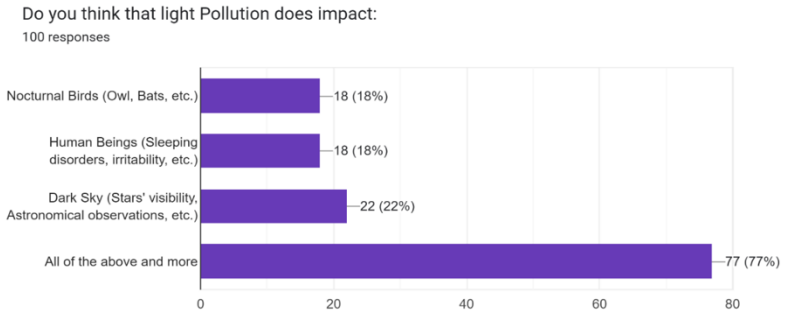

Fig. 4 - Perceived areas Impacted by Light Pollution

This question aims to assess the awareness and the opinions of the stakeholders regarding the effects of Light Pollution. When asked about the impacts of Light Pollution, 77 respondents believed that it impacts

Humans, Nocturnal Birds, the Dark sky, and more, whereas 22, 18, and 18 stakeholders responded that it impacts the Dark sky, Human beings, and Nocturnal Birds respectively. This indicates that a significant portion of stakeholders recognize the range of ecological and environmental impacts of Light Pollution.

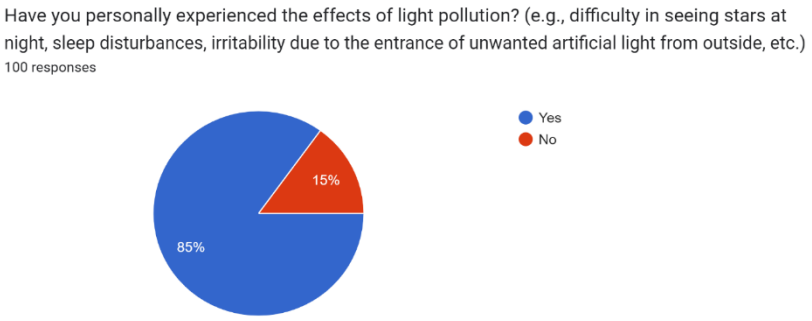

Fig. 5 - Personal Experience with Light Pollution

The question seeks to identify the percentage of respondents who have personally experienced the effects of Light Pollution. The result says that a substantial majority of 84.5% have experienced the effect of Light Pollution. This high percentage demands an urgent call for the regulation of Light Pollution.

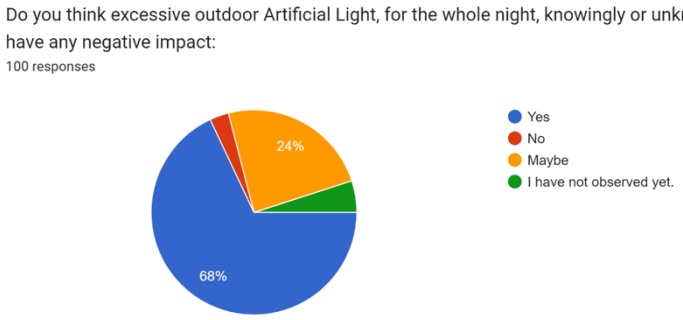

Fig. 6 - Perceived negative impact of Artificial Light at Night

This question seeks the opinions of the stakeholders regarding the negative impacts caused by artificial lights at night. The survey shows that 68% of the respondents said that excessive artificial lighting, knowingly or unknowingly causes ill effects. Whereas 24% of respondents were not sure about it. The 8% of stakeholders either do not know or think that it does not have any negative effects. This predominance may again have included social desirability bias(Kaushik et al., 2022b).

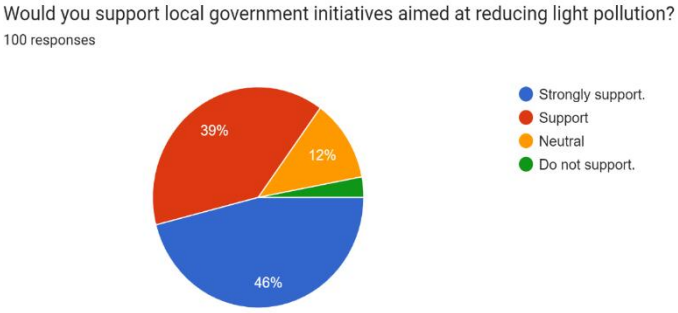

Fig. 7 - Public support behind efforts of Local Government

The purpose of this question was to assess the level of public support for government-led initiatives to reduce Light Pollution. A significant number of stakeholders, 85% expressed their willingness to support

local government to regulate Light Pollution. It shows a strong public backing for such measures so now it's high time when the government should start trying to regulate it. Conversely, a smaller segment remained neutral and not sure regarding this response. Only 3 respondents out of 100 denied supporting the local government in this regard as it can create a negative economic impact.

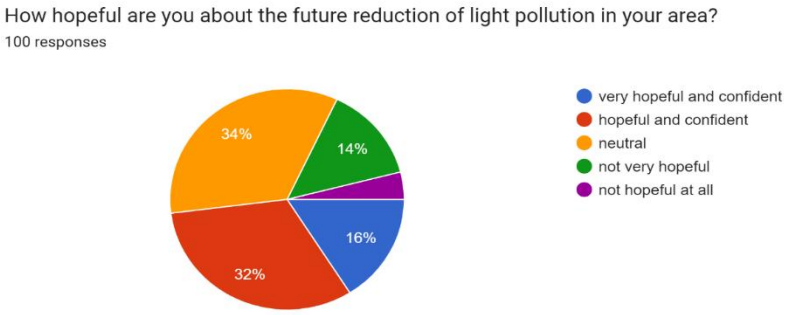

Fig. 8 - Level of Optimism Regarding Reduction of Light Pollution

This question was asked to gauge public sentiments and confidence for the future reduction of Light Pollution which is increasing steadily. Almost half of the respondents (48%) are optimistic, and they have faith in initiatives and measures being taken forward to address Light Pollution. Whereas a significant percentage of respondents (34%) are neutral indicating the likelihood of the reduction of Light Pollution in the near future. However, a small portion i.e. 18% are pessimist respondents who believe that as Light Pollution is continuously increasing nowadays, it is not possible to regulate it effectively now.

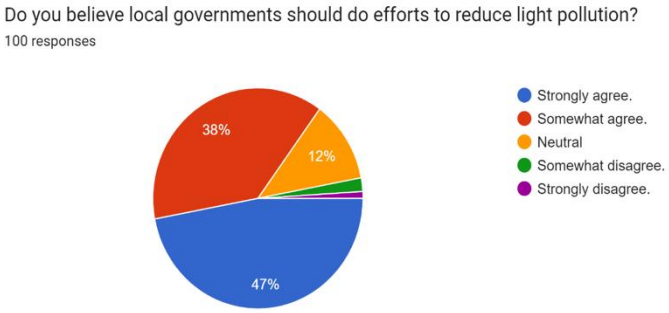

Fig. 9 - Level of Optimism Regarding Need for Government efforts to reduce Light Pollution

This question aims to identify the public's opinion on whether the government authorities should indulge in taking initiatives and measures to reduce Light Pollution. In the question above 85% of the respondents were ready to support initiatives by the government and a total of 85% of the respondents (47% strongly agree and 38% somewhat agree) want their local governments to act against the increasing Light Pollution. 12% of the respondents are neutral as they might be unsure or lack sufficient and relevant information regarding Light Pollution to form their opinion. However, a small percentage of the respondents (3%) disagree and oppose the government for indulging in activities aimed towards reducing Light Pollution as it may result in creating economic hindrances, or other issues, or they may not feel to control it as such. It clearly shows the support of the public is also there to initiate working with government agencies to reduce Light Pollution.

4. EXPERT'S OPINION ON LIGHT POLLUTION VIA INTERVIEW METHOD

Name: Dorje Angchuk
Profession: Engineer at the Indian Astronomical Observatory and Member of the International Astronomical Union from India
Date of Interview: 21.07.2024

Sir, Dorje Angchuk is an engineer in charge of the Indian Institute of Astrophysics (IIA) at the Indian Astronomical Observatory (IAO) Hanle and he became the first Indian to be a member of the International Astronomical Union (IAU). In the interview, the researchers asked him the questions mentioned below and the following are the answers given to them.

Q-1. Based on your extensive experience in the field, can you elaborate on how light pollution in India has changed over the years, especially around astronomical observatories?
Ans. Sir, Dorje Angchuk stated that Earlier Leh used to have a clear sky for astronomical observations but later on, became a tourist hub and many people started polluting it as the usage of lights increased and there was an increase in the number of streetlamps. Other than this, the airport security lights also became a huge concern. Even near the Hanle Observatory, tourism was increasing and so were the homestays. Although the optical facilities at the hilltop were safe the gamma-ray facilities at the base of the telescope were affected as the cameras were getting saturated because they were at the ground level where they have roads and villages. The IIA was initially situated in Kodaikanal, Tamil Nadu, but was later on shifted to a higher place in Kavalur, Tamil Nadu and it had a 2.3-meter telescope, the light pollution increased at that place between 1970 and 1980, therefore, it was decided that the location of the observatory needs to be changed. The site survey for setting up an astronomical observatory in Hanle was conducted in the 1990s and later, the observatory was set up as it was a remote and dark location. He also mentioned the Light pollution map which shows the increase of light pollution every year.

Q-2. What are some of the key initiatives or efforts that have been undertaken in India or abroad to address light pollution?
Ans. Sir, Dorje Angchuk stated that, in India, there are many amateur astronomers' groups who act to aware people for the protection of the Dark sky. However, we were lucky and received support from the community as well as the government, which proved to be helpful. Also, there is the Pench Tiger Reserve, a national park in Madhya Pradesh, which was declared as a dark sky park through the help of a group of dark sky advocates. Now this park has telescopes that help the public gaze at the night sky.
Other than this, in Ladakh, people are very conscious about lights, and they turn off the lights when not in use. He mentioned the Light management plan of the Union Territory. Sir, Dorje Angchuk stated that New Zealand has a huge business worth million when it comes to Astro tourism and even India can also follow such practice by dividing areas of the country into ecological zones as the authors have mentioned.

Q-3. Can you discuss any specific challenges or obstacles being in regulating light pollution in India, and how these have been addressed or overcome?
Ans. Sir, Dorje Angchuk replied that the notion that light gives us more security is false because light also creates harsh shadows. Some people believe that they can sleep well if the lights are on, therefore, some people deliberately keep lights on which is not required. Awareness crisis for driving in high beam or low beam is a big challenge. Many people use high beams while driving even when not needed. These lights

go far away and even hamper astronomy.

Q-4. What role do you see for the scientific community, policymakers, and the public in addressing light pollution and supporting regulations to protect the natural environment?
Ans. The scientific community can only inform the policymakers regarding the ill effects of Light Pollution. It is the need of an hour to form rules to regulate it. Whereas the public always searches for some benefit in exchange for any compromise. If they do not find any benefit to reducing light pollution, they may not accept it as a problem in the first place, therefore, it becomes essential to spread awareness regarding light pollution amongst the public and educate them.

Name -: Mr. Kesang Dorjey
Profession -: Amateur Astronomer working at Hanle Observatory
Date of Interview: 21.06.2024

Sir, Kesang Dorjey was initially interested in wildlife photography then gradually started working in Hanle observatory as a fitter and soon were rapt by the telescopes. He gained knowledge regarding light pollution and other tragedies occurring in the environment from different scientists.
Tourism for star gazing began in Hanle in the year of 2011 and is steadily increasing. He cited the features of Hanle as the best place for stargazing in India. They also mentioned that tourism is also increasing Light Pollution in Hanle due to lack of awareness resulting into loss of natural beauty.
When the Researcher asked him, what role he saw the people of Hanle playing in addressing light pollution to protect the natural environment, Sir, Kesang Dorjey responded earlier people were not aware of this but later, the Government distributed 24 telescopes to the people of Hanle to make them aware of the solar system, stargazing and Light Pollution. So, now some of the people of Hanle are concerned and teaching other tourists about Light Pollution when they visit.
Sir also mentioned a few steps that can be taken to curb Light Pollution:

- Enhancing awareness of Light Pollution
- Teaching the serious impacts of Light Pollution on Human Health in schools as well.
- While creating awareness, it is important to emphasize the connection between excessive artificial lighting and higher electricity bills.

5. CONCLUSION

The study highlights that light pollution in India is not only a growing environmental concern, but it also affects human health, wildlife, and energy consumption. The empirical survey shows that even when there is an existence of the issue of excessive artificial lighting, yet practical measures to reduce it are very limited. The findings suggest that while urban development and public safety require lighting as a necessity, there is an urgent need for balanced strategies that minimize light pollution without compromising functionality. Raising awareness, implementing regulations, and promoting responsible lighting practices can be proved as essential steps toward mitigating the issue of light pollution.

6. SUGGESTIONS

1. Awareness Campaigns: Educate citizens and corporate sector people about the adverse impacts of light pollution and promote responsible lighting habits.
2. Cultural Awareness: Promote public understanding of the cultural and aesthetic value of dark skies, preserving India's natural nightscapes.
3. Community Participation: Encourage the involvement of local government and communities in monitoring and reporting excessive lighting in their regions.
4. Educational Programs: Include light pollution topics in school and college environmental education curricula.
5. Further Research: Conduct a comprehensive and long-term study to evaluate the actual ecological and health impacts of light pollution.
6. Regulatory Measures: Formulate and enforce clear outdoor lighting guidelines and set limits on brightness and night timing illusion.
7. Urban Planning: Integrate the matter of light pollution in city planning, and public infrastructure projects.
8. Technology Adoption: Encourage the use of directional, and shielded lighting which minimizes the light spillage.
9. Sky Quality Monitoring: Promote amateur astronomy and citizen science projects for monitoring night sky brightness level.
10. Smart Lighting Systems: Promote automated and sensor-based lighting systems to reduce unnecessary illumination and spillage.
11. Monitoring and Reporting: Establish a national database to track light pollution hotspots in the country and monitor regular changes in the light emission over time.
12. Research Grants: Encourage education and research institutes to study regarding the health and ecological impacts of light pollution.
13. Local Ordinances: Empower municipalities to adopt local level lighting rules suitable for their urban or rural requirements.
14. Government Incentives: Plan and provide some incentives for households and businesses for early adoption of low-impact lighting solutions.
15. Public Participation Tools: Develop mobile apps or platforms where citizens can report the issue of excessive lighting which will also help authorities to take corrective actions.
16. Public Spaces Design: Design parks, monuments, and commercial areas with lighting that minimizes the issue of light glare and skyglow.
17. Collaboration with Industries: Work in collaboration of estate developers, event organizers, and advertising agencies who are majorly and actively involved in creating light pollution to limit excessive decorative lighting.
18. Corporate Responsibility Programs: Encourage businesses infrastructures to commit to "dark sky friendly" lighting practices in office campuses and industries.
19. International Best Practices: As per the Indian Conditions, Learn and adapt the strategies adopted by other countries to reduce light pollution.
20. Wildlife Protection Zones: Implement stringent lighting regulations near ecologically sensitive regions.
21. Seasonal and Event-Based Controls: Limit decorative or festive lighting during non-essential times to reduce excessive light pollution.
22. Public Transport Hubs: Implement low level lighting as per the requirements in airports, railway stations, and other transport terminals to minimize light spill.
23. Retrofit Existing Infrastructure: Replace outdated, and over bright streetlights with LED or shielded fixtures.
24. Policy Integration: Include light pollution considerations in environmental impact assessments for new urban development projects.

BIBLIOGRAPHY:

1. Achuthan, A. (2021). Laws of light pollution in India and other countries. *Indian Journal of Law and Legal Research*, *1*(1). https://3fdef50c-add3-4615-a675-a91741bcb5c0.usrfiles.com/ugd/3fdef5_f92db87c8f21460aa64718d42fd2e262.pdf
2. Alberta Dark Sky Association. (n.d.). *Light Pollution—The Problem of Light Trespass*.
3. Alvarez, G. A., & Cavanagh, P. (2004). The Capacity of Visual Short-Term Memory is Set Both by Visual Information Load and by Number of Objects. *Psychological Science*, *15*(2), 106–111. https://doi.org/10.1111/j.0963-7214.2004.01502006.x
4. Bierman, A. (2012). Will switching to LED outdoor lighting increase sky glow? *Lighting Research & Technology*, *44*(4), 449–458. https://doi.org/10.1177/1477153512437147
5. Bullough, J., Brons, J., Qi, R., & Rea, M. (2008). Predicting discomfort glare from outdoor lighting installations. *Lighting Research & Technology*, *40*(3), 225–242. https://doi.org/10.1177/1477153508094048
6. Chao, Y.-C., Huang, K.-Y., & Kuo, P.-Y. (n.d.). *Light Trespass from Exterior Lighting in Urban Residential Areas of Compact Cities*.
7. Chatterjee, B. (2017, November 28). South Mumbai resident files light pollution complaint against Wilson gymkhana. *Hindustan Times*. https://www.hindustantimes.com/mumbai-news/south-mumbai-resident-files-light-pollution-complaint-against-wilson-gymkhana/story-TfN1Vv26FXtiRSAgH5E2vL.html
8. Chepesiuk, R. (2009). Missing the Dark: Health Effects of Light Pollution. *Environmental Health Perspectives*, *117*(1), A20–A27. JSTOR.
9. Constitution of India, § art. 21 (1950).
10. Crawford, D. L. (1991). Light Pollution – A Problem for All of Us. *International Astronomical Union Colloquium*, *112*, 7–10. https://doi.org/10.1017/S0252921100003572
11. Davoudian, N. (2017). Background lighting clutters: How do they affect visual saliency of urban objects? *International Journal of Design Creativity and Innovation*, *5*(1–2), 95–103. https://doi.org/10.1080/21650349.2016.1182073
12. Du, J., Zhang, X., & King, D. (2018). An investigation into the risk of night light pollution in a glazed office building: The effect of shading solutions. *Building and Environment*, *145*, 243–259. https://doi.org/10.1016/j.buildenv.2018.09.029
13. Duriscoe, D. M. (2013). Measuring Anthropogenic Sky Glow Using a Natural Sky Brightness Model. *Publications of the Astronomical Society of the Pacific*, *125*(933), 1370–1382. https://doi.org/10.1086/673888
14. Energy Efficiency & Renewable Energy Management Centre Government of NCT of Delhi. (n.d.). *Initiatives and Achievements*. https://eerem.delhi.gov.in/eerem/initiatives-achievements
15. Falchi, F., Cinzano, P., Elvidge, C. D., Keith, D. M., & Haim, A. (2011). Limiting the impact of light pollution on human health, environment and stellar visibility. *Journal of Environmental Management*, *92*(10), 2714–2722. https://doi.org/10.1016/j.jenvman.2011.06.029
16. Francis Coralie Mullin vs The Administrator, Union Territory of Delhi and Ors., AIR 746 ___ (1981).
17. *Glare Light | What is glare, forms, types, pollution, prevention*. (2020, May 18). Light Journey. https://lightjourney.com.sg/blogs/articles/glare-light
18. Gough, E., & Today, U. (n.d.). *Light pollution is out of control, say astronomers*. Retrieved September 29, 2024, from https://phys.org/news/2023-06-pollution-astronomers.html
19. Hashim, N. B. (2013). Constitutional Recognition of Right to Healthy Environment: The way Forward. *Procedia - Social and Behavioral Sciences*, *105*, 204–210. https://doi.org/10.1016/j.sbspro.2013.11.021
20. Hills, B. L. (1980). Vision, Visibility, and Perception in Driving. *Perception*, *9*(2), 183–216. https://doi.org/10.1068/p090183
21. Ho, G., Scialfa, C. T., Caird, J. K., & Graw, T. (2001). Visual Search for Traffic Signs: The Effects

of Clutter, Luminance, and Aging. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *43*(2), 194–207. https://doi.org/10.1518/001872001775900922
22. *Home—Globe At Night*. (n.d.). Retrieved September 29, 2024, from https://globeatnight.org/
23. Kaushik, K., Nair, S., & Ahamad, A. (2022a). Studying light pollution as an emerging environmental concern in India. *Journal of Urban Management*, *11*(3), 392–405. https://doi.org/10.1016/j.jum.2022.05.012
24. Kaushik, K., Nair, S., & Ahamad, A. (2022b). Studying light pollution as an emerging environmental concern in India. *Journal of Urban Management*, *11*(3), 392–405. https://doi.org/10.1016/j.jum.2022.05.012
25. Legge, G. E., & Foley, J. M. (1980). Contrast masking in human vision. *Journal of the Optical Society of America*, *70*(12), 1458. https://doi.org/10.1364/JOSA.70.001458
26. Liebel, B. (2024, September 11). *My neighbor's lighting*. DarkSky International. https://darksky.org/resources/what-is-light-pollution/light-pollution-solutions/lighting/my-neighbors-lighting/
27. *Light Pollution—Globe At Night*. (n.d.). Retrieved September 28, 2024, from https://globeatnight.org/light-pollution/
28. Lima, R. C., Pinto Da Cunha, J., & Peixinho, N. (2016). Light pollution: Assessment of sky glow on two dark sky regions of Portugal. *Journal of Toxicology and Environmental Health, Part A*, *79*(7), 307–319. https://doi.org/10.1080/15287394.2016.1153446
29. Lystrup, D. E. (2017). THE DARK SIDE OF THE LIGHT: RACHEL CARSON, LIGHT POLLUTION, AND A CASE FOR FEDERAL REGULATION. *Jurimetrics*, *57*(4), 505–528.
30. Maneka Gandhi vs Union Of India, AIR 597 ___ (The Supreme Court of India 1978).
31. Miller, G. A. (1994). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *101*(2), 343–352. https://doi.org/10.1037/0033-295X.101.2.343
32. Ntoutsos, G., Doulos, L. T., Zerefos, S., Papalambrou, A., & Balafoutis, T. (2021). Light pollution and sports lighting in dense urban areas: Early results in a case study of a stadium. *IOP Conference Series: Earth and Environmental Science*, *899*(1), 012038. https://doi.org/10.1088/1755-1315/899/1/012038
33. Rabaza, O., Aznar-Dols, F., Mercado-Vargas, M., & Espín-Estrella, A. (2014). A new method of measuring and monitoring light pollution in the night sky. *Lighting Research & Technology*, *46*(1), 5–19. https://doi.org/10.1177/1477153513510235
34. Rajkhowa, D. R. (2014). Light Pollution and Impact of Light Pollution. *International Journal of Science and Research*, *3*(10), 861–867.
35. Rosenholtz, R., Li, Y., & Nakano, L. (2007). Measuring visual clutter. *Journal of Vision*, *7*(2), 17. https://doi.org/10.1167/7.2.17
36. Singh, D. (2023, November 8). Lights out! Mumbai's silent war on glare, and 'killer' billboards. *Mid-Day*. https://www.mid-day.com/mumbai/mumbai-news/article/lights-out-mumbais-silent-war-on-glare-and-killer-billboards-23318801
37. *Skyglow*. (2023, January 25). Drishti IAS. https://www.drishtiias.com/daily-updates/daily-news-analysis/skyglow-1
38. Stuart, J. A., & Burian, H. M. (1962). A Study of Separation Difficulty*. *American Journal of Ophthalmology*, *53*(3), 471–477. https://doi.org/10.1016/0002-9394(62)94878-X
39. Tyukhova, Y. (2015). Discomfort glare from small, high luminance light sources in outdoor nighttime environments. *ETD Collection for University of Nebraska-Lincoln*, 1–294.
40. *What is light pollution?* (2024, January 11). DarkSky International. https://darksky.org/resources/what-is-light-pollution/
41. Wolfe, J. M. (2018). Visual Search. In J. T. Wixted (Ed.), *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience* (1st ed., pp. 1–55). Wiley. https://doi.org/10.1002/9781119170174.epcn213