Original Research Article

LIGHT POLLUTION: TO WHAT EXTENT WE ARE CONCERNED ABOUT

ABSTRACT

Light pollution is now a global problem with a catastrophic impact on human health, environment, ecology, plant life cycle, and animals. Some nations have enacted laws aimed at limiting light pollution. Unfortunately, there is no such regulation in Bangladesh, and if there is, it is not being enforced. In this study, an attempt has been made to investigate people's perceptions of light pollution in Bangladesh. This study collected three hundred forty samples using a convenient sampling technique. Descriptive statistics were employed to analyze the data. Among the sources, the respondents identified commercial light, fireworks, light from the market, and light from billboards as the major sources of light pollution. Besides light from the neighbor's house, own domestic light, events light, and light from home were assumed to be the significant disturbing light sources. Findings showed that most respondents agreed with the hazardous impact of light pollution on human health, animals, the environment, and the ecosystem. Among the possible solutions, respondents recommended developing awareness, limiting light at night-time, cutting off unnecessary lights, and reducing the frequent use of decorative lights. Results conclude that people have a sound understanding and good perception of light pollution. So the associate agents can take appropriate steps toward light pollution control.

Keywords: Light pollution, artificial light, perception, light at night, Bangladesh

Introduction

Light pollution is inappropriate, ungoverned, and unwanted excessive artificial light, mainly introduced by rapid urbanization and population growth on earth (Bashiri, 2014). Light pollution can severely affect the environment, disrupt the life cycle of plants and wildlife, affect the safety of both physical and psychological human health and change the whole ecosystem (Lyytimäki& Rinne 2013; Howlader & Kazi 2020).

Light is necessary, especially at night, but human health can be adversely affected physically and psychologically by excessive and inappropriate light (Kim et al. 2015). Some lighting can improve mood, lower fatigue, and reduce eyestrain but it may have some bad effects like reducing concentration and making nervousness, which is one of the critical physiological aspects of excess use of artificial light (Chepesiuk 2009). It can adversely affect the eyes; glare can happen when light scatters in the eye causing high contrast (Spadea et al. 2016).

Bashiri (2014) reported that shiny lights can harm human health during the night, and they can change blood pressure by around eight times. This occurs in people who work with computers and watch television frequently. Among women who underwent fertility treatment, night shift workers were more likely than day workers to have menstrual irregularity or endometriosis (Fernandez et al. 2020), and the possible reason is working at night under artificial light for a very long period. Moreover, it is a factor to cause cancer in most female night-shift workers, who have a 50% greater risk of developing breast cancer (Anisimov 2006).

Besides the effect on human health, the ecosystem has direct effect of light pollution. Artificial light disrupts inter-specific interactions evolved in natural patterns of light and dark, with severe implications for community ecology (Longcore 2004). Ecological light pollution includes chronic or periodically increased illumination, unexpected changes in illumination, and direct glare (Száz 2019). Especially plants that use the night's length for flowering and fruit can face severe difficulty and damage. Raven & Cockell (2006) have

shown that excessive light can stop releasing photocrome hormone by plants at night and in darkness, which is needed for plant growth, and this phenomenon results from the extermination of the plants. Also light at night can disrupt reproduction, larval development, and pupal diapause, with likely negative impacts on individual fitness (Boyes et al. 2021)

Light Pollution is now a global concern and has a devastating effect on our environment, ecosystem, plants life cycle, human health, and wildlife, it is high time to pay proper concern in this regard in Bangladesh. Otherwise, in the future, we will have to pay more for this. In Bangladesh, there is a lack of enough literature regarding light Pollution. To our knowledge, almost no studies have been conducted on light Pollution, and peoples' perception-based related to light pollution-focused research literature are very rare in the perspective of our country. To successfully adopt good policies by the government and policymakers, knowing the people's perception and knowledge about light Pollution is very important. So,in this study, the specific objective was set to explore the people's perception of light Pollution in Bangladesh.

This paper will contribute in the following ways: first, it will provide an insight into the current state of people's perception of light pollution; second, it will assist academicians in further exploring the current state of light pollution and related studies; third, policy implications will be possible to address based on the findings of this study; and finally, general people will be able to learn more about the light pollution scenario in Bangladesh.

Materials and Methods

In this study, a cross-sectional survey design was employed. Using this method, data was collected simultaneously from a sample of individuals in order to assess their perceptions and experiences.Between May and June 2022, a well-developed questionnaire on the perception of light pollution was circulated using social media (Facebook and LinkedIn) by sharing

different groups and personal timelines of the authors especially focusing on the Sylhet division of Bangladesh. Besides, questionnaires were circulated physically to the respondents who were accessible to the authors and collected later from the respondents, using convenient sampling technique. Any male or female more than 18 years old and having at least 10 years of education were considered as the valid respondents of this study.

A total of 157 responses were received finally and among them a total of 140 complete responses were considered for this study. Before the circulation of the questionnaire pretesting was conducted to test the simplicity and accuracy of the questions. Necessary adjustments, like change in question pattern, defining terms etc., were made after pretesting. Questions related to the impacts of light pollution on human health, animal, plants and the environment were gathered based on the existing literature after necessary modification. The questionnaire has four sections: perception of light sources, views of light pollution, the sources of light that disturb the most, and their effect on humans and the environment. Questions about the possible impact of light pollution were designed on 5 points Likert scale (strongly agree, agree, don't know, disagree, and strongly disagree). The study used descriptive statistics to analyse the collected data. Tables, graphs, frequencies, percentages, averages, and standard deviations were all made in order to summarise the findings.

Result and Discussion

Top sources of artificial light at night

Table 1 shows the main sources of artificial light at night, for which respondents were asked to select up to five items from a list. According to the findings, 64.12 per cent of respondents identified commercial lighting as a potent source of light pollution. Commercial lighting was seen as a major source of light pollution since persons in commercial locations utilize lighting all night for security or adornment. Followed by this, almost half of the respondents said own domestic lightwere the second most common source of light pollution they witnessed. Light

from markets and social events at night ranked third in light pollution, with 45.29 per cent of respondents claiming these sources as a cause of light pollution. Light in the market at night is frequently used for security purposes or to make the market more attractive to the customers. Billboards are widely used to promote items in cities and towns, and at night, they employ light to boost the visibility of their ads. Since there is no time limit of showing these ads at billboard at night, it is assumed a major source of light pollution. In this survey, 42.35 per cent of respondents named billboard light as one of the major sources of light.

Table 1: Top sources of artificial light at night as per respondent's perception

Light sources	**Frequency**	**Percent**
Streetlight	106	31.18
Commercial light	218	64.12
Light from urban areas	82	24.12
Yard light	50	14.71
Car light	108	31.76
Light from home	44	12.94
Office light	72	21.18
Light from market	154	45.29
Sports light	82	24.12
Events light	154	45.29
Light from billboards	144	42.35
Neighbours house light	46	13.53
Fireworks	40	11.76
Own domestic light	166	48.82

Furthermore, one-third of respondents stated that car lights and streetlights are fundamental causes of light pollution in their localities. In Bangladesh, many people use a personal car, and as a means of night travel, people often use public transport at night. As a result it is considered as a major source of light pollution having impact on the environment.

Besides, street light is used over the night in the residential areas. Although this light is vital for better movements and ensuring security at night, it is becoming a major source of light pollution due to uncontrolled regulations. Other sources of light pollution mentioned by respondents included light from urban areas (24.12 per cent), sports light (24.12 per cent), office light (21.18 per cent), yard light (14.71 per cent), light from neighbours' houses (13.53 per cent), light from home (12.94 per cent), and Fireworks(11.76 per cent).

Top sources of light that bothered people most

In addition to the leading causes of light pollution, respondents were asked to name the top sources of light that bothered them the most. Table 2 reveals that light from neighbours' houses bothers individuals the most. Half of the respondents claimed that the light from their neighbours' houses disturbs their sleep. In a residential area, a group of people live together and use different light forms. Especially some people have a habit of sleeping earlier than others sleep at night. Those who sleep earlier frequently face problems when light enters their house. Unnecessary light from one's home is a significant source of light pollution worldwide. People often use unnecessary light in their own homes for decorative purposes.

Moreover, some light may disturb, especially when people are susceptible to high voltage light, which may bother them. In this study, 38.82 per cent of those surveyed said that light from their home also bothers them. Immediate following light from one's own house, events light was regarded as a distressing source of light pollution by 37.65% of the total respondents. In an event, people decorate their apartments and sometimes the entire building in Bangladesh. As a result, people who are old aged and children face problems while they go

to sleep. Besides, there is no time limit for this lighting, and sometimes people use it all night. The government has no specific laws against this to limit this light source. In some communities, different social organizations take steps for such a source of light but are not observed in all areas. Another source of light that occasionally disturbs people is light from homes in the community. In this survey, we discovered that nearly one-third of respondents said light from their homes bothered them. Businessmen frequently utilize light throughout the night in shopping malls and markets for commercial or security purposes. In this survey, 27.06 per cent of respondents said that light from markets bothers them since merchants utilize light all night. Other sources of light were billboard lights (23.53 per cent), streetlights (21.18 per cent), sports lights (17.06 per cent), and commercial light (14.71 per cent).

Table 2: Top sources of artificial light bother respondents the most during sleeping

Light sources	**Frequency**	**Percent**
Streetlight	72	21.18
Neighbors house light	174	51.18
Light from urban areas	52	15.29
Light from home	114	33.53
Light from market	92	27.06
Sports light	58	17.06
Events light	128	37.65
Light from billboards	80	23.53
Commercial light	50	14.71
Own domestic light	132	38.82

People's perception regarding effect of light pollution

Before commencing on any policy implications, it is critical to understand the public's view of any given goals. We asked respondents to give their thoughts in this survey. Sixteen statements were constructed on a five-point Likert scale to determine people's perceptions regarding light pollution as shown in Figure 1. Respondents could express their thoughts on each item by selecting five options: strongly agree, agree, do not know, disagree, or strongly disagree. Statements were developed that focused on the effects of light pollution on human health, animal health, and the environment. Light pollution influences photosynthesis and photoperiodism; with this assertion, 41.18 and 28.82 per cent of the respondents agreed and strongly agreed, respectively.

This implies that a significant portion of the respondents knew about the light sensitivity of plants in their photosynthesis and photoperiodism processes. 27.65 per cent of participants disagreed that light pollution affects photosynthesis and photoperiodism. Plants are sensitive to blooming, and the timing of flowering is primarily determined by the amount and duration of light available (Seif et al. 2021). Respondents were asked whether increased nighttime lights surrounding plants prevents them from ever flowering. In this context, 38.82 per cent of respondents agreed with this argument, while 25.88 per cent and 26.47 per cent strongly agreed and disagreed with it, respectively.

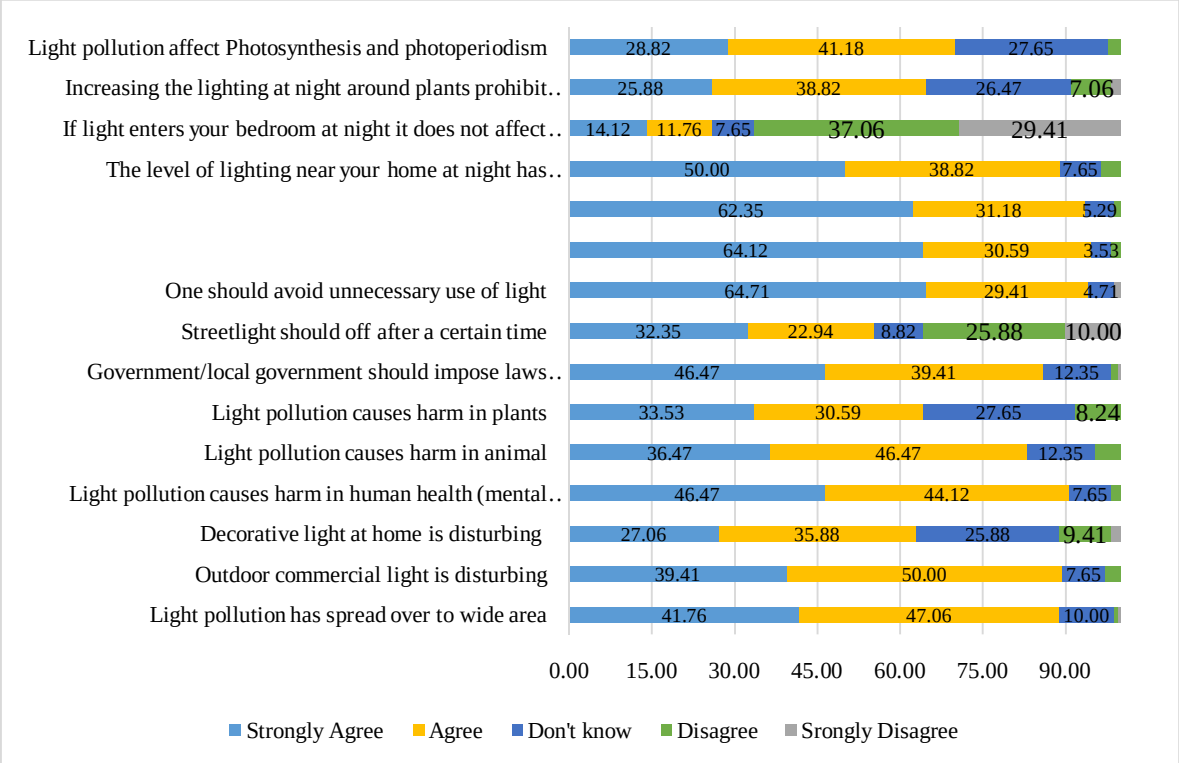

Figure 1: Perception of light pollution of the respondents (percent)

Some persons whose sleep quality was affected by the availability of light. One-third of those answered disagreed that if light enters their bedroom at night, it does not affect their sleep. In addition, 29.41 per cent strongly disagreed with this assertion. In this study, half of the respondents strongly agreed that the number of lights near their house at night had grown in the last five years, and 28.82 per cent agreed. Aside from that, around two-thirds of them strongly agreed that, compared to rural regions, urban areas are plagued mainly by light pollution. In Bangladesh, we are observing rapid urbanization, and with the increase in urbanization, artificial light at night is increasing due to heavy industrialization and commercialization.

As a result, people who live in urban areas are experiencing more and more lighting near their houses. Again, most industries and commercial areas are located in urban areas in Bangladesh due to lower decentralization of administrative management. As a result, light

pollution is observed more in urban areas than rural areas due to expanding urbanization in industries and commerce. When asked if excessive availability of artificial light affects the sleep cycle of humans and animals, 64.71 per cent agreed. A study found that nighttime artificial light disrupts natural sleep cycles and causes sleep deprivation, resulting in several health problems, including cancer (Rybnikova et al. 2015). In this study, 33.53 and 36.47 per cent of those polled believed that light pollution could harm plants and animals. Scientific proof suggests that artificial light will adversely affect creatures at night, along with amphibians, birds, mammals, insects, and plants (Jamal et al. 2022). Over half believed that light pollution harms human mental and physical wellbeing. As Provencio et al. (2000) stated that excess light could damage photoreceptor cells in the retina, causing vision loss. About sixty-five per cent of respondents strongly agreed that wasteful use of light should be avoided, while 32.35 per cent strongly agreed that streetlights should be turned off after a set hour. Even though street lights are a significant cause of light pollution, around 36% disagreed with the assertion. We questioned respondents whether they found light from decorations and commercials to be bothersome. In this survey, 25.88% and 50% agreed that both of these lights bother them. About half of respondents also strongly agreed that light pollution had spread across a vast region, while just 10% disagreed. Government should play an essential role in regulating the wasteful use of light. Half of the respondents strongly agreed that the government/local government should enact legislation against light pollution.

Possible solution to minimize light pollution

Respondents were requested to provide some feasible solutions to control light pollution in Bangladesh, rising every day until adequate regulation is implemented. Table 3 shows the possible solution to limiting light pollution by the respondents. Most respondents (72.35 per cent) agreed that raising awareness about light pollution may effectively minimize light pollution in Bangladesh. Raising awareness can be a better solution because if people know

the effect of light pollution on humans and the environment, they will willingly be more interested in controlling this. Aside from that, 61.18 per cent of respondents said that limiting nighttime light was a solution to light pollution. Light is essential at night, but after a certain period, excessive light is not necessary. Especially in the shopping mall, markets, and street lights can be switched off after a particular time.

Table 3: Possible solutions of light pollution as referred by the respondents

Solutions	**Frequency**	**Percent**
Cut off unnecessary lights	198	58.23
Limit lighting at night-time	208	61.18
Reduce frequently use of Decorative lights	192	56.47
Use LED lights	164	48.24
Make automated lights that switch off when they are not needed	168	49.41
Plant night-glow trees along roadsides and in residential areas	144	42.35
Only purchase IDA Approved light fixtures (IDA-International Dark Sky Association)	100	29.41
Develop awareness about light pollution	246	72.35

Occasionally, unneeded light is used in many areas, and 58.23 per cent believe that turning off unnecessary lights might be a suitable option. Decorative lights are a significant cause of light pollution in metropolitan areas. Reducing the frequency with which they are used is a preferred method mentioned by nearly half of the respondents. Making automatic lights that turn off when they are not needed is seen as a good option by 49.41 per cent of respondents, while 48.24 per cent believe that installing LED lights can be a solution for controlling light pollution. Planting night-glow trees along roadside and residential areas was also a helpful method for lowering light by 42.35 per cent of survey respondents. Finally, 29.41 per cent of

respondents indicated that purchasing IDA (International Dark-Sky Association) certified light fixtures can help reduce light pollution.

Conclusion and recommendation

Light is unquestionably essential for existence; at the same time, too much of anything is hazardous. For this excess, light is considered "pollution." With the acceleration of urbanization, light usage is expanding in tandem. This wastes a country's earnings and our finite natural resources. It is urgently needed to be worried about light pollution and to restrict its activity. This study explored people's perceptions and brought to light this significant issue that is growing at an alarming rate. It was found that the impact of light pollution on human health, animal, plant and the environment is well perceived by most respondents. Among a list of significant sources of light pollution, light from commercial areas, fireworks, events and markets, and street and car lights were considered the primary light sources. However, a slight difference was observed in the light sources that disturbed most. Incredibly light from the neighbor’s house, own domestic light, event light and light from home were most disturbing as found from the survey. All the following sources can be controlled by posing laws or setting a time limit to use high voltage light at night. Although in this study we mentioned a light of light that may be a major source of light pollution, other light sources may also be responsible for light pollution and hamper humans and the environment. We listed statements about the possible effect of light pollution. It was found that most of the surveyed respondents agreed that it affects human health, animal, plant and the environment on different dimensions. Besides positive attitude was observed toward controlling light pollution by limiting unnecessary use of light, and they think the government should play the primary role in this context. While respondents have concerned about the impact of light pollution, they also recommended some shorts of solutions which may limit this pollution. Among the solutions, creating awareness among people was found mostly recommended

solution. Besides limiting light use at night, cutting off unnecessary light and reducing frequent decorative use could be reasonable solutions.

The increasing trend of light pollution has been a serious concern globally in the last two decades. If we do not pay attention right now, Bangladesh may suffer a lot in the future due to the uncontrolled use of artificial light everywhere. Creating consciousness is very important in this context to know the importance of limiting light use and the consequence of unnecessary light on human health, animal, plant and the environment. In addition, the authorities can take actions such as with other pollution, consider light pollution or enact legislation for those activities with lights that most bother the public. An automatic shutting street light system can be proposed by the authorities to limit this source of pollution.

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