



Light Pollution and Its Effect on the Environment

Fereshteh Bashiri*, Che Rosmani Che Hassan

Faculty of Engineering University of Malaya, Kuala Lumpur, Malaysia

Email: angel_bashiri@yahoo.com

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ABSTRACT

Light pollution can cause disturbance to humans as well as animals. The aim of this study is to determine the effect of light pollution on human's health, plants, animals, human body and People's attitude about light pollution. About 90% of people strongly agreed that excessive lighting has adverse effects on a person's health. At least, 70% of people had difficulty in sleeping because of light pollution. Most of people believed that video Billboards, Spotlights, Car headlights and Street lights are the most important source of light pollution and about 60% of people agree that light pollution can affect animal's sleep. 60% of people believed that excessive artificial light can attract several kinds of birds and insects. The results of this study indicate that the human health, plants growth and animal behaviour are strongly affected by the light pollution.

Keywords: Light pollution, human health, animal behaviour, plant growth

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INTRODUCTION

Light is necessary, especially at nights. Lights are useful but can be dangerous. Light is one of the important sources of pollution in the environment but can adversely affect the human body, animals and plants, destroy the sky at night and increase energy costs. The intensity of light pollution in America, Europe, Japan, Australia and Middle Eastern has been showed in (Fig 1). Artificial lighting leads to more sky glow, reducing astronomical observations, and leading to changes in the night time sky. Sky glow is due to improperly shielded lighting, improper adjustment and unnecessary light fixtures (Pun & So, 2012). Humans can be affected psychologically and physiologically by different types of light. Some lighting can improve mood, lower fatigue and reduce eyestrain. One of the important psychological aspects from lighting is reduce concentration and making nervous (Chepesiuk, 2009). Light pollution can have adverse effects on eyes. Glare can happen when light scatters in the eye causing high contrast. Glare can also cause traffic accidents. Bright points of light from poorly designed roadway lighting produce a condition known as disability glare. Disability glare is so intense it causes us to avert our eyes from the veil of light being

scattered across our retinas. Fully shielded roadway lighting reduces this hazard and creates a safe and more pleasant driving experience by distributing the light evenly (Falchi, Cinzano, Elvidge, Keith, & Haim, 2011). Scientists report that shiny lights can be harmful to human health during the night. It can change the blood pressure around eight degree. This occurs in people who work with computers and people who watch television a lot. Light can create stress and confusion and cause serious physiological and ecological problems not only for the present but also for future generations. Excessive light can change behaviours and make the people moody. It can effect to everything in society and their relationships (Chepesiuk, 2009). Female employees working a rotating night shift were found to have an elevated breast cancer risk associated with occupational exposure to artificial light at night. It related to release of melatonin in the body causing changes in the body. Especially in industrial countries there is a straight link between breast cancer and light pollution. Breast cancer can rise where night time lighting is prevalent. It is the first risk factor to cause cancer in most female night shift workers who have 50% greater risk of developing breast cancer (Anisimov, 2006; Kerenyi, Pandula, & Feuer, 1990; Reiter, Gultekin, Manchester, & Tan, 2006).

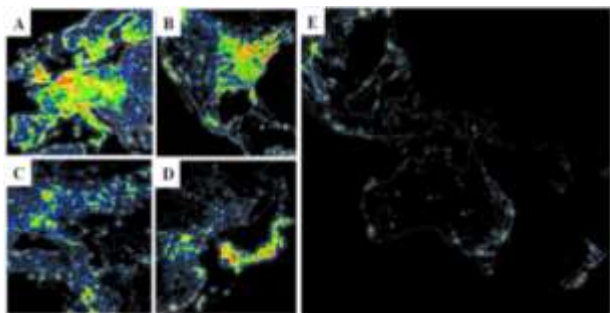


Fig1. Light pollution of America (A.D) Australia (C) Japan (D) and Middle Eastern (E)

This research found even blind women have high melatonin concentration and low risk of breast cancer (Anisimov, 2006). Light pollution can have severe effect on plants and animals as well as human. Using artificial light can affect the environment and can change birth, life and death. It can change birth habits by degradation of their eggs and Light pollution can change ecosystems directly (Chepesiuk, 2009). The extra light for plants can be dangerous for them and their life cycle can be affected by light. Many plants use the length of night for speed of growth and time of flowers and fruit and this can be very important. Photoperiodism is the term for adjusting the photochrome hormone (Raven & Cockell, 2006). Plants need the photochrome hormone for growing to be released at night and darkness. Light pollution can change the metabolism of plants such that if they are not in a dark place during for a period of time, they never can have flowers and colours. The investigation shows lights at night can stop the release of the photochrome hormone, resulting in the extermination of the plants (Raven & Cockell, 2006). The scope of this paper is limited to outdoor night time lighting, although it is quite common for indoor lights to be kept on overnight in office and retail buildings, which further contributes to night time light pollution.

MATERIAL AND METHODS

In order to achieve the goals set up, several different methods are used. The research method is concentrating on several areas of environment suffering excessive light and determining how people are affected by them. Sufficient qualitative data to be collected to confirm the survey results, then research and documentation of lighting in the environment was performed in order to determine the most suitable methods for reducing light pollution. In addition observations were conducted at locations of amount of excessive lighting in order to gather more data on source of light pollution. The objective of this paper is the effect of light pollution on environment, human, plants and animals. This research is based on gathering data through questionnaires and literature reviews followed by analysis by the researcher. Then sources of light pollution, kinds of adverse effects and problems that occur for humans must be identified. Suggestions will be made for reducing and controlling these issues.

STATISTICAL SOCIETY DATA COLLECTION

These Questionnaires answered were: 56% Students, 12% professors, 12% Experts, 20% Doctors in relation with this major. Most of these Questionnaires were distributed between University Putra Malaysia and University Malaya. The methods of data collection is based on books, magazines, papers and electronic documents were used and also the opinions and perspectives of managers and experts from official agencies, together with analysis of the questionnaire data. The research processes involves literature review of the definitions and classifications of light pollution, collection of resources available and data from questionnaire then analysis them. Also to identify some major factors that affects the environment. Conclusions and recommendations will be made at the end of the study. Moreover in this study, 63 questionnaires were filled and 50 of them were valid. The information from these questionnaires will be presented as, Gender: 86% male and 14% female, Position: 56% students, 12% professors, 12% experts, 20% Doctors. Age: 60% of them are over 40 years old and 40% below 40 years old. Education: 2% of them have Diplomas, 18% Bachelors, 80% Masters and PhD. Experience: 56% below 10 years and 44% over 10 years experience and in final, the degree of compliance with research is 94% of them study in this field and 3% of them don't study in this field.

RESULT AND DISCUSSION:

Light pollution has a negative impact on many different areas of the world. The evidence shows the impact of light pollution on animals, such as birds, turtles, insects and hatchlings near the sea can be dangerous and must be surveyed. Light pollution can be recognized as a factor for growing environmental problems. It occurs more in populated areas. Outdoor lighting and indoor lighting consumes lots of energy and is sometimes used without any purpose. During the last years the level of outdoor lighting has been increased with brighter lights. Another goal is researching regulations regarding light pollution to determine possible lighting in the area. The first step for reaching this goal is documenting light rules and adding to this list through research. These rules are different for every country but there are some international rules that have been approved by different countries. This section mainly tries to identify the sources of light pollution and measures them for getting results to control them.

LEVEL OF BRIGHT LIGHT FROM OUTSIDE RESIDENCES AT NIGHT

Level of bright light in fact is Light trespass that occurs when unwanted light enters every property that can cause sleeplessness or blocking the view. Many cities have good standards for outdoor lighting to protect from light trespass. It is necessary to know about minimum lighting requirement with good recommendations and information for citizens to identify damaging structures and provide a suitable mechanism for advising the consumer.

Table 1. Questions and answers

Questions	Responses (50)			
1. Do you believe excessive lighting can adversely affect a person's health?	Yes	90%	No	10%
2- How strongly do you feel affected by excessive artificial lighting outside of your residence?	No Effect A little Effect	10% 40%	Effect Highly Effectuated	10% 16%
3- If you do feel affected, please rate the following statements on a scale of 0 to 4, where 0 is No effect whatsoever and 4 is Highly affected	Sleep loss/deprivation No Effect A little Effect Effect Highly Effectuated Visual Fatigue No Effect A little Effect Effectuated Highly Effectuated Weariness No Effect A little Effect Effectuated Highly Effectuated	6% 16% 68% 70% 8% 4% 16% 72% 14% 10% 14% 62%	Anxiety No Effect A little Effect Effectuated Highly Effectuated Depression No Effect A little Effect Effectuated Highly Effectuated	10% 20% 10% 60% 4% 6% 8% 82%
4- Please rate how bright you feel the area outside of your residence is at night.	Pitch Black A Little Black	54% 10%	Fair Brightness Bright as day	30% 6%
5- What would be your ideal level of brightness outside of your residence at night?	Pitch Black A Little Black	10% 30%	Fair Brightness Bright as day	10% 50%
6- Have you ever considered moving elsewhere because of the level of light outside your Residence?	Yes	80%	No	20%
7- Please rate how much you feel the following contributes to exterior excessive lighting on a scale of 0 to 4 where 0 is "None whatsoever" and 4 are "Highly excessive"	Video Billboards None low Moderate High Spotlights None Low Moderate High Flashing advertising signs None Low Moderate High	10% 6% 4% 80% 20% 16% 24% 40% 30% 10% 20% 40%	Car headlights None low Moderate High Street lights None Low Moderate High	16% 30% 4% 50% 14% 6% 10% 70%
8- Do you know what is light pollution?	Yes	20%	No	80%
9- How much do you feel the excessive light can effect on plants?	None Low Moderate High	10% 16% 14% 60%		
10- Do you believe that artificial lighting can have adverse effect on animals?	Disorientation Yes No Mortality Yes No Sleepless Yes No	10% 90% 10% 90% 50% 50%	Nesting behaviour Yes No Attraction to light Yes No	20% 80% 60% 40%

MOVING BECAUSE OF THE LEVEL OF LIGHT OUTSIDE

Sometimes the level of brightness is very high and people cannot tolerate but they don't have any chance for moving to

another place because of money problems and they are obliged to tolerate it. These lights can change mood, fatigue and reduce eyestrain.

EXTERIOR EXCESSIVE LIGHTING AFFECT

Here we see how different sources of exterior excessive lighting affect people.

1-Billboards: Most of the people believe that video Billboard in contribute to excessive exterior lighting especially in city centres. These billboards have excessive light that can disturb human and animals.

2-Spotlights: Spot lights are one of the most important sources of light pollution that can affect every live thing because of its brightness.

3-Car headlights: People who live near the street, roads and highways are affected by car headlights. It disturbs their life because of the brightness outside. The level of light was high for this group.

4-Street lights: People who live near streets suffer because street lights are on all night and affect their sleep. They believed it has high effect. Insects don't have long life because of this excessive light that they cannot understand when is day and when is night. It can cause death as soon as possible.

5-Flashing advertising signs: There is a problem with flashing advertising signs and some people cannot tolerate this situation. Actually Researches show that Sources of light pollution include interior and exterior lighting for buildings, advertising, commercial properties, offices, factories, street lights and illuminated sporting venues. Light pollution also known as photo pollution or luminous pollution and is related to excessive artificial light. Most of the unwanted consequences are outdoors. Light is scattered in the atmosphere by minute particle of dust or water. The most important threat of light pollution is the impact on the environment and animals. Consequently we must have a plan to reduce the impact of this pollution and ensure the safety and protection of animal and human health and psychology. Overall evidence shows the impact of light pollution can be disperse around the world and can cause large-scale mortality due to this artificial light.

6-The awareness of light pollution: Unfortunately most of the people don't know about light pollution and they don't know the harmful effects on human health and environment.

EFFECTS OF EXCESSIVE LIGHTS ON PLANTS

Previous study shows extra light for plants can be dangerous for them and their life cycle can be affected by light. Many plants use the length of night for speed of growth and time of flowers and fruit. Light pollution can change the metabolism of plants such that if they are not in a dark place during for a period of time, they never can have flowers and colours. The investigation shows lights at night can stop the release of the photochrome hormone, resulting in the extermination of the plants. Low pressure sodium lamps can disrupt the photoperiodic regulation of plant growth and development.

ADVERSE EFFECT OF ARTIFICIAL LIGHTING ON ANIMALS

1-Disorientation: In this subject we can understand that artificial lighting can change the orientation to the wrong way.

2-Mortality: Artificial lighting can cause mortality for animals specially insects and birds that they cannot understand the time and right way.

3-Nesting behaviour: Many people couldn't believe that excessive light can affect nesting behaviour and it was new for them.

4-Attraction to light: Artificial lighting can attract several kinds of birds and insects. With the attraction to lights mortality increases too because they cannot understand the orientation and crash with objects around them.

5-Sleepless: Most of the experts know that sleeplessness can happen for both humans and animals. Researches show that using artificial light can affect the environment and can change birth, life and death. It can increase algae into the pools and decrease the quality of the water that can be dangerous for marine life. It can change birth habits by degradation of their eggs and Light pollution can change ecosystems directly (Fig 2).

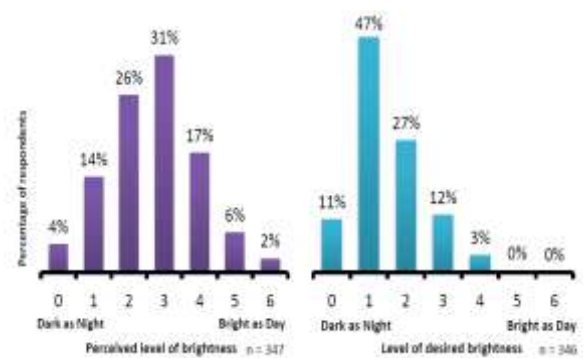


Fig 2. Perceived (left) and desired (right) levels of light

For example bright lights can disrupt the behaviour of birds. Sea turtles provide another example of how artificial light on beaches can disrupt their behaviour. In fact, Light pollution can attract sea birds and it is one of the important problems of world wide. Sea birds can strongly affected by man-made light. There are a lot of sources of light pollution that have the potential to affect sea birds especially street lights, parking places, individual houses, airports, fireworks and factories, stadiums and security lights. Light pollution is a critical problem around the globe. Managing light pollution effectively needs cooperation between the public, industries, government and private businesses. The unwanted light from indoor and outdoor can have psychological and physiological effects on human health depending on the amount, type and intensity of light. The results of research demonstrate light can have a negative impact on safety and research shows a link between exposure to light-at-night and human health hazards. It is necessary for research to examine light exposure and quantify the human factors. There is a link between reduced levels of melatonin (the melatonin hypothesis) and exposure to light-at-night. This leads to increase in breast cancer for humans. Light exposure, the physiological rhythms, exercise habits and diet are recognized as having a potential effect on cancer.

CONCLUSION

Obviously there is lots of evidence that humans have huge physiological problems due to all artificial light. It can be a positive or negative influence and should be studied by scientists to make a logical and valid conclusion. There is a link between mankind's health risks and light-at-night and this needs scrutiny to come to suitable conclusions (Anisimov, 2006). The study of light pollution needs further research. There should be collaboration between physical scientists, medical experts, engineers, biologists and ecologists. In environmental aspects, the measurement of light characteristics needs more research. Research regarding human physiology is quite active on carcinogenic effects of artificial night lighting, but the knowledge about the effects of dark periods on human physiology is not well known

REFERENCES

- Anisimov, V. N. (2006). Light pollution, reproductive function and cancer risk. *Neuro Endocrinol Lett*, 27(1-2), 35-52.
- Chepesiuk, R. (2009). Missing the dark: health effects of light pollution. *Environ Health Perspect*, 117(1), A20-27.
- 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. *J Environ Manage*, 92(10), 2714-2722. doi: 10.1016/j.jenvman.2011.06.029
- Kerenyi, N. A., Pandula, E., & Feuer, G. (1990). Why the incidence of cancer is increasing: the role of 'light pollution'. *Med Hypotheses*, 33(2), 75-78.
- (Anisimov, 2006; Kerenyi et al., 1990; Reiter et al., 2006). The illumination of every building can be attractive and it can improve security of the building and personal safety, but it must not have a deleterious effect on living or working conditions. Illumination should be limited in time and brightness. It should have low brightness to conserve energy, and not distracting for car drivers. The lighting of car parks or sports pitches needs good design to avoid overspill. The following recommendations are suggesting for reducing light pollutions as: 1-The Effect of all elimination of bare bulbs. 2-Using minimum light for decreasing the adverse effect of excessive light. 3-Shield or cut lighting for reaching suitable light in necessary areas that need illumination. 4-Using embedded road lights to illuminate the road. 5-Survey Government permits required for installing video billboards.
- Pun, C. S., & So, C. W. (2012). Night-sky brightness monitoring in Hong Kong: a city-wide light pollution assessment. *Environ Monit Assess*, 184(4), 2537-2557. doi: 10.1007/s10661-011-2136-1
- Raven, J. A., & Cockell, C. S. (2006). Influence on photosynthesis of starlight, moonlight, planetlight, and light pollution (reflections on photosynthetically active radiation in the universe). *Astrobiology*, 6(4), 668-675. doi: 10.1089/ast.2006.6.668
- Reiter, R. J., Gultekin, F., Manchester, L. C., & Tan, D. X. (2006). Light pollution, melatonin suppression and cancer growth. *J Pineal Res*, 40(4), 357-358. doi: 10.1111/j.1600-079X.2006.00325.x