

## **Light pollution: Are we forgetting Twinkle-Twinkle?**

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### **Abstract**

Contamination of urban space, both in the form of light and visual pollution, is a growing problem and affects virtually every city. It poses a threat not only on aesthetics but also to ecology. More and more people are slowly paying attention to the aesthetics of the city's information layout - new organizations and associations are emerging to fight against the excessive number of advertisements in space, this problem is getting more and more publicized, as is light pollution. The latter is talked about not only by ecologists and astronomy amateurs, but also by people who want their cities to be aesthetic and safe. Plants, Animals and Humans in urban and suburban areas are always at risk in the presence of artificial light; it alters physiology and may lead to pathology. There are no appropriate legal measures to govern the issues of interference with the urban space, and even if they exist, they are not implemented properly. Given its seriousness, the concerned agencies should pay attention to it.

**Key words :** Light pollution, Twinkle-Twinkle, Clutter, Skyglow.

**H**umans have always tried to transgress the limits of nature by controlling and subduing various elements of the surrounding world. One of the greatest abilities of primitive man was the mastery of making and sustaining fire. During prehistoric times before the invention of fire, the night was more dangerous than the day for humans. In the darkness, it is always hard to see the danger of predators and orient oneself. Fire gave a sense of security, provided warmth and made it possible to work even after dark. Nevertheless, almost until the invention of electricity, we were dependent on sunrise and

sunset. Light has completely changed people's lives; the subsequent development of civilization is the history of increasingly better sources of artificial light, which enabled people to extend their activity hours until late at night<sup>14</sup>.

The concepts of "light" and "darkness" are deeply rooted in culture. Light personifies God or something divine; in all the cultures of the World Light or Bright evokes positive associations, such as life, joy, safety, goodness or morality; Dark or Black symbolizes death, sadness, evil, fear or lies. In India, every year

on Kartik Amavasya (no moon day of the eighth month of the Hindu Calendar), fall in October or November, the Diwali festival is celebrated, consisting of the symbolic offering of light as a sign of the triumph of good over evil. Diwali is also observed in Indonesia, Malaysia, Singapore, Nepal, and Fiji.

#### *Light and lighting :*

Light plays a very important role in people's lives; the city at night began to bloom from the moment electricity appeared on the streets<sup>10</sup>. The first oil lamps were installed in the cities in eighteenth century. To this day, they are used rarely or ceremonially.

Now, after 200 years, metropolises are big sparkling spots; that can be seen from space. So, we can talk about the extraordinary conditions that urban lighting has created. Lanterns/streetlamps are one of the elements of the so-called Small architecture. These small architectures participate in the development of the city<sup>23</sup>. We would like to draw attention to the fact that small architecture can structure space both in a beneficial and harmful way. The same is true for city lights; it is noticed that these are not uniform in any city, ill-maintained and do not always fits well into a given space or have an inappropriate form, *e.g.* instead of illuminating only the sidewalks/streets, they shine in the windows of houses.

Street lamps play a significant role in the city - they are designed to illuminate streets, pavements, squares, promenades and parks, so they significantly contribute to guaranteeing safety; the number of traffic accidents and the criminal threat is decreasing. Usually, luminaries

are placed along streets and pavements at a distance of about 15-60 m from each other. A good street light design is very important, required for minimizing light pollution, *i.e.* minimizing the torrent of light directed upwards and to the sides, which contributes to poor visibility on the ground and is a useless waste of electricity. Present lampposts in the streets are fitted with numerous LEDs, which increases the efficiency of the lamp and avoids the possibility of placing the next pole too close<sup>1</sup>.

#### *Light pollution definition and concepts :*

Contamination of space with light can be defined as "Light Pollution"<sup>14</sup>. Although the combination of the words pollution and light may seem surprising. Technically, light pollution is defined in various ways, most often it is defined as:

- onerous impact of artificial lighting caused by its excessive or inappropriate use,
- any negative effect of artificial lighting, such as: dazzling, crossing the border of areas intended for lighting, over-illumination, reduced visibility due to poor lighting, light glare and waste of energy,
- change in the level of lighting in the external environment under the influence of an artificial light source,
- the introduction by man, directly or indirectly, of artificial light into the environment.

The source of ecological light pollution is man-made artificial light. Light pollution is caused by all artificial light sources used in outdoor lighting: road luminaires (estimated at 35% to 50%), illuminated advertisements, lighting of sports facilities, car headlights and reflective surfaces such as road surfaces or building

Table-1. Types, Causes and Effects of Light Pollution Hidden Causes and Visible Effects

Type	Causes	Effects
Over illumination	Improper design, Incorrect choice of lightings, high lighting intensity than the required	Affect local ecology, Animal Migration Problems
Trespass	Unwanted light entering into one's property (not needed)	Blinding Effects, dark areas in the field of vision
Clutter	Excessive groupings of lights	Generate confusion, Distract from obstacles, leads to Accidents
Glare	Difficulty of seeing in the presence of direct excessive bright light	Impairment of the vision
Skyglow	Excessive use of outdoor lighting and brightening of the night sky over inhabited areas	Diminishment pristine sky, Loss of stars, Impact on animals and Humans

walls. There are three main problems that accompany light pollution: intrusive light, illumination of the sky and glare. Intrusive (undesirable) light is light emitted towards objects that are outside the area for which the lighting was designed. The illumination of the sky (glow) is the result of the scattering of light in the atmosphere. The source of this phenomenon are luminaires emitting light above the horizon and light reflected from the surface of the road or buildings<sup>21</sup>.

An urge to protect the darkness is gradually a gaining global attention. We desperately need light, but we also abuse it. It is not only used to illuminate the interiors of houses, street spaces or pavements but it is mainly intended to facilitate functioning after dark and ensure safety. In addition to practical functions, light began to be used for decorative and iconic purposes.

But light only points to seemingly

absent elements in the simple sense of bringing things and events out of the darkness. Light reflects and scatters, creating new meanings from fragments already existing in our perception. It also fulfils a significant decorative function, sometimes changing and even falsifying the reality of certain places. It is often related to specific time circumstances - in the city, a particular intensity of light decorations can be observed during festivals or fancy shows of lasers and fireworks. In fact, not only do we see the city better, but we also see it differently. Light - especially those present in the space of the metropolis – is read as a sign of Civic-Pride/Development. Opulence/luxury means illuminating selected spaces by giving them meaning and a specific value<sup>19</sup>.

Festive lighting is a global custom, people decorate their houses and gardens with lights, and cities are wrought with colourful illuminations and flickering lights, which give a unique atmosphere and warm up the image

of cities. However, such seasonal illuminations are not the biggest problem. The only source of light pollution is improper and excessive lighting. A typical example is unshielded streetlamps, which can be found in almost every city, half of the light it produces is wasted and sent directly into the sky and cause glare, this worse visibility of the illuminated area. It is a massive waste of electricity. It is similar to the case of shielded lamps; in some cases, the shade is convex, directing about one-third of the light where it is not fruitful or needed. The increased beam angle also causes glare<sup>4,5</sup> and the use of this type of housing is ineffective. Only lamppost covered from above, with a flat shade (necessarily directed downwards), direct the light only where it is needed, *i.e.* on sidewalks or streets. The lack of light scatter beyond the designated area; the absence of glare makes it possible to use lamps with lower brightness to achieve a similar lighting effect as in the previous two types. The use of this type of housing gives better visibility of the surface, better usability and more safety of night lighting, and also uses less power.

Light pollution can be reduced, by changing the shape of the lampposts, a simple though expensive in the scale of the metro city. However, if the problem of light pollution was caused only by the wrong type of streetlights installed in the urban space, it could be solved or significantly minimized sooner or later. Unfortunately, as already mentioned, illumination has become a sign of prestige, a way to mark one's presence. All metropolises were founded as small towns, which now completely dominate the surrounding space. The glow of light hovering above these can be seen from a distance, and even from space, these places

appear as sparkling patches of light on Earth. Looking at the light maps of the world, we can see the difference between different parts of the world. Most of Africa, South America and Central Asia appears Black or Dark, devoid of light. The most illuminated regions of the Earth are the United States, China, Japan, South East Asia, Arabian Peninsula and Western Europe. These areas of world are regarded as developed and thus light has become embodiment of development.

Light is also strongly associated with architecture. An indispensable element of the exhibition is both natural and artificial light and manipulable. The 20<sup>th</sup> century brought an increase in interest in the possibilities offered by the use of artificial lighting, enabling the use of the aesthetic function of architecture after dusk. The illumination of bridges (through the reflection in the water mirror) gives special aesthetic effects, creating dignified, monumental, though often light, structures dressed in glitter. Well-thought-out and properly constructed lighting can result in extraordinary results, multiplying the emotional impact<sup>19</sup>.

It is interesting to see the values of the city, its attractions and the most significant points of the city by night signboards using light. They often show us the image of the cities we do not know while hiding their shortcomings, which daylight naturally highlights. Billboards, where light and an object play the paramount role, practically do not require processing with graphic programs because playing with light is sufficient. We can admire globalized cities on almost identical city-by-night signboards, where all major establishments and resorts look the same, and the inscription tells which place is embellished<sup>11</sup>.

The importance of the information layout is enormous, especially when modern cities are filled with various messages. Space users are attacked with more and more advertisements, presented in ever more sophisticated forms, and as a result they become indifferent and insensitive to the aesthetic aspect of the city. Particular intensity of information coverage can be found in city centres, but the peripheries are not free of it either - advertising there is even less orderly and more chaotic.

Cities, therefore, use light to promote and advertise themselves. Light attracts us like moths to fire. As we know, advertising is the lever of commerce and marketing. This also applies to cities that have become products; so, they take action to appear more attractive. Within cities, there is constant competition between various institutions, corporations or companies, which is not always subject to top-down control. As a result, there is colour and light chaos in the city space caused by the constant multiplication of neon signs. Initially, all these were attractive, but today they are becoming an element of visual pollution. Nowadays, the light of signboards, pubs and discos flashes everywhere; shopping malls and centres have grand illuminations, tourist attractions and monuments are excessively luminous.

Light pollution is a problem that affects not only large agglomerations; is now more and more common in small towns and villages. Artificial light has a negative impact on the ecosystem: forests, meadows, water reservoirs; disrupts the natural circadian cycle of plants and animals, disorients and traps migrating birds that cannot leave the illuminated area.

Hundreds of wildlife such as deer and zebras are killed on the roads in the evenings since the glares blind and distort their night locomotive aspects. Sea turtles have also been found to be highly reliant on natural lighting for reproduction, movement, eating, and development which can be heavily impacted by artificial lighting<sup>2,3,9,13,14</sup>.

Urban, suburban and rural populations respond significantly differently to night lighting (urban population is more comfortable to artificial light at night as compared to others), greater activity of individuals exposed to night artificial light in the morning and after dark is also observable. Disruption of the natural rhythm of day and night is the cause of sleep problems in many people, it also causes fatigue and lowers the body's natural immunity<sup>12,14,17,22</sup>. The illumination of the sky deprives people of the view of the starry sky and makes astronomical observations difficult. Light pollution is additionally accompanied by significant energy losses and therefore also financial losses.

LED advertisements in cities appear more and more often. Screens are hung everywhere, regardless of whether they blend into the background or stand out from it. However, the light they emit is often a threat to traffic, and its intensity is not yet regulated by any laws/regulations. The screens are usually placed close to the road at the main intersections in cities. The worst are the advertisements that change very quickly, drivers keep glancing at them unconsciously. It distracts them; causes a glare effect and can even blind them at night, and hence a step to the accident<sup>7</sup>.

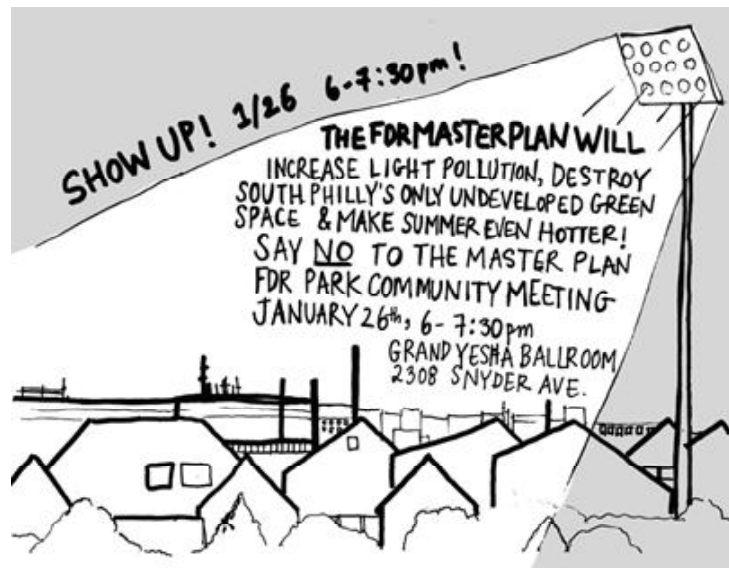


Figure 1: An effort (Source: <https://www.savethemeadows.com/events>)

No standards are there that could become their foundation; the threat is becoming bigger and bigger. Therefore, it would be worth having precise rules about where advertisements can be placed and what light intensity is acceptable but its far fetching<sup>8,24</sup>. Animals have always lived their natural rhythm dictated by nature. However, man is interfering with this nature more and more. It negatively affects mainly the migration of animals. Brightly lit cities confuse their instinctive migration directions, and many animals die as a result.

*Plan wiser-Do wisest :*

Besides the fact that excessive lighting is simply unhealthy and dangerous, it is also a massive overlooked environmental problem. Therefore, actions of ecological organizations, encouraging the reduction of light emissions, are becoming more and more popular. An example is “Earth Hour”, an action

related to the pro-ecological policy of the World Wildlife Fund (WWF) for Nature, held annually. In 2008 initiated globally, the concept was conceived in 2006 and for the first time “Earth Hour” was held on 31<sup>st</sup> March 2007 in Sydney, Australia. Later, San Francisco inspired and ran its own “Lights Out” program. Since 2008 every year, on the last Saturday of March, “Earth Hour” is held internationally between 8:00-9:00 pm, local time. The lights of famous buildings are turned off for an hour, in every country<sup>6,15,16</sup>.

One should remember to maintain a certain balance between development and the natural world, the eternal dissonance between development and nature. Often the solutions are very simple, and the benefits for nature and us - are immeasurably greater. Understanding the problem of light pollution leads to conclusions that contradict the symbolism of light and dark: light can be harmful, and

darkness is necessary. So, there needs to be a balance between light and dark. Fortunately, a compromise is possible. We all can make the night and the night sky darker. And it is not about plunging our towns and villages into darkness. We can have brightly lit streets and darker skies overhead, at the same time, and lower lighting expenses. For this to happen, a few simple rules should be followed when illuminating:

1. Use light sources with optimal brightness that is necessary. Brighter does not mean better and safer. There must be strict standards for how brightly different places should be lit. By reducing the brightness of the lighting to the appropriate level, we also reduce the amount of light hitting the sky after being reflected from the illuminated surfaces. In addition, it should be illuminated evenly so that there is no glare effect when moving from a lighter to a darker area and vice versa.
2. Turn lights off or dim their brightness when not in use. An example is the lighting of shopping malls and parking lots, which can be turned-off when these are closed. Another example is the illuminating the historic buildings throughout the night<sup>20</sup>.
3. Use lamp housings that direct the light downwards only and only onto the area to be illuminated, rather than shining directly into the sky. It is best to use lamp types that cause the least light pollution while being highly efficient<sup>18</sup>.

Light makes us feel safer. However, in excess, it can disturb the ecological order. Currently, attempts to reduce light pollution are becoming more and more popular. Organizations, cities, and sometimes even entire countries,

such as the World Wildlife Fund (WWF), National Geographic and International Dark sky Association, are involved in reducing this threat. It is increasingly difficult for us to see the stars in the sky. Nearly two-thirds of the Earth inhabitants live under skies polluted by light, and about one-fifth of people can no longer see the star constellations and Milky Way.

Perhaps that is why so far most of the information about light pollution can be found on websites dedicated to astronomy. Especial maps are cartographed showing light pollution in a given country and exhibiting places where this problem is not so alarming and where amateurs of the night sky can still watch the stars. Light pollution is a phenomenon that affects more spheres of life than it might seem. It concerns areas such as health and safety, ecology and economy, astronomy and finally culture and aesthetics<sup>6,8</sup>.

People need light because our most important sense, sight, works poorly in the dark. However, we are not very good at using light, in a sense, we abuse it. Day and night are natural phenomena of the circadian cycle, and people have blurred the line between these times by illuminating the night - they have extended the day to 24 hours. Artificial light disrupts ecological interactions evolved in natural patterns of light and dark, with serious implications for environment.

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