

Comparative Analysis on the Light Pollution Policies in Metropolitans

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Abstract: Light pollution is currently an influential environmental issue, and different countries are adopting varied measures to reduce its impact. As two of the most developed metropolitans, Shanghai and London, one representing the East and one representing the west, have applied different approaches to reduce obtrusive light in the last two decades. This study aims to compare the restrictions and guidance published by Shanghai and London. Specifically, it compares the statutory methods used by the two cities in fields such as complaints investigation, environmental zone division, outdoor regulation, indoor regulation, and non-human organism protection. To make a detailed comparison, the regulations are viewed on the governmental websites of the two cities and are analyzed. Specific commitments from different guidance and restrictions are categorized into several fields and are compared accordingly. The results showed that London focuses on the establishment of general goals and has a comparatively slower process, while Shanghai focuses on the details and has implemented numerous regulations in the last decade with surprisingly fast speed. It is believed that different political structures accounted for this result. On this basis, Shanghai needs to put more effort into responding the public opinions, and London needs to implement specific guidances that directly target the issues.

1. Introduction

Environmental issues have significantly increased along with the rapid development of industries and the change of lifestyle in recent decades. As a result, how to protect the environment from the damages brought by our new living style has become a hotly discussed topic. Thousands of legislations have been enacted targeting air pollution, land pollution, water pollution, and numerous other types of pollutions in all countries [1]. While everyone is concerned about the air, the water, and the plastic, there is one type of pollution that is also causing severe damages but is comparatively less acknowledged light pollution.

Since the 19th century, electric lights have been used to illuminate the city streets. This lighting revolution has marked the beginning of the rapid development of outdoor lighting. By clicking a switch or pushing a button, human defeats the nights. With the increasing use of electric light, people could work, play, and enjoy their life during nights in unlimited ways [2]. Soon, the urban spaces have been covered with brightness even during mid-nights. As people enjoy the beautiful brightness during the night, the negative side of excessive lighting began to show. This excessive misdirected, or obtrusive artificial lighting during the light environment is granted with a simple and clear term: light pollution [3].

According to the 2016 groundbreaking World Atlas of Artificial Night Sky Brightness, 80 percent of the world's population lives under skyglow, the brightening of the night sky. In the United States and Europe, 99 percent of the public can't experience a natural night!

The harms of light pollution, however, extend far behind the loss of the beautiful night sky. It has been found out that excessive lighting is affecting our health, our safety, our energy consumption, and our environment. Medical research on the effects of excessive light suggests that a variety of adverse health effects, including increased risks for obesity, headache, depression, sleep disorders, diabetes, breast cancer, and many others may be caused by light pollution or excessive light exposure. At the meanwhile, light pollution is constantly influencing our sense of sight, causing

various safety issues [4]. As reported by the Florida Atlantic University, the glaring light decreases our ability to see in the dark beyond the light, causing temporary night blindness, thus leading to huge driving safety concerns [5]. Light pollution also disturbs ecosystems. It can confuse animal navigation, alter competitive interactions, change predator-prey relations, and cause physiological harm. As a result, policymakers, regulatory agencies, and conservation groups from numerous countries are agitating for solutions to light pollution problems. Although been culturally, geographically, and economically varied, China and the United Kingdom are both suffering from this very same issue. The problem is particularly severe in the economic center of the two countries--Shanghai and London. Various mandatory and voluntary regulations on lighting have been enacted or drafted during the last two decades. The current study will compare and contrast the policies these two metropolises have employed to resolve the issues of light pollution.

2. Methodology

The current study discusses the similarity and differences between two cities Shanghai and London. Literature review, internet search, and document analysis took significant parts of this comparative analysis. Information about different policies was gathered from governmental websites such as the website of the Chinese People's Congress, the site of the Shanghai People's Government, the site of the United Kingdom Government, etc. Various other research analyses were read and referenced to better understand and describe the background of the two cities, the reasons behind different policies, and the implementation and enforcement of those policies. Google Scholar and CNKI.net. Shanghai and London were chosen to be the case to study since they are two significant commercial centers and are known for their considerably large use of artificial lightings. They are also the leaders in environmental protection in their countries the UK and China.

3. Background/Broad Environment

3.1 London

London has a relatively long history of combating light pollution. As one of the most developed metropolis in the world, public complaints about the obtrusive lightings have long existed in London. Voices against artificial light have occurred ever since the industrial revolution centered in London.

In 2003, the House of Commons Select Committee on Science and Technology reported on the impact of light pollution on astronomy, escalating the public awareness of the problem. Around the same time, the Department for Environment, Food, and Rural Affairs (DEFRA) had consulted on whether to make light pollution a statutory nuisance.

The voices against the obtrusive lighting are first officially responded. in the Clean Neighbourhood and Environment Act of 2005, which amended the Environment Protection Act of 1990. According to the section 79(1)(fb) of the amended Environment Protection Act, the local authorities of different cities, especially in a metropolis like London, have the obligation to accept and investigate the local complaints about artificial light emitted from premises so as to be prejudicial to health or a nuisance” and provide corresponding restrictions and regulations if necessary.

In 2009, the Royal Commission on Environmental Pollution (RCEP), a government agency in the UK that has the duty of advising the governmental officials and the public on environmental issues, published a report entitled ‘Artificial Light in the Environment’. In this report, the RCEP examined the impacts of artificial light on humans and on wildlife in depth. It recommended that the British government departments should be responsible for the implementations of legislation regarding light pollution. In response to this report, the Government's Natural Environment White Paper was published to emphasize the value of nature. It is committed to have Defra reduce “the impacts of artificial light and protect existing dark areas” and “consult relevant organizations on

whether the exemptions from artificial light statutory nuisance continue to be appropriate and then take action if necessary”.

Although many environmental plans acknowledge the issue of obtrusive lightings, specific guidelines and mandatory restrictions are still lacking. The light pollution issue was barely mentioned in the report of London Environment Strategy in 2018 and was not acknowledged at all in the London plans in 2017 and 2018. Generally speaking, there are still significant vacant in London’s statutory regulations toward light pollution. These areas for improvements will be revealed and explained in later parts of this paper.

3.2 Shanghai

“The Shanghai at night, the Shanghai at night, you are an ever-glowing city without night”. As sung in this symbolic 1980 Shanghai song “Ye Shanghai (Shanghai at Night)”, the city of Shanghai is beautifully bright even during nights: the LED and spotlights from night clubs and architectures always illuminate the night sky of this thriving city . Consequently, this “night city” faced severe problems with light pollution. This problem, however, was only directly faced and regulated in China in the last decade.

Obtrusive lighting was slightly mentioned in some National guidance along with other issues like odor and noises, but no specific regulation and measurement regarding light pollution was ever established before 2010. Light pollution became a “blind point” among all the environmental protection legislations. Soon, local authorities in some metropolises recognized this problem and implemented various guidance and restrictions regarding light pollution in response to the increasing public complaints.

The complaints about light nuisance from the Shanghai public reached a climax in 2010. In 2010, Shanghai hosted the World Expo. In order to equip for this international event, new lighting systems have been developed to decorate the river, the roads, the bridges, the streets, and landmarks for the beautification of the city. These efforts not only brought a fabulous World Expo but also triggered many voices against the obtrusive lights and the bright and blurry night sky. Numerous news occurred, reporting public concerns and complaints about the decorative lights and LED lights in commercial centers.

In response to those complaints, the local policymakers in Shanghai drafted “The Maximum Visible Brightness Limit and Measurement Method of Light-emitting Diode (LED) Display in Public Places”. This regulation, which is drafted in 2010 and published in 2013, officially marked the beginning of Shanghai’s battle against light pollution.

In 2012, the “Shanghai Environmental Decorative Lighting Code” and the “Measures of Shanghai Municipality on the Administration of Building Glass Curtain Walls” were passed to regulate the use of decorative light and set standards on the technical aspects of outdoor lighting . The former is widely adopted as the most authoritative guidance in Shanghai. In 2016, the “Regulations of Shanghai Municipality of Environmental Protection”, which was first published in 1994 and is one of the most powerful regulations in Shanghai, was revised . As one of the amendments, the reflective materials on the exterior walls of buildings were strictly controlled, and authorities in different districts and environmental protection agencies were asked to strictly supervise and restrict the use of materials that are going to produce light pollution. In 2019 November, the “Measures of Shanghai Municipality on the Administration of Landscape Lighting” was passed to provide mandatory instructions to solve light pollution . Under the lead of Shanghai, national guidance for lighting design of urban areas also started to include light pollution restrictions. For example, the “Code for lighting design of urban nightscape”, which was published in 2009 and provided a guideline for nightscape throughout the country, listed light pollution restriction as one of its purpose.

4. Comparison of Statutory Light Pollution Regulation

4.1 Environmental Zones

Authorities in both London and Shanghai have divided their cities into environmental zones based on the level of light pollution. The division of these four types of environmental zones provides significant convenience since it established recommended maximum illuminance levels for different zones. Those recommended maximum values could be used as goals, and more specific and efficient policies could be implemented with these goals as guidance.

According to “The Shanghai Environmental Decorative Lighting Code”, Shanghai is divided into four types of environmental zones: E1, E2, E3, and E4. E1 represents areas with the least light pollution, such as national parks, conservation zones, astronomical observable skies, etc. Those areas are meant to be protected from human influences, which, of course, include light pollution. E2 represents urban-rural fringe and inhabited zones. In those areas, illumination is necessary due to safety concerns, but the overuse of lighting would cause potential health issues on the residents, thus the luminaries in those zones should be limited to a comparatively small amount. E3 represents areas between E2 and E4, which represents commercial centers and city centers. E4 zones produce the most light pollution, and relatively large amounts of decorative lightings and LED commercials during nights are enabled. The guidance for maximum pre-curfew and post-curfew illuminance value is also presented.

Table 1. Regional division of urban environmental brightness from the “Shanghai Environmental Decorative Lighting Code”

Lighting environment	Dark Night Conservation Zone	Low Lighting Zone	Medium Lighting Zone	High Lighting Zones
Area Code	E1	E2	E3	E4
Examples	National Parks, Conservation zones, Astronomical observatory zones	Sub-urban areas and neighbourhoods	Low brightness urban areas and urban neighbourhood	Urban centres and commercial centres

Table 2. Maximum value of vertical luminance from the “Shanghai Environmental Decorative Lighting Code”

Time	Environmental Zone			
Pre-Curfew	2	5	10	25
Post-Curfew	0.5	1	5	10

This division of environmental zones is not the only criteria. Some guidance in Shanghai is published regarding more specific zones such as residential areas, commercial centers, administrative regions, and public spaces. These guidances are published owing to the specialties of these listed areas. For example, the residential area has the highest concentration of population, thus the potential influences of light pollution on human health should be more carefully considered in those areas .

The authorities in London use similar criteria for the division of environmental zones. Instead of four, however, London has five different zones. The ILP guidance note in London has divided Shanghai’s E1 into E1 and E0. Conservational lands with investigatory uses, such as astronomical observatory skies and starlight reserves, are classified as E0 since absolutely zero light pollution is allowed in those areas. National parks and relatively uninhabited areas are classified as E1, where a small amount of light pollution is allowed.

Besides the division of environmental zones, London also has a stricter regulation on the maximum value of post-curfew illuminance for E1, E3, and E4. The recommended maximum value of post-curfew illumine for E1 in Shanghai is 0.5 lx and is <0.1 in London. The maximum value for

E3 is 5 in Shanghai and is 2 in London. Shanghai's maximum value for E4 is 10, while London's maximum value is 5.

It is believed that London's criteria for environmental zone division are more reasonable. The London's E0 zones, such as astronomical observatory skies, have significant scientific uses. Thus, for the accuracy of scientific researches that is based on these areas, completely shielding the E0 zones is necessary. The researches conducted in those areas all have the potential to boost the development in astronomy and environmental studies, thus their accuracy should be guaranteed.

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4.2 Nuisances Complaints Investigations

Authorities in both London and Shanghai receive numerous complaints about obtrusive lights. Those complaints could be about street lamps, road lighting, giant LED commercials, etc. The two cities have varied attitudes toward those complaints.

Complaints investigation is neglected in Shanghai. Although the number of complaints about light pollution is rapidly increasing for the recent years, very few were directly responded since the local government hasn't assigned any specific agency to take care of light pollution issues reported by the residents. Thus, complaints about light pollution could be delivered to various agencies. Normally, if the obtrusive lightings are caused by street lights, the citizens could report the problem to municipal administration. If light pollution is produced by decorative lightings, the complaints should be delivered to the Landscape management agency in the district. If the obtrusive lights are produced by the LEDs for commercial uses, the citizens could call the City Environmental Protection hotline to report the problem. No direct response, however, is guaranteed even after the complaints have been delivered to the governmental agencies listed above. Deeper investigations of the complaints would also be difficult since the complaints are sent to different institutions.

London, on the other hand, has a complete system for complaint investigations. In 2005, the Clean Neighbourhood and Environment Act extended the duty on local authorities to periodically check their areas for nuisances arising from artificial lightings. The local authorities are required to reasonably investigate the complaints about obtrusive lightings and issue abatements if necessary.

In order to further understand the impacts of light pollution and draft corresponding policies, the Department for Environment, Food and Rural Affairs (Defra) has conducted several research projects to investigate light nuisances complaints. In 2010, Defra published a report investigating artificial light nuisance complaints and associated guidance available to local authorities. In the report, the data on the number of light nuisances complaints were examined. It found out that the overall numbers of complaints made about artificial light sources were low since the introduction of the legislation [36]. A 2011 Defra project that reviewed street lighting trials also encouraged local authorities to take notes of the outcome of trials by analyzing the complaints in order to examine the impact of reducing obtrusive lighting.

4.3 Protection Toward Non-Human Organisms in Urban Areas

The "Shanghai Environmental Decorative Lighting Code" listed several guidances that aim to protect green zones in the urban areas.

Light sources that are harmful to plants are forbidden in urban lighting system. Lightings in green areas and animal habitats during nights are not allowed. Line 5.2.1 set up several specific regulations regarding lighting toward plants in the green areas. It suggested the illuminates be installed on the ground and should be 3-5 meters away from the plants. Line 5.2.3 directed that the lightings in parks and green areas should prioritize safety, and the environmental damages should be kept at minimums.

Instead of publishing regulations targeting all protected zones, London mainly established national parks and Dark Sky Reserves to protect certain natural night skies from the interference of artificial light. According to Defra, a Dark Sky Reserve is “public or private land possessing an exceptional or distinguished quality of starry nights and a nocturnal environment that is specifically protected for its scientific, natural, educational, cultural, heritage and/or public enjoyment mission of a large peripheral area”. As mentioned in section 4.1 of this paper, absolutely no light pollution is allowed in conservation zones like Dark Sky Reserves. In this case, the animals and plants in those established Dark Sky Reserves can be fully protected from the artificial lightings. The establishment of such conservation zones is also statutorily encouraged. According to the UK government, “National Parks, Areas of Outstanding Natural Beauty and other areas with especially dark skies can apply for Dark Sky Status, an accreditation for locations that meet strict guidelines, awarded by the International Dark-Sky Association”.

Artificial lightings could have significant damages to plants and animals in the tree areas of the cities. Comparing to humans, other species are much more vulnerable while facing obtrusive lights. Thus, effective policies are required to protect these last bits of nature in the urban areas from the contamination of artifice lighting.

Also, as a coastal city, Shanghai definitely needs to draft light pollution policies specifically regarding the coastal regions. Shield light sources from the nestling beaches are necessary for protecting the ecology near the beach. Beaches are normally far from the urban areas and thus are often ignored on the issue of light pollution. Those areas need more attention because species living near those areas are easily influenced by light pollution.

5. Conclusion

Under comparison, it can be seen that London and Shanghai are taking the nearly opposite approach to regulate light pollution.

As one of the earliest cities to acknowledge the issue of obtrusive light, London has established a relatively solid background for solving light pollution issues. The local authorities set up a comprehensive system for investigating public complaints. The public could directly reach the government officials and gain answers for any confusion they obtain. The environmental zones are also nicely divided. However, London is weaker in practical terms. Despite the big and vague environmental promises, London has comparatively much less specific restrictions and guidelines that aim to reduce light pollution.

On the other hand, although Shanghai’s history of combating light pollution began several years later than London’s, it soon reached a similar level as London with its rapid implementation of restrictions and guidance. The regulations toward reflective lights are detailed to the thickness of glasses on buildings. Codes such as the “Shanghai Environmental Decorative Lighting Code” and the “Measures of Shanghai Municipality on the Administration of Building Glass Curtain Walls” are all about very specific guidance and limitations. The voices of the public, however, are neglected by the Shanghai light pollution investigators and policymakers. The general political ideologies of the two cities partially account for the differences in their approaches to regulate light pollution.

For London, public opinions are heavily weighted while drafting and passing environmental policies. In London, the mayor of London and the Greater London Authority (GLA) is responsible for proving the policies that regulate the important aspects of the city. Both the mayor of London and the GLA are elected democratically. The London mayor is elected by the general population who are eligible to vote, and the GLA is made up of selected representatives from the London Borough council, which is also democratically elected. This democratic system established the fundamental political belief that emphasizes public wishes. This belief is partially reflected in London official’s emphasis on complaint investigations. In addition, the drafts of different policies and plans, such as the London Plan, are posted on London’s governmental website to be viewed by the citizens. As presented in the picture, the citizens can raise questions, and the mayor will answer them publicly. The drafts might also be adjusted according to the confusion and suggestions of the

public. Under London's policymaking process, the citizens are able to contribute to the process of policymaking, and their wills and complaints are considered.

The shortcut of this system is obvious: since the public opinions are weighted heavily, the efficiency of policymaking is significantly decreased. Under this system, it takes years to pass a single guidance. As a result, although London has established general goals to reduce light pollution, more specific guidance and mandatory regulations are still lacking. Thus, boost the efficiency of policy and guidance making is the priority of London.

Shanghai is in the opposite situation. Since the process of policymaking is solely held in the hands of the local government, the regulations can be passed very quickly. The first regulation was passed only a few weeks after the rise of public complaints on obtrusive lights. This efficiency makes Shanghai one of the most superior countries in dealing with light pollution. This high efficiency, however, comes with disadvantages. The voices from the public are neglected, and people have little interference or even awareness of light pollution policies. Therefore, instead of emphasizing only the number of regulations that are passed, Shanghai might need to lay more attention to the investigation on public complaints, the regulation of public streetlight and road light systems, protection toward coastal regions, etc. Conflicts in the published guidances should also be fixed in order to clear the public confusion.

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