

SPATIAL TREND OF LIGHT POLLUTION IN OBIO/AKPOR LGA, RIVERS STATE, NIGERIA

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Abstract: The study examines the spatial trend of light pollution across the study area. The Global Positioning System (GPS) was used to acquire the coordinates of each respondent resident, where structured questionnaire were administered in the study area and then imported to the ArcGIS 9.3 software environment to analyse the spatial trend in light pollution using the Inverse Distance Weighted (IDW) method of interpolation. Findings, reveals that the perception of pollution by light stray is obviously noticed by the respondents with particular emphasis on light stray from traffic light, neighbor security lights which to a large extent alters their level of comfort and distort their level of outdoor relaxation. Thus, the study recommends, among others, that: shielded light bulbs or properly designed light fittings should be installed to avoid light rays spreading beyond the needed boundaries. And measure should be taken to ensure car drivers use properly fixed headlamps that are not damaged and also, awareness should be passed on adequate use of headlamps by road users (vehicle drivers) on streets when compared with use on highways and minor roads.

Keywords: Light, Pollution, Stray, Spatial, Anthropogenic, Environment.

1. INTRODUCTION

Light pollution is a form of pollution in the urban area that environmentalist do not pay adequate attention to, rather emphasis are paid on other forms of pollution like waste, noise etc. One of the massive downfalls of the modern civilization is the alteration of the natural environment, which include ambient light alteration. This phenomenon is classified as one of the human pollution towards the environment and is referred to as light pollution. Globally, there is a growing concern with the expansion of human habitation near and within natural habitats; fragile ecosystems are increasingly exposed to artificial night lighting. The natural night sky light comes from starlight, zodiacal light (sunlight scattering from dust in our solar system), and airglow in roughly equal quantities. Even a small amount of artificial light interferes with this delicate balance and overwhelming the starlight. Light pollution has become a worldwide problem impacting on culture, environment and energy, with unforeseeable consequences. Although the widespread use of artificial light at night has enhanced the quality of human life and is positively associated with security, wealth and

modernity, the rapid global increase of artificial light has fundamentally transformed nightscapes over the past six decades. Despite these significant increases, the impacts of artificial lighting from streetlights, and other outdoor lights, which concentrates largely in urban metropolis have a negative impact on the biosphere. This trend in the use of artificial lighting increases by 20% each year, depending on the region, and noted that, there is an urgent need for light pollution policies that surpass energy efficiency to include humans, animals and the environment (Holker et al, 2010). Light pollution in our urban center should be paid much attention to as it affects the feeding, sleeping, mating, and migration cycles of all wildlife. Wildlife can also experience disorientation of time when there is too much artificial light at night. Humans, like plants and wildlife, are regulated by circadian rhythms, the physical, mental and behavioral changes that occur in a 24 hour cycle (Mara, 2013). The circadian clock regulates physiologic activities such as brain wave patterns, hormone production and cell regulation. The rhythms respond to light and darkness around an organism. Disrupting these rhythms can result in a variety of health problems, including sleep disorders, anxiety, depression etc. Melatonin, the naturally occurring hormone that regulates the sleep and wake cycle, is acutely affected by light pollution. The hormone is activated by darkness and repressed by light. According to Lopez (1975), pollution is very annoying as most light pollution are caused as a result of officials who have lights installed and feel completely justified in allowing the light transfers beyond their property boundary. The problem is complicated by public ignorance: as most people do not know when light trespass and this concept of pollution by light trespass, therefore do not know what they are losing as a result of light pollution. The urban peripheries of Port Harcourt are fast developing, with an increased illumination and poor lighting installations outdoor. Poorly designed residential, commercial, and industrial outdoor lights are contributing significantly to light pollution. Unshielded light fixtures are emitting more light sideways and in many instances, fewer lights are seen to illuminate the ground, as such; it is expedient that something be done about the misdirected and unregulated artificial lighting that is polluting the environment. Bright and unshielded light not only helps promote crime but it increases the risk of being temporarily blinded while driving. This is because light that is unshielded or poorly directed results in light trespass, which is otherwise, seen as unwanted light and enters into ones property by shining over neighbors property is becoming a major problem, difficult for residents to deal with the glare and other resultant effects such as restricting view and sleep distortion. Glare causes reduced visual performance as light rays are scattered or reflected within the eye reducing the contrast of images on the retina. Such effects dramatically worsen as the human eye ages, contributing to poor night vision and difficulty in driving at night for older drivers (Shaflik, 2012).

Hence, this study seeks to understand the spatial trend of light pollution across Obio/Akpor Local Government.

Study Area

Obio Akpor LGA is one of the 23 local governments of Rivers state, found in the south southern part of Nigeria, otherwise called the Niger Delta Region of Nigeria, located approximately between latitude $4^{\circ} 45''$ N through $4^{\circ} 56''$ N and longitude $6^{\circ} 52''$ E through $7^{\circ} 6''$ E. It has a general elevation of less than 15.24m above mean sea level (Oyegun & Adeyemo, 1999). It is bounded by Ikwerre LGA to the north, Port Harcourt LGA to the south, to the east, Oyigbo LGA and to the West, Emohua LGA as shown in figure 1 & 2. Port Harcourt, Eleme and Obio/Akpor LGAs, make up the Port Harcourt metropolis which is on a firm ground and about 66km from the Atlantic Ocean (Oyegun & Adeyemo, 1999). Obio/Akpor LGA is one of the major centres of economic activities in Nigeria, and part of a major city in the Niger Delta, also referred to as the richest LGA in Rivers State. Consequent on rapid urbanization and the rising of industrial and commercial growth of the city of Port Harcourt, more goods and services are being made available, thus the springing up of urban activities, to meet up with the demand of the growing population.

Obio/Akpor LGA was created on the 3rd of May, 1989 out of the Port Harcourt LGA of Rivers state by the then Military administration of President Ibrahim .B. Babangida. It is mainly constituted by the Ikwerre ethnic nationality and has its LGA headquarters at Rumuodumanya (Mamman, Oyebanji, & Petters, 2000).

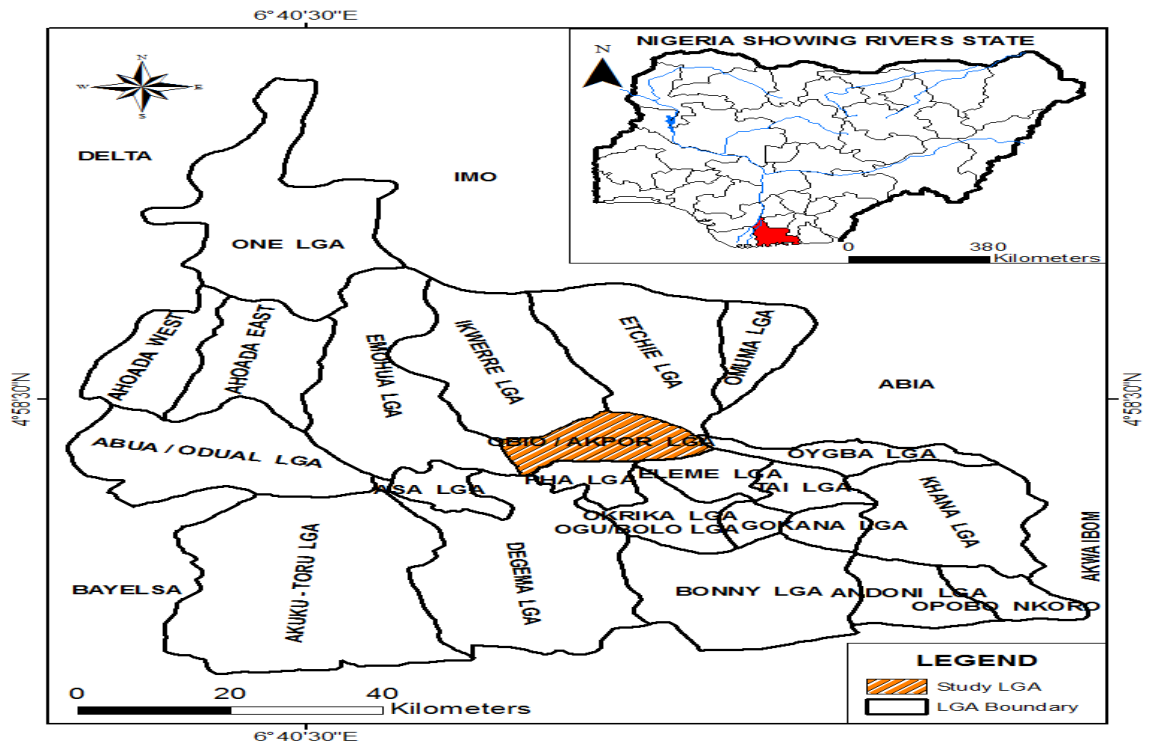
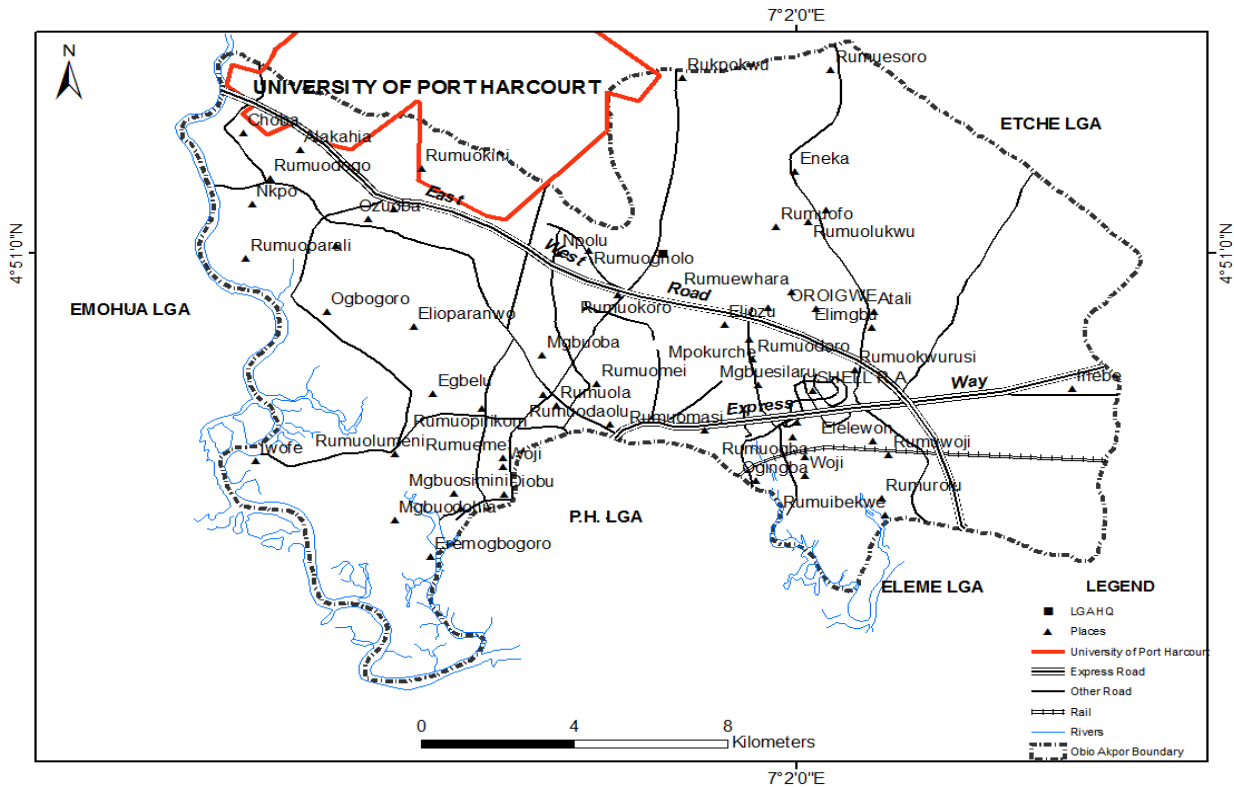


Figure 1: Rivers State Showing Study Area (Obio/Akpor LGA)



Source: Ministry of Lands & Housing, Rivers State

Figure 2: Study Area (Obio/Akpor LGA) showing Communities

2. MATERIALS AND METHODS

The nature of data that will be used in this research is derived from two sources: primary source and secondary source. The primary sources of data are derived from observation using personal interview, administration of questionnaire to respondents within the study area. The secondary sources of data were retrieved from journals, publications and reports done annually. The study population is made up of street lights, security lights, advertising lights, lights from neighboring building such as are unshielded, lights from cars headlamp. Random sampling technique was used in the distribution of structured questionnaire across the Local Government.

The data was collected with the use of cameras and questionnaires administered to extract information of the various lighting systems selected and classified according to types for the purpose of analysis. The Global Positioning System (GPS) equipment was used to collect the geographic location of each light pollution source or area (point) within the study area to understand the spatial dimensions of light pollution and was analyzed in the ArcGIS environment using the spatial analysis tool of Inverse Distance Weighted (IDW) method of interpolation.

3. RESULTS

Light pollution spots across the study area were mapped with the aid of the Global Positioning System (GPS GARMIN etrex 10) and ArcGIS. The data collected was used to show the spatial tendency of areas of noticeable light pollution. Colours were used to delineate boundaries of intensity across scale. For figure 1, the pink colour represents areas with more pronounced impact of light pollution, whereas the areas in light green coloration show little or no observable light pollution.

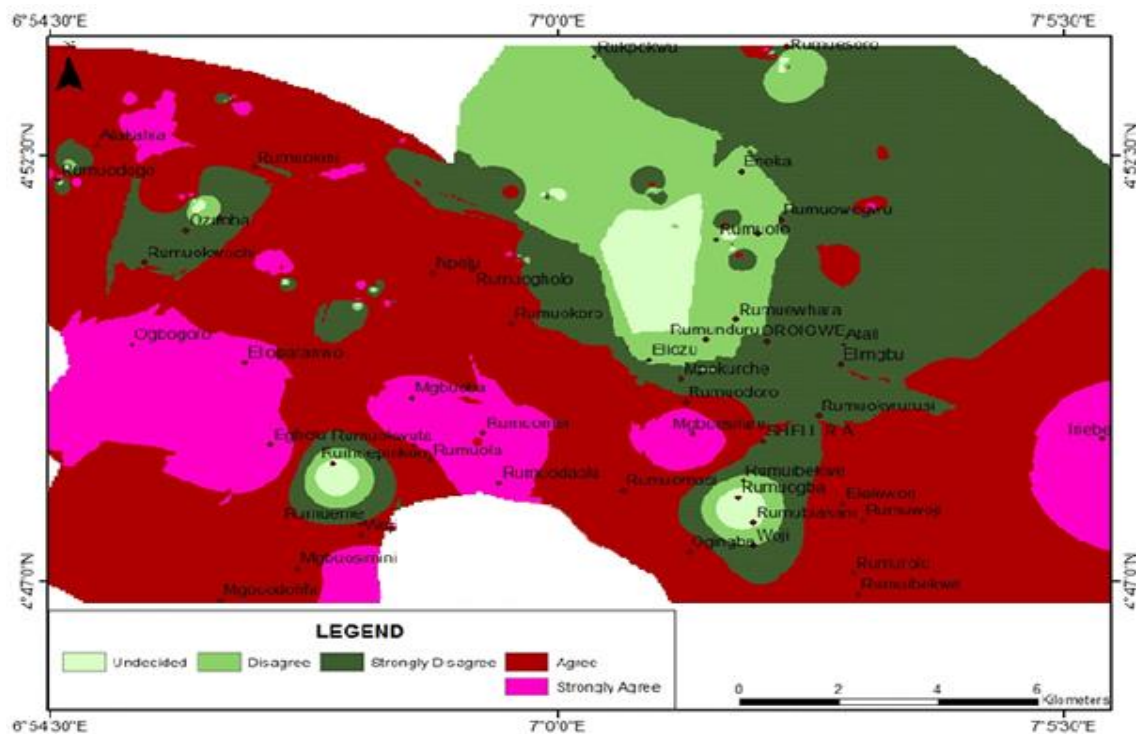


Figure 3: Perceived light pollution intensity across the study area.

Figure 1, shows the areas of intense light pollution on neighborhood and street as perceived by residents in the study area. The category of light pollution as observed by the residents reveals the intensity light pollution that prevents view beyond certain distance, thereby creating some level of dark hotspots within their neighborhood. From the figure 1, it is believed that there is intense light on street and neighborhood that prevents observation beyond certain distance at night and is noticed to be stronger within sections of the urban city. Also, homes having much outdoor illumination scattered across other residents are most times unaware of the pollution they generate causing some level of discomfort to those living around them, especially in the case of light trespass.

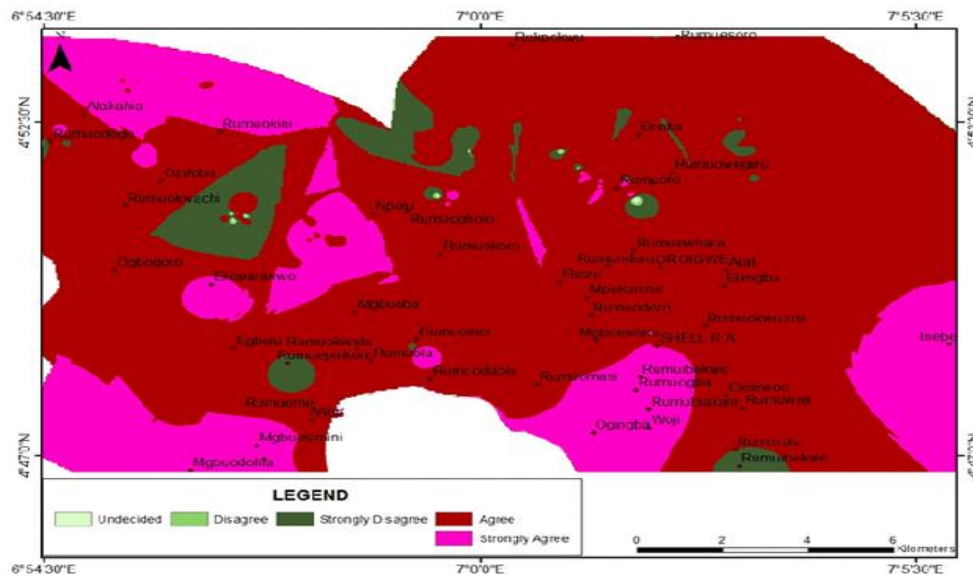


Figure 4: Perceived discomfort induced by anthropogenic night light stray/ pollution

Figure 4, this shows areas of intense stray of anthropogenic outdoor lightings causing discomfort to the people at different locations at night as retrieved from questionnaires and GPS across all the locations in the study area. The map reveals the strength of outdoor lighting resulting to the discomfort of the people residing in the area. From the figure, it is believed that intense outdoor lightings resulting in discomfort of the people within the stipulated regions as pronounced across the entire urban city area, having high level verdict affirming lighting stray discomfort by the respondents in the regions. Some of this light strays are associated to extreme light from car headlamps causing discomfort to the people living in most of the regions. The respondent’s views to anthropogenic light pollution expresses concern on the manner of car headlamp use especially along major roads and streets as car owners drive on streets with full intensity of light from car headlamps and annoyingly turn them on without dimming the lights when car is not in motion, reversing, and rather parked somewhere temporarily at night amidst occupants discussing.

This trend has to a large extent, threatened night outdoor relaxation among residents in the study area as shown in figure 5, revealing the attitude of car owners.

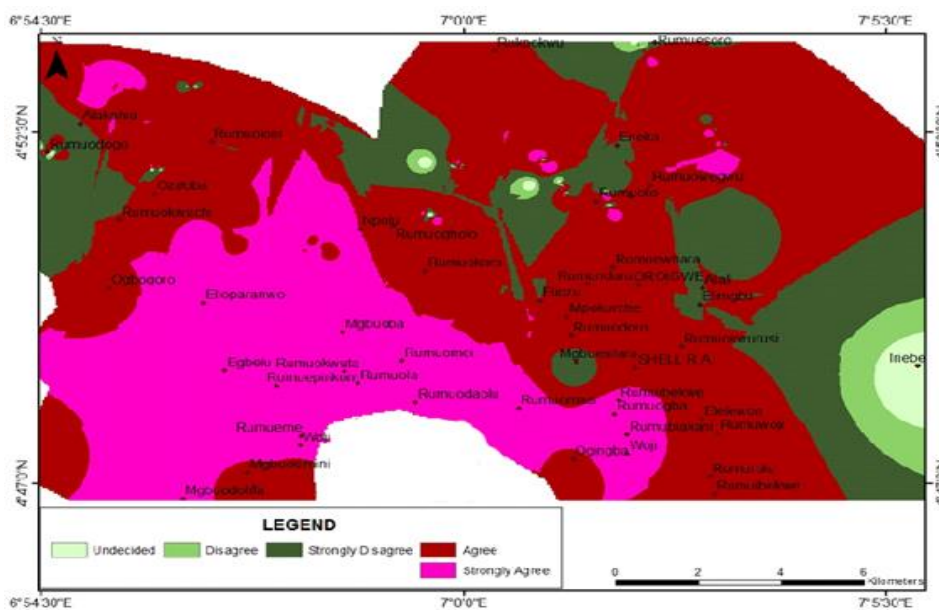


Figure 5: Car headlamp light stray threatens outdoor relaxation at night

Figure 5 shows responses from the respondents on the attitude of road users which obstructs or diminishes outdoor relaxation behaviours of residents. From the responses, it is observed that car owners most often than not, use car headlamps inappropriately when driving or reversing to discomfort the people spending time outdoors during relaxation, threatening the relation of the residents to stay outdoor.

4. CONCLUSION

The analysis on the spatial trend of light pollution across the study area reveals that, majority of the people residing in the city are just coping with or adapting to the lighting on homes and streets impacted by light pollution, pretending not to recognize its effect; while others move away from the spot, ignore, face the consequences or do not cope at all. Whether we pretend to recognize this concept or not, cope with it or not, move away to regain comfort, stay and adapt to it, turn off the light if possible and prefer to remain in darkness while outdoor.

From the findings of this study, the perception of pollution by light strays are obviously noticed by the respondents with particular emphasis on light strays from traffic lights, neighbours and neighbourhood security lights which to a large extent alters their level of comfort and distort their level of outdoor relaxation.

Hence, if nothing is done to regain our comfort and save our environment for the future (by using appropriate design style, proper positioning and accurate level of brightness when needed) light pollution will continue. It is therefore, recommended that shielded light bulbs or properly designed light fixtures should be installed to avoid light rays spreading beyond needed boundaries and measures should be taken to ensure that car drivers use properly fixed headlamps that are not damaged and also awareness should be passed on the adequate use of headlamps on streets when compared with use on highways and minor roads.

REFERENCES

- [1] Adam Fyfe and Genevieve Thompson (2015) Light Pollution Abatement: The Feasibility of Light Retrofitting for Trent University, Restoration Ecology - Trent University, Peterborough, Canada.
- [2] Fischer, A. (2011). Starry night. *Places Journal*. Retrieved 22 October, 2014, from <https://placesjournal.org/article/starry-night.com>
- [3] Gallaway, T. (2014). The value of the night sky. In J. Meier, U. Hasenöhrl, K. Krause, & M. Pottharst (Eds.), *Urban lighting, light pollution and society*. New York, NY: Taylor & Francis.
- [4] Holker, F., T. Moss, B. Griefahn, W. Kloas, C. C. Voigt, D. Henckel, A. Hanel, P.M. Kappeler, S. Volker, A. Schwope, S. 2010. The dark side of light: A transdisciplinary research agenda for light pollution policy. *Ecology and society* Vol.15 (iss10).
- [5] International Dark-Sky Association. "About IDA's Fixture Seal of Approval." Accessed November 19, 2013. <http://www.darksky.org/outdoorlighting>.
- [6] Jan Hollan (2009) what is light Pollution and how do we quantify it? Online as [http://amper.ped.muni.cz/light/lpwhat is.pdf](http://amper.ped.muni.cz/light/lpwhat%20is.pdf).
- [7] Kyba, C., Hänel, A., & Hölker, F. (2014). Redefining efficiency for outdoor lighting. *Energy & Environmental Science*, retrieved from [http://www.web of science.com](http://www.webofscience.com)
- [8] Mamman, A. B., Oyebanji, J. O., & Petters, S. W. (2000). Nigeria: A People United, A Future Assured. Abuja: Millenium Edition, Gabumo Publishing.
- [9] Mara Bermudez (2013) how does outdoor lighting cause light pollution. Del Mar Fans & Lighting. Retrieved from <http://www.delmarfans.com>
- [10] Mara Bermudez (2013) how does outdoor lighting cause light pollution. Del Mar Fans & Lighting. Retrieved from <http://www.delmarfans.com>
- [11] Mark Johnson A. (2009) "Missing the dark" health effects of light pollution. *Environmental health perspectives* vol.117(1).

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- [12] Morgan-Taylor, M. (2014). Regulating light pollution in Europe: Legal challenges and ways forward. In J. Meier, U. Hasenöhrl, K. Krause, & M. Pottharst (Eds.), *Urban lighting, light pollution and society* (pp. 159–176). New York, NY: Taylor & Francis.
- [13] Oyegun, C. U., & Adeyemo, A. (1999). Port Harcourt Region. Port Harcourt: Paragraphics.
- [14] Rasna Rajkhowa (2014) light pollution and impact of light pollution: International journal of science and research (IJSR), volume 3 issue 10, October 2014.
- [15] Rasna Rajkhowa (2014) light pollution and impact of light pollution: International Journal of Science and Research (IJSR). 2014; vol. 3(10)
- [16] Sperling, N. (1991). The disappearance of darkness. In D. L. Crawford (Ed.), *Light pollution, radio interference, and space debris* Vol.17 (10). San Francisco, CA: Astronomical Society of the Pacific Conference Series.
- [17] Starlight Initiative. (2007). *Declaration in defence of the night sky and the right to starlight*. La Palma: La Palma Biosphere Reserve. Retrieved 14 January, 2015, from <https://www.starlight2007.net>
- [18] Taylor Stone (2017) the Value of Darkness: A Moral Framework for Urban Nighttime Lighting. *Science and Engineering Ethics*. 2018; Vol. 24(2)