

Project Background

Night Time Light data from satellite imagery can give an indication of access to electricity which has a critical role in tackling poverty as it facilitates development. According to the World Bank, just 44.6% of Sub Saharan Africa had access to electricity in 2017. For Sustainable Development Goal 7 to be achieved, this must be increased to 100% access by 2030. This project aims to determine if light pollution is a suitable proxy for poverty in Sub Saharan Africa. Night time lights could offer an alternative, quick and visually impactful method of identifying underdeveloped areas, facilitating better distribution of resources.

7 AFFORDABLE AND CLEAN ENERGY



Procedures and Methods

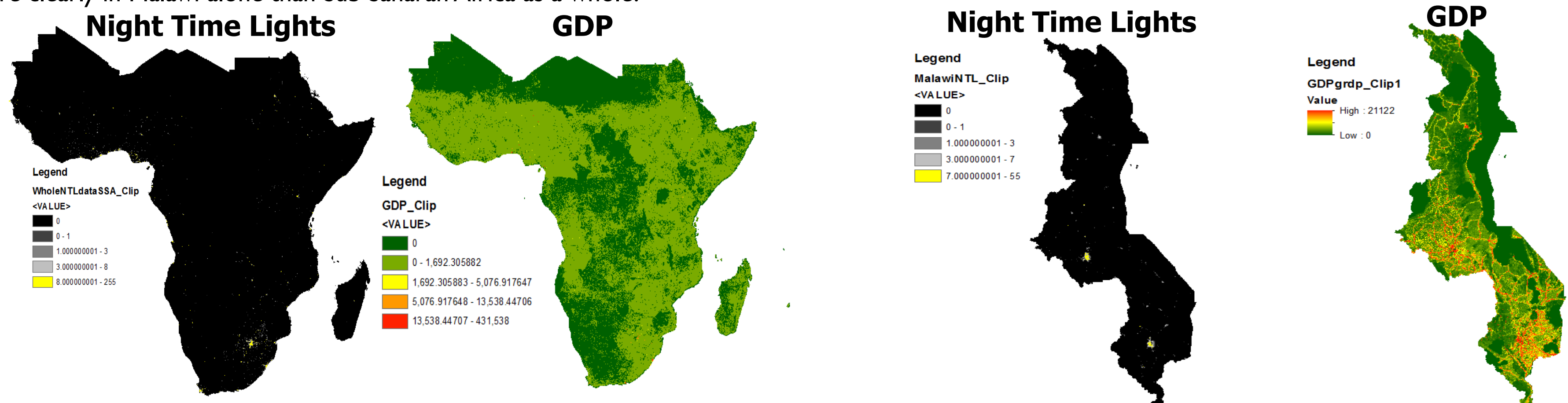
An Integrated Poverty Index was created to give a holistic representation of poverty by encapsulating three factors - health, education and income - and contained the following development indicators:

- Literacy Rate
- Life Expectancy
- Unemployment
- Government Effectiveness
- GNI (Gross National Income) per capita
- Measles Immunisation Rate
- Water Stress
- Access to Electricity
- Food Security
- Individuals Using the Internet
- Homicide Rate

Principle Component Analysis was applied to this dataset. This is a statistical method which reduces the quantity of variables while preserving as much information as possible. This returned a unique Integrated Poverty Index for each Sub Saharan African country which was compared to the mean value of night time light pollution in each nation. This data had already undergone an outlier removal processes and had background lights set to zero. The data was made more robust by the removal of areas of zero population from the night time light raster.

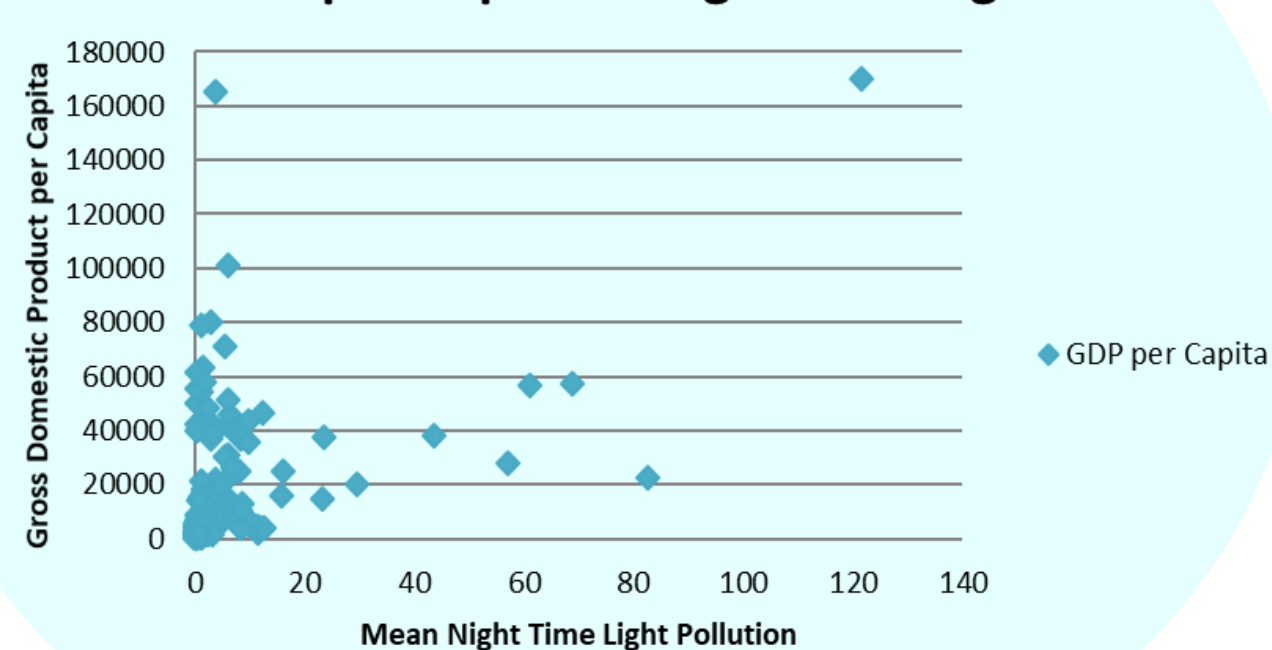
Results

The correlation between the Integrated Poverty Index and Night Time Lights was, although statistically significant, fairly weak as demonstrated by the correlation coefficient of 0.33 which was obtained. When the area of interest was localised to encompass just one country – Malawi - and when a single development indicator was isolated – Gross Domestic Product (GDP) - the correlation with light pollution strengthened considerably as highlighted by a new correlation coefficient of 0.92. This implies that certain development indicators may be more strongly linked to light pollution than others. GDP is a standardised indicator as it has a standardised method of data collection used by every country. Other indicators, such as literacy rates, are determined in different ways in different countries, perhaps resulting in a weaker correlation with light pollution. Furthermore, by considering data with a finer resolution and which has been zoned in counties rather than nationally, it seems that night time lights become a more suitable proxy for development. Maps show that although there is a correlation between night time lights and GDP, the correlation can be seen much more clearly in Malawi alone than Sub Saharan Africa as a whole.

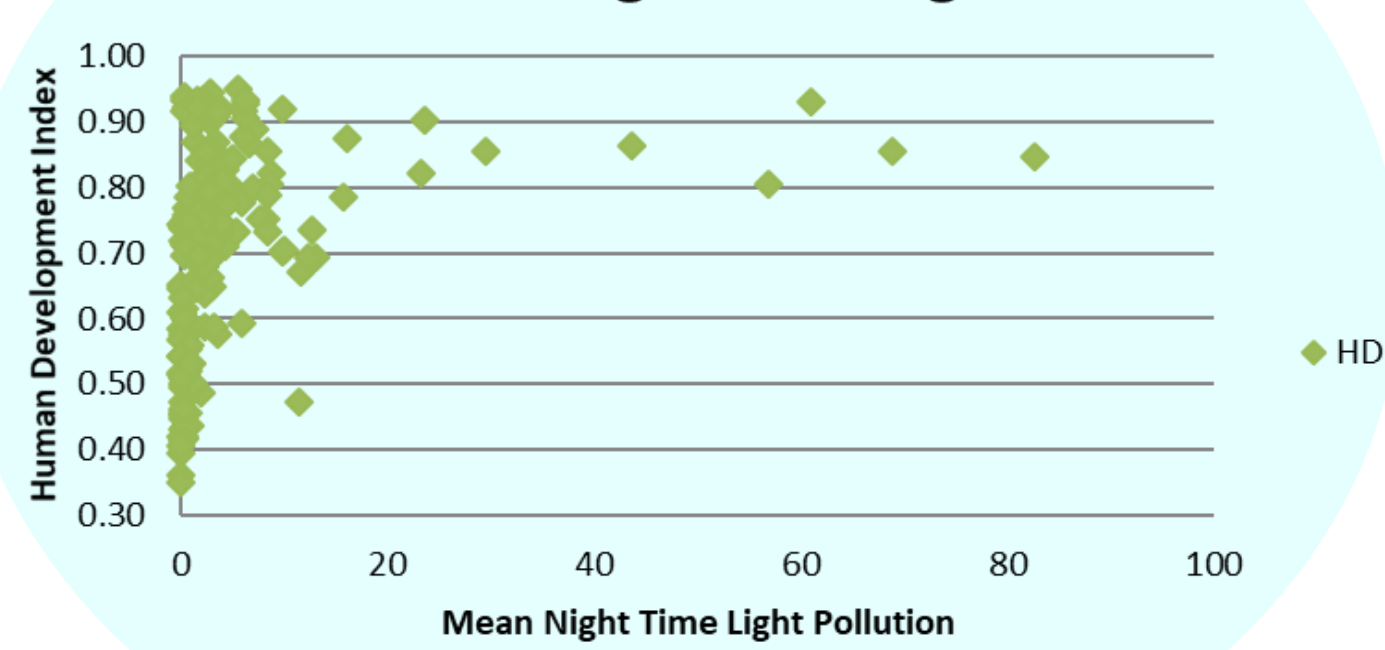


Broadening horizons to the whole world, it is clear that a correlation exists between light pollution and development but that this relationship may be exponential rather than linear. The relation between Human Development Index (HDI) and light pollution is particularly interesting due to its striking resemblance to that of an HDI versus per capita energy consumption graph from Energy for Development, implying that these relations are very similar. Further work is required to truly understand these relationships and the influential factors present. Overall it can be concluded that it is possible to use night time lights as a proxy for development, however, the type of development indicator used and the resolution, zoning and localisation of data are all very important considerations.

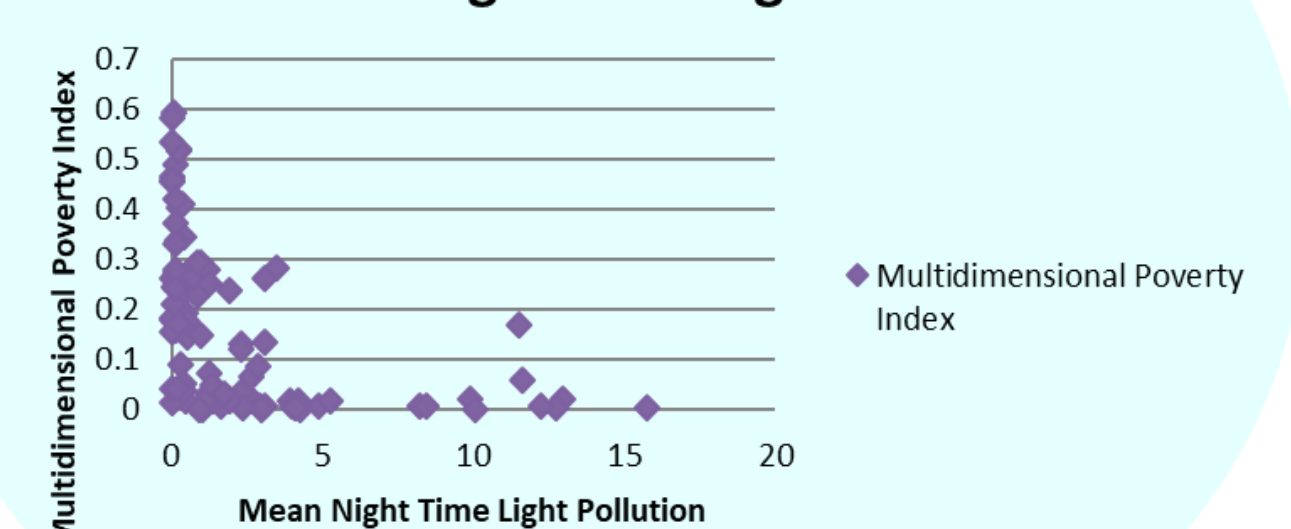
GDP per Capita vs Night Time Lights



HDI vs Night Time Lights



Multidimensional Poverty Index vs Night Time Lights



This index was taken from the United Nations