

Methodology – site selection

Using change in nighttime light data

To compile a longlist of potential study areas in Uganda and Tanzania, annual nighttime light data produced and described by Elvidge et al. (2021) was used in this study. Annual nighttime light imagery, called masked medians, of the years 2012 and 2020 were analysed to detect changes over that period. In this masked imagery other forms of radiation, e.g. biomass burning, have been removed.

Map algebra was applied to perform a change detection analysis for Uganda and Tanzania, looking at the years 2012 and 2020: The 2012 raster was subtracted from the 2020 raster (i.e. 2020-2012). Based on the histograms of the resulting rasters, three classes were defined, where:

- *Class 1:* areas with change below 0.2 nW/cm²/sr (no change, decrease, or small increase) were assigned the value 1.
- *Class 2:* areas with change from 0.2 to 1 nW/cm²/sr (moderate increase) were assigned the value 2.
- *Class 3:* areas with change above 1 nW/cm²/sr (large increase) were assigned the value 3.

After this reclassification, the data was polygonised, and the three classes were separated into individual layers. The *Class 2* data was then studied more in depth, as lower-level urbanization was assumed to have the potential of occurring in those areas, i.e. where there has been a moderate increase in nighttime light over the period 2012-2020.

nW/cm²/sr refers to light intensity

The NTL intersect with population data

NTL Class 2 layer – omit sites smaller than 2 pixels or smaller than 5km² in area = 462 sites

- Omit all sites peripheral to Dar es Salaam and within a 45km buffer from the following secondary cities:
 - Mwanza (pop:436,801)
 - Arusha (pop: 341,136)
 - Mbeya (pop: 291,649)
 - Morogora (pop: 250,902)
 - Tanga (pop: 224,876)
 - Moshi (pop: 201,150)
 - Dodoma (pop: 180,541)

(Popn data was taken from www.worldpopulationreview.com, 8th April 2022)

In Uganda this buffer was from Kampala and Mbarara and Mbale.

- This edited NTL Class 2 layer was then intersected in GIS with population size 30,000-100,000 layer. Here we used 2015 data from Africapolis. This is at the entire district level, thus larger than individual towns, thus why the higher range otherwise we ended up with sites too small to be classed as towns. Totaled 189 sites = 123 sites of intersecting polygons
- Due to the large distances in Tanzania in particularly we then draw a selection within a radius of 800km from Dar es Salaam and 300km from Kampala, due to the time and budget constraints which would limit traveling further afield. This resulted in 87 potential towns in Tanzania and 50 in Uganda.
- These towns were then further screened by looking at the resulting polygons in the GIS and non-towns e.g. mines, industrial facilities, army bases or unexplained rural polygons not coinciding with a clear settlement etc were removed from the selection. Where an entire town was covered with just one polygon tended to be an indicator of town electrification processes, rather than actual urbanization or town expansion (multiple polygons found in specific parts of the towns, often around the fringes). Most of such one-polygon sites were excluded after cross-checking by conducting a visual assessment of change over time using Google Earth Pro satellite imagery.
- The remaining possible sites were then assessed in more detail using the historic image (timeline) function in Google Earth to search for evidence that the towns did indeed seem to grow (densify or expand or otherwise become more built-up) over the past 8-10 years (from 2012), depending on what imagery was available in Google Earth.
- This step resulted in a longlist of about 10-15 towns for each country. These were then shared with our in-country counterparts to draw from their knowledge of the urban hierarchy, development trends and drivers of change. We then agreed upon a final selection of 8 towns per country as shown in Table 1:

Table 1: List of 8 selected towns per Country

Site	Uganda	Tanzania
1	Bugiri	Babati
2	Iganga	Bagamoyo
3	Luweero	Boma Ngombe
4	Masindi	Chalinze
5	Mityana	Gairo
6	Mpigi	Karatu
7	Nazigo	Kondoa
8	Pallisa	Korogwe

Maps of the locations of the resulting town selection are shown in figures 1 and 2.

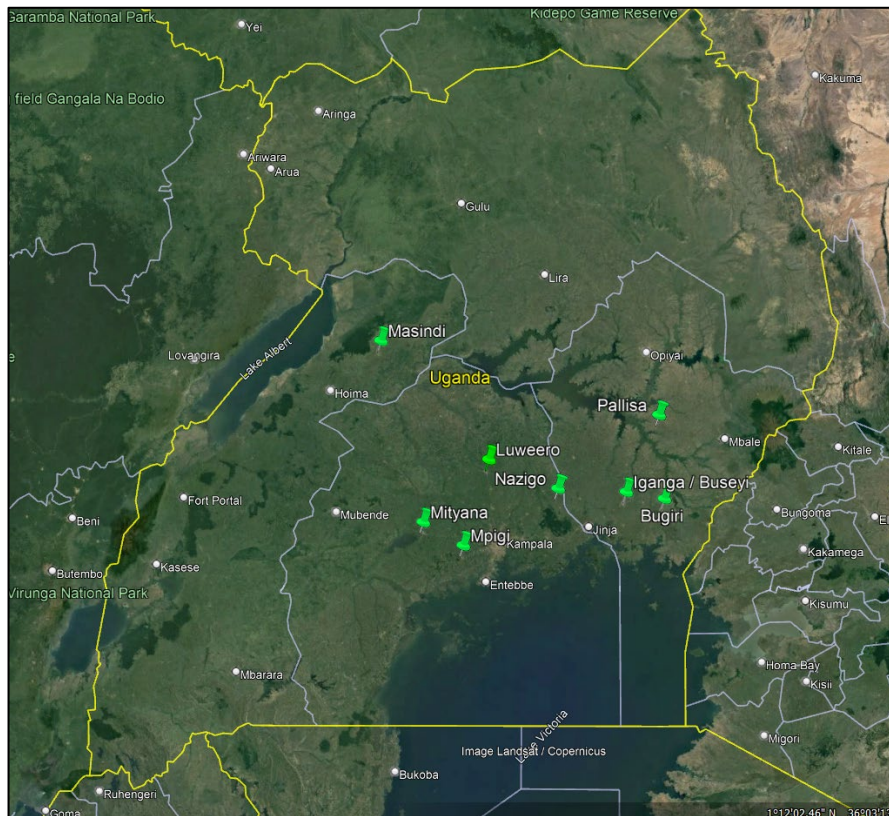


Figure 1: Selected Towns in Uganda



Figure 2: Selected Towns in Tanzania

A description of the final selected towns and our initial understanding of what may have been characterizing or driving growth in those towns is shown in Table 2.

References

Elvidge, C.D.; Zhizhin, M.; Ghosh, T.; Hsu, F.-C.; Taneja, J. Annual Time Series of Global VIIRS Nighttime Lights Derived from Monthly Averages: 2012 to 2019. *Remote Sens.* 2021, 13, 922. <https://doi.org/10.3390/rs13050922>

Table 2: About the Towns

Site	Uganda	Population, Urban Cells * (2010)	Population Official Administrative Level (2014 census)	Suspected driver(s) of growth	Tanzania	Population, Urban Cells* (2022)	Population Official Administrative Level (2022 census)	Suspected driver(s) of growth
1	Bugiri	22,632	Bugiri Municipality: 28,747 Our 4 wards: 28,747	Transit town for long-distance trucks; agriculture	Babati	32,530	Babati Town Council: 129,572 Our 2 Wards: 60,734	Administrative HQ; agriculture
2	Iganga	48,444	Iganga Municipality: 55,263 Our 4 wards: 17,909	Business & transit centre [also smuggling from Kenya]	Bagamoyo	53,367	Bagamoyo District Council: 205,478 Our 4 Wards: 66,149	Some heritage tourism. Old town. Stagnated but may be showing signs of recovery.
3	Luweero	29,144	Luweero Town Council: 43,800 Our 4 wards: 27,777	Business; agriculture; centre for Roman Catholic Church	Boma Ngombe	44,985	Hai District Council: 240,999 Our 3 Wards: 53,720	Tourism and administration (near Kilimanjaro)
4	Masindi	36,703	Masindi Municipality: 94,438 Our 3 wards: 40,826	Nearby oil development; sugar / other agriculture; administration	Chalinze	38,753	Chalinze District Council: 316,759 Our 1 wards: 58,071	A junction town, transport hub
5	Mityana	39,414	Mityana Municipality: 95,428 Our 4 wards: 36,957	Municipal admin; agriculture	Gairo	38,105	Gairo District Council: 258,205 (large area) Our 3 Wards: 45,019	Mining (gold, graphite); Agriculture
6	Mpigi	9,805	Mpigi Town Council: 44,200 Our 4 wards: 15,141	Transport hub; agriculture. Old town. Stagnated in recent years due to boundary changes.	Karatu	29,615	Karatu District Council: 280,454 Our 2 Wards: 50,175	Tourism (near Ngorogoro national park); Agriculture
7	Nazigo	8,641	Nazigo Town Council: 23,900 Our 1 ward: 8,641	Agriculture; Religious history; Teacher Training College, Church of Uganda	Kondoa	36,518	Kondoa Town Council: 80,443 Our 3 Wards: 44,159	Administrative HQ and historical archaeology
8	Pallisa	13,855	Pallisa Town Council: 34,200 Our 3 wards: 20,412	Old industrial town; Cotton & other agriculture; trade	Korogwe	43,541	Korogwe Town Council: 86,551 Our 7 Wards: 61,310	Sisal industry; Railway; Market town

* Totalling of cell-level populations – built-up areas only (using Google Earth satellite imagery and maps as a guide). We sampled a sub-section of these in our survey