

ABSTRACT

Cities in developing countries in Africa and notably many cities in Republic of Benin are still scarcely informed about the growth trend and its influence on the extra changes for further sustainability needs. The patterns of urbanisation are causing multiple problems to urban green spaces (UGS) and the holistic management and planning are crucial for urban sustainable environment. The aim of this study is to generate both quantitative and qualitative information on urban green landscape of studied cities in order to support the sustainable development through land use planning. Three multi-date satellite imageries, "Satellite Pour l'Observation de la Terre" (SPOT) 4 of 2000, SPOT 5 of 2010 and Google Earth Pro V 7.3 images (Landsat/Copernicus) of 2020 were used to generate data and examine occurred changes over two decades time. Google Earth Landsat/Copernicus images in 2022 were digitalized to extract data from individual layer of different categories of UGS. Ripley function was applied to assess pattern and distribution of UGS and landscape metrics were computed to quantify UGS configuration. Monthly satellite derived Normalized Difference Vegetation Index (NDVI) series were also collected using Google Earth Engine open-source while observed air temperature (AT) were obtained at National Meteorological Agency to examine seasonal variation of NDVI and a simple linear regression was applied to show the relationship between AT and NDVI. Questionnaires were used with 800 interviewees to assess resident perception on the existing greenery spaces, the prerogative for environmental safeguard, and the determinant of resident's willingness for urban greenery improvement. The results showed the built-up areas exert incredible pressure on non-built-up areas in the both cities except on water body class. Crop lands were the most threatened in the cities (around 24 per cent and 46 per cent were respectively converted to built-up areas in Porto-Novo and Parakou). An average of 40 per cent of city bushes were also under threat in Parakou from 2000 to 2020. A significant difference ($p\text{-value} \leq 0.000$) between UGS categories that were all in the aggregative distribution within cities was found. Furthermore, no significant linear trend ($p\text{-values} > 0.05$) was found, and NDVI was decreasing from 2000 to 2011 (0.21 to 0.19) and increased up (0.19 to 0.23) until 2020. In addition, a significant difference ($p\text{-value} < 0.001$) was shown between climatic seasons and the periods of January to March and April to June showed the lowest values (0.137 and 0.145) of NDVI respectively in Porto-Novo and Parakou. It was also found a positive correlation ($r = + 0.56$ and $+ 0.76$) between annual mean AT and NDVI during the dry seasons respectively in Porto-Novo and Parakou. Moreover, around 80 per cent of existing urban greeneries are mostly located in the core of the town and the state of the density and diversity of these greenery areas were differently perceived in the borough of each city. The main benefits lost from urban greenery were air quality (45.25 per cent) for Parakou and cooling effect (74 per cent) for Porto-Novo and the causes of these losses depended also on the cities and the districts within the cities. Public participation was perceived to be low (> 85 per cent) and the institutional cooperation with local communities, educational level and knowledge on greening main impacts must be improved to foster the involvement of people in urban greenery development. The effective enforcement of urban land use policies and the update of urban planning to climate change effects are recommended for each city. Decision-making should also establish specific strategies or actions for the development, improvement or conservation of each UGS configuration categories. Smart urban management of water availability such as greenery irrigation should be

helpful for ensuring the sustainable urban surface temperature mitigation. It was also suggested the enhancement of resident commitment for urban green space improvement and development through the operative institutional cooperation.

Keywords: Analog, Climate action, Nigeria, Sustainable cities, Temperature, Urban residents