# Mapping urban land use in Lusaka city, Zambia: an expert-based approach

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**(1) Purpose:** The purpose of this study was to map the urban land use (ULU) of Lusaka city over time (1990-2000-2010). Dividing the built-up area into different ULU classes (residential, industrial, commercial, public etc.) still remains a challenge due to spectral confusion in complex urban environments. The study was aimed at developing an approach capable of overcoming the challenges and limitations encountered when using freely available remote sensing datasets (i.e. Landsat and Google Earth imagery) and available classification methods.

**(2) Data and methods:** The proposed approach in this study involved, first, accurately extracting the built-up area from three Landsat imageries (1990, 2000, and 2010) using a combination of pixel-based and object-based classification techniques plus post-classification image control (PCIC). PCIC was conducted to identify and correct misclassified pixels through the integration of spatial ancillary data, visual interpretation and object-based multi-resolution image segmentation technique. PCIC ensured that the built-up area was accurately extracted which is a crucial first step in the proposed approach for mapping ULU. The built-up area was then divided into six ULU classes based on the study area: (i) Unplanned High Density Residential (UHDR), (ii) Unplanned Low Density Residential (ULDR), (iii) Planned High Density Residential (PHDR), (iv) Planned Low Density Residential (PLDR), (v) Commercial and Industrial (CMI) and (vi) Public Institutions and Areas (PIA). This was then followed by an expert–based on-screen digitization of polygons representing the identified six ULU categories through visual interpretation using high resolution Google Earth imagery, Object-based multi-resolution image segments, grids and close reference to detailed georeferenced cadastral and land use data. A coverage of ULU polygons using Google Earth Imagery for the latest date (2010) of this study with all the ULU categories defined was produced. Based on the assumption that built-up pixels representing a particular ULU category in 2010 would still represent the same category in the preceding years (2000 and 1990) if it existed, the same ULU polygons were used to extract and reclassify the built-up pixels from Landsat Imagery into their respective ULU categories for all the three time points (1990, 2000 and 2010).

**(3) Results:** Figure 1 shows the ULU maps for 1990, 2000 and 2010 while Figure 2 shows the total ULU area and the percentage of each ULU category in the three time points. The classification accuracies of ULU maps achieved in this study ranged from 91.2% to 92.8%, above the recommended minimum standard of 85%.

**(4) Conclusion:** An approach capable of overcoming the challenges and limitations encountered when using freely available remote sensing datasets and available classification methods has been proposed. Overall, the proposed approach shows good potential for ULU classification at local and regional scales. The study has also revealed some interesting results relevant to land use policy makers and urban development planners.

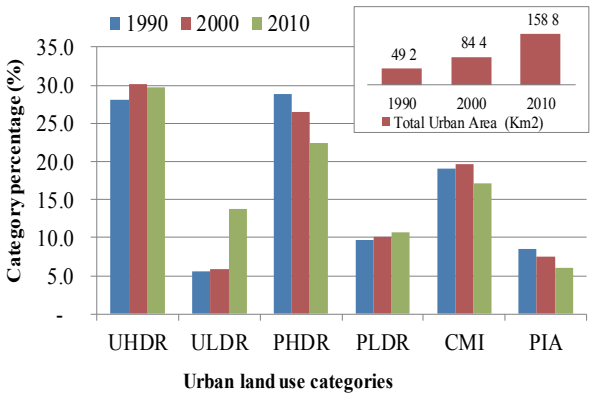


**Fig. 2:** ULU percentage in 1990, 2000 and 2010

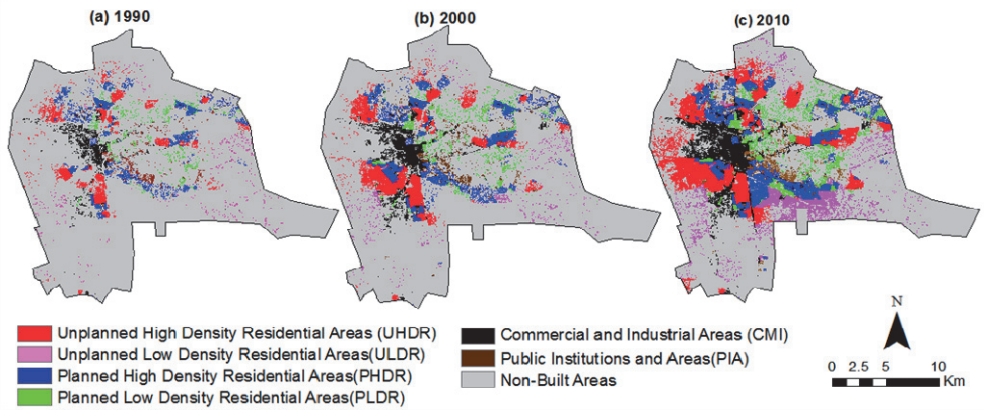


**Fig. 1:** Urban land use maps for 1990, 2000 and 2010