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Spatial Expansion of Urban Agriculture in Khartoum, Sudan

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Abstract

The population of Khartoum has exploded during the past century, from about 300,000 in 1955 to approximately six million today, and continues to grow fast. A rapidly increasing food demand in the city and limited opportunities for crop production in the arid surroundings of Khartoum made urban production of agricultural commodities economically attractive. The objective of this study was to quantify the expansion of urban agricultural area from the city's colonial past to the present.

We derived the agricultural area within Greater Khartoum (comprising the three cities of Khartoum, Khartoum North and Omdurman) from scenes captured by scanners of Landsat satellites in the fall of 1972 (Multispectral Scanner — MSS), 1987 (Thematic Mapper — TM) and 2002 (Enhanced Thematic Mapper Plus — ETM+). For each dataset, the Normalized Difference Vegetation Index (NDVI) was calculated, and all grid cells with NDVI values higher than one standard deviation above the mean were classified as vegetated land.

To extend our time series further into the past and future, we quantified vegetation on a grayscale mosaic of aerial photographs taken in 1958, and on a recent satellite image downloaded from Google Earth. While image processing options on the grayscale image were limited, we extracted the green band from the recent image and interpreted all areas with green values smaller than a third of a standard deviation below the mean as vegetated. To exclude natural vegetation and, in the recent image, water bodies, we roughly sketched the outline of all major agricultural regions of the city, and interpreted the vegetated area in these polygons as active agricultural land.

The agricultural area of Khartoum, as detected by our analysis, amounted to only 4799 ha in 1958, but increased rapidly to 8751 ha in 1972, 10501 ha in 1987, 12920 ha in 2000 and 13249 ha today. In spite of the conversion of much agricultural land to residential and commercial areas, agriculture in the city has kept expanding. Along the banks of the Nile, agricultural areas have persisted, whereas many irrigation schemes further inland have been pushed into the peri-urban region.

Keywords: Aerial photography, Landsat, remote sensing