Spatial Expansion of Urban Agriculture in Khartoum, Sudan
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Introduction
• Urban agriculture (UA) is of primary importance for the livelihood of city-dwellers all over the developing world
• The temporal and spatial dynamics of urban agriculture in Khartoum (shifts, expansion, shrinkage) is unknown

Materials and Methods
• Historical aerial pictures and satellite images from five points in time → UA area estimated by calculating index, roughly digitizing agricultural areas, summarizing vegetation in area:

<table>
<thead>
<tr>
<th>Year</th>
<th>Image type</th>
<th>Filtering</th>
<th>Image classification</th>
<th>Target area</th>
<th>Agricultural vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>Classic aerial images</td>
<td>Calculate NDVI:</td>
<td>&gt;1 standard deviation</td>
<td>Summarize vegetation</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>Landsat MSS</td>
<td>NearInfrared - Red</td>
<td>above mean</td>
<td>in agricultural areas</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>Landsat TM</td>
<td>RedInfrared + Red</td>
<td>Roughly digitize</td>
<td></td>
<td>&gt;1/3 standard deviation</td>
</tr>
<tr>
<td>2000</td>
<td>Landsat ETM⁺</td>
<td></td>
<td>main agricultural</td>
<td></td>
<td>above mean</td>
</tr>
<tr>
<td>~2005</td>
<td>Google Earth mosaic</td>
<td></td>
<td>areas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results and Discussion
• Agriculture has always been an important land use in Khartoum over the five decades studied, but has geographically shifted over time (Fig. 1)
• Since 1958, agriculture in Khartoum has expanded by on average 172 ha per year (Fig. 2)
• Urban agriculture is likely to be a major contributor to the city's food supply
• Urban agriculture is likely to consume a large amount of resources in the city

Conclusions
• Agriculture is an important land user in Khartoum
• Urban agriculture needs more research to clarify its role in urban ecosystems in terms of nutrient cycling, food production and human health

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