City pattern as a factor influencing the impact of urbanization on ecosystems

A diachronic analysis of the dynamic of two cities: Kisangani and Lubumbashi (Democratic Republic of Congo)

André M., Mahy G., Lejeune P., Bogaert J.
Introduction
Introduction: a growing urban population

ONU, 2004
Introduction: a growing urban population

ONU, 2004

Adapté de UN, 2012
Introduction: a lack of data and of maps
Introduction: variable definitions

Forstall et al, 2008

<table>
<thead>
<tr>
<th>Type of definition</th>
<th>Population 2000</th>
<th>Area (km²) 2000</th>
<th>Population per km² 2000</th>
<th>Annual average Population change</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo (2000 and 1995 censuses)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City proper</td>
<td>I</td>
<td>8,134,688</td>
<td>621</td>
<td>13,099.3</td>
<td>33,000</td>
</tr>
<tr>
<td>Administrative area</td>
<td>II</td>
<td>12,064,101</td>
<td>2,187</td>
<td>5,516.3</td>
<td>58,000</td>
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<tr>
<td>Urbanised area*</td>
<td>III</td>
<td>28,271,210</td>
<td>3,084</td>
<td>9,167.1</td>
<td>169,000</td>
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<tr>
<td>UA (administrative boundaries)</td>
<td>IV</td>
<td>30,402,132</td>
<td>6,057</td>
<td>4,956.9</td>
<td>165,000</td>
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<tr>
<td>Metropolitan area (1)* [WUP]</td>
<td>V</td>
<td>34,493,466</td>
<td>13,504</td>
<td>2,554.3</td>
<td>179,000</td>
</tr>
<tr>
<td>Metropolitan area (2)*</td>
<td>V</td>
<td>30,724,311</td>
<td>7,628</td>
<td>4,027.8</td>
<td>170,000</td>
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<tr>
<td>Consistently defined metropolitan area</td>
<td>CDMA</td>
<td>31,865,900</td>
<td>8,014</td>
<td>3,976.3</td>
<td>175,000</td>
</tr>
</tbody>
</table>
Introduction: the sustainability triangle

Wordpress, 2009
Objectives
1. Quantify the dynamic of the different areas (urban, suburban, rural) in the urban-rural gradient during the last decade
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2. Quantify the effect of a decade of urban and suburban growth on ecosystems
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SENSITIVE ECOSYSTEMS TO PRESERVE?

2. Quantify the effect of a decade of urban and suburban growth on ecosystems
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Objectives

2. Quantify the effect of a decade of urban and suburban growth on ecosystems
Material & method
Material

- SPOT 5 images
- Two years:
  - 2002 and 2008 (2009) for Lubumbashi
  - 2002 and 2010 for Kisangani

Study zone of Lubumbashi, SPOT Image, July 17, 2002
Material: localisation of the two study cases

Munyemba 2010, Google Earth 2013
Material: localisation of the two study cases

Lubumbashi

Kisangani
**Material:** localisation of the two study cases

- Lubumbashi
- Kisangani
Method

1. Oriented-object classification

Study zone of Lubumbashi, SPOT Image, July 17, 2002
Method

1. Oriented-object classification

Study zone of Lubumbashi, SPOT Image, July 17, 2002
**Method**

1. **Oriented-object classification**

   - Built, bare soil
   - Wooded savannah, old fallow, regenerating forest
   - Fields, young fallow, grassland, bushland, savannah
   - Water
   - Fire
   - Forest
   - Wetlands
   - Slag heap

Classification, 2002
Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

Study zone of Lubumbashi, SPOT Image, July 17, 2002
Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

2.1 Gridding
Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics.

2.2 Landscape metrics calculation
Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

2.3 Field work: reference points for each area
Method

Dominance of constructed surfaces
AND
Continuous built, constructions mainly two or three facades

Land use mainly residential
AND
French speaking study zone

yes

Land use and land cover almost only agricultural and/or forested

yes

Workers commuting from the area toward the urban area

yes

Study area: french speaking

yes

no/don’t know

exurban, rurban

rural

periurban

suburban

no/don’t know

no/don’t know

yes

no/don’t know

no/don’t know

 André et al., in press

Study zone of Lubumbashi, SPOT Image, July 17, 2002
Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

2.3 **Field work reference points for each area**
2.4 Recursive segmentation

Built densities and corresponding areas:
- 0.000 - 0.150 Rural
- 0.161 - 0.433 Suburban
- 0.434 - 0.769 Urban

\[ K = 0.81 \]
Results
Results - Lubumbashi

Built densities and areas

- 2.2 %
+ 1.5 %
+ 0.7 %
Results - Lubumbashi
Results - Lubumbashi
Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)

- Burned areas
- Built
- Fields, young fallow, grassland, bushland, savannah
- Wooded savannah, old fallow, regenerating forest
- Forest
- Wetlands
- Water
- Slag heap
- Unclassified
Results - Lubumbashi

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- Wetlands
- Water
- Slag heap
- Unclassified
- Urban
Results - Kisangani

Built densities and areas

- 0.2 %
- 0.1 %
+ 0.3 %
Results - Kisangani
Results - Kisangani
Results - Kisangani

Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)

- Fields, young fallow and bamboos
- Built
- Ponds and wetlands
- Water
- Old fallow and secondary forest
- Burned areas and bare soil
- Floating vegetation
- Unclassified
- Primary forest
Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)

- Fields, young fallow and bamboos
- Built
- Ponds and wetlands
- Water
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Discussion and conclusions
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- Thresholds depend on the spatial resolution of the images and on the accuracy of the classification.
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- Burned areas = fields and fallow land?
Discussion and conclusion

- Thresholds depend on the spatial resolution of the images and on the accuracy of the classification.
- Burned areas = fields and fallow land?
- Different cities, different dynamics.
Discussion and conclusion

1. **Quantify the dynamic of the different areas (urban, suburban, rural) in the urban-rural gradient during the last decade**

<table>
<thead>
<tr>
<th>Diff (Ha)</th>
<th>Lubumbashi</th>
<th>Kisangani</th>
</tr>
</thead>
<tbody>
<tr>
<td>rural</td>
<td>-9 013</td>
<td>-431</td>
</tr>
<tr>
<td>suburban</td>
<td>6 256</td>
<td>-275</td>
</tr>
<tr>
<td>urban</td>
<td>2 756</td>
<td>706</td>
</tr>
</tbody>
</table>
2. Quantify the effect of a decade of urbanization on ecosystems

Lubumbashi: Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)

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Kisangani: Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)

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THANKS FOR YOUR ATTENTION!

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