Mapping urban food security in West Africa

Cornelia F.A. van Wesenbeeck
Amsterdam Centre for World Food Studies,
VU University, Amsterdam

Study for SWAC/OECD
Introduction

- Policies to improve FNS require solid empirical base
  - At least headcounts of people below/above thresholds
- Internationally, FAO measures used, but
  - Based on indirect measurement
  - Nationwide only
- Current trend in the world:
  - Urbanization
- Main question:
  - How can we develop methods to monitor FNS in urban areas on a large scale?
**Introduction (cont)**

- Demographic and Health Surveys
  - Commissioned by USAID
  - Available for many countries
  - Nowadays, mostly geo-referenced
  - Include nutritional data
    - Children
      - Weight
      - Age
      - Height
      - Weight for age
      - Height for age
      - Weight for height
    - Adults
      - Weight
      - Age
      - Height
      - BMI
The study focuses on West Africa and uses:
- Population map (Landscan)
Study area and data (II)

- Population pyramid for the 17 countries in the study

![Population pyramid chart for the study area]
Study are and data (III)

- DHS surveys
  - Georeferenced data available for 11 countries
  - Provincial reference available for 3 countries
  - Report available for 2 countries
  - Other source used (MICS) 1 country

- Survey years vary from 2010–2015
Africapolis data (OECD)

- Geospatial database on urbanization in Africa
- Combines
  - National population data
  - Satellite and aerial imagery
  - Other cartographic sources
- Provides
  - Population estimates at level of agglomerations
  - Information on the evolution of built-up area since 1950
- Identifies over 1,950 urban agglomerations
Methods (I): integrating data

- Integrating population map and Africapolis data
  - Africapolis overrules landscan for urban locations
  - Landscan total rural population corrected to maintain aggregate totals

- DHS surveys have to be harmonized
  - Coding of questions
  - Checking georeference on consistency
  - Checking consistency of rural/urban classification with Africapolis database
Methods (II): slum index

- Combine indicators related to quality of life in city
  - Quality of wall material
  - Quality of floor material
  - Type of toilet facility
  - Type of water source

<table>
<thead>
<tr>
<th></th>
<th>Severe slum</th>
<th>Moderate slum</th>
<th>No slum</th>
<th>Rich area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall/Floor</td>
<td>--</td>
<td>-- or ++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Water/Toilet</td>
<td>--</td>
<td>-- or ++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>remarks</td>
<td>One --</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Method (III): Polling

- Basic observation: variables define joint empirical frequency distribution.
  - Conditional frequency distributions can be derived from this joint distribution by partitioning the answers
    - Conditional frequencies are naturally interpreted as probability estimates
    - Hence, we compute the most probable characteristics associated to each x-value.
      - Estimates of the probability that a specific FNS outcome is associated with rural or urban residence.
      - Estimates of the probability that a specific FNS outcome is associated with specific urban conditions
Methods (IV) Estimating calorie intake

- Following Van Wesenbeeck et al. (2009)
  - Biophysical relation between calorie intake and weight
  - Usually invoked for recommendations on diet
  - Here: reverse relation
    - Dependent on age, weight, physical activity
      - For children: growth allowance
      - For women in fertile age group: birth rate

\[
\text{cal}_{g,t} = \begin{cases} 
A_{g,t} + b_{g,t} \times \text{weight}_{g,t} - c_{g,t} \times \text{weight}_{g,t}^2 + \text{growth}_{g,t} \\
(b_{g,t} \times \text{weight}_{g,t} + A_{g,t}) \times PAL_{g,t} \\
(b_{g,t} \times \text{weight}_{g,t} + A_{g,t}) \times PAL_{g,t} + c_{g,t} \times RATE_{g,t}
\end{cases}
\]

for age groups 0-17

for age groups 18+

for women in fertile age groups
Outcomes: rural/urban

BMI distribution

WFA distribution
Outcomes: with city distribution

**BMI distribution**

**WFA distribution**
Outcomes: rural vs urban slum

BMI distribution

WFA distribution
Zooming in: FNS in cities

Underweight

Overweight/obese
Outcomes: comparing with FAO

<table>
<thead>
<tr>
<th>Region</th>
<th>FAO (2017)</th>
<th>Own</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>4.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Benin</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Gambia</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Ghana</td>
<td>2.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Guinea</td>
<td>2.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>3.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Liberia</td>
<td>1.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Mali</td>
<td>0.7</td>
<td>2.6</td>
</tr>
<tr>
<td>Niger</td>
<td>2.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Nigeria</td>
<td>14.3</td>
<td>26.5</td>
</tr>
<tr>
<td>Senegal</td>
<td>1.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Togo</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>3.7</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>52</td>
</tr>
</tbody>
</table>

High levels of child malnutrition and high share of children in population

Millions of undernourished
## Outcomes: comparing with FAO (II)

<table>
<thead>
<tr>
<th>Region</th>
<th>FAO (2017)</th>
<th>Own estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Benin</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Gambia</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Ghana</td>
<td>1.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Guinea</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Liberia</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Mali</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Niger</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Nigeria</td>
<td>8.1</td>
<td>9.0</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Togo</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.3</strong></td>
<td><strong>17.8</strong></td>
</tr>
</tbody>
</table>

Millions of obese adults
### Outcomes: comparing with FAO (III)

- Estimated average intake
- Plus allowance for waste and losses
  - 100 Kcal/day rural
  - 200 Kcal/day urban

<table>
<thead>
<tr>
<th>Region</th>
<th>Own estimates</th>
<th>FAO</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chad</td>
<td>2371</td>
<td>2204</td>
<td>-167</td>
</tr>
<tr>
<td>Benin</td>
<td>2548</td>
<td>2713</td>
<td>165</td>
</tr>
<tr>
<td>Gambia</td>
<td>2496</td>
<td>2588</td>
<td>92</td>
</tr>
<tr>
<td>Ghana</td>
<td>2570</td>
<td>2969</td>
<td>399</td>
</tr>
<tr>
<td>Guinea</td>
<td>2407</td>
<td>2580</td>
<td>173</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>2447</td>
<td>2814</td>
<td>367</td>
</tr>
<tr>
<td>Liberia</td>
<td>2423</td>
<td>2098</td>
<td>-325</td>
</tr>
<tr>
<td>Mali</td>
<td>2473</td>
<td>3090</td>
<td>617</td>
</tr>
<tr>
<td>Niger</td>
<td>2430</td>
<td>2581</td>
<td>151</td>
</tr>
<tr>
<td>Nigeria</td>
<td>2477</td>
<td>2601</td>
<td>124</td>
</tr>
<tr>
<td>Senegal</td>
<td>2855</td>
<td>2487</td>
<td>-368</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>2411</td>
<td>2313</td>
<td>-98</td>
</tr>
<tr>
<td>Togo</td>
<td>2493</td>
<td>2656</td>
<td>163</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>2344</td>
<td>2810</td>
<td>466</td>
</tr>
</tbody>
</table>
Conclusions and further work

Conclusions
- Urban slum areas deserve attention in FNS policies
  - Levels of undernutrition getting close to rural ones
  - But obesity already severe problem

DHS–based data provide empirical base
- Georeferenced
- Directly measured
- Conditional estimates possible
- Tracking over time possible
Further work

- Complete database by adding
  - WFH, HFA
  - Report-based data for missing countries

- Refining method
  - More detailed population pyramid
  - Reconsidering slum indicators

- Presentation
  - City outcomes as maps
Thank you!