SLUM MAPPING
SOME REFLECTIONS ON METHODS USING VERY HIGH RESOLUTION IMAGES

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OUTLINE

- What is a slum
  - UN-HABITAT’s definition
  - Global Slum Ontology
- Slum mapping
  - Purpose
  - Methods – data sources and data acquisition
    - Aerospace (spatial data)
    - Field-based methods
- Current research directions
  - Geo-Object Based Image Analysis (GEOBIA)
SLUM DWELLERS AND SLUMS

Who are slums dwellers?

- UN 2002: Urban households lacking at least 1 of the following:
  - Adequate water
  - Adequate sanitation
  - Sufficient living space
  - Secure tenure
  - Durable housing (quality of structures & environment – hazards)

www.unhabitat.org
SLUMS: SPATIAL CONCENTRATION OF SLUM DWELLERS - DIVERSITY OF PHYSICAL FORMS AND SETTINGS

Dar es Salaam Tanzania

Vizag, India

Cairo, Egypt
Libya: can we see the slum areas?

Source: J. Turkstra UN-HABITAT
DURABLE HOUSING

- Principle research focus is on building a robust method to map and monitor *durable housing* as an indicator of slums
- House is a physical asset – visible and (generally) immovable
- Link to land occupation and tenure
- Occupants (owners/tenants) can be spatial registered via house
- Building quality: building materials, state of repair (roofs) and some building standards (size, location aspects perhaps)
- Also include Neighbourhood quality: (adjusted) planning standards for neighbourhood development – open space, road access (widths, pattern, connectivity)
- Hazards: natural and technological – not always visible, often high degree of spatial-temporal variability (e.g. floods, landslides, industrial accidents)
GLOBAL SLUM ONTOLOGY (PHYSICAL)

- Environs
  - Location
  - Neighborhood Characteristics
- Settlement
  - Shape
  - Spatial order
  - Density
  - Road Layout
- Object
  - Building Characteristics

Aerial views of slums in different contexts with visual interpretation

Key variables used
- Colour, shape, size, tone, pattern
- Size of houses
- Roads: Lack of or irregular
- Lack of vegetation
- Lack of open spaces
- Building Density (compactness)
- Irregularity of layout
- Roof materials
- Absence of / irregular roads
- Association with environs
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- Current research directions
  - Geo-Object Based Image Analysis (GEOBIA)
  - Some emerging tools for urban (slum) monitoring
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Slum settlement level</th>
<th>City wide level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial level</td>
<td>Object – settlement</td>
<td>Settlement-environs-city</td>
</tr>
<tr>
<td>Spatial resolution</td>
<td>Very high (&lt; 1m)</td>
<td>Medium – Very high</td>
</tr>
<tr>
<td>Temporal resolution</td>
<td>Annual or more frequent e.g. upgrading projects</td>
<td>1-5 years depending on growth rates and capacity</td>
</tr>
<tr>
<td>Spectral resolution etc.</td>
<td>Generally optical (possibly also oblique or terrestrial, LIDAR)</td>
<td>Optical VHR Radar (DLR)</td>
</tr>
<tr>
<td>Applications</td>
<td>Regularization of tenure Settlement upgrading Vulnerability assessment</td>
<td>Urban (slum) policy and strategic planning Monitoring (modelling) Topographic mappingUrban growth monitoring Vulnerability assessment</td>
</tr>
</tbody>
</table>
EARTH OBSERVATION (REMOTE SENSING)
TRADITIONAL AERIAL MAPPING TECHNIQUES

Topographic maps various scales
MODERN DIGITAL CAMERA E.G. ULTRACAM

- Simultaneous vertical and oblique images, Infrared
- Suitable for 3D city model generation via pictometry techniques
AIBOTIX HEXACOPTER
MICRO AERIAL
VEHICLE

Dense image matching
- Point cloud generation
- 5 cm GSD

Issues:
- Security clearance
- Safety
VHR images in participatory mapping for problem scoping, analysis and planning
NGO-CBO PARTNERSHIPS
E.G. SHELTER ASSOCIATES, SANGLI – MURAD-KUPWAD INDIA

Electoral Ward No.1

Govardhan Nagar, Rajivgandhi Nagar is the only two slum in this electoral ward. The area of this electoral ward is 4.57 square kilometers (By Google Earth).

Elected Representative:
Ms. Miparkar Vinay Pandurang (Vikas Mandirahad) is the elected member. Her mobile number is 9821979392.

Municipal Administrative Ward: SANGM Administration Ward No.1

Rajivgandhi Nagar JunaBudhsonRaod
Rajivgandhi Nagar (Juna Budhson Road) is a slum in Sangli. It was established in 1965 and covers an area of 6049 sq. mts. It has an approximate population of 1125 residing in 225 houses.

Govardhan Nagar
Govardhan Nagar is a slum in Sangli. It was established in 1996 and covers an area of 1103.33 sq. mts. It has an approximate population of 190 residing in 30 houses.
SLUM MAPPING AND ENUMERATION RESULTS
SANGLI GANDHI NAGAR.

Rajiv Gandhi Nagar, Ward No. 1 Survey No. 133, 134

<table>
<thead>
<tr>
<th>ADDRESS</th>
<th>Off Juna Bughax Road, Near Sangli Tosgaon Bypass, Sangli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declared/Undeclared</td>
<td>Declared</td>
</tr>
<tr>
<td>Approximate Year Of Establishment</td>
<td>1985</td>
</tr>
<tr>
<td>Land Ownership</td>
<td>SMKMC</td>
</tr>
<tr>
<td>Name Of Land Owner</td>
<td>SMKMC</td>
</tr>
<tr>
<td>Land Reservation on DP</td>
<td>NA</td>
</tr>
<tr>
<td>Tenure Status of Slum Dwellers</td>
<td>Own the hut</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOILETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 block- 4 stalls for women and 4 stalls for men</td>
</tr>
</tbody>
</table>

Earlier the toilet was washed once a week but now it is irregular. The open fields are also used for defecation as the facility is inadequate. Also the approach road to the toilet is very bad and the area around is perpetually slushy. There is no electricity or water storage facility in the toilet block.

<table>
<thead>
<tr>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off Juna Bughax Road, on flat land</td>
</tr>
</tbody>
</table>

Water logging around the slum is a perpetual health hazard.

<table>
<thead>
<tr>
<th>HAZARDS</th>
</tr>
</thead>
</table>

Water logging around the slum is a perpetual health hazard.

<table>
<thead>
<tr>
<th>GARBAGE</th>
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</thead>
</table>

Waste is dumped in and around the slum and no clearance systems.

<table>
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<tr>
<th>PAVING</th>
</tr>
</thead>
</table>

There are paved lanes within the slum but outside it is slushy.

<table>
<thead>
<tr>
<th>NEARBY AMENITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest Hospital</td>
</tr>
<tr>
<td>Nearest Bus Stop</td>
</tr>
<tr>
<td>Nearest School/Colleges</td>
</tr>
<tr>
<td>Nearest Telephone</td>
</tr>
<tr>
<td>Nearest Police Station</td>
</tr>
<tr>
<td>Nearest Market</td>
</tr>
<tr>
<td>NGO in slum</td>
</tr>
<tr>
<td>Credit/Other savings</td>
</tr>
</tbody>
</table>

Dr. Patil Hospital, Dr. Suryovanshi Hospital
RTO office
Shantiniketan Lok Vidyapeeth in the slum
Vishrambaug Police Station
Shivaji Market

<table>
<thead>
<tr>
<th>DRAINAGE</th>
</tr>
</thead>
</table>

Drain water flows down from the slum into the fields. All gutters are open.

<table>
<thead>
<tr>
<th>HOUSES/POPULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>app. No of house-225</td>
</tr>
<tr>
<td>approx. Population 1125</td>
</tr>
<tr>
<td>Kuccha houses made of tin and wood</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER</th>
</tr>
</thead>
</table>

There are two taps in the settlement and water is available from 5 hours in a day. There are also two hand pumps which provide water 24 hours.

<table>
<thead>
<tr>
<th>ELECTRICITY</th>
</tr>
</thead>
</table>

There are 18 electric poles cum light poles within the settlement but no telephone poles.
Voluntary Geo-Information (VGI)

http://mapkibera.org/

**MAP KIBERA**

citizen mapping | citizen media

Kibera in Nairobi, Kenya, was a blank spot on the map until November 2009, when young Kiberans created the first free and open digital map of their own community. Map Kibera has now grown into a complete interactive community information project.

### programs

| Mapping | Voice of Kibera | Kibera News Network |

### get involved

| Wiki | Discuss | Download | Contact |

Want to learn more about Map Kibera? Thinking about doing similar work?
Open Street Map Tandale, Dar es Salaam Tanzania.
Google Earth: Tandale. Most objects and features have not been digitized on OSM in Tandale.
ARDHI Ministry, Tanzania

DELINEATION AND DIGITISATION OF PROPERTIES FOR RESIDENTIAL LICENCING

Source: Sarah Kyessi, MLHUD, Tanzania
CREATION OF DATABASE

MWANANYAMALA KWAKOPA
RESIDENTIAL LICENSE

HALMASHAURI YA MANISPAA YA KINONDONI
SHERIA YA ARDI YA 1999,
(NA 4 YA 1999)

LESENI YA MAKAZI NA. KND000001
(Chini ya fungu la 234176)
Ardhi Na.
KND/MZS/KN3536
Kata
MANZSE
Mtaa
KILIMANI
Makulio ya ukabwa wa Ardhi ni 340 m²

Halmashauri ya MANISPAA YA KINONDONI kwa leseni hili inatoa KIBALI
CHI MAKAZI kwa: Bibi WEMBO SHABANI MARIJANI

Jua ya ardhi kama inayotafasilia kwenye leseni hili kwa masharti
yafatavyo:

1. Muda wa leseni ni mlezi mwaka milaka m/ili (2) kuanzia tarehe 9 mwizi Mei mwaka 2005 hadi tarehe 8 mwizi Mei mwaka 2007

2. Kadi ya Ardhi ya shilingi 2,720.00 italiwa kila mwaka, chimpya ya kitungu cha 23(3) (c), Kiwango hiki kinaweza kubadilishwa na Kamishina wa Ardhi kwa majibu wa Sheria.

3. Matumizi ni Makazi na shughuli nyungenze zaote ambazo zinaendana na makaazi na hazibaathiri majirani kimaazingina.

4. Ujuzi wowote jua ya ardhi hili au umegaji wa ardhi lazima upata kibali cha Manispaa kupitia Kamati ya Mtaa ambayo itasimamia kwa karibu utekelizaji wa masharti haya na maendeleo ya ardhi ya maeo hili.

5. Milikiwiwamiliki watahesimu na kuhudhuriki haki za njia zilizopo.

6. Muda wa leseni hili unaweza kuongezwa.
Main land use and informal settlement map Cairo 2000
Prepared from Ikonos satellite images
Partners:
- Ministry of Planning Egypt
- GTZ
- Governorates of Cairo
- CAPMAS

Legend:
- Study Area
- Land Use 2000
- Core Villages
- Informal Residential
- Vacant Pockets
- Formal Residential
- Other Urban
- Ring Road
- Road Under Construction
- Construction Sites
- Agriculture
- Desert
- Nile and other water bodies

Source of Data:
This land use map of Greater Cairo was produced at the ITC, The Netherlands using a mosaic of Ikonos imagery from the period June 2000.
The initial interpretation of informal settlements was carried out by students of the Urban Planning and Land Administration programme from June to September 2002. Additional interpretation was carried out by Chris Flesker. The interpretation was supervised by Wael Belal and Richard Shurin. Data of 1991 and 1996 produced by CEDBU, Cairo provided the basis for the delineations.
The Greater Cairo Land Use Map is a collaborative project involving the following organizations: GTZ, ITC, CEDBU, and the Ministry of Planning, CAPMAS, Ministry of Local Government, Egypt. Information about the project can be obtained from Diederik Bohnet (Diederik.Bohnet@ITC.NL) or the GTZ office Cairo (projekt@mk.net).
Examples from Cairo (Ikonos)

Multi-storey high density informal development without proper sanitation & services

Former Agricultural land
Cairo land use key for Ikonos Interpretation
Rules and procedures for group interpretation
Training programme
Quality control