

Use of Geospatial Information and PHC data in measuring Land Use Efficiency Indicators *Case of Tunisia*

Ms. Samira Ouadday – INS

Measuring Ratio of land consumption rate to population growth rate

*The indicator was computed for 1994 - 2004 and 2004 – 2014
Corresponding to the three last Censuses*

- Extract built up areas for each census year
- Delimit city boundaries for each census year
- Integrate population for each analysis year
- Compute *land consumption rate*
- Compute *population growth rate*
- Compute *land Consumption to Population Growth Rate*

Computing Land Consumption Rate

the formula for Land Consumption Rate (LCR)

$$LCR = \frac{(\ln(\text{Urb}(t2)/\text{Urb}(t1)))}{(y)}$$

Where:

- **Urb(t1)** is the total area covered by the urban area in the initial year **1994 (2004)**;
- **Urb(t2)** is the total area covered by the urban area in the final year **2004 (2014)**; and
- **y** is the number of years between the two measurement periods (**10 years**)

Urbanized area is the entire spatial extent that meets the defined threshold of “urban”
It is defined by Spatial Analysis using GIS tools

Computing Population Growth Rate

*The Population Growth Rate for years 2004 – 1994 and
2014 – 2004*

$$PGR = \frac{LN(Pop_{t+n}/Pop_t)}{(y)}$$

Where

- **Pop_t** Total population within the urban area in 1994(2004)
- **Pop_{t+n}** Total population within the urban area in 2004(2014)
- **y** number of years between the two measurement periods (10 years)

Computing Population Growth Rate

*The ratio of Land Consumption Rate to Population Growth Rate
(Indicator 11.3.1)*

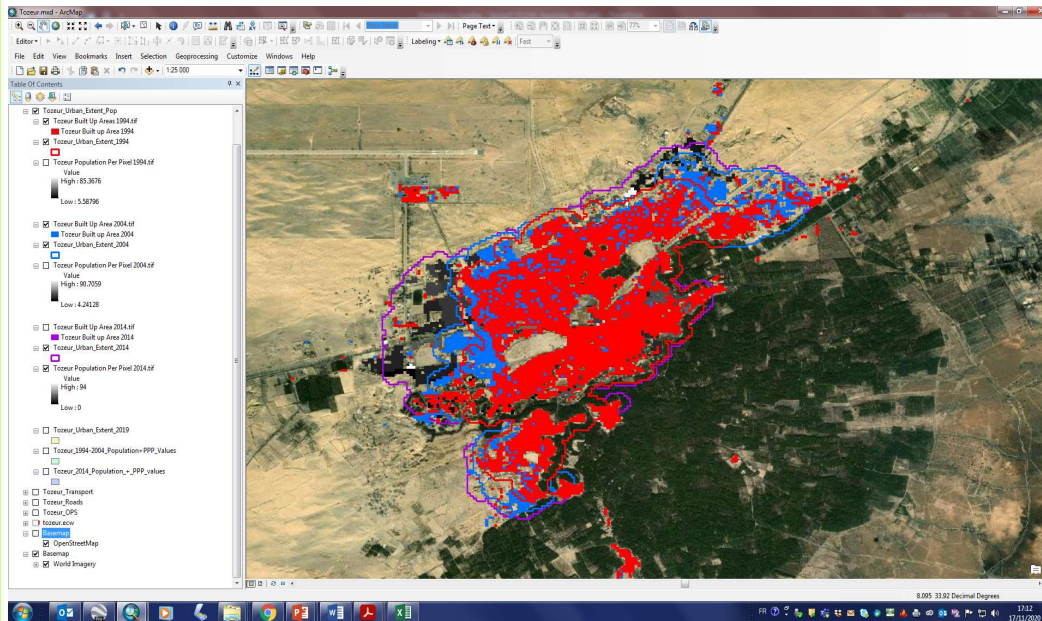
$$LCRPGR = \left(\frac{\text{Annual Land Consumption rate}}{\text{Annual Population growth rate}} \right)$$

$$LCRPGR = \left(\frac{\text{LN}\left(\frac{Urb_{t+n}}{Urb_t}\right)}{y} \right) / \left(\frac{\text{LN}\left(\frac{Pop_{t+n}}{Pop_t}\right)}{y} \right)$$

Land Consumption Rate

Data

- Google Earth/Landsat Imagery at 1994, 2004 and 2014 Censuses Years

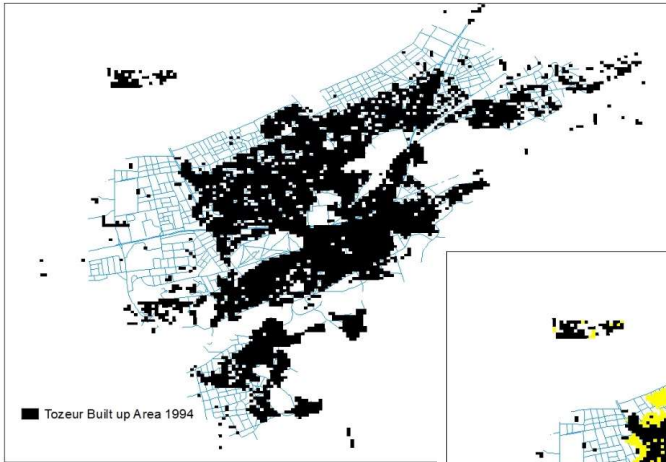


Method

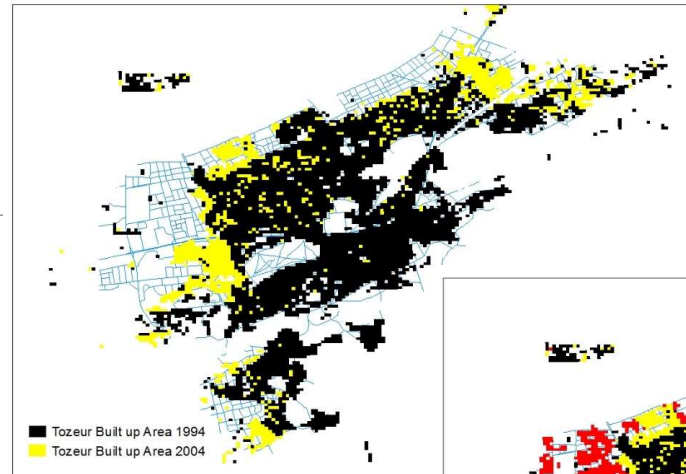
Spatial Analysis with GIS tools to define built up areas

Built Up Area

Built up area for 1994

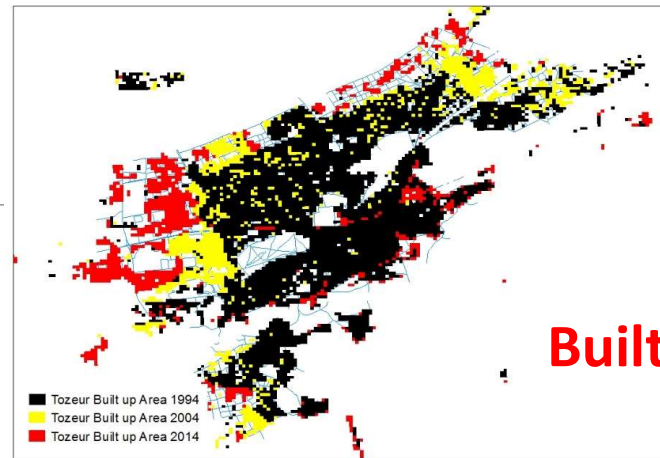


Built up area for 2004

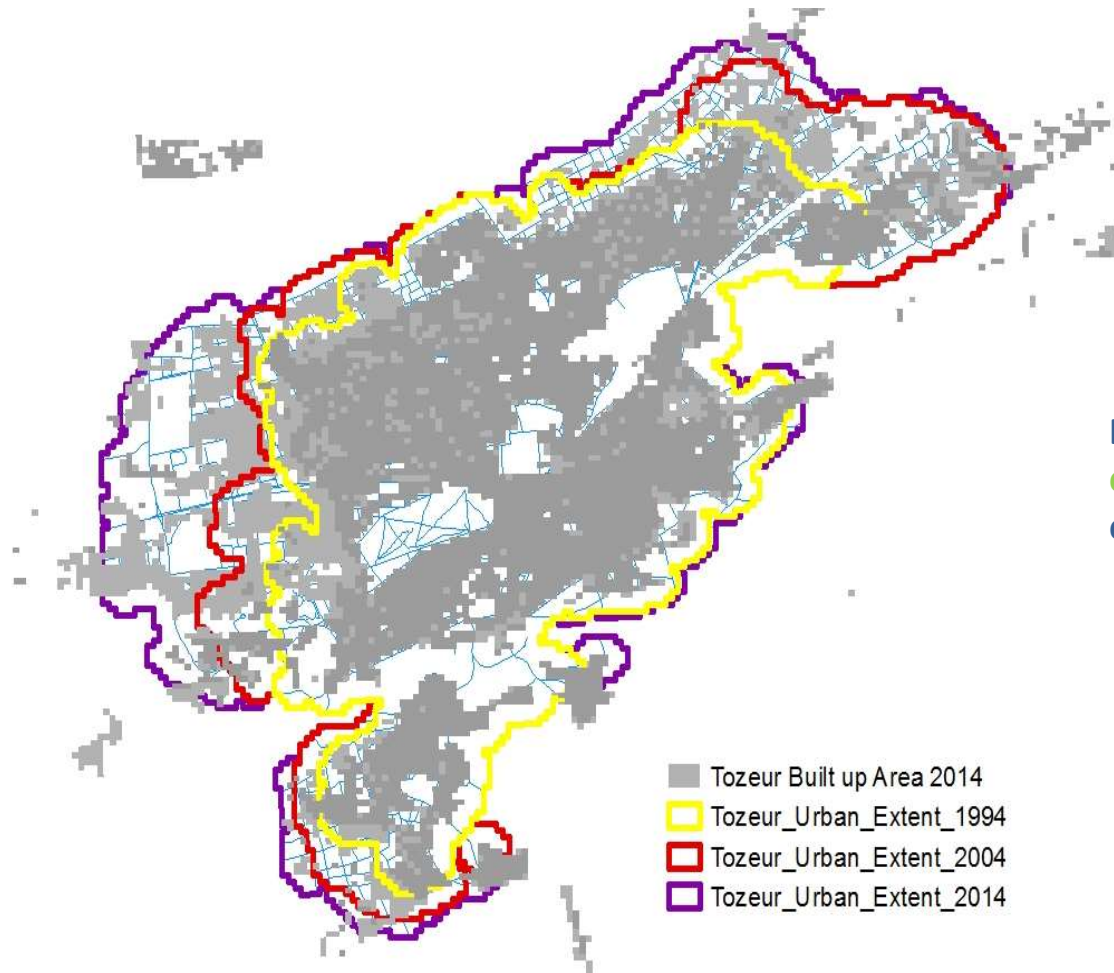


Example of Tozeur City

Built up area for 2014

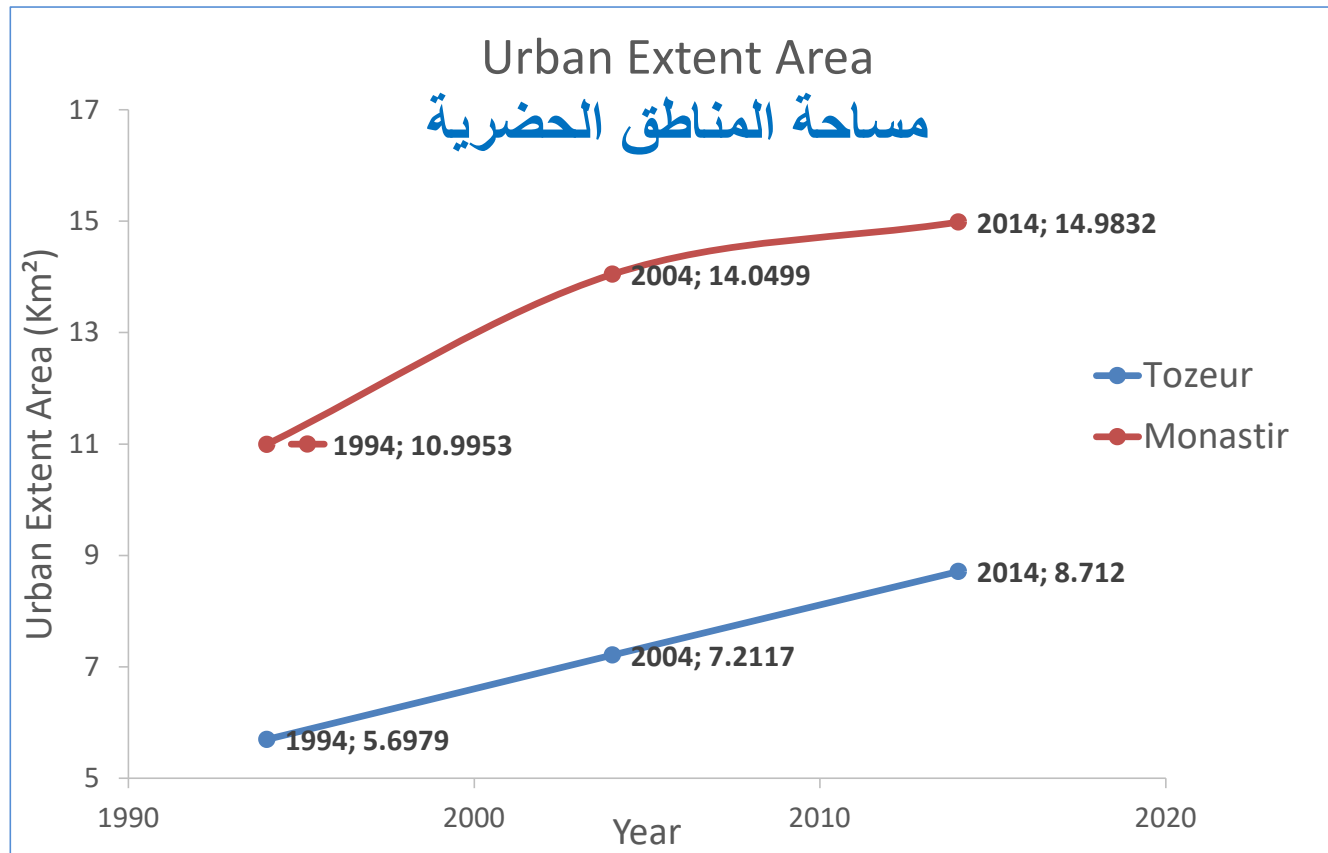


Functional City Boundaries



Built up areas and
city boundaries for
each census year

Functional Cities Boundaries



LCR: Results

$$\text{Urb}_{1994} = 5,6979 \text{ Km}^2$$

$$\text{Urb}_{2004} = 7,2117 \text{ Km}^2$$

$$\text{Urb}_{2014} = 8,712 \text{ Km}^2$$

$$y = 10$$

$$\begin{aligned} \text{So; } \text{LCR}_{1994-2004} &= \frac{(\text{LN}(7,2117/5,6979))}{10} \\ &= 0,0235 \end{aligned}$$

$$\begin{aligned} \text{So; } \text{LCR}_{2004-2014} &= \frac{(\text{LN}(8,712/7,2117))}{10} \\ &= 0,0188 \end{aligned}$$

From the computation above, between 2004 and 2014, the city of Tozeur appropriated land from other uses to urban use at an annual rate of 1.88%.

Population Growth Rate

Defining the population in functional city area

- Census data at **enumeration area** level
- **Link** censuses data with spatial data
- Data aggregated to determine population in the city area
- Spatial analyses to produce the **Gridded Population**

Gridded Population

Data

- **Built up** area at Censuses dates
- **Population at Enumeration Area level** from **Censuses**



Result → **Population density at each grid cell (1 km²)**



Method

- **Distribute** population to habitable land use within each EA
- **Aggregate** (تجميع) population to a grid cell

PGR: Results

$$\text{Pop}_{1994} = 43014$$

$$\text{Pop}_{2004} = 59895$$

$$\text{Pop}_{2014} = 85169$$

$$y = 10$$

$$\text{So; } PGR_{1994-2004} = \frac{(\text{LN}(59895/43014))}{10} = 0,0158$$

$$PGR_{2004-2014} = \frac{(\text{LN}(85169/59895))}{10} = 0,0138$$

The population of The city of Tozeur increased at an annual rate of 1.38% between 2004 and 2014

PGR: Results

$$LCRPGR = \left(\frac{\text{Annual Land Consumption rate}}{\text{Annual Population growth rate}} \right)$$

| | |
|--|--|
| $LCR_{2004-2014} = 0,0235$ | $LCR_{2004-2014} = 0,0188$ |
| $PGR_{1994 - 2004} = 0,0158$ | $PGR_{2004-2014} = 0,0138$ |
| $LCRPGR = \frac{0,0235}{0,0158}$ $= 1,484$ | $LCRPGR = \frac{0,0188}{0,0138}$ $= 1,369$ |

The city of Tozeur still compact in the last two decades

Thank you for your Attention

Ouadday.samira@ins.tn