ASSESSING SUSTAINABLE URBAN DENSIFICATION USING GEOGRAPHIC INFORMATION SYSTEMS

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"Measure what is measurable, and make measurable what is not so"
Galileo Galilei

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1. THE COMPACT CITY APPROACH

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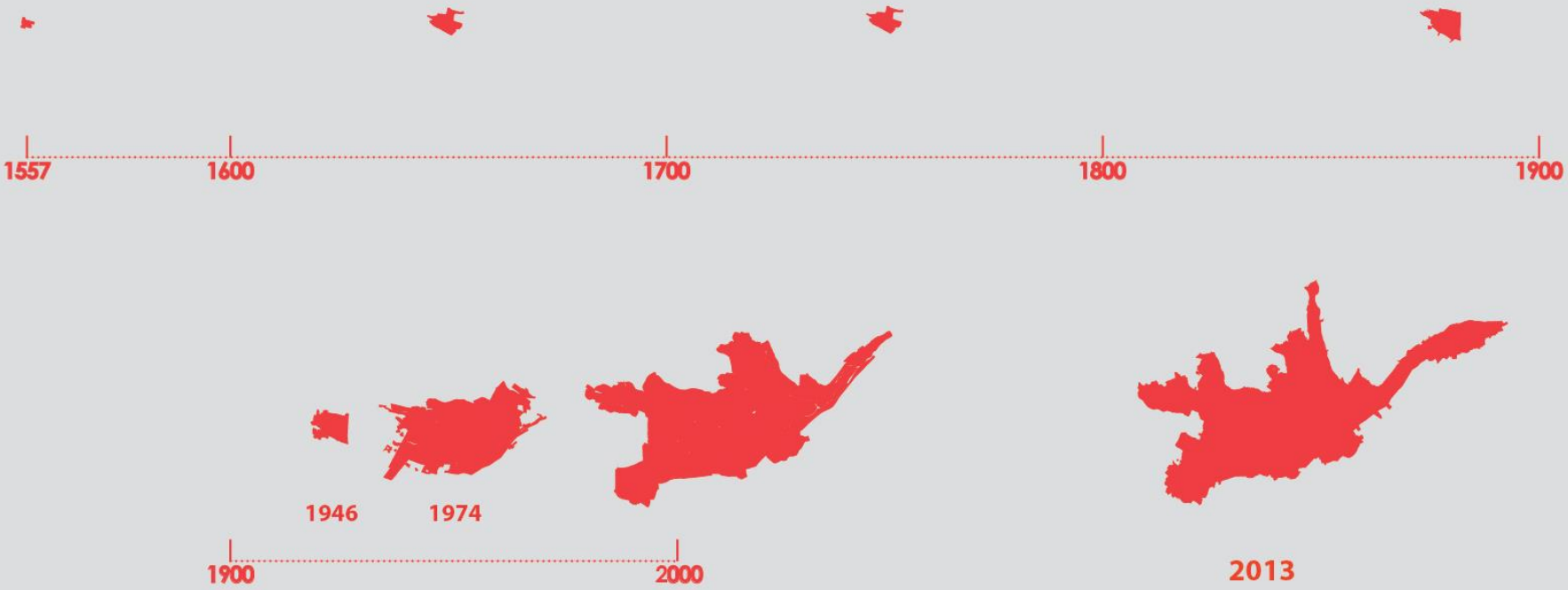
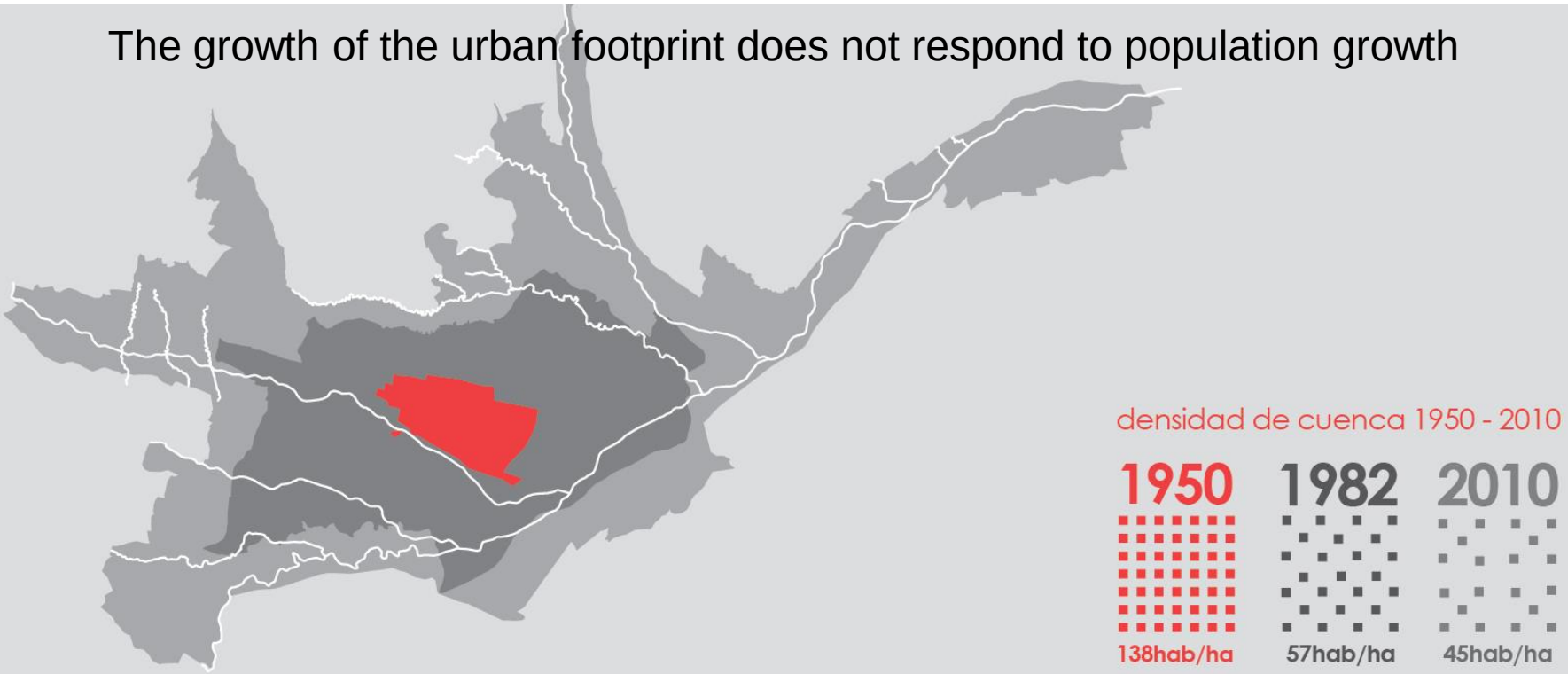


From 1950 to 2010 the area that Cuenca occupied grew 25.14 times

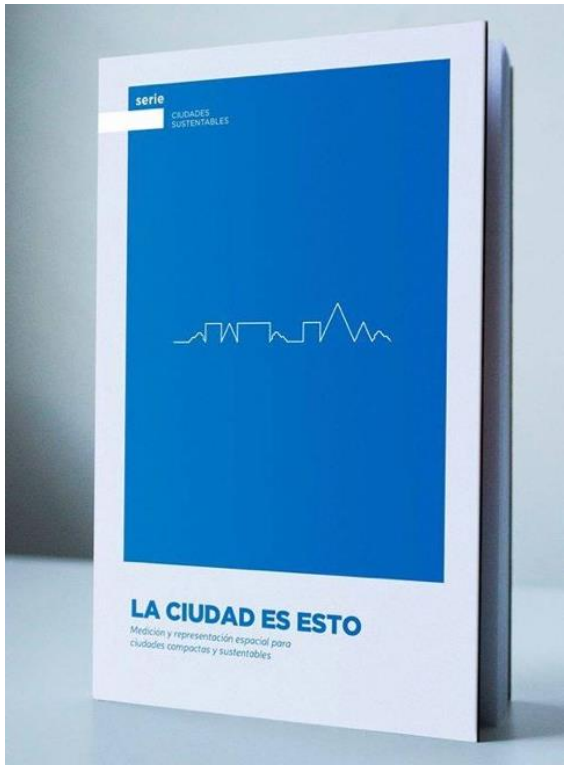
1. THE COMPACT CITY APPROACH

The growth of the urban footprint does not respond to population growth



In the last 50 years density has decrease a 67%

1. THE COMPACT CITY APPROACH



In *"La ciudad es esto"* we proposed an approach for **measuring sustainable densification** based on the idea of a **compact and complex city**

LA CIUDAD ES ESTO *Medición y representación espacial para ciudades compactas y sustentables* (Hermida et al., 2015)

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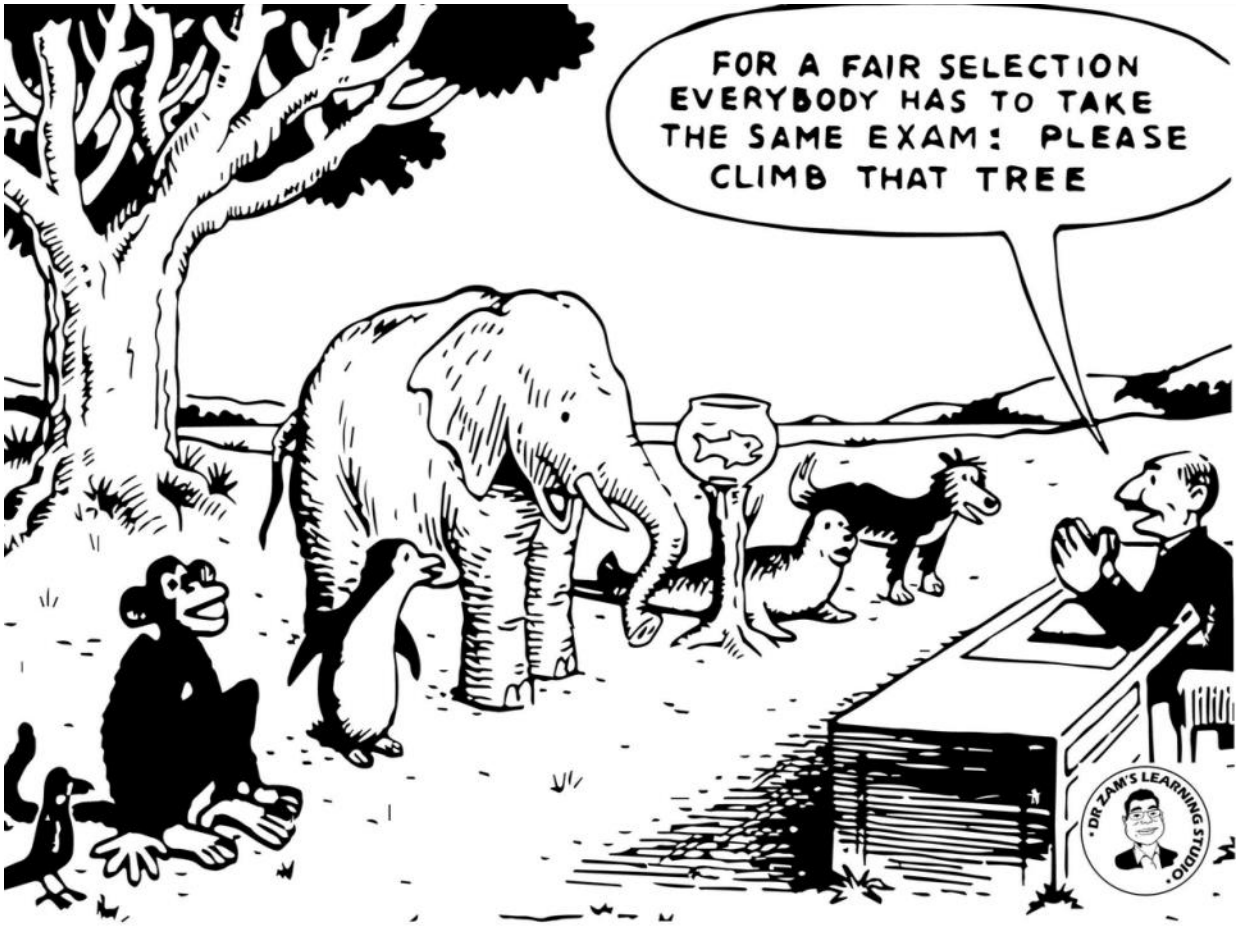


1. THE COMPACT CITY APPROACH

20

indicators

4 axes

Socio-spatial integration

- Provision of infrastructure
- Percentage of households in narrow circumstances
- Socio-spatial segregation

Diversity of uses

- Urban complexity
- Ratio of activity and residence
- Daily commerce activities
- Spatial and functional continuity of corridor

Urban green

- Permeability of public land
- Green area per capita
- Volume of green in public space
- Proximity to the nearest green area
- Simultaneous proximity to 3 types of green areas

Compactness

- Urban housing density
- Inhabitants density
- Absolute compactness
- Percentage of pedestrian road
- Alternative transportation proximity
- Pedestrian accessibility
- Percentage of closed condominium
- Empty lots area

2. SPATIAL HETEROGENEITY

Urban indicators are inherently spatial. We need to know **WHERE**, not only WHAT is sustainable.

2. SPATIAL HETEROGENEITY

”Not all neighbourhoods are created equal”

3. REPLICABILITY AND COMPARABILITY

An indicators system must:

- Allow to **compare** different cases
- Be able to monitor **changes** in time
- Have a **transparent** and replicable methodology.
- Be **efficient** in time and resource consumption.

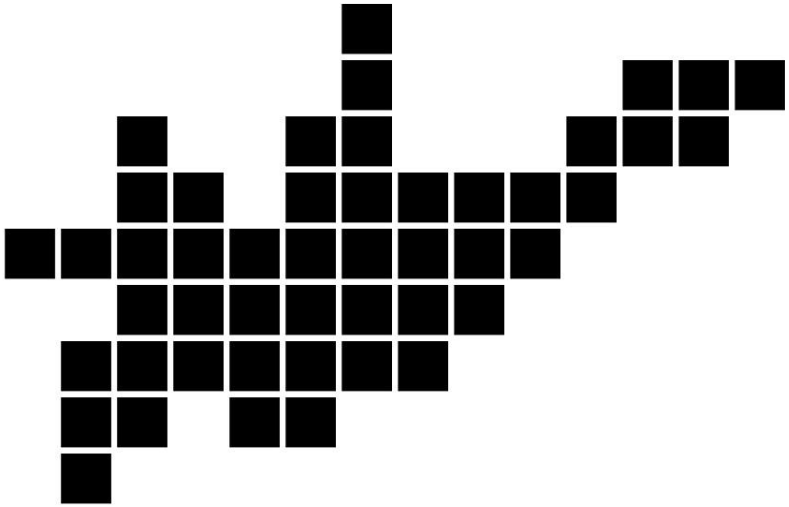
4. MODEN TOOLBOX

Sustainable Urban Densification Index

Sub-index	Indicator	Optimum value
Housing and diversity of uses	Urban housing density	>40 dwellings/hectare
	Urban complexity	>4
Pedestrian accessibility	Pedestrian accessibility	>75%
	Alternative transportation proximity	100%
Urban green	Green area per capita	>15m^2/inhabitant
	Volume of green in public space	>30%
	Simultaneous proximity to three types of green areas	100%
Socio-spatial integration	Percentage of households in quartile 1	25%
	Socio-spatial segregation	0,76-1,25

4. MODEN TOOLBOX

Spatial Abstraction



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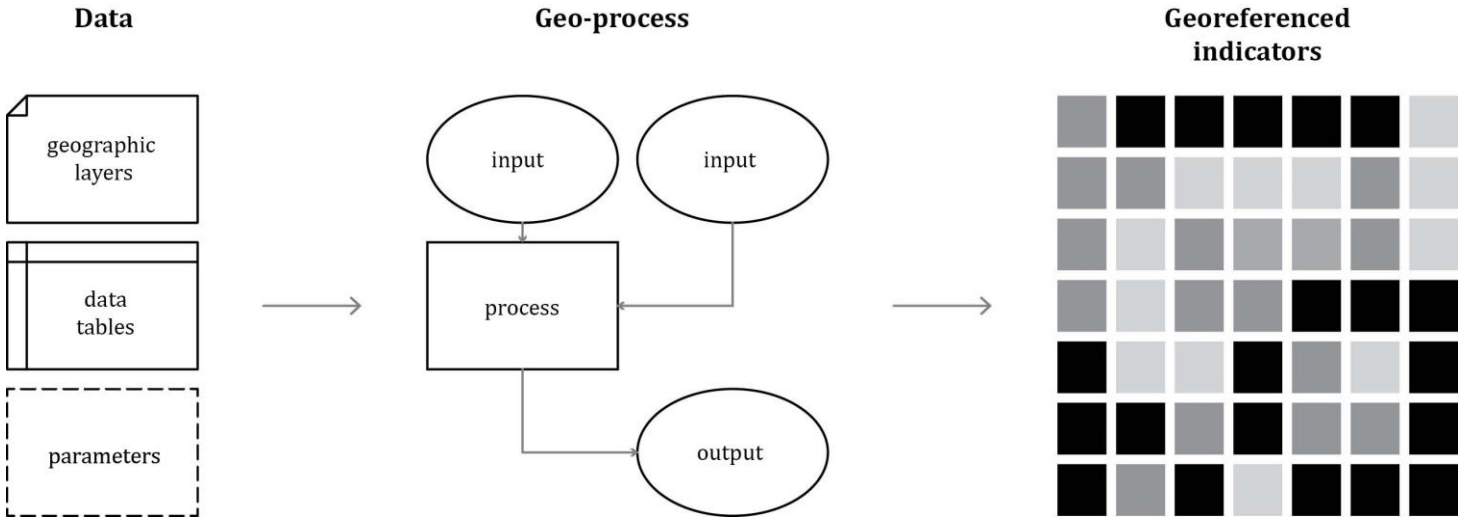


A GIS ToolBox to facilitate the assessment of sustainable urban densification

4. MODEN TOOLBOX

Indicators as Geo-processing tools

19. Porcentaje de Viviendas con Carencias

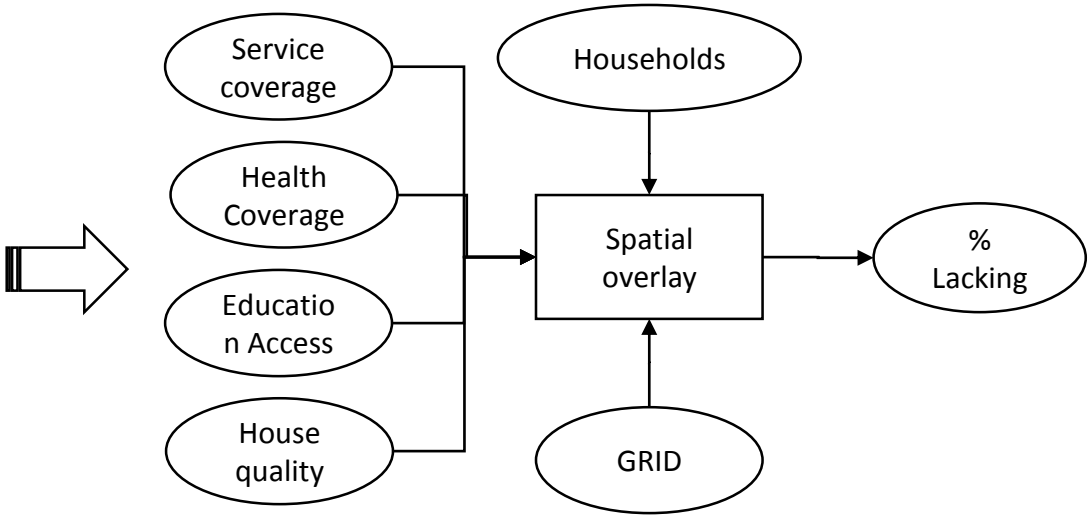
Descripción
Mide el porcentaje de viviendas que se encuentra en condiciones de carencia, determinado con base en el Índice de Condiciones de Vida (ICV). Este indicador evidencia el déficit en la satisfacción de necesidades de la población en la zona de estudio tomando en consideración cuatro elementos: la calidad de la vivienda, los servicios públicos, la educación y la afiliación a servicios de salud (Orellana & Osorio, 2014).

Fórmula Aplicada

$$\text{Porcentaje de Viviendas con Carencias} = \frac{\text{Número de Viviendas con Carencias}}{\text{Total de Viviendas}} * 100$$

Cálculo
Se identifican las viviendas que no cumplen con el umbral mínimo de condiciones de vida. Se considera que un hogar ha cumplido con las mínimas condiciones de vida cuando obtiene un valor igual o mayor a 0,95 en su ICV (ICV≥0,95).
Los datos necesarios para la construcción del ICV y para conocer el número total de viviendas se obtienen del *Censo de Población y Vivienda* 2010, información proporcionada por el *Instituto Nacional de Estadísticas y Censos* (INEC), a nivel de manzana.

Valor Óptimo Propuesto
0,00%*
**Rango determinado con base en los estudios del proyecto MODEN (2013).*



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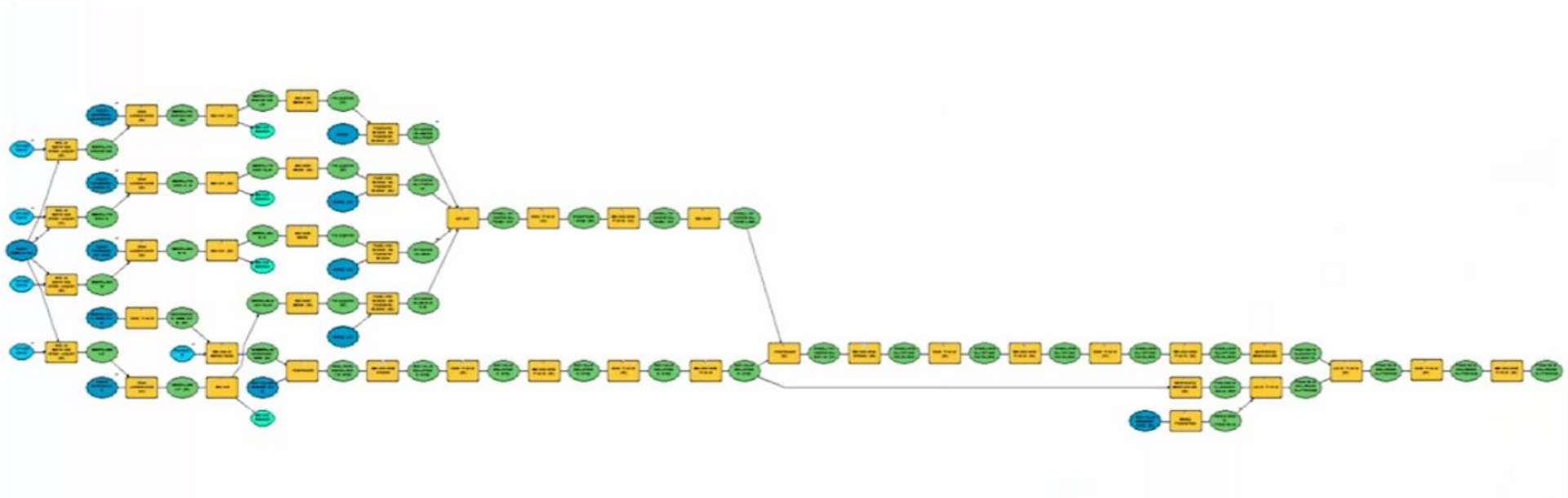
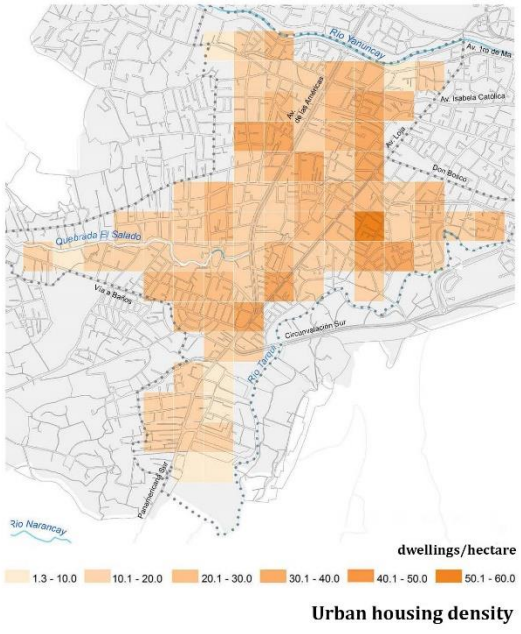
Automation

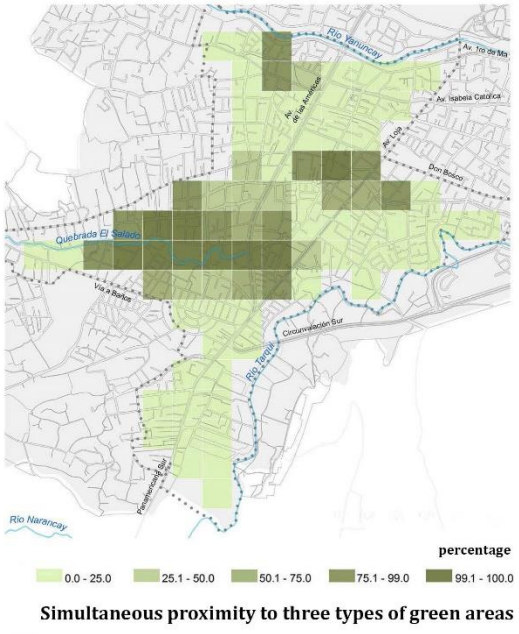


4. MODEN TOOLBOX

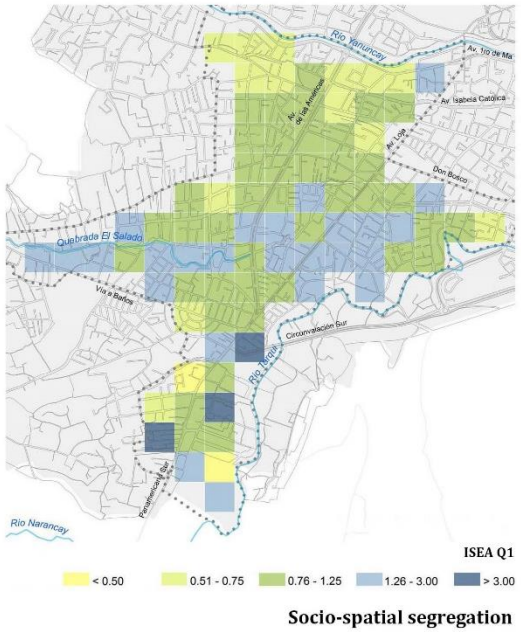
Spatial Representation and visualization



Urban housing density



Simultaneous proximity to three types of green areas



Socio-spatial segregation

4. MODEN TOOLBOX

Distribution and dissemination

- Digital copy of the book *"La ciudad es esto"*
- ToolBox Installer
- Sample data
- User manual
- Video tutorial

http://llactalab.ucuenca.edu.ec/investigacion/toolbox-densificacion-urbana-sustentable/

5. CONCLUSIONS

The MODEN Toolbox:

- Facilitates the evaluation of urban sustainability using a clear, replicable methodology.
- Allows the parameterization of the calculations and representation ranges, for different assessment approaches.
- Promotes the debate about different ways of assessing the parameters that affect sustainability, especially in terms of densification.
- User-friendly implementation allows exploring what-if scenarios and assess impacts of urban interventions.

5. CONCLUSIONS

Limitations and outlook:

- Quality and availability of required data are **highly variable** for the Latin American cities.
- Implementing a version for open-source software (QGIS)
- Looking for other researchers and practitioners willing to test, implement and improve the toolbox.

Thank you

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