Role of remotely sensed data in estimating SDG indicators at smaller spatial scales:
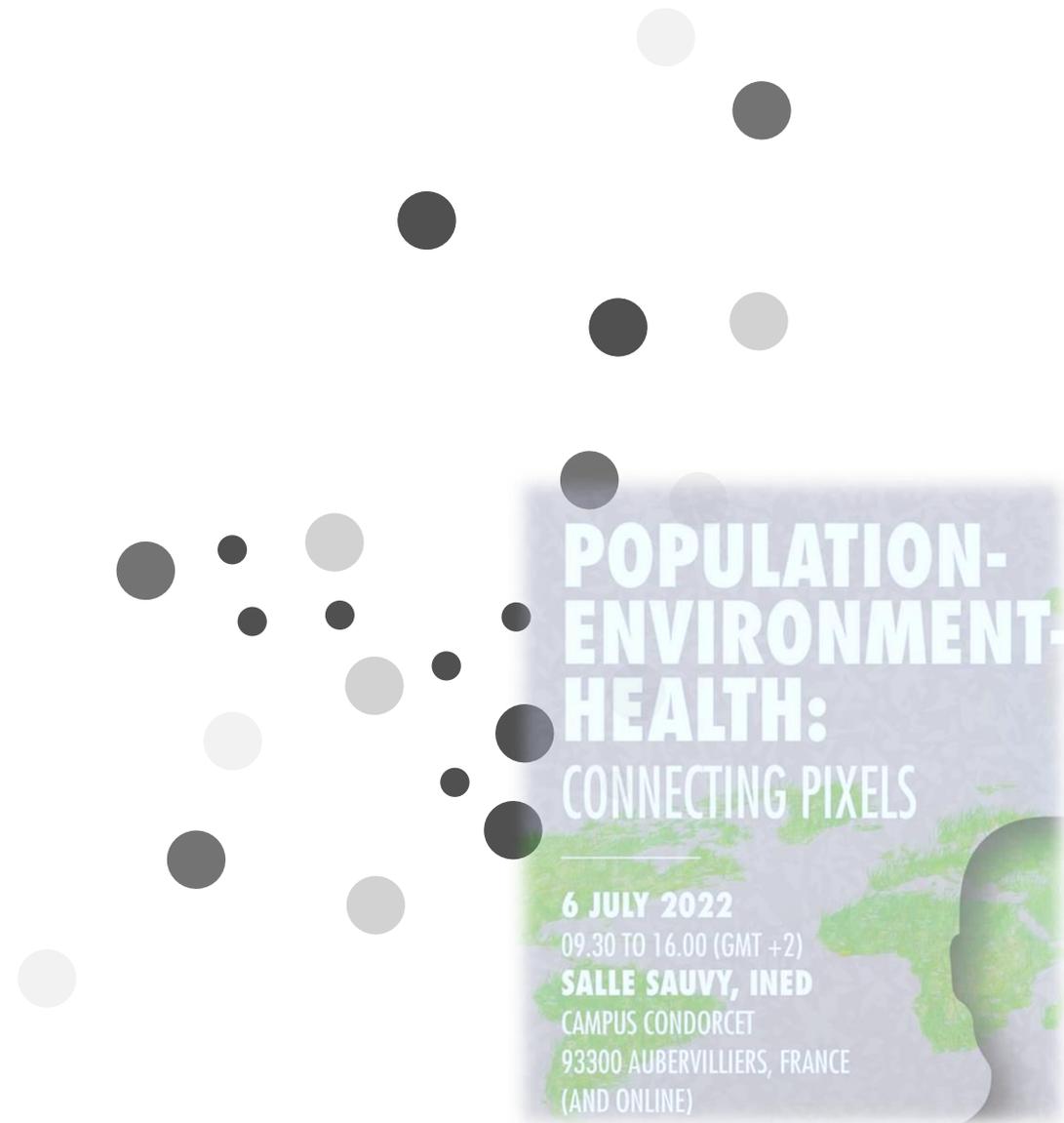
A case study on Indian peri-urban villages

Ankit Sikarwar

Post doctoral research fellow
INED-France
Email: anks.sik@gmail.com

POPULATION-
ENVIRONMENT-
HEALTH:
CONNECTING PIXELS

6 JULY 2022
09.30 TO 16.00 (GMT +2)
SALLE SAUVY, INED
CAMPUS CONDORCET
93300 AUBERVILLIERS, FRANCE
(AND ONLINE)

ined
INSTITUT NATIONAL
D'ÉTUDES DÉMOGRAPHIQUES

Background

Sustainable Development Goals

- 17 goals > 169 targets > 231 unique indicators

- To improve the quality of life on our planet and ensure we live in a world that is prospering

- Reduced effects, and eventually elimination, of any social, economic, and environmental downfall

By 2030

- Monitoring issues

- Role of reliable data

- Specifically to LMIC

- Spatial and temporal challenges

Source: thegef.org
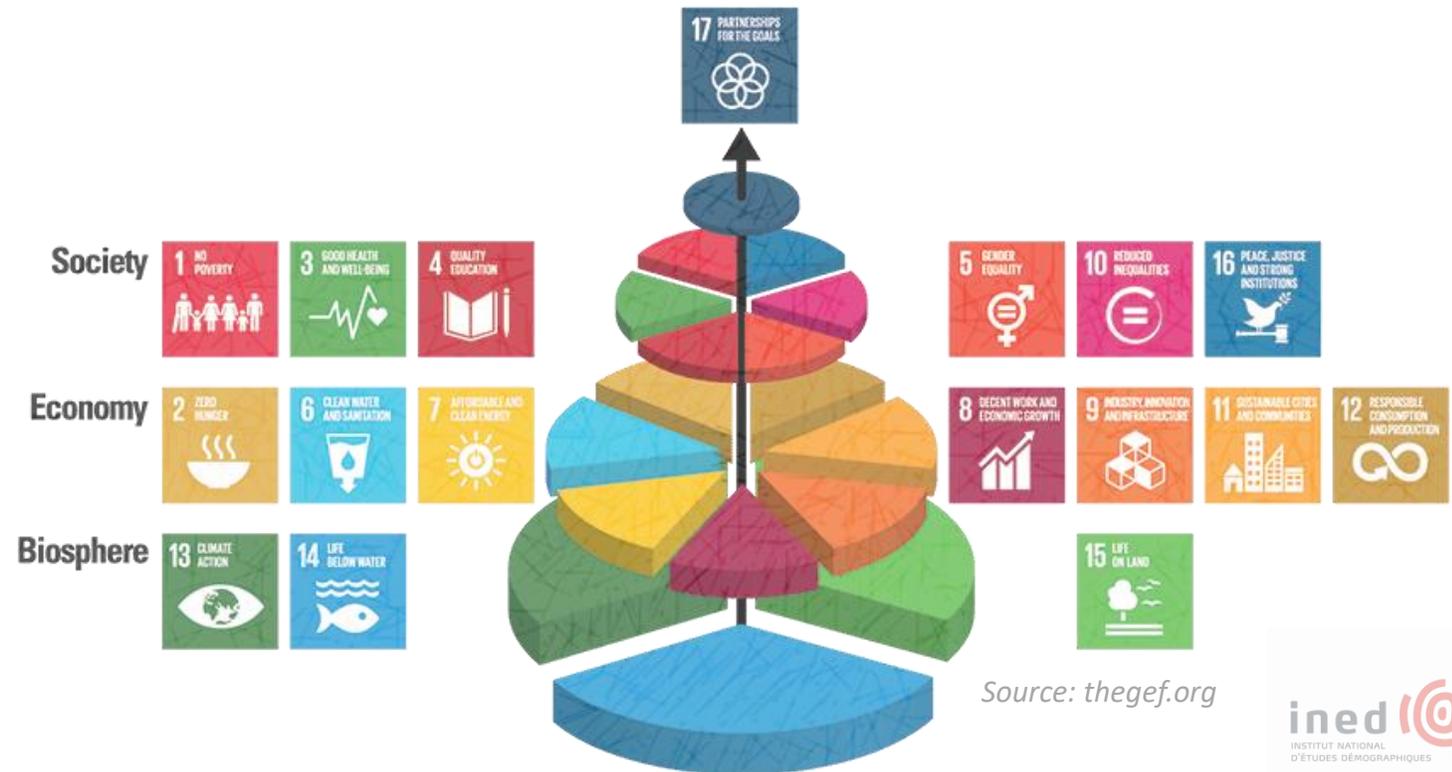
Background

Geospatial information to monitor SDGs

Source: knowledge4policy.ec.europa.eu

ADVANTAGES

Regular and repeatable observations

Multi-annual time series of observations

Cost-effective to monitor remote areas

ined
INSTITUT NATIONAL
D'ÉTUDES DÉMOGRAPHIQUES

Background

Geospatial information to monitor SDGs

Source: Avtar, R., Aggarwal, R., Kharrazi, A., Kumar, P., & Kurniawan, T. A. (2020). Utilizing geospatial information to implement SDGs and monitor their Progress. Environmental monitoring and assessment, 192(1), 1-21.
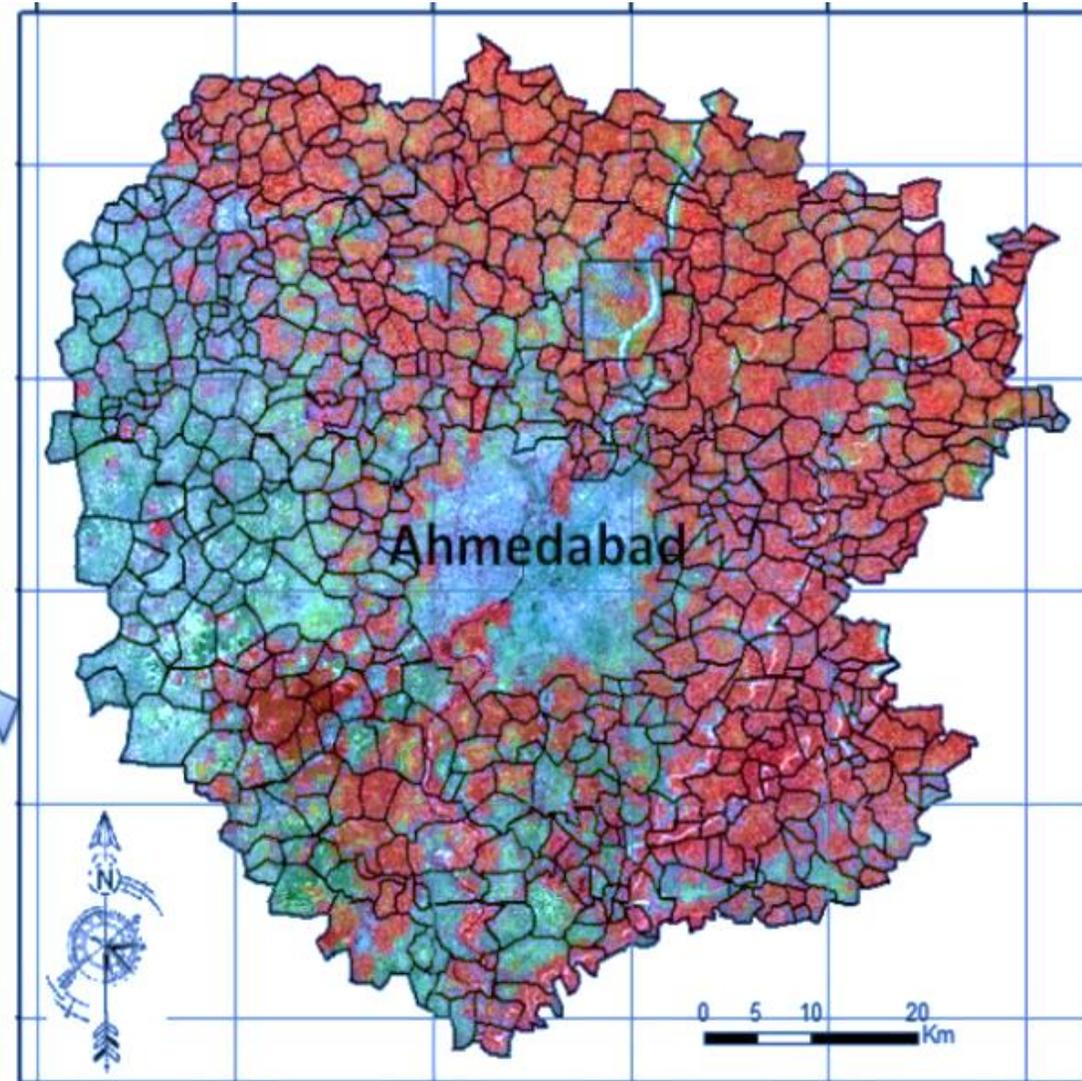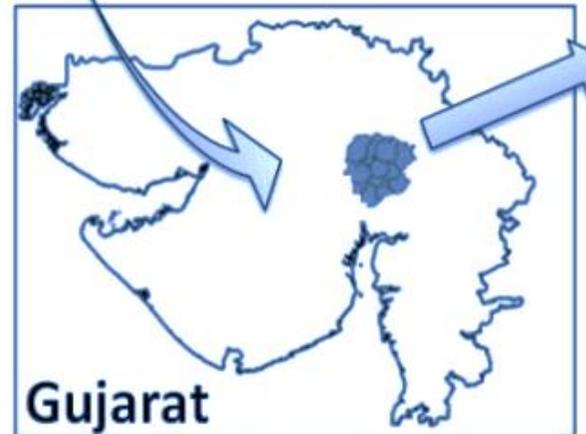
The case study

Estimation of SDG indicator 11.3.1 (LCRPGR) at smallest spatial unit in a transforming peri-urban region.

- 615 peri-urban villages

- Surrounding the rapidly growing Ahmedabad metropolitan city of Gujarat state in India

- Peri-urban: a dynamic interface

India

Gujarat

Ahmedabad

0 5 10 20 Km

SDG indicator 11.3.1 (Land use efficiency)

This indicator measures how efficiently land has been utilized compared to the population growth over time.

Population growth rate

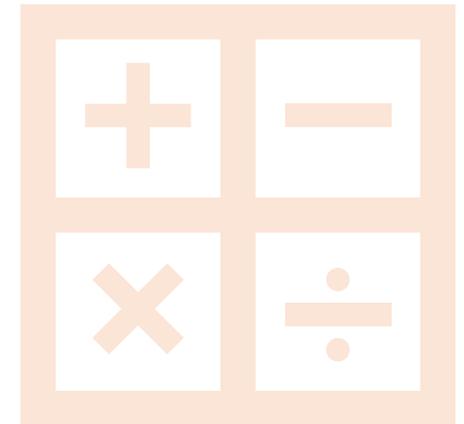$$PGR = \left(\frac{LN(\frac{Pop\,(t+n)}{Pop\,(t)})}{time} \right)$$

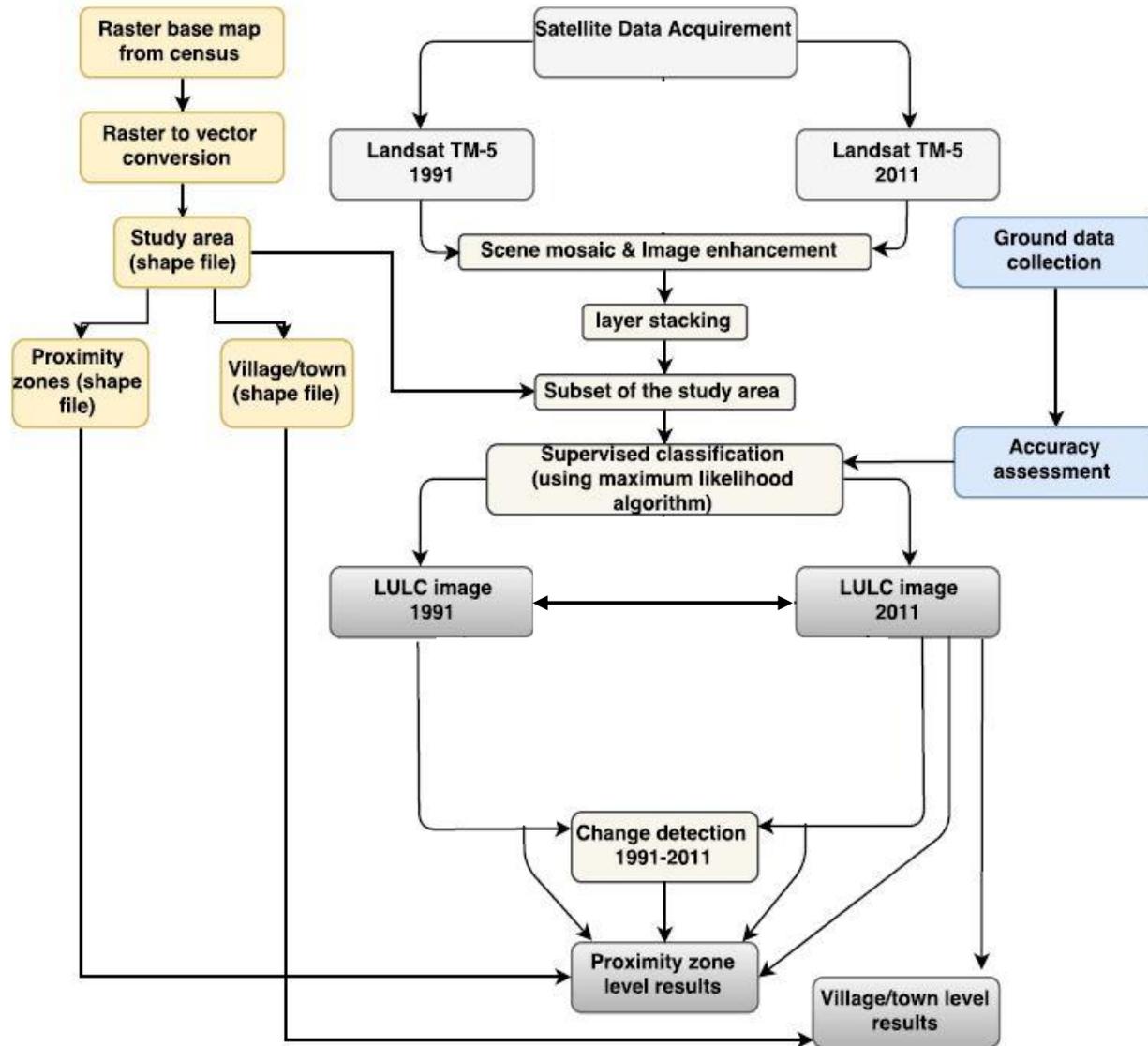Population Census (1991 & 2011)

Land Consumption rate

$$LCR = \left(\frac{LN(\frac{Built\,(t+n)}{Built\,(t)})}{time} \right)$$
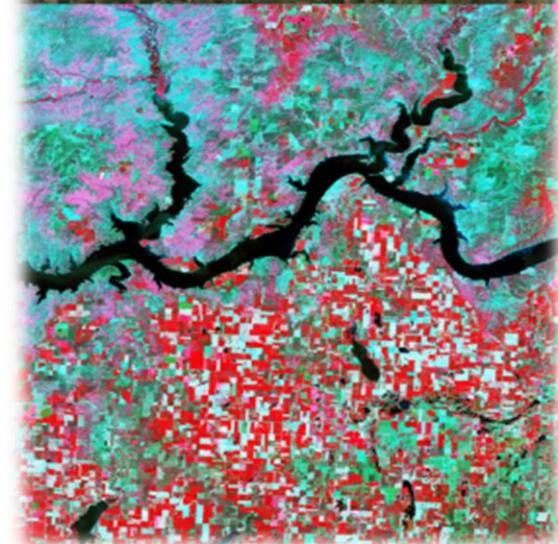
LANDSAT TM-5 (USGS) (1991 & 2011)

$$LCRPGR = \frac{LCR}{PGR}$$
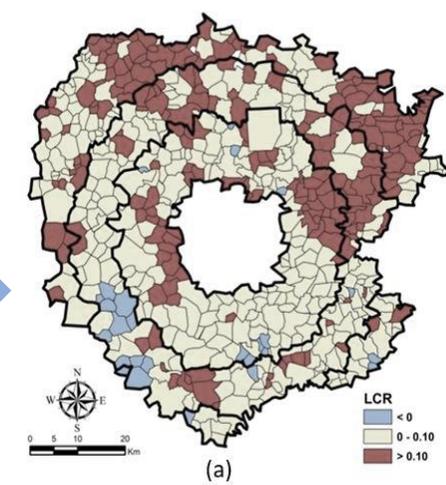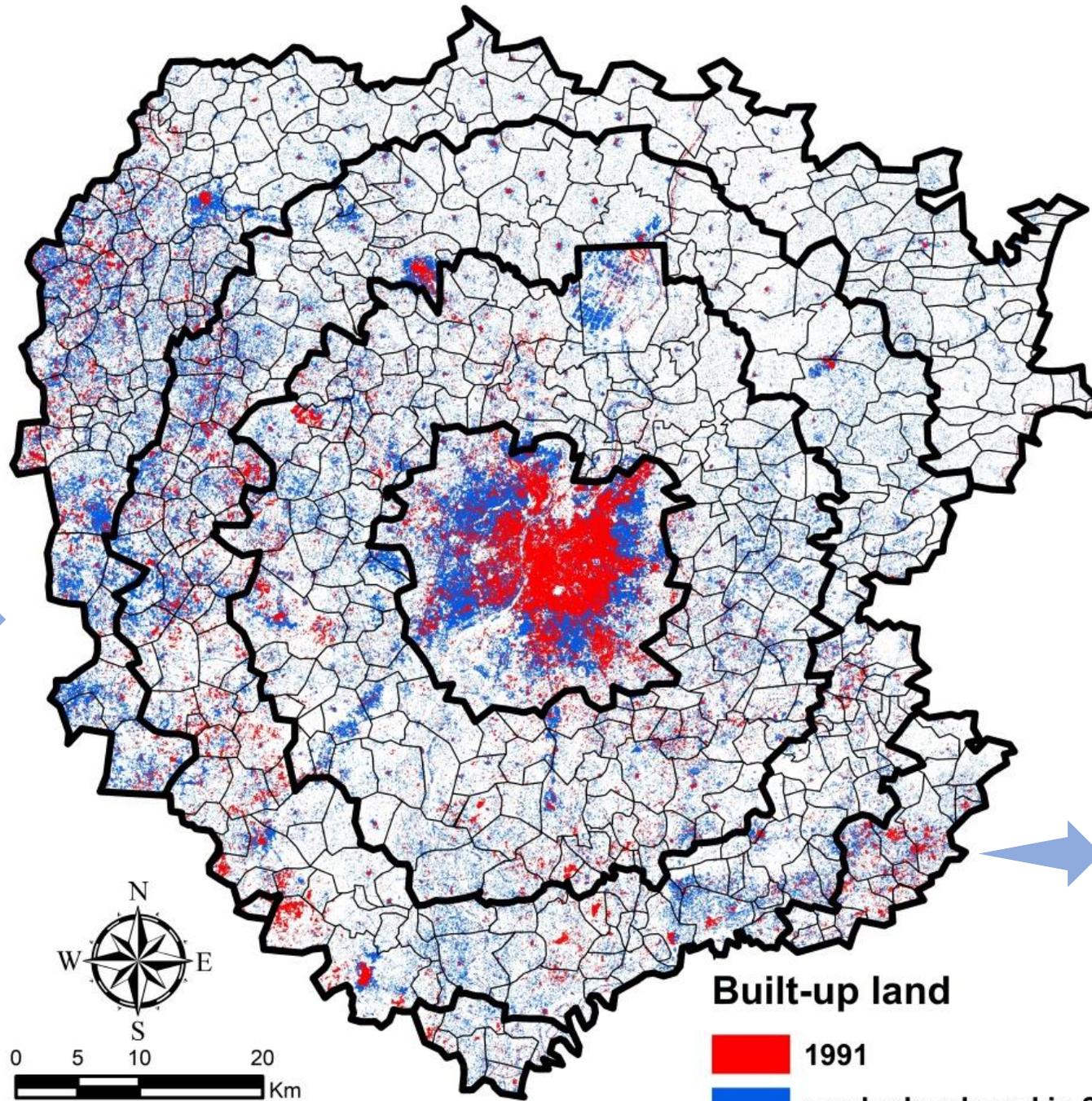
Measuring Land Consumption rate
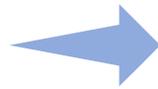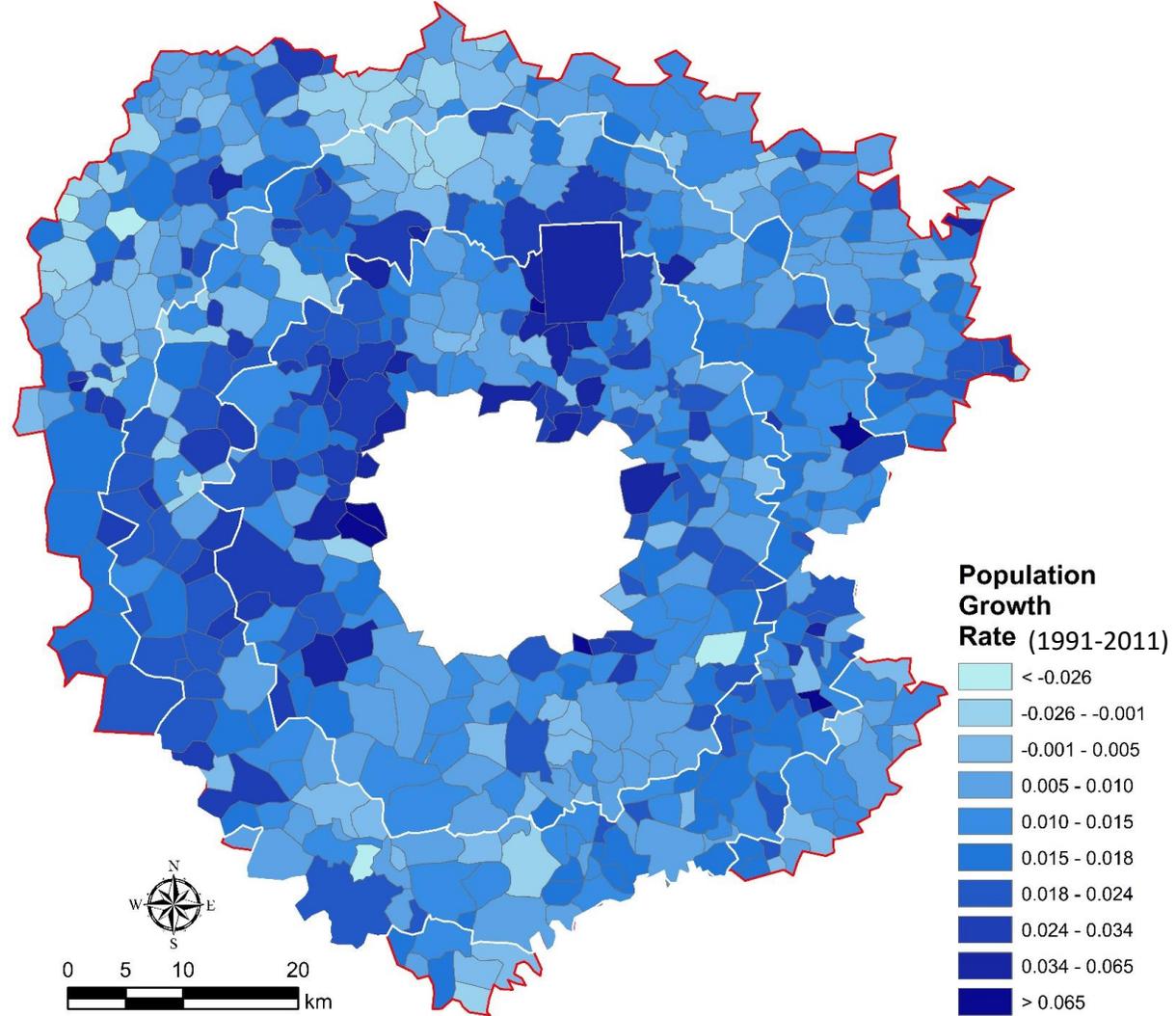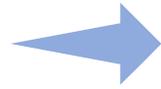

Raw satellite image

Processed satellite image

Patterns of Land development

Remarkable change not only in Ahmedabad city but also in the surrounding villages (even in the distant ones).

Built-up land

🟥 1991

🟦 newly developed in 2011

LCR
< 0
0 - 0.10
> 0.10

(a)

ined
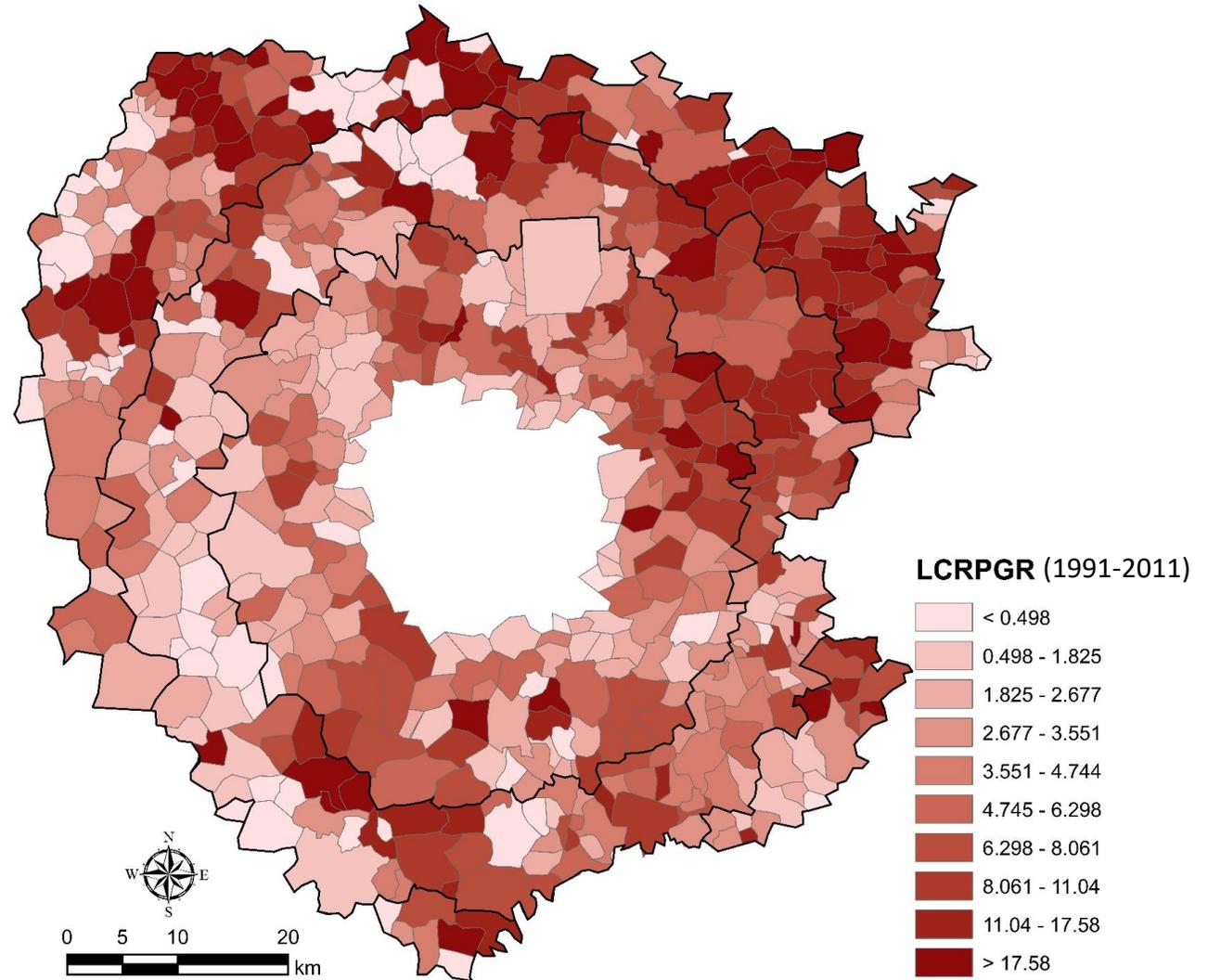INSTITUT NATIONAL
D'ÉTUDES DÉMOGRAPHIQUES

Patterns of population growth

Villages nearer to the main city have witnessed a higher population growth compared to the distant ones.

Population Growth Rate (1991-2011)

- < -0.026
- -0.026 - -0.001
- -0.001 - 0.005
- 0.005 - 0.010
- 0.010 - 0.015
- 0.015 - 0.018
- 0.018 - 0.024
- 0.024 - 0.034
- 0.034 - 0.065
- > 0.065

0   5   10   20
km

Patterns of LCRPGR

Spatially varying LCR and PGR are resulted in higher LCRPGR in villages at higher distance from the city.

LCRPGR (1991-2011)

	< 0.498
	0.498 - 1.825
	1.825 - 2.677
	2.677 - 3.551
	3.551 - 4.744
	4.745 - 6.298
	6.298 - 8.061
	8.061 - 11.04
	11.04 - 17.58
	> 17.58

0 5 10 20 km

Average LCR, PGR and LCRPGR at different spatial extents
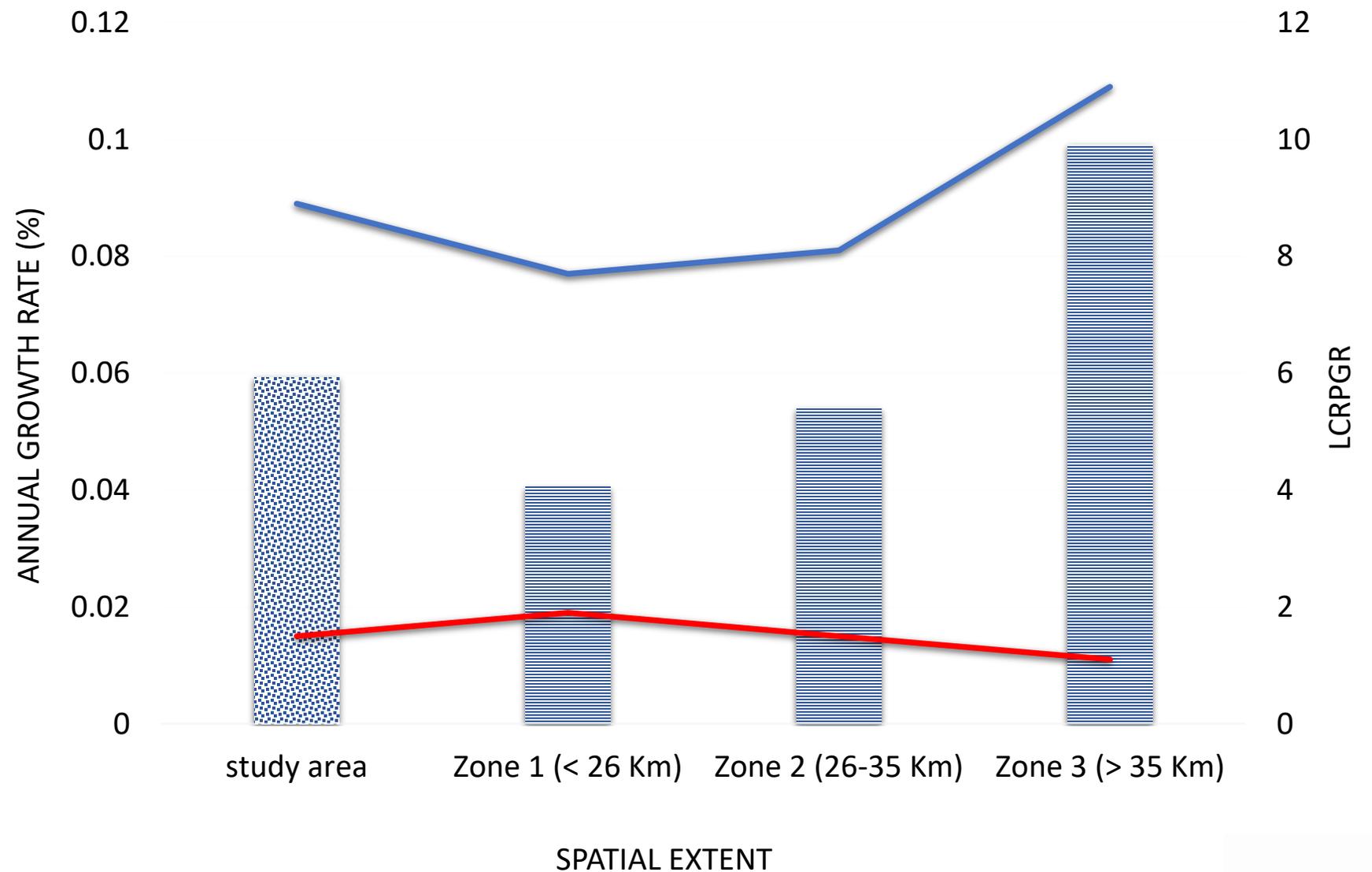
Number of villages under different LCRPGR groups within three proximity zones

Distance from major roads

(a) Overlay of two raster

(b) Forming new raster

(C) Filling village level information

Distance (mtr)
High : 7208.19

Low : 220.975

0   10   20   40
km
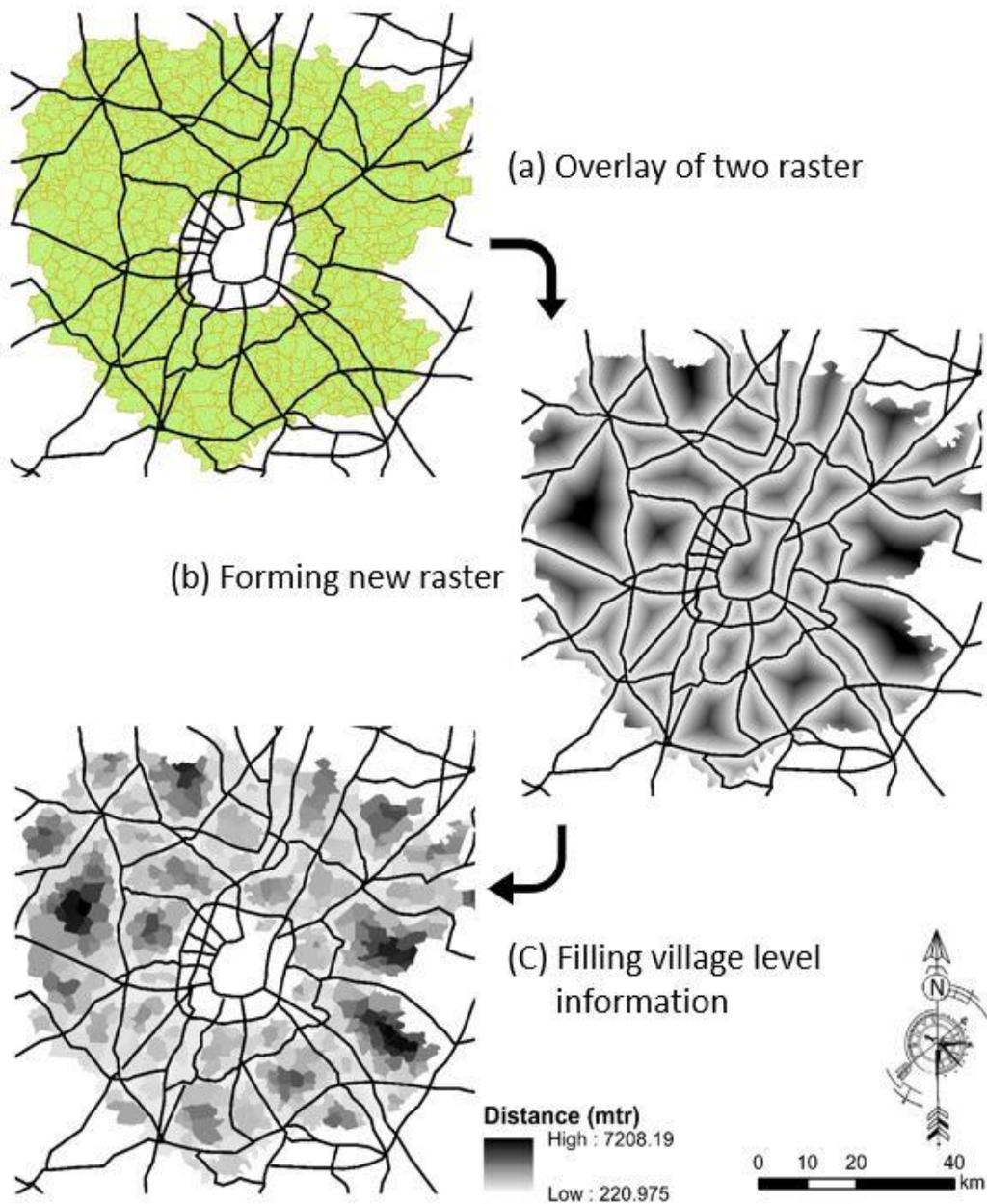
Distance from town locations

High : 25398.7

Low : 0

(a) Overlay of raster of Euclidian distance form town over study region

High : 22264.1

Low : 732.393

5 10   20
km

(b) Village level distance from towns
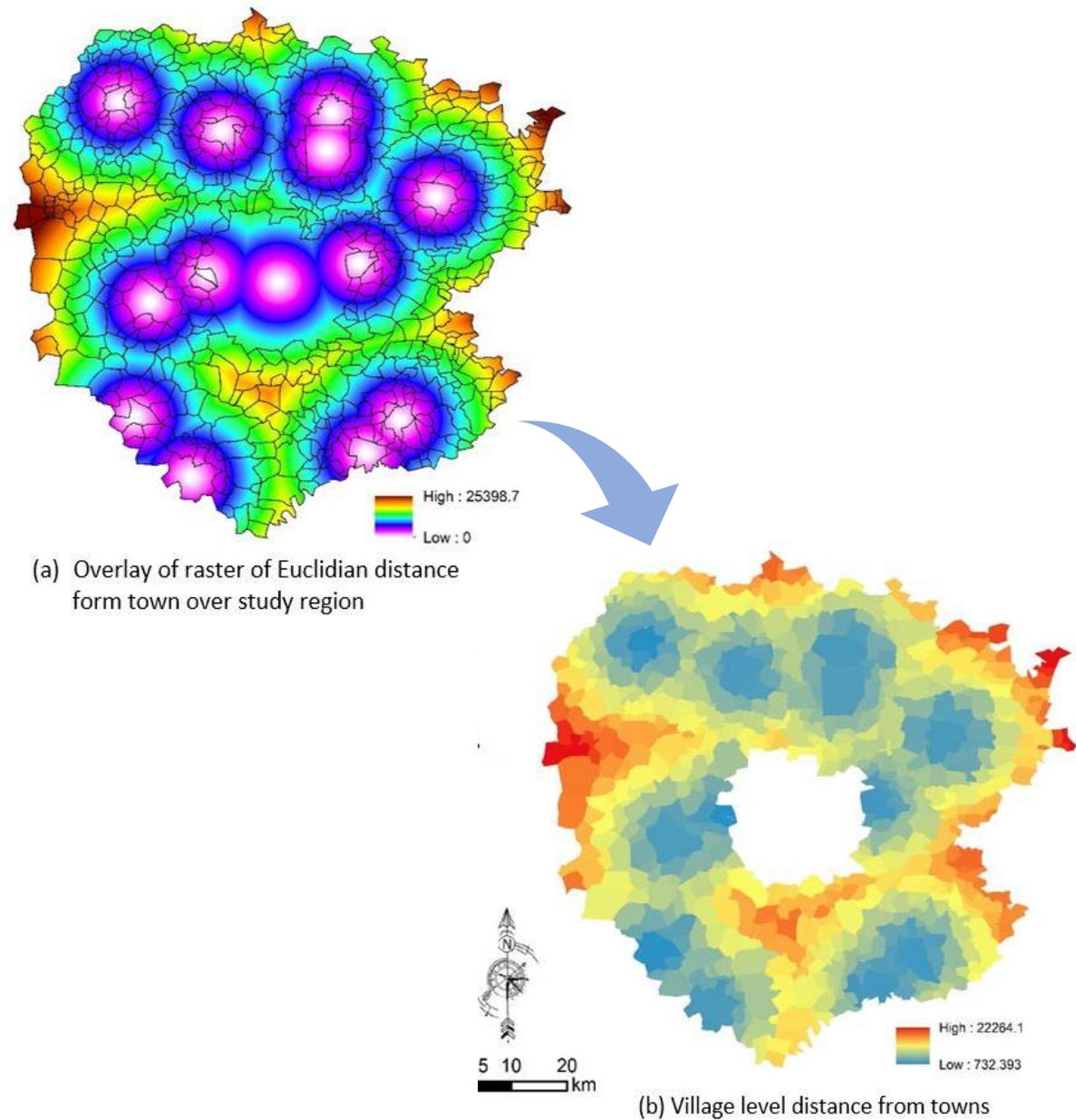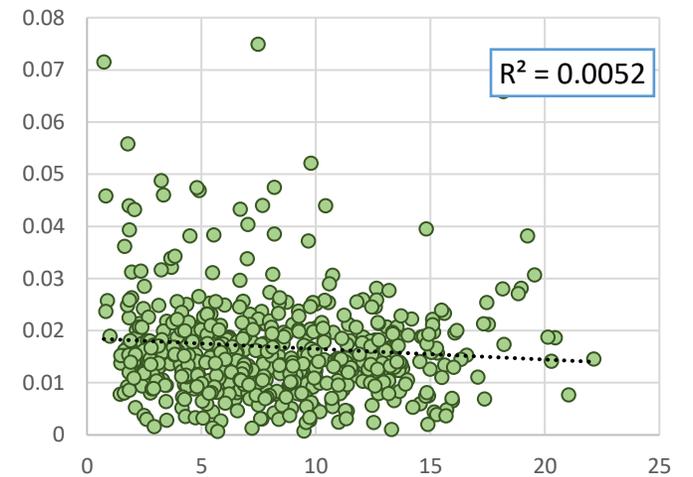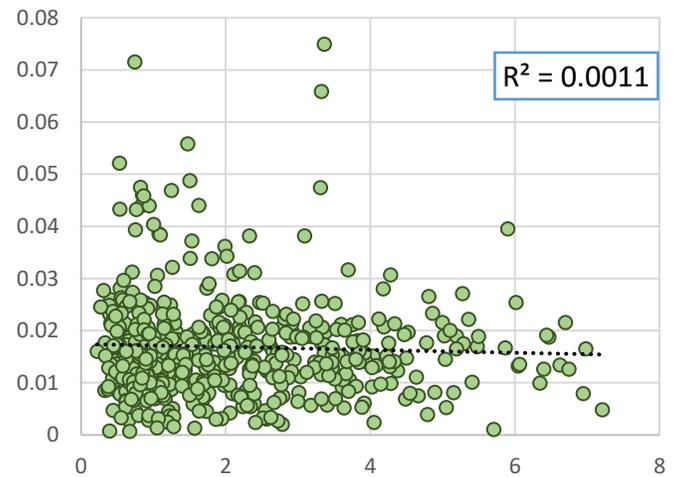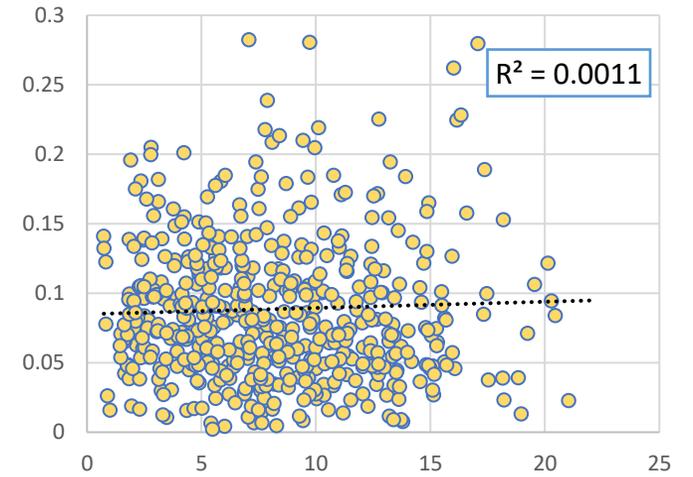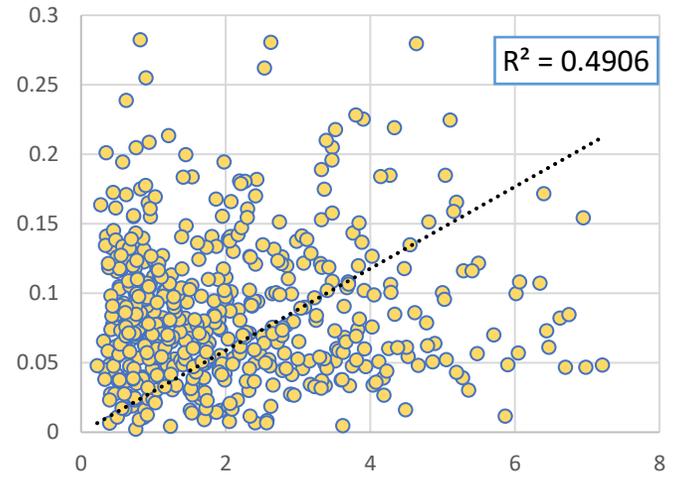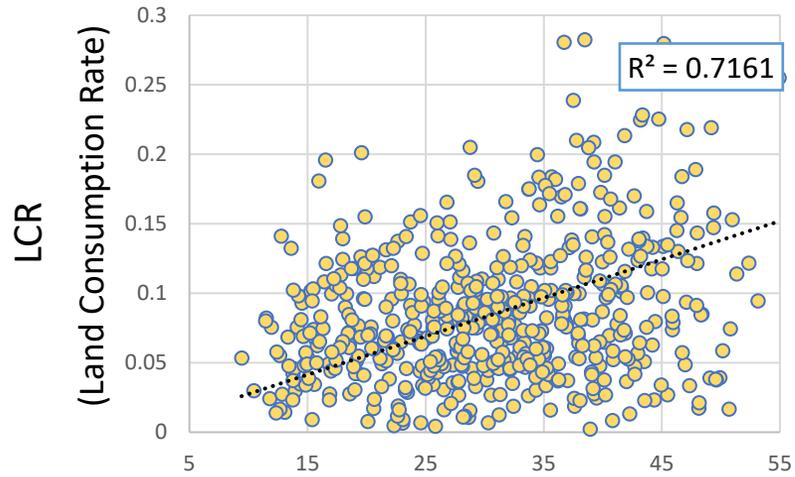
LCR (Land Consumption Rate)	R² = 0.7161	R² = 0.4906	R² = 0.0011
PGR (Population growth Rate)	R² = 0.5342	R² = 0.0011	R² = 0.0052
	Distance from **main city**	Distance from **major roads**	Distance from **major towns**

ined
INSTITUT NATIONAL
D'ÉTUDES DÉMOGRAPHIQUES

Conclusion

- The peri-urban villages are transforming rapidly.

- Rural land has been utilized for urban development.

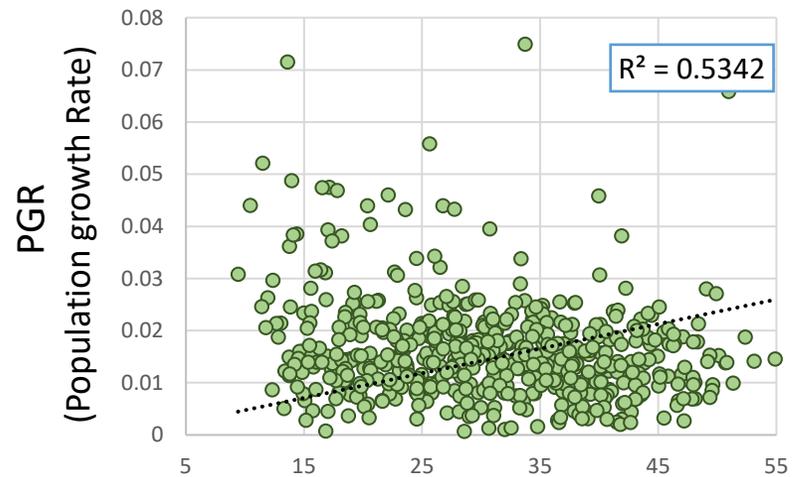- Distant villages were not able to pull population growth, yet they have witnessed huge land conversion.

- Presence of town have no effect on LCRPGR .

- Urban proximity is affecting village's *'man & land'* balance.

- In such situations agricultural communities may face adverse challenges.

Spatial scale matters

KERALA ON TOP AGAIN With a composite score of 75, Kerala topped the NITI Aayog's 2020 Index, based on the State's performance across 16 Sustainable Development Goals

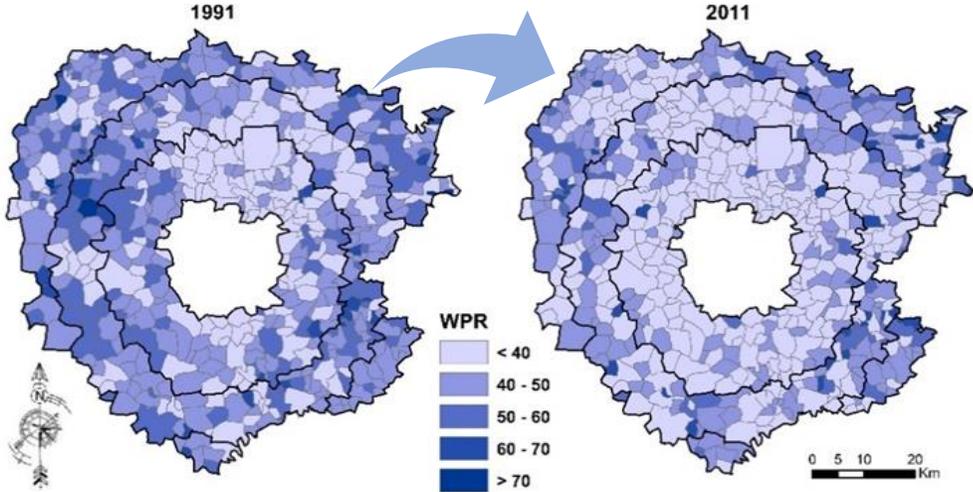A score of 100 implies that the State/UT has achieved the targets set for 2030. A score of 0 implies that it is at the bottom of the table

52 **2020 INDEX SCORE** 79

Goal	Top States
No poverty	Tamil Nadu
Zero hunger	Kerala
Good health and well-being	Gujarat
Quality education	Kerala
Gender equality	Chhattisgarh
Clean water and sanitation	Goa
Decent work and economic growth	Himachal Pradesh
Industry, innovation and infrastructure	Gujarat
Reduced inequality	Meghalaya
Sustainable cities and communities	Punjab
Responsible consumption and production	Tripura
Climate action	Odisha
Life below water	Odisha
Life on land	Arunachal Pradesh
Peace, justice and strong institutions	Uttarakhand

GOAL-WISE TOP STATES

Source: blog.forumias.com

Other challenges

- **Employment**

1991 → 2011

WPR
- < 40
- 40 - 50
- 50 - 60
- 60 - 70
- > 70

0 5 10 20 Km

- **Basic infrastructure**

IFS
- <20
- 20-30
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80
- >80

0 5 10 20 Km

- **Green area**

NDVI-1991
- < 0.1 (Poor)
- 0.1 - 0.3 (Moderate)
- > 0.3 (Good)

NDVI-2011
- < 0.1 (Poor)
- 0.1 - 0.3 (Moderate)
- > 0.3 (Good)

0 5 10 20 Km
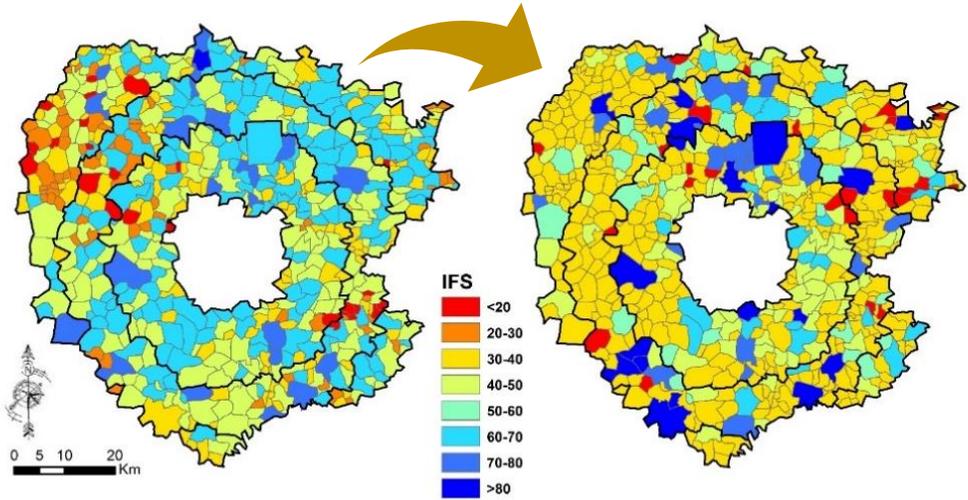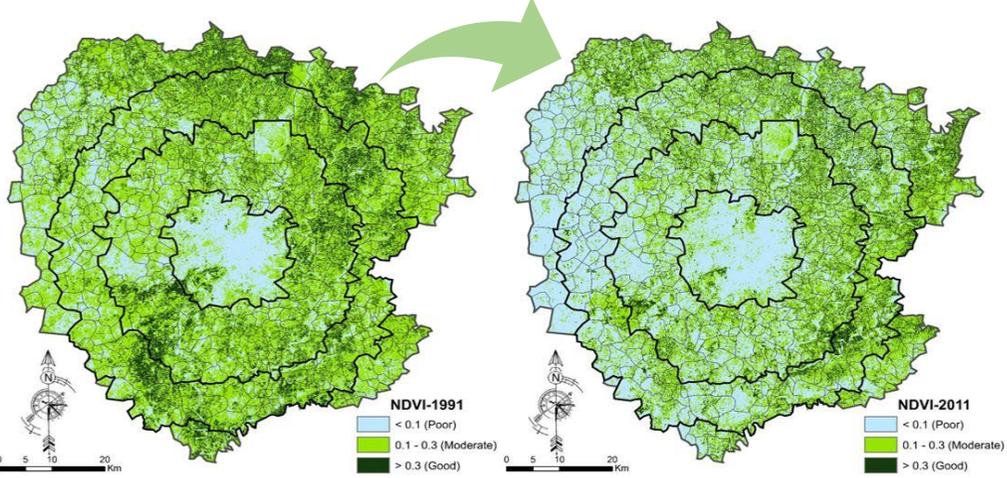
- **Land surface temperature**

LST-1991
- < 28
- 28 - 32
- 32 - 36
- 36 - 40
- > 40

LST-2011
- < 28
- 28 - 32
- 32 - 36
- 36 - 40
- > 40

0 5 10 20 Km
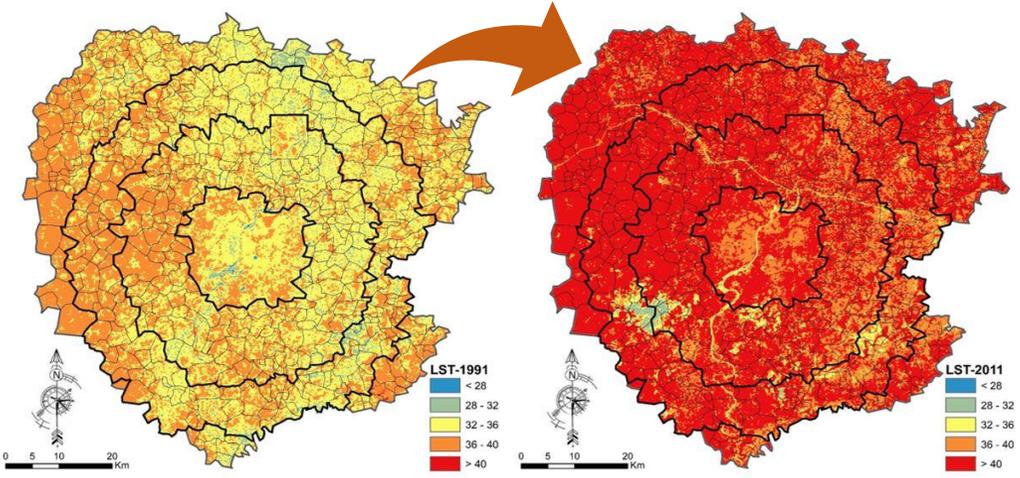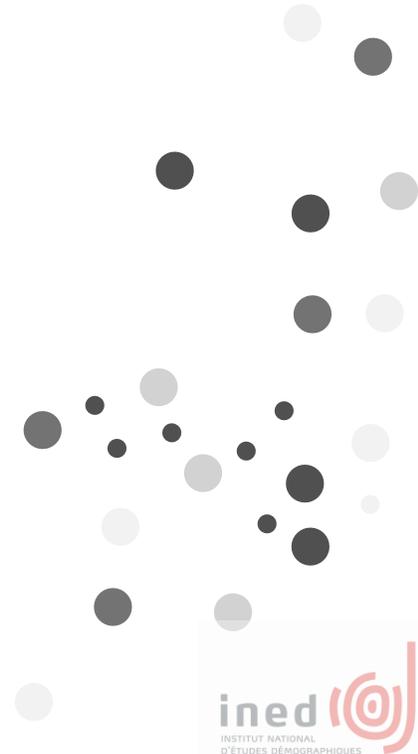
Way forward

- *Micro-level analyses of SDG indicators with the help of geospatial information are vital to know complex challenges ahead of their fulfillment.*

- *Inclusion of 'agricultural land change' in the existing 'land consumption' component.*

- *These peri-urban villages, specifically the distant ones, should be considered under the framework of city/urban planning for the sustainable development.*

Urban sustainability

Rural sustainability

Thank you

ined
INSTITUT NATIONAL
D'ÉTUDES DÉMOGRAPHIQUES