Multi-scale and multi-sensor analysis of urban cluster development and agricultural land loss in China and India

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Project Goals

1. Detect and quantify the growth of **urban cluster hot spots** in China and India.

2. Identify **agricultural land loss** in urban cluster hot spots and when they occurred.

3. Explain the **drivers of the growth of urban clusters** and urban land conversion within them.
India’s urban population: Peaking in second half of 21 C

UN. 2011. World Urbanization Prospects
China’s urban population: Peaking in first half of 21 C

12% 77%

(UN. 2011. World Urbanization Prospects)
Vegetation Adjusted NTL Urban Index to identify urban clusters

\[ \text{VANUI} = (1 - \text{NDVI}) \times \text{NTL} \]

The Vegetation Adjusted NTL Urban Index: A new approach to reduce saturation and increase variation in nighttime luminosity

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Monitoring urbanization dynamics in India using DMSP/OLS night time lights and SPOT-VGT data

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Goal 1: MODIS and DMSP OLS to identify urban cluster hot spots
A global fingerprint of macro-scale changes in urban structure from 1999 to 2009

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Urban centers are dense but buildings often do not rise above 3-4 stories.
High rise residences are common in peri-urban areas.
KEY MESSAGES FROM GOAL 1

• Chinese cities are building up and out
• Indian cities are primarily building out
• Urban hot spots do not change significantly due to inertia and agglomeration economies
• Growing concentration of activities and resources in urban hot spots
• Little urban growth spillover around Indian cities
• Different magnitudes and rates of growth
Goal 2: Identify agricultural land loss in urban cluster hot spots

Filtered Time Series

Additive Decomposition using LOESS method (Cleveland et al. 1990)

Seasonal Component

Trend Component

Error Component
**OLS- MOSUM Test**

- Structural Break Present
- $\alpha = 0.05$ (p = 0.01)

Compute F-Statistic to identify change point (Chow Test for statistical significance of change point)

Seasonal + Trend Component

Segmented Seasonal Component

Change estimated in 2006
Change estimated in 2002

Source: Google Earth
Change estimated in 2005
During 2001 – 2010, India lost 0.7 million hectares (roughly five times the size of Delhi) of its agricultural land to urban growth.

Agricultural land loss in each state is less than 1% of its total geographical area.

Agricultural land loss is lower in the northeastern states compared to other states.

The total amount of agricultural land lost to urban growth was highest (0.12 million hectares) in the one year period from June 2001 to May 2002.

Since 2006, the amount of agricultural land converted has been increasing steadily.
Agricultural land loss is largely in states and districts which have a larger number of operational or approved special economic zones (SEZs).

Agricultural land loss is occurring around smaller cities more than around bigger cities.

Agricultural land loss is concentrated in a few districts and states with:
I. High rates of urbanization
II. High rates of economic growth
III. Higher agricultural land suitability compared to other states
Agricultural land conversion is slow
Agricultural land uses often conflict with converted urban land
Goal 3: Explain the drivers of the growth of urban clusters and agricultural land conversion

- In China, urban expansion is associated with decline in agricultural land use intensity
- Growth in the industrial sector negatively affects agricultural land use intensity
China’s Three Major Planning Systems

The “Development” System
- National Development and Reform Commission
- Provincial Development and Reform Commissions
- City and County Development and Reform Commissions

The “Land” System
- Ministry of Land and Resources
- Provincial Land and Resources Bureaus
- City and County Land and Resources Departments
- Local Land Surveying and Planning Institutes

The “Urban” System
- Ministry of Housing and Urban and Rural Development
- Provincial Construction Bureaus
- Provincial Planning and Design Institutes
- City and County Construction Departments
- City and County Planning Departments
- Local Planning and Design Institutes

Source: A. Perlstein, PhD dissertation
Basic features of the 3 major types of plans

Development System
- 5-year plans
- Broad economic goals
- Industry development
- Major infrastructure

Land System
- Focus on rural land
- Farmland preservation
- Numerical quotas

Urban System
- Spatial layout of urban construction
- Coordination of infrastructure development
- Urban design
- Specialty plans
Central versus local states: Which matters more in affecting China’s urban growth?

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Small agricultural holdings make it difficult for developers to acquire contiguous plots, leading to ribbon development.
Small-scale industries lease land temporarily from farmers
KEY MESSAGES FROM GOAL 3

• Growing role of private sector in China’s urban development
• Declining role of central government in shaping urban growth in Chinese cities
• Lack of capital hinders infrastructure development in India
• Private provision of infrastructure led urban development in India
Education and Outreach

Yale from Dongguan to Delhi
Urbanization and Environment in China and India

ABOUT THE COURSE
WHO WE ARE
WHO WE ARE
STUDENT PROJECTS
BLOG
ITINERARY
PHOTOS

Course Description
The Instructors
The Students
What we're researching
From on-the-ground
Where we went
of Our Trip

From China...
Ernst Strungmann Forum
UGEC & GLP
Sept. 23–28, 2012

Urban in Future Earth Scoping Meeting
February 21-22, 2014

Future Earth Urbanization and Global Environmental Change Project (UGEC)
2nd International Conference
November 6-8, 2014
http://ugec.org
http://www.ugec2014.org/

• Theme 1: Urbanization Patterns And Processes
• Theme 2: Urban Responses To Climate Change: Adaptation, Mitigation and Transformation
• Theme 3: Global Environmental Change, Urban Health And Well-Being
• Theme 4: Equity And Environmental Justice In Urban Areas
http://www.ugec2014.org/
For more information

http://urban.yale.edu

http://urban.yale.edu/chinaindia