LEMA

Local Environment Management and Analysis
University of Liege, Belgium

Land use change in Hanoi: socio-economic impacts on local populations

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Project 25: Impacts of urbanization on agricultural and rural development of Hanoi.

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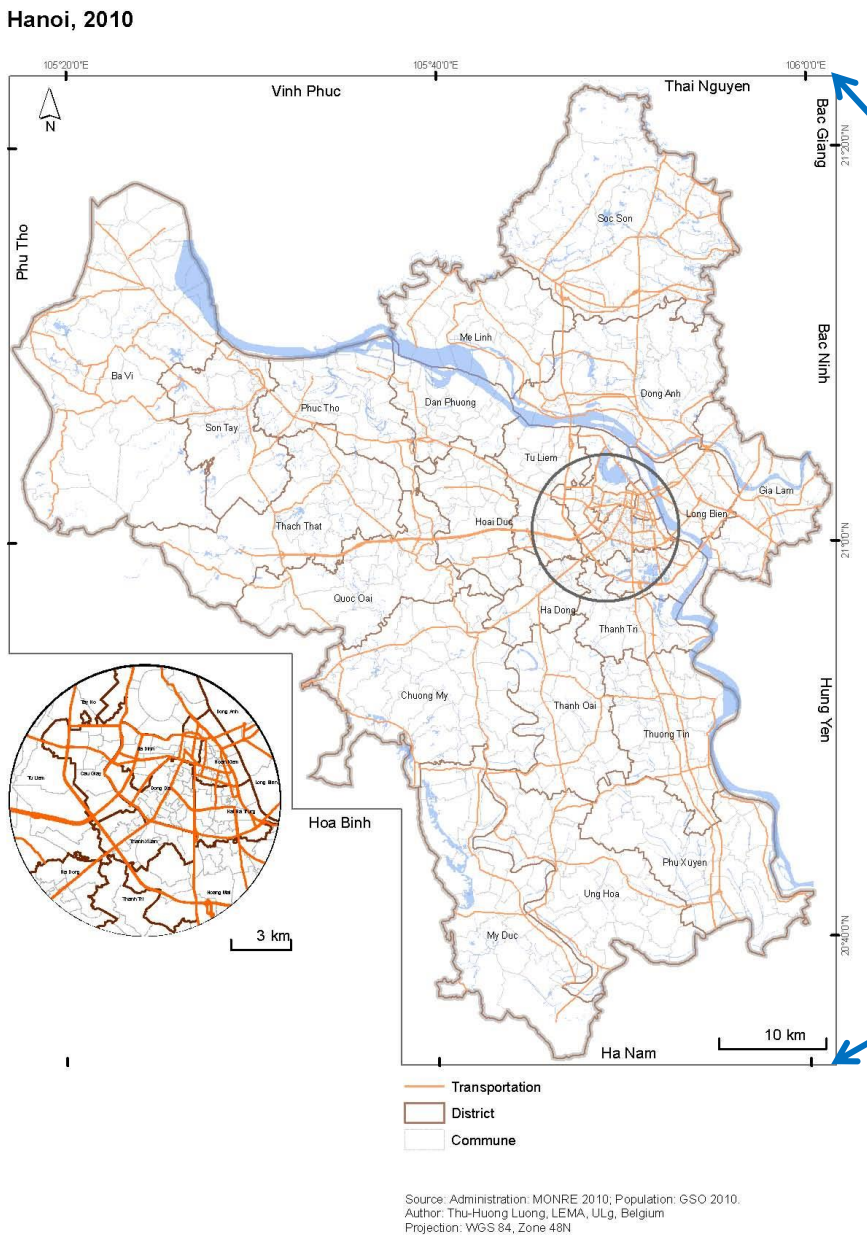
1. Problem statement

1.1 Study area: Hanoi, Vietnam

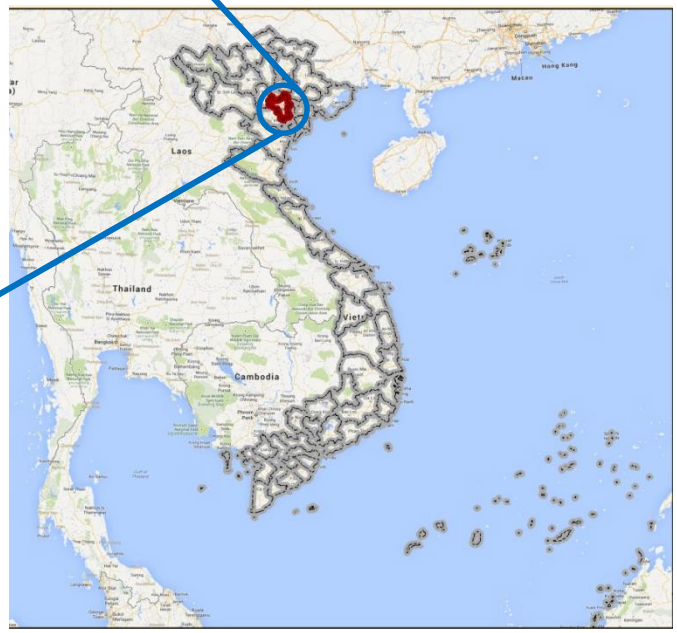


New Hanoi (*)

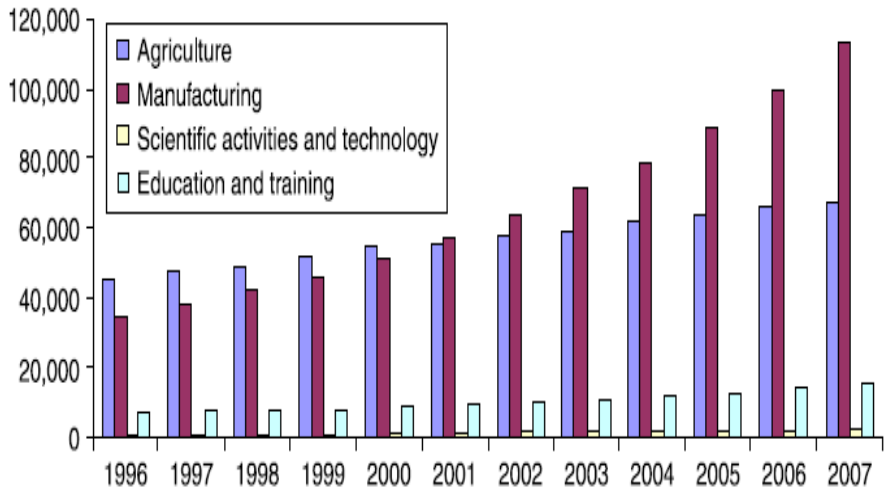
Area: 3 340 km2;

Population: 6,45 mil people

GSO, 2008



1.2 Economic growth: GDP, income



GDP from 1996-2007 of Vietnam (Anwar S and Nguyen L.P, 2010)

Vietnam:

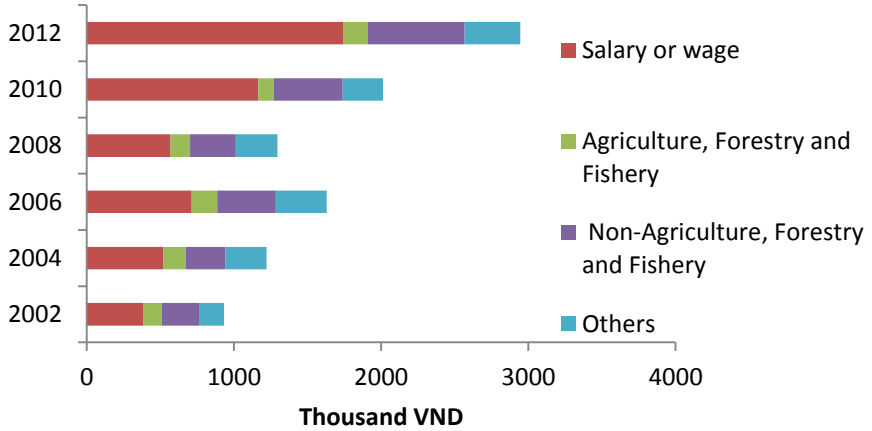
-Economic growth of Vietnam: GDP has double '96-'07

Hanoi:

Average monthly income of Hanoians has increased 3 times in last 10 years ('02-'12)

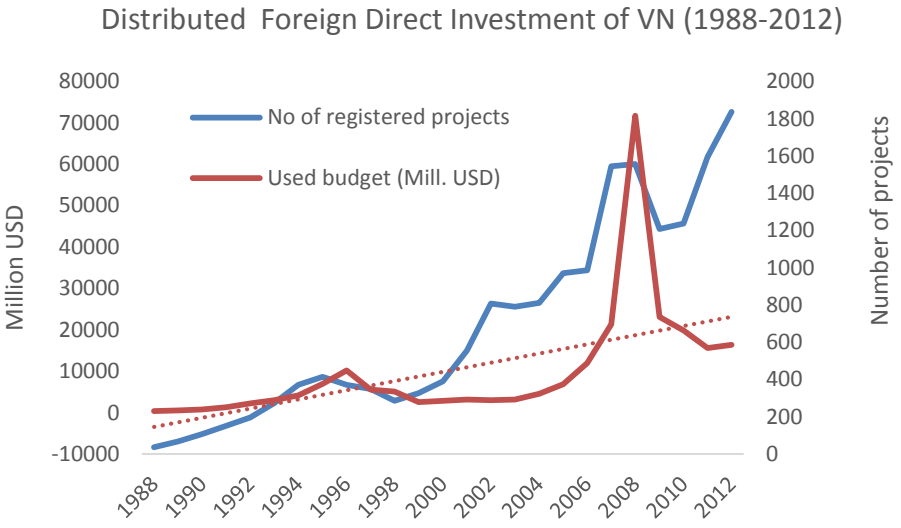
but still this increase is not equally distributed along all groups/professions and does not record the growing informal sector

Monthly income per capita by sector , Hanoi 2002-2012



GSO, 2013

1.2 Economic growth: GDP, FDI, Income

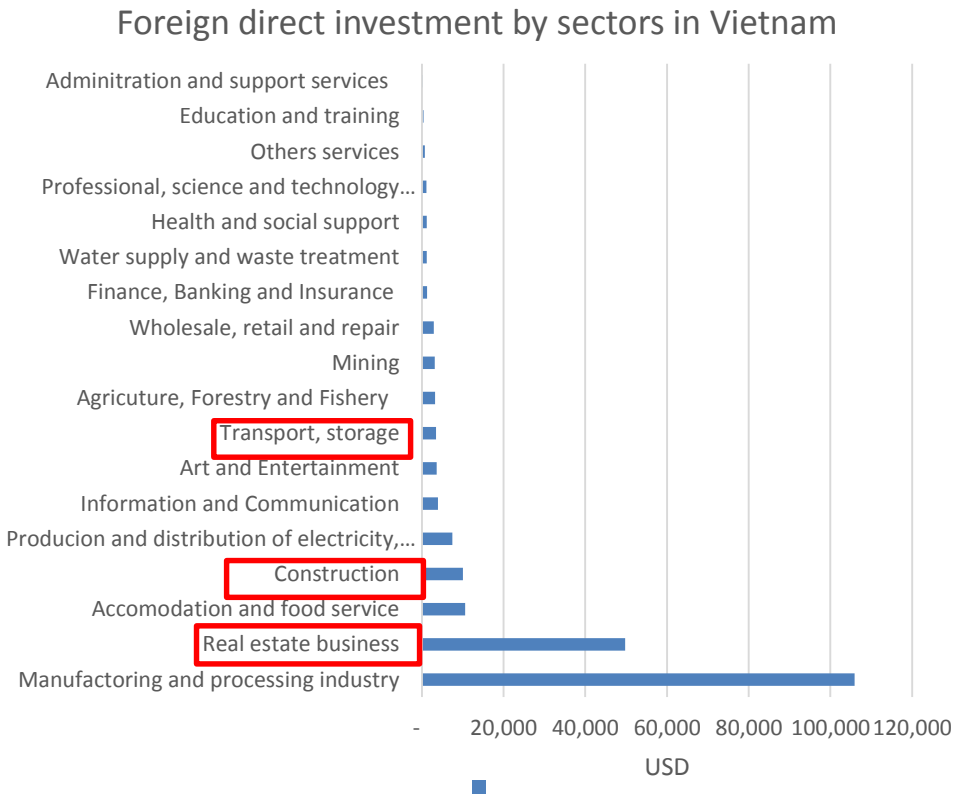


Vietnam:

FDI: yearly increase of 14%

Real estate, construction, transportation are the most important sectors over the last 24 years (‘88-’12)

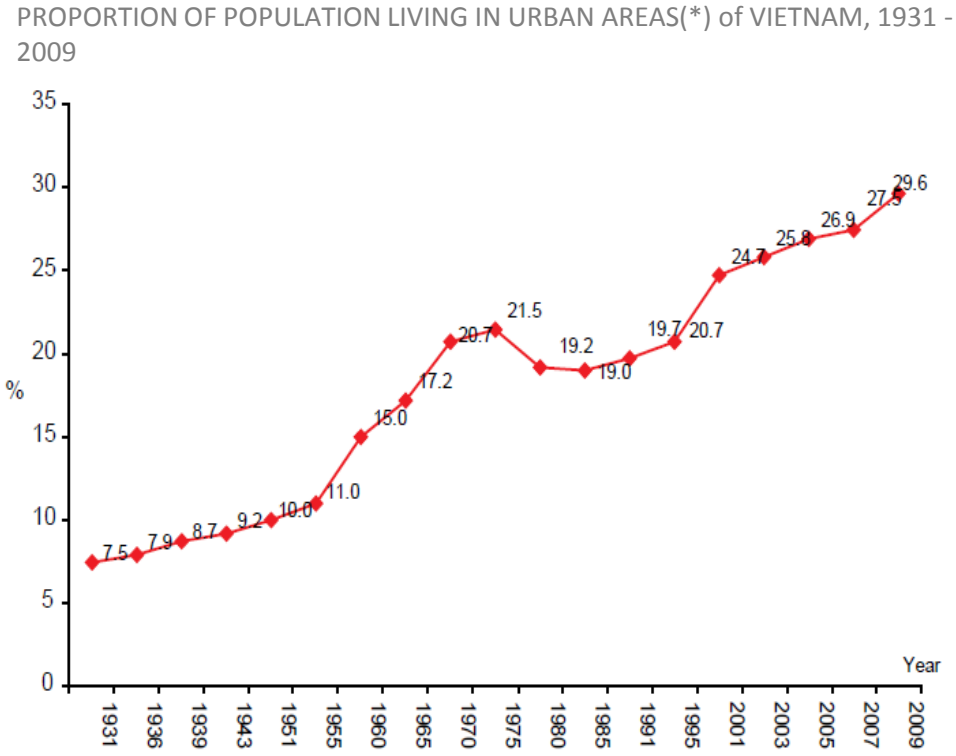
Source: GSO, 2013



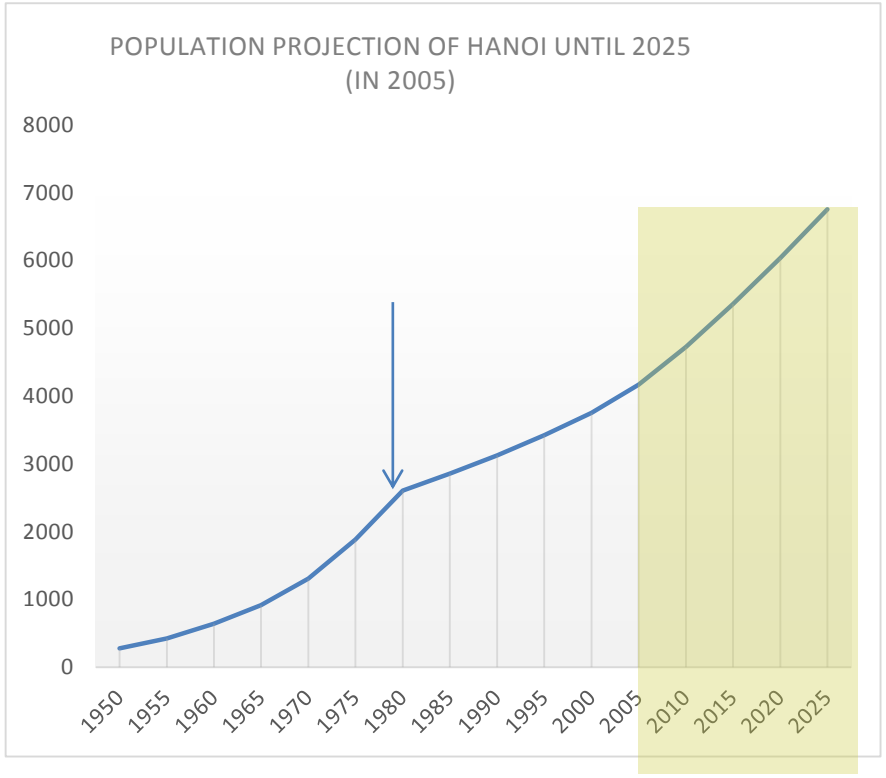
1.3 Population growth of Hanoi

Vietnam: Urban population of Vietnam increased 3 times since 1950; and increased 1.5 times since 1985

Hanoi: Population growth of Hanoi: 2.8 > 4.7 million inhabitants from 1985 to 2010 according to UNHABITAT



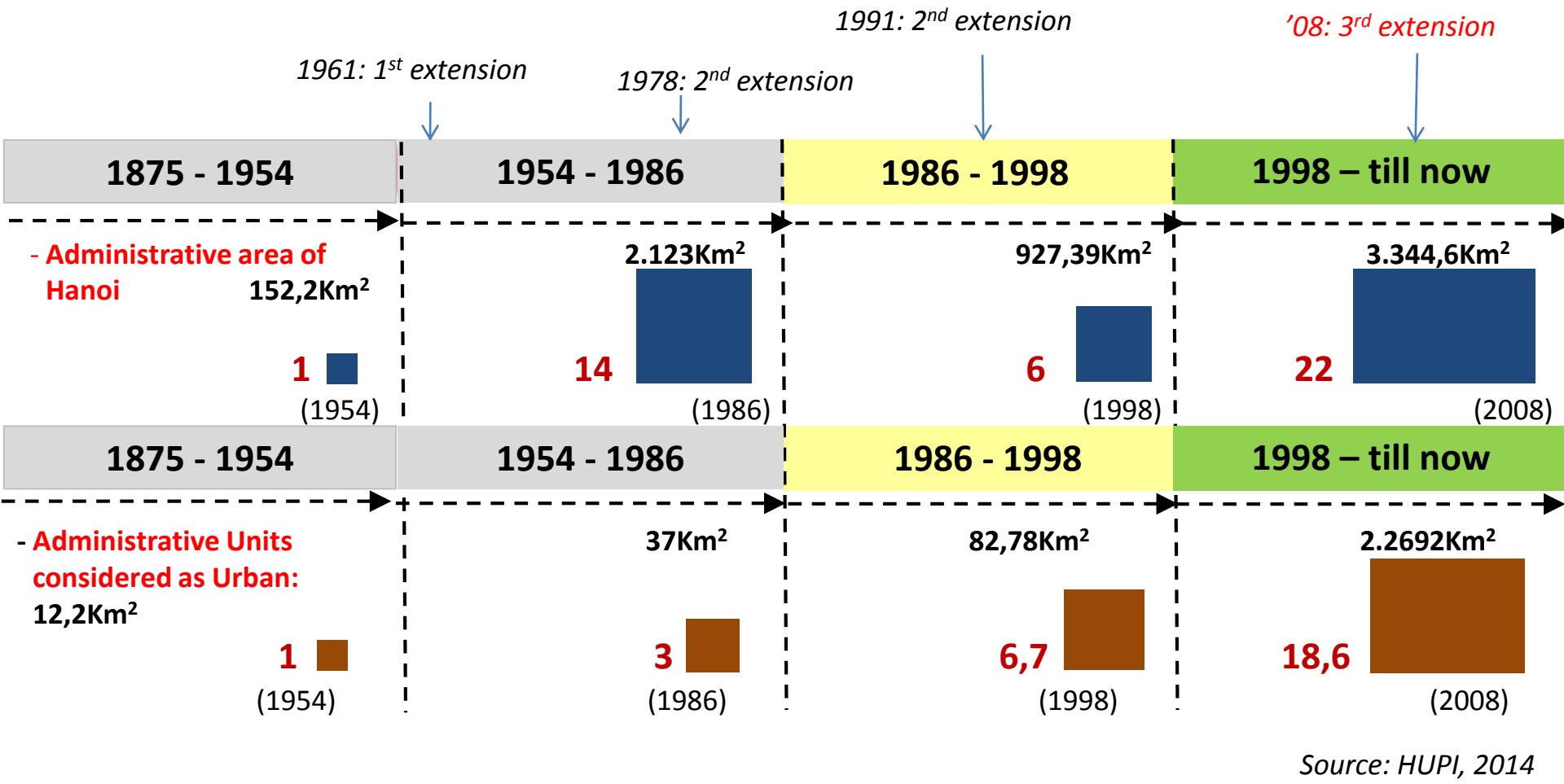
(Source: GSO, 2011. pp 62)



(Source: UNHABITAT, Global Urban Indicators Database 2010)

Urban area: *Areas which have at least 4,000 people with at least 60 per cent of the labor force engaging in non-agricultural activities*

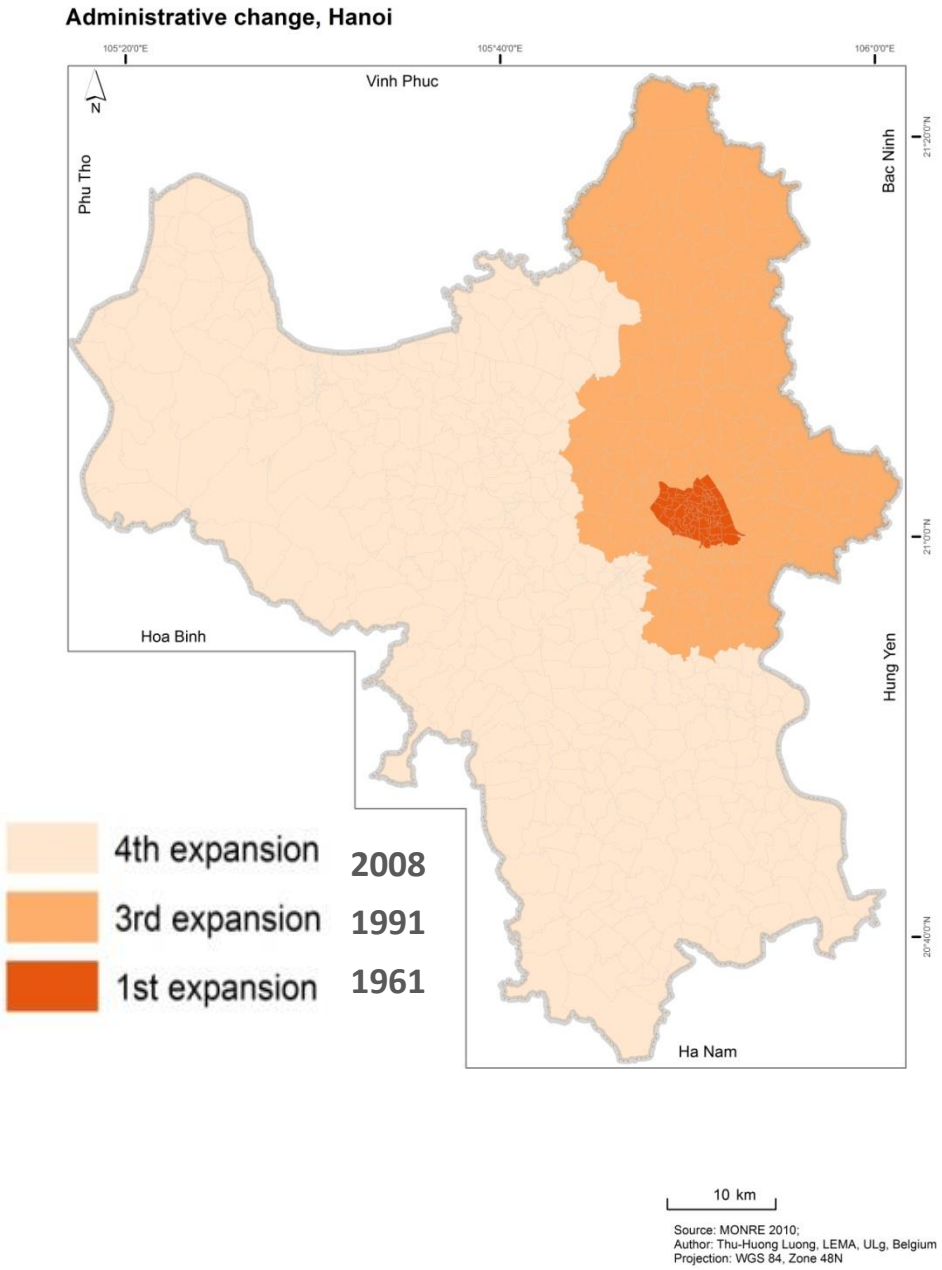
1.3 Administrative boundary changes

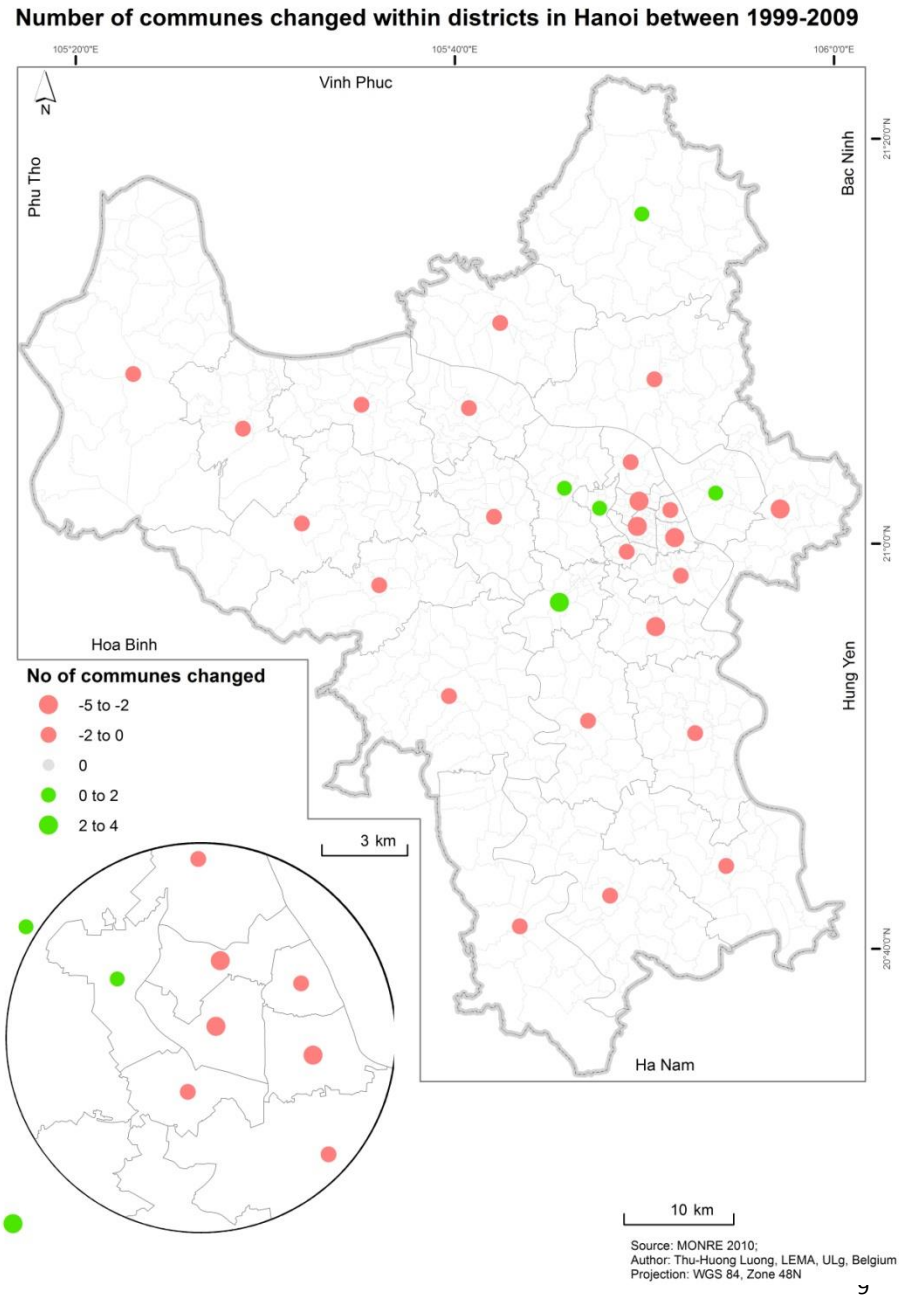


Source: HUPI, 2014

Urban area: *Areas which have at least 4,000 people with at least 60 per cent of the labor force engaging in non-agricultural activities*

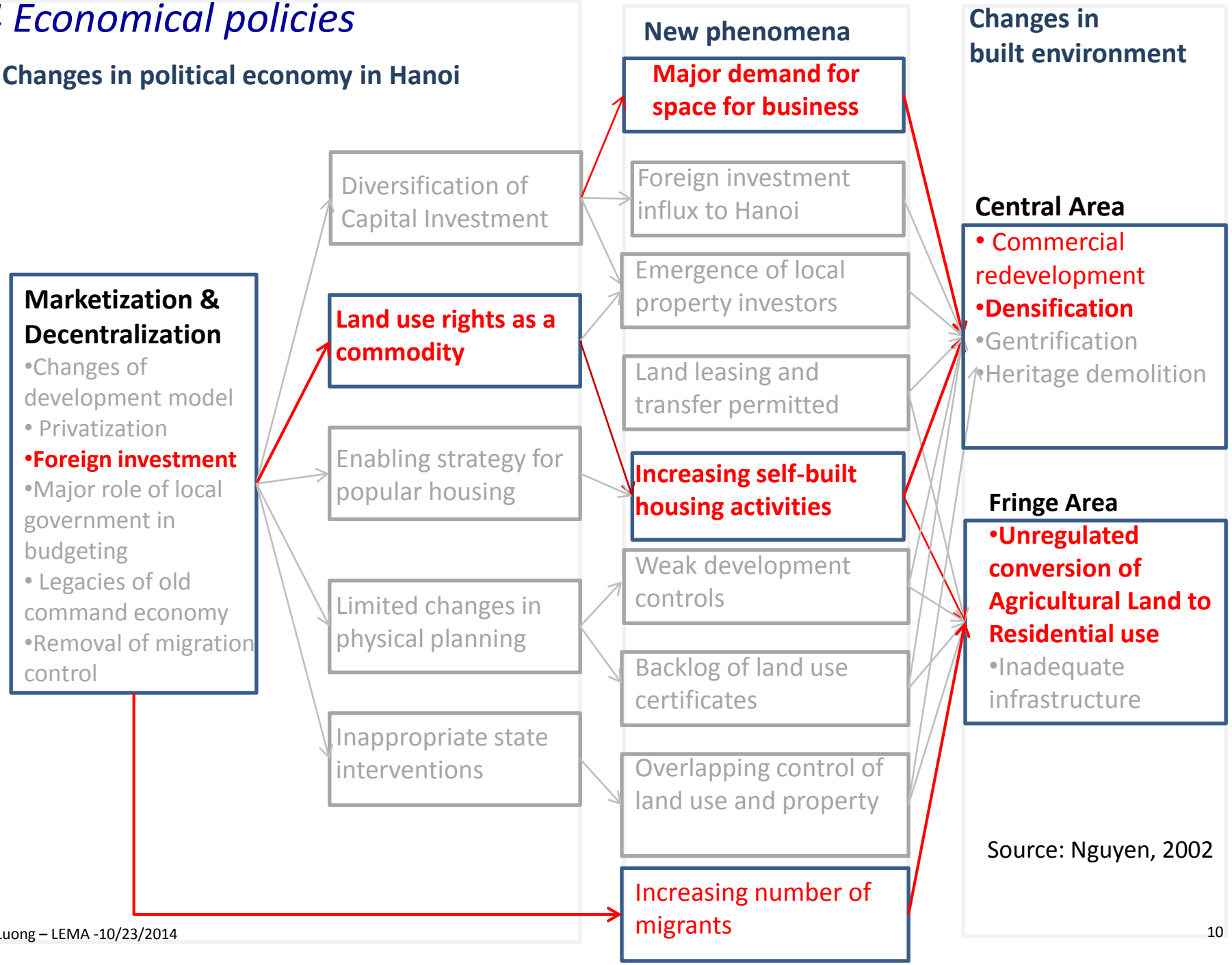
1.3 Administrative boundary changes





1.4 Economical policies

Changes in political economy in Hanoi



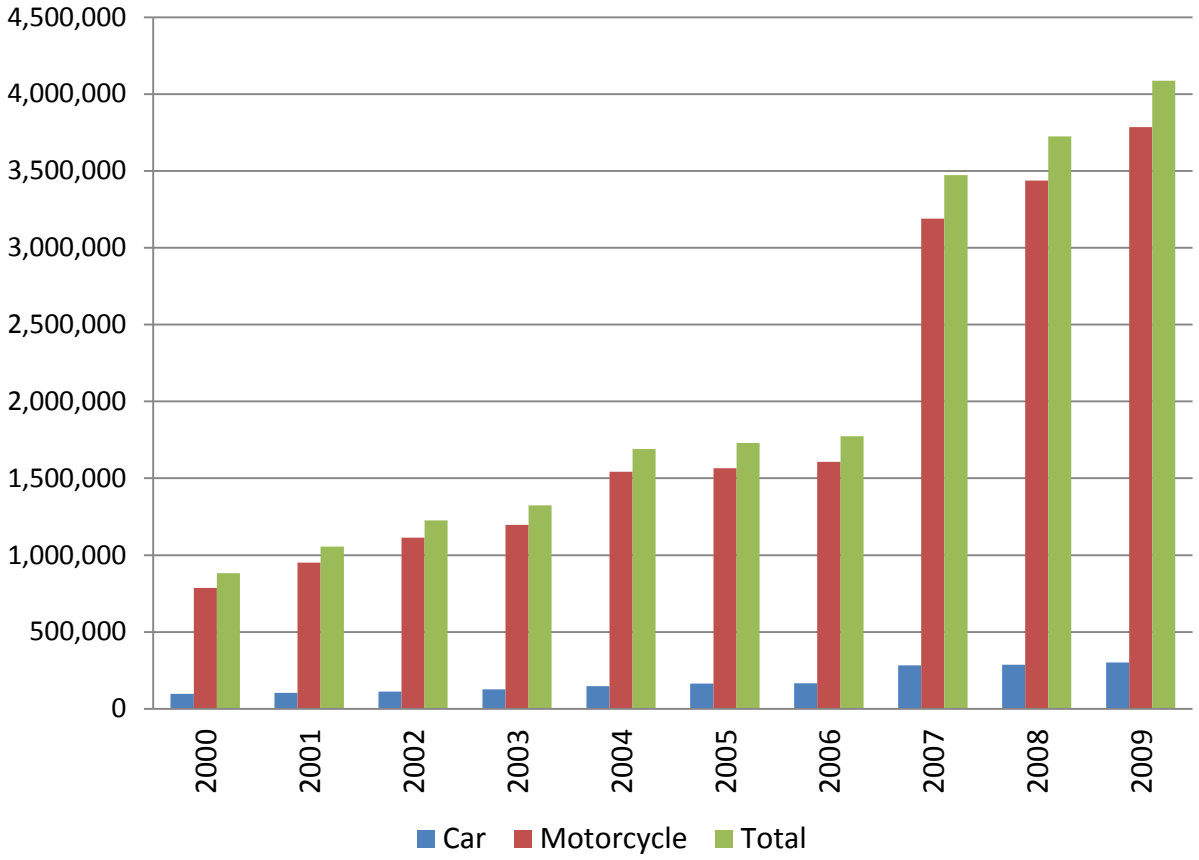
Source: Nguyen, 2002

1.5 Technology break

- No of vehicle increased > 4 times in 10 years between 00-09

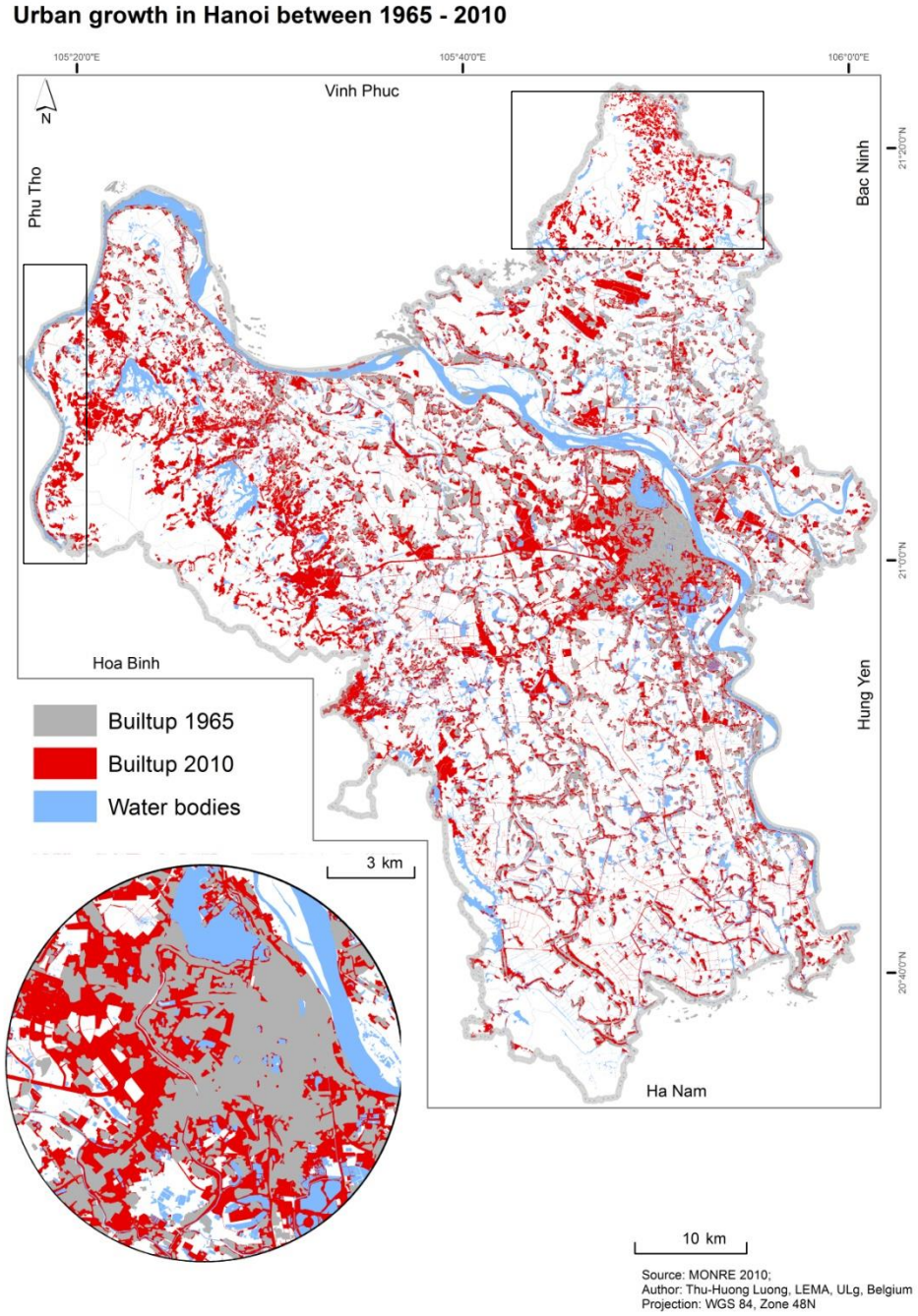
-Motorcycles are predominate vehicles 62.7% (3.6 mil) *(Almec et al. 2007)*

-By 2010, public transport could meet only 40% of passenger traffic demand (Hai, L. D., & Noi, H. 2003)



Number of vehicle in Hanoi 2000- 2009. Source. *(Almec et al. 2007)*

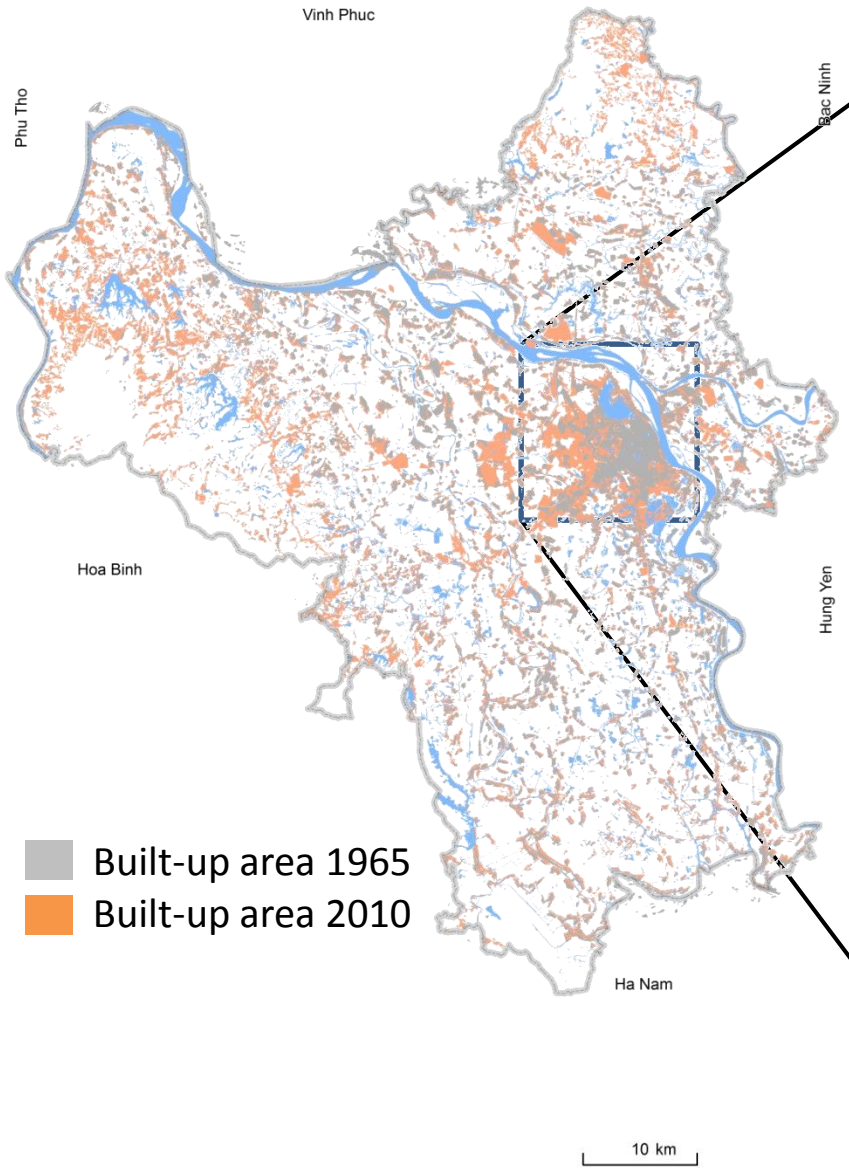
1.6 Urban growth in Hanoi

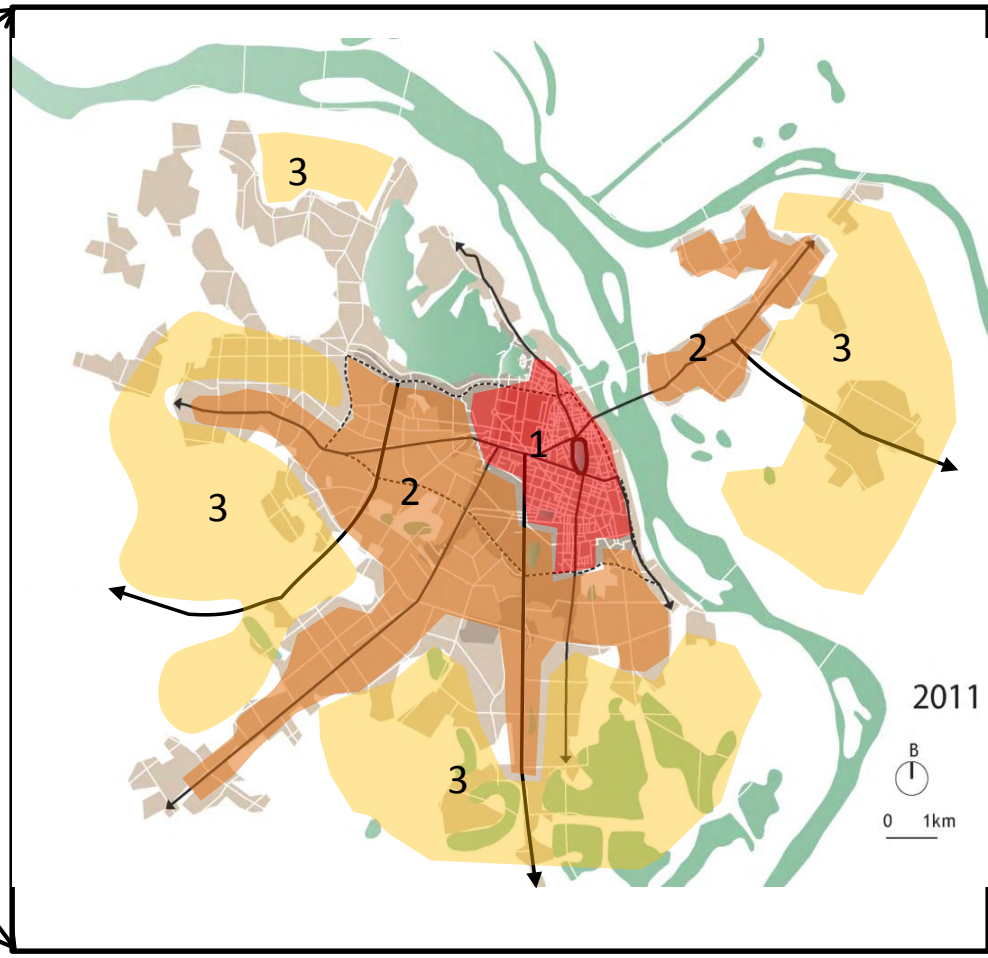


No data in 1965

Built-up area 1965 and 2010 are derived from topographic maps1965 and 2010

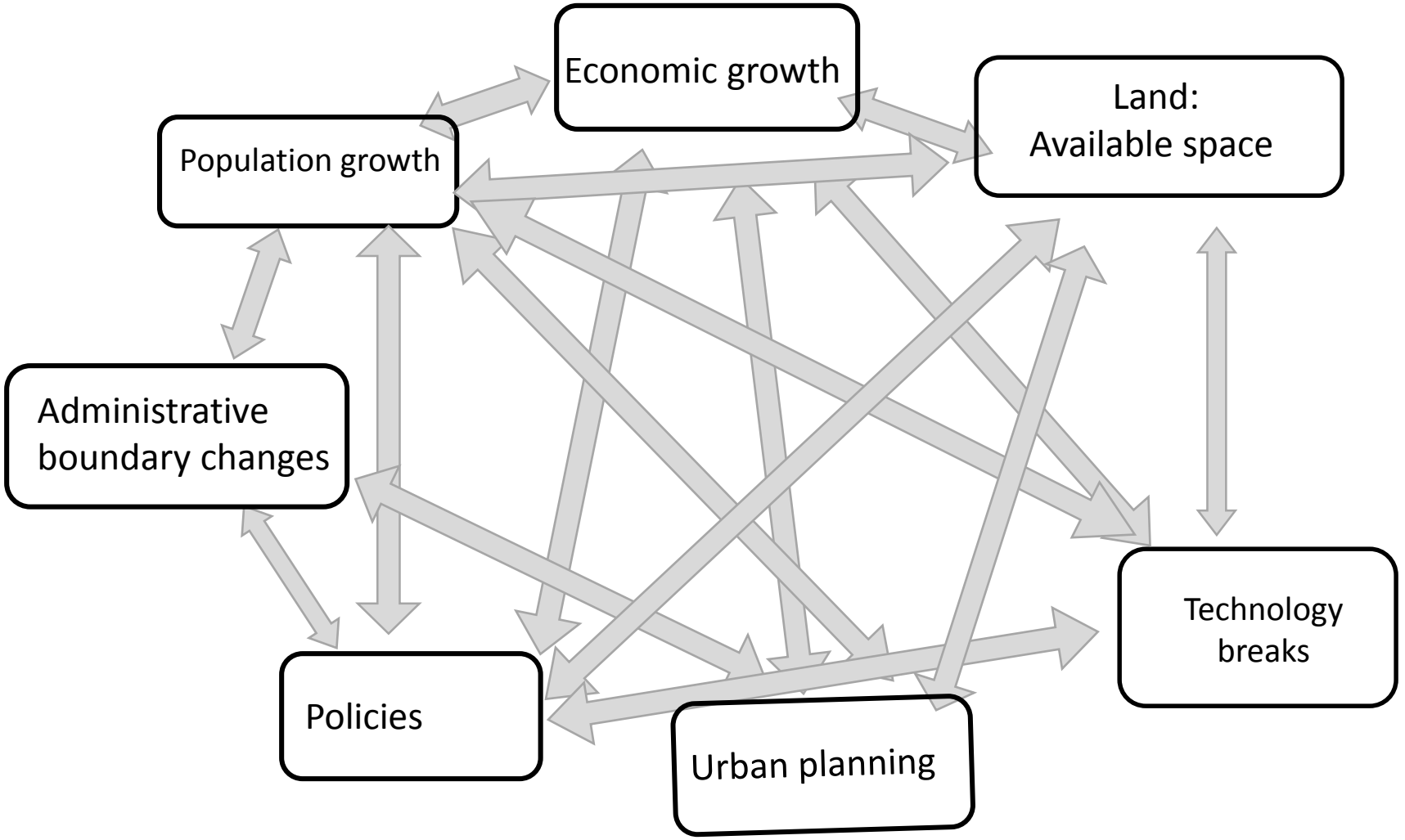
1.6 Urban growth in Hanoi





HUPI, 2014

1.7. Urban growth : a complex system



→ A complex system that drives changes through out time and space

2. Goal and objectives of the research

2. 1 Goal and objectives

Main objective of the research

Evaluating socio-economic impacts of land use / cover change (LUCC) in Hanoi on local populations

Specific objectives

1. Measuring and spatializing LUCC, especially from agricultural to urban land;
2. Understanding the main driving forces of these LUCC;
3. Analyzing the socio-economic impacts of these LUCC on local populations, especially in the close periphery of Hanoi;
4. Proposing management policies for alleviating these impacts, either in terms of controlling LUCC or compensating households more adequately.

2.2 Key theme of our research

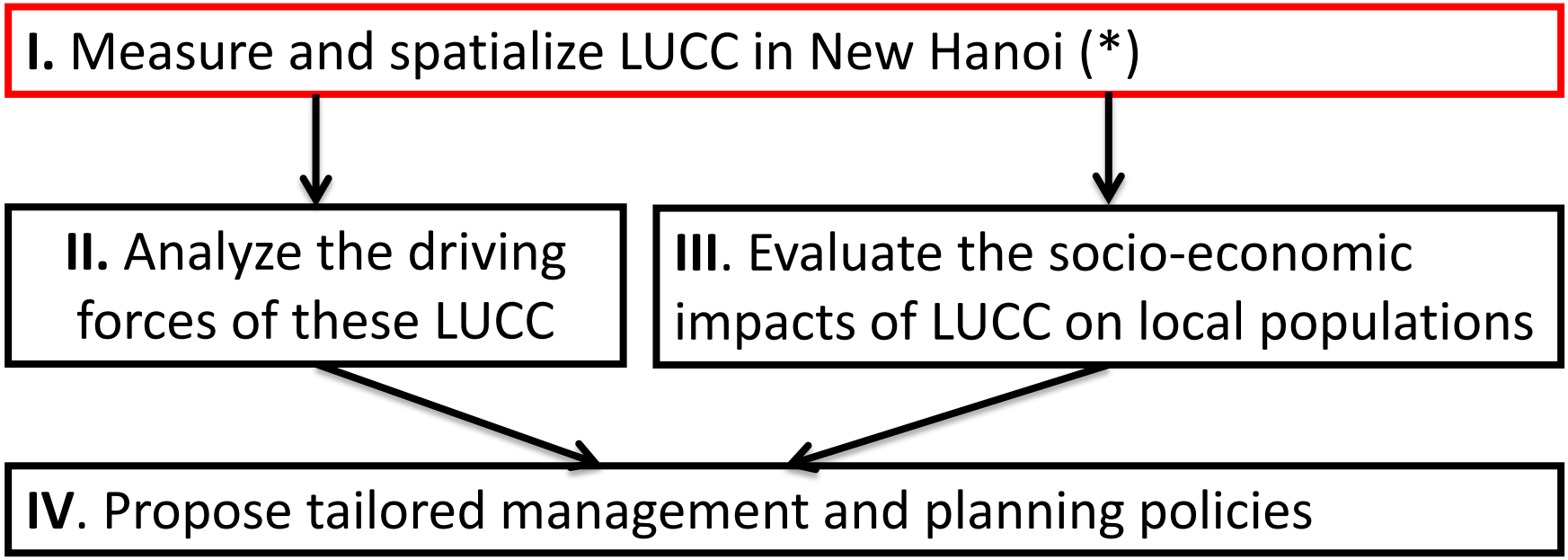
Urban growth has number of different impacts : political, cultural, historical, environmental, congestion, GHG emissions, historic landscape.

Our research focuses on socio-economic impacts of LUCC on local populations, especially those located in the periphery of Hanoi

By socio-economic impacts, one will mean for instance impacts on access to work, revenues, social networks and the like.

3. General methodology of the research

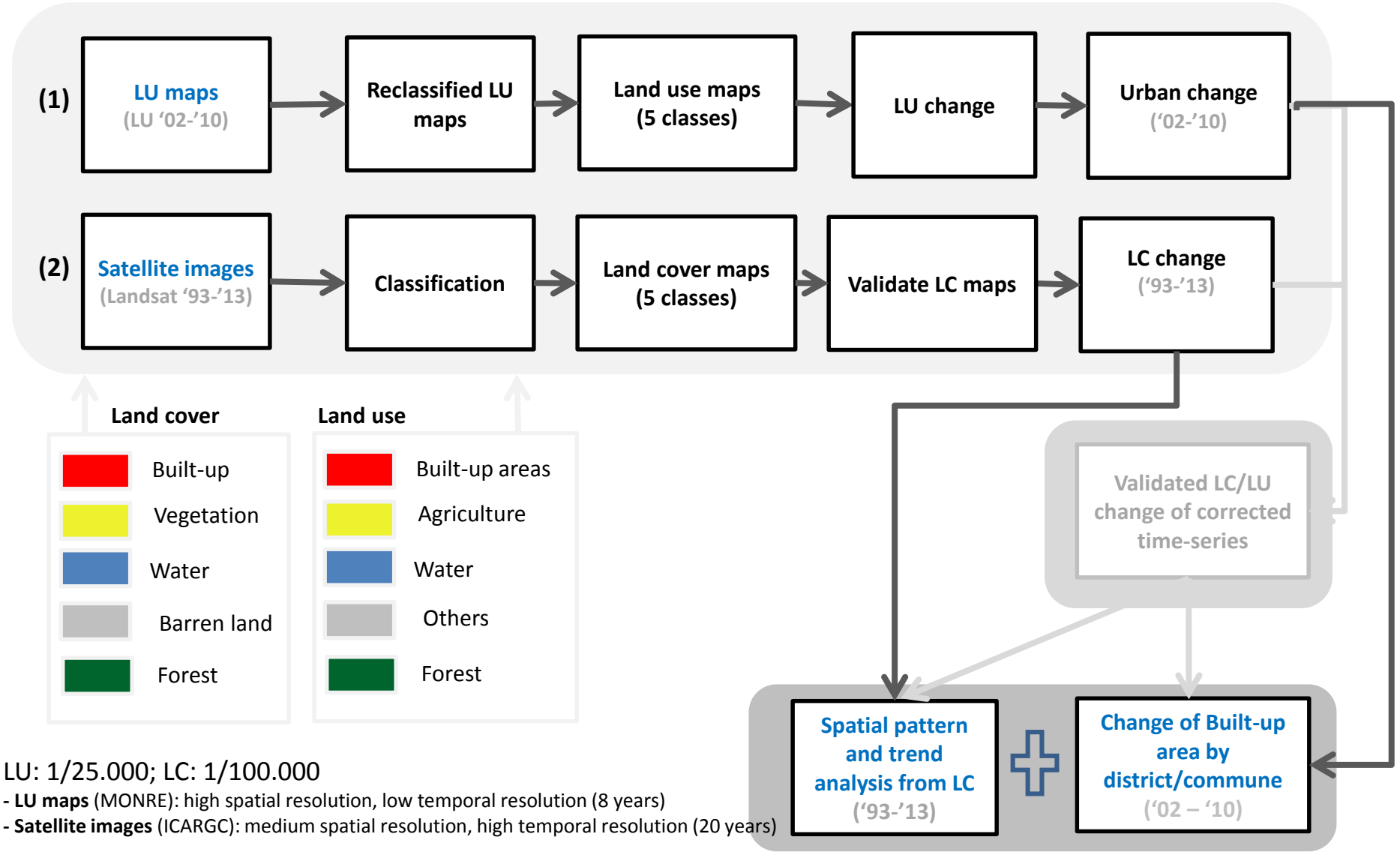
3.1. Work flow



(*) New Hanoi covers the entire administrative area of Hanoi Province, namely 3.344 km2.

3.2 Measure and spatialize land use / cover change

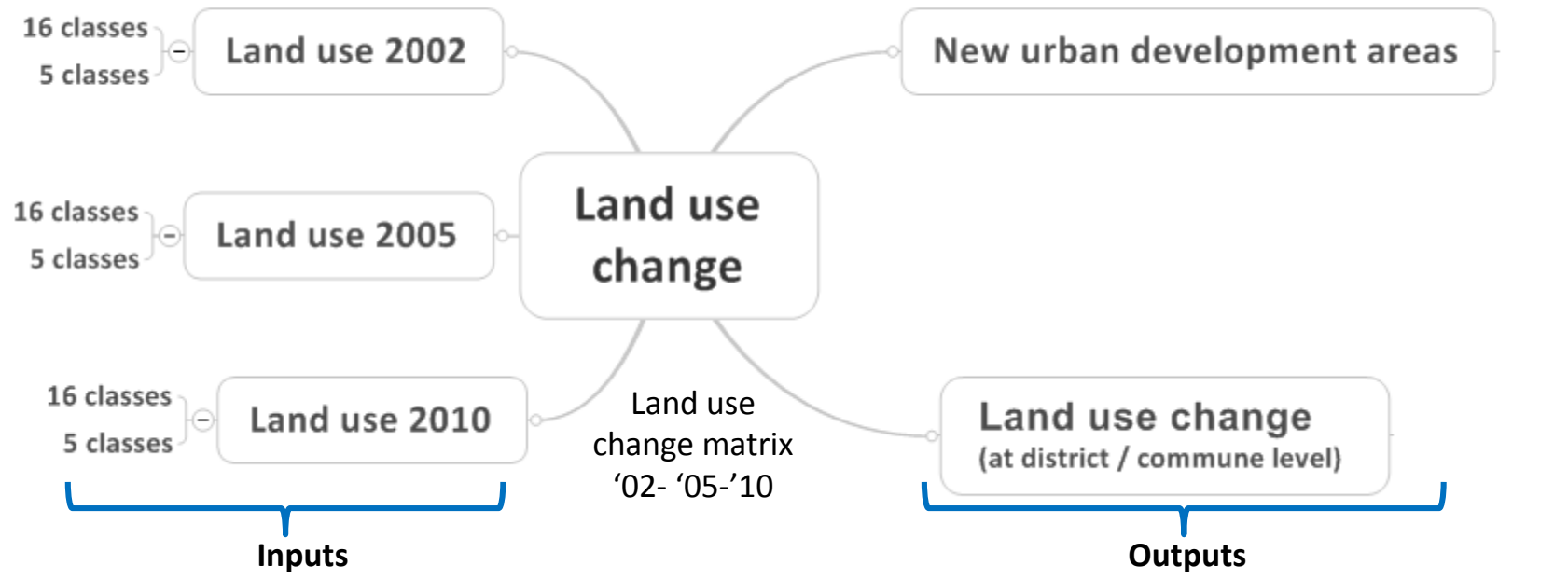
Land use (LU) Land cover (LC), change detection



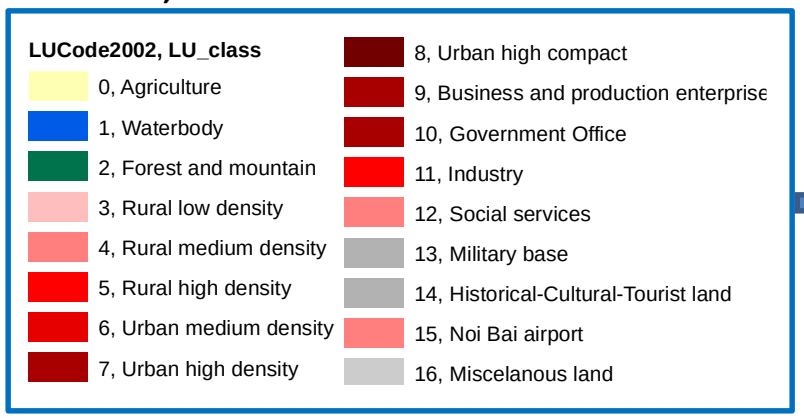
LU: 1/25.000; LC: 1/100.000

- **LU maps** (MONRE): high spatial resolution, low temporal resolution (8 years)
- **Satellite images** (ICARGC): medium spatial resolution, high temporal resolution (20 years)

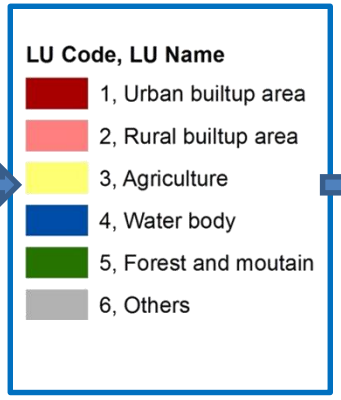
3.2.1 Land use change (LUC) from land use maps



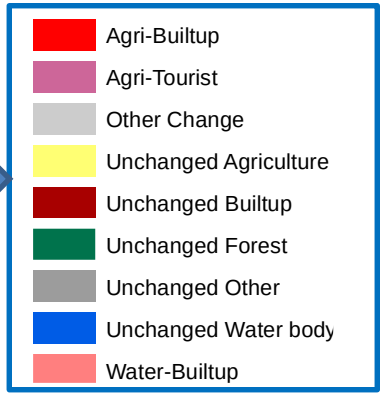
Land use, 16 classes



Land use, 6 classes



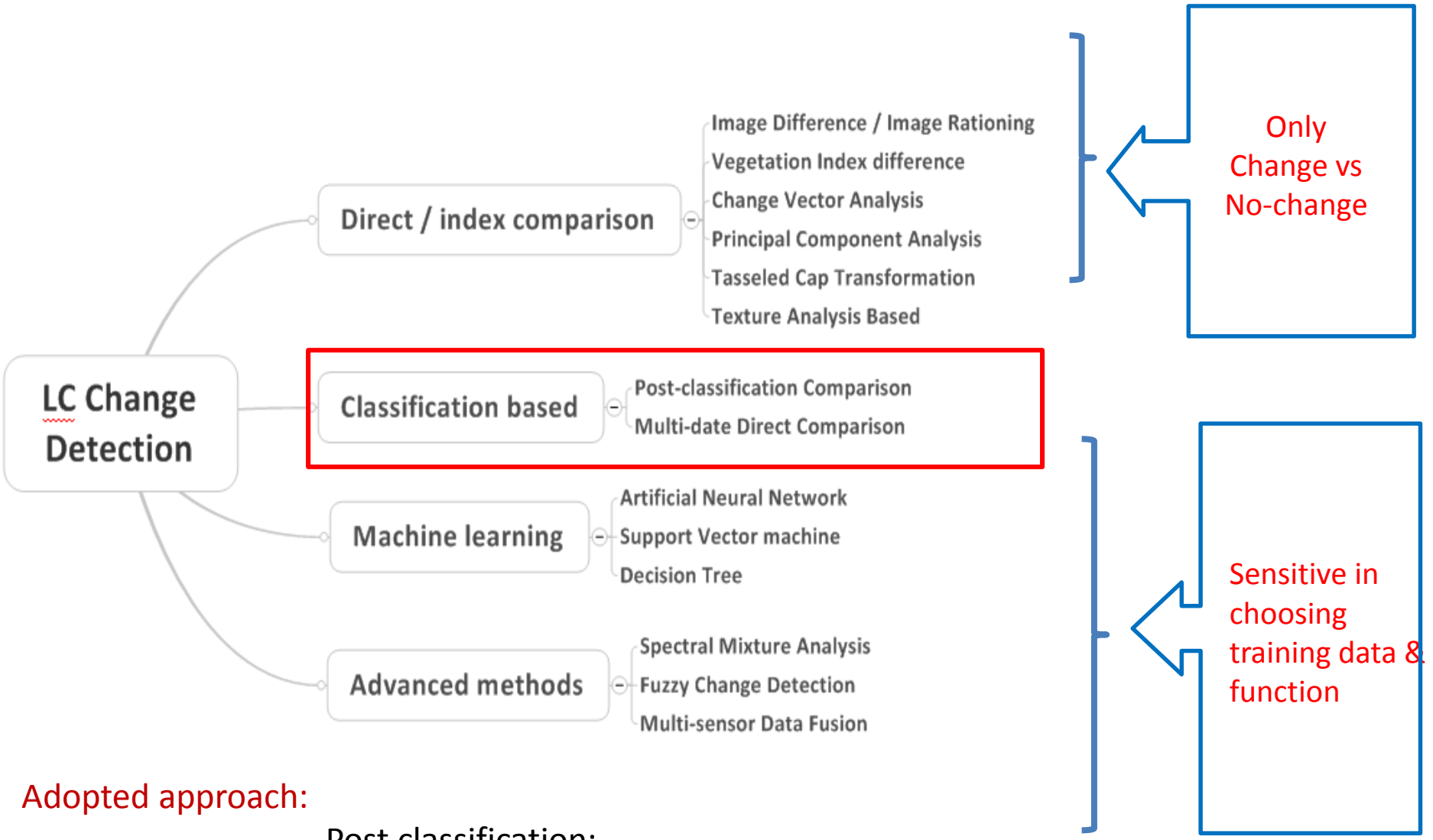
Land use change 2002-2010



Scale of available Land Use maps: 1/25.000

Validation data: High resolution images & topographic maps

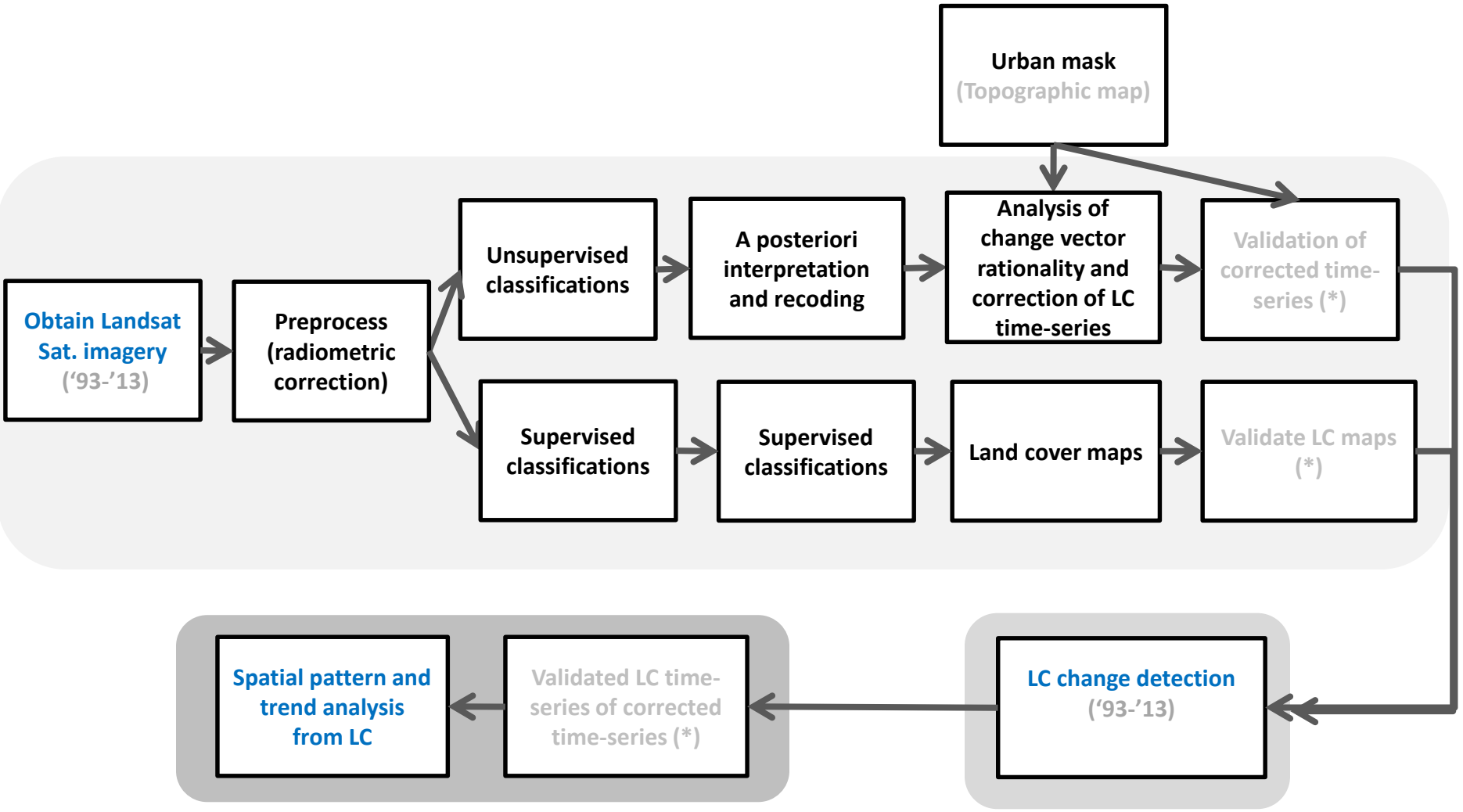
3.2.2 Land cover change (LCC) from satellite images



Adopted approach:

- Post classification;
- GIS Integration and Multi-date stacking comparison are used for selecting training sample

3.2.2 Land cover (LC), classification of Landsat images '93-'13



(*) *Validation method: Validate spatial-balanced-random points using high resolution images & topographic maps*

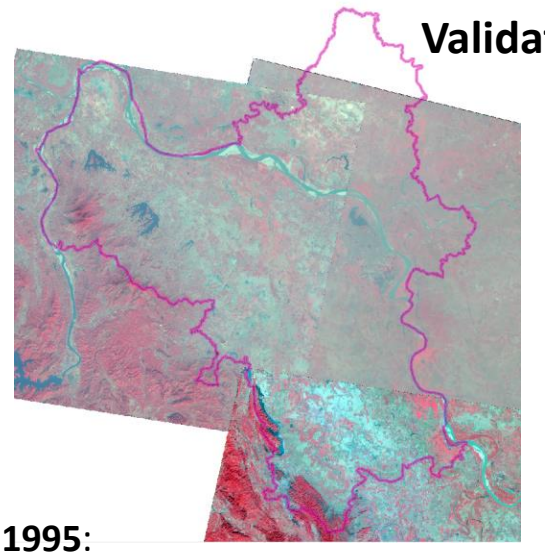
3.2.3 Inputs: Satellite images

Inputs

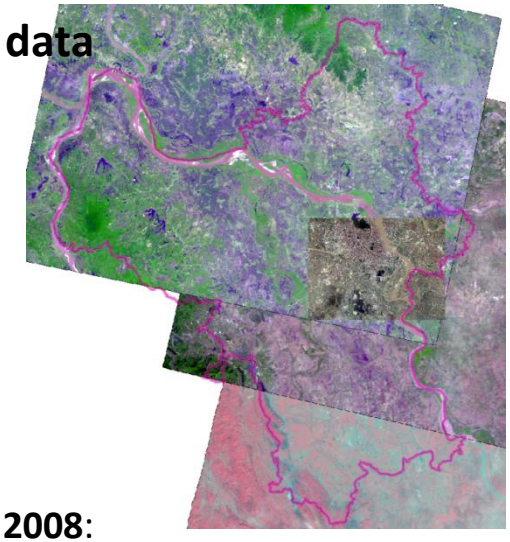
Landsat 5 and 7 *(30 m)*
1993 –2000- 2003-2007-2013

Period	Landsat (LS) images	High resolution images
1990-1995	LS 1993	Spot4 1995
2000-2005	LS 2000, 2003	SPOT3 2003
2005-2010	LS 2007	SPOT5 2008
2010-2014	LS 2013	Rapideye 2014

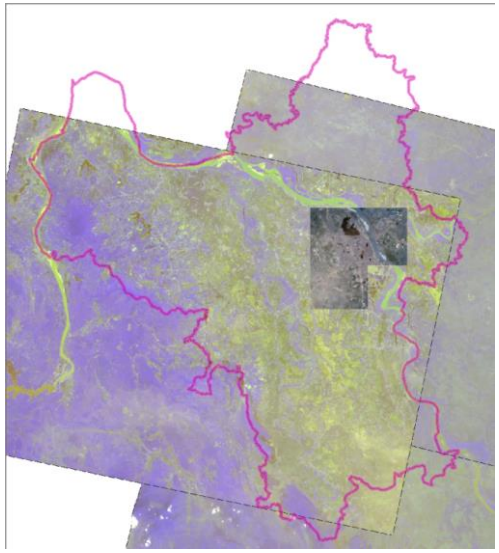
Validation data



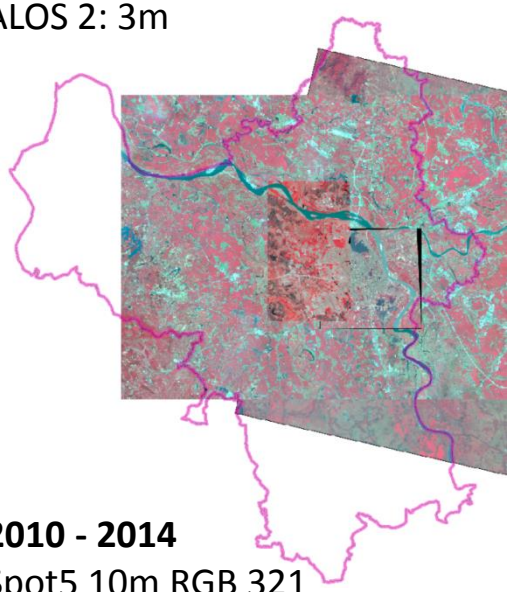
1995:
Spot4 20m RGB 321



2008:
Spot5 10m RGB 321
ALOS 2: 3m



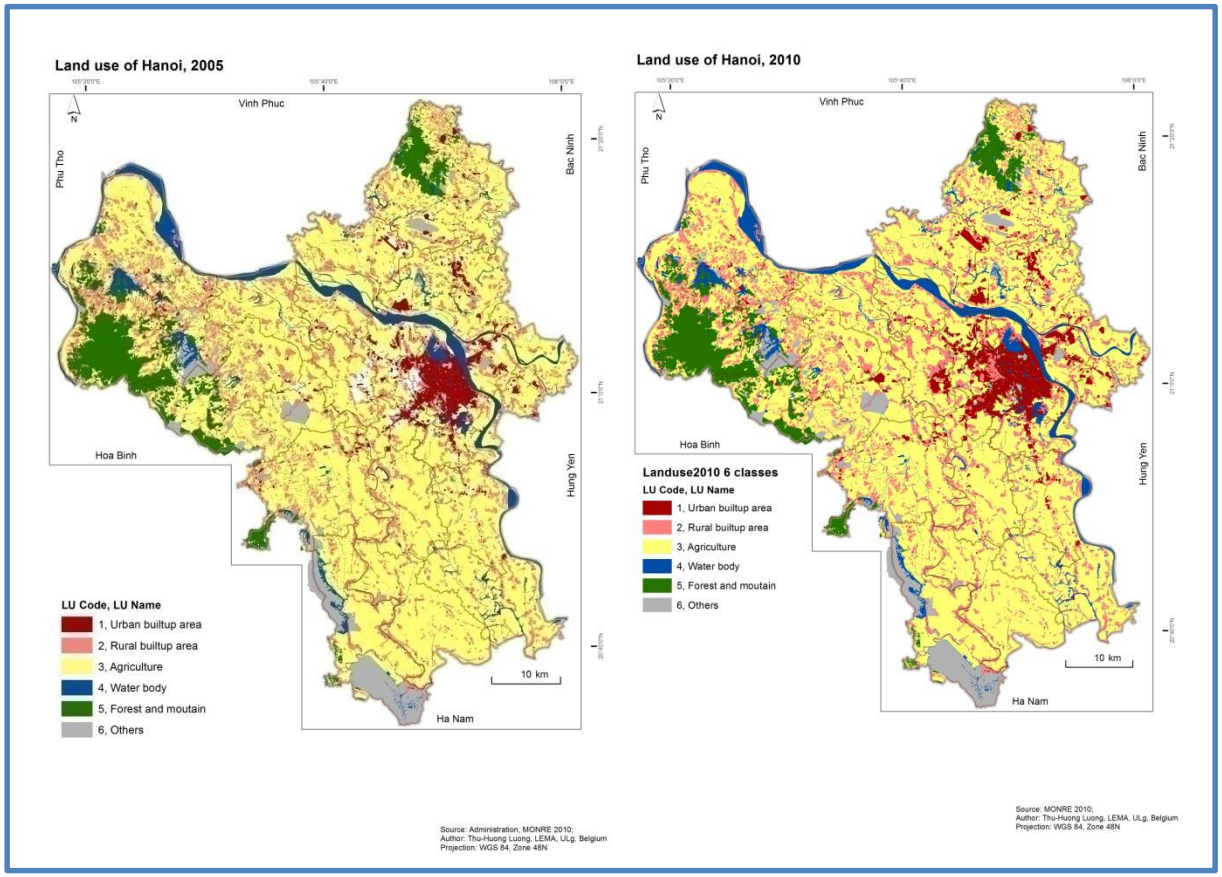
2003:
Spot3 10m (RGB 321) &
Quickbird 0.7m (RGB 123)

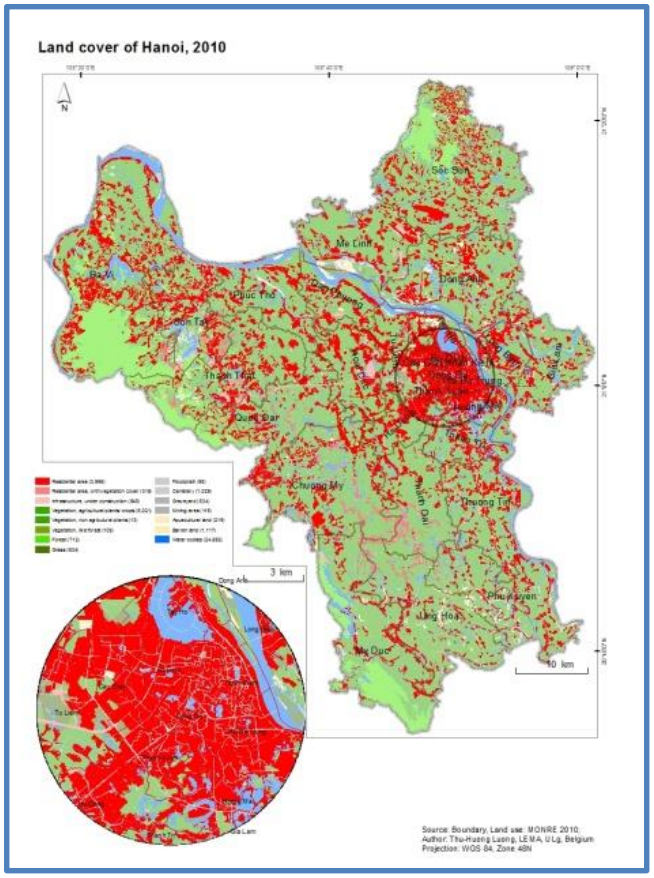


2010 - 2014
Spot5 10m RGB 321
Rapideye 5m RGB 532
Worldview: 2m / 0.5m RGB 854

10km

3.2.3 Inputs: Maps





Land use maps: *2002-2010(1/25.000)*

Built-up land in LU map	Built-up land in LC map
682.5 km2	814.4 km2

Data source: MONRE, 2012

LU Code, LU Name

- 1, Urban builtup area
- 2, Rural builtup area
- 3, Agriculture
- 4, Water body
- 5, Forest and moutain
- 6, Others

Topographic map, 2010. *Vegetation cover*

- Residental area (3,996)
- Residental area, with vegetation cover (315)
- Infrastructure, under construction (645)
- Vegetation, agricultural plants / crops (6,021)
- Vegetation, non agricuiural plants (13)
- Vegetation, like forest (108)
- Forest (712)
- Grass (634)
- Floodplain (98)
- Cemetery (1,029)
- Graveyard (534)
- Mining area (115)
- Aquacultural land (219)
- Barren land (1,117)
- Water bodies (24,692)

3.3. Driving forces - review

Driving forces	**Mechanism**	**Variables (Assess the drivers)**	**Data available** (of Hanoi)
Demographic growth	• Increase houses for rural – urban migrants because of job opportunities for low and medium income in urban areas (Tana. L., 1996) • Household size is reducing (more nuclear family is separated from traditional family) • Young people prefer to live near central area	• Population growth by district • Population density • Evolution of household size • Share of young population	• Population characteristics (age, …) • Population density • Household size
Economic growth	• Big difference of resident land price in periphery; • Agricultural land is taken for residential expansion	• Land prices • Distance to existing residential areas	• Land prices
Natural conditions	• Soil and construction type are linked • Better view for close-to-water areas • Tendency of moving to the West	• Soil type (for construction) • Distance to water body (lakes, ponds) • Northing / easting coordinates	• Soil type • Water • Direction

3.3. Driving forces - review

Driving forces	Mechanism	Variables (Assess the drivers)	Data available (of Hanoi)
Transportation and accessibility	• Urban development areas are distributed along main roads (Ho.D., 20) • Agricultural land loss is close to main roads Pham.H., 2013; Pham.C., 2014)	• Distance to national roads • Accessibility to urban center (distance: 0-3-5-10 km) • Accessibility to public services (kindergarten, schools)	• Road system (national, district level) • Time to go to public service buildings
Tourist development	• Development of eco-tourism and commercial areas around tourist attractive places (Nguyen.Q. 2002)	• Distance to tourist attractive places	• Tourist places
Logit regression *LUCC (Agri-Builtup) = F (Soil type; Distance to water, Direction, Distance to Industrial area, Distance to New BUA, Distance to Train station, Distance to Bus station, Distance to tourist attractive places, Time to public service buildings)*			

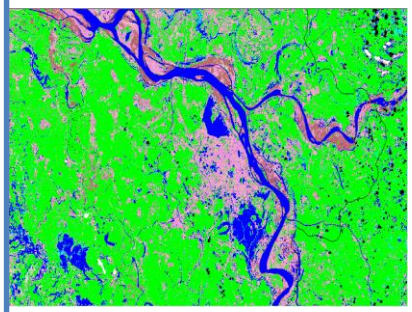
3.4. *Socio-economic* impacts on local populations

Socio-eco impacts	Positive	Negative
Employment	• Increased income due to changing jobs from agriculture to services (Bui.T., 2013; Nguyen.S., 2009; Gubry P., 2010); • Increase low-medium income jobs: workers in industrial zones (Wit. D.J., 2011) .	• Loss of income related to reduction of agriculture production (Tran.H.T., 2013); • Lack of skills to integrate the growing formal job market (Bui.Q.T., 2013); • Growing distance to work and associated travel costs (Nguyen. S., 2009).
Other revenues and expenses	• Growth of informal sector related to the presence of new populations (Tunner.S., 2006; Bui Q.T, 2013, 2014); • Additional revenue related to compensation mechanisms (one-shot income) (Ha. A., 1998).	• Higher cost to buy food and new demands related to urbanization (Pulliat.G., 2013) .
Services	• Access to urban services (education, water, sanitation and transportation) (UNHabitat, 2013).	• Lack of provision of adequate services in newly developed areas ; • Lack of public transport.
Families and relatives	• ??	• Larger distances between members of family and migration of part of the family to urban centers .
Conflicts	• ??	• Increase land dispute between developers and local authorities for using public land (Labee.D, 2012); • Decline access to public spaces due to diversification and intensification of use including informal activities (Labee.D, 2012).

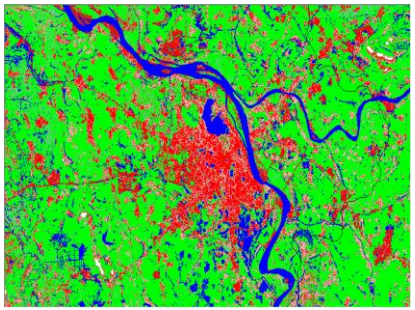
4. Preliminary results

4.1. LCC from unsupervised classification 2000-2013

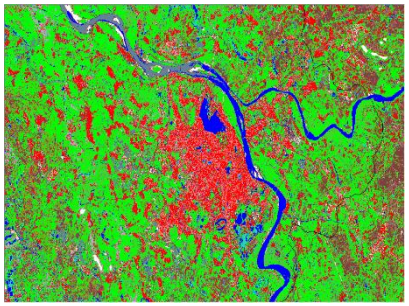
LC classified 26 classes



LC classification 2000

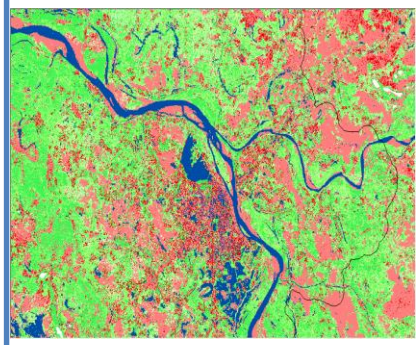


LC classification 2007

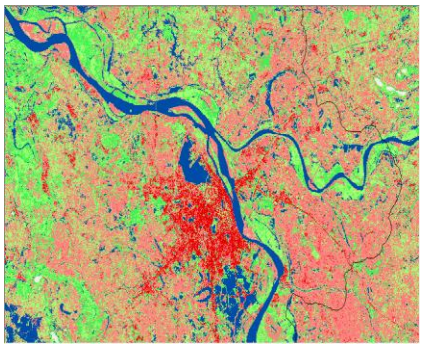


LC classification 2013

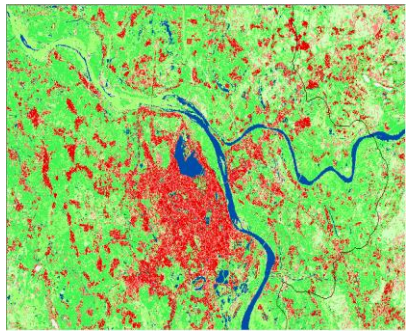
LC reclassified 6 classes



LC reclassified 2000



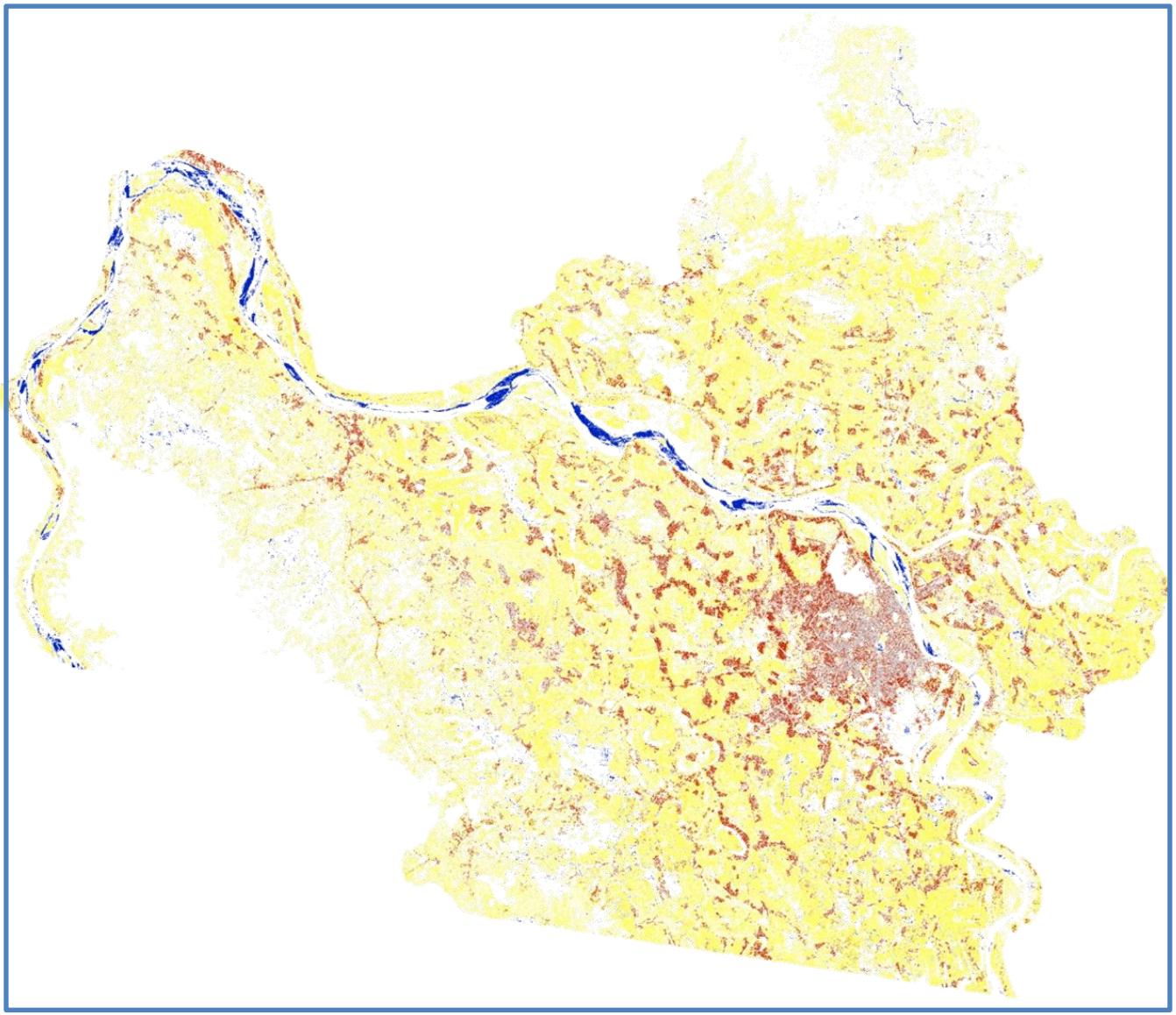
LC reclassified 2007



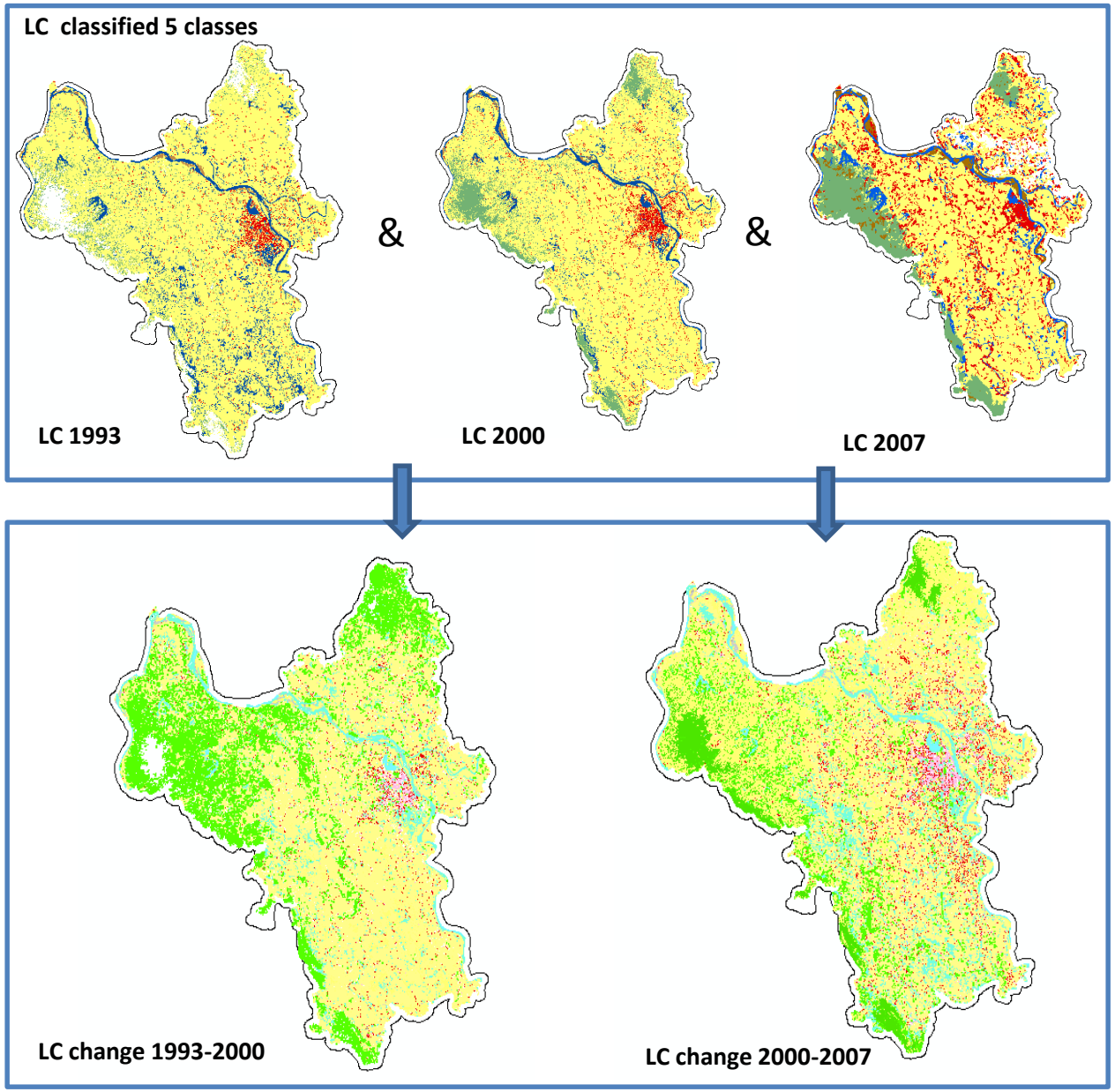
LC reclassified 2013

10km

4.1 LCC from unsupervised classification 2000-2013



4.2 LC and LCC from supervised classification (1993-2000-2007)=>2013



Legend

Landcover

- Barren land
- Built-up
- Crops
- Forest
- Water

Legend

bd_00_07

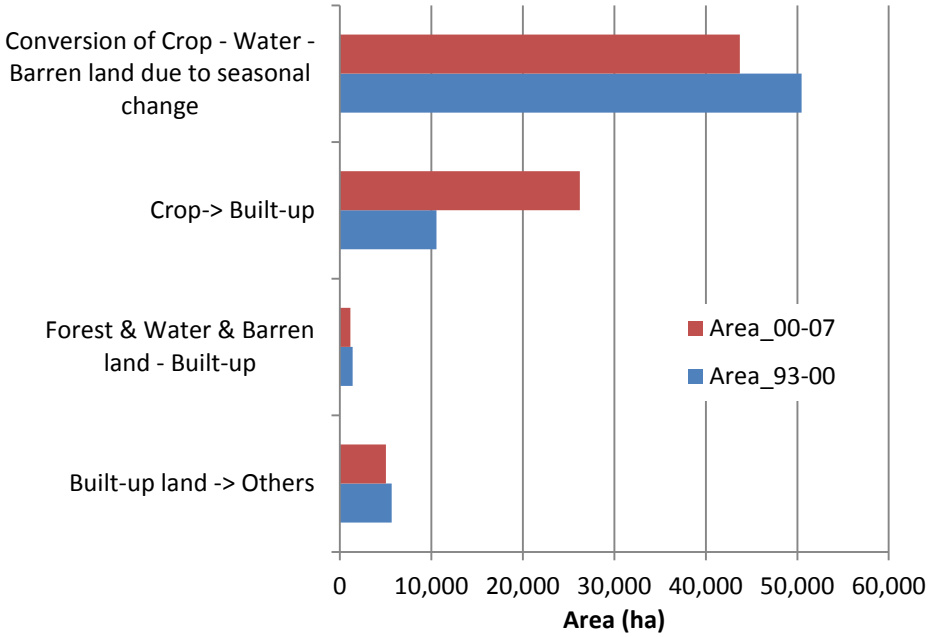
Landcover change 2000-2007

- Built-up
- Barren land
- Water
- Agriculture
- Forest
- Barren - Built-up
- Barren - Water
- Barren - Agriculture
- Barren - Forest
- Water - Built-up
- Water - Barren
- Water - Agriculture
- Water - Foreset
- Agriculture - Built-up
- Agriculture - Barren
- Agriculture - Water
- Agriculture - Forest
- Forest - Built-up
- Forest - Barren
- Forest - Water
- Forest - Agriculture
- Province boundary

10km

33

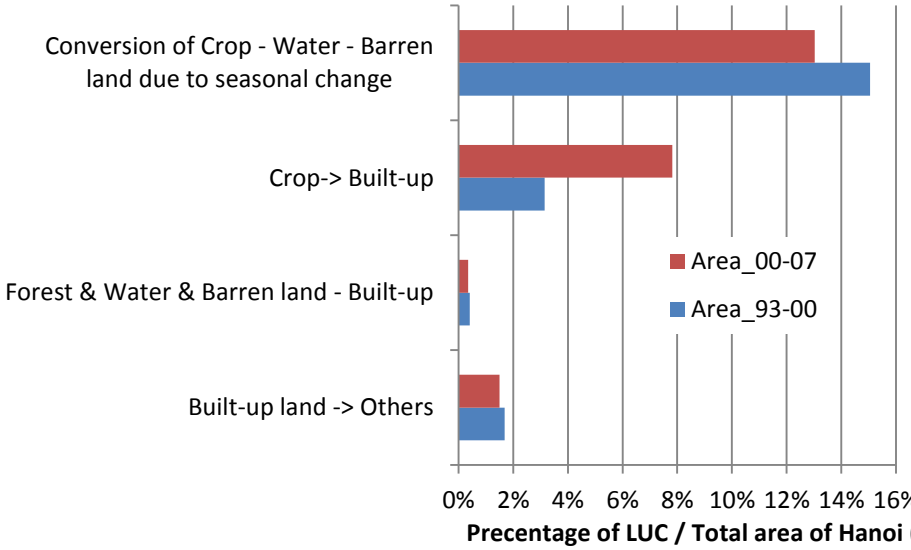
4.2 LCC from supervised classification (1993-2007)=>2013



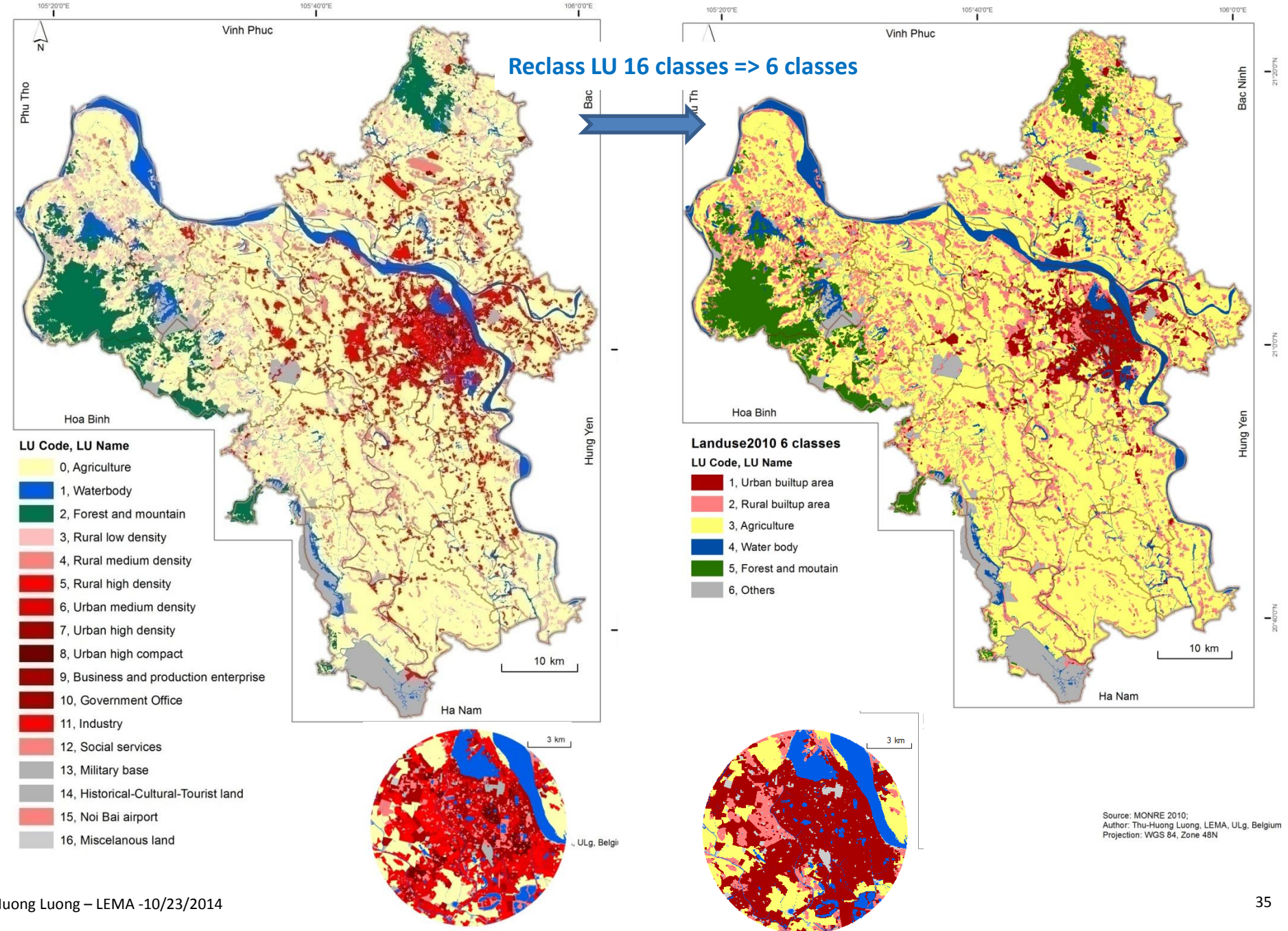
- Major changes of land cover from 1993-2007 or 2000-2013 in agricultural land to built-up land;

However, it is necessary to

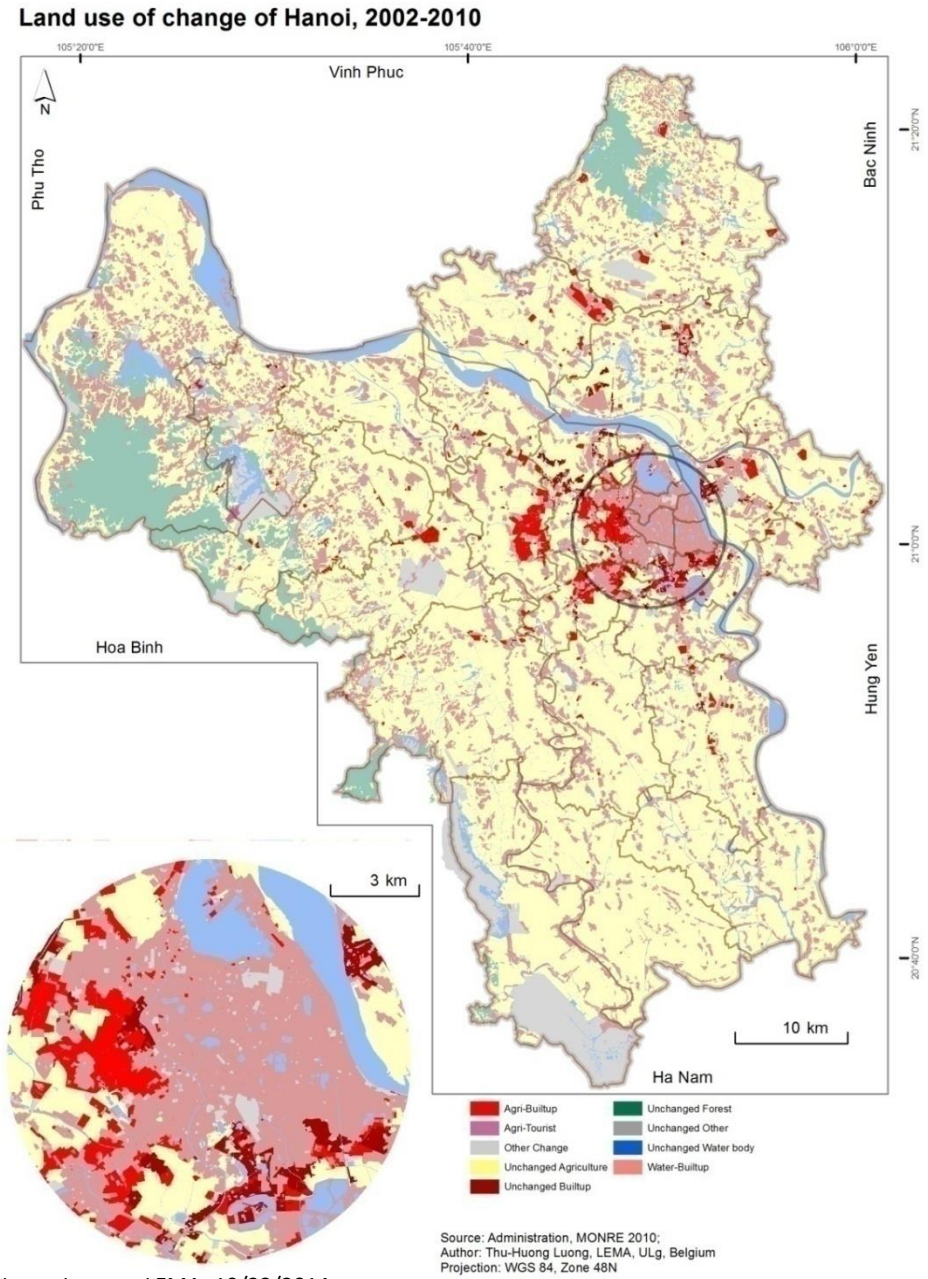
- validate LC maps and correct for un-meaningful changes eg. built-up to crops;
- check if water to /from crops is due to seasonal reasons;



4.3 Land use maps(2002-2010): Reclassification



4.3 Land use change map (2002-2010)



- Total areas changed to urban between '02-'10 is around 6,500 ha, account for nearly 2% of total land of Hanoi, mainly from agricultural land;
- Agricultural land is reduced 3.13%; built-up land increased by 10.5 % in comparison to 2002;
- Major change is observed between '05-'10 - 0.31% average annual rate

(ha)

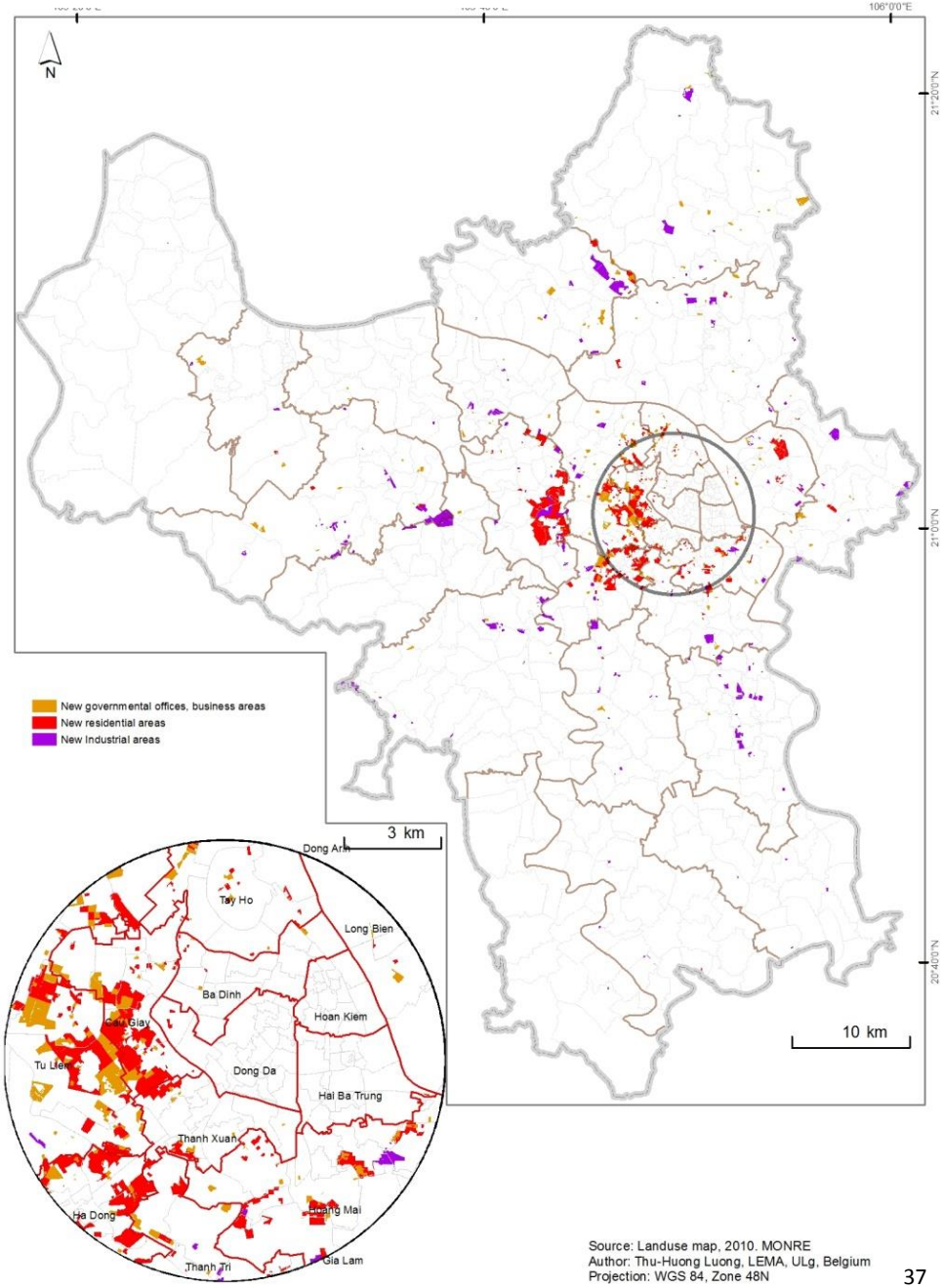
Land use change	Area
Agri-Builtup	6,106.98
Agri-Tourist	252.94
Other Change	23.49
Unchanged Agriculture	203,453.48
Unchanged Builtup	62,128.07
Unchanged Forest	22,103.33
Unchanged Other	18,116.17
Unchanged Water body	24,294.29
Water-Builtup	125.30
Grand Total	336,604.03

4.4 New development areas (2002-2010)

New urban development areas =

- New public-service buildings
- New residential areas
- New industrial areas

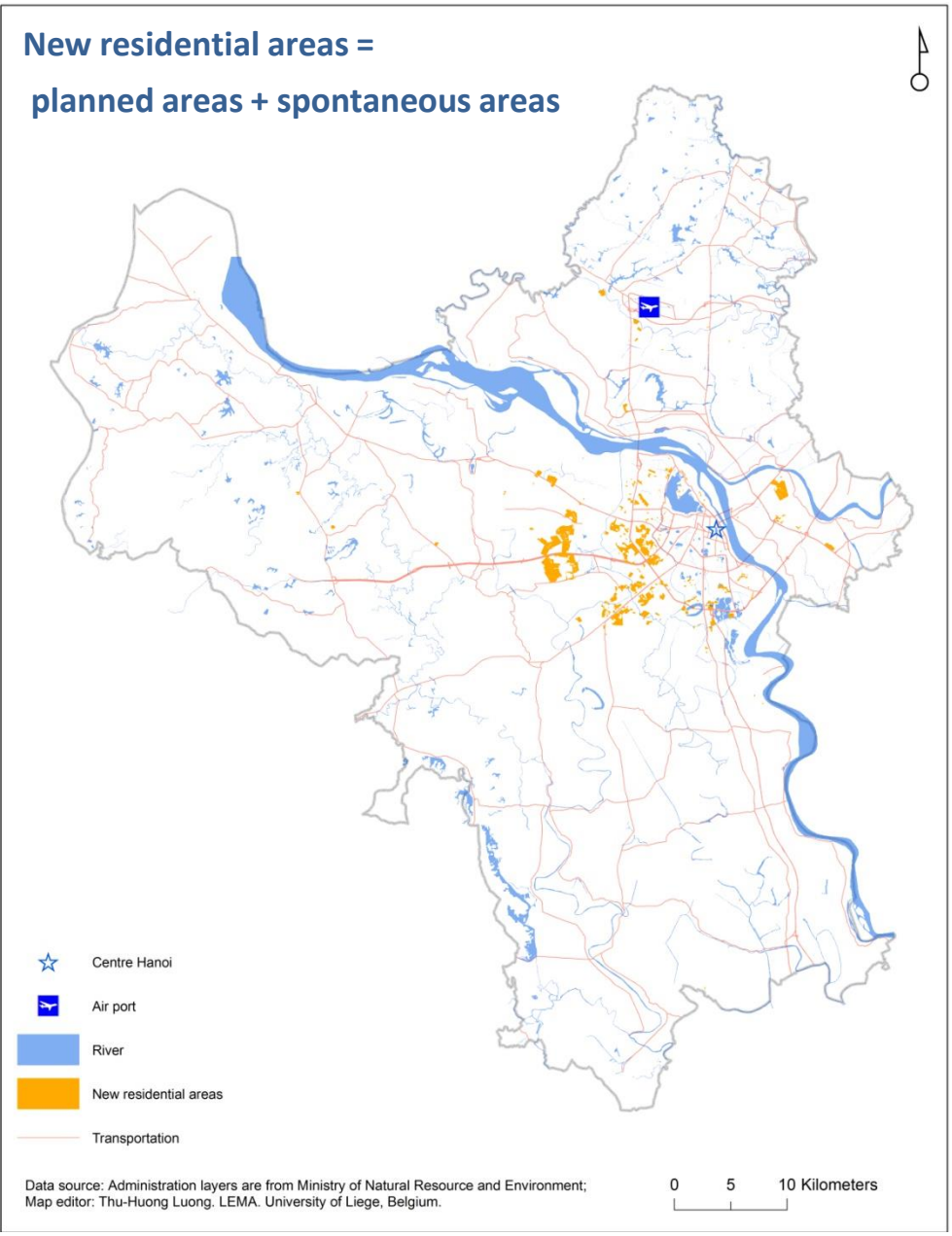
- **New residential areas** are distributed surround existing urban residential areas and follow 3 main transects South, South-West and West
- **New industrial areas** are moved further from residential areas, and connected to highways
- **New public-service buildings** shifted and clustered at the western areas



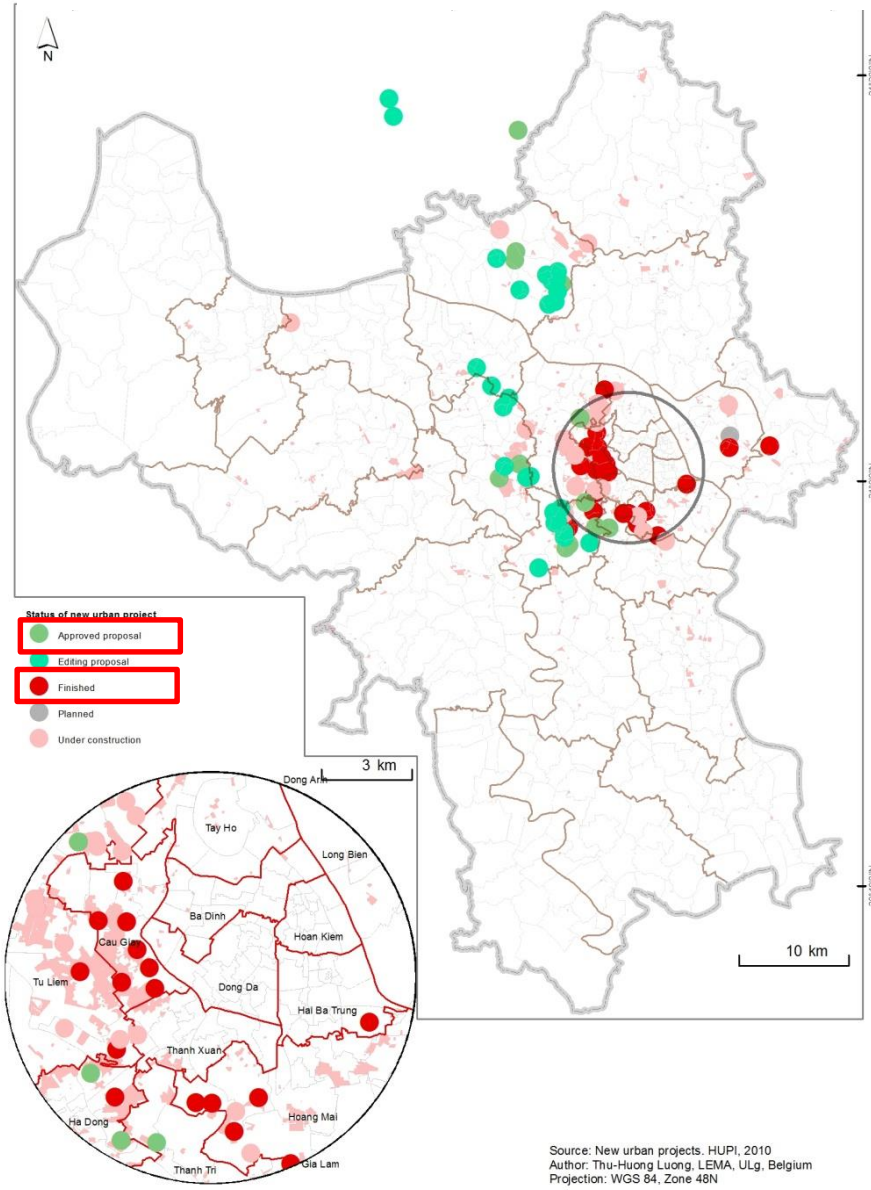
4.5 New urban projects (residential areas classified by status)

New residential areas =

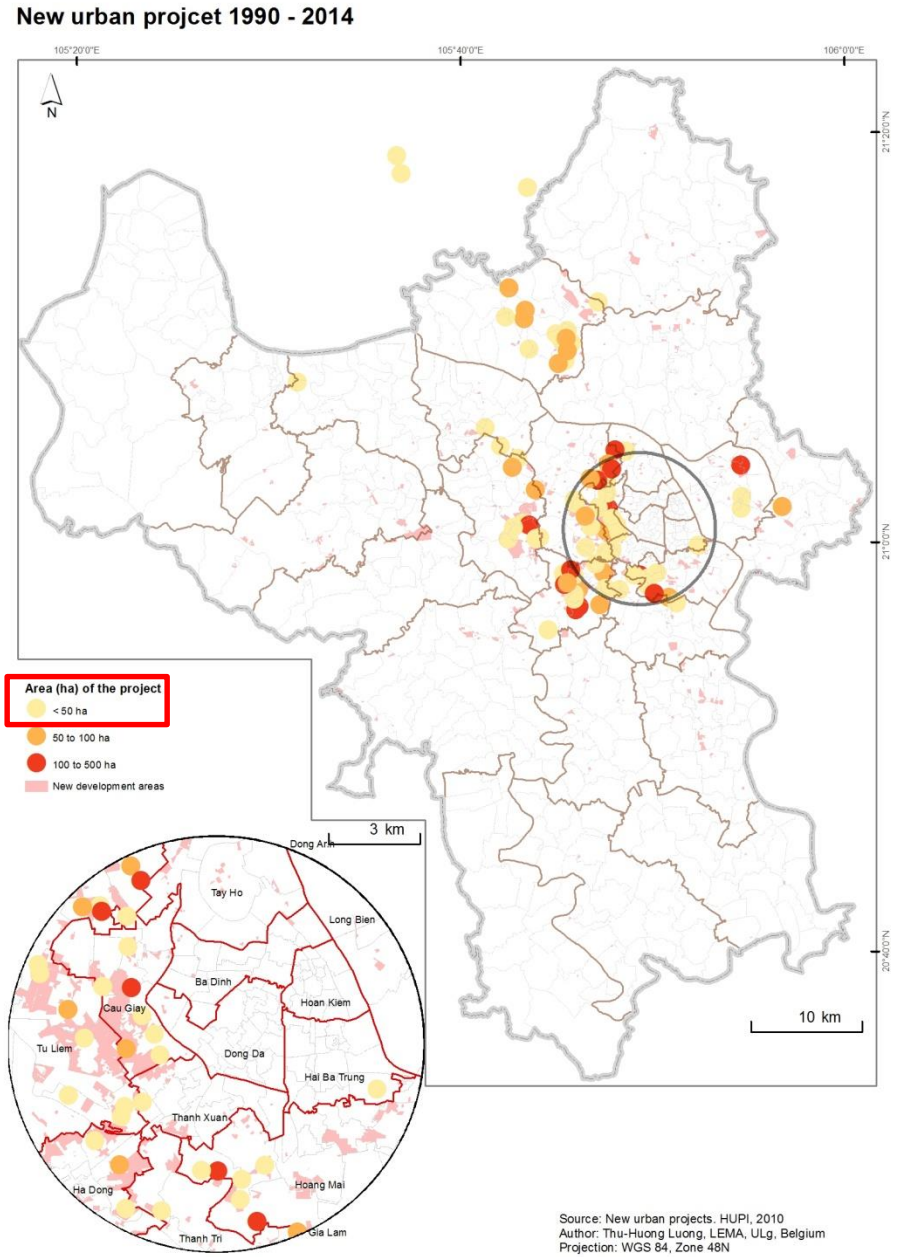
planned areas + spontaneous areas

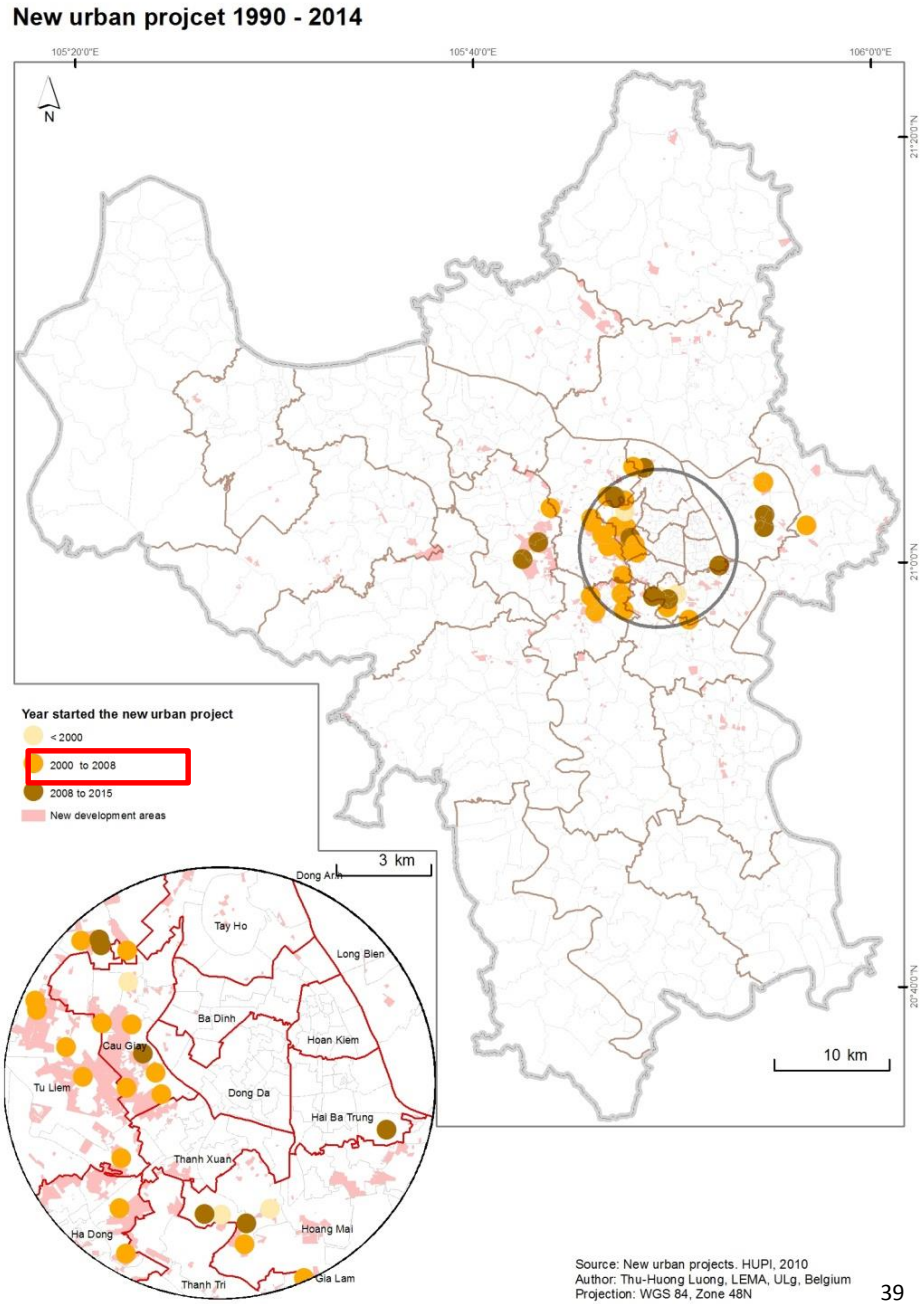


Planned urban development areas (classified by status)

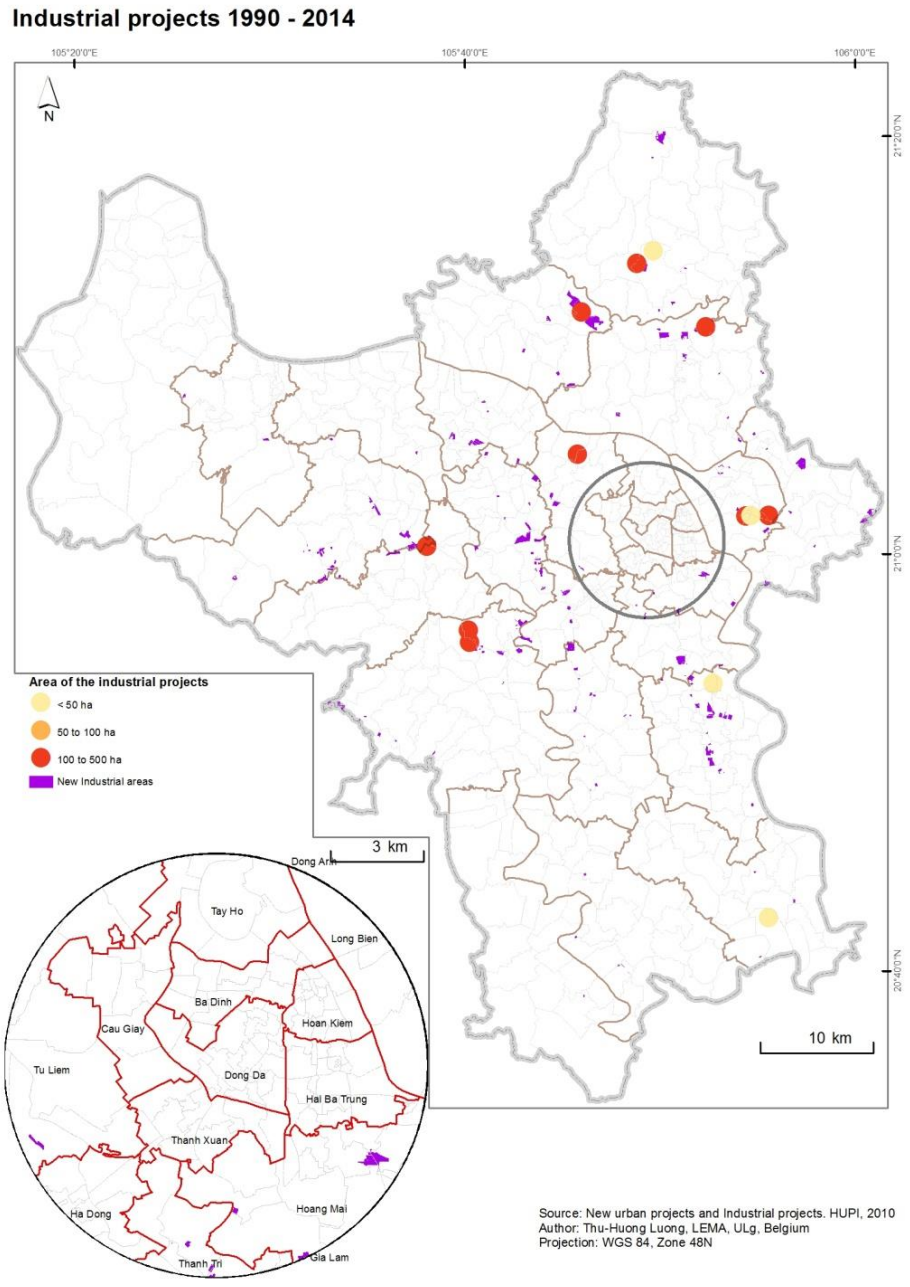


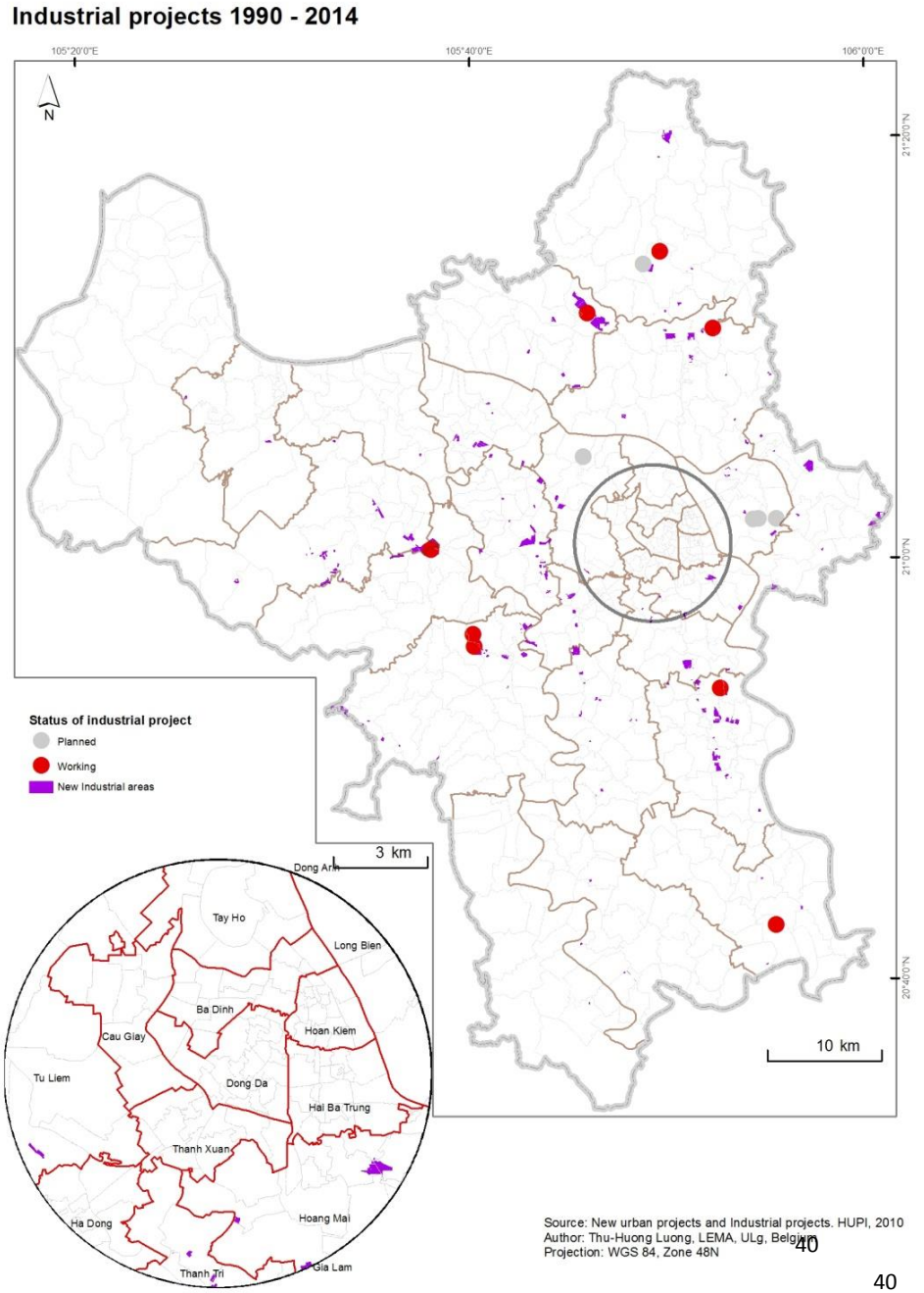
4.5 New urban projects (New planned residential areas classified by areas & age)





4.6 New urban projects (new industrial areas, classified by areas & age)





4.7 Preliminary conclusions

- Significant discrepancies between LCC as measured by Satelite Images and LUC as measured through comparing LU maps ;
  - Especially important in the west of Hanoi ;
  - Maybe due to several factors (data type effects but also informal developments, densification of existing rural areas etc.)
- New developments mainly located at the west (2002-2010)
  - With an average size less than 50 ha
  - Large new urban/industrial projects (> 100 ha) located near new highways/bridges and airport ;
  - Planned to move further to the west and north.

5. Next steps

5. Further research

- Revise and complete tables of driving forces and socio-economic impacts of LULCC on local populations ;
- Report on problem statement: pace of growth in Hanoi and main challenges ;
- Report on LUCC: comparison between techniques ;
- Analyze driving forces of LUCC (regression, geographic weighed regression) ;
- On-site surveys for analyzing the typology of land use change at the periphery ;
- Qualitative interviews on socio-economic impacts on local population (using LUCC maps for selecting areas).

Thank you for your attention