

Land use, transportation and air quality linkages: A study in New Delhi, India

May 2001



Harvard University

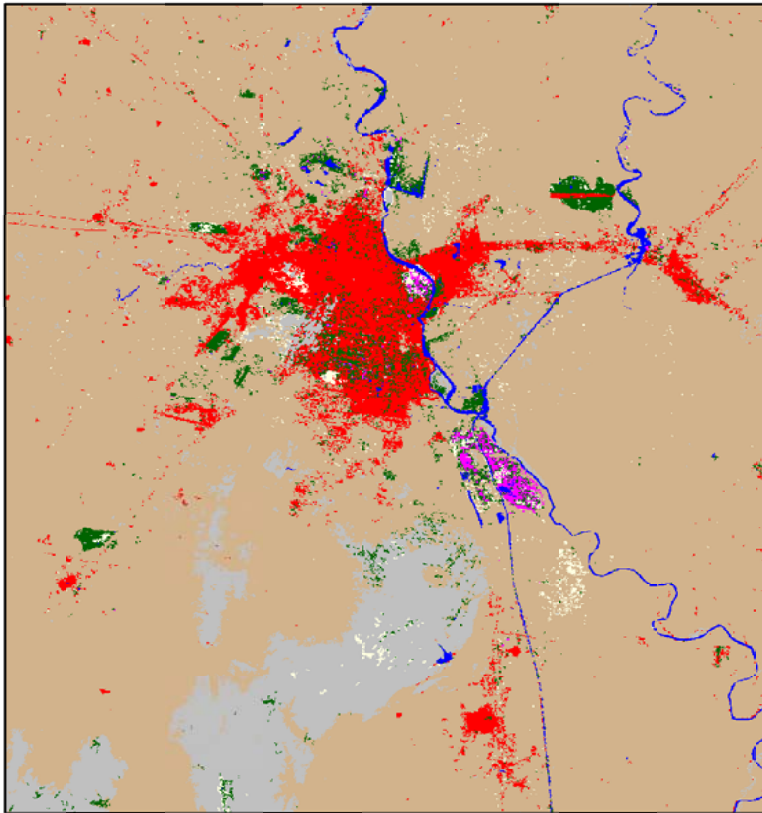
Urbanization continues....

From 2001 Census:

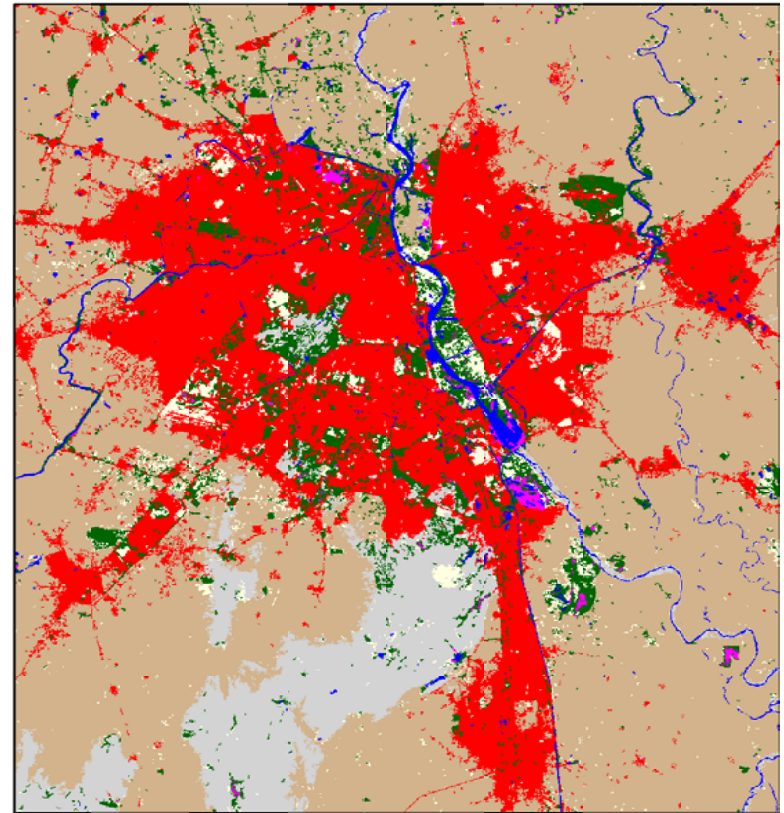
“The total population of Delhi as at 0:00 hours of 1st March 2001 swelled to 13,782,976 as per the provisional results of the Census of India 2001. The density of population in Delhi (9,294) is also the highest among all States and Union Territories. Its population sharply rose by 46.31% during the decade 1991-2001. Men-women ratio in Delhi has further widened when compared to 1991 Census.”

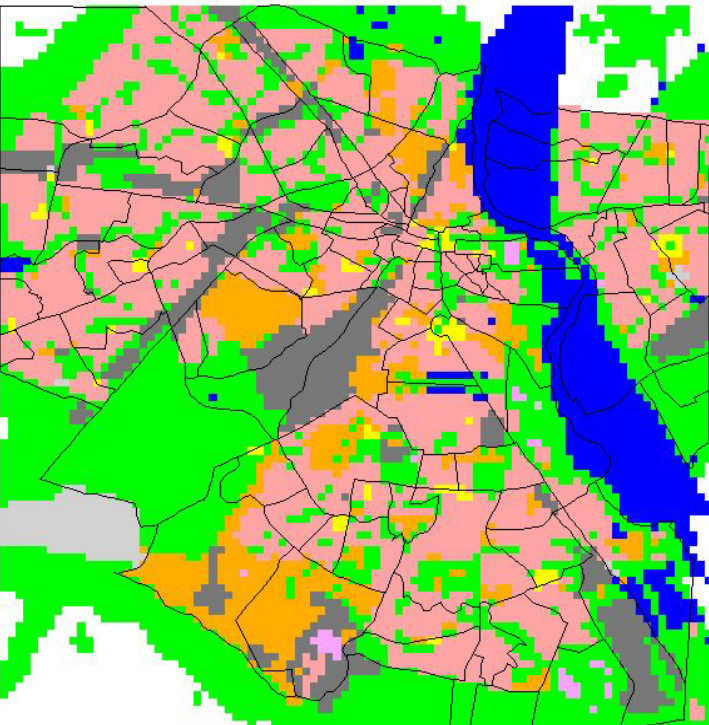
Land use change in New Delhi

Delhi 1974 Land cover derived from Landsat MSS
acquired May 8, 1974

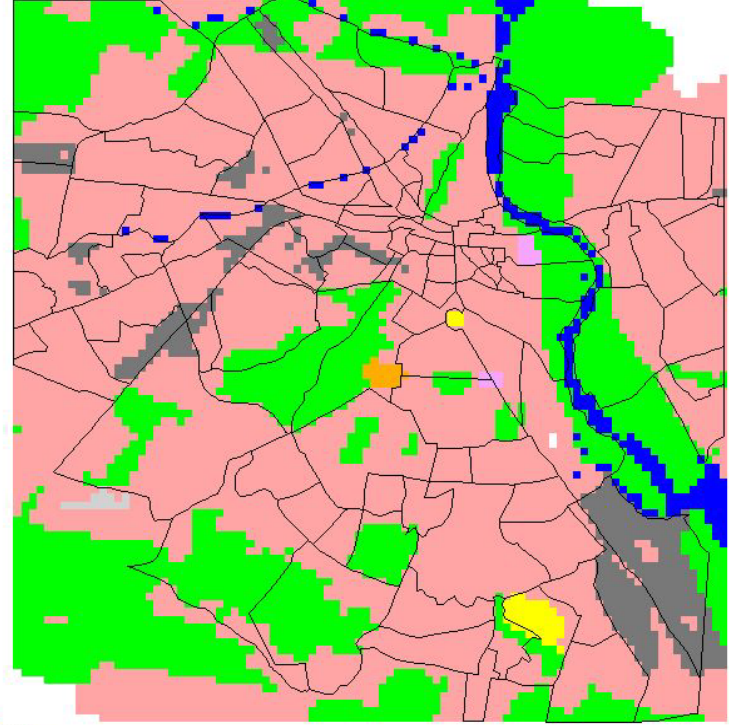


Delhi 1999 Land cover derived from Landsat TM
acquired April 21, 1999

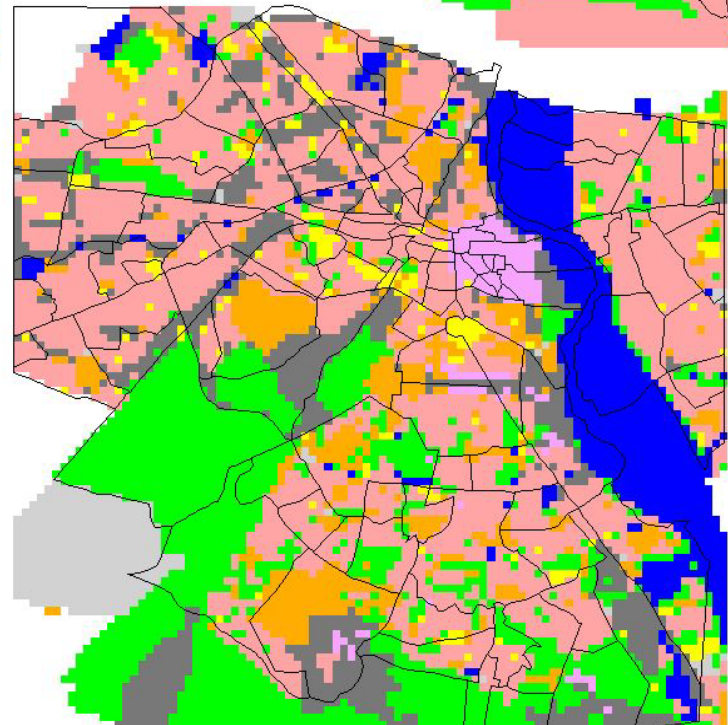




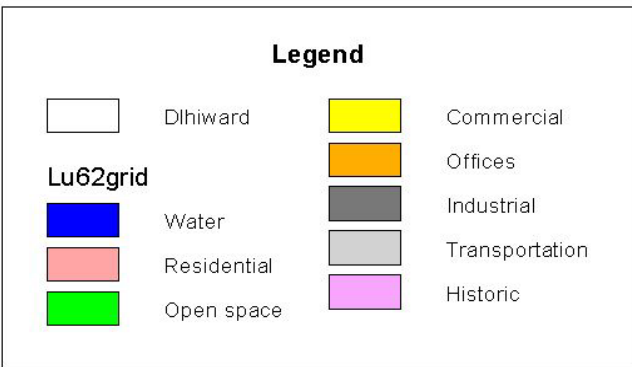
1962



1990

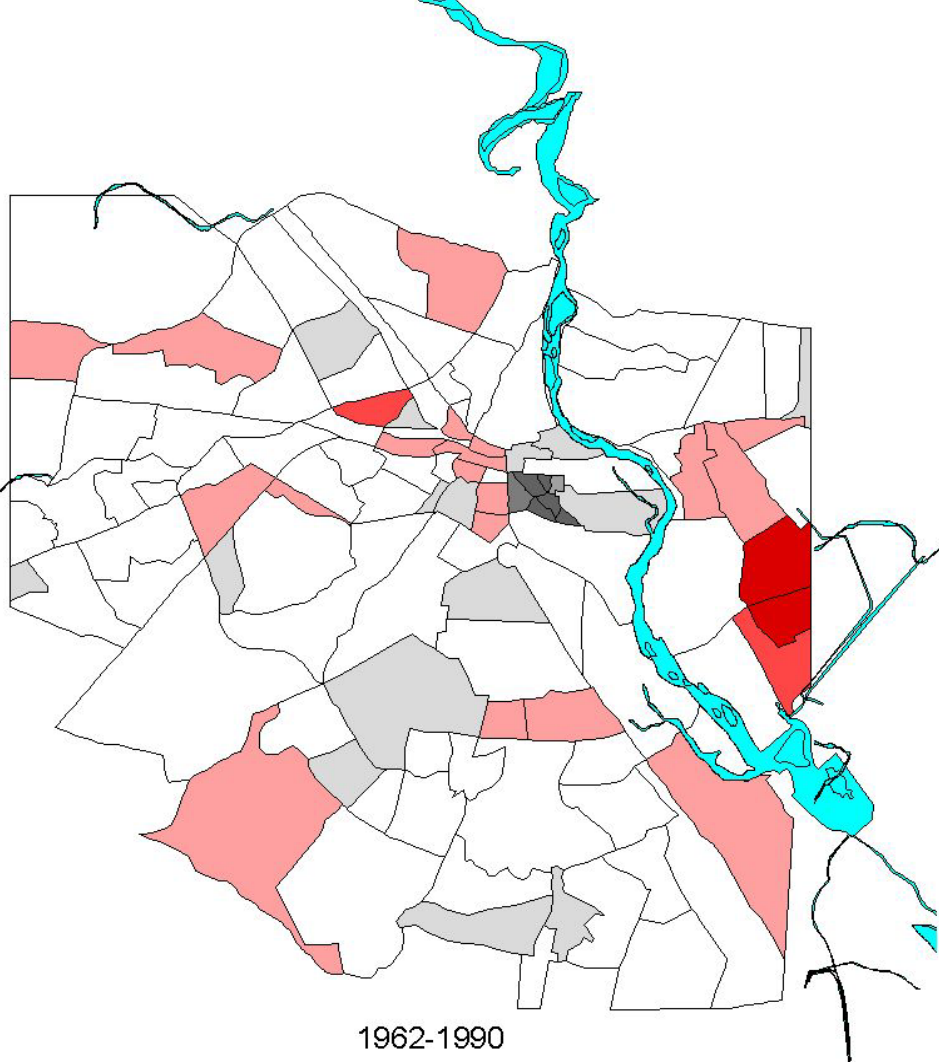


1999

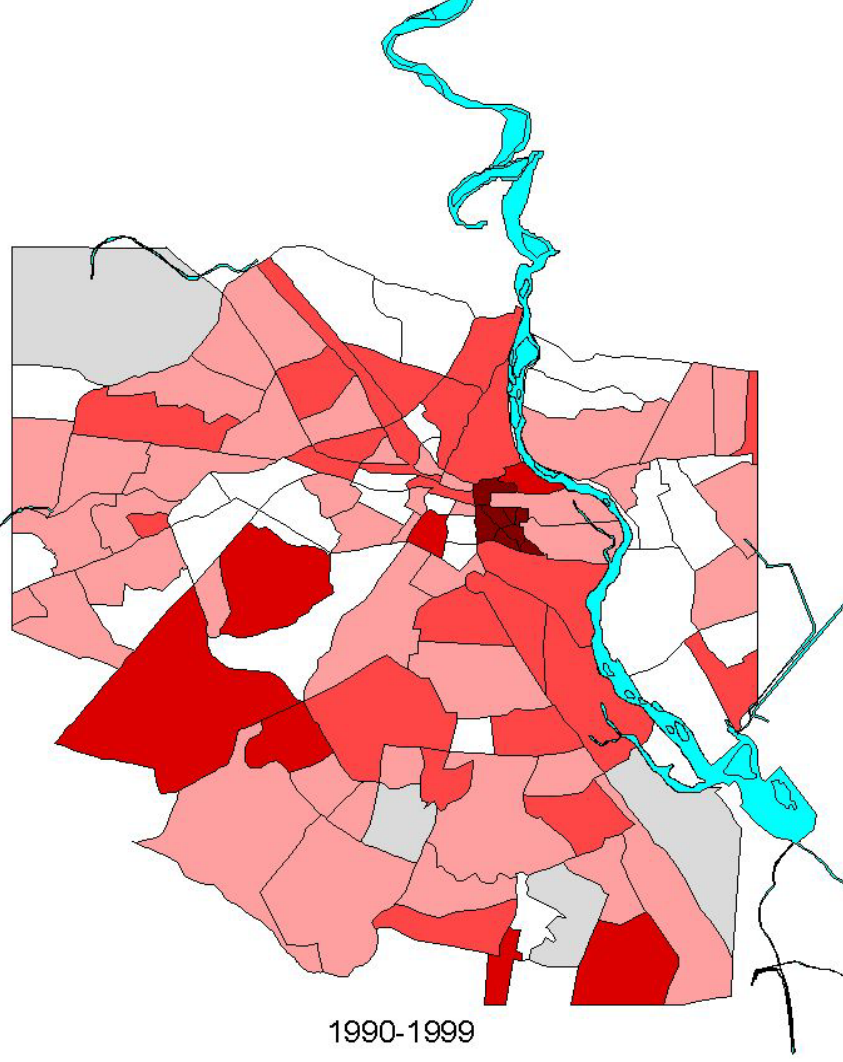


**Changes in land use
1962-1999**

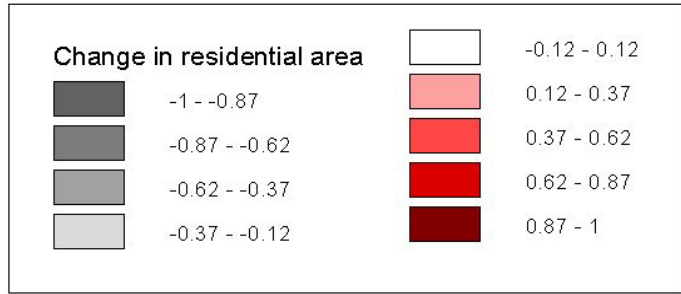




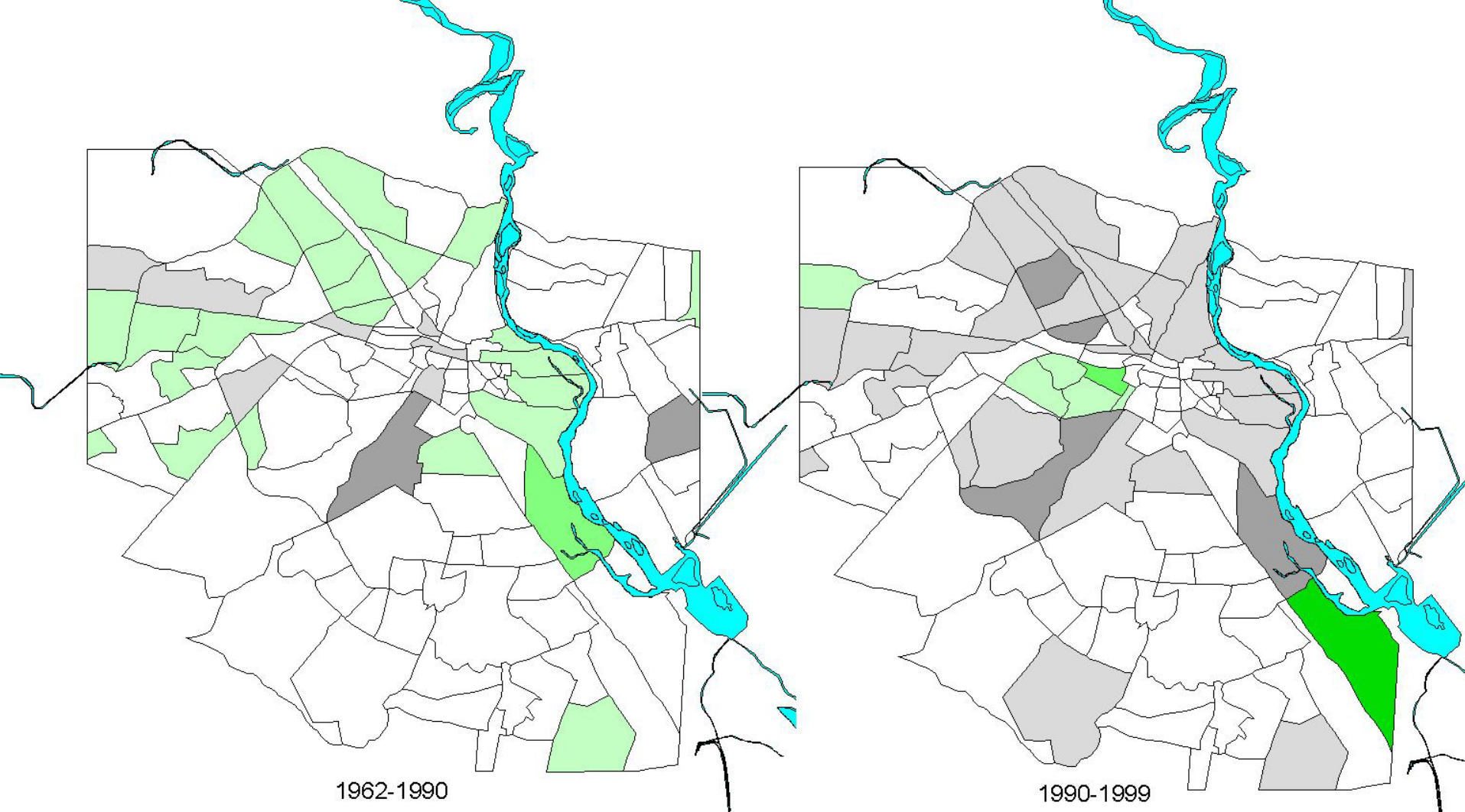
1962-1990



1990-1999



**Changes in residential area proportion by ward
1962-1999**



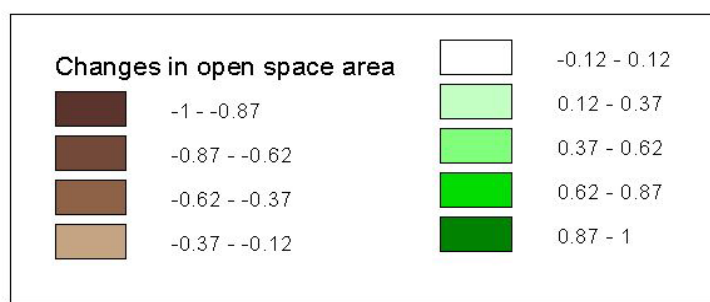
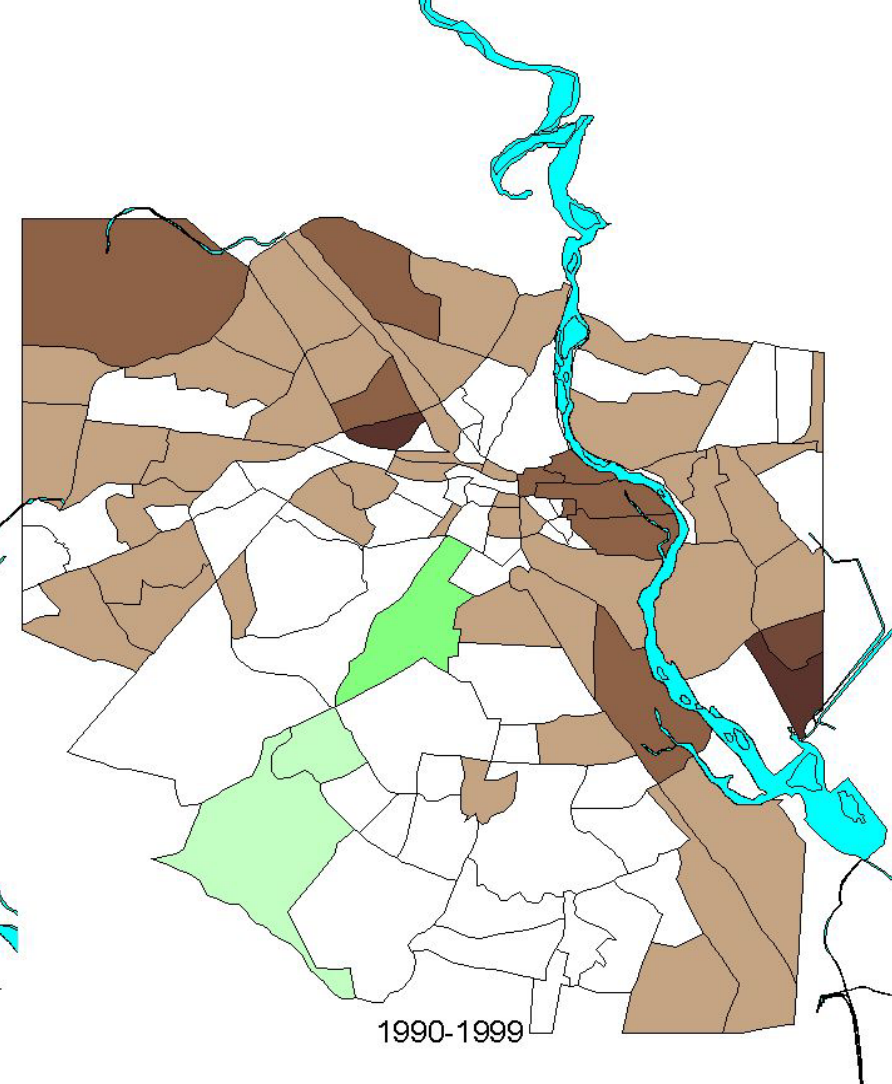
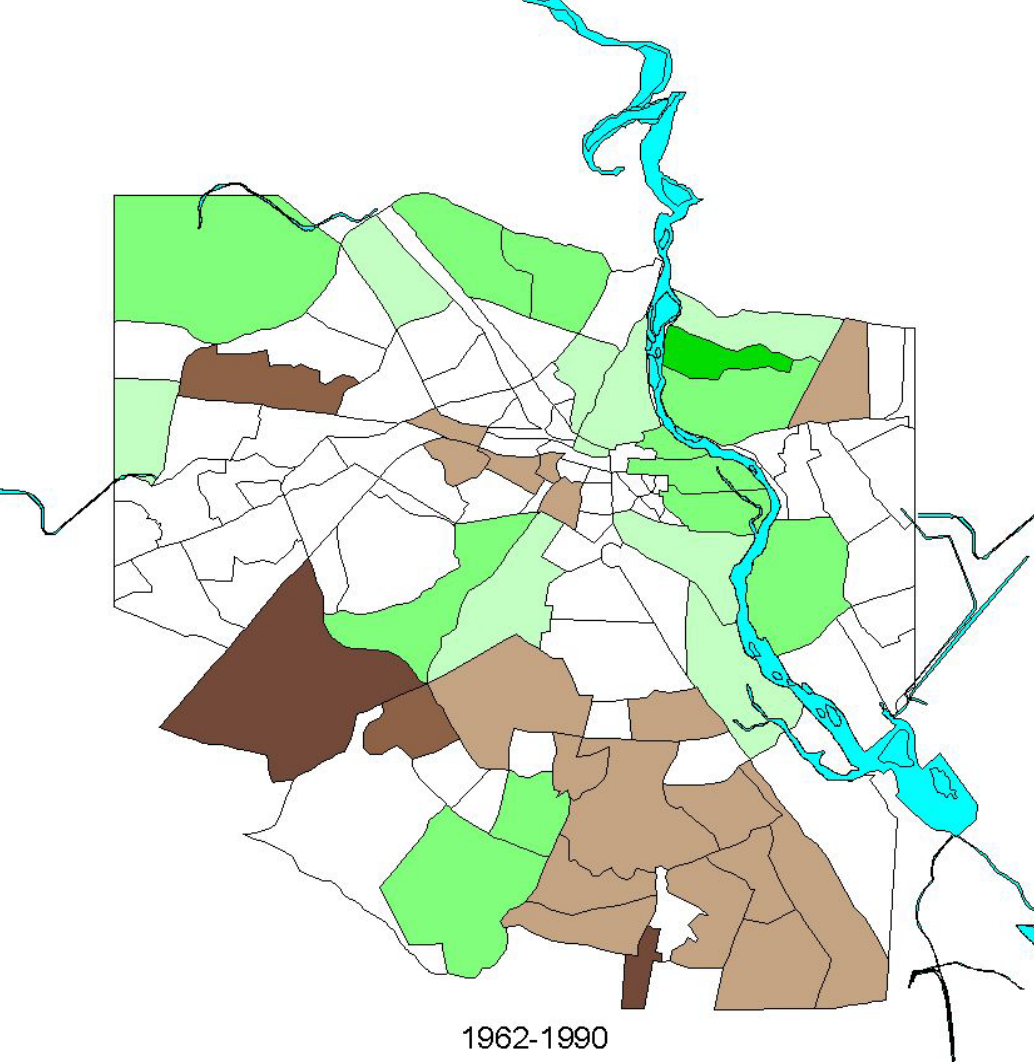
1962-1990

1990-1999

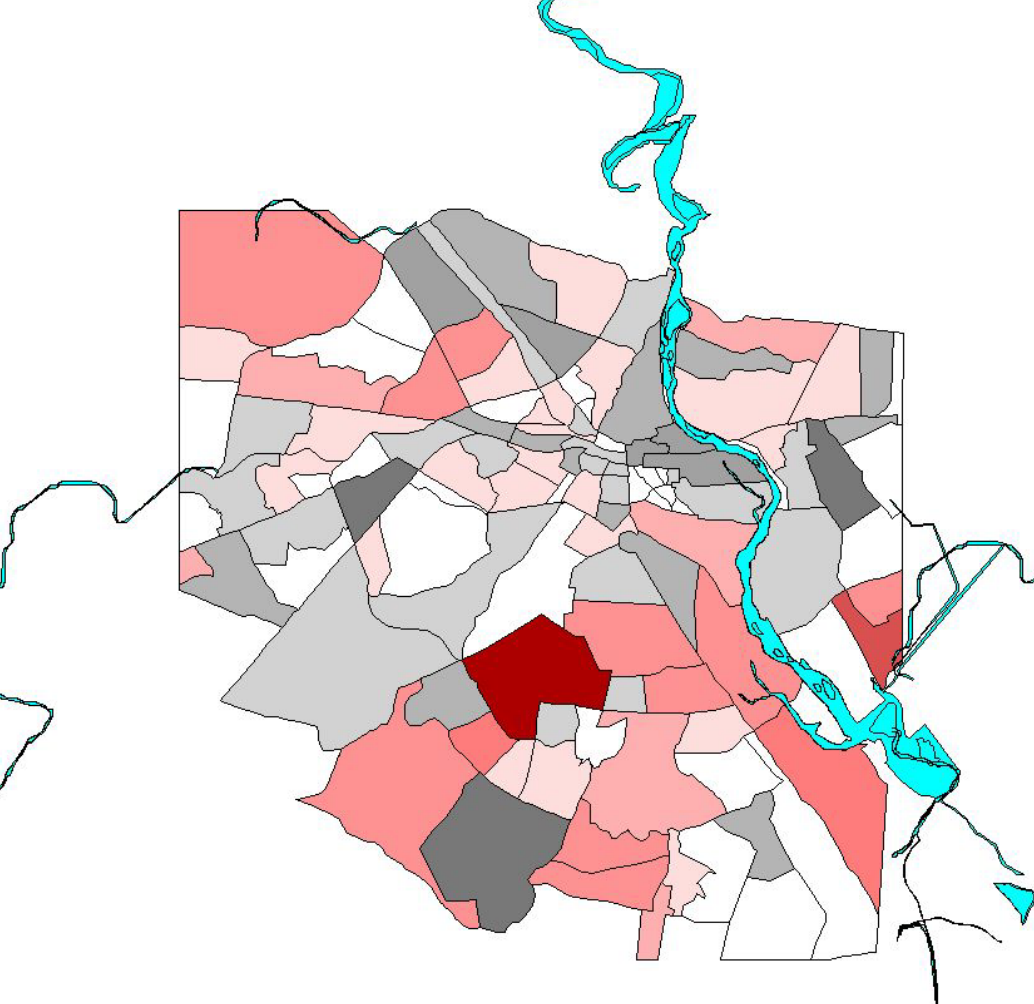


Changes in industrial area proportion by ward

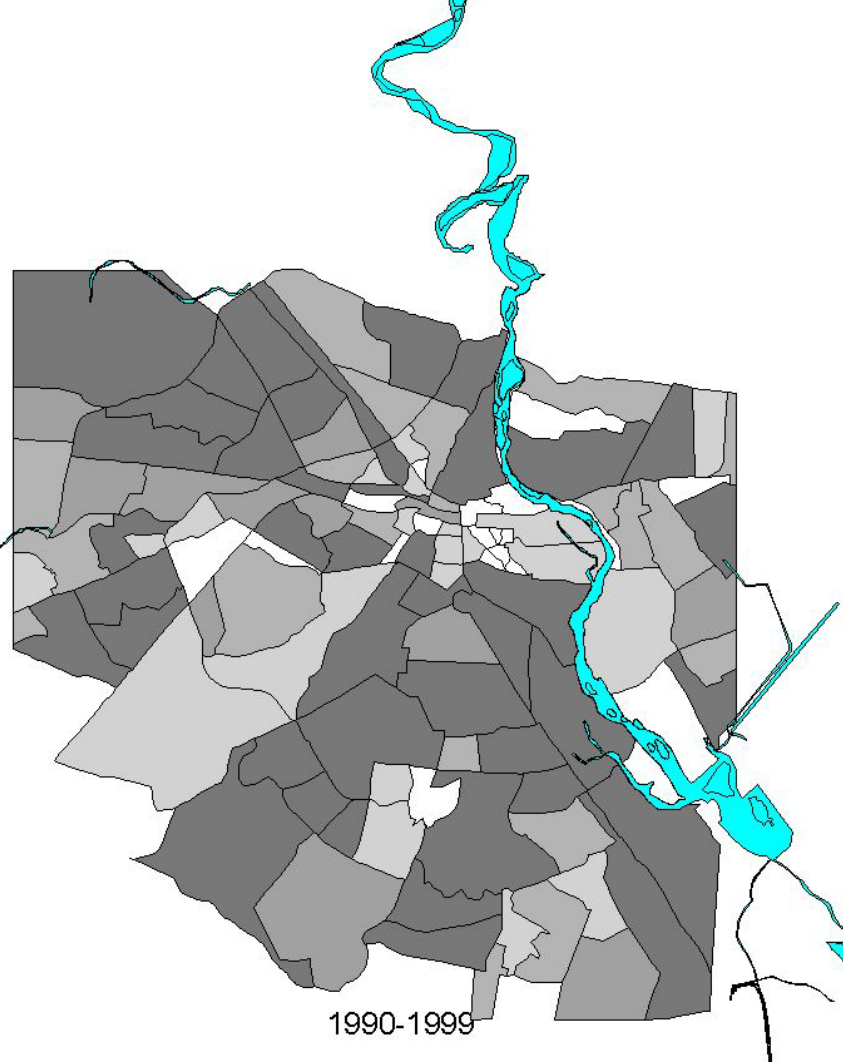
1962-1999



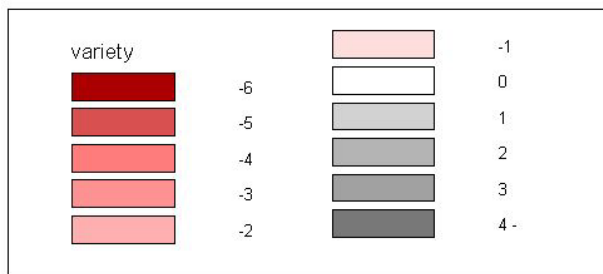
**Changes in open space area proportion by ward
1962-1999**



1962-1990



1990-1999



**Changes in variety by ward
1962-1999**

2001 Master Plan - 1

Population and Employment

.... Effective measures are required during the implementation period to restrict the population of Delhi at a lower level of 11.2 million.

To accommodate the 12.2 million population 2 pronged strategy has been recommended :

- To increase the population holding capacity of the area within urbanizable limits.
- Extension of the present urbanizable limits.

2001 Master Plan - 2

Industry

– To avoid pollution and conflicting land uses there has been a ban the following new industries :

- (1) Hazardous and noxious Industries
- (2) Heavy and large Industries
- (3) Extensive industries

Retail

To accommodate shopping, commercial offices etc 5 tier system of commercial activity is envisaged :

- A Central Business District, Sub-Central Business District, District Center, Community center, Local shopping and convenience shopping center.

2001 Master Plan - 3

Transportation

- Establish a reliable, efficient and attractive multi-modal public transportation system.
- Generate safe conditions for the usage of bicycles
- Establish reasonable freedom to automobile traffic
- Provide safe pedestrian movement
- Encourage innovative management technique to resolve problems of critical areas

Environment

- Ecology, Nature Conservation and Parks.
- Urban Design
- Conservation of Urban heritage
- Community Life
- Conditions for Health, safety and convenience.

2001 Master Plan vs. reality

- Population exceeds 12 million
- Not clear if industries have been zoned out
- Five tier commercial center hierarchy is not systematically implemented
- Traffic management has not been implemented nor are conditions safe for pedestrians
- Green spaces are being lost rapidly

Land use and transportation

This link does not appear to be functioning among planning agencies in New Delhi. Who does planning? Who is concerned about the transportation problems arising from sprawl?

- Who collects transportation data?
 - ORG 1994 survey is private data,
 - Town and Country Planning Organization 1957 data is the only publicly available survey
 - CRRI does not share its transportation models with other agencies
- Who analyzes land use data?
 - DDA GIS does not share data with other agencies
 - CPCB does not share GIS data with other agencies

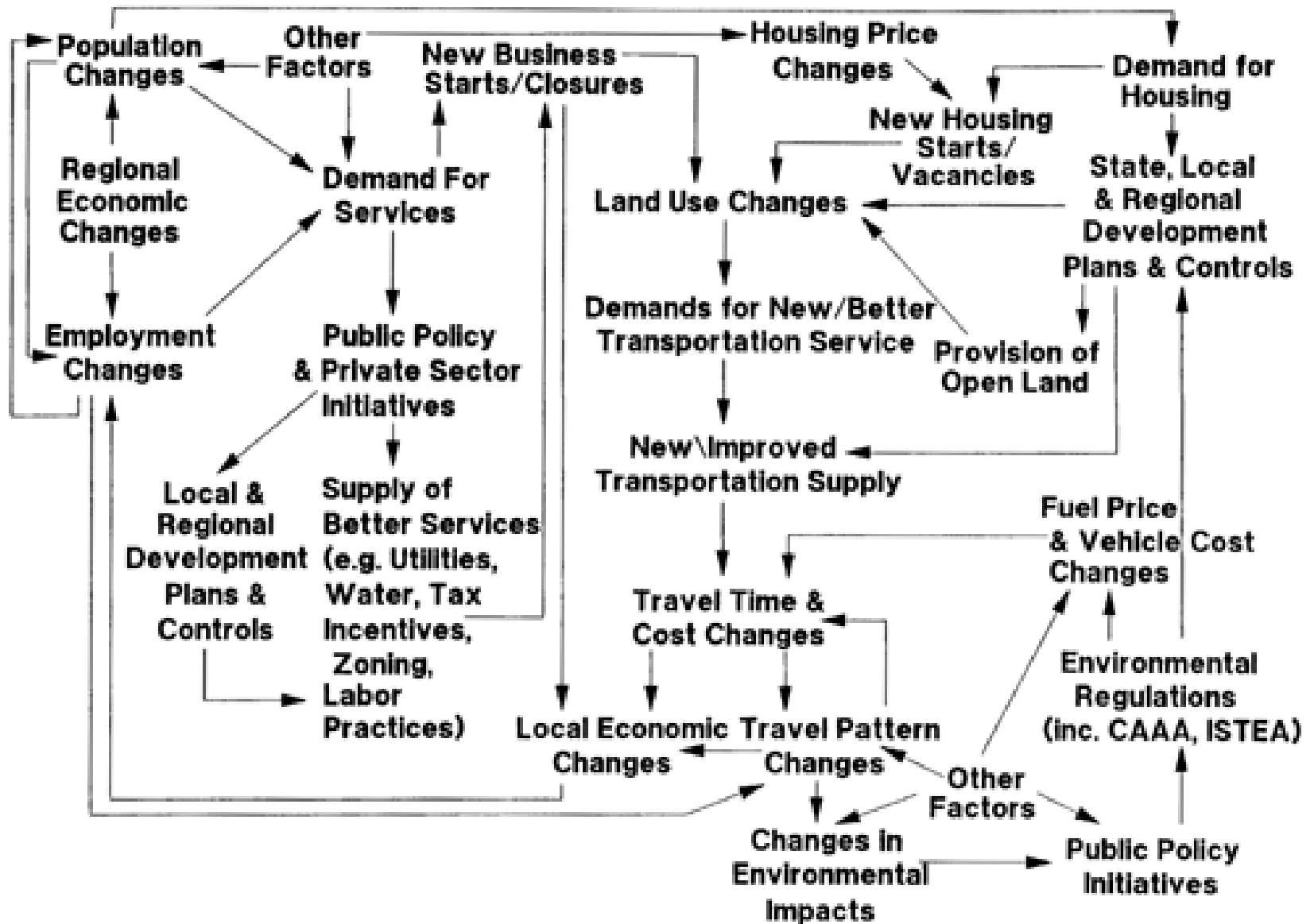
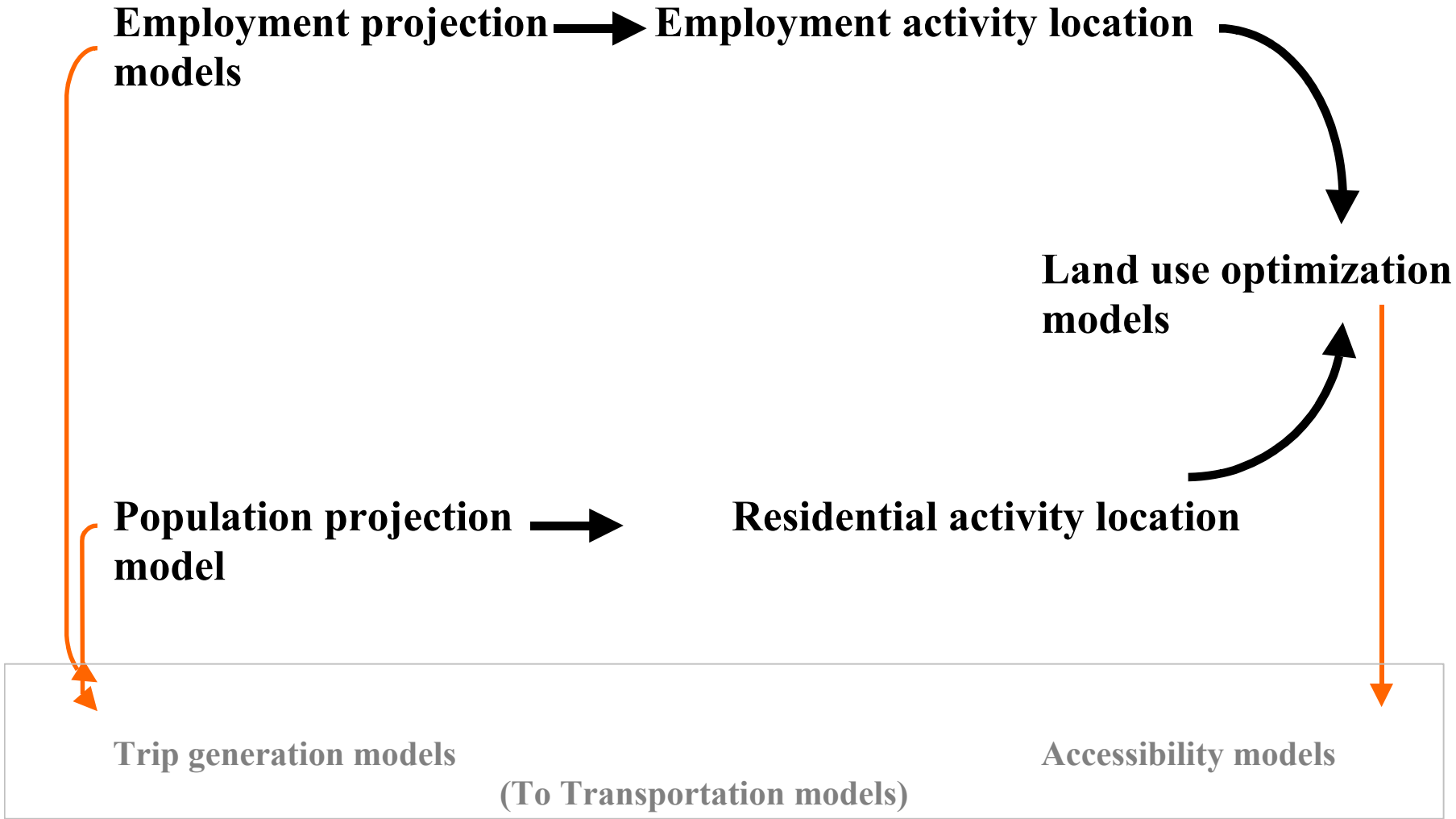


Fig. 1. Complexity of functional linkages in urban system dynamics.

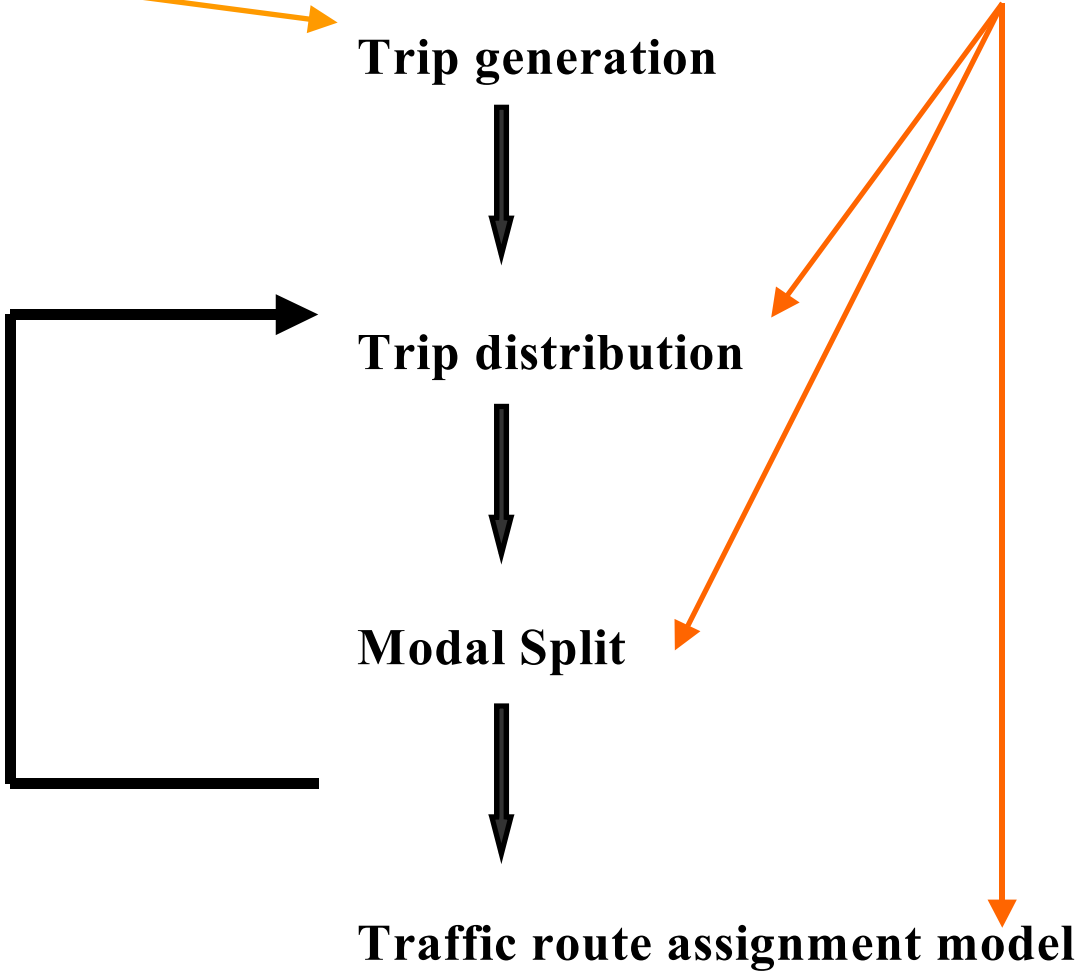
Source: Southworth, F. 1995. *A Technical Review of Urban Land use*. Oak ridge National Laboratory.



Traditional Land Use Planning Model

(From land use models)
Disaggregated population and employment data

Transportation network and mode data
(OD and travel surveys)



Traditional Transportation Planning Model

Models projecting land use change

SLEUTH Model

(Formerly Clarke Cellular Automata model)
Simulates various scenarios of urban growth using a cellular automata model

UrbanSim

Interaction between land use, transportation and public policy. Simulates the land market as the interaction of demand and supply using random utility theory

(Pending availability of data)



Models of land use, transportation and environmental effects

TRANSIMS

versus

Other Models (Dortmund, DRAM/EMPAL, MEPLAN)

Disaggregated to the household level

Zonally aggregated data

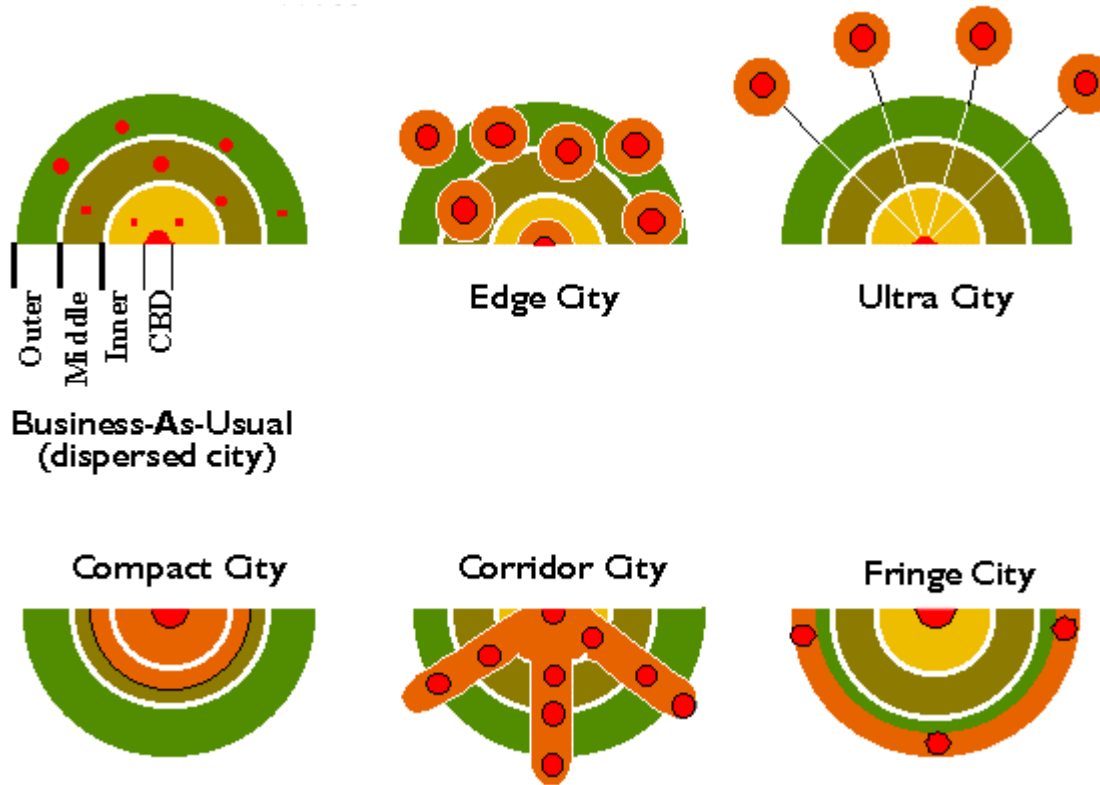
(How to get data for Delhi at disaggregated level?)

Land use and air quality

- The next step is to generate alternative futures through different land use scenarios
- The land uses are projected based on the models discussed earlier
- We then use air quality dispersion models to generate a spatial picture of air pollution for 2020

Land use scenarios

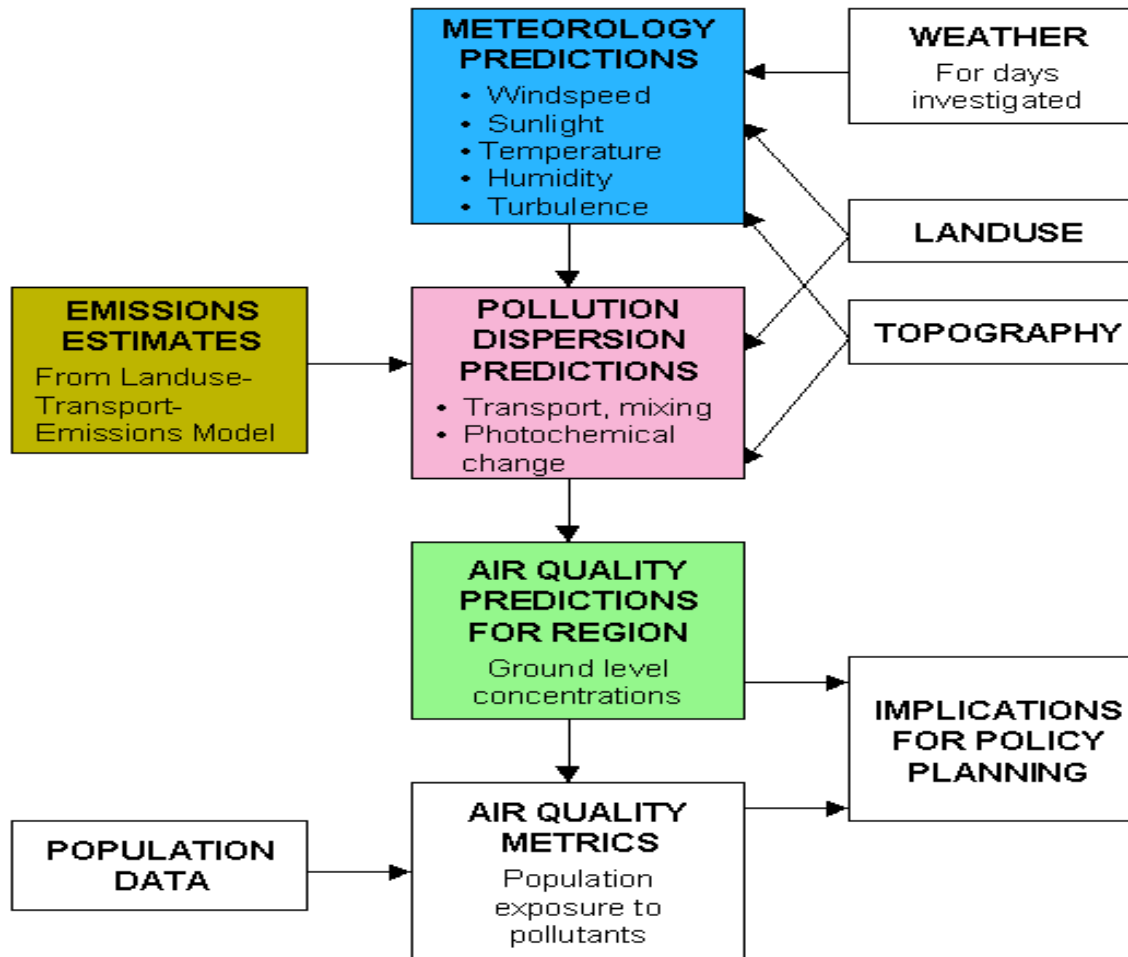
Source: P.C. Manins, M.E. Cope, P.J. Hurley,
P.W. Newton, N.C. Smith and L.O. Marquez
CSIRO, Australia



Types of urbanization
(derived from land use change models)

Land use and air quality models

Source: P.C. Manins, M.E. Cope, P.J. Hurley,
P.W. Newton, N.C. Smith and L.O. Marquez
CSIRO, Australia



Final goal

- To have a prototype for a complete transportation, land use and air quality model for New Delhi (e.g. TRANSIMS)
- But the first step would be a statement of complete data required to implement this model
- Then several prototype implementations of land use, transport and air quality models