Mainstreaming Adaptation in Urban Development Plans

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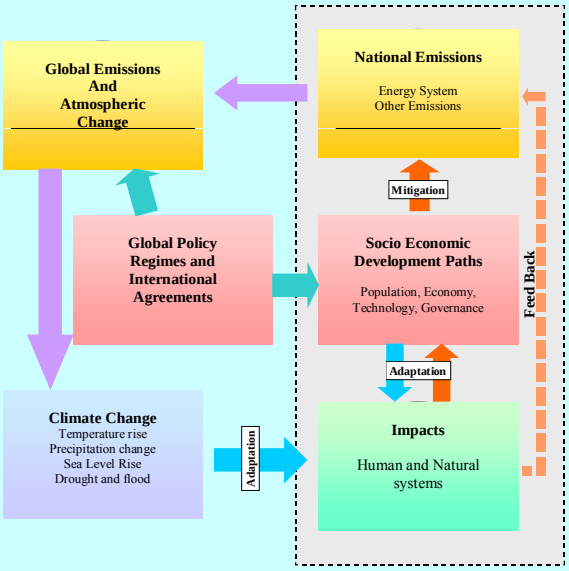
Background

- Global warming will induce other changes
- Even with best of efforts the process is irreversible in near future
- There will be a wide range of impacts due to these changes on natural and manmade systems
- Two possible approaches to deal with this are -
  - Mitigation
    - Action to reduce greenhouse gases, and therefore reduce future climate change and associated impacts.
    - Many different sectors can contribute
  - Adaptation
    - Action to minimise the impacts of climate change and to reduce its severity as it happens.
    - Public services, businesses and communities need to adapt to the effects of climate change that are apparent now.

Mitigation and adaptation both are necessary

Integrated Assessment Framework

- Prime issues identified are emission assessment of local and global pollutants, and assessment of impacts on natural and human systems.
- These interactions and their results are modified by the socio-economic development paths selected by the country.
- Emission analysis is very well covered
- Present work only on the component related to Impacts and Adaptation through a case study



Difficulties in Adaptation

- Global policies v/s local action
- No common generalized policies, Individual solutions are needed
- Successful adaptation is possible only if local government / people contribute
- Building the capacity to adapt is slow and time taking
- Good quality infrastructure and services are almost always necessary for adaptation actions
- Climate stresses superimposed on existing stresses (multiple stresses)
- Difficult to unpick weight of climate change
- Economic implications of adaptation actions

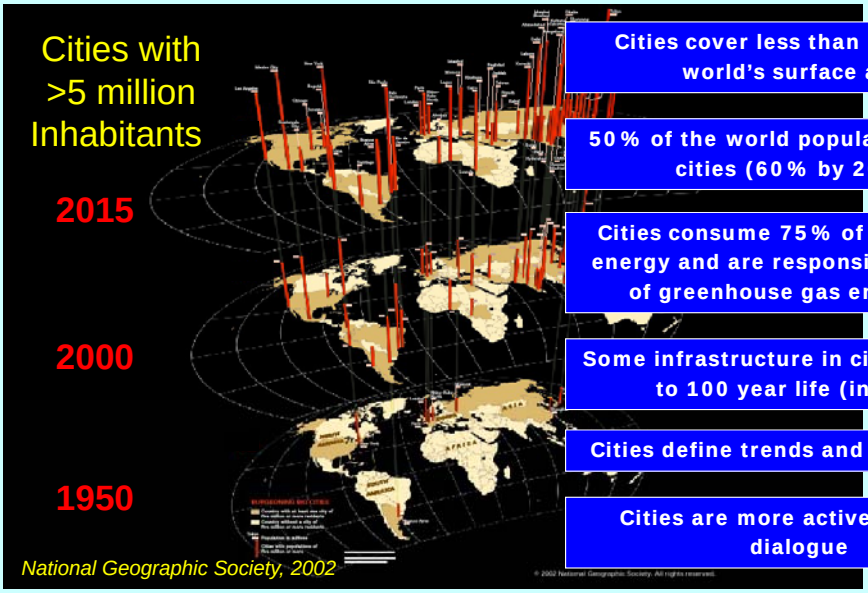
Why Cities?

Cities with >5 million Inhabitants

2015

2000

1950



National Geographic Society, 2002

- **Cities cover less than 1% of the world's surface area**
- **50% of the world population lives in cities (60% by 2030)**
- **Cities consume 75% of the world's energy and are responsible for 80% of greenhouse gas emissions.**
- **Some infrastructure in cities has a 50 to 100 year life (inertia).**
- **Cities define trends and civilizations**
- **Cities are more active in global dialogue**

Likely Impacts for Settlements

Climate Change Parameter	Impacts on Settlements
Warm spells / frequent heat waves	Extreme high temperatures (worst in heat islands in cities); air pollution may increase / decrease.
Heavy precipitation events	Floods/landslides; injuries and deaths, households losing homes, possessions, assets, livelihoods.
Intense tropical cyclone activity	Population displacements and disruption of city economies, transport and other infrastructure damages. Health services and emergency services unable to cope.
Increased area affected by drought	Water shortages, food shortages, malnutrition, distress migration into urban centres, hydro-electric constraints
Increased incidence of high sea level	Loss of lives, property and livelihoods to coastal flooding, damage to tourism, damage to buildings, salinization of water

Adapted from Satterthwaite David, IIED

Indian Towns and their Population (2001)

Class	Population Range	No of Towns	% of towns	Population (million)	% Population
I	≥ 100,000	423	8.20	172.044	61.48
II	50,000 to 99,999	498	9.65	34.431	12.30
III	20,000 to 49,999	1386	26.86	41.974	15.00
IV	10,000 to 19,999	1560	30.23	22.603	8.08
V	5,000 to 9,999	1057	20.48	7.983	2.85
VI	< 5,000	237	4.59	0.801	0.29
	All Classes (I -VI)	**5,161**	**100.00**	**279.837**	**100.00**

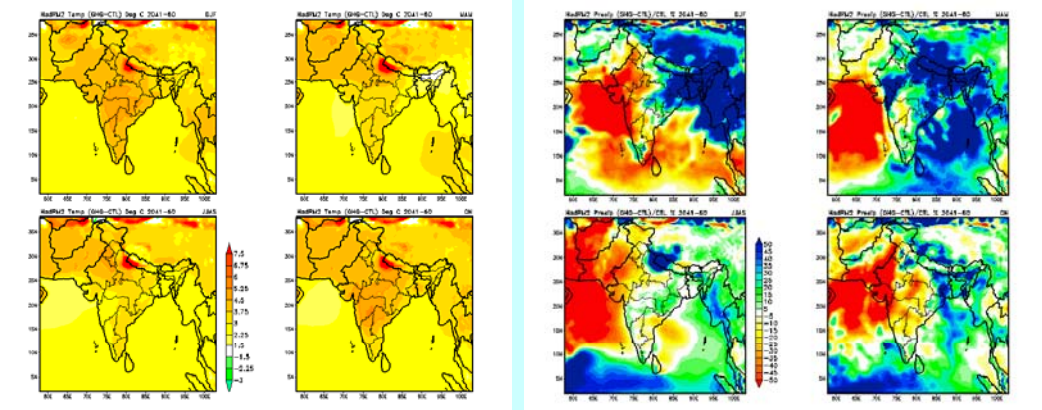
- India has 5,161 towns out of which 27 are metropolitan cities, 423 are class- I, 498 are class –II, and the rest are 4240 below 50,000.(2001 Census)
- Slow growth of population in smaller towns and fast urbanisation in larger cities
- Large cities are provider of major services and smaller towns are centres of development for surrounding rural area
- Towns close to rural agriculture economy and cities are modernising faster
- IT revolution has been a major influencing factor in recent years

Climate Projections: Summary for India

- *Maximum temperature*: increase by 2-4° C during 2050s in regions above 25° N.
- *Minimum temperature*: Increase up to 4° C all over the country.
- May exceed 4° C over southern peninsula, northeast India and some parts of Punjab, Haryana and Bihar.
- *Monsoon Rainfall* : marginal changes in monsoon months (JJAS)
  : Large changes during non-monsoon months
- *Number of rainy days*: Decrease in the number of rainy days over a major part of the country. More in western and central part (by more than 15 days) while near foothills of Himalayas (Uttaranchal) and in northeast India the number of rainy days may increase by 5-10 days.
- *Extreme Rainfall events*: overall increase in the rainy day intensity by 1-4 mm/day except for small areas in northwest India where the rainfall intensities decrease by 1 mm/day.
- *Cyclonic storms*: Increase in frequency and intensity of cyclonic storms is projected

There will also be regional and local variations

Projected Changes in Temperature and Precipitation



Projections of seasonal precipitation for the period 2041-60, based on the regional climate model HadRM2
Source: India NATCOM

Who is at Risk Among Urban Population?

- Urban populations already facing difficulties with extreme weather events
  - High vulnerability of infants & young children including impacts on long term development as well as more immediate impacts
  - Disruptions that affect urban livelihoods
- Urban centres/districts at risk of sea-level rise - on coasts with settlements and water sources at risk
- Coastal Settlements and industry show a higher vulnerability.
- Urban populations that cannot adapt
  - Who cannot change locations
- Urban populations with the least resilience
  - There will be lots of disasters; the extent of impact is dependent on what is done in advance regarding preparedness
  - Especially vulnerable are informal settlements within urban areas, which tend to be built on hazardous sites and to be susceptible to floods, landslides, and other climate-related disasters.

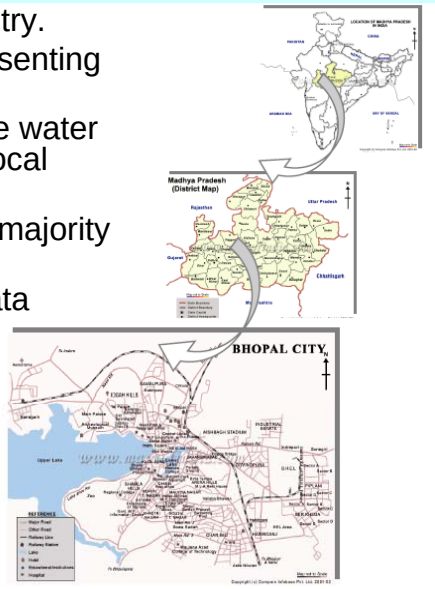
Identifying the vulnerable sectors and areas is important

Urban Infrastructure is the key to adaptation

- Transportation system
  - Railways, Roadways, Waterways and airways.
- Sewage and drainage system
  - Sewage carriage network, Treatment plants, Recycling plants, Rain water disposal network and natural runoff.
- Water supply system
  - Source of raw water, transportation system, Treatment plants and supply network.
- Energy system
  - Generation plants, Transportation system, supply network.
  - Refineries and distribution.
- Built infrastructure
  - Public buildings, Private buildings, Heritage buildings,
  - Tourist attractions, Parks, open areas, Play fields, Parking lots & Community gathering points

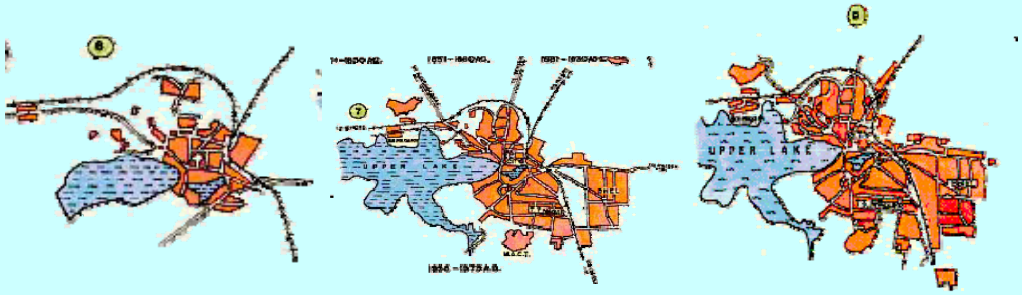
Case Study City: Bhopal

- The city is centrally located in the country.
- The climate is composite climate representing a large portion of the country.
- The city has physical features like large water body, Hills and forests for analysis of local variations.
- A million plus city, it can represent the majority of Indian cities.
- Availability of climatic and electricity data



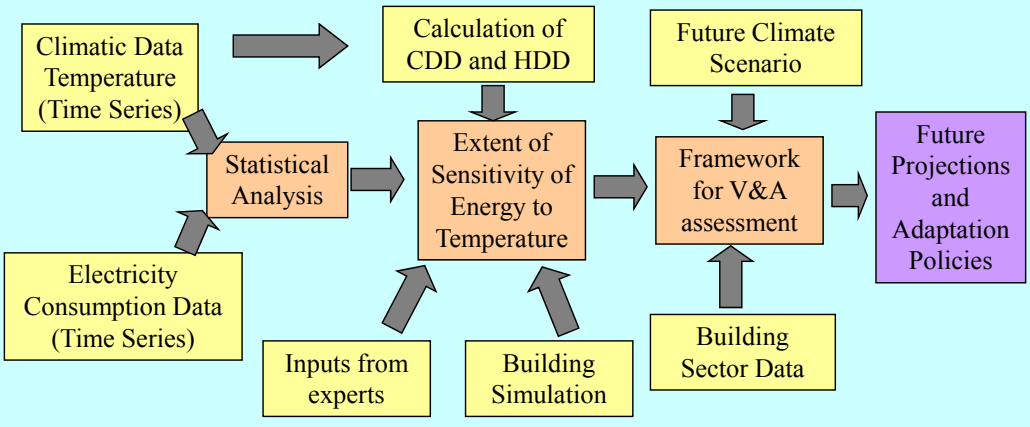
Bhopal: Chronological Development

1010 - 1200 AD | 1201 - 1800 AD | 1801 - 1850 AD | 1851 - 1880 AD | 1881 - 1930 AD



1931 - 1955 AD | 1956 - 1973 AD | 1974- 2000 AD

Analytical Framework

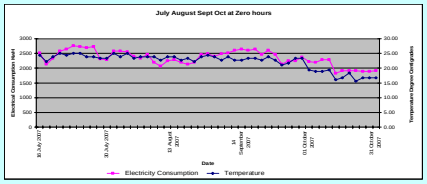


Methodology

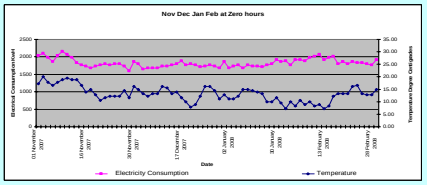
- Assumptions
  - The energy consumption in built environment is primarily a function of “Cooling” and “Heating” needs
  - Case Study Approach provides opportunity to study local variations and is suitable for developing and harmonizing adaptation strategies
  - Building Design: Form (shape), Orientation, Materials and Technology play an important role
- Temperature change and electricity demand
  - Temperature data of the city analyzed for one year period
  - Seasonal variations in electricity consumption identified
  - Hourly temperature data and electricity consumption compared and analyzed for any selected year.
- Simulation
  - Double storey building considered with select parameters
  - Six alternate configurations analysed
  - eQUEST used for simulating the building.

Emerging Findings: Temperature Effect

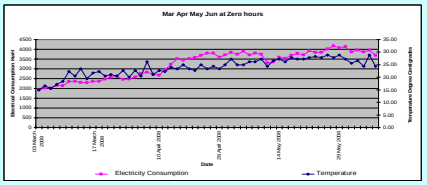
- Electricity consumption in buildings is dependent on many factors.
- It is necessary to eliminate the effects of other influences to bring out the effect of temperature.
- Marked seasonality and periodicity in electricity demand
- Electricity consumption well correlated with temperature change
- The correlation is more prominent during night hours
- CDD and HDD analysis more useful



July-Aug-Sept-Oct



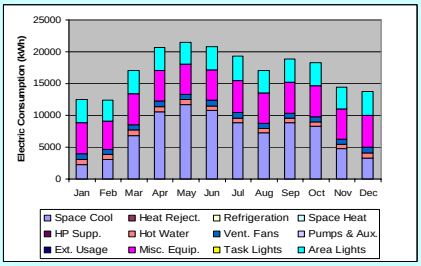
Nov-Dec-Jan-Feb



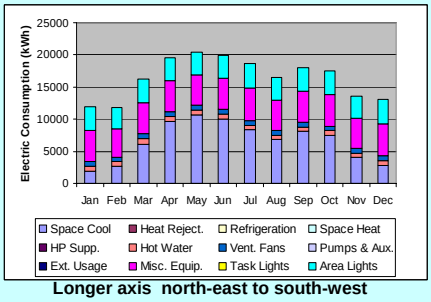
March-Apr-May-June

Emerging Findings: Simulation

- Building with longer axis north-south consumes the highest energy
- The most efficient orientation is obtained when longer axis is north-east to south-west
- Energy consumption well correlated with temperature change
- Highest energy consumption in summer months
- Space cooling requires maximum amount of energy
- Suitable construction material or provision of adequate insulating material may further reduce energy consumption



Longer axis north-south

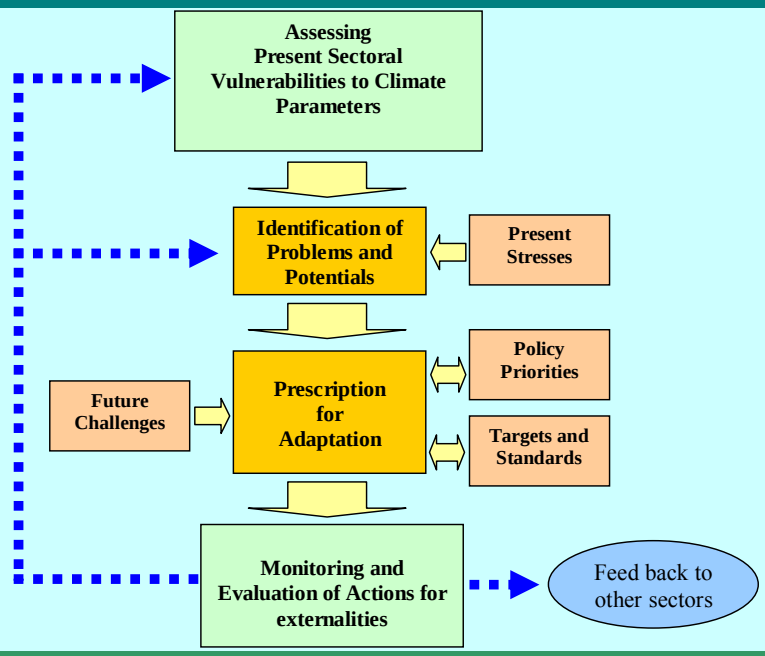


Longer axis north-east to south-west

Important Considerations and Adaptation Options

- Considerations
  - Present practices are not the best. Buildings are being designed for current climate. Future climate may change and thus requires special understanding
  - Making a building climate responsive needs additional investment
  - Indigenous and vernacular technologies are suitable on small scale. Vertical growth of cities requires intervention with new technologies
  - Retrofitting in short run and design modifications for the new building in the long run.
  - Existing building stock will remain for some time and changes will be realized at a lower rate
  - Adaptive responses of building sector to climate change may have undesirable feedback effects
- Adaptation Options
  - Solar passive techniques and building design
  - Energy-efficient lighting and HVAC systems
  - Use of renewable energy systems
  - Assessments of technologies and energy-saving potentials.
  - Policies for overcoming institutional/social/financial barriers
  - Capacity Development in - Energy-efficient building design and operations, Improved building performance and comfort, Energy and economic simulations, Analysis of new building designs, Buildings and Demand-side management (DSM)

Process for Adaptation Actions



Criterion for Selection

- High climate sensitivity and dependence
- Socio-economic (e.g. income level, poor infrastructure, illiteracy, public health, etc.)
- Magnitude, timing and reversibility of regional/sectoral impacts at national level
- Cross cutting concerns across sectors (e.g. water, land-use, energy, coastal)
- Representativeness for national circumstances
- Connections across other hotspot selection
  - Dense population areas (inlands and coastal agglomerations)
  - Highly climate sensitive resources with multiple forward dependencies

The Response Mechanism

- Development actions in the context of climate change
- Climate Change to be linked to all services and tasks
- Facilities and linkages against extreme weather-related events
- Changing the Building Code/ Standards
  - Increased efficiencies in thermal conditioning
- Planning for likely increase in demands
  - Contingency planning (such as stockpiling)
- Attention to the security of transportation and other linkage infrastructures
- Changes in financial mechanisms to increase resiliency
  - Risk financing and risk mitigation
- Need for shared responses and awareness building
- Working-out specific local adaptation requirements

Thank You….