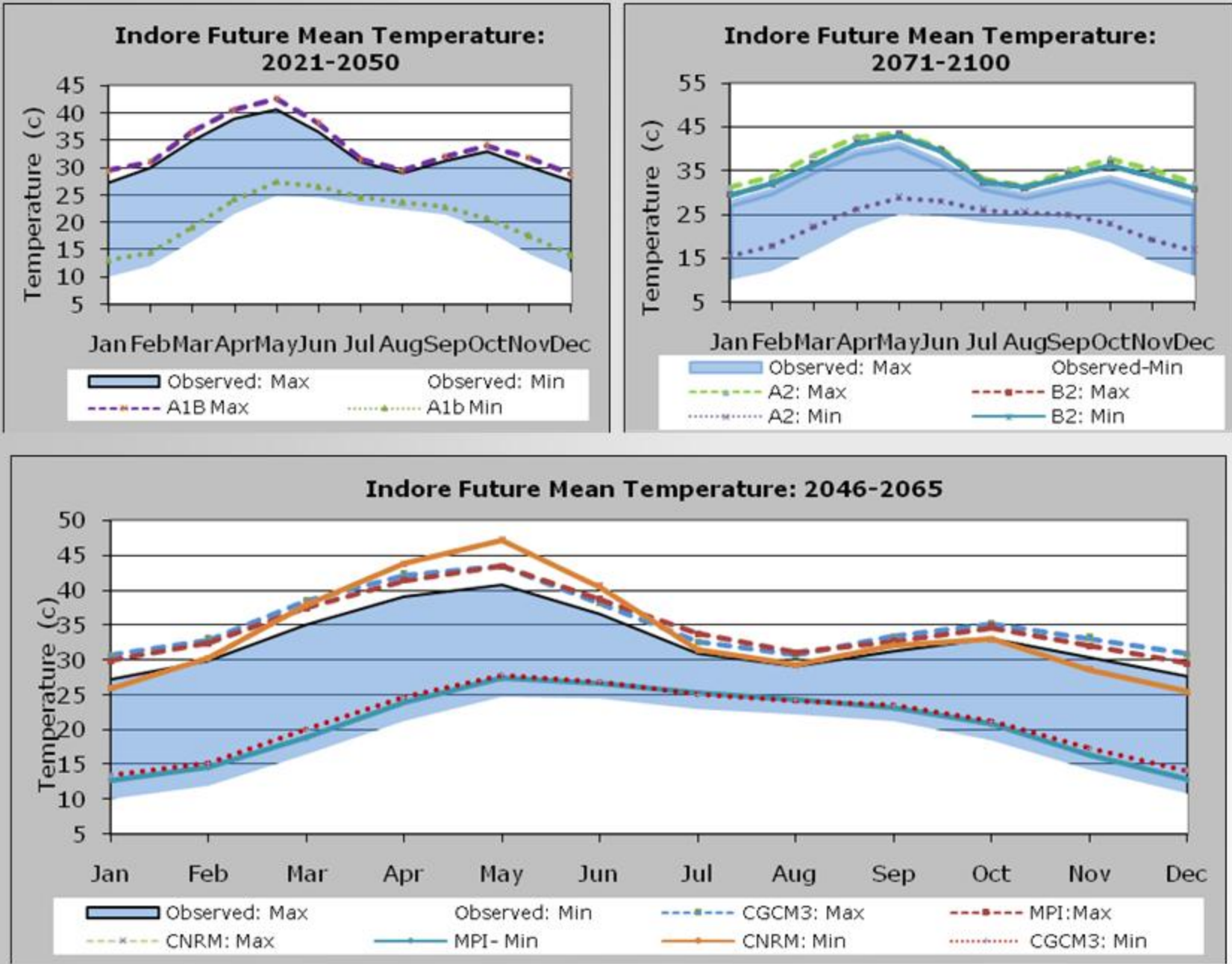


Temperature Change Prognosis:

Bias corrected model results presented in the Figure 3-2 indicate that the monthly average minimum temperature in Indore is expected to increase by about 2°C by 2030's to about 3-4°C by 2080's. The urban heat island (UHI) effect may add another 2-4°C over and above these figures.

The maximum increase is expected during the winters in most of the above models. This may extend viability period of some of the disease vectors well in to winters. The March to September period may require space cooling devices working through the day and night, considering the addition from UHI effects.

Future mean monthly temperature ranges: 2021-2100



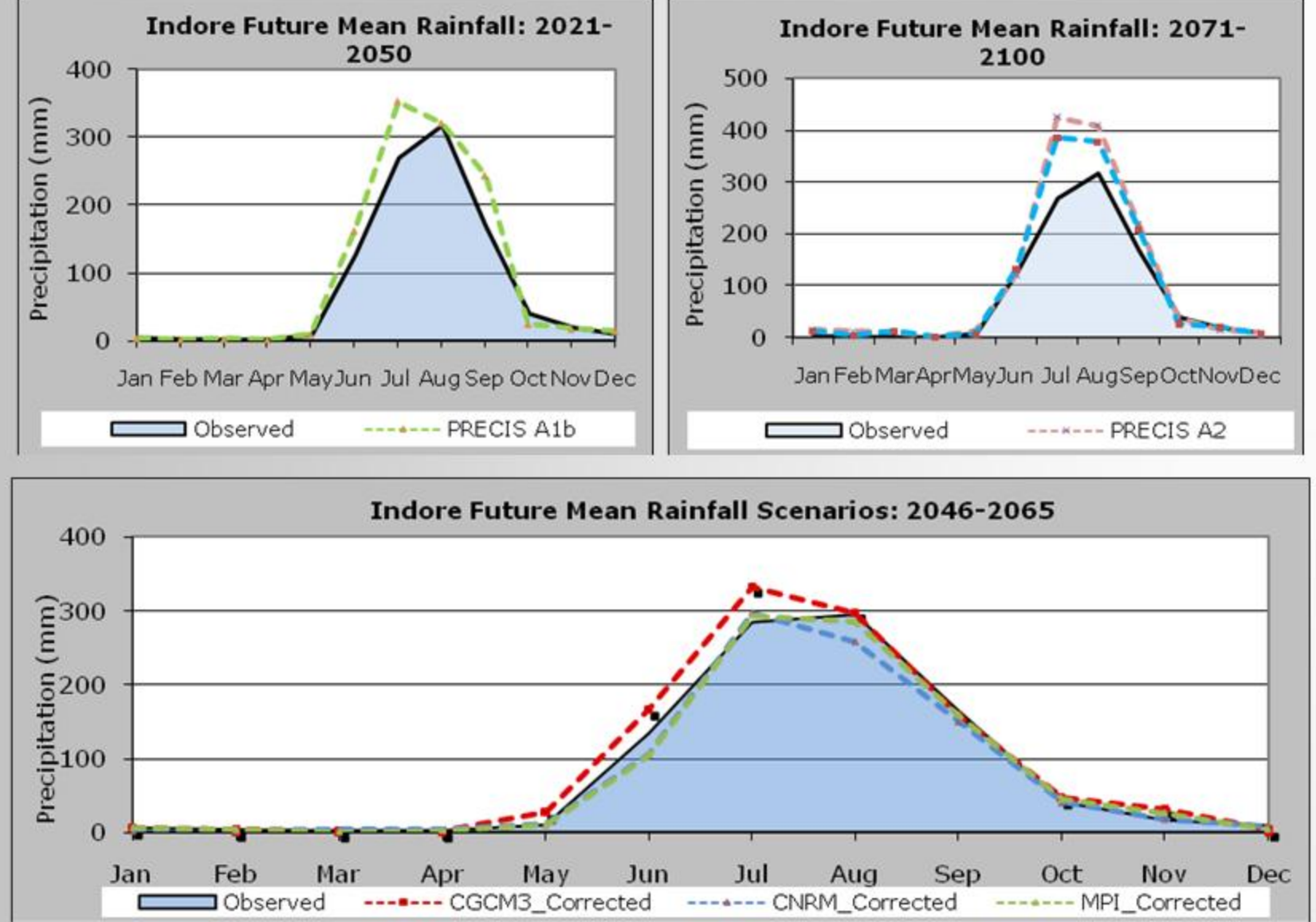
Source: TARU analysis, 2010; GHCN 2009 and CSAG, 2010

The bias corrected model outputs indicate that the average monthly maximum temperatures are also expected to rise by 1.5°C by 2030s to about 3 to 4°C by 2080s. Considering the heat island effects another 2-4°C increase can be expected in different parts of the city.

The maximum temperatures on some summer days may reach close to 50°C, which is likely to impact the outdoor work as well as increase the consumption of energy for space cooling.

Precipitation Prognosis:

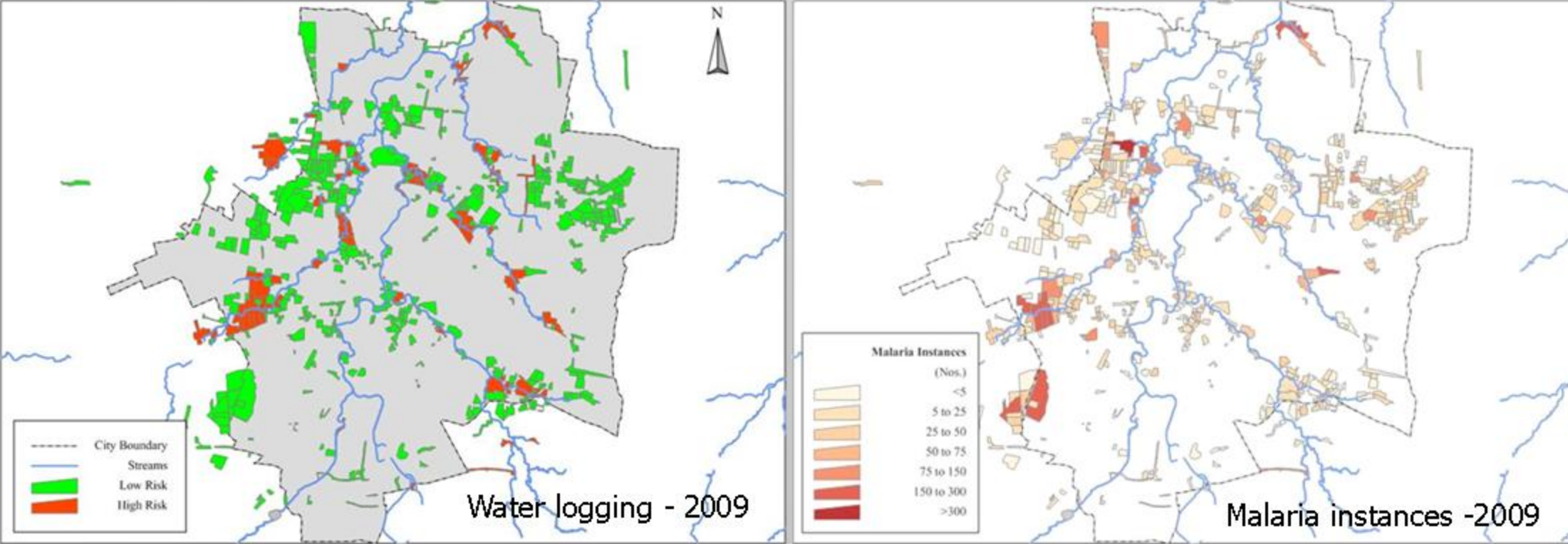
Future monthly mean rainfall: 2021-2100



Source: TARU analysis, 2010; GHCN 2009 and CSAG, 2010

Rainfall scenarios show higher diversity across bias corrected models. An increase in annual; rainfall of about 200 mm is predicted by A1B scenario of PRECIS regional model for 2030's, while the increase of about 100-150 mm is predicted by CGCM3 for 2050s while CNRM and MPI models do not show any changes. The A2 and B2 scenarios under PRECIS predict an increase of about 330 and 250 mm respectively. The rainfall prediction is less certain than temperature changes, especially considering the terrain context of Indore city.

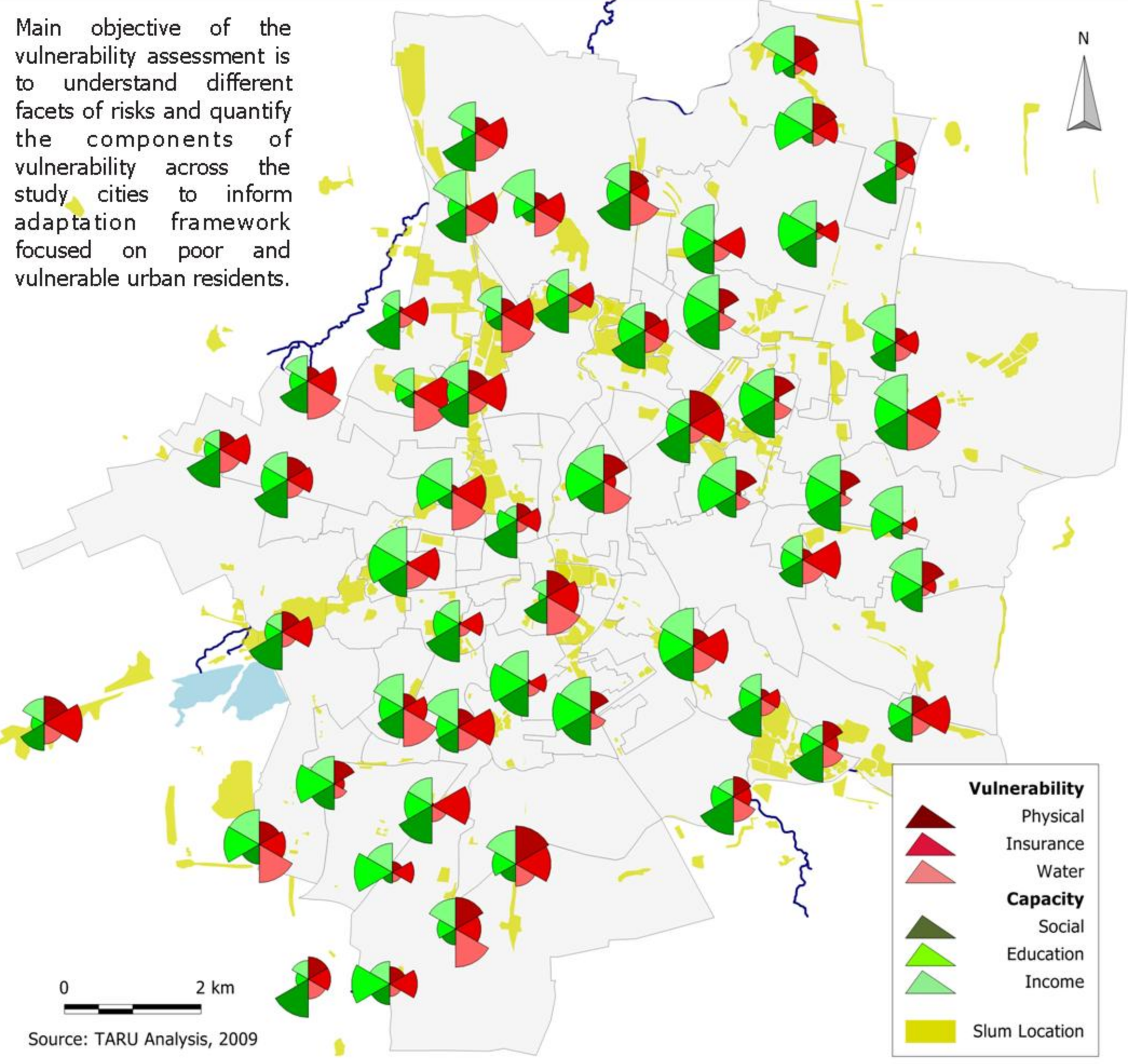
Health Risk



Water logging often continues for weeks after floods. Some areas are perpetually water logged due to lack of sewerage and blockage of natural drains.

The 2009 dengue epidemic is believed to be due to prolonged water logging and affected all socio-economic groups. Health risk is high due to poor water quality, and vector borne diseases. The disease surveillance system is not working and the urban authorities are forced to take knee jerk control action after the scale of outbreaks creates panic in the city.

Capacity and Vulnerability across Communities



Main objective of the vulnerability assessment is to understand different facets of risks and quantify the components of vulnerability across the study cities to inform adaptation framework focused on poor and vulnerable urban residents.

Source: TARU Analysis, 2009

City wide **Vulnerability assessment** was carried out using GIS assisted vulnerability assessment technique to gain knowledge about current vulnerability of different sections of population across space and SECs. Key points of the assessment have been summarized below:

Education Capacity Index (ECI) analysis indicates that the literacy rate is comparatively high; however the level of education hardly provides any benefit in terms of earning capacity. Transformation to service sector based economy will require major improvements in education and skill levels, failing which the income vulnerability may increase.

Income Stability Index (ISI) indicates that nearly one third of the city's households (predominantly slum, lower and middle income categories) have less income stability.

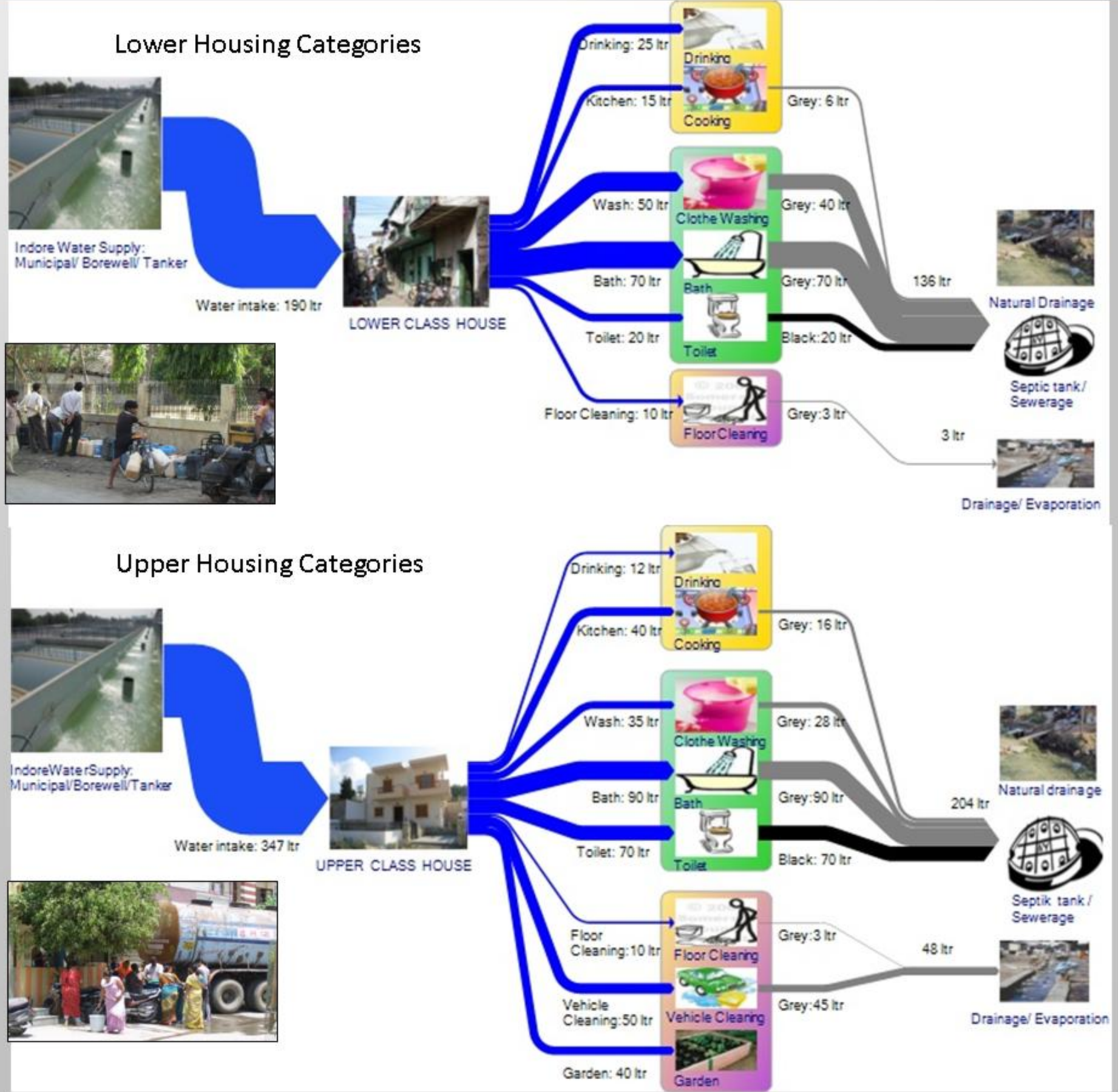
Social Capacity Index (SCI) indicates that the social capacity among the poor is comparable to that of other SECs. There has been a continuous improvement in social capacity especially amongst poor through ongoing pro poor focused development programmes and schemes (e.g. MPUSP).

Drainage and Sewerage Vulnerability Index (DSVI) indicate the condition of sewerage and drainage is poor in most areas. The results also indicate that significant proportion of middle class and upper SECs also do not have adequate access to sewerage.

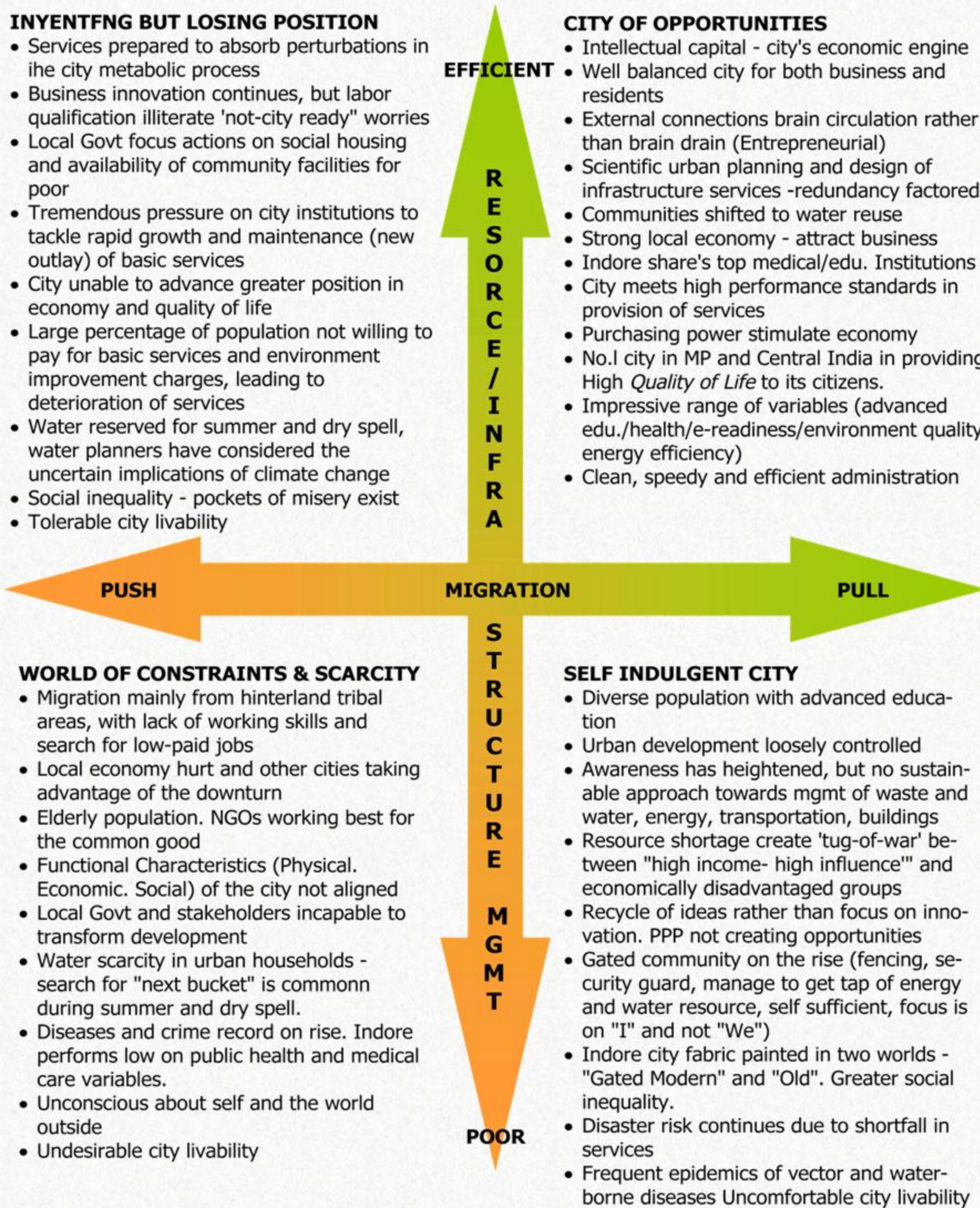
Water Scarcity Index (WSI) indicates that all the SECs suffer from water scarcity. Slum and lower middle class are differentially vulnerable, with nearly half the households facing acute water scarcity.

Loan and Insurance Vulnerability Index (LVI) indicates the penetration of insurance is poor (less than 25%) as well as incidence of loans is higher in case of lower and slum SECs. This causes higher financial vulnerability to these households. These results have to be seen in conjunction with income stability index.

Water usage pattern in different housing categories



Critical Uncertainties



Resilience Strategy

Resilience Strategy development is based on the existing climate science/climate risk information, urban planning and development framework, current vulnerability and anticipated future risks, resource constraints, industry/economic development, future consequences of climate variability/change and most importantly identification of critical uncertainties (which also included identification of critical uncertainties and further developed a range of early signs and optional measures).

The resilience strategy is structured around five major principles:

- Build on current and planned initiatives
- Create awareness about climate risks and generate demand: Bottom up approach
- Demonstrate resilience building projects to leverage further action
- Multi-sectoral information generation and shelf of projects
- Build synergy with state and national level institutions

Sectors	Resilience Options/Interventions
Resources (Water)	<ul style="list-style-type: none"> Comprehensive water management plan / Improving redundancy (including ground water recharge, waste water recycling) Rain water harvesting plan and strategy for Indore City Revive old water tanks and wells as emergency supply source. Urban user groups for conjunctive water management of local and distant water resources with focus on building resilience to Climate Change 100% Sewerage coverage, Sewage treatment plants and water recycling Demand side management including Leak detection and retrofitting. Water auditing system (zero tolerance) Water literacy modules Citizen engagement & reporting system
Resources (Energy)	<ul style="list-style-type: none"> Energy efficiency programme / Promotion of energy efficiency products Green Buildings - Develop guidelines and regulations for environmental sustainable building design, construction and operation (Water/Energy/SWM) Study on renewable energy options at various scales and end uses Hotline maintenance in monitoring of lines and transformers Setting up of cogeneration plant Technology upgradation for electricity distribution at city level
Natural Disasters / Urban Health	<ul style="list-style-type: none"> Flood zoning and land use control. City level storm water drainage master plan Emergency Response Plan Disease surveillance system with Epidemiological research support to track diseases & Health GIS
Urban Services	<ul style="list-style-type: none"> Benchmarking vulnerability of critical lifelines and infrastructure to CVCC risks Hardening city infrastructure to withstand CC risks Develop framework for online/continuous monitoring of gaps/deficiencies in urban services
Population	<ul style="list-style-type: none"> Skill building Programme (HRD plan) Monitoring programme on migration, Identification of social safety nets/schemes Climate leadership training programmes introduced
Environment	<ul style="list-style-type: none"> IT enabled Transport system / Comprehensive Transport Master Plan Increase in Green Cover (Urban forestry) City's environment management plan City level group for monitoring and advisory to the ULB Implementation of environmental building guidelines/energy code in the construction of new buildings and retrofit of existing buildings
Economy	<ul style="list-style-type: none"> Business Continuity Plan Water/energy efficiency improvement conservation plans Regional economic growth strategy and plan Sector specific forward looking policies and action plans (infrastructure landscape, health, safety and security, livability) City branding strategy for high quality human resources in key sectors.
Social/equity	<ul style="list-style-type: none"> Ward level / micro-planning initiatives Community action and management of assets Empowering poor communities Establishment of Training and Learning Center to impart skill development
Technology	<ul style="list-style-type: none"> Technology plan for water and energy sector Creation of support agency for energy efficiency improvement Demonstrate effectiveness of technology in select units (residential/commercial/industrial) Clean and sunrise industry/service sector Establishment of Theme Park to create public awareness and provide solutions

Issues/Impact Matrix for Vulnerable Poor People

Scenario Sectors	Current Status	Future Trends (BAU) without CC	CC issues
Population	Medium demographic growth	Growth rates increase unless economic growth slows down	Increased Push migration periods from impacts on hinterlands, dominance of low skilled population
Disasters	Droughts common, Occasional short term flooding and water logging	Trend likely to continue, Impacts due to city expansion and other anthropogenic changes likely to worsen the flood intensity, Vector borne diseases may increase due to water logging	More intense and frequent floods amplified by urban development. Poor residing along drainage lines, even in the upper parts of minor catchments impacted by flash floods. Droughts trigger increased push migration.
Health	Malaria, and Dengue common, strong seasonality, Heat strokes unknown	Trend likely to continue	Seasonality of the vector-borne diseases likely to change, expansion of disease transmission period likely to increase due to increased temperature and changes in humid seasons. Morbidity from heat strokes expected
Resources (Water, land, energy)	Water scarcity despite about 85% dependence on distant sources, high UFW. Growing clout of informal water markets. Focus on capital works, without exploring soft paths	short lived water sufficiency followed by water scarcity with increase in energy prices, Major challenges to recover cost of water. If water prices increase and financially viable, soft paths may be tried as last resort. Competing demands	Faster reemergence of water scarcity due to increasing unreliability of local sources due to uncertain rainfall, competition over Narmada water.
Environment	Very dense core, Vehicular pollution high in core area	Traffic issues, pollution may increase, Rapid transport can reduce some load	Higher impacts of pollution due to higher temperatures, especially during summers,
Economy	High growth	Medium to high growth expected with increase in efficiencies. Quality of life may not improve if current trends continue.	Minor change in energy consumption for processes, but significant impact on energy demands for space cooling, vector borne diseases may impact the labor productivity.
Technology	Fast up gradation to overcome labor scarcity	Shift to more efficient water and energy technologies, especially by those who can afford.	Water reuse technologies can alleviate scarcity. Efficient lighting, mass rapid transport can reduce energy use and pollution impacts
Social/equity	Iniquitous growth being addressed by improving Service access to poor, sustainability issues exist	Gated communities and slums coexist. Poverty may increase due to push migration from large underdeveloped drought prone hinterlands with skill poor population	Push migration can lead to conflicts and distress

Prioritization of Adaptation/ Resilience Activities

1. Comprehensive water management option
2. Development of high resolution flood zoning maps and drainage master plan
3. Synergy with National level interventions.