

75th International Executive Council meeting & 9th Asian Regional Conference



75th IEC Meeting & 9th Asian Regional Conference
1-7 September 2024, Sydney, Australia



APPLYING MACHINE LEARNING AND WEF NEXUS TO ASSESS URBAN GROWTH IMPACTS ON WASTEWATER REUSE

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The Water-Energy-Food-Nexus: Applications & Impact on Societies, Environment and Ecosystem

Working Group on Water Food Energy Nexus (WG-WFE_N)

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Sydney ICC



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Background: Rapid Urbanisation

Global Perspective



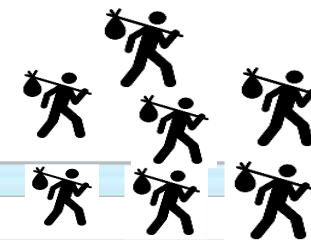
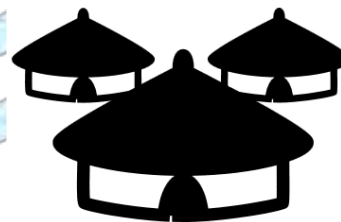
Today: More than 50% of the world's population lives in urban areas



2050: More than 60% of the world's population will be living in urban areas

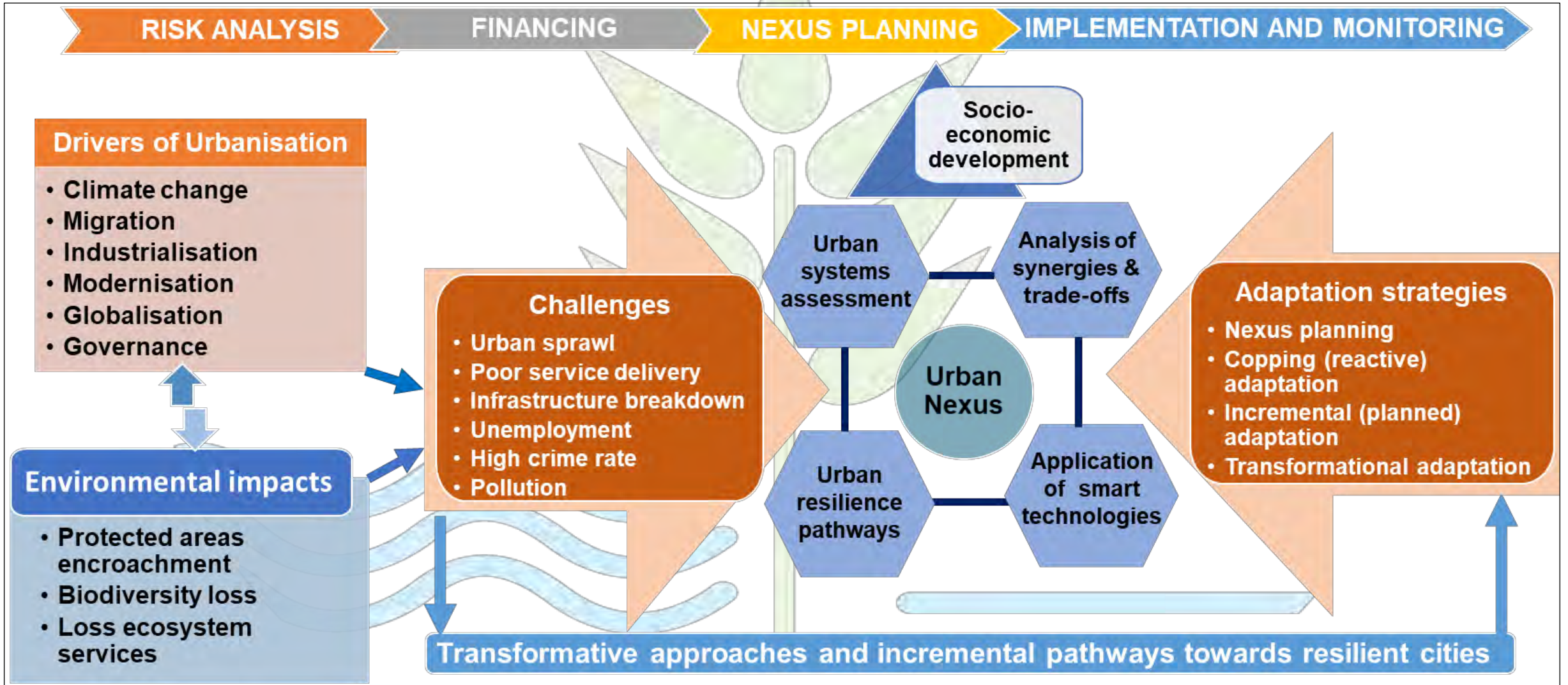
Gauteng Perspective

- Population increased from 8.8 million people in 2000 to more than 16,2 million people in 2023.
- Witnessed an urban growth of more than 153% between 1986 and 2023
- Projected population density of 105 persons/ha by 2050
- 67% of the migration in the province is intra-regional
- Built-up area increased from 7.8% to 23% between 1986 and 2023

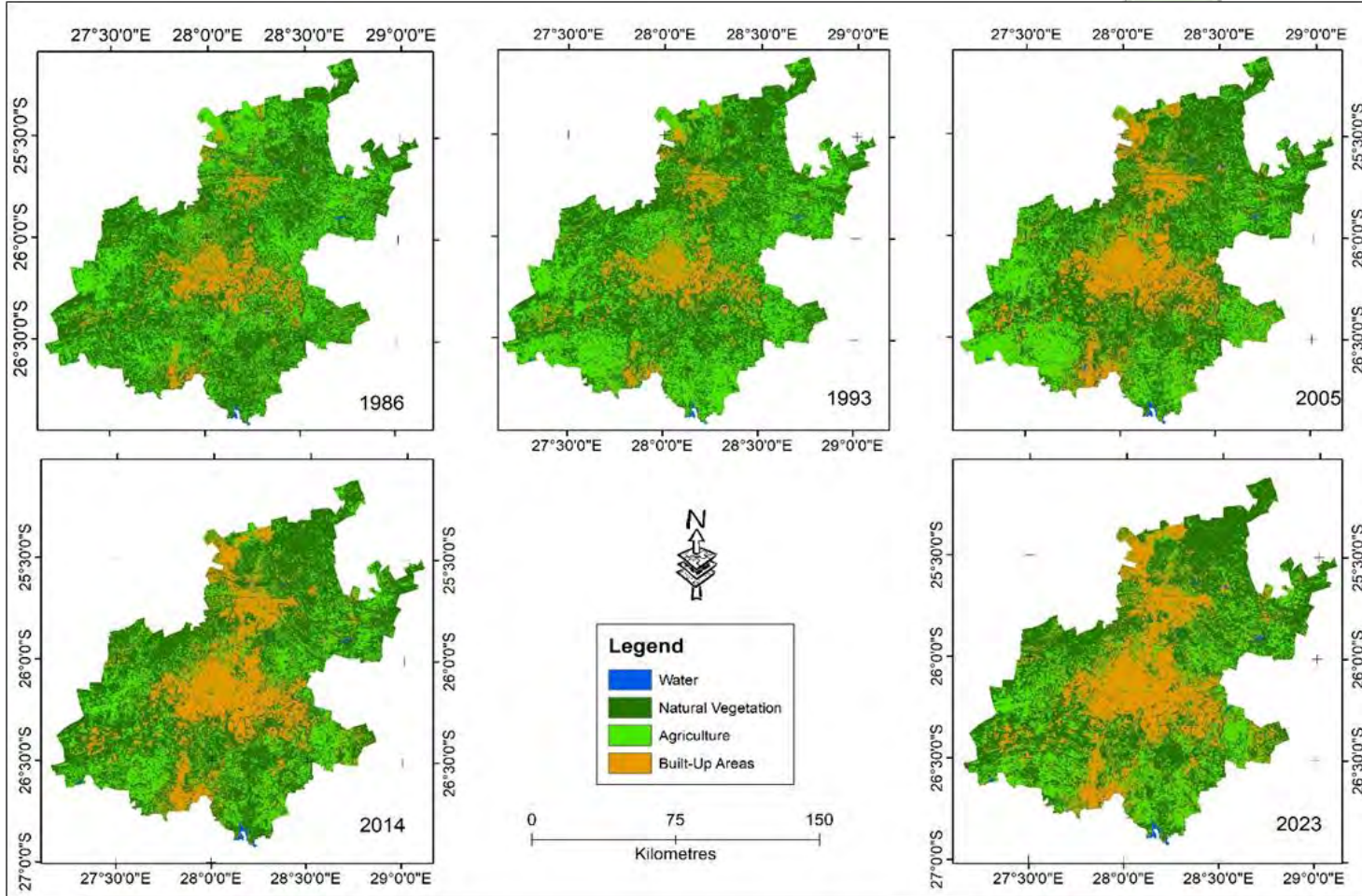


Rural to urban migration

An urban-wastewater nexus methodological framework



Landuse/cover changes in Gauteng Province



Year	Water (Ha)	Vegetation (Ha)	Agriculture (Ha)	Built-up area (Ha)
1986	7 517.90	995 219.04	610 568.86	205 557.52
1993	7 736.49	932 842.88	667 753.32	210 532.28
2005	12 720.25	898 475.35	519 155.37	388 481.07
2013	9 295.32	955 230.26	420 264.91	434 236.72
2023	13 066.68	873 841.29	411 154.77	520 826.31
% change	73.81	-12.20	-32.66	153.37

Implications of rapid urbanisation



Changing consumption patterns of the ever-growing middle class, leading to pressure on limited resources



Increased demand of already depleting water, energy and food (WEF) resources



Widening inequality that may cause conflicts

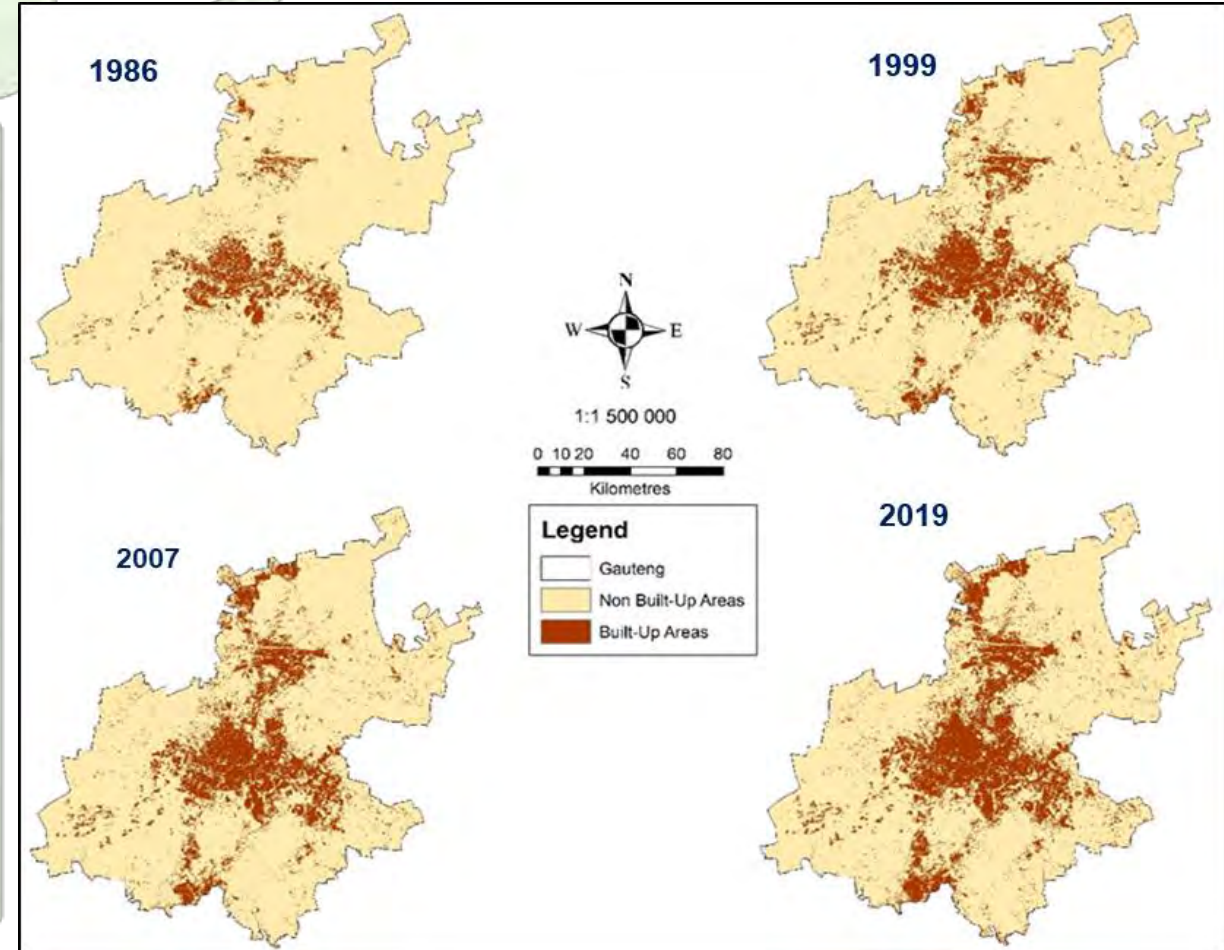


Increasing pollution



Increasing land surface temperatures (LST) (urban heat island)

Urban growth – Gauteng Province



Implications of rapid urbanisation (cont.)



Increased incidences of flooding



Encroachment of built environment into ecological infrastructure



Increasing rate of unemployment, stands at 32% in Gauteng



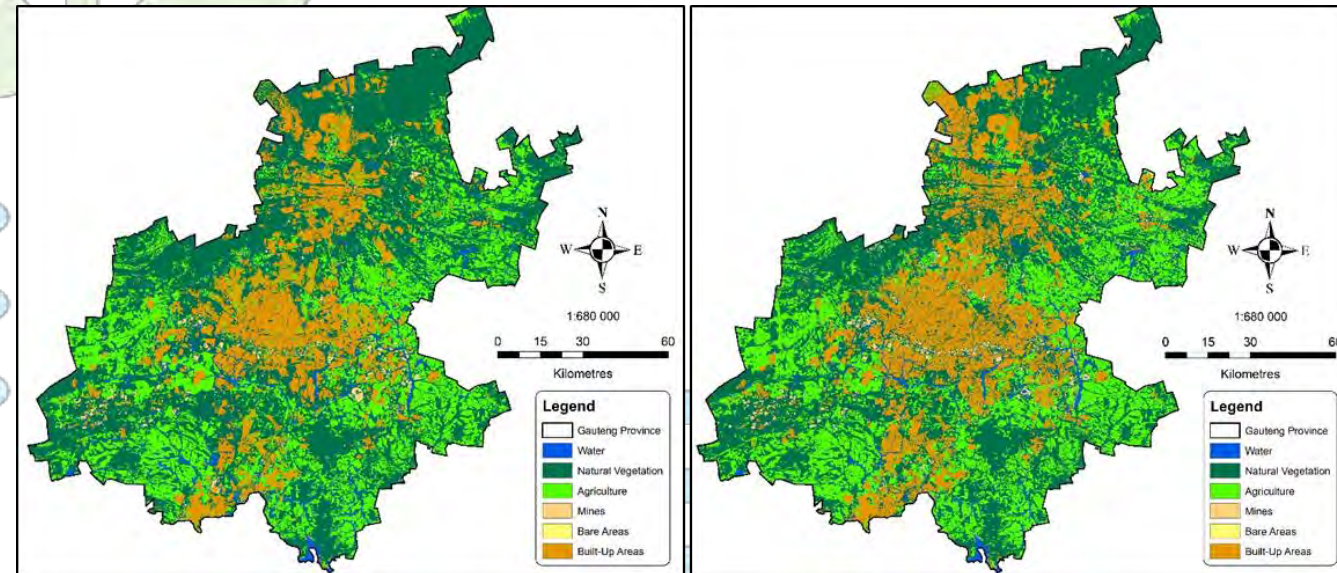
Increase in wastewater disposal



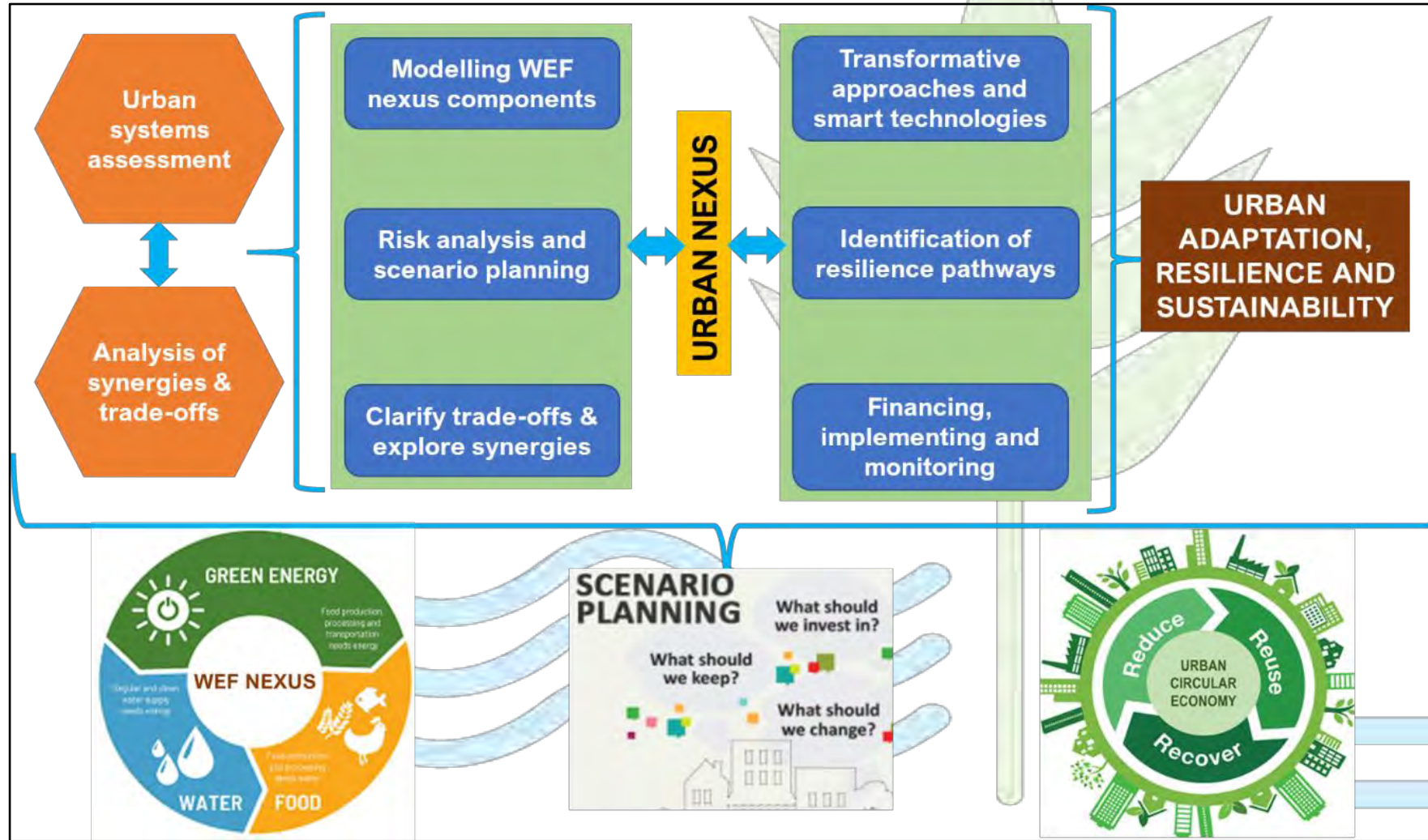
Increasing crime rate

Landuse	Area in 2010 (ha)	Area in 2019 (ha)	Percentage change
Water	73,107	62,967	-13,87
Natural Vegetation	943,999	845,695	-10,41
Agriculture	456,251	475,834	4,29
Mine	24,635	22,495	-8,69
Bare Areas	1,494	18,260	1,122,22
Built Up Areas	317,541	391,776	23,38

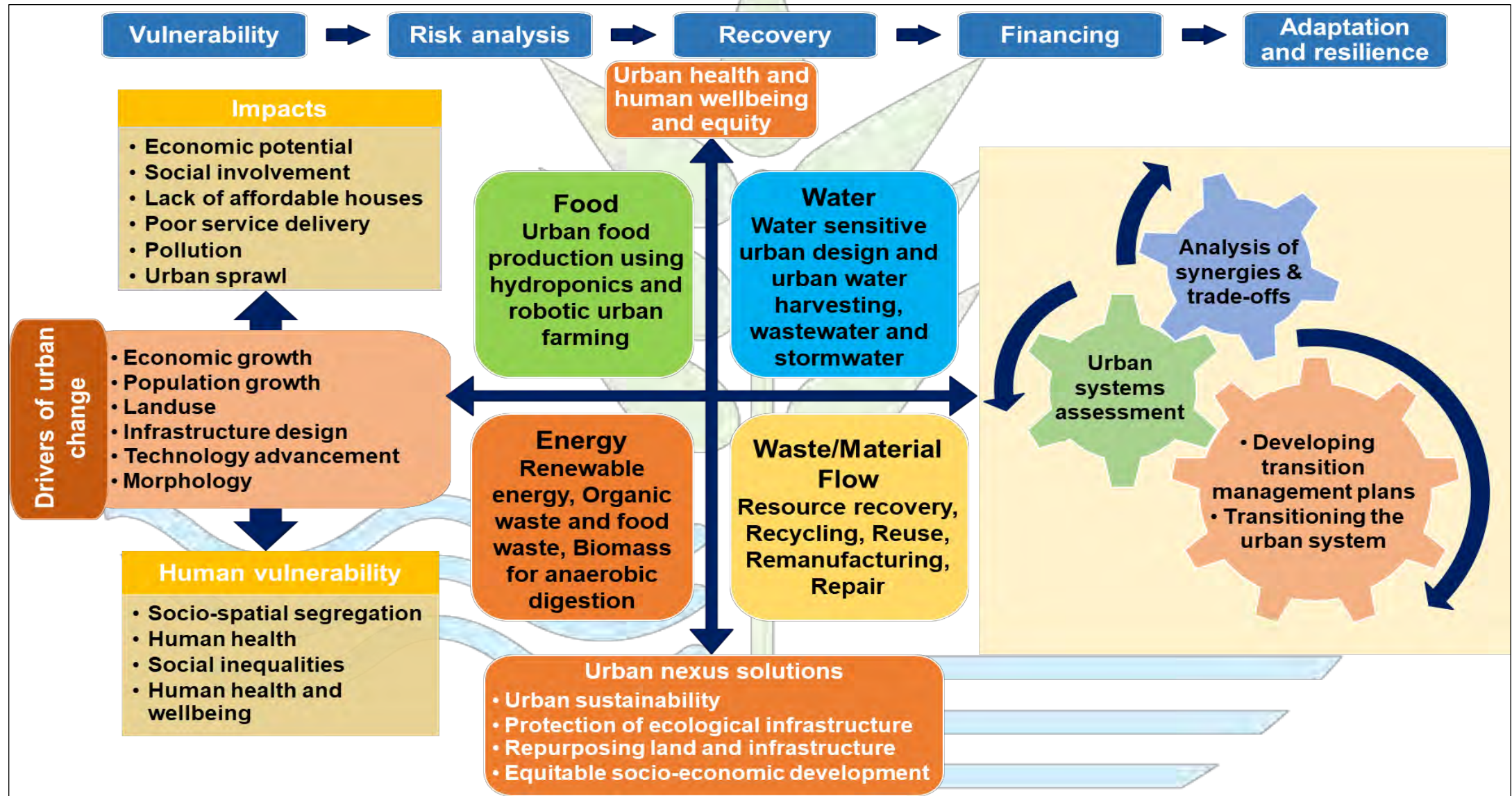
Encroachment into ecological infrastructure



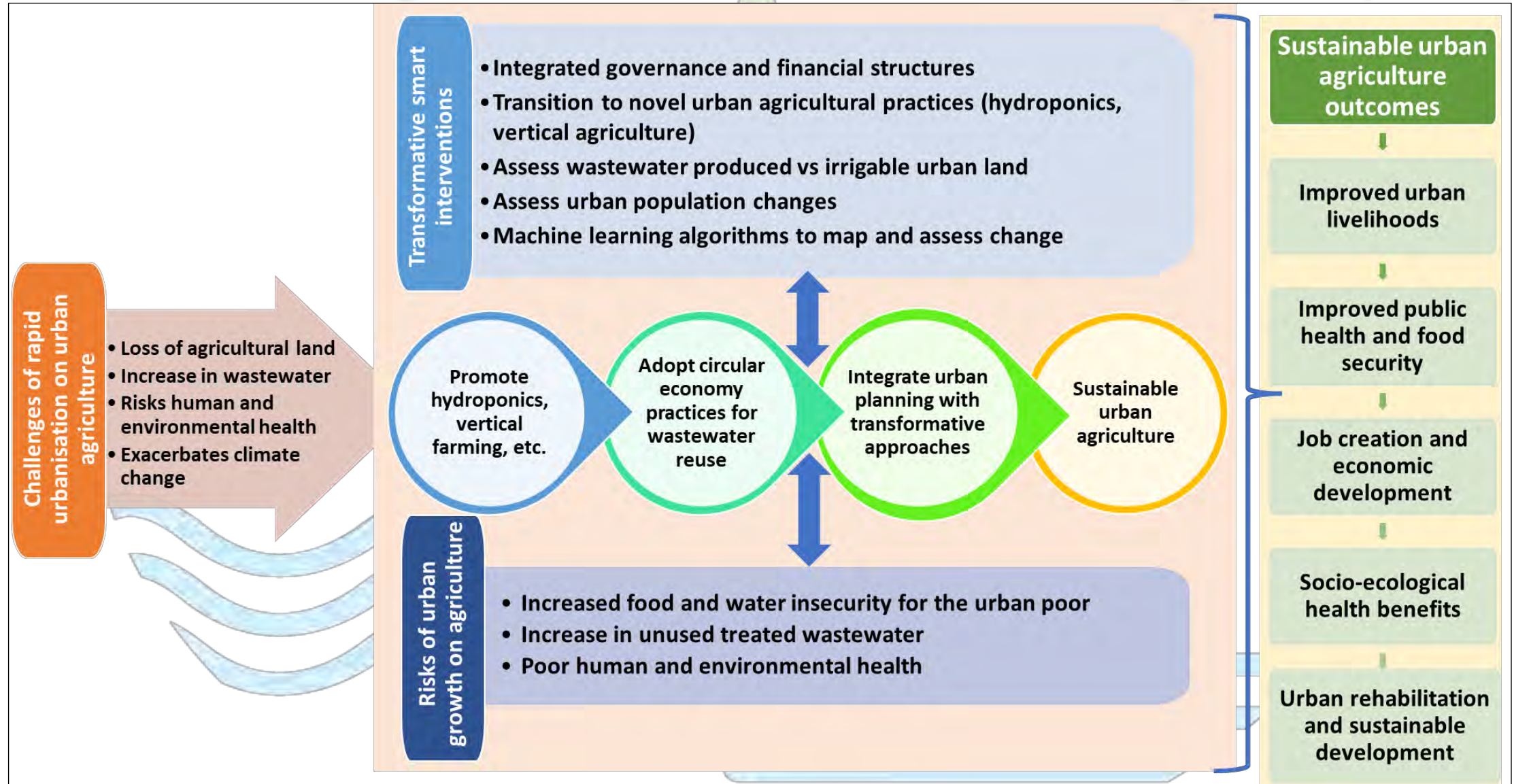
Urban nexus and systems provisioning



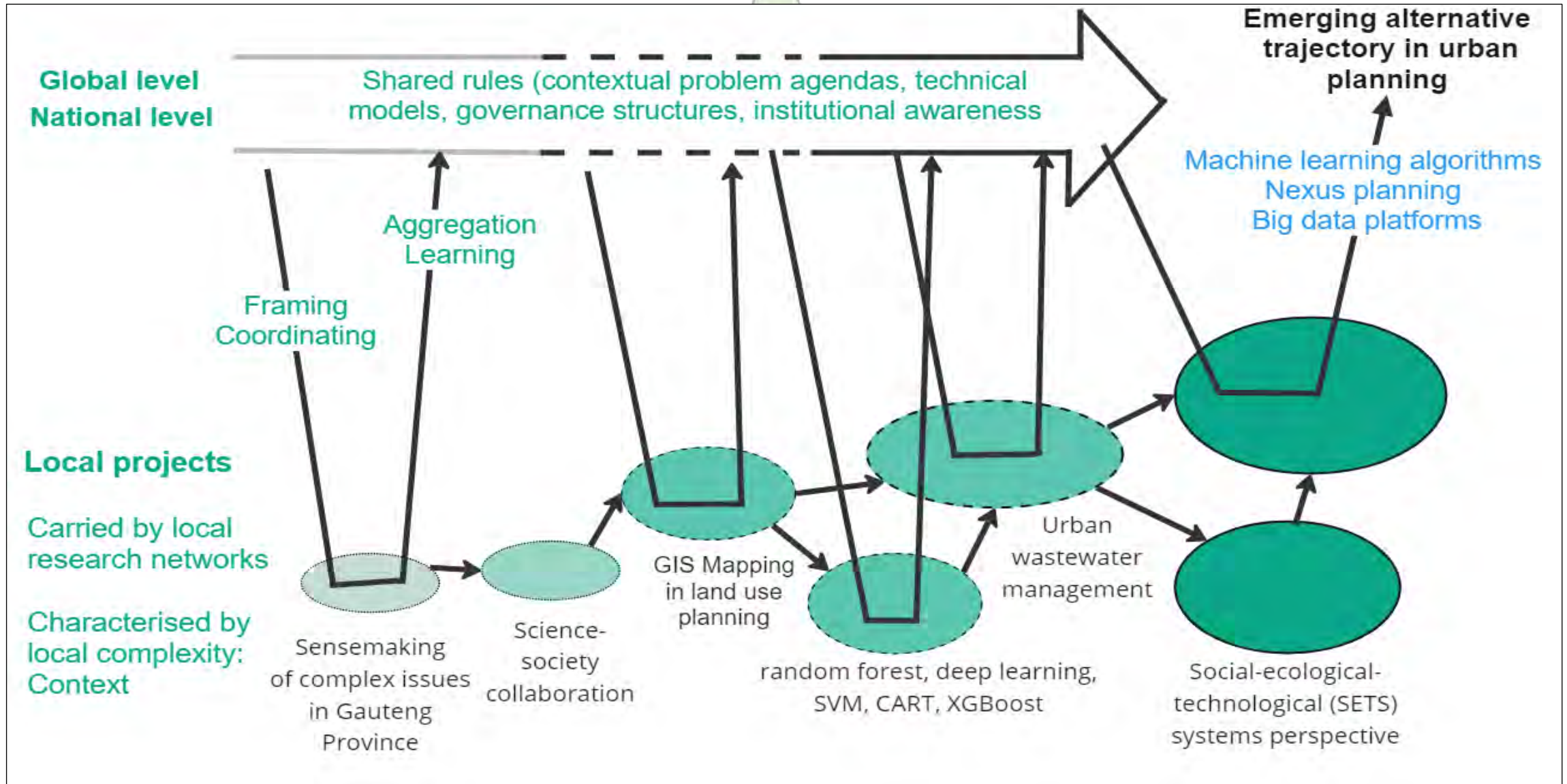
An urban nexus transformative framework for urban transition



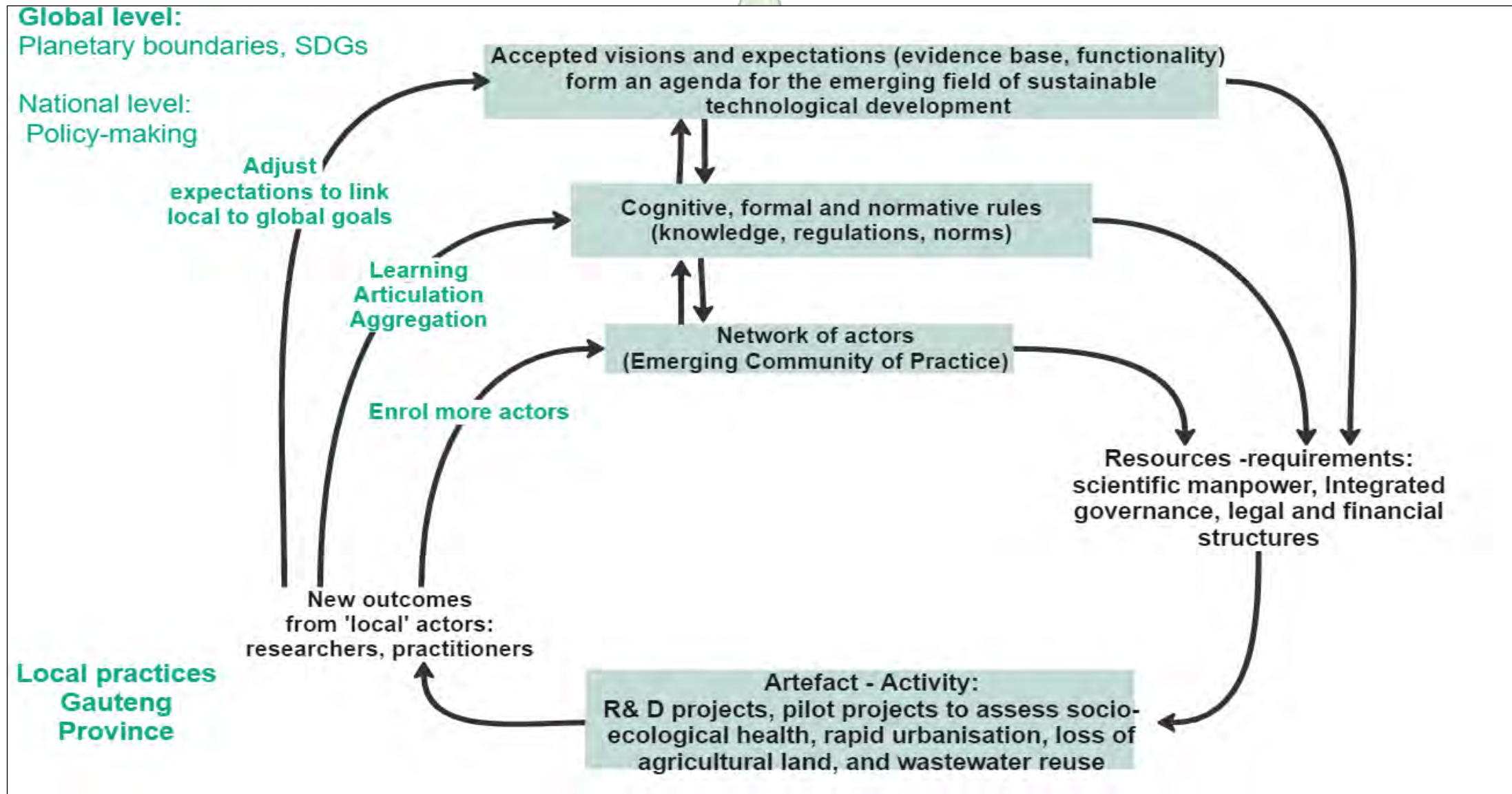
Sustainable urban agriculture and wastewater management pathways



Emerging alternative trajectories in urban planning



Niche urban transformation actions and actors

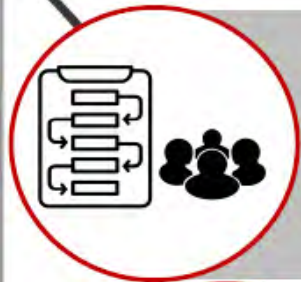


Three key elements to achieve the urban nexus objectives



SDG 11:

Make cities and human settlements inclusive, safe, resilient and sustainable by 2030



Governance, Planning and enabling frameworks (soft ware)

Horizontal and vertical governance; stakeholder engagement; empowerment of cities; urban-rural linkages



Physical infrastructure (hard ware)

Innovative engineering technologies and standards, semi-decentralized, cross sectoral infrastructure projects (grounded)



Circular economy approach



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