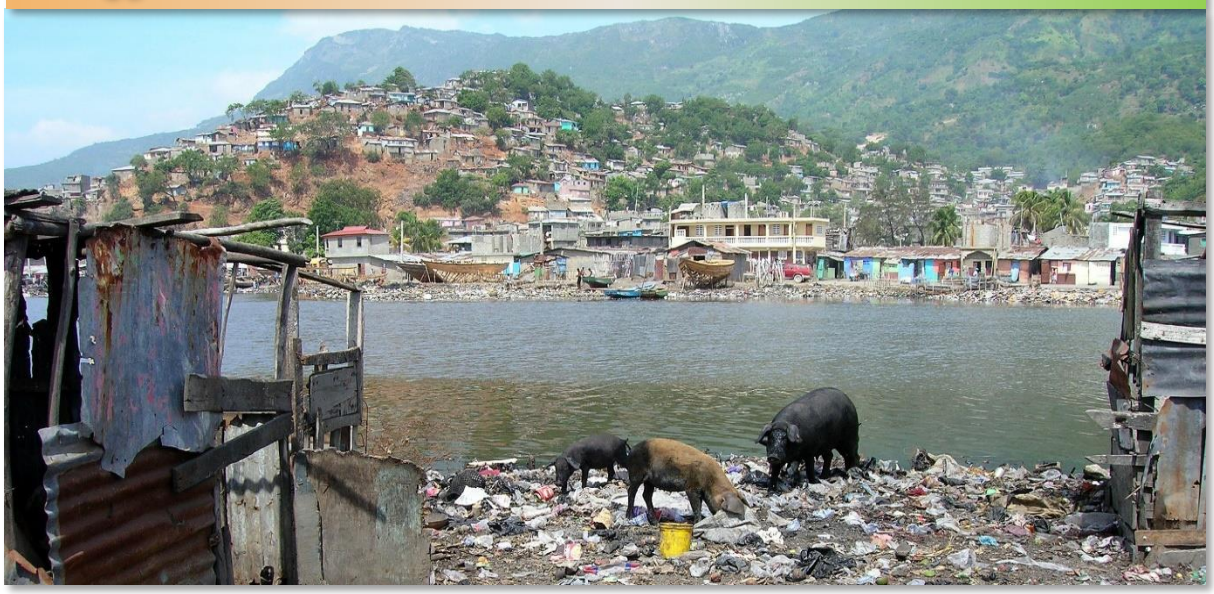

Title

# Peri-cene Synthesis Report II: Library of cases

Sub-title

A working knowledge platform for peri-urban-climate analysis & synthesis around the world

Deliverable #

**D3-3b**

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**Joe Ravetz**

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## Acknowledgments

# Synthesis Report II – Compendium of Cases

*v0.8 – 12-02-22*

# 1 Introduction

## 1.1 About this report

This report is the second part of the ***Peri-cene Synthesis Report***, with a compendium of 17 outline case studies from around the world.

It works in conjunction with the ***Part I – Overview***, which sets out:

- aims and methods of the project
- global analysis of cases
- adaptive pathways
- adaptive governance.
- Policy recommendations

This compendium is a summary of a larger body of material on each case, available as the deliverable report D3-2, as on http://peri-cene.net.

Report sections for each city case can be available on request.

The maps here contain much fine detail which may not get through on this pdf or print version. They are available in dynamic form on the Peri-cene online system P-CAT , as on the link from http://peri-cene.net

## 1.2 The Peri-cene Policy Lab

At the centre of the Peri-cene project is the international 'Policy Laboratory'. This is a space for (a) diagnosis / mapping of problems, and (b) design of responses and 'adaptive pathways'. Due to the pandemic all activities moved online: this was a challenge for creative thinking, but also an opportunity for a wider consultation.

This included structured interviews with a '20 questions' template, small group meetings, and an international series of online workshops.

This ran in parallel with the development of the Peri-cene Analysis Tool ('P-CAT') for spatial mapping of peri-urban-climate interactions. The general method followed the Peri-cene Pathways Tool for system mapping of problems and pathways: this provided a unique '1-2-3' combination of online whiteboards and virtual meeting hubs.

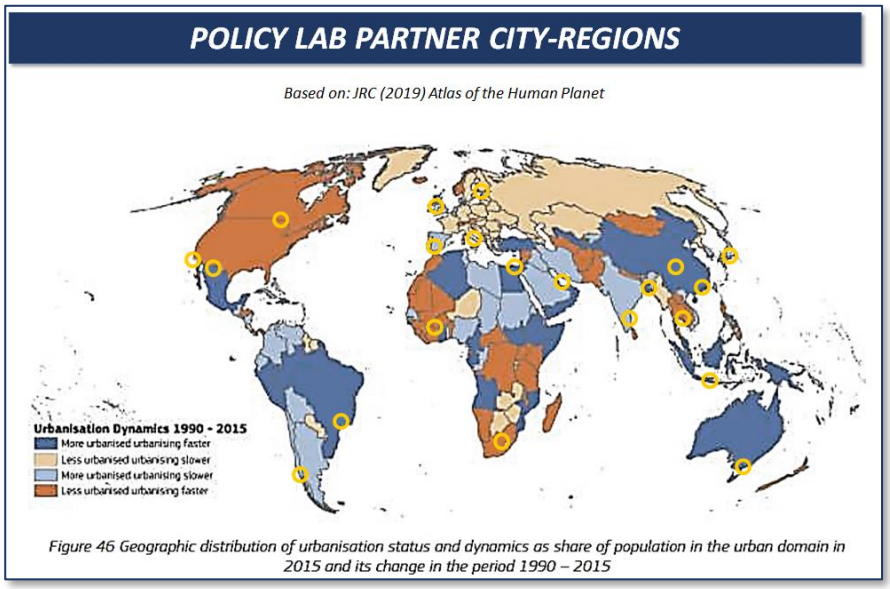



*Figure 46 Geographic distribution of urbanisation status and dynamics as share of population in the urban domain in 2015 and its change in the period 1990 – 2015*

The case study partners include: 2 in-depth case studies and 15 active cases (*also there were 4 sleeping cases, shown in italics*). These appear in this report approximately from east to west - Melbourne, *Tokyo, Guangzhou,* Changsha, Surabaya, Bangkok, Dhaka, Chennai, Cairo, *Doha,* Kumasi, Helsinki, Johannesburg, Manchester, Naples, Granada, *Belo Horizonte,* Santiago, Mexicali, San Diego, Toronto. The total population represented is around 420 million (as of 2015) or nearly 10% of the global urban total.

The global stakeholder / user community is represented by UN Habitat, Regional and Metropolitan Planning Unit, Urban-Rural Linkages program. The Peri-cene findings aim to contribute to that program of research and capacity building. There is also strong linkage with ICLEI (International Council for Local Environment Initiatives).

Together these partners represent the major urban types and climate risk types, from both developing (urban South) and developed countries (urban North). They also cover the various types of urbanization dynamics, (as defined in the Atlas of the Human Planet), as shown in *Figure 1* above:

- Urbanized - more / less:
- Urbanizing - faster / slower.

## 1.3 About the compendium

This compendium is an atlas or resource library of results so far. There are two main aims:

a) Putting together a global collection can bring new insights on the global peri-cene, and on the comparison between the different locations and situations around the world.
b) Each of the case studies calls for further debate and investigation: the various templates and online workspaces can provide materials to take forward.

Overall there are far-reaching implications for this kind of research.

Peri urban development is a complex interaction of systems with systems: we can look for simple 'results' on two-way interactions, for instance the effect of temperatures on crop production, but these are likely to miss the bigger pictures, in which many factors are in relation to many.

Likewise, climate change projections, impacts and risks are hedged with uncertainty and controversy: it is not easy to find detailed or reliable information at the global scale, beyond the mapping of present day flood events, land-use change or forest loss. And on the 'socio-climatic' axis, the uptake of highly uncertain evidence into policy and public awareness, is at best patchy or more typically controversial and conflicted.

In that case, the interaction of the peri-urban dynamic with climate-based risk can be approached –

- As a direct technical problem, e.g. building of flood defences for short term hazards
- As a system-level transformation: e.g. new patterns of peri-urban development, agro-ecology or landscape stewardship.

The cases in this Compendium provide a something of a first take on both of these. Where the evidence for direct 'technical fixes' is often lacking, the system level 'adaptive pathways' point towards the bigger picture of potential transformation.

## Structure of the report

Each of the 17 case studies here contains:

- Orientation map with examples of peri-urban geographies on the ground
- Overview text
- Summary of peri-urban, climate, societal and governance issues
- Spatial analysis: maps & charts (see below)
- Climate effects: maps & charts
- Systems & pathway mapping diagram
- Summary of potential pathways

The Annex (when complete) also contains maps and charts for the 'sleeping partners': Tokyo, Guangzhou, Doha, Belo Horizonte.

The maps and charts sources and methods are detailed in the spatial analysis reports D2-1 & D2-2. In summary:

- Spatial analysis charts visualize the distribution of population and of land area, in different density classes, within the FUA ('functional urban area') and outside the FUA, from the peri-urban 50-300 p/km$^2$, to the dense urbanity over 7500 p/km$^2$: and with the 25 year growth 1990-2015. (Source: GHSL)
- (for the eastern cities, there is an experimental mapping of population / distance from the metropolitan centre (CBD): this can show interesting results)
- Peri-urban land area change: examines in detail the transfer between the peri-urban types over 25 years.
- Sea level rise risk: this is based on simple land elevation above mean 2020 sea level (this is preferred here as the various model projections involve many assumptions)
- Forest loss and gain: based on mapping data from Global Forest Watch.
- Systems & pathway diagrams: the logic of this mapping format is detailed in the D3-3a: *Synthesis I – Overview*.

For the comparison and analysis of the whole set of cases, see the D3-3a: *Synthesis I – Overview*.

## Note on pathways

The ***'adaptive pathways'*** in the following cases appear in various forms: some are based on the 'global menu' coming from the Policy Lab workshops, while others are distilled combinations of technical, social, economic and political.

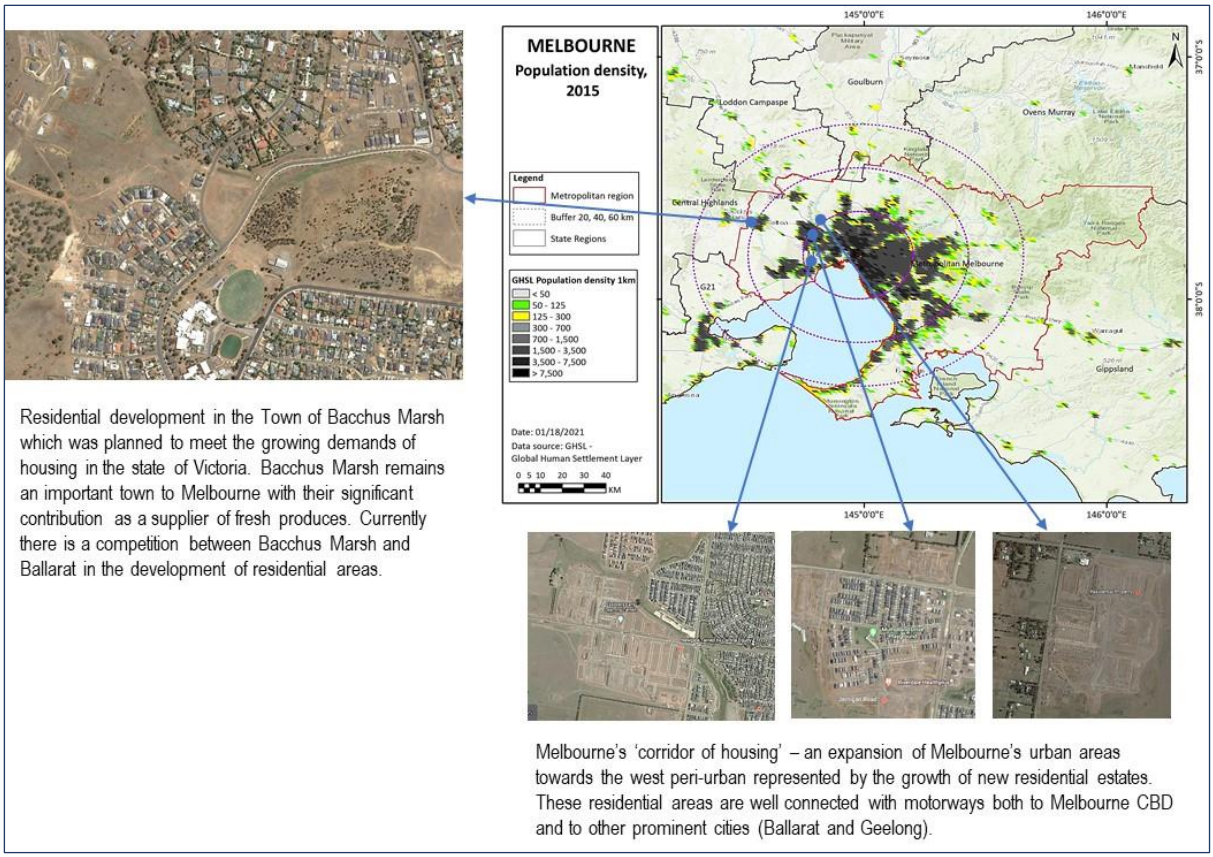
As discussed in the Synthesis I - Overview, such pathways are highly flexible and overlapping, open to interpretation, transformative and trans-boundary, and often challenging todesit the existing socio-political order.

In that sense the pathways set out in this report are not the end result of investigation, more like a resource for work in progress, and the beginning of a next stage of creative enquiry.

# 2 Melbourne

***Scope:*** *the frame includes the whole Greater Melbourne boundary which extends to the east. Much of the peri-rural hinterland lies to the west and north. There is a local focus on the town of Ballarat and north west sector.*

***Figure 2.1: where is the peri-urban***




## *OVERVIEW*

Greater Melbourne contains 31 municipalities, in a (generally) affluent multi-cultural metropolis of 4m population, set to double in size in 30 years. Large suburban-peri-urban areas are scattered, car dependent, vulnerable to drought and wildfire, and in certain areas river flooding. Social polarization and middle class vulnerability may be on the increase. Peri-rural areas suffer from out-migration, dependency on agriculture and corporate landholdings, declining services.

***Peri-urban syndromes:*** low density car based expansion: rural decline & gentrification: livelihood disruption: high risk locations

***Climate change syndromes***: Climate hazards include wildfires, drought and all forms of flooding. Coastal areas are at risk from sea level rise and coastal storm hazards on critical infrastructure. These will have increasing knock-on effects on farming, peri-urban communities and ecosystems.

***Societal vulnerability***: fragile landscape & ecosystems: farming in transition : social tensions & divisions: suburban expansion & exclusion:

***Governance syndromes***: institutional silos & multi-level fragmentation: climate awareness & policy exists but with little capacity to respond:

***Adaptive pathways***: integrated water management: landscape diversity resilience: multi-functional landuse: traditional owners knowledge: climate-wise peri-urban devt.

***Adaptive governance***: collaborative-associative governance with civil society: socio-climatic integration:

## Peri-urban issues

***Spatial analysis*** *(from the charts overleaf)*

- *Within the urban area the population is concentrated at a medium density of 1500-3500 p/km2 (in contrast to other Asian cities), with steady growth over the period.*
- *Outside the urban area there is around a tenth of the urban population, mainly at similar densities, tapering off into the landscape.*
- *Overall a predominantly urban region with a widespread peri-urban shadow.*

- Large scale suburban development in peri-urban areas is set to continue. The NW direction & town of Ballarat is on a rail route 75 mins from the city (see area case below).
- Political economy of housing, suitable for middle & lower-income groups. E.g. Backas March is a 'bedroom community' with minimal services & local jobs, long commutes.
- Mixed demographics, transient communities, overlaid on traditional rural towns, & rural elite 'lifestyle' landowners.
- Underlying issues with traditional owners
- Much housing is 'buy to rent' & new development is a financial proposition.

## Climate change issues

- Temperature projections for 2100 - 1.5 (low) – 5.5 (high).
- Precipitation reduces ~20% both summer & winter.
- Major wildfire risk is increasing in the hinterland.
- Drought periods increase with loss of ecosystems & fertile land
- Sea level rise: large coastal areas to SE & SW are vulnerable to 1m-4m rise.
- Farming increasingly difficult. Forests are vulnerable to fire & pest
- Traditional wetlands ecosystems have to adapt rapidly
- Peri-urban development is heavily car based & so contributes to climate emissions, urban air pollution & heat island effects.

## Societal issues

- Much water is trucked in to new communities. High value horticulture is intensive production operation, often located on a declining landscape. Nearby national park & tourist areas also under climate stress

- Much of the NW area is economically fragmented with 'deprived' groups, ethnic groups, commuters, traditional rural towns, lifestyle 'horsi-culture' landowners, distant landlords.
- Inbuilt social structures can increase vulnerability: e.g. in recent grass fires, non-driver women were isolated.
- Estate developers & infrastructure providers have no clear obligations for climate-proof design.

## Governance issues

- Local government generally fragmented & under-funded.
- for fire or flood. Competitive tendering for public services.
- Some transfer of responsibility to civic groups. But e.g. the fire emergency service has got more closed & centralized.
- Some new ways of working with traditional owners are emerging, e.g. in fire management.
- Many forward looking state policies & resources on climate change. But in many communities & in national government, culture of denial & scepticism, overlaid on many other social divides & traumas.

***Figure 2.2: spatial mapping & analysis***

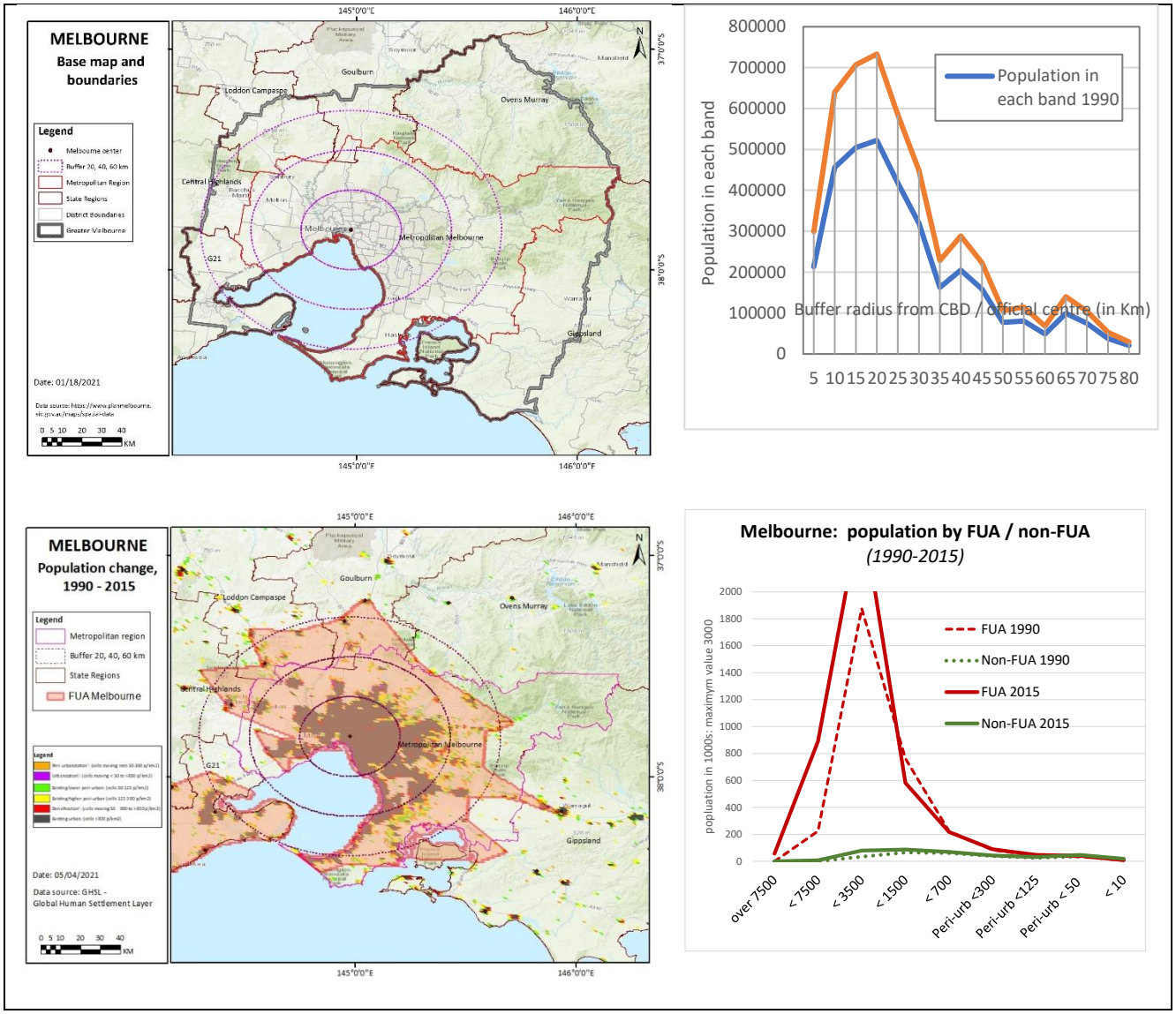
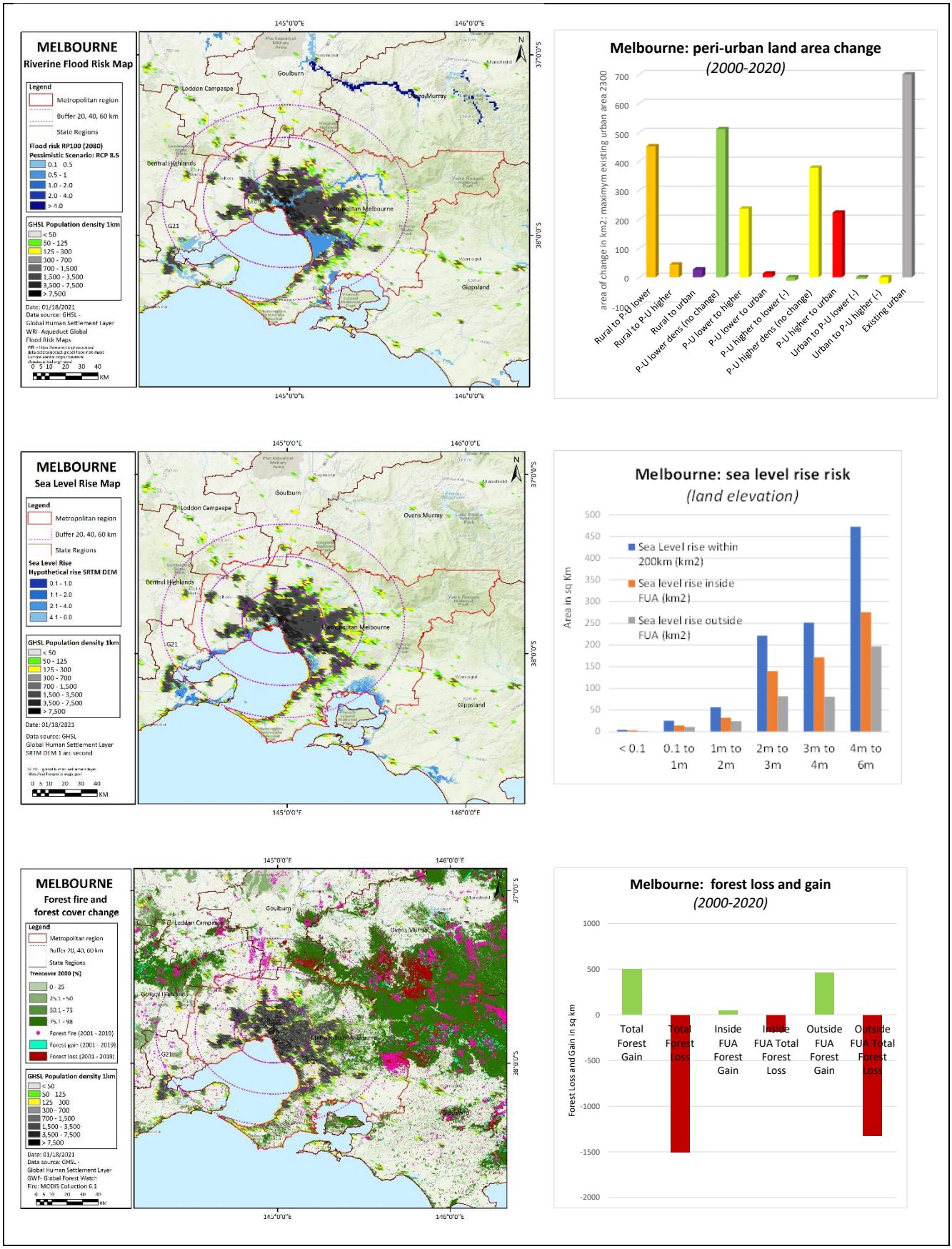


***Figure 2.3: climate effects mapping & analysis***

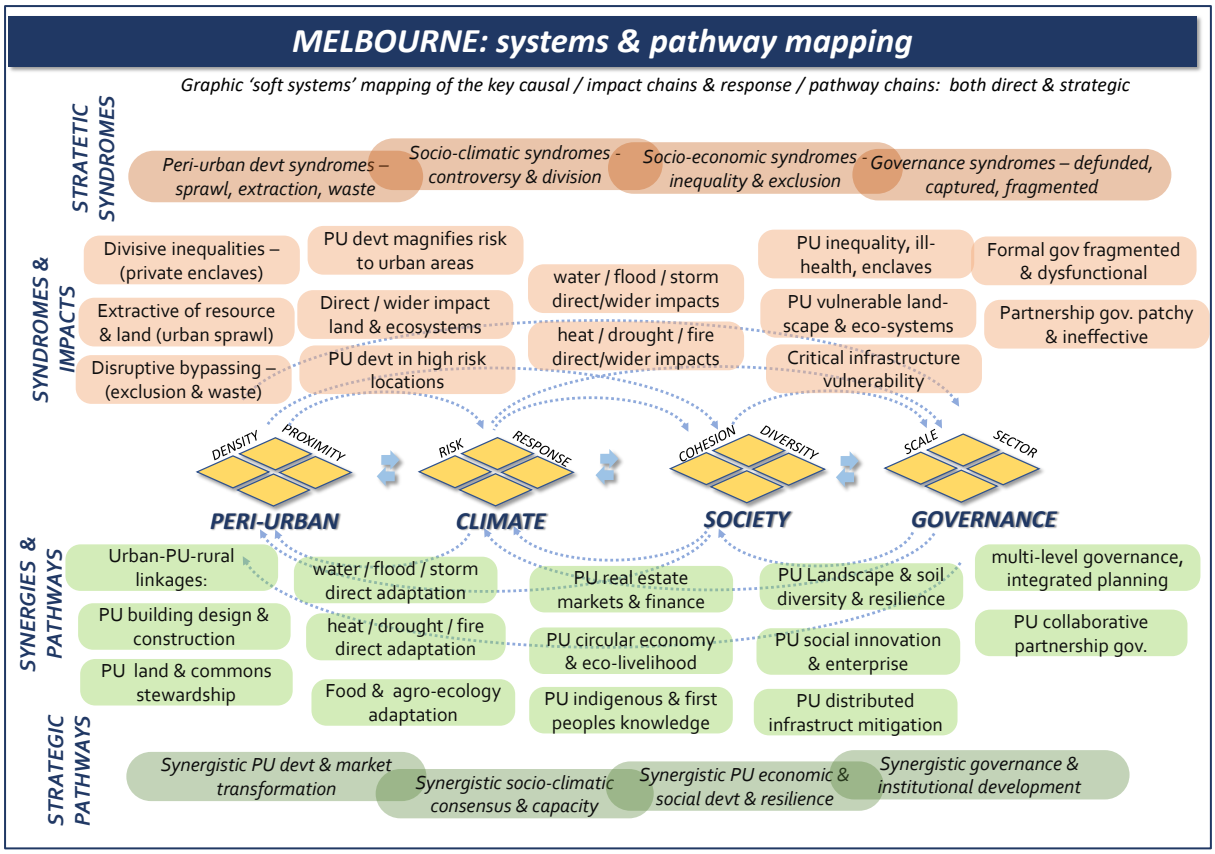


## Area focus

For the case study of  Ballarat and its area:

- Rapid new urban development, on train line, but a typical 3 hour commute
- Surrounding area of high landscape value, tourist destination, but under climate pressure
- Much housing is buy to rent, for families coming into new affordable housing
- Social fabric & cohesion is often lacking, also public services
- Water is often trucked in
- The new development takes over previous rural farming towns, including older 'lifestyle' units of 20+ acres with horse stables.
- Large bushfires were seen in the 1980s
- The bushfires also raise the agenda of the indigenous & traditional owners –
- Not only technical approaches, but human centred social / cultural /psychological approaches seem more effective, in management of fire risk, response & recovery

***Figure 2.4: system & pathway mapping***

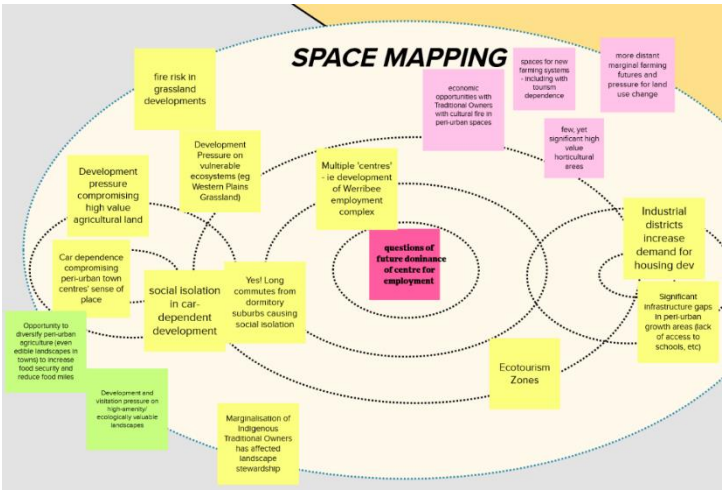


## Adaptive Pathways

(With example section of the online workspace)

***Urban-rural linkages in the peri-urban***

- The city-region mapping shows a complex overlap and interaction of extended urban expansion / rural transformation: there may be great opportunities for new forms of urban-rural synergies and linkages.




***Peri-urban stewardship of land & commons***

- Marginalisation of Indigenous Traditional Owners has affected landscape stewardship
- Opportunity to diversify peri-urban agriculture (even edible landscapes in towns) to increase food security and reduce food miles
- Development and visitation pressure on high-amenity/ecologically valuable landscapes

***sea level rise & coastal adaptation***

- Industrial areas and critical infrastructures will need increasing levels of protection
- Older housing in lower income areas also may need a rethink on planning & investment.

***landscape diversity & resilience***

- there are landscapes falling apart in various ways on all sides, more so with the onset of climate change, calling for a dynamic integration of social, economic, ecological forces.

***demographic shifts & new forms of eco-housing***

- Social divides are already in evidence with the syndromes of suburbia: there may be opportunity for rethinking housing forms, finance and access to land for the upcoming generation .

***Peri-urban real estate markets & insurance***

- To look beyond dysfunctional peri-urban developments and disruption of land & ecosystems, the real estate sector can rethink its processes of social and ecological value creation. With rapidly increasing flood risk & vulnerability, the insurance sector also needs new forms of positive investment.

***Circular economy & eco-livelihood***

- There is a strong case for a peri-urban circular economy in Melbourne, with its combination of globalized industry and regionalized agriculture / forestry / ecosystems. This could provide an organizing principle for the climate-proofing of a new emerging peri-urban.

***indigenous & first people knowledge***

- It may be the traditional owners have keys to sustainable living in the new climate-challenged peri-urban

***Multi-level governance, integrated planning*.**

- Bridging gaps between policy & politics, to improve the effectiveness of multi-level planning & government.

***Collaborative governance, civil partnerships***

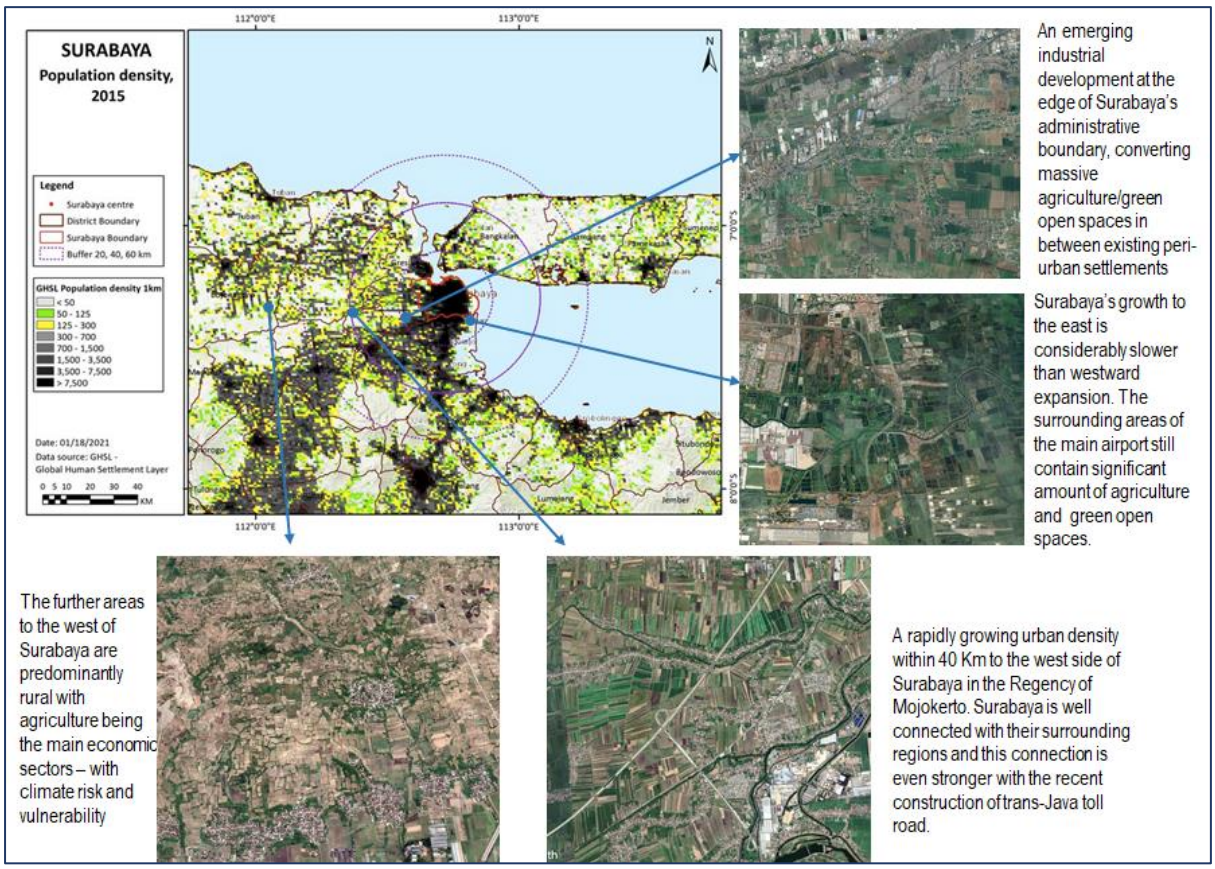
- As an open thriving democracy with effective systems, it seems Australia can show some pathways for adaptive / collaborative forms of governance to respond to complex multi-level problems

However there are many embedded layers of elite power and wealth to respond to, also certain socio-cultural dynamics which bring gaps and barriers to the ideal of collaborative governance.

# 3 Surabaya

***Scope:*** *the frame includes the Surabaya metropolitan region together with adjacent urban areas (Gresik at the north-west and Sidoarjo at the south). However this 200km frame includes only some of the extended agglomeration to the south.*

***Figure 17.1: where is the peri-urban***




## *OVERVIEW*

***Peri-urban syndromes:*** rapid urban sprawl into landscape patterns of broad river valleys with forested mountains: disruption of ecosystems & rural livelihoods: development & infrastructure in high risk locations:

***Climate change syndromes***: riverine flood, storms, landslides: sea level rise & incursion: loss of forest, soil & ecosystems: displacement of flood to urban areas: increasing extreme wet heat days:

***Societal vulnerability***: disruption to livelihoods & farming & rural communities: social change & gentrification: suburban exclusion & privatization:

***Governance syndromes***: economic devt pressures: institutional silos & fragmentation: post colonial legacies: climate awareness & capacity is lacking:

***Adaptive pathways***: urban-rural linkages for food, ecosystems, livelihoods: circular economy principles: integrated water management & multi-functional landuse: climate-wise peri-urban devt.

***Adaptive governance***: regional strategic climate-wise planning: civil society governance: socio-climatic integration: managing private sector interests.

## Peri-urban issues

***Spatial analysis*** *(from the charts overleaf):*

- *Within the urban area, the historic city is very high density (>7500): the population in the extended city area is then medium-high density (3000-7500), with a steady increase, which drops off at the edges*
- *Outside the urban area most population is at medium of 700-3500 p/km2, with a rapid near doubling over 25 years.*

Surabaya Metropolitan Area is the second largest urban agglomeration after Greater Jakarta and the most rapidly growing urban region in Indonesia (by urban population size). In general, sprawl of large-scale residential enclaves surrounded by small housing clusters. Infilling urban development (housing, big and local retails) beyond the inner-city area. Formation of contiguous urban areas between neighbouring regencies (Gresik at the north-west and Sidoarjo at the south).

- Sprawl of large-scale residential enclaves surrounded by small housing clusters. Infilling urban development beyond the inner-city area. Peri-urban expansion along river basin to SW, overlaid on paddy field patterns. Major industrial areas to NW & SE
- Growing middle class & rapid transition from rural society to industrial & urban. Over-pricing of city, preference for peri-urban, property investment motives (some residential areas have low occupancy rate).
- Surabaya as capital city in main province, means large commuting & in-migration. CBD is shifting to orbital route locations, W&E are becoming industrial, stable growth in north and south. Suramadu bridge connects Surabaya & Madura Island.

## Climate change issues

Climate & environment: increased flood vulnerability, & Urban Heat Island effect is increasing. UHI tends to decrease as more public paths are being developed, UHI in central Surabaya is lowering. In east and west UHI is low, due to area dominated by palm and mangrove. North and east development is overlapping with sea level rise areas. River pollution and acid rain.

- Precipitation projections: summer large rise, winter rapid fall. Temperature projection of 2-6 degrees by 2100: Sea level rise N&E: rapid development of urban enclaves overlapping areas below sea level
- Growing flood vulnerability & UHI effect. UHI is lower in E&W areas, due to palm & mangrove. North and east development is overlapping with sea level rise areas. River pollution and acid rain.

- Acidic rain from industrial gas emission flows into water bodies - soil & water contamination - effect on agriculture, public health, quality of drinking water
- High mobilization, dynamic area development, fast population growth requires massive flows of energy, food, water and other goods.

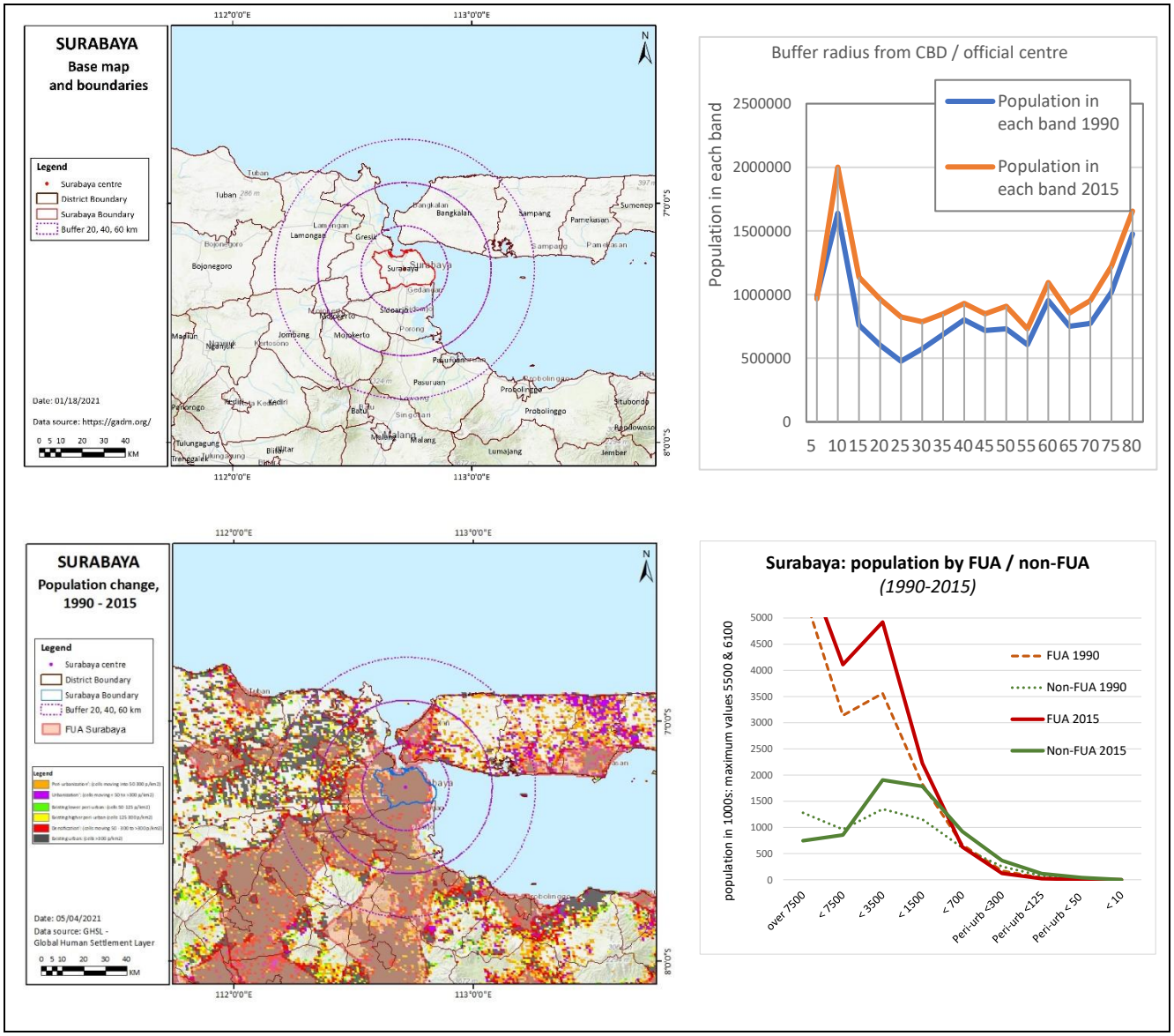
## Societal issues

- family land ownership is small ~1/4 Ha: government policy for each family to have 2 Ha. In Surabaya the pastures could be held by one company or person, local small-scale workers don't own land. Farming in Surabaya is mainly hand managed (non-industrialised), with good maintenance of soils.
- peri-urban expansion to S& W overtakes the infrastructure, with long commutes to industrial jobs. Peri-urban communities are polarized - with affluent professional / former rural now industrial workers.
- Vulnerability decrease & sensitivity increases - higher resiliency: New suburbs & ex-urbs may lack social cohesion & capital.
- Community participation towards adaptive actions with environmental movement (e.g. mangrove plantation). Government initiatives to foster community – private (associations & industries) – academics (e.g. CSR for public parks, river normalization, biophilia, bio pore)

## Governance issues

- 2007 spatial planning act recognises the role of local government: practice of planning has improved & more actors are (formally) involved (e.g. developers, local people): but questions on 'real engagement'.
- Some governments have advanced digital systems. For water policy government took a top down management view: more recently locals are involved in communications & outreach on waste management & pollution.
- Indonesian Corruption Watch (National – Local Level); WALHI – environmental issues; Indonesian Green Peace: Informal process of land acquisition and planning permission. High level local authority and private sector coalition (the elites) and political interests and goals
- Social resiliency seems stable + high adaptive capacity; economic resiliency fluctuated – macro level is quite vulnerable, micro level (community level) is quite stable, impact of COVID-19 is significant for informal sectors (UMKM – micro/small enterprises).

***Figure 3.2: spatial mapping & analysis***



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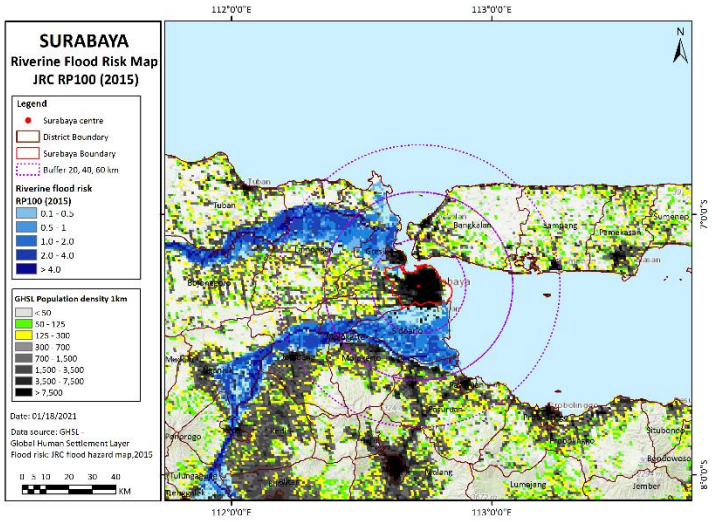
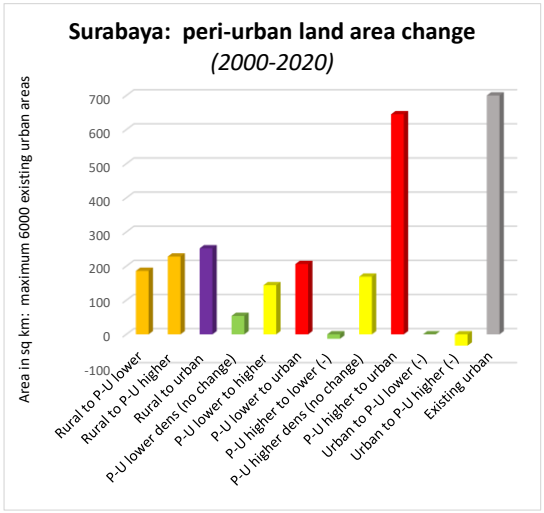
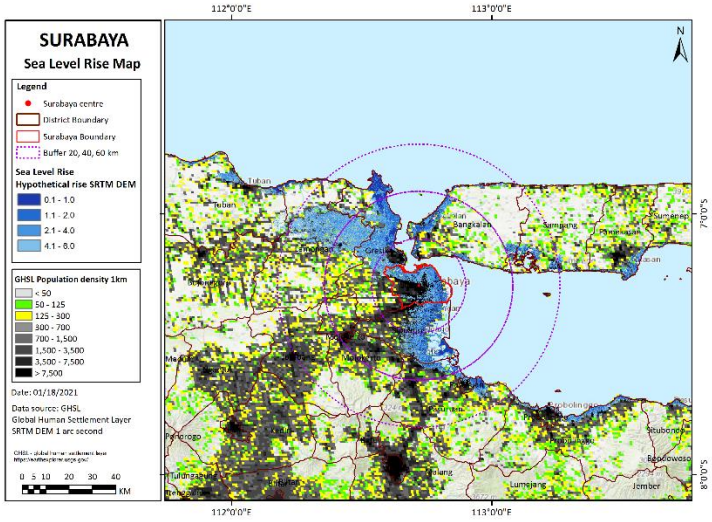
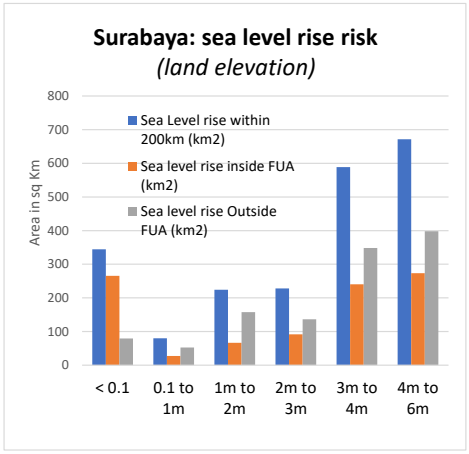
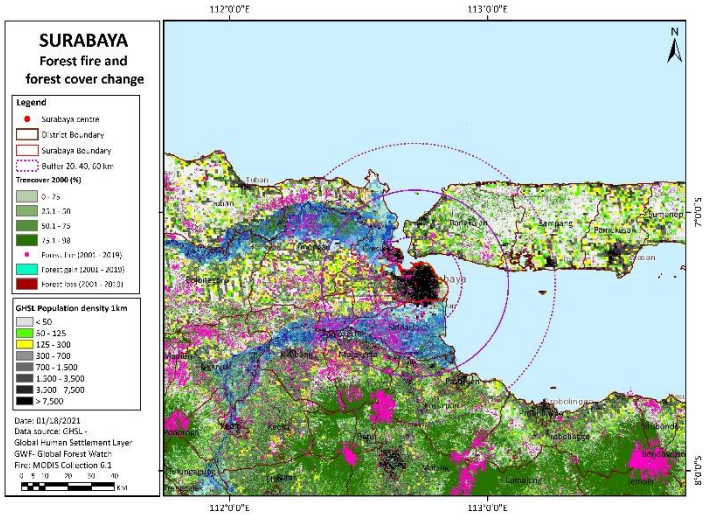


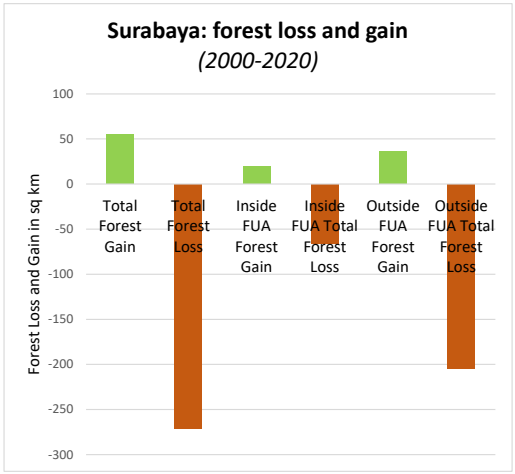
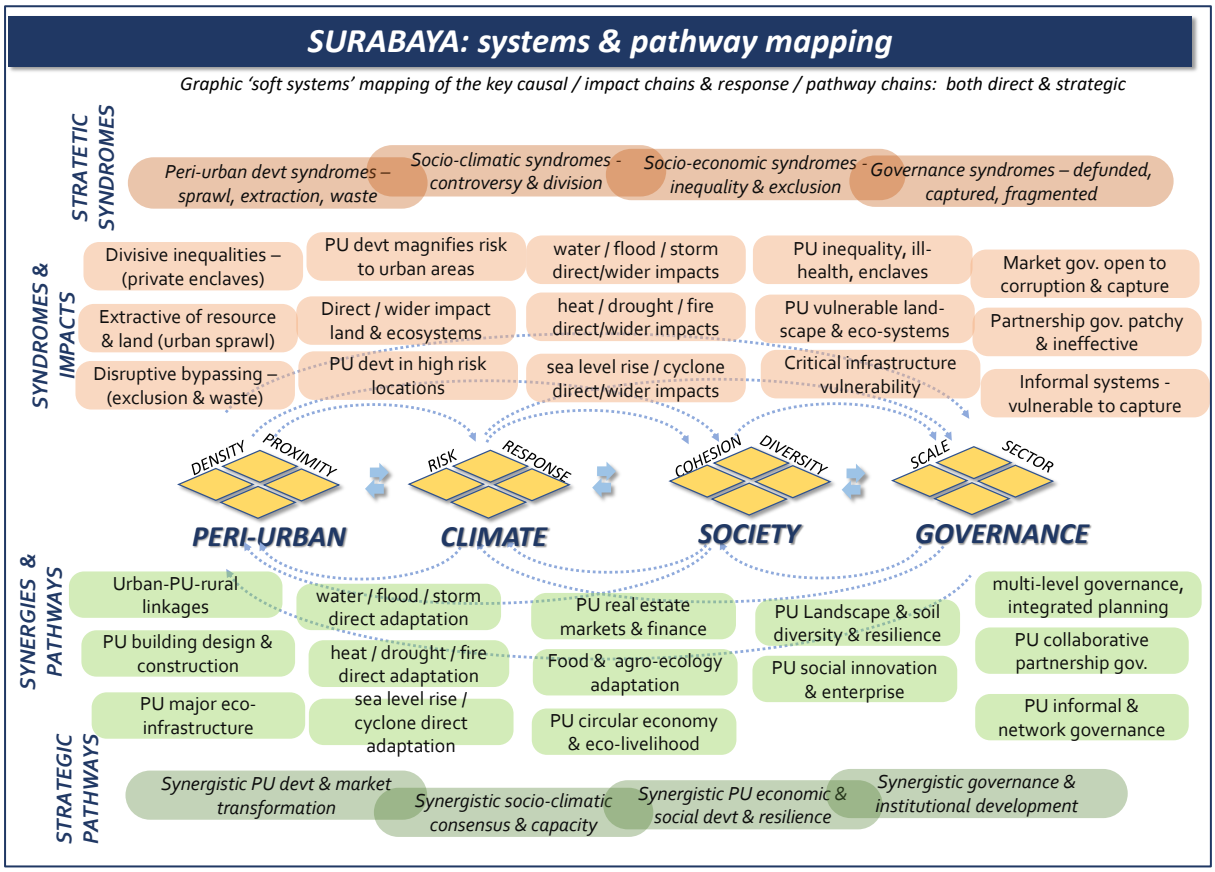



***Figure 3.4: system & pathway mapping***




## Adaptive pathways

*(preliminary list with generic menu text for discussion)*

First comes a review of which pathways would be most likely to combine in which types of area:

- ***Urban fringe & coastal areas:*** set up a national climate protection coastal zone: promote agro-ecological systems of landscape & water management.
- ***Inner urban extension areas***: planning for retrofit of climate-proof settlement design, water management, peri-urban livelihoods, climatic management of heat and storm.
- ***Hinterland sprawl areas***: explore new combinations of rural village & urban settlement; water management for extreme conditions: ecosystems livelihoods with new global-local economic systems, niche products, visitor economies: multi-level settlement structure with local-regional services & facilities.
- ***Hinterland peri-rural areas***: forested mountain slopes and river valleys: plan for transition of former agriculture to new combinations of eco-agri-tourism livelihoods: ensure the conservation of forest cover, soil, water systems.
- ***Governance systems***: overall multi-level multi-sector governance which combines entrepreneur energies, with public sector responsibilities, with the deeper values of civic society… (all in a rapidly changing population and economic structure).

***urban-rural linkages in the peri-urban:***

*Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.*

- The city-region mapping shows a huge overlap and interaction of extended urban expansion / rural transformation: there may be great opportunities for new forms of urban-rural synergies and linkages.

***peri-urban building design & form***

*Typical urban patterns & building forms show huge variety: but there is an globalized model of gated communities with single houses or serviced apartments. For both lower / middle / higher income housing, there are low impact design, eco-design and eco-building forms and construction methods, which can enable climate-wise adaptive pathways.*

- The mapping shows a large area of urban / peri-urban sprawl along the river valley to the south west: the question is - how far is it possible to retrofit this for greater climate resilience, higher social value and lower resource intensity?
- Also the perennial struggle between: a) over-engineered A/C based modern housing in security-controlled enclaves: and b) learning from indigenous building forms and layouts with natural micro-climatic and micro-social systems.

***Peri-urban stewardship of land & commons***

*Many peri-urban territories include large areas of leftover 'lost space', and much of this (in some countries) is in common / public ownership. The community based stewardship of marginal land on edges or corridors, can be a powerful way to generate social synergies, e.g. by local food democracy, which can then manage ecosystems for resilience and adaptive capacity.*

- use of space to enable formalizing of informal space, for those without space
- sea water intrusion management with mangrove - good collaboration with private sector

***Peri-urban infrastructure, airports, industrial areas***

*Large facilities in the peri-urban can cause disruption & depletion – or, contribute to positive transformation of the peri-urban as a zone of diversity, local-global linkages, and socio-ecological resilience. Airports, major roads or industrial plants can be designed as green corridors with built in adaptation capacity.*

- Industrial parks are a clear priority, with great potential as hubs for a future circular economy system.

***Water / flood / storm adaptation***

*Short term: we need ways to manage rising floodwaters and extreme events, via SUDS, walls, canals, basins etc. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a water-friendly co-existence.*

- major flood future risk zones cover the industrial areas to the west and peri-urban sprawl to the southwest. For both the existing building patterns may be less viable, and more radical pathways may be needed .

***sea level rise / cyclone adaptation***

- The map here shows the digital elevation (not actual model of sea level rise), to indicate zones of future vulnerability.
- One priority is the extensive and intensive east coast mangrove forest.
- Industrial areas and critical infrastructures will need increasing levels of protection

- Older housing in lower income areas also may need a rethink on planning & investment.

***peri-urban real estate markets, insurance***

> *Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.*

- To look beyond dysfunctional peri-urban developments and disruption of land & ecosystems, the real estate sector can rethink its processes of social and ecological value creation. With rapidly increasing flood risk & vulnerability, the insurance sector also needs new forms of positive investment.

***circular economy & eco-livelihood***

> *The practical question is how can businesses invest and create jobs from these peri-urban 'climate-wise' transitions and pathways. The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.*

- The case for a peri-urban circular economy is very strong in Surabaya, with its combination of globalized industry and localized agriculture / forestry / ecosystems. This could provide an organizing principle for the climate-proofing of a new emerging peri-urban.

***Collaborative governance, civil partnerships***

> *As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.*

- As a young and thriving democracy with effective digital systems, it seems Indonesia might show some pathways for adaptive / collaborative forms of governance to respond to complex multi-level problems
- The vision is there for an *'Institutionalized inclusive city - formal & informal sectors, horizontal – vertical'*
- However there are many embedded layers of elite power and wealth – e.g. *'we need new forms of collaborative governance (not just helicopter billionaires)'*

***Radical governance, grassroots networks***

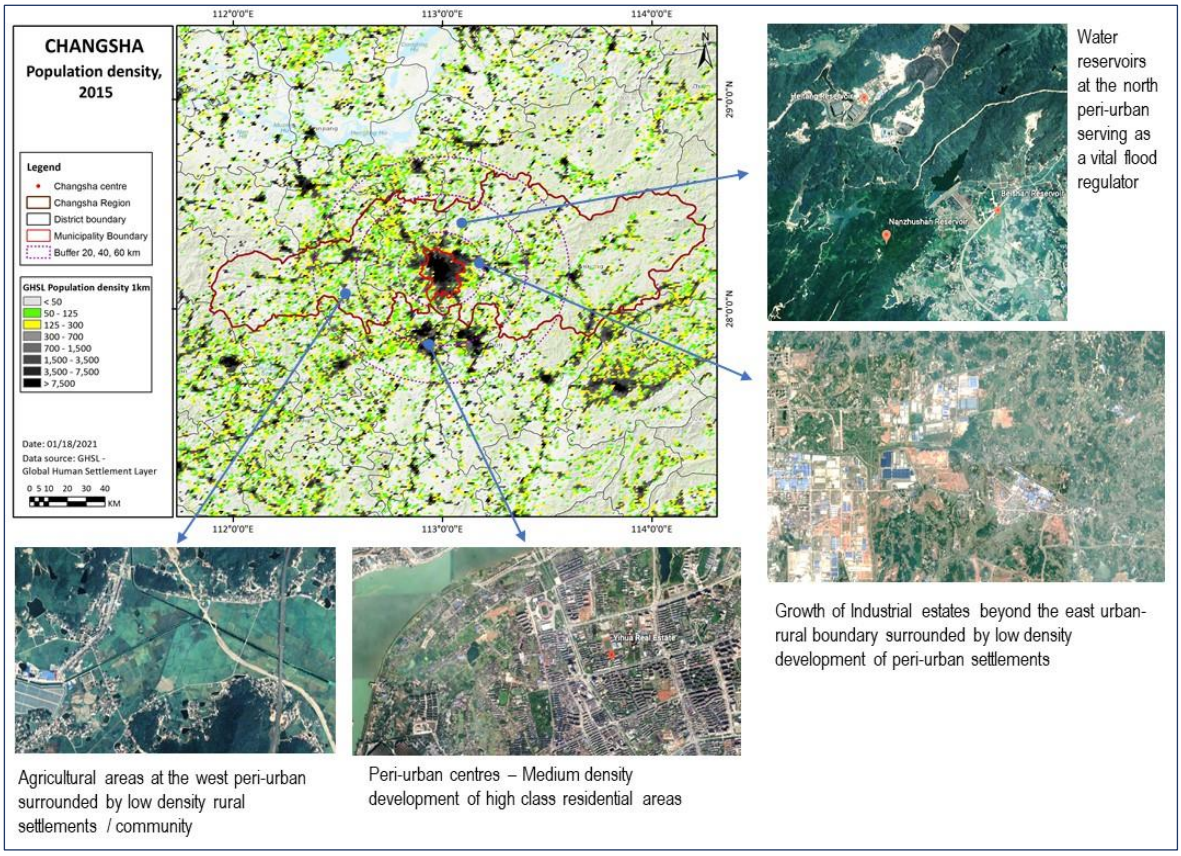
> *Emerging forms of radical ecological democracy & the 'pluriverse': these are beginning to show real alternatives to the mainstream top-down neo-liberal consensus on development & livelihood. The peri-urban can be host to many creative variations on agro-ecology, local livelihoods, grassroots self-help, social mutual aid, stewardship of the commons etc.*

- This is a more open question, starting with the aspirations e.g. '*use of space to enable formalizing of informal space, for those without space'*. For those not (yet) included in the growth and development narrative, or those at the bottom of the ladder, there may be alternative ways forwards, and the peri-urban may be the location of future social innovations.

# 4 Changsha

***Scope:*** *the Changsha metropolitan region is at the centre of the frame here, in a continuous Hunan landscape of forested hills and fertile valleys.*

***Figure 4.1: where is the peri-urban***




## *OVERVIEW*

***Peri-urban syndromes:*** rapid urban & industrial expansion into traditional landscape patterns of hills and forest: disruption of ecosystems & rural livelihoods: development in high risk locations:

***Climate change syndromes***: riverine flood, storms, landslides: some loss of forest, disruption to soil & ecosystems: displacement of flood to urban areas:

***Societal vulnerability***: livelihoods & farming in transition: social change & gentrification: suburban expansion & exclusion:

***Governance syndromes***: economic devt pressures: multi-level disconnection: climate change awareness is lacking beyond the short term:

***Adaptive pathways***: urban-rural linkages for food, ecosystems, livelihoods: integrated water management & multi-functional land-use: PU climate-wise development:

***Adaptive governance***: regional strategic climate-wise planning: civil society governance: socio-climatic integration of all policies.

Changsha is a historic centre (e.g. home to Mao Tse-Tung in the 1920s). It is now a rapidly expanding provincial capital, located on a large river system, with a fertile and mountainous hinterland.

Changsha is the Capital of Hunan Province, one of the top 10 most populated regions in China. The growth of urban population has been remarkable from 1.1 million in 1991 to 4.7 million in 2021. Changsha is surrounded by hills, which serve as a constraint to urban expansion.

Peri-urban development is mainly in standard high rise blocks, which replace traditional agricultural lands. Climate risks include storm, heat, wildfire and regular urban flooding. These are generally under control, but as climate change increases, the effects may be very challenging.

- Changsha is designed as a compact city, with encouragement of high-rise development. Within the inner-city zone (particularly at the west side of the Xiangjiang River), there are development of industrial estates. This area in particular is strictly regulated where only of those green and high-tech industries will be approved for development.
- Urban areas are expanding in a slow rate as the central government applies strict measures in granting development in the peri-urban spaces. The expansion of urban areas is mainly towards the west with enclaves of industrial estates surrounded by low density peri-urban settlements and towards the south forming new suburban centres of high-class medium density residential development.
- In the north peri-urban areas, there are sites managed as water reservoirs which is vital to regulate floods. Meanwhile, the west peri-urban areas comprise of agricultural lands and enterprises surrounded by low-density rural settlements.
- For every agricultural land being converted to urban areas, the landowners are given great amount of financial compensation from the central government. To some extent, this is problematic as there are tendencies for landowners, who profited from the compensatory scheme, to purchase properties in the inner-city zone. Their migration into the urban areas contributed to the abandonment of agriculture. With uncertainties of jobs in the urban centres and their lack of financial investment literacy, they have been put into severe social and economic vulnerability.
- In overall, this compensatory scheme potentially accelerates urban expansion, while at the same time can cause the proses of rural-urban transformation to become socially and economically problematic. However, it is strictly prohibited for individuals and local authorities to put peri-urban lands on market. The utilisation of peri-urban lands fall under the discretion of the central government.

## Peri-urban change

***Spatial analysis*** *(from the charts overleaf)*

- *Within the urban area, the historic city is tightly defined with very high densities in the centre, and little change in 25 years.*
- *Outside the urban areas, there is a large population in the medium band (750-7500 p/km2), which has grown steadily at around 1% per year. Population in the lower density areas has doubled meanwhile.*

- Peri-urban development is mainly in standard high rise blocks, which replace traditional agricultural lands. Rapid expansion of housing & industrial areas into former rural areas. Grid patterns are overlaid on a rich & complex landscape pattern.
- As capital of Hunan province, economic growth & restructuring has doubled its population in 30 years. Rapid development of road network has promoted peri-urban locations. New AirBnB type rental sector.
- Rapid change & urbanization of rural areas & communities: Lower income areas are spread around. Government compensation for land acquisition promotes new urban lifestyles.
- Changsha is on new high speed rail network, with a flow of higher income groups & enterprises.

## Climate change issues

- Large increase precipitation in winter is projected, smaller in summer. Temperature increase between 2-6 degrees by 2100
- Riverine flooding is already annual, will increase, mainly in the river valleys due to topography. Lakes to the north are seasonal with large fluctuations. Temp rise may change ecosystems with new diseases & pests.
- Changsha is prone to flooding from the overflowing Xiangjiang River. One of the most recent flood disasters happened in September 2020 (Xinhuanet, 2020 - https://bit.ly/2Oq5UOp ) with the collapse of over 21,000 of homes and 628,000 hectares of agricultural lands damaged.
- Hinterland of small hills shaped by rivers, prone to flooding, with unique wetlands: near urban areas are developed with high flood risk.
- Landuse is shifting to intensive farming in some areas of level ground.
- Around Changsha many low hills with forest cover, with some tree loss in the hinterland. UHI is increasing along with air pollution.

## Socio-economic issues

- Many settlements are on the edge of water bodies, with risk of future flooding. Landscape to W has unique combination of housing / forest with low paddy fields with frequent flooding.
- Rural livelihoods are rapidly urbanized (with land compensation some buy a large car, gamble & start a business). Few have house insurance, but house construction is durable & govt provides basic compensation.
- could be social conflicts between new urban & old rural: social cohesion / capital is lacking in new urban areas.

## Governance issues

- Generally strong centralized forms of government & public services, but with underlying elite patronage.
- Some tension between central, province & city government: & between sustainability & economic growth objectives. Multi-level integrated water & ecological planning is new, also local LID policies & codes.
- National Yangtze protection zone : some ‘regional sustainable development’ zones.
- Some civic NGOs are involved, basic citizen participation

- An example of the strong influence of central government in Changsha is how the pro-environmental ideology of the President, which, upon his visit to Hunan Province addressed the importance of Xlangjiang River and other ecosystem services within the peri-urban areas as imperative natural capital: this was believed to be a strong factor to the urban containment policy of Changsha.

***Figure 4.2: spatial mapping & analysis***

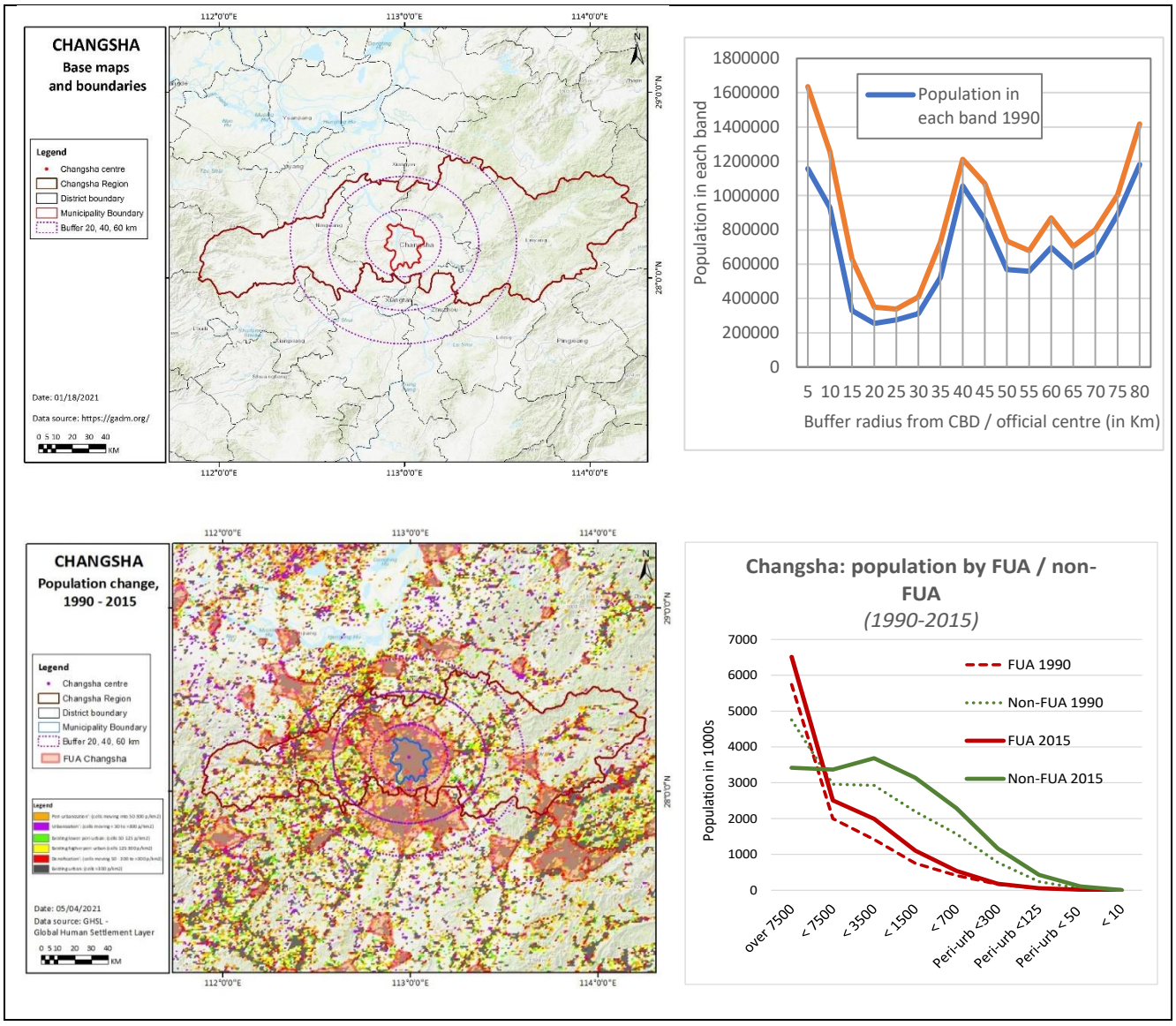
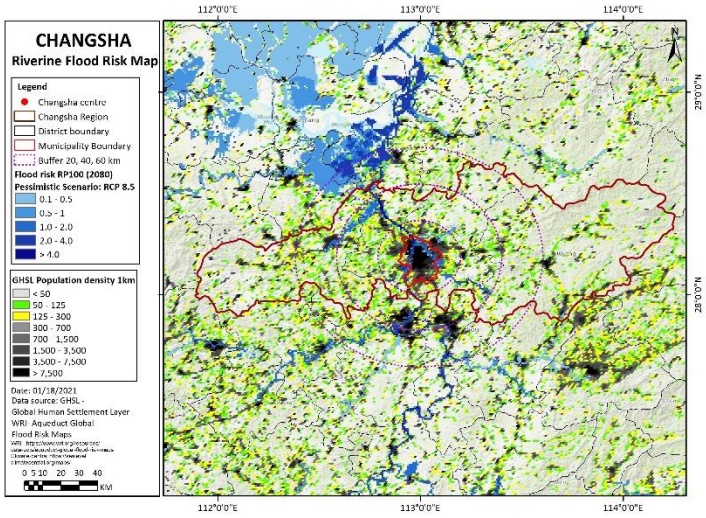
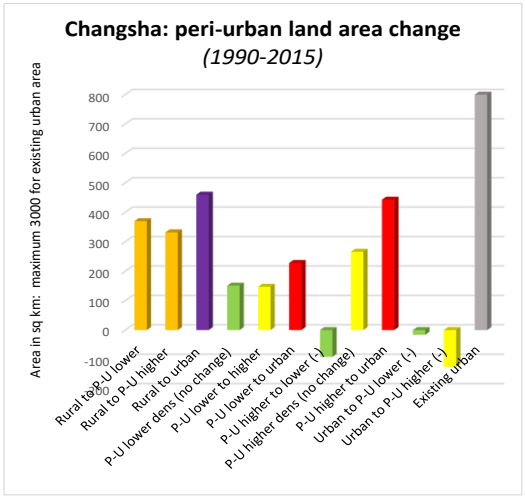
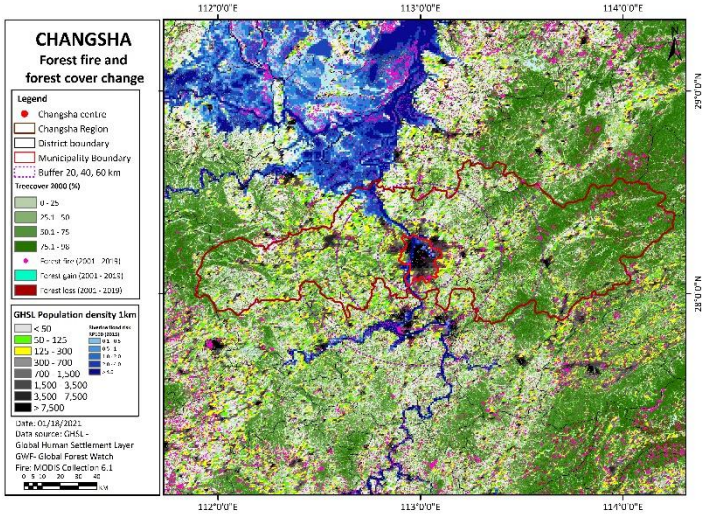
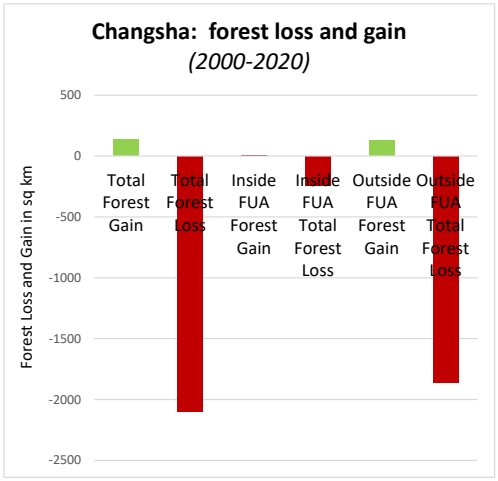


***Figure 4.3: climate effects mapping & analysis***



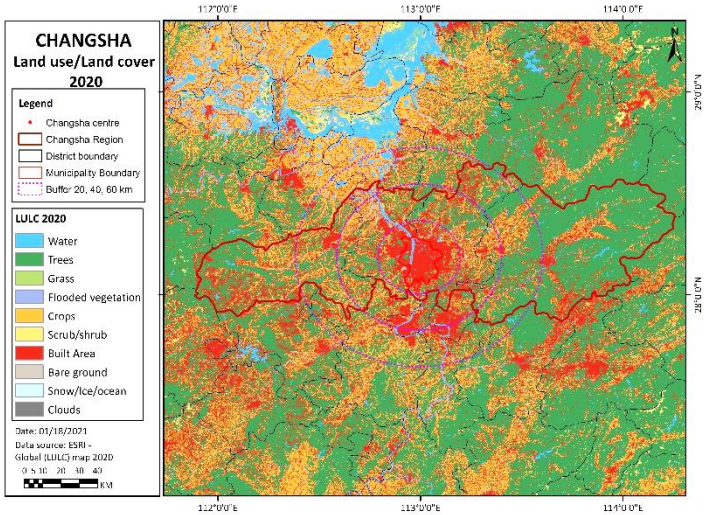
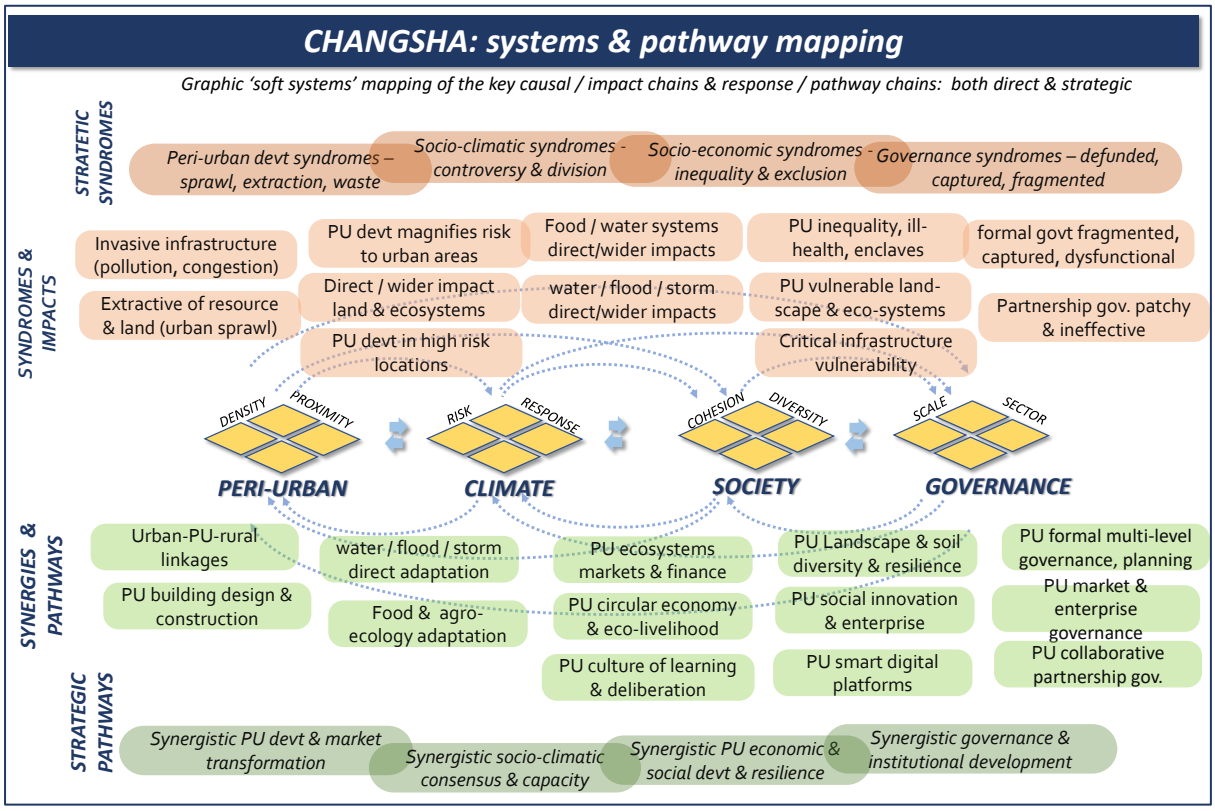



***Figure 4.4: system & pathway mapping***




## 4.1 Adaptive pathways

*(preliminary list with generic menu text)*

***Rural-urban linkage pathways:***

Changsha shows different peri-urban themes divided into different zones from enclaves of high-class residential areas, zones with key infrastructures for regulating floods and areas of predominantly agriculture and low-class social groups. Maintaining the uniqueness of each zones can be equally important with improving connectivity between the different peri-urban zones. However, strengthening rural-urban linkage is most essential in the social domain. This points at the transformation of jobs and social status of local people from farming to a more urban based jobs alongside rural-urban migration. Importantly, there is a need to identify potential policy areas (and programs, funding etc) which enables the empowerment of local people to retain and increase the value of farming to follow on the central government's compensation scheme.

***Climate resilience and vulnerability pathway***

With imminent increase in the event of flooding, the climate resilient pathway shall focus on strengthening this particular ecosystem services provided by the peri-urban areas. The water reservoir situated in the north peri-urban should retain their service and needs to find ways to extend the provision in other locations. This water infrastructure can also be a component to

support the supply of water for agriculture to anticipate imminent droughts as temperature is predicted to rise. The climate resilient pathway thus themes on creating water sensitive urban design to channel policies for a better management of areas along the Xiangjiang River.

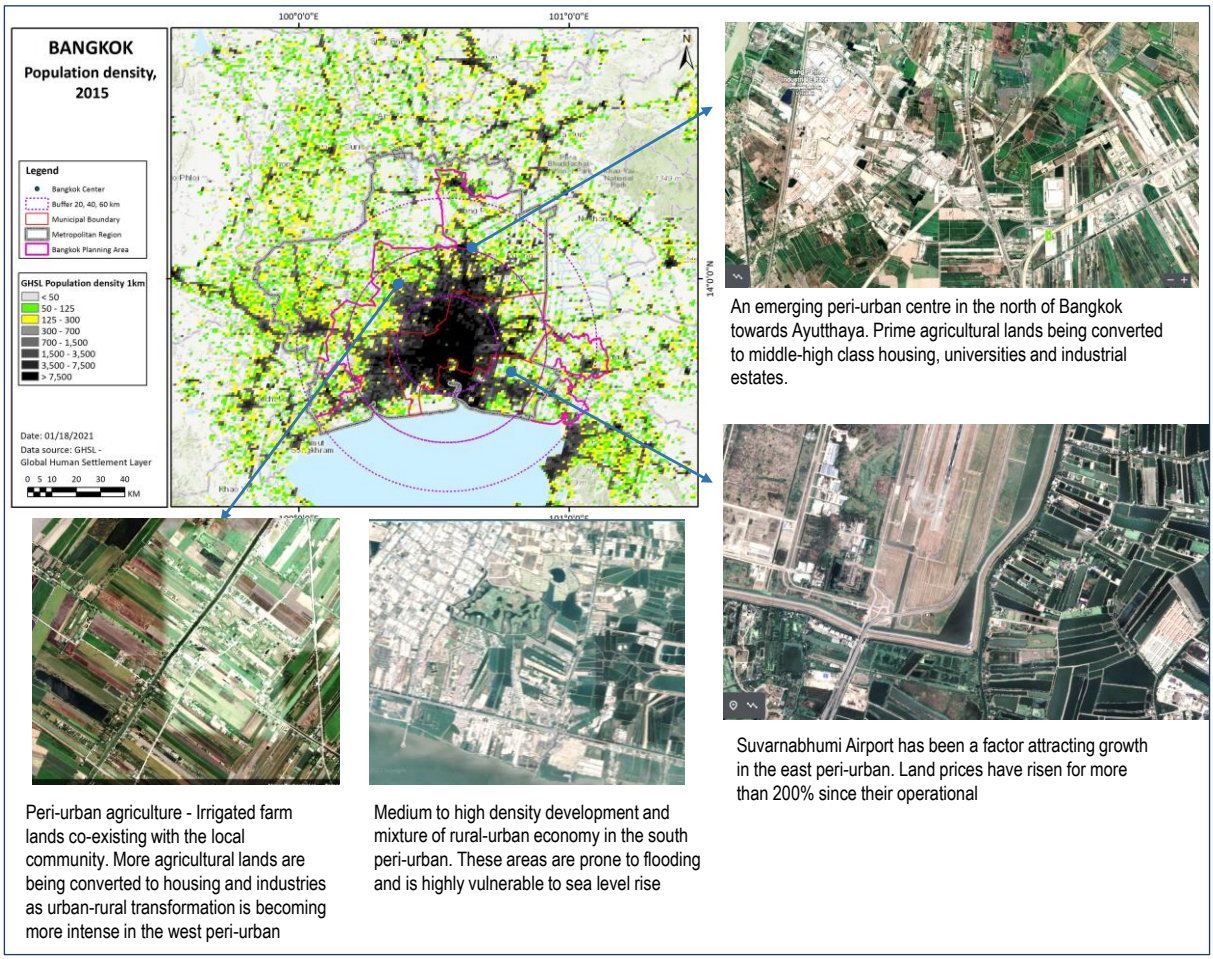
***Collaborative and integrative governance pathway***

In general, the central government have significant roles, and power, to control peri-urban development. This can be a positive governance arrangement in the sense that the utilisation of peri-urban spaces is strictly controlled to avoid over-exploitation by market-driven development agenda. To enhance the practice under this institutional structure, the governance pathway thus suggests a stronger collaboration both vertically (between central and local government), horizontally (between authorities of urban centre and peri-urban) and sectors (private, public, agriculture, water infrastructures, housing).

# 5 Bangkok

***Scope:*** *the Bangkok metropolitan region is clearly defined within the 200km frame here. However the upstream water catchments and bio-regions are on a larger scale.*

***Figure 5.1: where is the peri-urban***




An emerging peri-urban centre in the north of Bangkok towards Ayutthaya. Prime agricultural lands being converted to middle-high class housing, universities and industrial estates.

Suvarnabhumi Airport has been a factor attracting growth in the east peri-urban. Land prices have risen for more than 200% since their operational

Peri-urban agriculture - Irrigated farm lands co-existing with the local community. More agricultural lands are being converted to housing and industries as urban-rural transformation is becoming more intense in the west peri-urban

Medium to high density development and mixture of rural-urban economy in the south peri-urban. These areas are prone to flooding and is highly vulnerable to sea level rise

## *OVERVIEW*

Bangkok is a rapidly expanding megacity, with intensive disruption of water systems & ecosystems, in a highly climate challenged location, struggling with divided governance systems.

***Peri-urban syndromes:*** rapid urban & industrial sprawl into low-lying landscape with complex water systems: disruption of ecosystems & rural livelihoods: development in high risk locations:

***Climate change syndromes***: riverine flood, storms, landslides: sea level rise & incursion: upstream forest depletion, disruption to soil & ecosystems & water systems, displacement of floodwater to urban areas: urban heat island & air pollution: increasing extreme wet heat days:

***Societal vulnerability***: social change & gentrification: suburban expansion & exclusion: disruption to livelihoods & farming:

***Governance syndromes***: widespread political instability & fragmentation, materialist priorities, elite capture, illegal construction & encroachment: climate awareness & climate policies hardly exist:

***Adaptive pathways***: urban-rural linkages for food & ecosystems, distributed work & local livelihoods: integrated water management & multi-functional landscape resilience: climate-wise peri-urban design & infrastructure:

***Adaptive governance***: strategic integrated climate-wise planning: civil society governance structures: socio-climatic integration of all policies.

## Peri-urban issues

***Spatial analysis*** *(from the charts overleaf)*

- *Within the urban areas, very high / high density populations have more than tripled:*
- *Outside the urban areas, populations at medium urban and peri-urban densities have doubled.*

- Rapid urbanization of formerly rural areas with industrial & residential development. A complex interaction of new urban development overlaid on existing field patterns, canal & paddy farming systems. Urban expansion to the W more intense with agricultural land takes by urban development. To the N & E peri-urban is mainly in agriculture (prime irrigated parcels) but with growing urban pressure.
- Peri-urban development is led by corporate real estate with many forms of suburban and ex-urban development, displacing water-intensive cultivation. The water system & rural field pattern is the main shaper of the urban form. Even with rapid expansion, growing housing shortage & land price inflation.
- Many developers buy up farming land, some with international finance. The coup made further complications in government & financial systems.
- Rural-urban transformation take place by first by the abandonment of agricultural lands by cutting them of form the irrigation canal. Usually industrial development follows this phase before residential areas are constructed in the following stages. In social-economic terms, there are transformation of jobs from farming to manufacturing industries. Following the agricultural land takes, the construction of manufactures or real estate is usually followed by further damage of the irrigation system. This cause a growing number of abandoned agricultural lands and hence attracted further land takes.

## Climate change issues

- Precipitation: summer slow increase is projected: winter major reduction. Temperature rise projection of 1.8 –5.5 degrees by 2100

- Sea level rise – _much of coast area is below 2m: most of region 2-4m above sea level. Climate-environment prospects on a tropical savanna h coastal location: high risk of extreme heat & wildfire, coastal flooding & cyclone.
- Droughts, coastal and riverine floods (Chao Phraya River). Bangkok is on average 1m above sea level, and currently sinking due to over consumption of groundwater, combined with sea level rise the risk of coastal flooding increases faster than other coastal areas of Thailand
- Sea level rise causing salination of farmland: lack of tree cover & biodiversity in the city-region.
- chronic traffic congestion and severe air pollution. Urban heat island - temp increase of 13 °C. International airport was located on agricultural land reducing water drainage services: illegal construction obstructs drainage efficiency, increasing flood severity.
- Strained healthcare infrastructure in response to flood borne diseases. Farming industry affected by flooding. Thailand is the world's largest rice exporter, 40% of the population rely on agriculture for employment. Tropical storms, and droughts are likely to affect future rice yields. Livestock farming may be at risk due to heat stress, and disease outbreaks.
- Urban heat island in Bangkok looks to have an increase effect of 13 °C. International airport was located on agricultural land reducing water drainage services, this may increase future flood intensity. Illegal construction obstructs drainage efficiency, increasing flood severity

## Societal issues

- As the world's largest rice exporter, 40% of Thai population rely on agriculture for employment. Tropical storms, and droughts are likely to affect future rice yields. Livestock farming may be at risk due to heat stress, and disease outbreaks. Freshwater fish populations affected during drought periods.
- Heat stress and water borne diseases are likely to increase such as dengue fever. Weather related air pollution will continue to increase as temperature and humidity increase. Summer heatwaves will affect health labour productivity and increase urban energy consumption. Increased global migration by 2050, Bangkok predicted to receive large numbers of migrants. Bleaching corals may reduce tourism to the area, having negative economic consequences
- With the decline of green open spaces, and destruction of irrigation canal (which also functions as flood regulator) some areas in the peri-urban are prone to flooding. The recent major flood disaster in the north peri-urban triggered temporary out-migration, but now people have returned to inhabit the peri-urban.

## Governance issues

- Land use planning is ineffective, vested interests shape plans. Recent attempt to transfer authority for spatial planning national to local level. Private sector have already acquired many of the peri-urban lands before land use policy was constructed. Local governments favour 'hard' water management & flood defence
- Environmental grassroot movements of farmers, reconstructing natural water system to mitigate flooding while maintaining supply for crops. But when private sectors approach to purchase their lands at higher prices, they release them & move to another job in the industrial sectors

- lack of environmental law enforcement, and lack of climate change response framework. Corruption in political systems, and low institutional capacity to consult, and manage real commitments. In the past budgets have been diverted to crony projects, infrastructure investment has suffered.
- Governance is contested between a centralizing state, under-resourced local authorities, some civic groups & some farmers groups.

***Figure 5.2: spatial mapping & analysis***

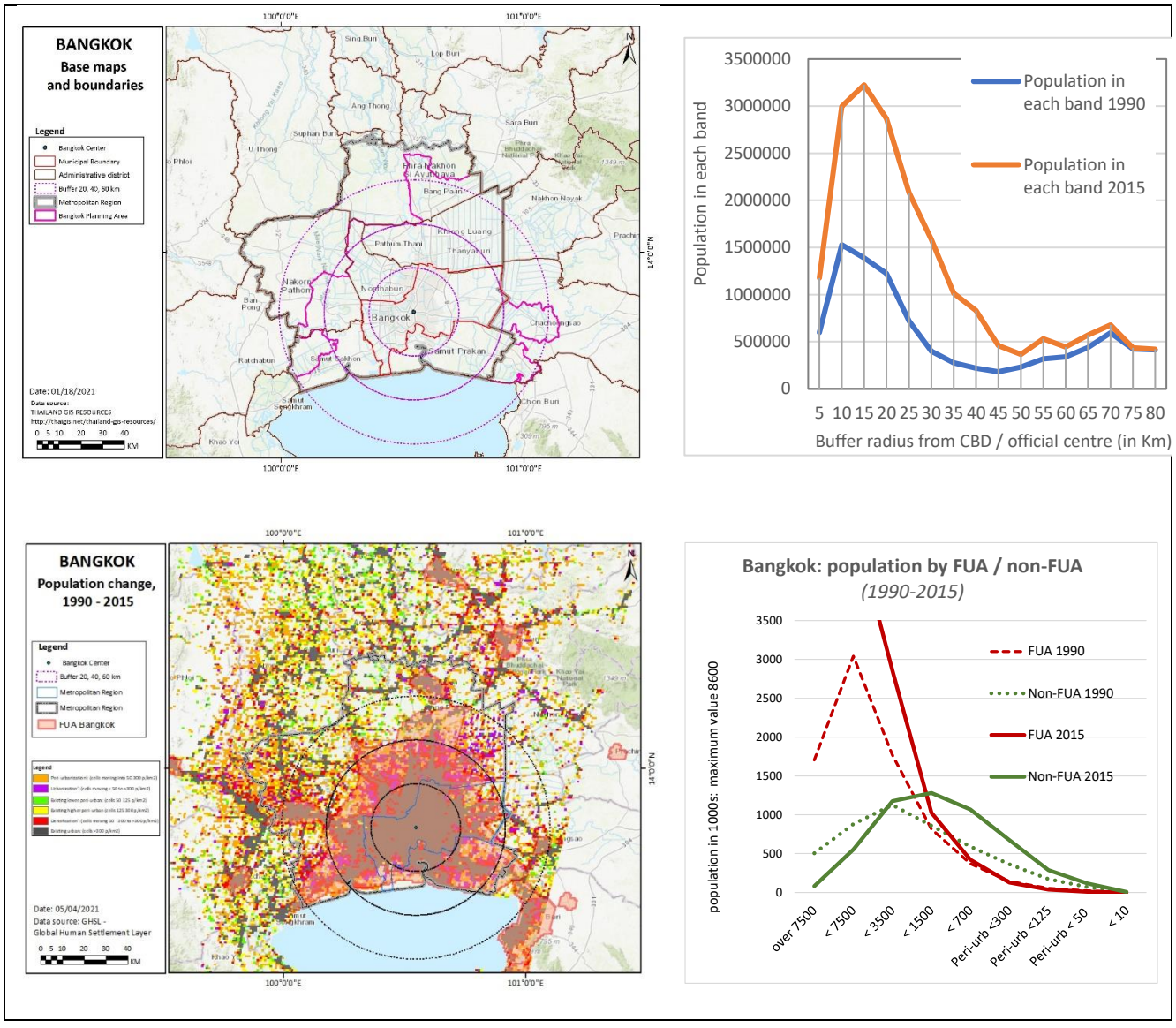


***Figure 5.3: climate effects mapping & analysis***

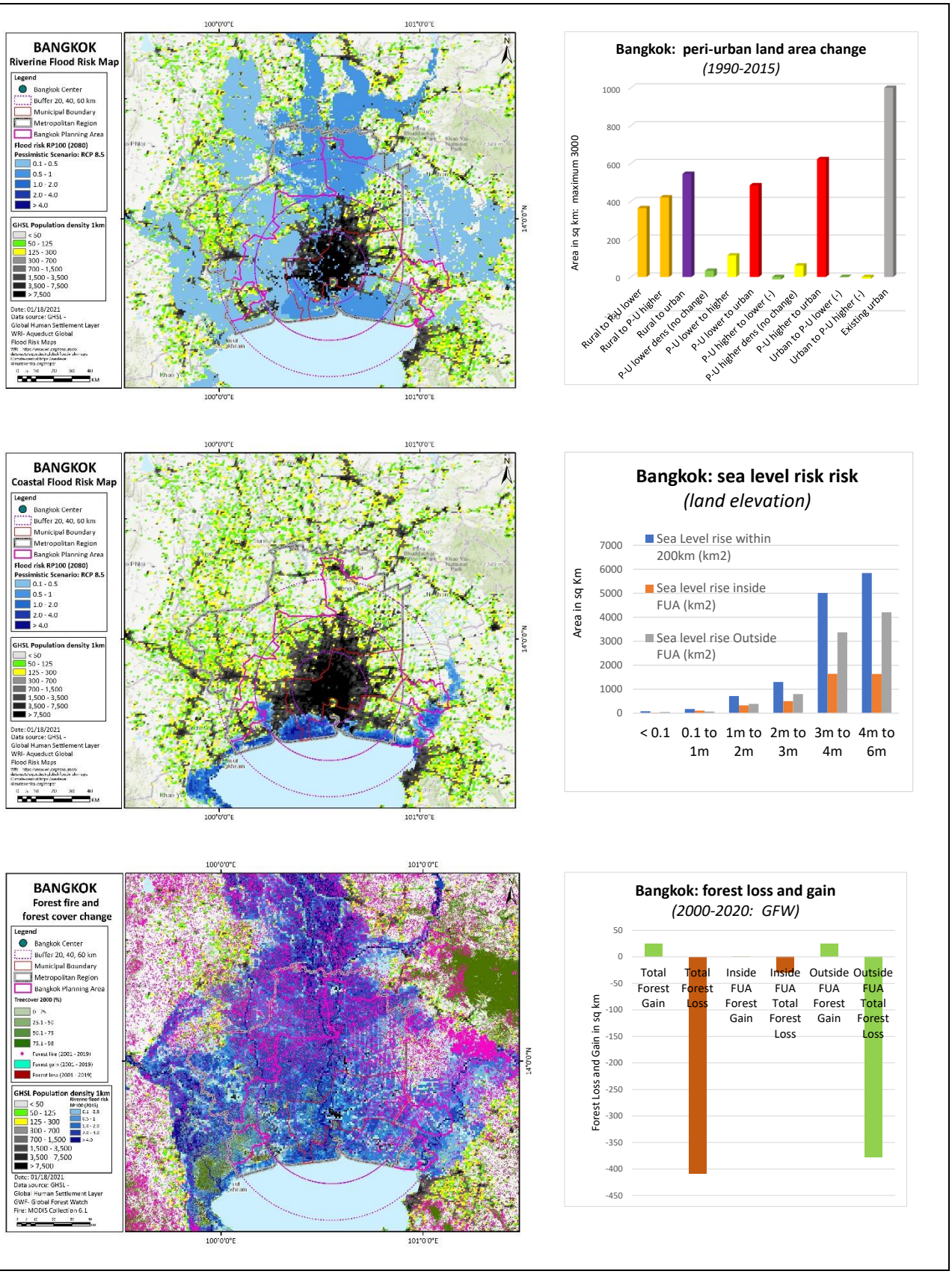
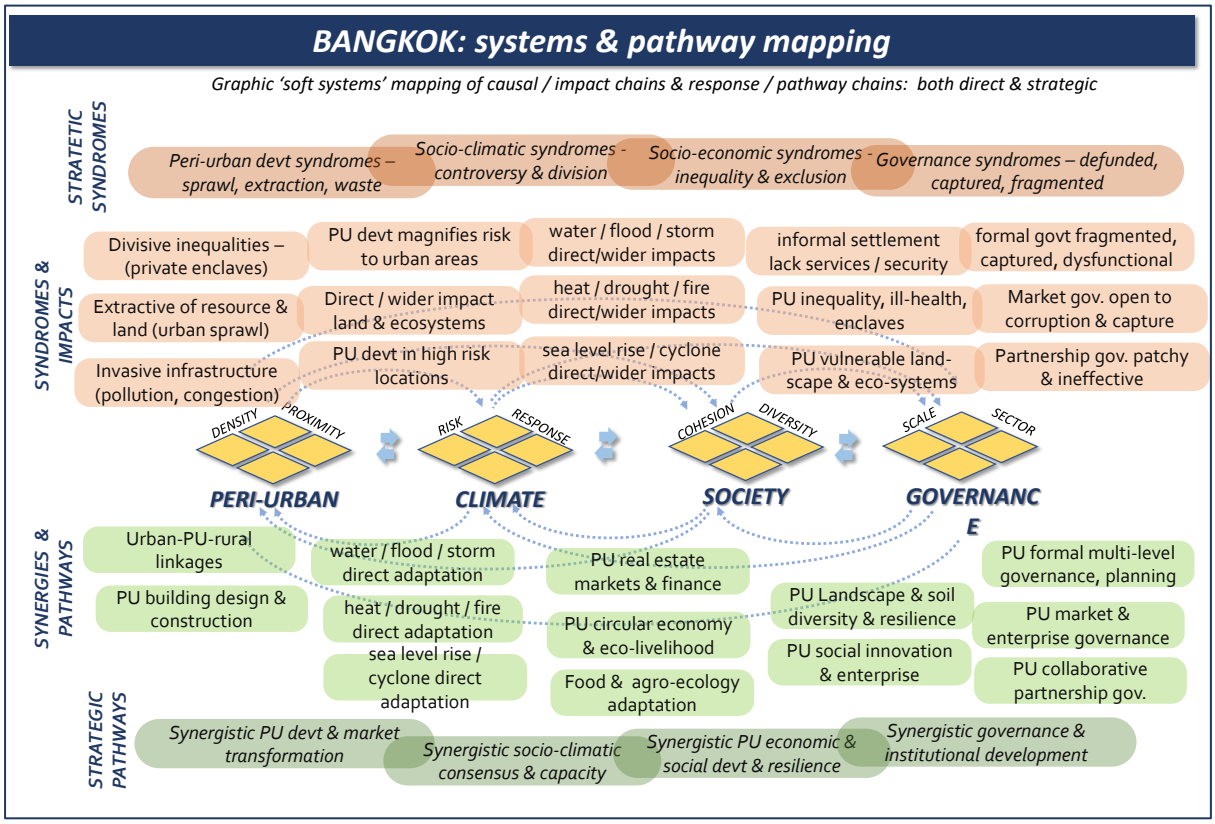


***Figure 5.4: system & pathway mapping***




## 5.1 Adaptive Pathways

***Rural-urban linkage pathways:***

Bangkok's urban expansion and peri-urbanisation connects strongly with the dynamic changes in their agricultural sectors. As the biggest producer of rice in South East Asia, Bangkok's peri-urban areas is home to an immense area of primary agricultural lands. In social terms, this can be problematic as peri-urban development introduces new economic sectors, mainly industry and other secondary and tertiary sectors. All these sectors have the potentiality to replace farming. A point needs raising here is that a 'rural-urban linkage' pathway is one that endeavours to create a smooth socioeconomic transformation. This accounts for the potential loss of jobs in the farming sectors and how to create opportunities for substitutive jobs.

The second agenda on this pathway can focus on minimising the gap between the growth of residential areas and the provision of infrastructure services. As noted in the interview, there is a need for a better mechanism of peri-urban development to make possible the synergy between real estate and infrastructure. As the majority of development in Bangkok's peri-urban areas are led by real estate corporates, Bangkok has great opportunity to involve private sectors in supporting the provision of better infrastructures and public services. However, this is at the same time challenging as the private and public sector agenda seemed to be overlapping. This requires a strong collaboration from both the public and private sectors to work on sustainable peri-urban growth.

***Climate and resilient pathways:***

This pathway centralises on the better management of water – Ground water conservation and flood risk management particular for the Chao Praya River catchment. The river plays a vital role in maintaining stability of water supply for the irrigation system as well as an important component of to control flood can contribute to an eco-design of peri-urban areas. There is also a need of a strong regulatory framework and implementation of climate policies to reduce emission in the transport sector considering the increase of traffic in the peri-urban.

Additionally, there is a need to deliver better management of coastal areas as Bangkok's has great threats from the sea level rise. Strict zoning control to minimise development in the vulnerable areas can be an essential agenda, but foremost, is to maintain or revitalise the environmental well-being of the coastal areas.

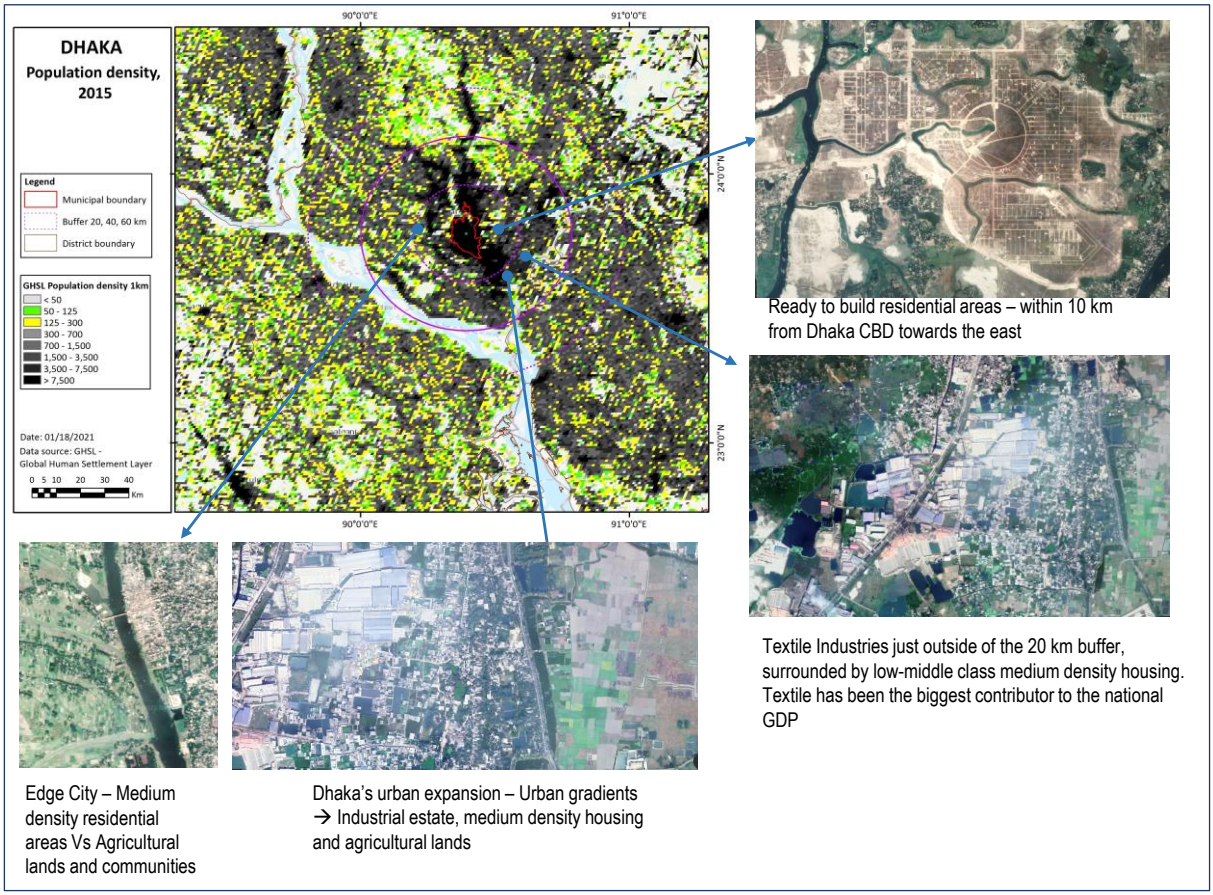
***Integrated governance pathways:***

With complexities and the multi-scalar and multi-sectoral dynamics of Bangkok's peri-urbanisation, it is vital for this pathway to encourage the establishment of a strong collaborative framework of peri-urban planning. This can be done by synergising actors in the various sectors – real estate, agriculture, transport, water and agencies or bodies responsible for the management of coastal and rivers. For the public sector, it is important to note that there must be strong integration between the state and the local government should transferring authorities become efficient in decision making and controlling development. There is also a need for both public and private sectors to nurture grassroot organisation working in the area of improving the socio-economic well-being of local people – for example, the community of farmers who did collective action to reconstruct the water system as both to mitigate flood and to maintain sufficient level of irrigation.

# 6 Dhaka

***Scope:*** *The Dhaka functional area has expanded rapidly, as many surrounding cities have merged and spread into a very densely populated peri-urban and peri-rural hinterland. Hence the standard 200km 'frame' used here can only show a subset of this unique mega-agglomeration, and the global typology of peri-urban density (50-300 p/km$^2$ ) should be adjusted in further research.*

***Figure 6.1: where is the peri-urban***




## *OVERVIEW*

Dhaka is an expanding megacity with a problematic peri-urbanization, in the most climate-challenged of any major location: however the adaptive pathways can build on decades of societal learning on 'living with water'.

***Peri-urban:*** rapid urban & industrial sprawl into densely populated hinterland, in low-lying landscape with complex water systems: general disruption of ecosystems & livelihoods: major development in high risk locations:

***Climate change***: riverine & flash flooding: major cyclones: indirect sea level rise & incursion: upstream forest depletion, disruption to soil & ecosystems, displacement of floodwater: increasing extreme wet heat days: urban heat island & air pollution:

***Societal issues***: large scale rural-urban migration, with regional & ethnic displacements: rapid social change & gentrification: disruption to rural livelihoods & farming systems:

***Governance***: widespread political instability & fragmentation, elite capture, illegal construction & encroachment: widespread climate awareness & policy but capacity is lacking:

***Adaptive pathways***: urban-rural linkages for food, ecosystems, livelihoods: integrated water management & multi-functional land-use: eco-design for large infrastructure:

***Adaptive governance***: integrated regional climate-wise planning: civil society governance & expertise in 'living with water': transformative grassroots initiatives.

## Peri-urban issues

***Spatial analysis*** *(from the charts overleaf)*

- *From the previous equal split of urban / non-urban, high density urban population has tripled. Both urban / non-urban also peak in the 15-3500 p/km2 band.*
- The Dhaka Metro Area is a fast-growing FUA with an average density of 1500 people/Km2, at the confluence of 3 major river systems. Dhaka's urban areas expanded mainly towards the south-east with growth of residential areas and industries converting large amount of agricultural lands. Most of the lands is not under the ownership of private sectors.
- The peri-urban was pictured as a fluid space where at current times there are strong blending between urban and rural in terms of physical landscape and socio-cultural conditions. These typical areas existed beyond the border of the metro area (over 100 km). The problem with Dhaka's urban growth is that it exacerbates the vulnerability of flooding as water flows from the north towards the south east. Dhaka's urban centre has an elevation above the surrounding regions with large areas of urban slums blocking the flow of water. This made Dhaka's south and east peri-urban areas prone to flooding (Mortoja and Yigitcanlar, 2020)
- Many informal slums are insecure, & seen by elites as a rural problem. Land prices very high in some parts, so development pushed outwards.
- Multi-national firms finance local industries via local elites, very difficult to set social-environmental standards

## Climate change issues

- Temperature projection 1.5-5 degrees by 2100 - Precipitation: winter fall of 40%, summer rise of 40% in watershed and Sea level rise – indirect effects on river flows
- Increase in event rainfall intensity for short duration events [1]. Cyclones and storm surges are set to increase. Urban Heat Island causes 2 °C uplift: extreme wet heat days may double
- Temp increase: Increased energy demand, degraded air quality, water scarcity. Rainfall increase: increased flooding, increased water logging, increased inward migration due to river bank erosion.
- Urban expansion lacks adequate drainage, destroys wetlands with adaptive capacity, leads to traffic & industrial air pollution, depletes groundwater, contributes to UHI, increases energy demand

## Societal issues

- Much urban green infrastructure is polluted & degraded. Farming in hinterland is declining as land is sold for development. Loss of forest cover in hills
- Informal & insecure settlements lack flood investment from govt and/or residents: poor construction (e.g. tin roofs) adds to heat stress
- Widening gaps of rich / poor, with elite / gang control of policy & resources. Many transient & migrant communities with lack of social cohesion.

***Figure 6.2: spatial mapping & analysis***

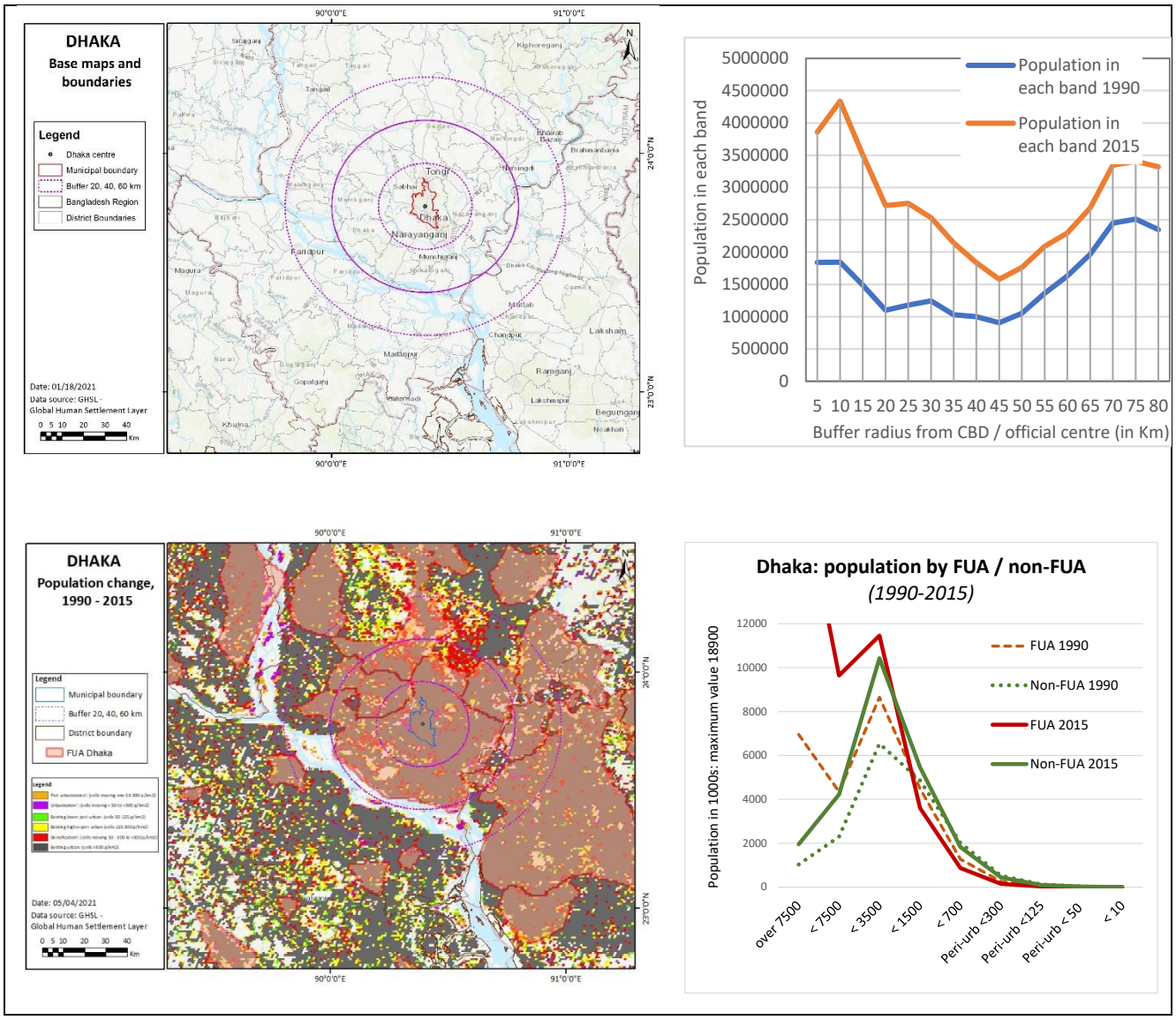


***Figure 6.3: climate effects mapping & analysis***

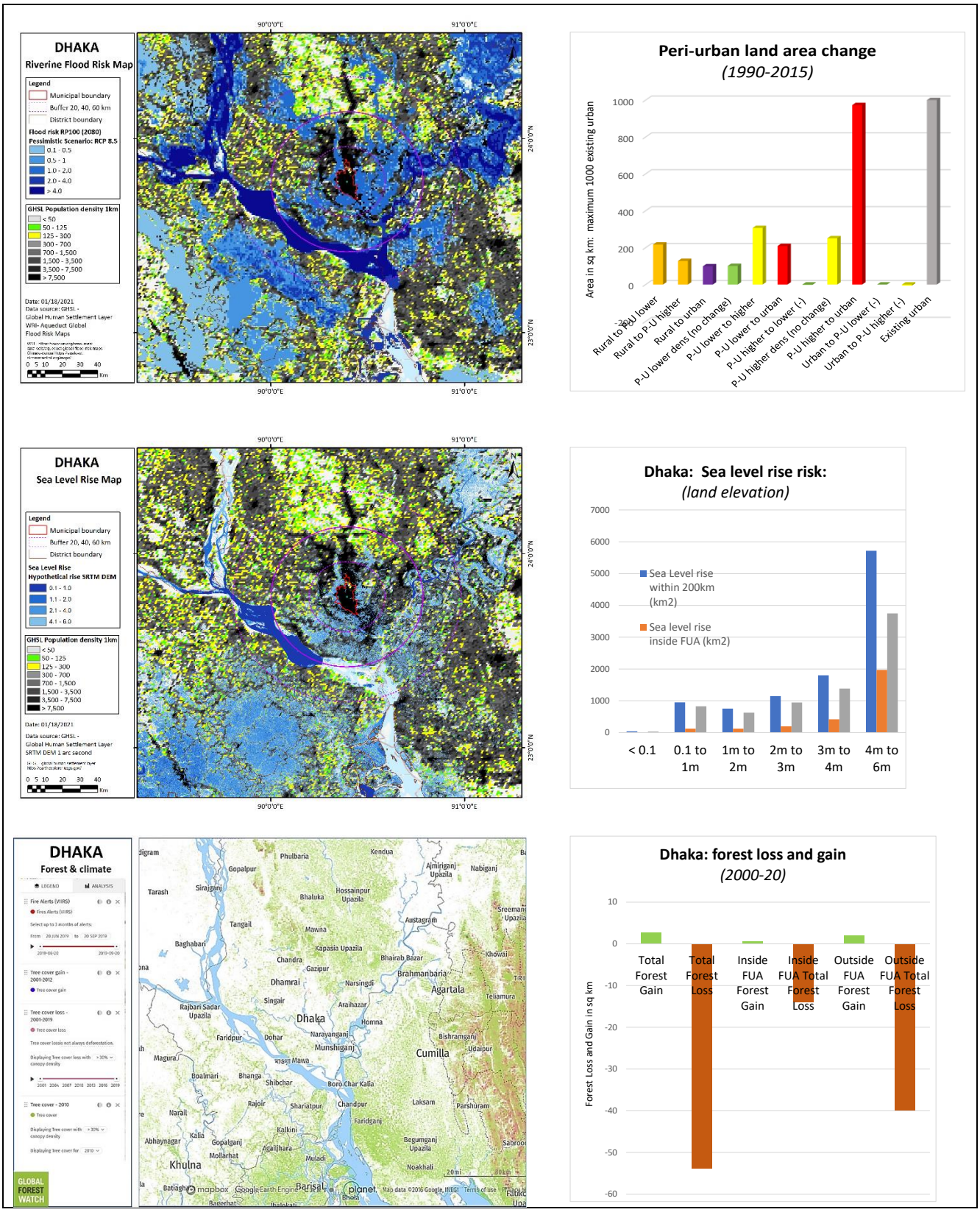
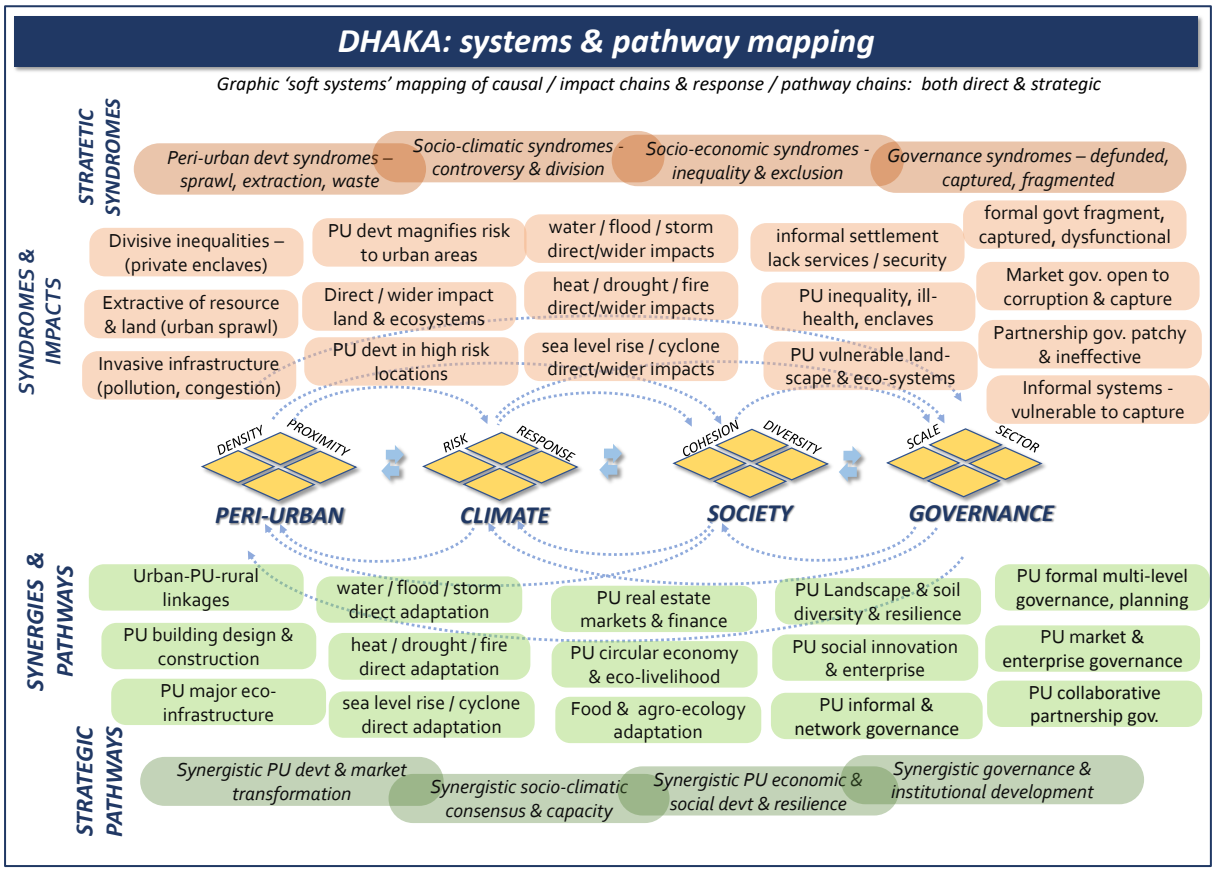


***Figure 6.4: system & pathway mapping***




## Governance issues

- Clientelist state with a dual 'party-archy'. Spatial planning is disconnected between local, metropolitan and national level. Climate policy is recognized but not yet mainstream.
- Many civil society organizations in a complex mix of patronage. NGOS are active in slum dwelling advocacy, for security & services
- Corruption & elite capture is standard. Informal settlements often without basic services are in the grip of local elite & enforcers
- However, Bangladesh is a known development 'success story', due to high levels of education and gender empowerment.

## 6.1 Adaptive Pathways:

***Rural-urban linkage pathways:***

This pathway emphasises on the need to manage a more sustainable growth of Dhaka's peri-urban areas through a stronger urban and rural linkage. This is important considering the multiscale, sectors and actors contributing to the expansion of Dhaka's urban areas. Taking as an example on the informal slums occurring in the peri-urban areas. While this could cause or reflect a social, economy and environmental problem, there had been difficulties to deal with them. By location, it falls under a rural jurisdiction it is not considered as urban problems.

This pathway also focuses on ensuring sufficient infrastructure supplies and public services for an inclusive peri-urban development. This is to minimise the bypassing of, for example, water and transport infrastructure which has not yet been inclusively serving the peri-urban community

***Climate resilience and vulnerability pathway***

This pathway correlates with the major issue of environmental degradation like the decline of water quality, flooding and riverbank erosion due to uncontrollable residential development and marginalisation in the peri-urban areas of Dhaka. It is of paramount importance to ensure the sufficient provision of a minimum standard quality of water. At the same time, this calls for an emergent collaboration from the public, private and local people to contribute in the better management of rivers and settlement drainage system for better flood mitigation. It is also important to ensure the protection of green open spaces for a fully functioning catchment area.

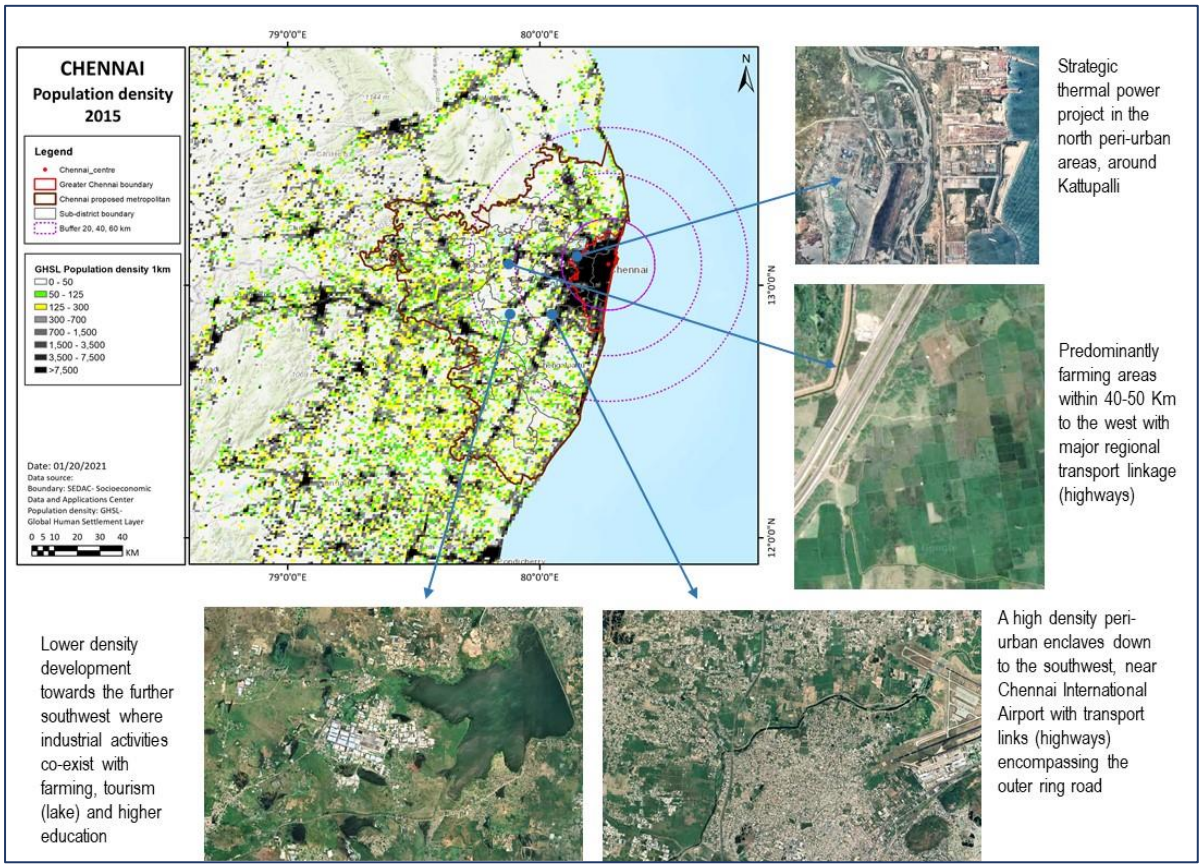
***Collaborative and integrative governance pathway***

Referring to the case of informal slums (as an example), there is a need for integration in the many aspect of governance – public, private, national, local and most importantly urban and rural. It can be problematic if informal settlement is recognised as a rural problem – for instance, urban and rural policies apply different indicators and thus can lead to different policy outcomes. It is also important to empower the practice of good governance by establishing strong authoritative bodies to control clientilsim, corruption and so on.

# 7 Chennai

***Scope:*** *The Chennai region includes the new metropolitan area with its bio-regional hinterland. The detailed case study (see Deliverables 4-1a & 4-2a) focused on three local areas: (micro-scale) a village in the industrial corridor to the west: (meso scale) the IT corridor / coastal zone, and the larger hinterland of rural river catchments to the east.*

***Figure 7.1: where is the peri-urban***




## *OVERVIEW*

Chennai is a rapidly developing coastal megacity. Its story demonstrates the growing vulnerability to sea level rise and cyclones, riverine flooding and water stress, and the major disruption of livelihoods and ecosystems by the impact of peri-urban sprawl on a very complex sensitive water-based landscape.

***Peri-urban syndromes:*** rapid urban & industrial sprawl into low-lying landscape of complex water systems, & further hinterland: general disruption of ecosystems & livelihoods, development in high risk locations:

***Climate change syndromes***: riverine & flash flooding: major cyclones: sea level rise & incursion: general water stress, disruption to soil & ecosystems, displacement of floodwater to urban areas: urban heat island & air pollution: increasing extreme wet heat days:

***Societal vulnerability***: large scale transformation of rural economies & livelihoods: rapid social change & gentrification: disruption to rural farming & landscape systems:

***Governance syndromes***: political fragmentation, widespread elite capture, illegal construction & encroachment: growing climate awareness but policy so far is lacking:

***Adaptive pathways***: urban-rural linkages for ecosystems & livelihoods: agro-ecology & integrated food systems: integrated water & adaptation management: social grassroots innovations & community resilience:

***Adaptive governance***: integrated regional climate-wise planning: private sector & market integration: civil society governance.

## Peri-urban issues

Peri-urbanization can be seen as a process of being and becoming over time and space. One conception of the peri-urban is to employ ecological boundaries instead of administrative ones manufactured and rendered porous through multiple processes such as urbanization.

a) The community / neighbourhood scale is usually managed by village panchayats. However, villages like Katchipattu that sit at the crossroads of globalizing forces, show that other actors and stakeholders in the region can have direct and indirect impacts on their lives and livelihoods.
b) At the landscape scale is the Kovalam sub-basin to the south of Chennai, with wards within city limits and village panchayats just beyond, capturing the peri-urban continuum and the wide spectrum of communities. It also captures the 'corridor effect,' a symptomatic feature of Chennai's urban expansion. This landscape between Muttukadu on the coast and Siruseri in the hinterlands comprises multiple ecologies and communities: with varying levels of fragmentation, risks and vulnerabilities.
c) At the Bio-regional/macro scale, we explored using the Chennai watershed (made of up the basins of four rivers that drain through Chennai) that cuts across adjacent state boundaries to understand the larger intersectionality between Urbanization processes and climate change.

***Spatial analysis:*** *(from the charts below)*

- Much of the open and peri-urban land area is both within inside and outside of the FUAs (functional urban areas):
- Urban areas: very high density of inner city is stable: 25-year rapid growth in high density & medium-high density settlements. Urban land areas show continuous expansion
- Non-urban areas: very rapid growth in medium & lower density peri-urban. Land area triples in peri-urban bands.
- The overall picture is of higher population growth in the urban/suburban areas with moderate growth in the higher density peri-urban areas.

## Climate change issues

- One key focus for the Chennai case study has been extreme weather events like flood and drought in the peri-urban, and the use of the local traditional water management to mitigate

these disasters: and this raises topical questions on water governance, which crosses administrative boundaries and economic sectors. Flooding and flood risk management, concerning current flood hazards and also in the context of projected climate change induced increases in flood risk, are key concerns in the Chennai basin, given the sudden risks posed to communities, livelihoods and critical infrastructure. Indeed, recent flood events associated with extreme rainfall events in November 2021 have further focused on this risk.

- Areas like Sholinganallur and Siruseri on the IT corridor are most at risk for floods and inundation. There are cascading water bodies uplands that drain into the Buckingham canal and eventually into the Bay of Bengal. However, rapid development in these areas have seen encroachments on channels and water bodies that have given rise to inundation in low-lying areas and roads adjacent to channels.
- Overall, these diverse peri-urban areas are both generators of climate risks (particularly inundation, drought) and providers of climate change adaptation functions (for example, related to natural water management through the cascading braided tanks that are interconnected with one another and biodiversity conservation).

## Societal issues

- At the local scale: Katchipattu, a hamlet of around 5000 people with largely unemployed or underemployed youth located on the outskirts of this town tells a different story. This community, formerly small-scale farmers and landless laborers have largely been “bypassed” by the tremendous growth in their neighbourhood, and the youth, many with technical diploma degrees, suffer a worse fate.
- At the landscape scale:  Sriperumbudur, a town about 40 Kms from the city centre of Chennai is somewhat of a poster child for the Chennai growth / peri-urban story. It has three Special Economic Zones (SEZs) housing global giants like Nokia and Saint Gobain which were set up to create thousands of jobs. Accompanying this is rife real estate speculation that has significantly altered the landscape with gated communities and shopping complexes, with land value skyrocketing around villages that were largely agrarian communities.
- Conflict for water has heightened with industries, tankers carrying water to faraway neighbourhoods in Chennai clashing with those still practising local agriculture; furthermore, many industries are the main culprits in polluting water bodies like the one above.

## Governance issues

Working to conserve and enhance the water management functionality of landscapes in the peri-urbn hinterlands of the Chennai watershed can reduce flood risk in downstream urban areas and mitigate drought upstream, while also delivering benefits locally. However, this raises significant governance challenges that remain unaddressed. Appropriate governance frameworks are needed, encompassing the wide range of sectors and stakeholder groups interested in the future of these areas. Current governance frameworks are fragmented, spatially and sectorally: there are also high levels of informality and elite capture, encroachment of land, diversion of resources.

However emerging good practices can also be found.

- informal partnerships which exist with a mandate and role within more extensive institutional arrangements: e.g., Independent third sector formal organizations which play an active role in informal partnerships (e.g., Meenavar Sangam/fishermen collectives; Water-User Associations);
- Formal governance partnerships which bring together different levels and units of government: e.g., Chennai River Water Restoration Trust.

***Figure 7.2: spatial mapping & analysis***

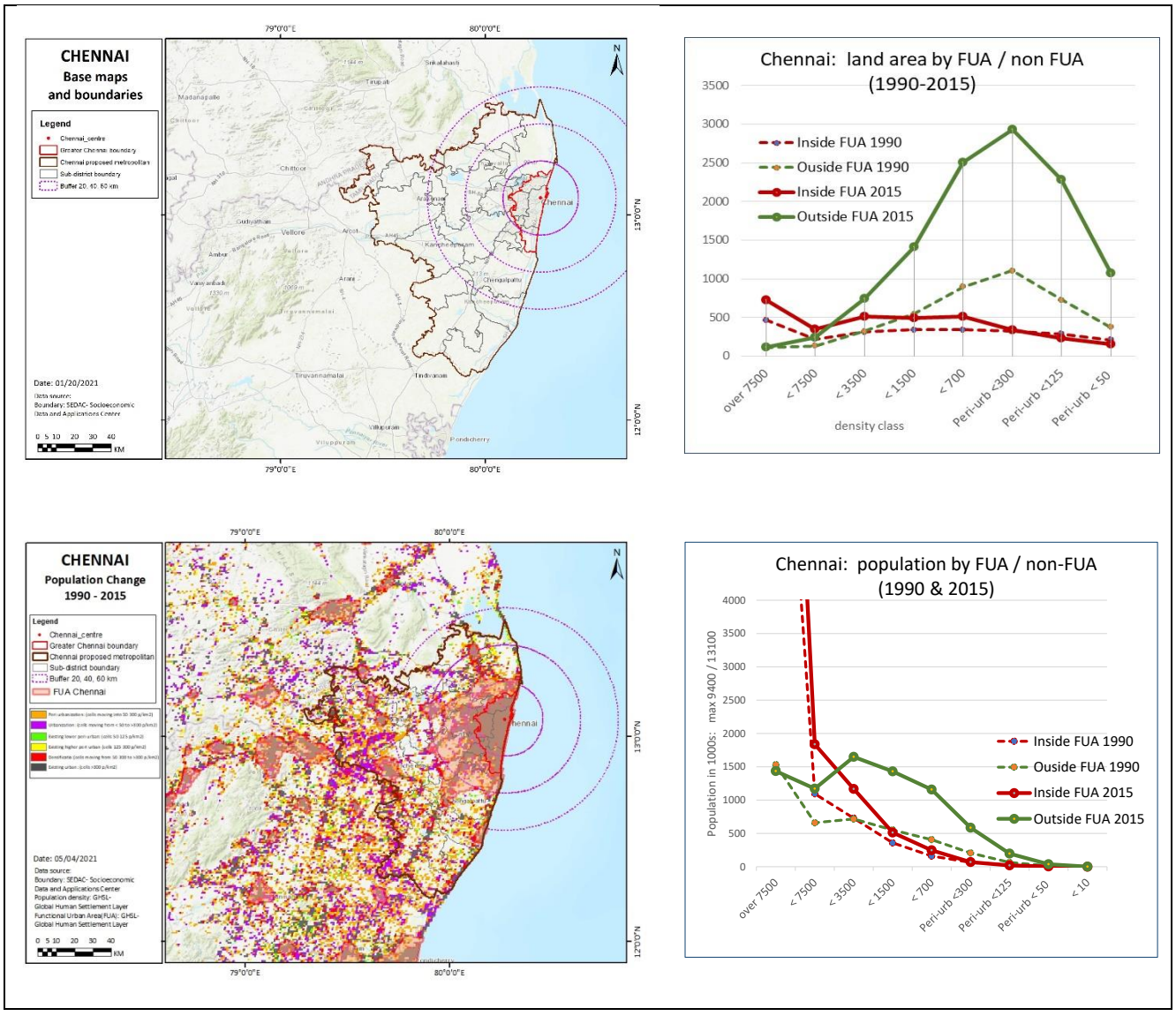
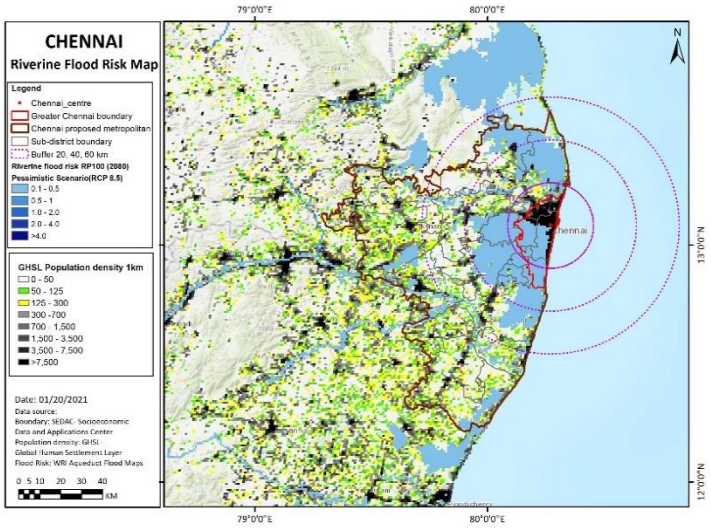
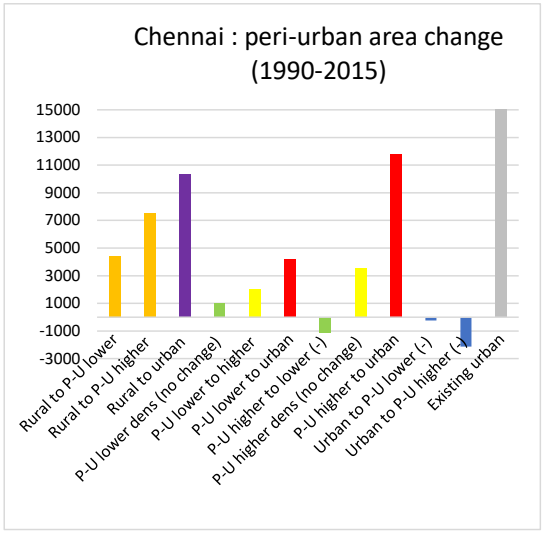
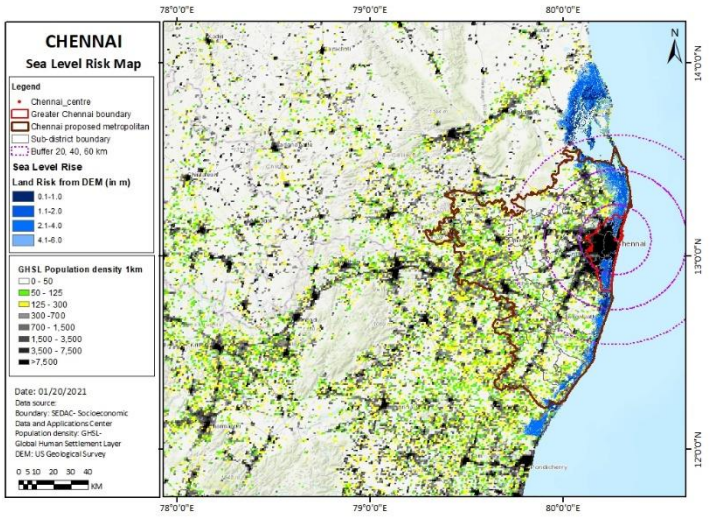
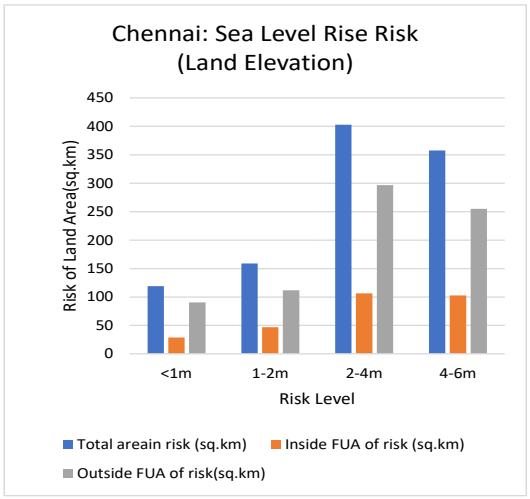


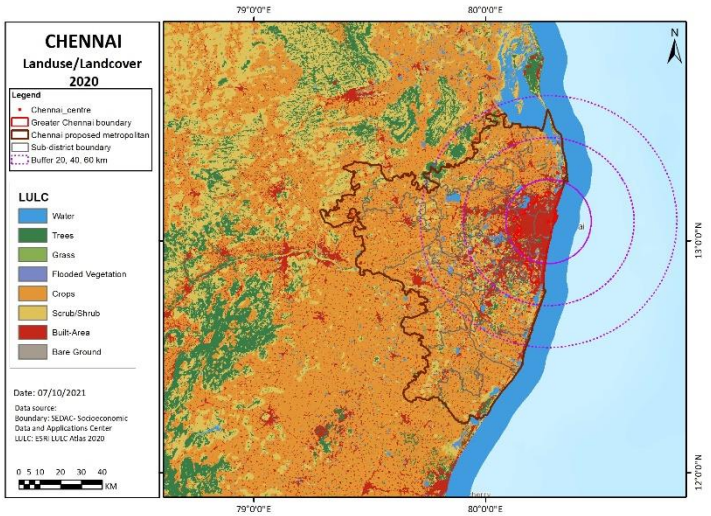
***Figure 7.3: climate effects mapping & analysis***



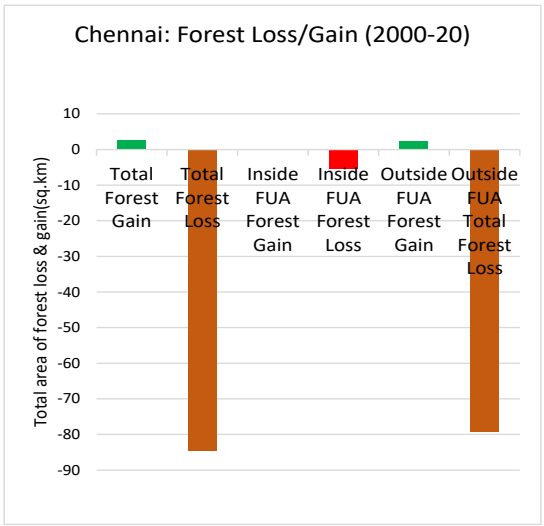
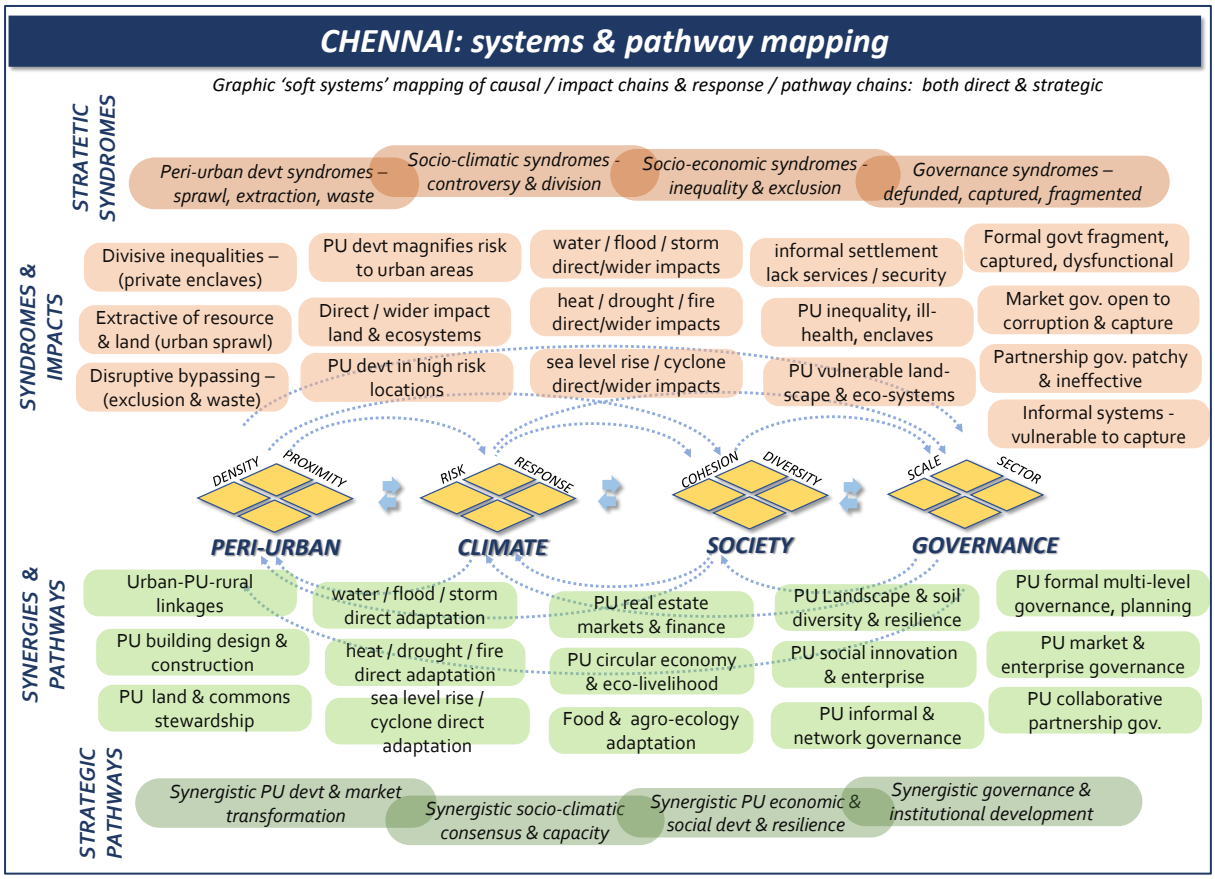



***Figure 7.4: system & pathway mapping***




## Adaptive Pathways at multiple scales

The potential for water management measures to sit as one of the different elements of a broader flood-drought risk management response in the Chennai basin has risen up the agenda. Managing and restoring these traditional water-bodies encompasses a wide range of interventions: From restoring degraded reserve-forests Upstream in the catchment areas to clearing the drainage channels, desilting the tanks, removing invasive species in the water-spread area, removing encroachments especially along with soft-edge, strengthening the bunds and associated infrastructure, addressing point and nonpoint pollution risks and preserving the natural ecology of the associated wetlands.

***Social eco-innovation and micro-governance***

- At the neighbourhood scale, use of a community gardening initiative to develop social capital amongst disenchanted youth groups and marginalized communities by providing a supplementary source of income and potentially rebuild and rekindle a lost sense of community and arrest social unrest within the community. This is already demonstrated in the village of Katchipattu near Sriperumbudur, in the industrial corridor.

***Eco-tourism pathway***

- At the peri-urban landscape scale, an earlier project '*Water as Leverage'* shows possibilities to intervene in a region that will continue to urbanise rapidly. Future policies could use design tools to incorporate "blue-green" and "sponge-city concepts to avoid further social and ecological fragmentation and raise the potential for resilience at such a scale.

***Agro-ecology pathway***

- At the bio-regional scale there is an emerging agenda for food sovereign spaces in 'poramboke' lands ('commons' attached to water bodies) thereby building climate resilience in the urban and peri-urban geographies involving local communities. This is also about greening the city's waterscapes with food-forests. This would mean re-imagining current food supply chains, shortening them, involving local, marginalised communities, alternative socio-economic models such as FPOs (farmer producer organizations) that will over time ensure food sovereignty and safeguard ecological assets.

At the macro scale, we explored the idea of using the Chennai watershed (made of up the basins of four rivers that drain through Chennai) that cuts across adjacent state boundaries as well. We asked what conceptions might such a scale add to the discourse on Peri-cene? However the proposed Chennai Metropolitan Area, four times the present area and covering 3 other districts, represents the diverse landscape and hence was chosen to represent the bio-regional scale.

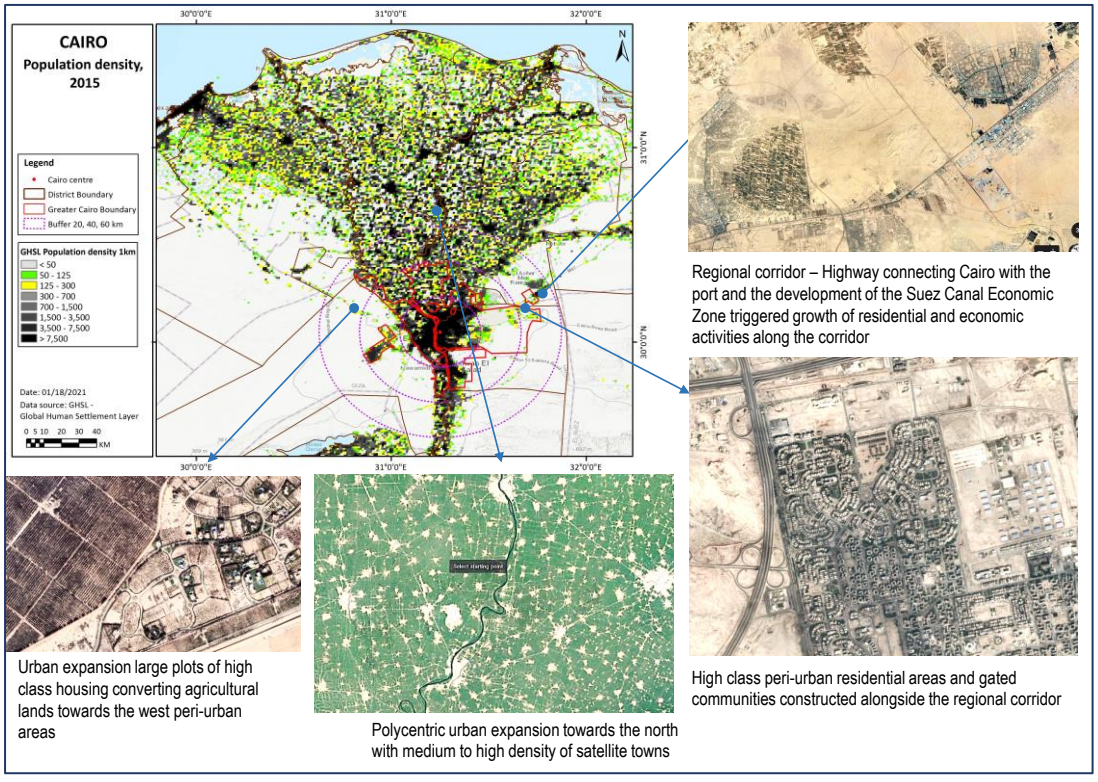
In that case, the peri-urban-climate agenda is subsumed in a larger and more uncontrollable moving picture of power, conflict, turbulence and disruption. This shows up in practical cases: for instance the Chennai adaptation agenda translates into practice, with the clearing of informal settlements from the banks of the rivers and water bodies, for the management of flood defence etc. However the residents are then moved to peri-urban 'resettlement colonies', cut off from jobs and services and communities: quite likely to be adding to the disruption of water and ecosystems in the hinterland which contributes to such flooding.

The implications: sooner or later the Peri-cene 'adaptive pathways' and recommendations, have to challenge in some way the existing system, which has produced such problems, and enables them to continue and reproduce.

# 8 Cairo

***Scope:*** *a historic and modern city with a very dense older core housing nearly 10 million, surrounded by a Greater Cairo Region (GCR) with an equivalent population. The Greater Cairo Region is defined as the Governorate of Cairo, Giza and Qalyubia: plus the new urban communities that are located around Cairo. Peri-urban development is concentrated in the expanding cluster of satellite cities and towns. However the entire Delta region including Alexandria, is in a similar peri-urban development pattern and density type, so is included here in the wider 200km hinterland of GCR.*

***Figure 8.1: where is the peri-urban***




## *OVERVIEW*

Cairo is a historic megacity-region: rapid expansion with new settlements into surrounding desert, and a steady filling up of the delta and coastal area: the peri-urban faces multiple climate threats from flood, heat, drought and sea level rise, overlaid on a problematic governance system.

***Peri-urban syndromes:*** (a) in desert areas new satellite towns & cities are lacking in connections & livelihoods: (b) in delta & riverine areas, densification & sprawl into low-lying landscape of complex water systems: widespread conflict on land & ownership, encroachment & informal construction:

***Climate change syndromes***: riverine & flash flooding: sea level rise & incursion: general water stress with projections of drought & upstream flood: urban heat island & air pollution: new settlements are vulnerable in hostile environment: increasing extreme wet heat days:

***Societal vulnerability***: ongoing transformation of rural economies & livelihoods: rapid social change, migration & gentrification: disruption to traditional farming & landscape patterns:

***Governance syndromes***: top down system with widespread military / corporate / elite capture, bureaucratic fragmentation, informal construction & encroachment: climate awareness lacking so far (this may change at COP27):

***Adaptive pathways***: urban-rural linkages for ecosystems & livelihoods: landscape diversity & agro-ecology systems: integrated water & adaptation management: heat & drought management: social innovations & community resilience:

***Adaptive governance***: integrated regional climate-wise planning: formal government capacity building: civil society governance & participation systems: social & grassroots initiatives.

## Peri-urban issues

***Spatial analysis:*** *(from the charts overleaf)*

- *Urban areas: very rapid growth in high density & some medium density*
- *Non-urban areas: steady growth in medium density.*

- Urban areas of Cairo had been expanding extensively to the north towards the coastal areas where farmlands are the predominant social and economic activities. In these areas there are several satellite cities of medium to high density, which form a pattern of polycentric urban region
- In recent times Cairo's urban areas are expanding towards the east and west in a form of scattered and sporadic urban development. In these areas there are construction of several high-class residential areas, mainly within the 20-40 km buffer zone.
- Some of the scattered urban expansion were informal. Agricultural lands are being converted by buildings that are known to be without planning permission. These are also emerging alongside the ring road towards the north.
- Multinational companies settle around the Suez Canal economic zone, which trigger growth alongside the highway connecting the Cairo urban centres to the canal. This regional corridor bypasses the existing settlements as density seems to be increasing with more newly built high-class residential areas. The development of this regional corridor coincides with the emerging growth of economic activities in Ramadan City, situated between Cairo and the Suez Canal.

## Climate change issues

*(From ASU presentation)*

- A dominant type of the peri-urban areas (not planned new urban communities) in GCR mainly is located around the ring road as an illegal expansion of the core city or as an encroachment on agricultural lands.
- These structures are highly exposed to a high level of pollution because of the roads' approximate and the high capacity of motorized vehicles

- In addition, the compact urban form with low permeability may suffer from UHI effect
- The expansion of the peri-urban areas on the agricultural lands causes agricultural lands removal and land cover changing, which can lead to food insecurity among other challenges.
- In addition to water shortages, the city, especially its per-urban areas and new urban communities are challenged by urban flooding, whose dangers are intensified by increased urbanization around the city that limits where floodwaters can flow.
- These extreme weather conditions, that are expected to grow due to climate change and water systems in cities in the global south are often unable to cope with these challenges, bringing cities to halt and damages and losses in millions (WEF, 2011).
- In the past years, Egypt has been witnessing increase in rainfalls and flooding in the winter seasons that caused houses collapse, power outages and chaotic traffic conditions (Egyptian Streets, 2020).
- the majority of climate mitigation funding is dedicated to low coastal development so far: very little funding goes to addressing climate change impacts in agricultural lands in the delta or protecting the vulnerable communities of informal areas in the urban and peri-urban areas (O'Connell, 2021), (Charbel, 2017).

## Societal issues

- Some of the Peri-urban areas suffer from the inappropriate urban structure (physical vulnerability). Buildings suffer from inadequate spaces for living or inappropriate orientation for ventilation. On the other hand, there are buildings with well-constructed concrete structure.
- Infrastructure provision of the peri-urban areas in terms of electricity, water, sewage....etc. mainly depends on illegal connections to the public networks or depending on off-grid sources.
- Some development plans of the peri-urban areas depends on international grants such as GIZ grant for developing the informal areas in Egypt and initiatives of the NGOs.
- The governmental act in these areas is represented in granting legal ownership rights to residents of these areas and legalizing their status and their benefit from the infrastructure.
- On the physical layer, those areas can suffer from some sort of conflict in term of building requirements that can mainly happen in expanded urban areas on the agricultural lands when the area is following a village and attached to cities.
-

## Governance issues

- Public land management: land owned and controlled by the government forms around 90%of the country's surface area. Managing this resource in ways that benefit the country's economy and the mass of its people is crucial.
- Challenges related to public land management: There is almost no publicly available public land information system or inventory, resulting in confusion for both investors and citizens alike on which institutions control what land, where it is available, and under what conditions.
- There is limited monitoring of development projects 'feedback loops', once lands have been allocated to find out what has worked and what hasn't and why. The various authorities that allocate public land, such as NUCA, GARPAD, and TDA, rarely carry out evaluations or lessons-learned exercises.
- The need for a coherent national policy that defines the purposes of the public land asset and how to deal with it is yet to be met, individual self-serving decisions about public land are common. there are general pronouncements about generating employment and creating

affordable housing for the poor. But the actual figures show how little public land has managed to directly benefit the masses. (Sims, 2015).

***Figure 8.2: spatial mapping & analysis***

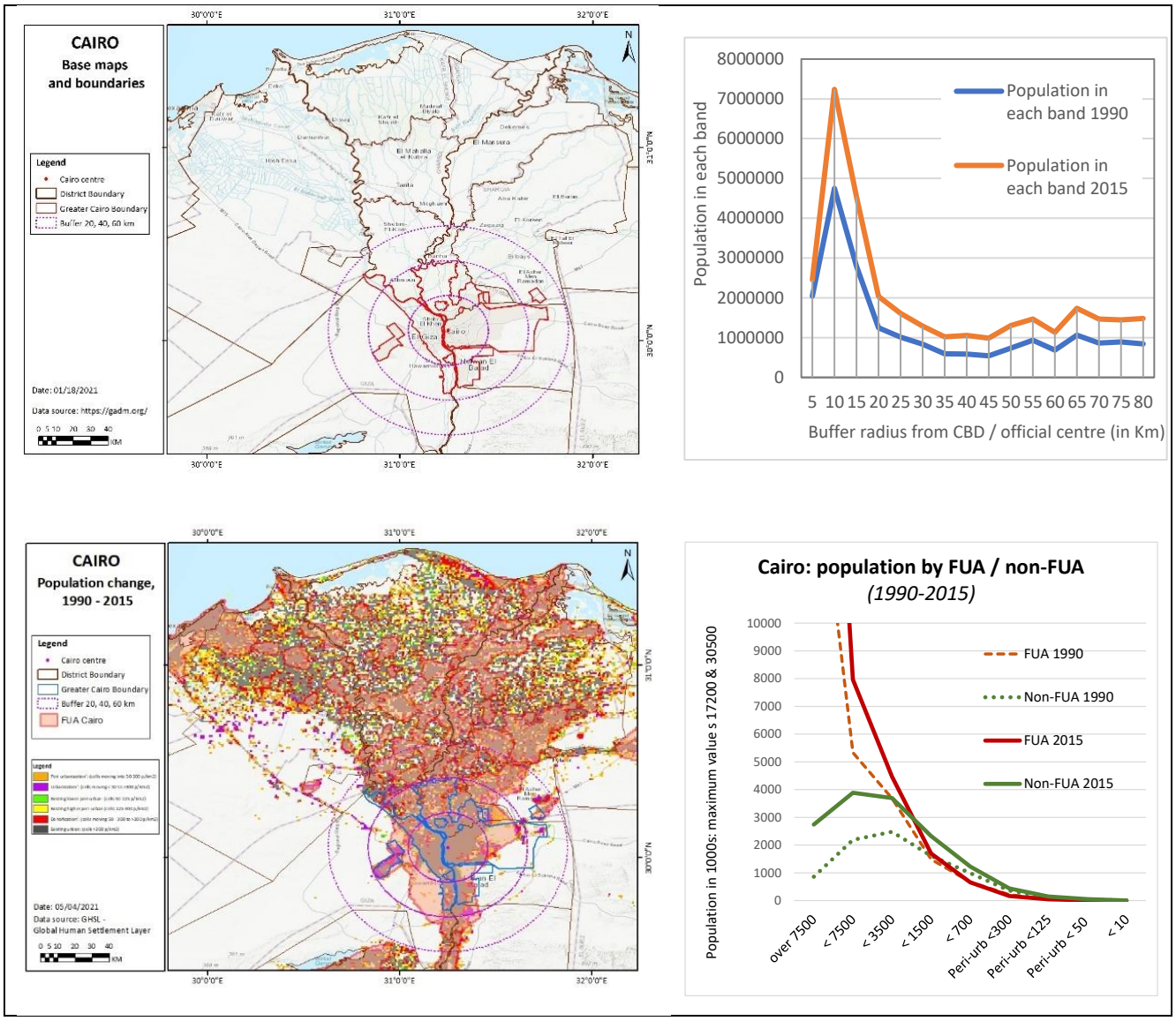


***Figure 8.3: climate effects mapping & analysis***

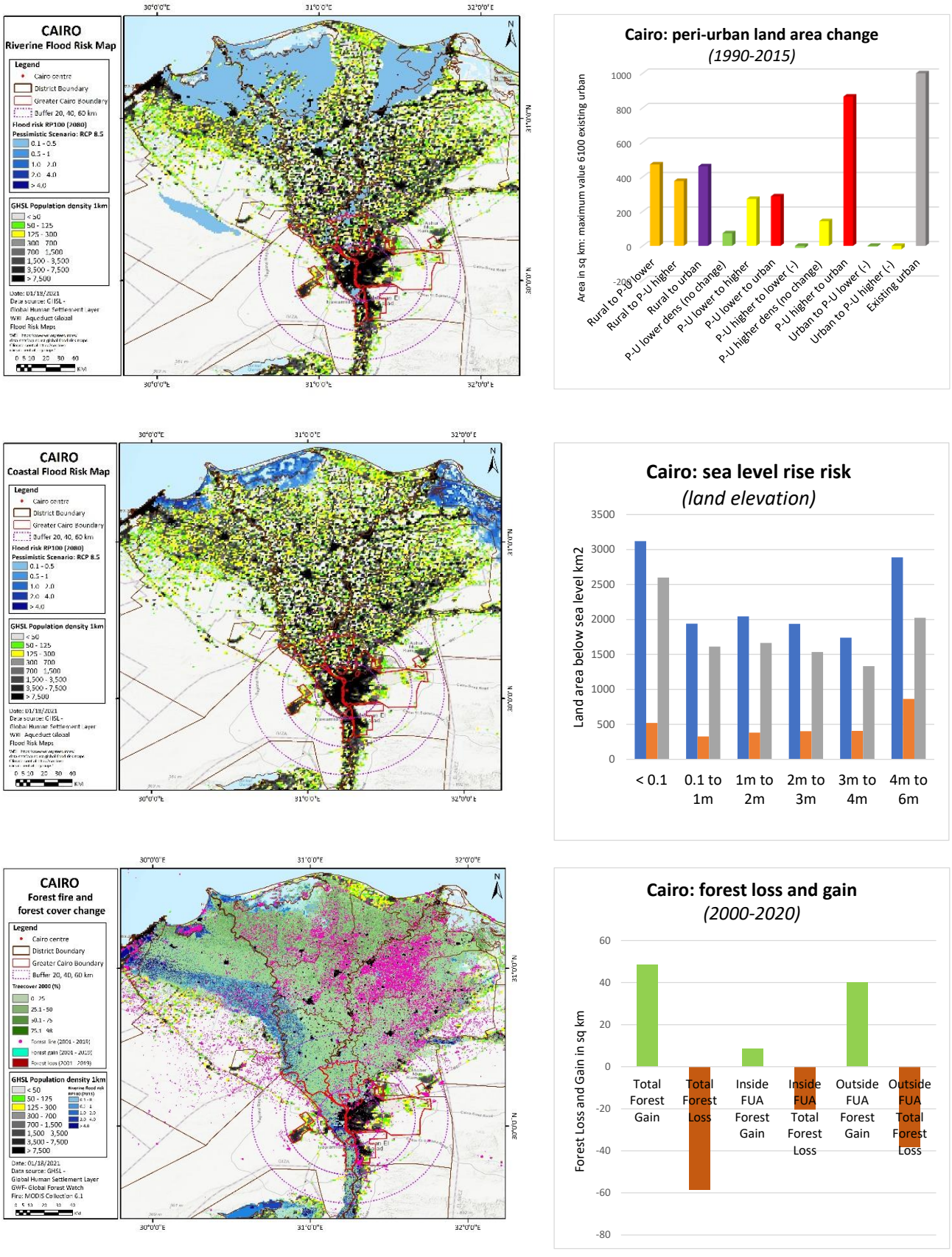
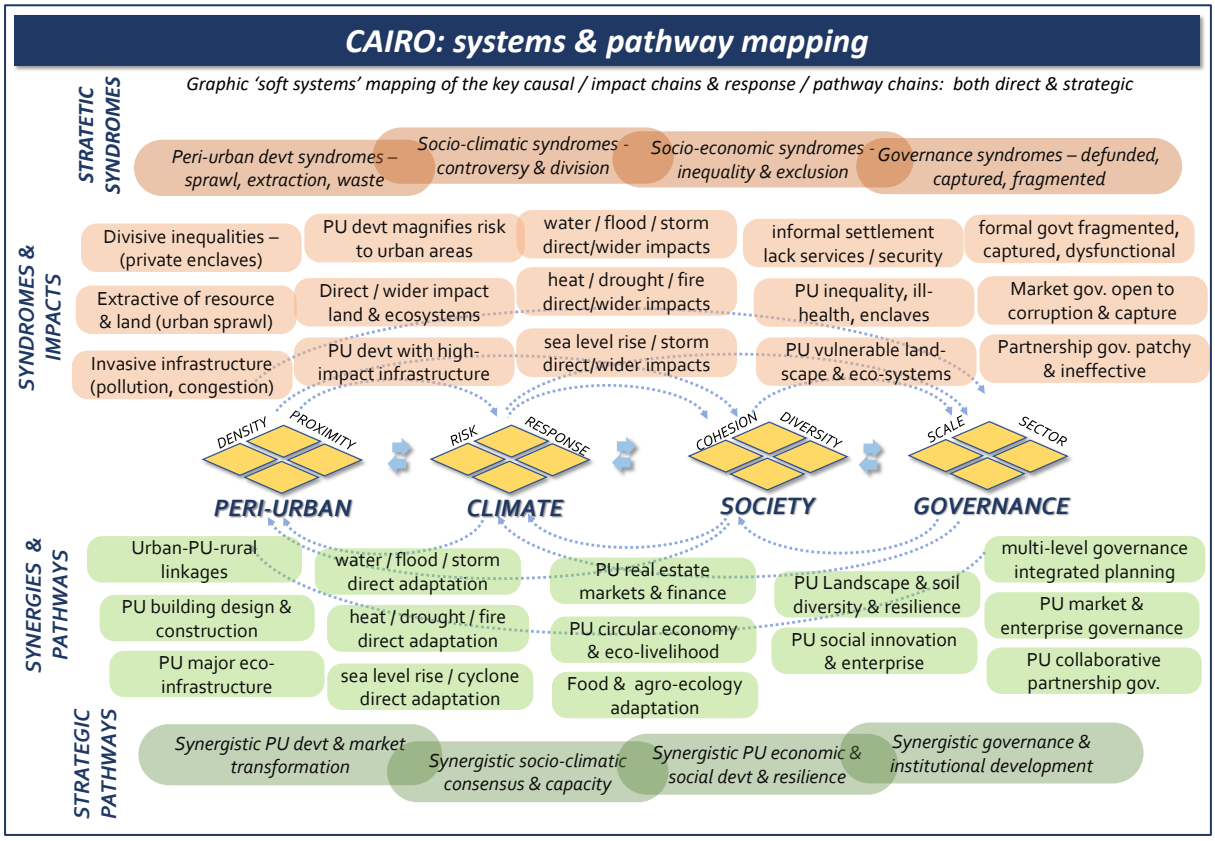


***Figure 8.4: system & pathway mapping***




## 8.1 Adaptive Pathways

On the positive side, there are great examples of renewing the 'peri-eco-urban' resilience. Looking beyond one-off projects, these ***adaptive pathways*** combine ecological stewardship, collaborative governance, agro-ecology farming, integrated water systems, low impact coastal defence, nature based livelihoods, and so on. And to make all these work calls for enhanced forms of governance – adaptive, collaborative and inclusive of all stakeholders.

***Peri-urban-rural linkage pathways:***

A stronger link, connectivity or integration between urban and rural is a key theme to bring Cairo's peri-urban areas a place of resilient communities. This particular pathway channels policies for responding to the fragmented and socially segregated peri-urban areas of Cairo. Additionally, considering the massive conversion of agricultural lands, particularly along the regional economic corridor connecting Cairo and the Suez Economic Area, there is a need to for an integration of urban and rural economy. This calls for policies to protect the remaining agricultural lands while 'restoring' the intrinsic peri-urban values that has been declining due

to dramatic rural-urban transformation. Meanwhile, it is also essential to connect the long-term local people with the new people residing in the new high-class residential areas to narrow the gap and prevent potential social conflicts. Establishing community-based programs that bring together the peri-urban community might be a visionary strategy. On the other hand, there is also a need to ensure inclusive provision of basic infrastructure for all. Currently, the local-long term people's residential areas are bypassed by the construction of regional transport corridors. Ensuring local connectivity between enclaves and improving access of local people to a better waste management, clean water and transport to urban centres is seen as equally important.

***Climate resilience and vulnerability pathway***

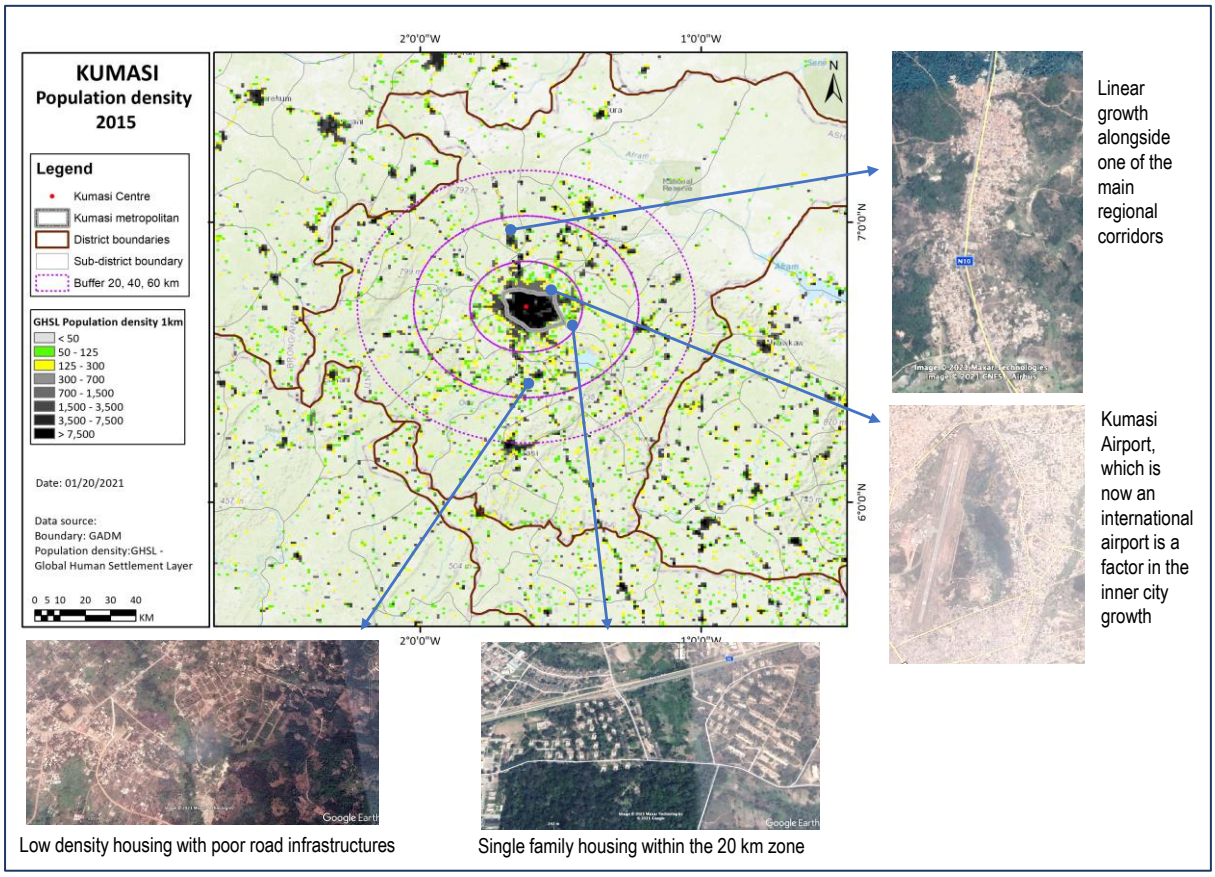
One of Cairo's biggest climate challenges is related to water – potential flooding along the coastline and the Nile Delta due to sea level rise and the shortage of water supply potential affecting the overall agricultural productivity in the foreseeable future. This challenge is typical for regions situated within close distance to the coast and of those with high reliance on agricultural sectors. To address this two 'opposing' phenomenon, Cairo needs a better design of peri-urban areas in two big themes. First is redesigning the coastal areas which can involve delineating the flood-prone areas and impose a strict zoning regulation. This needs to be followed by restoring the ecosystem values of those areas. The second theme is to ensure the provision of sufficient water supplies along the Nile Delta to maintain the food production capacity. This can be done by constructing and maintaining irrigation canals. Suggesting a crop change can also be an alternative strategy to promote a resilient and sustainable food production. Meanwhile, to prevent severe impacts of climate change to the people, a better design of settlements can be a core strategy. This can include eco-designs of housing and also to allocate development to suitable locations (e.g. fair distance to industries that is currently growing along the Cairo-Suez corridor). Providing basic infrastructure is of a paramount importance – e.g. health and sanitation, access to clean water etc.

***Collaborative and integrative governance pathway***

Some of Cairo's peri-urban development is unplanned. Thus, bringing a more formalised peri-urban development can be a key component to an improved governance of peri-urban areas. This channels a better monitoring and evaluation of policy and to ensure they are implemented accordingly. A climate resilient peri-urban area also requires strengthening the roles of Environmental Impact Assessment for better screening of development, particularly of those with significant impact (e.g. manufacturing, transport hubs and other strategic major projects along the Cairo-Suez corridor). Another important point to suggest is the need for a better technical guidance or indicators to regulate development. Currently, there are confusions in the use of indicators applied to both rural and urban development. There is a need to provide a separated but integrated guidance for both. Lastly, while Cairo's peri-urban development reflects their local, regional and global dynamic, it implies that there is a need for stronger collaboration of actors of all levels and between the public, private and community.

# 9 Kumasi

***Figure 9.1: where is the peri-urban***




## *OVERVIEW*

Kumasi is a fast developing West African city set in a fertile landscape, with impending climate stress from extreme heat, storm & ecosystems change:

***Peri-urban syndromes:*** rapid peri-urban expansion into a complex tropical landscape of forest, pasture & bush: lower-income settlements under pressure from middle/upper-income encroachment: disruption of peri-urban indigenous livelihoods & ecosystems:

***Climate change syndromes***: growing riverine & flash flooding: water stress, disruption to soil & ecosystems: urban heat island & air pollution: increasing extreme wet heat days: rapid depletion & burning of forest in the hinterland:

***Societal vulnerability***: rapid transformation of peri-urban communities, rural economies & livelihoods: urbanizing social change & gentrification: disruption to indigenous farming livelihoods, landscape & ecosystems:

***Governance syndromes***: dual system of customary tribal government & land ownership: widespread political inertia, elite capture, informal economies: little if any climate awareness or policy:

***Adaptive pathways***: urban-rural linkages for peri-urban livelihoods: agro-ecology & integrated food systems: circular economy livelihoods: grassroots innovations & community resilience:

***Adaptive governance***: integration of formal / customary governance: strategic climate-wise planning: private sector & market integration: civil society as active institution.

## Peri-urban issues

***Summary of spatial analysis:*** *(from charts overleaf)*

- *Urban areas: sudden growth in higher density population, falling off to the urban edge:*
- *Non-urban areas: inner peri-urban areas show rapid growth in medium densities:*
- *hinterland shows a steady land area growth, & outward spread of population along the urban-rural gradient.*

Built & developed as a concentric 'Garden city', radiated by 5 main corridors, connecting Kumasi to Ghana. Peri-urban devolvement occurs along the major corridors: led by individuality, local and traditional land management combined with planning agencies. Peri-urban change map shows rapid conversion of rural to peri-urban in SE areas.

Small communities live around the cities, farming communities (subsistence). The subsistence farmers cannot afford to buy their land, the tribal leaders can sell it off. Even if land is 'bought' by those living on the land, it is leased for 99 years. With rapid urbanisation the traditional leaders just take the land back.

Middle income families are pushing subsistence farmers out of their land. Some farmers are changing livelihoods to construction. Peri-urban areas are growing mainly by middle class encroachment, under a dual 'customary' legal system, displacing the land and livelihoods of many indigenes.

## Climate change issues

- Temperature projections to 2100 – 2-7+ degrees rise:
- Precipitation: DJF 30% uplift, with growing storm conditions.
- Extreme wet heat days of 35+ degrees could double or more
- All existing river systems are set to flood in rainy season.
- Forestry loss in most of hinterland, many forest wildfires in NE sector. Farming under pressure from new economic models, urbanizing cultures / lifestyles.
- Landuse change is impacting on ecosystems & carbon balance: water balance is fragile for subsistence farmers.
- Farming and former national parks are being encroached. Most of the wetlands and rivers are drying out, this is changing the ability for farmers to farm and so they must diversify their livelihood or relocate.

## Societal & governance issues

Unreliable rainfall patterns with heavy reliance. Inadequate irrigable lands. Harvest failures from improper adaptive strategies. Reduced biological productivity. Progressive loss of non-timber forest products. Increased land degradation, loss of arable land.

Reduction in livestock size and nutrition. Industry disruption possibly due to energy sector crisis. Raw material supply chain disruption. Higher risk property insurance. Population displacement.

Informal settlements are moved but without a clear location, so residents move back towards the centre, which then is unattractive to the middle classes, who then seek new peri-urban locations. Westernisation of the middle class is changing the housing preferences from compound housing to nuclear family living, greater peri-urbanisation.

***Figure 9.2: spatial mapping & analysis***

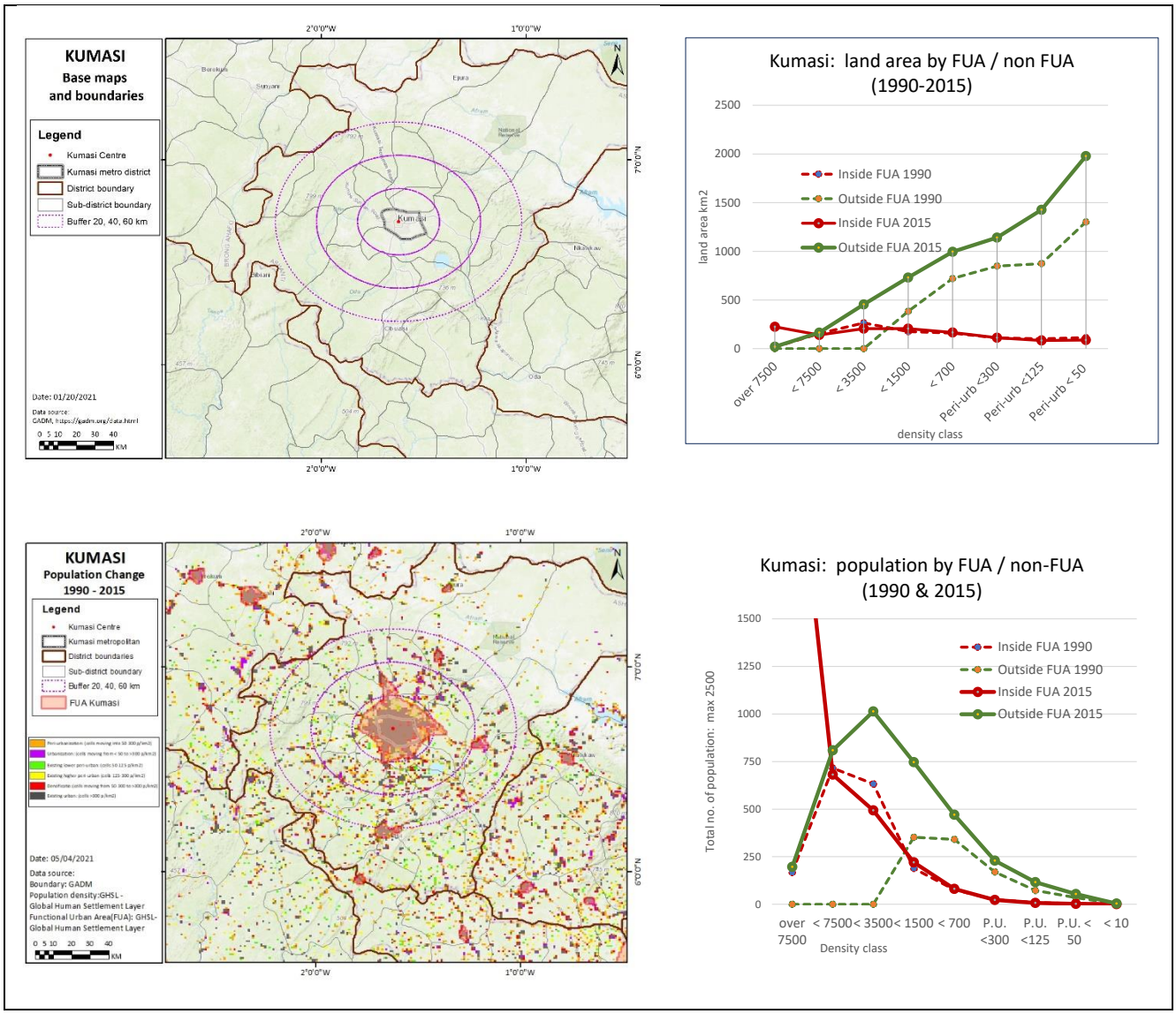
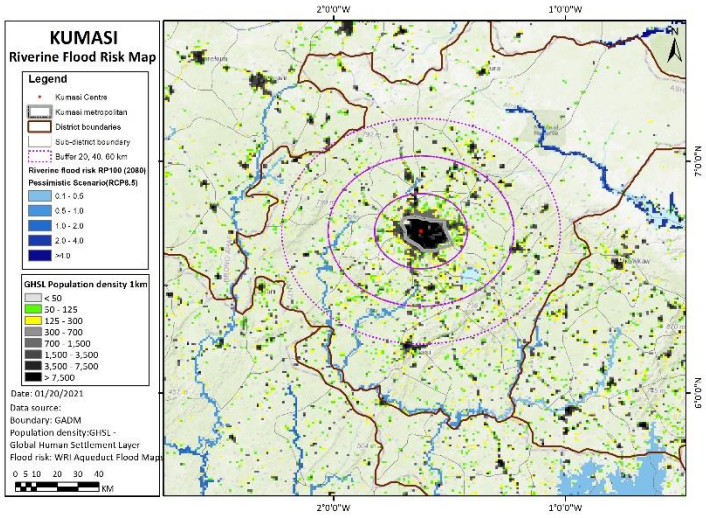
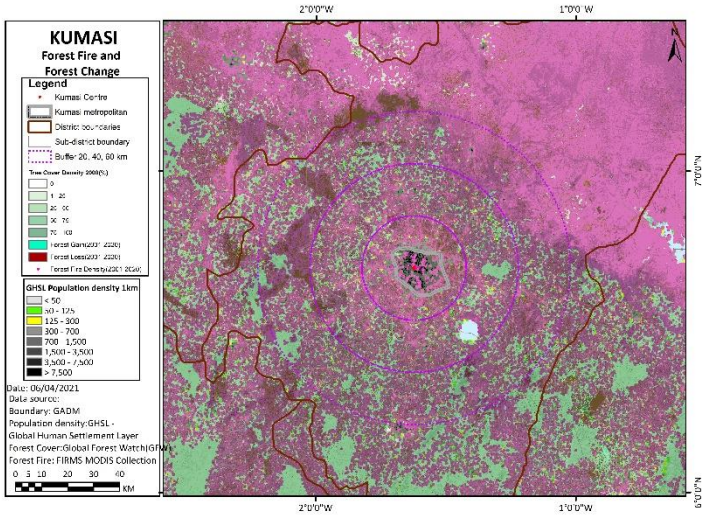
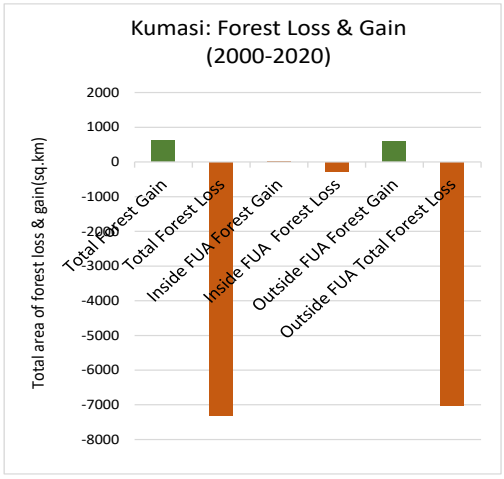
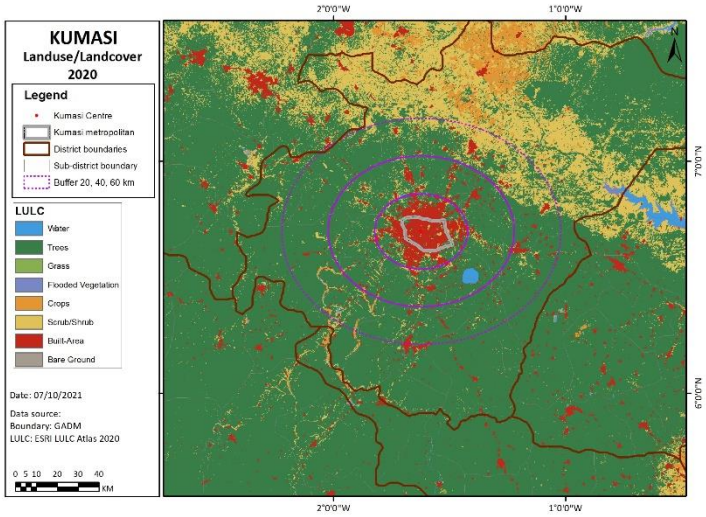


***Figure 9.3: climate effects mapping & analysis***



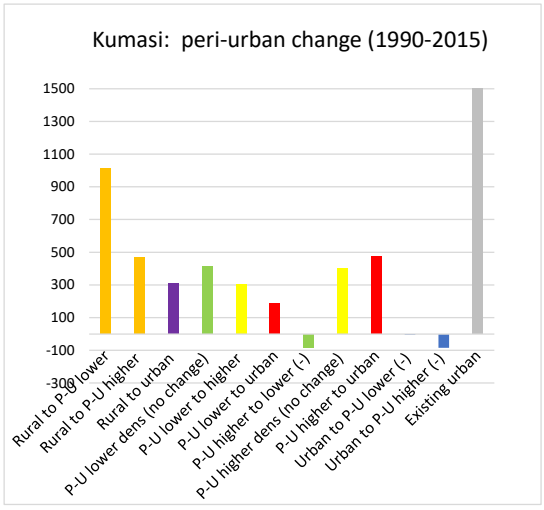
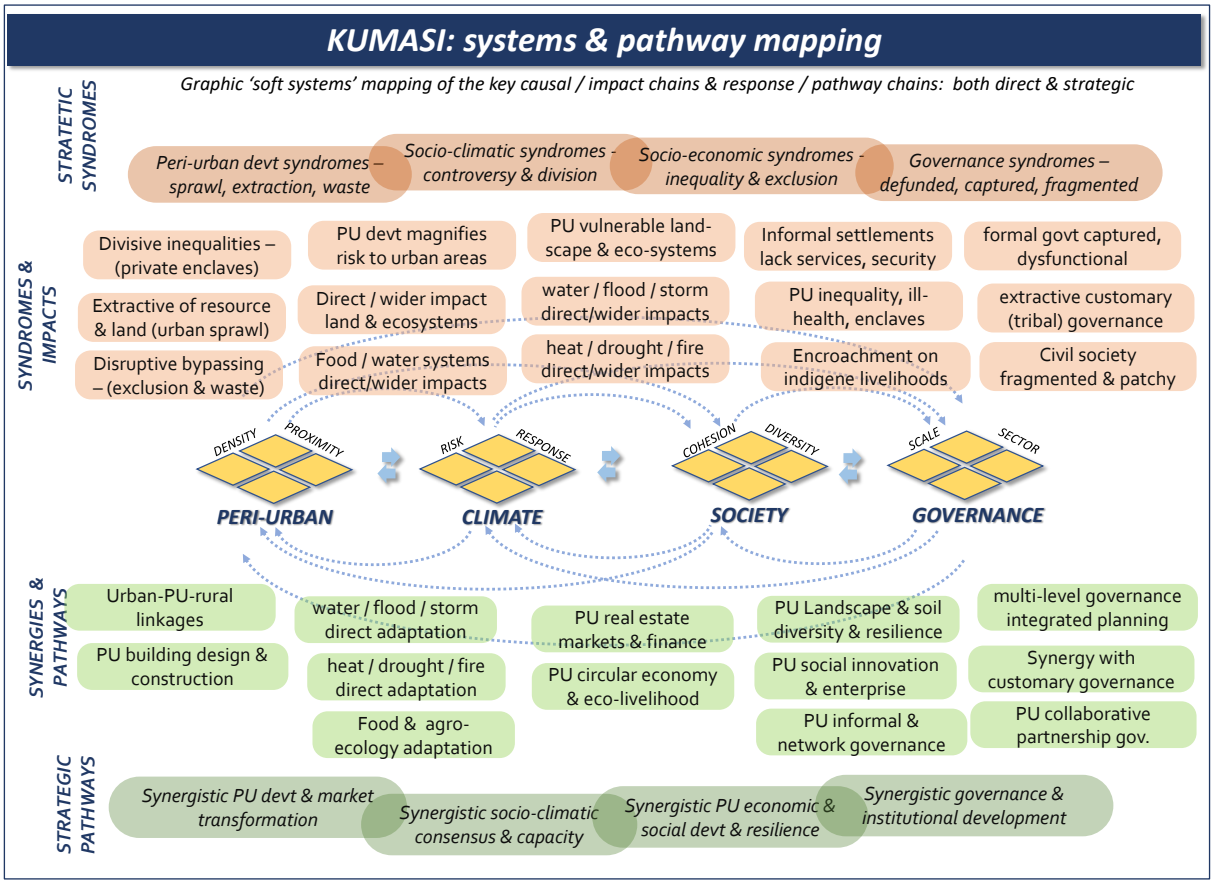



***Figure 9.4: system & pathway mapping***




Huge diversity of faith groups and informal community networks. African cities are largely informal, 80% of economic activities is informal, of 80% of land ownership is informal as owned by tribal leaders.

Kumasi is seen as the 'seat of the king': conflict between traditional 'customary' authority & modern administration. In reality traditional leaders are determining land use due to a weak planning system. Currently tribal leaders own 80% of the land.

Informal housing development occurs across Kumasi, in locations lacking infrastructure (water, electricity, roads). First housing is built, then access to infrastructure is considered.

People buy land and develop it before they have sought permission from planning authority. Land is bought from traditional owner. Traditional or tribal leaders need to work with new planning systems: the power struggle results in the informal development of Kumasi.

## 9.1 Adaptive pathways

(preliminary menu for debate & investigation)

***urban-rural linkages in the peri-urban***

Kumasi already shows many active urban-rural linkages & inter-dependencies, in food, labour, services: however many of these are exploitative and disruptive. The peri-urban adds another dimension to that mix: the 'PURL' aims to maximize opportunities and

minimize negative impacts on each kind of territory. Decentralized services, distributed eco-infrastructure, autonomous governance, each combine with agro-ecology, landscape resilience & climate adaptation, circular economy.

***heat / drought / fire / flood adaptation*** :

Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: rethinking where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence. For extreme heat, a growing agenda for building eco-design, social welfare, health & safety, adaptation of livelihoods etc.

***agro-ecology & food democracy***

Agro-ecology can rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

***circular economy & eco-livelihood***

businesses need to invest and create jobs & the peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

***distributed / networked infrastructure & services***

in the further hinterland, energy and water technologies see rapid innovation in local distributed harvesting, storage, conversions etc. These can enable further peri-urban off-grid expansion: they can also enable climate-proofing of development with practical alternatives to centralized / intensive infrastructure.

***Collaborative governance, civil partnerships***

As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

***Radical governance, grassroots networks***

For Kumasi the unique dual system of customary governance should be an opportunity for emerging forms of radical ecological democracy & the 'pluriverse'. These can show real alternatives to the mainstream top-down neo-liberal consensus on development & livelihood. The peri-urban can be host to many creative variations on the social dimensions of agro-ecology, local livelihoods, grassroots self-help, social mutual aid, stewardship of the commons etc.

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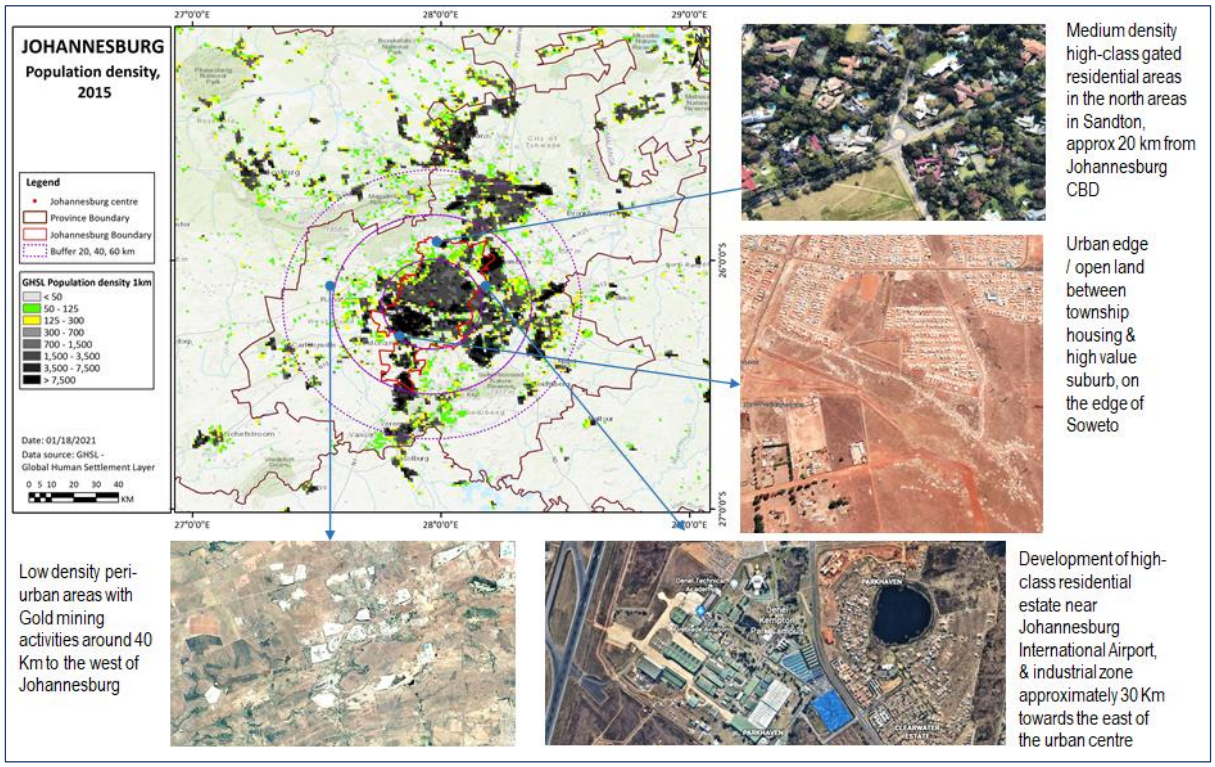
# 10 Johannesburg

***Scope:*** *the Johannesburg hinterland is basically the Gauteng-City Region, with 3 main conurbation stretching over Joburg, Pretoria and Vereeneging.*

***Figure 10.1: where is the peri-urban***




## *OVERVIEW*

Johannesburg is a vibrant city region expanding into a semi-arid bush landscape: isolated enclaves overlaid on apartheid-era townships: growing water stress, heat stress and forest depletion, in a divided & vulnerable society.

***Peri-urban syndromes:*** legacy of apartheid-era townships lacking connections, services & livelihoods: rapid low density expansion with high-security enclaves: ongoing disruption of rural livelihoods in the hinterland:

***Climate change risks***: growing water stress, drought & extreme heat days: forest fire with depletion of forest in hinterland: urban heat island & air pollution:

***Societal vulnerability***: growing structural inequalities & social tensions: fragile bush landscape, soil & ecosystems: growing water stress & urban-rural competition:

***Governance syndromes***: general institutional inertia & multi-level fragmentation: elite & corporate capture: active civil society lacks connections: little climate awareness & policy so far:

***Adaptive pathways***: integrated water management, design for heat & drought: agro-ecology & food democracy: landscape diversity & multi-functional land-use: decolonization agenda for peri-urban livelihoods: climate-wise peri-urban real estate & development patterns.

***Adaptive governance***: capacity building for government & public services: collaborative-associative governance with civil society: community grassroots initiatives

## Peri-urban issues

***Spatial analysis:*** *(from charts below)*

- *Urban areas: growth in high & medium density*
- *Non-urban areas: growth in medium density*

- Apartheid spatial planning has defined the SA "Peri-cene": Joburg hinterland is the Gauteng-City Region stretching over Joburg, Pretoria and Vereeneging.
- Huge residential component to the Joburg Peri-cene: both informal, govt housing (RDP) and new gated communities.
- So as Africa's "arrival city" the Peri-cene in Joburg is connected to the whole continent, with economic priority of mining: not only on the urban edge, but within the City too, deeply connected to rural networks
- Planning policies post-apartheid - "compact city" and TOD: but with privatisation of housing and services, and historical apartheid planning as a key driver. Since democracy, a move to a neo-liberal democracy: govt housing relied on the private sector -> housing projects on cheap peripheral land. Dependent on international donor orgs and loans.

## Climate change issues

- Rising temperature & regular droughts & water stress
- Flooding due to building under the water lines
- Polluted rivers making residents sick: toxic land from mining waste
- Fire a huge problem in informal settlements

## Societal & governance issues

- Historic apartheid policy still is evident in space: with xenophobia - the marginalization of local South Africans towards other African migrant groups
- State-owned enterprises filled with corruption: distrust and cynicism of government: data collection is weak: Siloes between spheres of government and within spheres
- Crime, unemployment, inequality very high: youth unemployment major issue
- poor waste collection services: informal taxis filling the gap of insufficient transport
- informal sector is massive, but not enabled: diverse and rich cultural offering, but no market: many street committees, trading associations,
- Mining communities exploited and under-serviced, with mines' toxic waste: huge mining companies

- private sector-driven development, with private housing and services companies
- Organised land grab groups: business forums or SMMES (often understood to be gangsters)
- large-scale white-owned peri-urban farms

***Figure 10.2: spatial mapping & analysis***

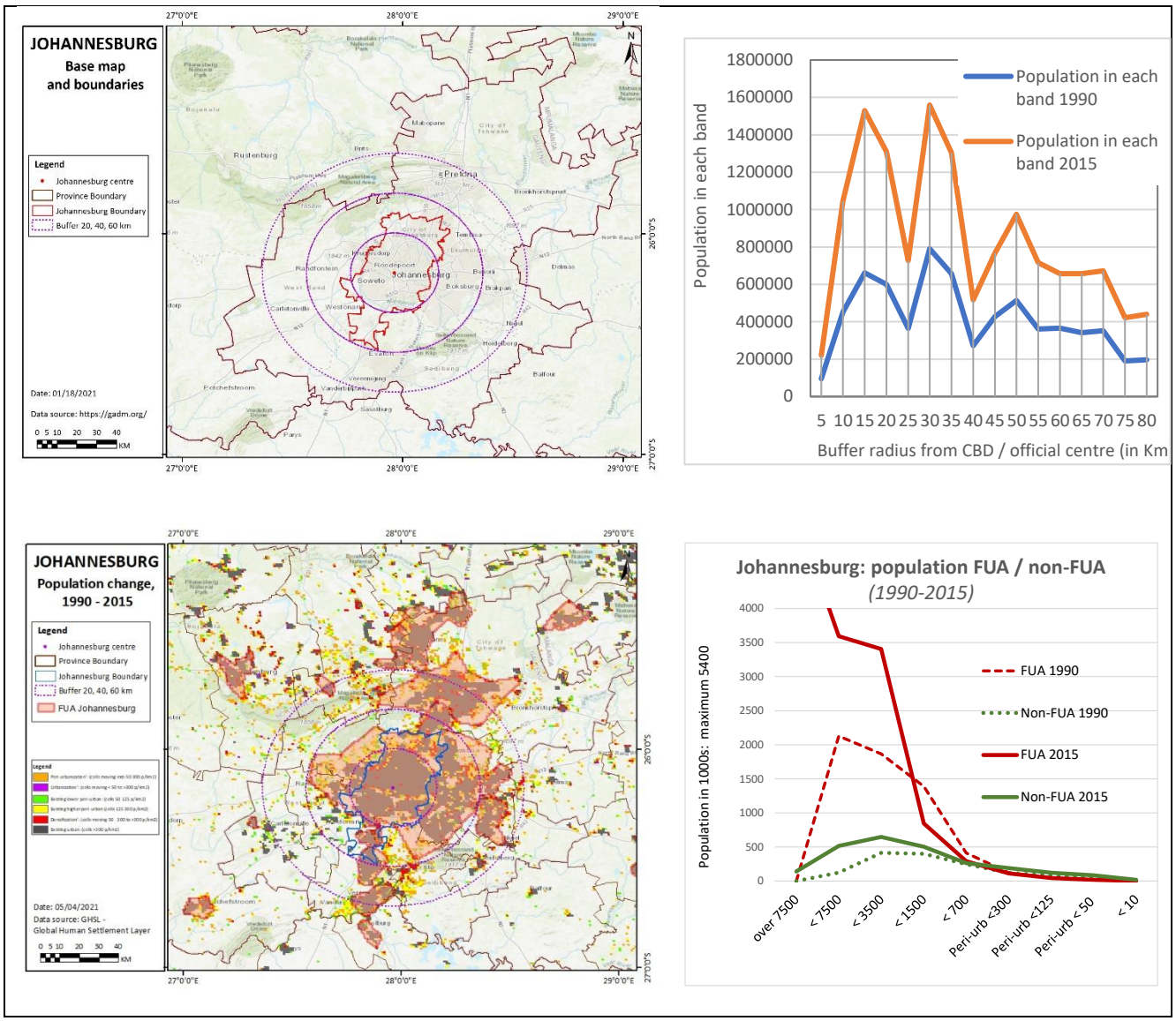
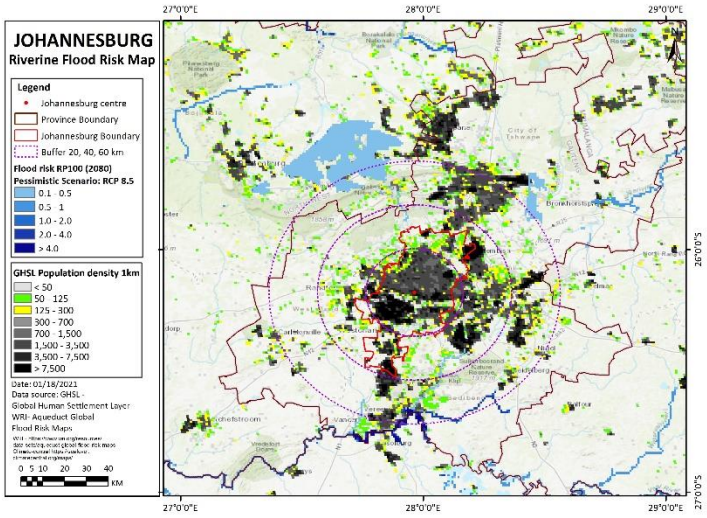
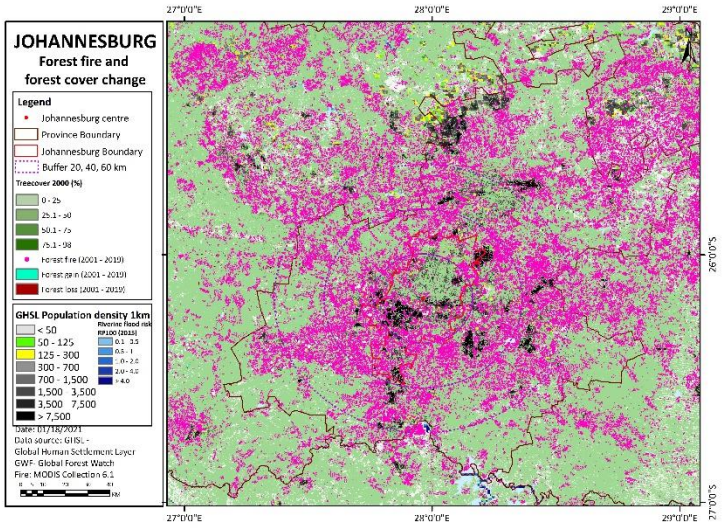
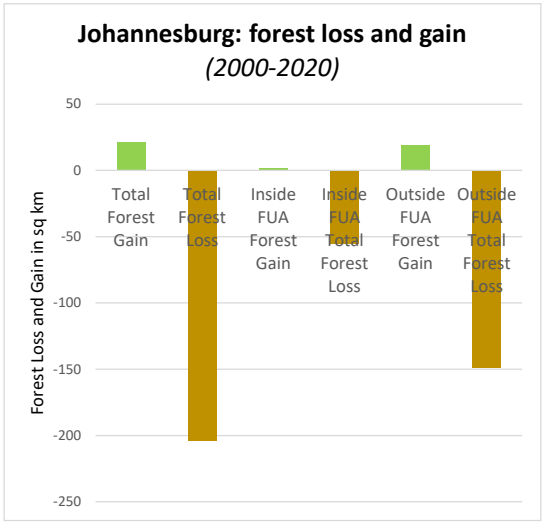
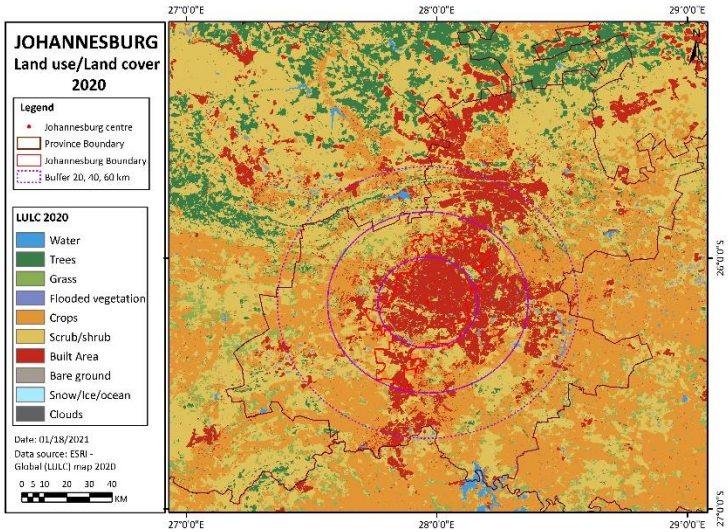


***Figure 10.3: climate effects mapping & analysis***



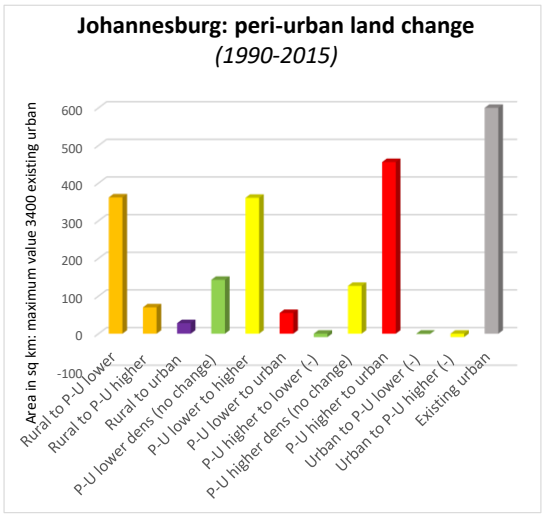
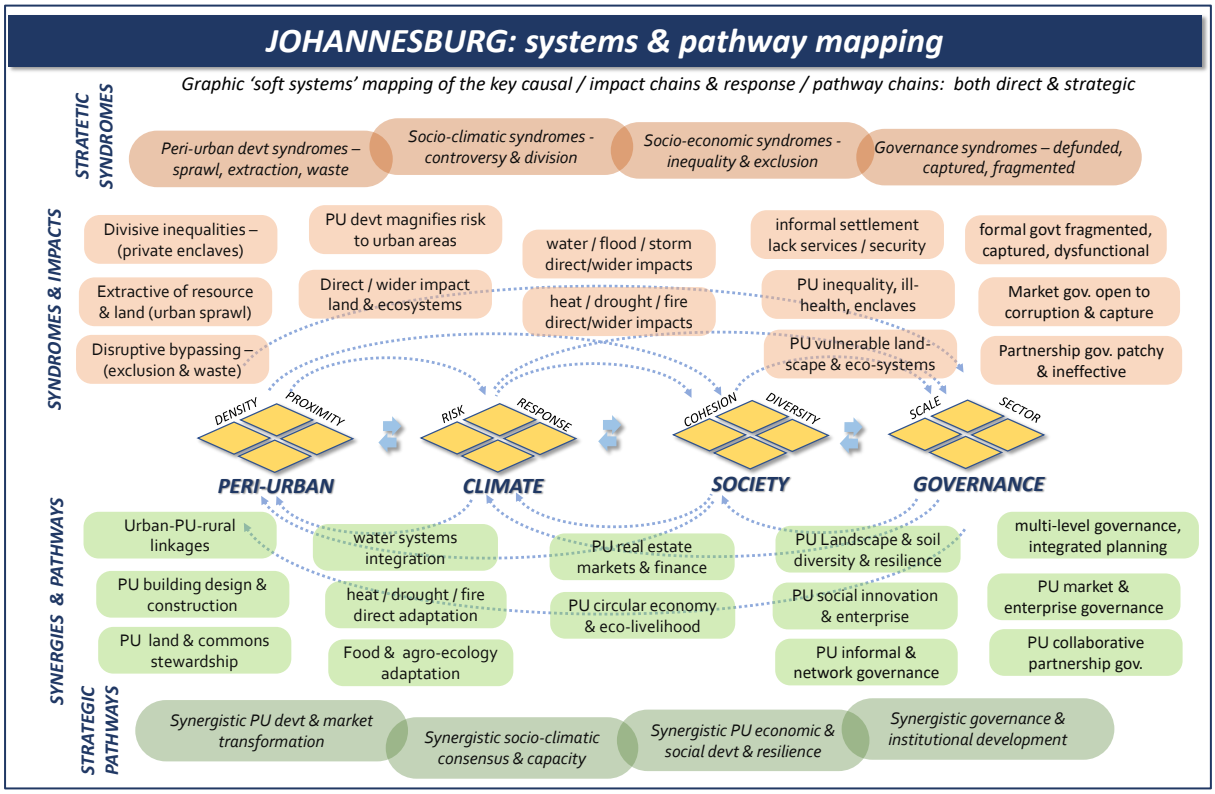



***Figure 10.4: system & pathway mapping***




## 10.1 Adaptive pathways

(preliminary menu for debate & investigation)

***urban-rural linkages in the peri-urban***

> Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.

***heat / drought / fire adaptation*** :

- solar solutions for government housing: increase in rain water tanks due to droughts: emergence of micro-developers in informal areas

> Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence. For extreme heat, a growing agenda for building eco-design, social welfare, health & safety, adaptation of livelihoods etc.

***agro-ecology & food democracy***

Agro-ecology can rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

***landscape diversity & resilience***

A wider agenda is for sustainable / adaptive / resilient landscapes, soils, forests, water bodies & wetlands etc, both within / without formal designations. Policies for forestry, farming, infrastructure, housing, business, leisure & tourism etc, can steer towards adaptive planning & design for the surroundings of housing, industry, farming etc. These may be strengthened by eco-systems markets, green finance, carbon offsets etc.

***demographic shifts & eco-housing***

While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***circular economy & eco-livelihood***

The practical question is how can businesses invest and create jobs from these peri-urban 'climate-wise' transitions and pathways. The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

***distributed / networked infrastructure & services***

- solar solutions for government housing: increase in rain water tanks due to droughts: emergence of micro-developers in informal areas

Energy and water technologies see rapid innovation in local distributed harvesting, storage, conversions etc. These can enable further peri-urban off-grid expansion: they can also enable climate-proofing of development with practical alternatives to centralized / intensive infrastructure.

***Market-led governance, finance & enterprise***

Beyond the limits of formal government, market led approaches may enable innovation, forward investment, enterprise of all kinds. Ecosystems markets, green finance, impact investment, or social return on investment may bridge the gap between ecological social & economic values. Public services and public procurement can also have a powerful effect, such as local / organic food policies or ecosystems reinvestment.

***Collaborative governance, civil partnerships***

- Active civil society with NGOs, academia, GCRO (Gauteng City-Region Observatory), Religious groups

- New progressive policy: IUDF, CDS, SPLUMA:  C40 and international agendas: Pan-African cultural links
- street committees, cultural groups, musicians, dancers: residents groups fixing services: Informal waste pickers
- ward councillors have a lot of power, some are close to the people
- Digital enablers: apps, sending money easily, enabling informal flows: Wifi providers for the informal outskirts

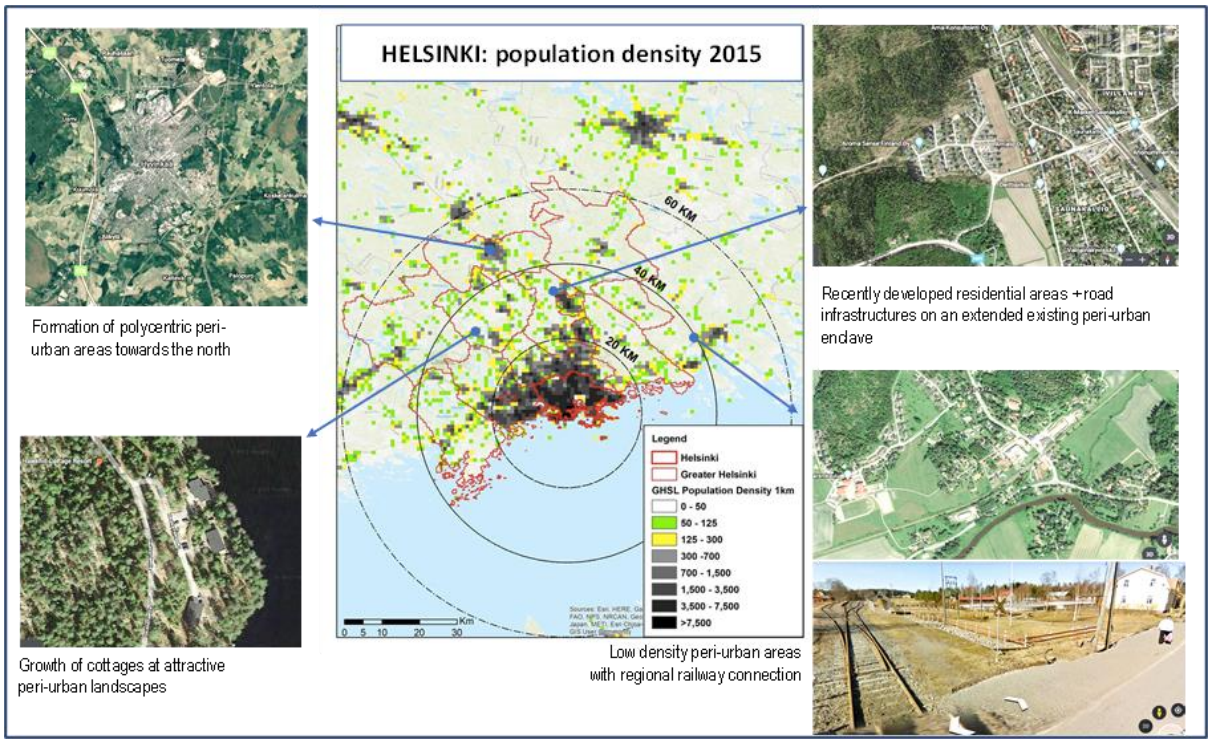
***Radical governance, grassroots networks***

Emerging forms of radical ecological democracy & the 'pluriverse':  these are beginning to show real alternatives to the mainstream top-down neo-liberal consensus on development & livelihood.  The peri-urban can be host to many creative variations on agro-ecology, local livelihoods, grassroots self-help, social mutual aid, stewardship of the commons etc.

# 11 Helsinki

***Scope**: includes the Greater Helsinki metropolitan region, and its peri-urban / rural landscape of lakes and forests, with smaller / larger towns on strategic corridors.*

***Figure 11.1: where is the peri-urban***




## *OVERVIEW*

***Peri-urban syndromes:*** gradual metropolitan expansion towards planned extensions & satellites on growth corridors: some gentrification & rural decline in further hinterland: rural summer cabins & some housing development in high risk locations:

***Climate change risks***: growing risk of riverine flooding in low lying areas: limited sea level rise: increasing drought & forest fire: indirect impacts on ecosystems & invasive species:

***Societal vulnerability***: growing fragility of forest / lake landscape & ecosystems: rural livelihoods in transition: generally high social cohesion but some tensions & divisions from social change:

***Governance syndromes***: government institutions are effective but in sectoral silos with multi-level tension: functioning civil society, strong climate awareness & policy, but much diversion and inertia:

***Adaptive pathways***: integrated water / forestry / ecosystems adaptation: real estate & ecosystems market integration: eco-housing & distributed infrastructure: climate-wise peri-urban development patterns & design:

***Adaptive governance***: continuing policy integration & multi-level government: collaborative-associative governance with civil society:

## Peri-urban issues

- Rapid expansion of suburban family housing, followed by some reverse movement back to cities, in search of jobs, culture etc. Large expansion of per-urban densities are seen on the maps.
- Public services & public transport not easy to provide in scattered low density developments. Decentralization push via multi-locality, digital services & jobs – in tension with the pull of community & networks.
- Social & cultural drivers: mythology of the forest lifestyle: demographic shift & out-migration of rural young. Also out-migration of urban families to smaller towns
- Helsinki metro region rapid expansion, while many rural regions are shrinking with large social costs. Large 'beltway' sprawl area around orbital road witih global businesses.

## Climate change issues

- Temperature rise projection 2080-2100: 1.5 to 6.5 degrees max
- Precipitation winter: 30%+ average: Precipitation summer: 20%+ average
- Large areas of pluvial flood risk in forest hinterland. Fluvial flood risk increased by rainfall intensity and melting snow. Increased winter flooding. Sea level rise due to climate change increases flood risk
- Floods / heavy rains: farming damage, water services effected.
- Drought: Increased irrigation for farming, weakened flora growth, increased forest fire risk, decreased summer hydropower production, diminishing groundwater sources, water traffic difficulties
- Increasing city density and climate change may increase the flood risk due to increased impermeable surface and intensified rainfall

## Societal issues

- Wildfires in some forest areas. Tick-borne diseases may increase as growing season increases. Biodiversity threatened buy increased city development and reduction of green areas. Flora will be affected by rapid change in winter conditions, loss of species may affect habitats and eco-system functions. Plant diseases and pests may increase.
- Climate change may possibly combine with other demographic changes, influx of migration, urban rural divisions etc: Flood defence is advanced, however not possible to cover the large areas of hinterland
- Generally a strong society with high cohesion. Reduced sunlight in winter months may exacerbate winter depression. Aging populations will experienced increase health risks due to increased heat stress.

- Local government is generally well organized but there may be some in-flexibility.

## Governance issues

- Regional planning for the metro region is now taking shape, in a sophisticate multi-level system. The Ministry provides a toolkit for climate policy assessment.
- Many civil society groups are strong, e.g. labour unions, academics, heritage etc.
- From the Anti-Corruption.fi Finland is one of the least corrupt countries in the world

***Figure 11.2: spatial mapping & analysis***

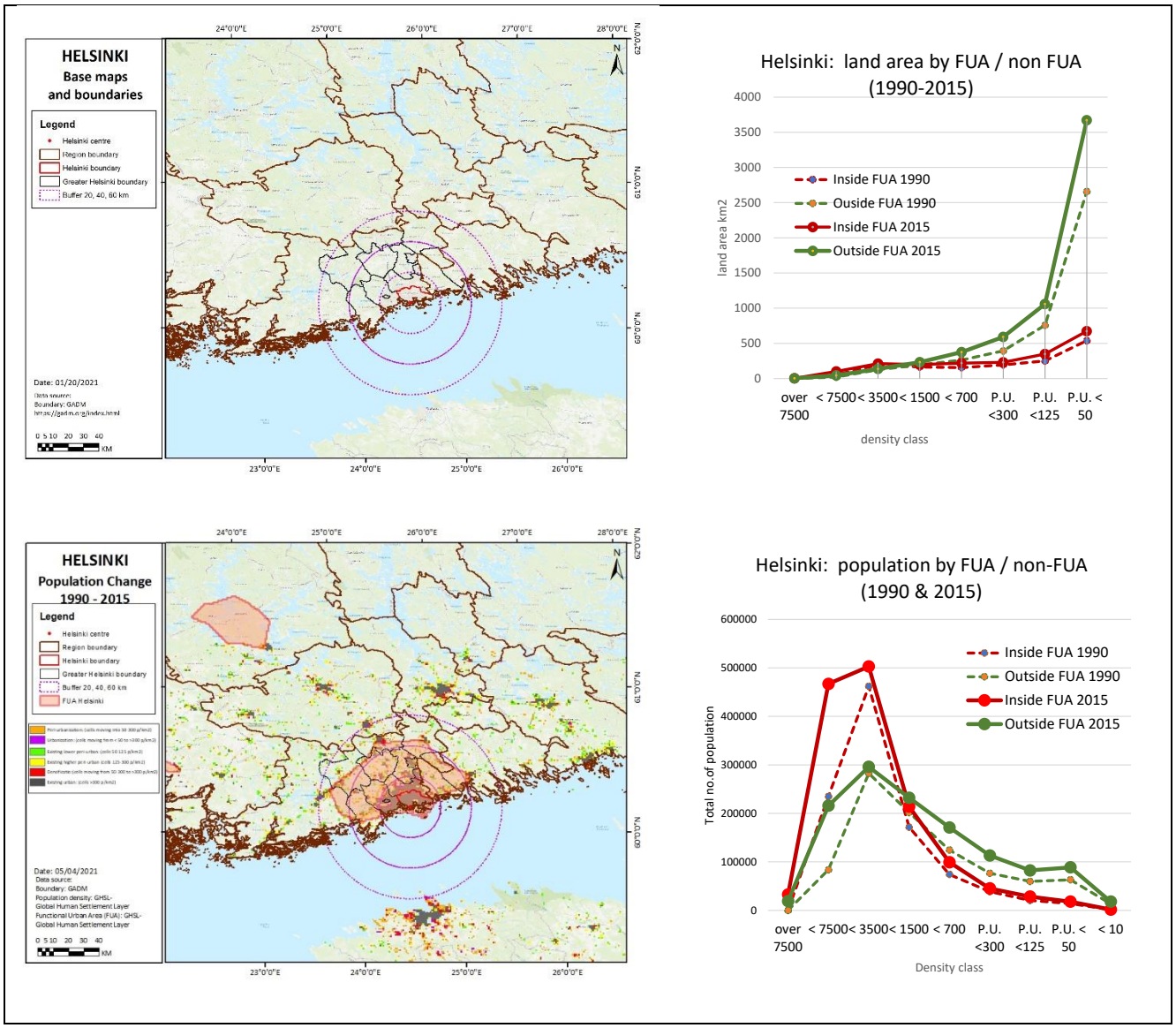
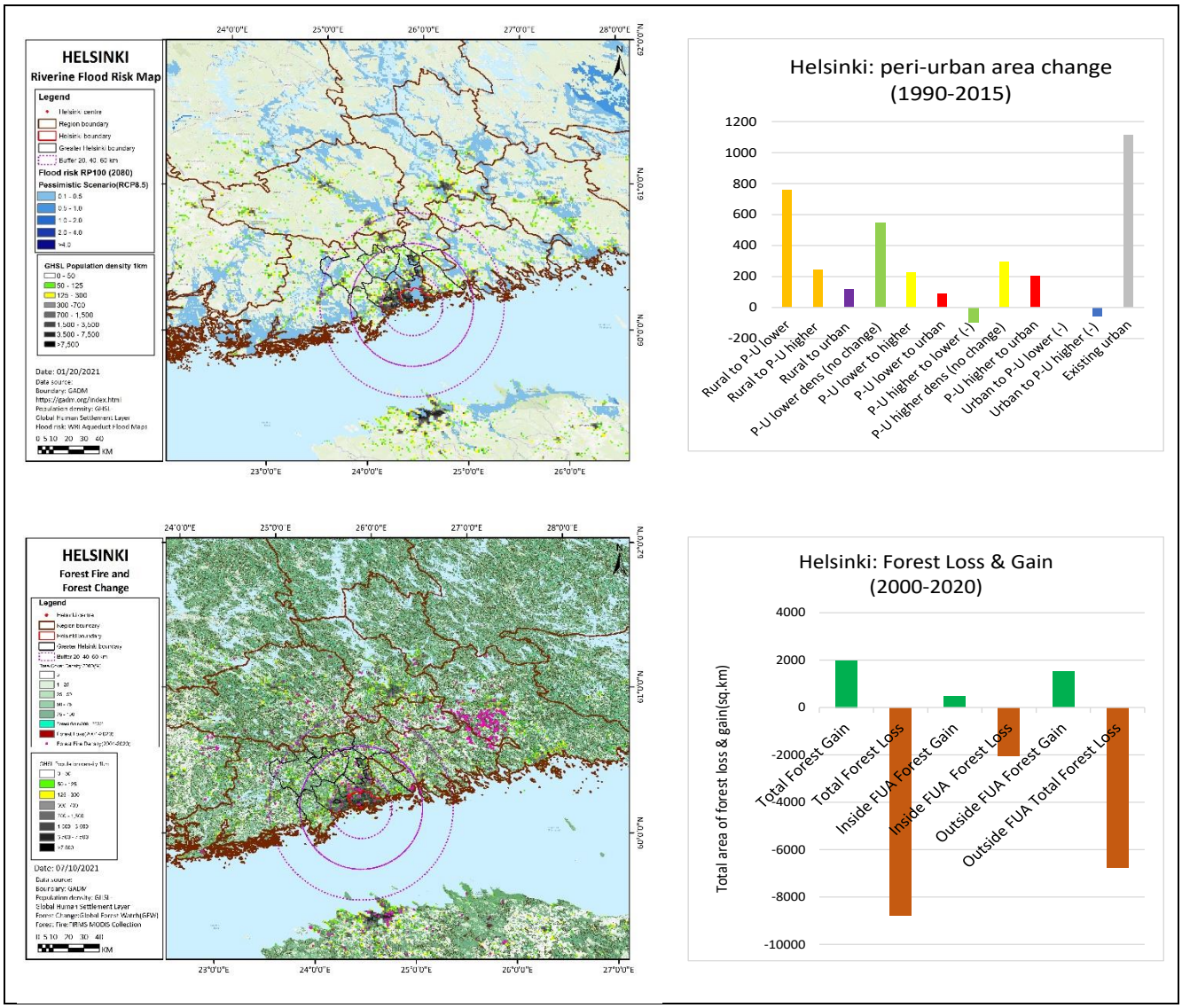


***Figure 11.3: climate effects mapping & analysis***



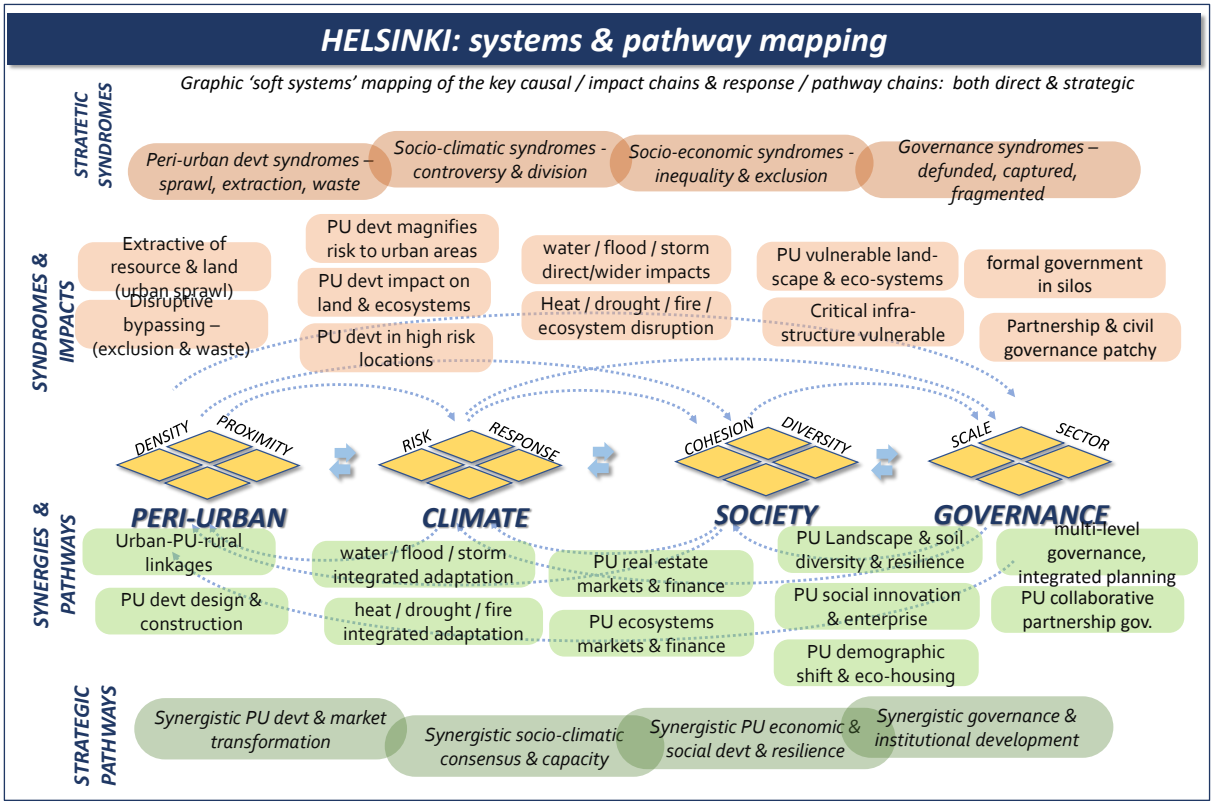

## 11.1 Adaptive pathways

*(notes from the Policy Lab workshops)*

context - peri-urban development may bring transformations in the urban-regional system.... need new forms of governance to look ahead and avoid problems. Multi-level governance - starts with a new kind of peri-urban agenda, e.g. the 10 municipalities.

Looking for new forms of 'adaptive governance' - which can maybe help people to self-organize & cooperate in times of crisis.

***Figure 11.4: system & pathway mapping***




Circular economy of cities and peri-urban areas - adaptation pathway rural & peri-urban - starting from transition in the forest areas: peri-urban is part of the solution - based on biodiversity / urban greening. There is 'everyman's right to go to the forest' - but - growing pressure on green areas - a way of living which is behind the peri-urban agenda

integrated spatial planning – some structural challenges:

- low density planned areas? both planning & markets are now pushing towards urban areas. Should be part of strategic plan?? but maybe impossible to control. Many areas planned before 2010 are lower density.
- As for lake district & coastal areas: midsummer period - population can double or 3x in some areas, challenge for services: traffic jams - huge road investment in peri-urban for logistics. For dense urban areas in Finland - 20% have summer houses, or stay with relatives: is the out-migration continuing / permanent due to pandemic? Some mobile data.
- Many areas e.g. Uusimaa has declining population - peri-urban infrastructure can be flexible & easy to change, e.g. heating, water etc.
- There are also different languages e.g. Estonians now moving to peri-urban.
- We can revisit the urban fabrics concepts: implications for polycentric city structure?? transit cities are growing around main rail connections: but many others are mainly automobile cities -
- There is a need for centralized services in peri-urban - but people want more local services: growing tensions between Helsinki & outer peri-urban areas, competition for services which are going more centralized - e.g. before, school in every village, now these are more centralized

In response, potential pathways include - (preliminary menu for debate and research)

***urban-rural linkages in the peri-urban:***

- Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.

***water / flood / storm adaptation***

- Short term: we need ways to manage rising floodwaters and extreme events, via SUDS, walls, canals, basins etc. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a water-friendly co-existence.

***landscape diversity & resilience***

- A wider agenda is for sustainable / adaptive / resilient landscapes, soils, forests, water bodies & wetlands etc, both within / without formal designations. Policies for forestry, farming, infrastructure, housing, business, leisure & tourism etc, can steer towards adaptive planning & design for the surroundings of housing, industry, farming etc. These may be strengthened by eco-systems markets, green finance, carbon offsets etc.

***demographic shifts & eco-housing***

- While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***digital platforms & monitoring***

- A digital approach sees potential to enhance climate adaptation, flood defence, ecosystems management & markets. Indicators & metrics for systems change, adaptation and resilience can be defined & monitored by local stakeholders in combination with experts.

***Market-led governance, finance & enterprise***

- Beyond the limits of formal government, market led approaches may enable innovation, forward investment, enterprise of all kinds. Ecosystems markets, green finance, impact investment, or social return on investment may bridge the gap between ecological social & economic values. Public services and public procurement can also have a powerful effect, such as local / organic food policies or ecosystems reinvestment.

***Collaborative governance, civil partnerships***

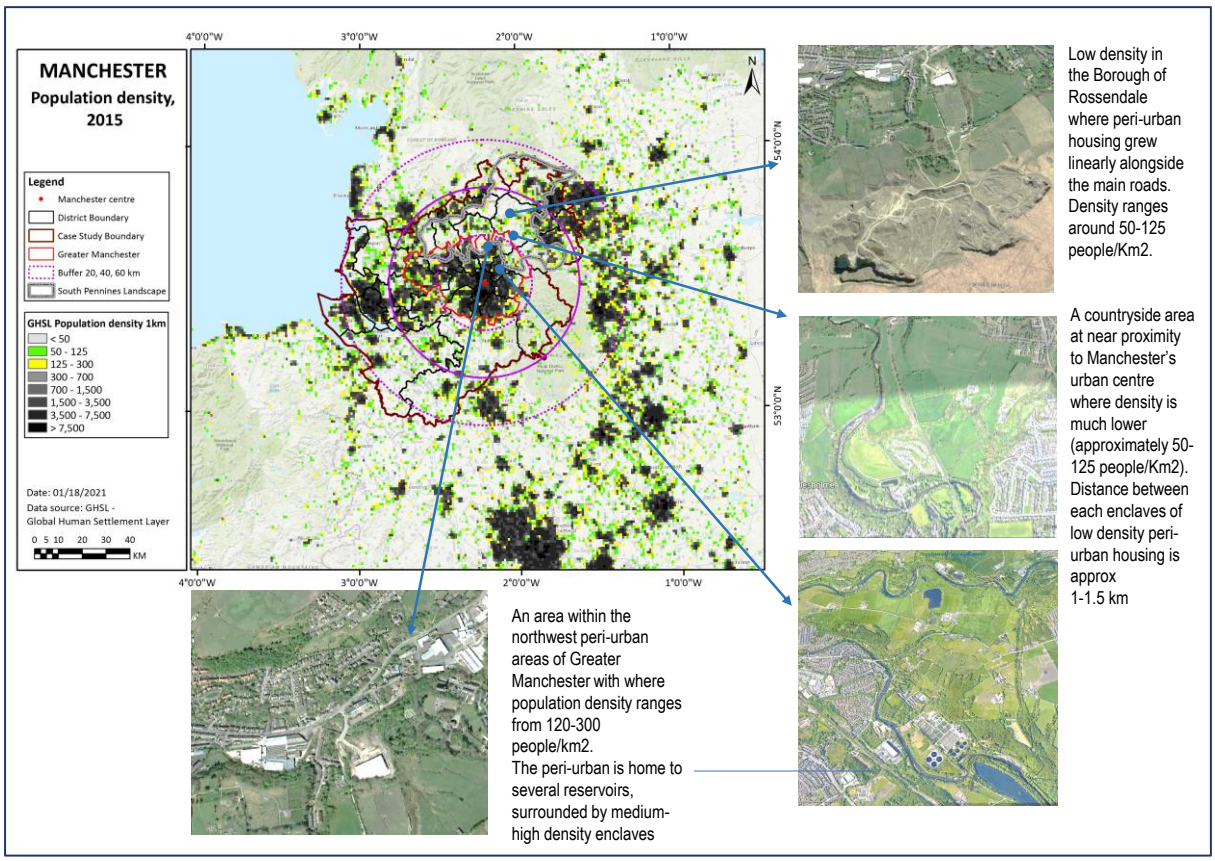
- As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 12 Manchester

***Scope:*** *the Manchester region is defined as Greater Manchester (GM) plus its surrounding hinterlands. Three case study zones cover most of this wider region with its hinterland:*

a) *The Irwell river catchment, running from the hills to the north, through the main urban area, to join the Mersey river towards the south west*
b) *South and West Pennines, an area of moors and upland farming, with steep sided valleys and historic industrial development.*
c) *East Cheshire plain, an area of commuter towns and rolling agricultural landscapes.*

***Figure 17.1: where is the peri-urban***




## *OVERVIEW*

Manchester is at the centre of a post-industrial city-region with moderate peri-urban change, in a complex layered landscape: moderate levels of climate risk, overlaid on (possibly) growing social vulnerabilities & dysfunctional governance. The overall picture is of higher population growth in the lower density peri-urban, along with moderate growth in the urban areas.

***Peri-urban syndromes:*** a poly-centric conurbation with: (a) to N&E, post-industrial expansion into low hills & narrow valleys with peri-urban low-value towns & high value enclaves: (b) to S&W, ex-urban expansion into rolling mixed landscape. With gentrification of rural settlements in further hinterland, much old & new development is in high risk locations.

***Climate change risks***: riverine flooding in low lying areas & river valleys: sea level rise on west coast: increasing frequency drought & moorland fire: heat stress affects vulnerable: indirect impacts on ecosystems & farmland:

***Societal vulnerability***: growing social tensions & divisions from gentrification: housing stress / economic vulnerability in post-industrial areas: high vulnerability to flooding of river valleys in upland areas to N&E, with ageing & low-income populations: privatized utilities have other priorities.

***Governance syndromes***: most government & public services are functional, but under-funded & fragmented, with multi-level tension & general inertia: active civil society is often not connected: growing climate awareness & policy, but under-funded & diverted:

***Adaptive pathways***: urban-rural linkages with new stewardship of peri-urban landscapes: climate-wise development patterns & forms: real estate & ecosystems market innovations: possible role for digital platforms: integrated water / flood / landscape resilience management:

***Adaptive governance***: continuing efforts on policy integration & multi-level government: new roles for adaptive 'collaborative-associative' civil society governance:

## Peri-urban issues

The key map (***Error! Reference source not found.***) shows these three areas of interest. The Irwell r iver catchment incorporates a cross-section of the region from the Pennine watershed, through the urban fringes and the northern suburbs, through to the urban core of GM. The catchment embraces peri-urban areas and presents peri-urban, rural and urban connections and dynamics.

The South and West Pennines is in a peri-urban gravity field of 3 major conurbations – Manchester, Liverpool and Leeds - and contains various peri-urban types, including sparsely populated upland landscapes, steep sided river valleys with settlements along the valley bottoms (which are at risk from flooding), commuter towns and marginal livestock farms. The Cheshire plain represents a contrasting peri-urban landscape, sitting to the south of the GM conurbation, and is an area of (generally) higher income commuter towns and rolling agricultural landscapes.

In the ***Irwell catchment***, the central zone, the main focus is fluvial flooding (from rivers and streams), and the use of natural flood management (NFM) responses. This raises topical questions on water governance, which crosses administrative boundaries and economic sectors. Flooding and flood risk management, concerning current flood hazards and also in the context of projected climate change induced increases in flood risk, are key concerns in the Irwell catchment, given the risks posed to communities, livelihoods and critical infrastructure. Indeed, recent flood events associated with Storm Eva (in December 2015) have further focused attention on this risk.

In the ***Pennine hills*** to the north and east, there is a landscape of low heather moors & peat bogs, with former industrial towns in steep sided river valleys, in the hinterland of large conurbations. There is economic change via industrial decline & shift to services & commuting economies: some new land-based activities, horsiculture etc: social change incoming migrants, widening income

gaps, gentrification & rising asset values, along with eco-alternative cultures. Direct vulnerability to climate change is increasing mainly by drought, wildfire, soil erosion, & fluvial flooding.

These issues show how peri-urban development and climate change can be mutual 'threat multipliers' (and also, potentially 'opportunity multipliers'). There are many policy options which raise topical questions:

With increasing pressures of population and housing, combined with climate change disruption – should the South and West Pennines:

(a) expand with population coming from urban areas?
(b) maintain existing population levels?
(c) plan to reduce population in areas of high risk & high ecosystem value?
(d) look for new synergies & combinations of people, economic activity & climate proof ecosystems?

## Climate change issues

Future projections here assume a relatively mainstream 'worst case' scenario, (based on RCP 8.5), which follows the current trend pointing towards a 3-4 degree average temperature rise. These are the headlines from the UKCP18 for the 2070s (for locations typical of central England):

- summer precipitation change: between 57% drier and 3% wetter
- winter precipitation change: between 2% drier and 33% wetter
- summer temperature change: up to 5.8°C warmer
- winter temperature change: up to 4.2°C warmer

While these averages are very significant the greater risks are from extreme events:

- extreme rainfall events
- extreme heat / drought episodes

Rainfall volumes during the wettest day in winter are projected to increase by 14.6% by 2050 (under the central estimate for the high greenhouse gas emissions scenario). This will increase pressure on flooding infrastructure and potentially increase the risk of flooding Extreme heat and drought is more tricky to project.

## Climate effects on the peri-urban

There are two ways to answer this: the first is about the local conditions in the peri-urban, and the second sees the peri-urban as part of a whole city-region system.

For the first, the local conditions in the MCR peri-urban, many such areas are at high climate change risk:

- Fluvial & surface flooding, particularly in the river valleys where former industrial towns and infrastructure were sited: and this is partly a result of the land management on the surrounding uplands.
- Drought periods, with effects on ecosystems, landscape types and local farming. Upland sheep farms are vulnerable to drought, as is the intensive arable areas of Cheshire.

- Wildfires with impacts on human & ecosystems. Peri-urban wildfires in the Pennines scrub land and peat bogs have increased, and now cast smoke across the entire conurbation.
- Extreme heat, which affects vulnerable social groups, in particular the elderly and outdoor workers.
- In the coastal & estuary peri-urban areas of Lancashire and Merseyside (on the edge of our case study), sea level rise, coastal erosion and saline incursion is a growing problem.

For the second, the MCR peri-urban is also highly inter-connected to the urban and rural areas, as part of an extended city-region:

- Water management in the peri-urban has a direct effect on the flood risk and exposure of downstream urban areas;
- Landscape management in the peri-urban has an indirect effect on water: e.g. where upland land-use and ownership creates problems of storage & run-off;
- Farming practices in the peri-urban create further problems of run-off, chemical pollution, soil erosion, clearance of natural areas etc.
- Housing development in the peri-urban is a direct effect of urban pressure, including urban heat island, and urban natural capital / biodiversity gaps.

Some key issues show up on the land-use/cover map:

- Scrub areas – risk of wildfire and loss of peat bog
- Grass & forest areas – risk of drought, soil
- Crop areas – risk of drought and change in agro-ecology
- Built area proximity – risk of disruption of ecosystems, water systems

The forestry and wildfire map (Figure xxx) based on Global Forest Watch data, then overlays these on the peri-urban typology:

- Most peri-urban areas, both fringe and hinterland, contain numerous small areas of woodland
- Some of the hinterland both in the Pennines and Cheshire, contain larger areas of mainly mixed woodland or deciduous forest;
- Major wildfires are increasing even within the GM boundary: the upland peat bogs are especially at risk in dry or drought conditions.

## Societal issues

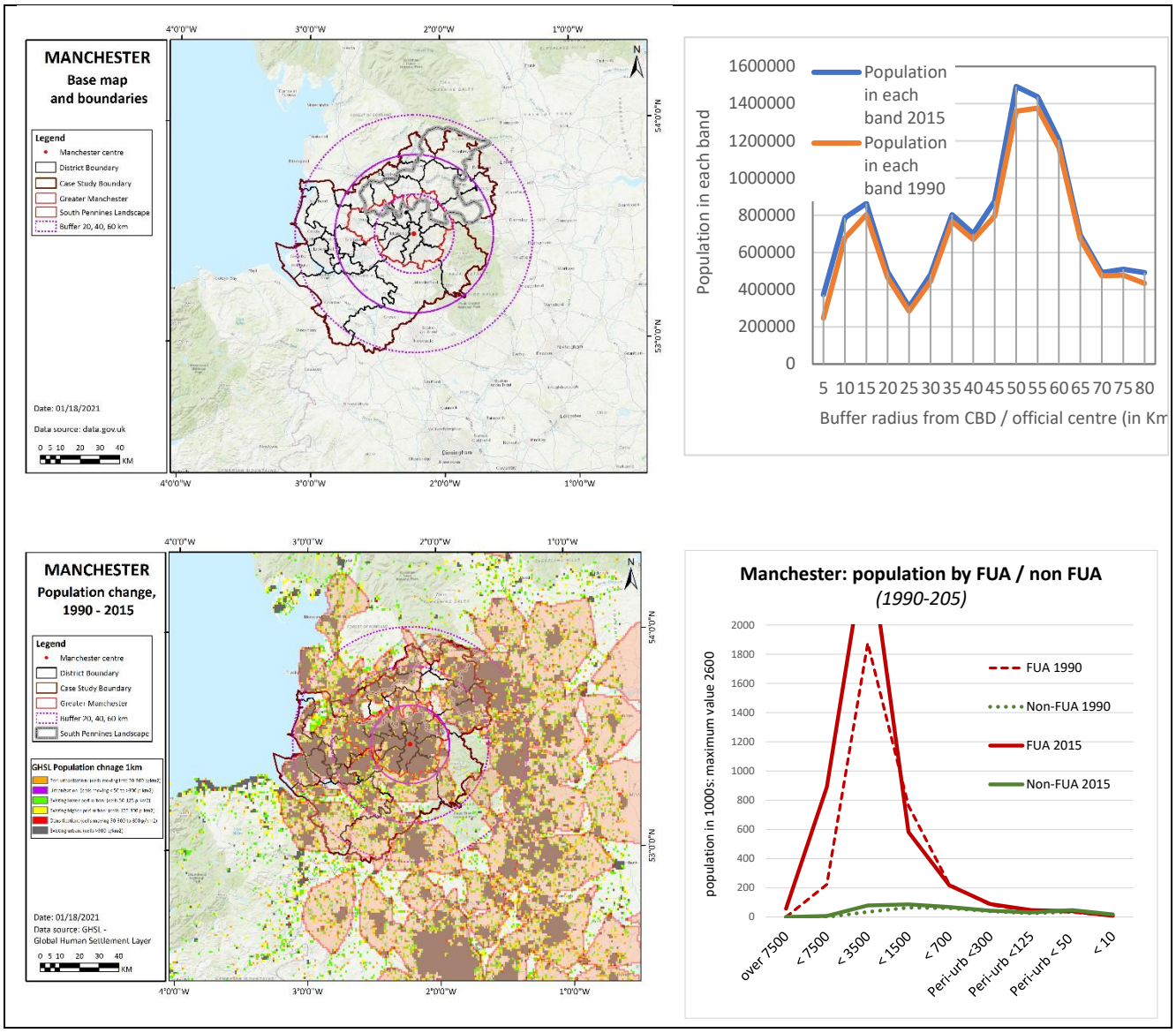
As above there is a tendency for the most vulnerable social groups (poverty, dependency, poor health and poor housing conditions) to be at most risk of flooding, and in other ways to extreme heat. While many such groups are in the inner cities, there are pockets and patterns across the peri-urban areas, and this may increase with the current trends of out-migration and counter-urbanization.

The spatial distribution is shown below, as the ‘neighbourhood flood vulnerability index’, from the Climate-just project. This is a composite of indicators including (for both locations and/or social groups): age structure, population health, care / disability, built-up density, dwelling form, employment, dependency, income, rental / ownership, social mix / change, household structure, transport access.

The broad distribution across the region shows the highest vulnerability for lowest income groups in urban areas. For the peri-urban the picture is quite mixed:

- For the Pennine zone to the north, there are localized areas of poverty, many in the post-industrial towns in narrow river valleys with much higher flood risk than average;
- For the Irwell river catchment, the headwaters come from more affluent peri-rural areas, with flood risk accruing to the low-income groups in urban areas with high vulnerability.
- For the Cheshire zone to the south, a mainly affluent peri-rural hinterland conceals pockets of poverty in smaller towns and villages, only some of which show on this map.

***Figure 12.2: spatial mapping & analysis***



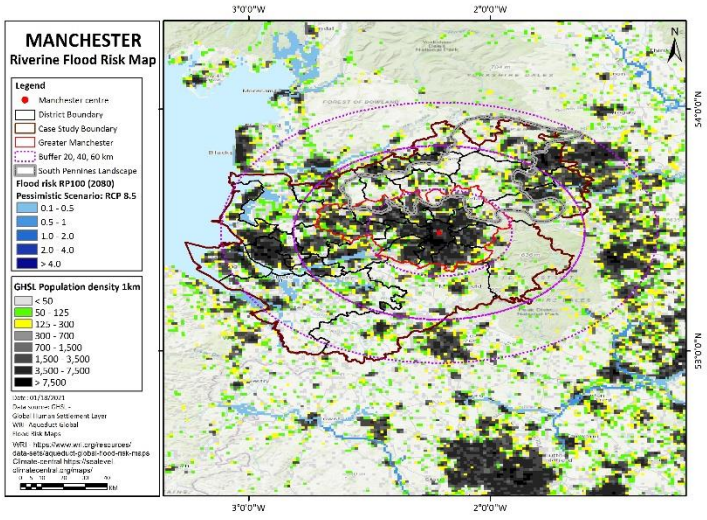

## Governance issues

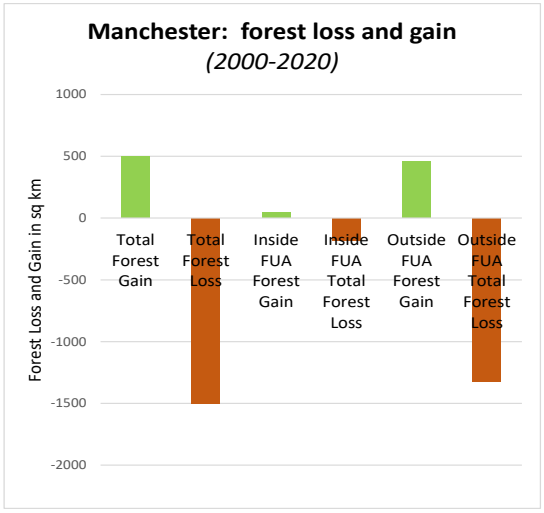
Overall these diverse peri-urban areas are both generators of climate risks (particularly fluvial flooding) but also providers of climate change adaptation functions (for example related to natural flood management and biodiversity conservation).

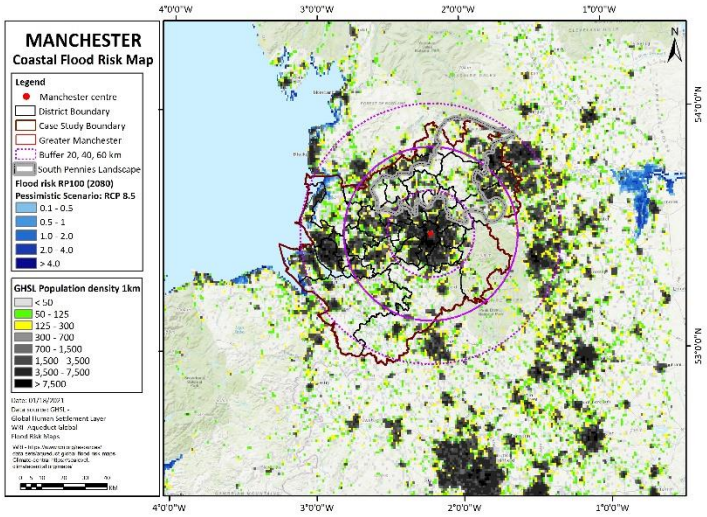
To address these issues, appropriate governance frameworks are needed, encompassing the wide range of sectors and stakeholder groups that have an interest in the future of these areas. Current governance frameworks are fragmented, spatially and sectorally, although emerging good practices

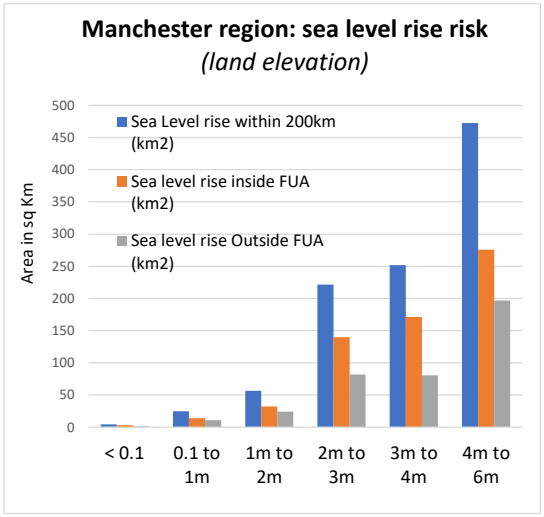
do exist. Some examples include (see the Annex for a full listing of water governance institutions in GM):

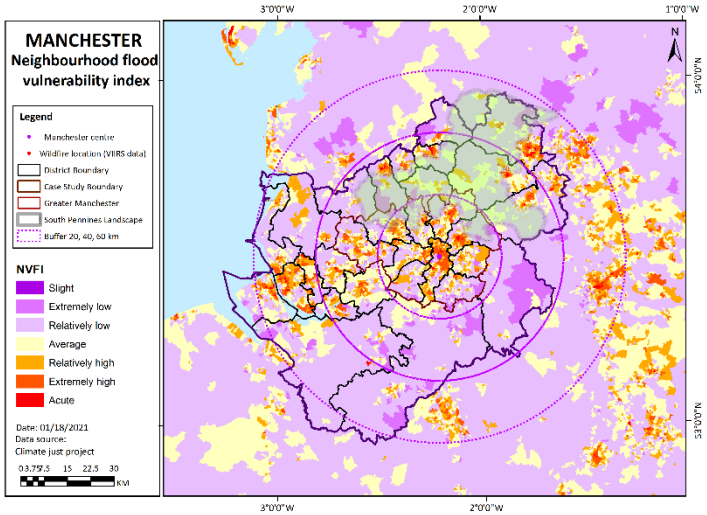
***Figure 12.3: climate effects mapping & analysis***



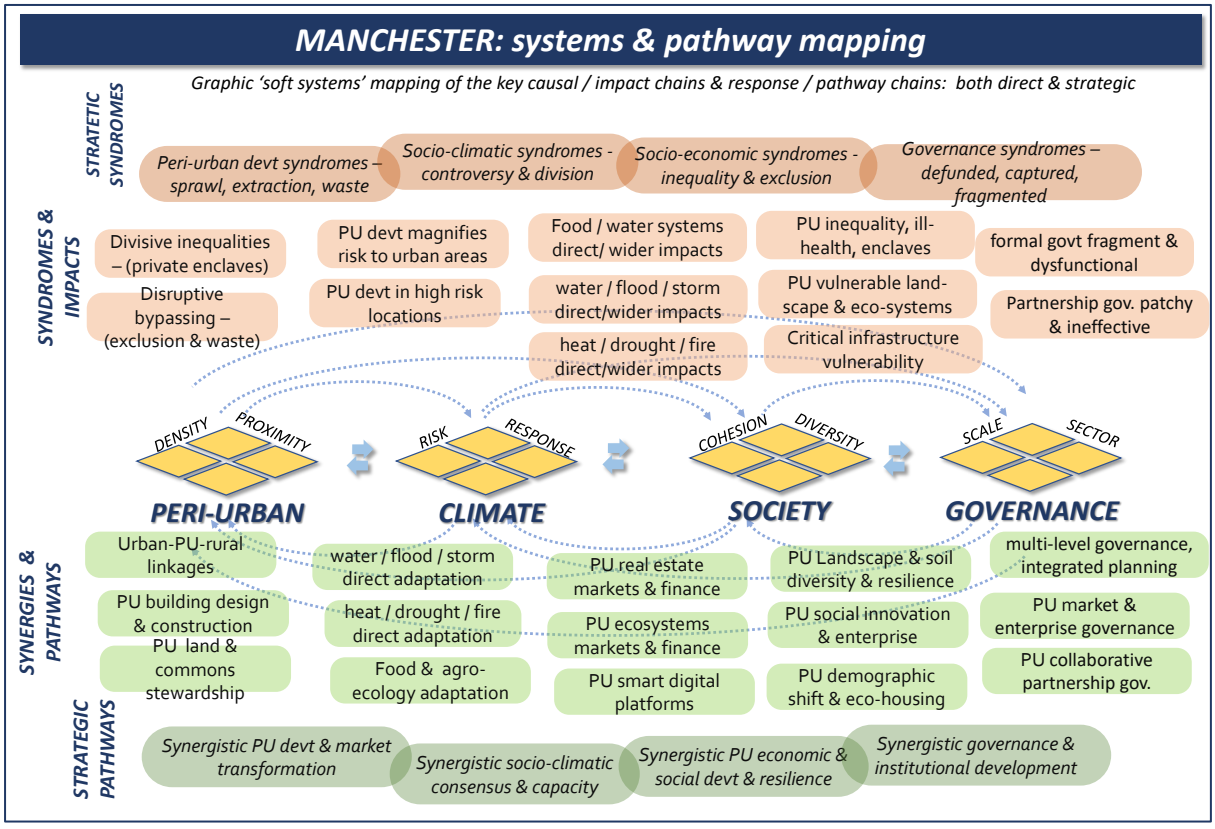



- Mainly informal partnerships which exist with a mandate and role within larger institutional arrangements: e.g. River Catchment Partnerships;
- Independent third sector formal organizations which play an active role in informal partnerships (e.g. Wildlife Trusts);
- Formal governance partnerships which bring together different levels and units of government: e.g. Technical Flood Risk Officers Group
- New formal organizations, in the form of public-private-civic partnerships, which aim at trans-boundary integrated planning: e.g. Pennine Prospects / South Pennine Trust.

The overall systems effects are summarized in the impact / pathway mapping at *Figure xxx*:

***Figure 12.4: system & pathway mapping***




## 12.1 Adaptive pathways

(A preliminary menu for debate and investigation)

***urban-rural linkages in the peri-urban:***

- Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.

***peri-urban stewardship of land & commons***

- Many peri-urban territories include large areas of leftover 'lost space', and much of this (in some countries) is in common / public ownership. The community based stewardship of marginal land on edges or corridors, can be a powerful way to generate social synergies, e.g. by local food democracy, which can then manage ecosystems for resilience and adaptive capacity.

***water / flood / storm adaptation***

- Short term: we need ways to manage rising floodwaters and extreme events, via SUDS, walls, canals, basins etc. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a water-friendly co-existence. Natural Flood Management is the start of a wider agenda on how modern urban systems can co-exist with climate challenges.

***landscape diversity & resilience***

- A wider agenda is for sustainable / adaptive / resilient landscapes, soils, forests, water bodies & wetlands etc, both within / without formal designations. Policies for forestry, farming, infrastructure, housing, business, leisure & tourism etc, can steer towards adaptive planning & design for the surroundings of housing, industry, farming etc. These may be strengthened by eco-systems markets, green finance, carbon offsets etc.

***demographic shifts & new forms of eco-housing***

- While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***ecosystems markets & green finance***

- From the 'Economics of Ecosystems & Biodiversity' agenda, there are many variations in different countries. Payment for ecosystem services, local carbon markets, green / long finance, developer contributions, precautionary bonds / escrow accounts, and social return on investment are some of the options.

***digital platforms & monitoring***

- A digital approach sees potential to enhance climate adaptation, flood defence, ecosystems management & markets. Indicators & metrics for systems change, adaptation and resilience can be defined & monitored by local stakeholders in combination with experts.

***Market-led governance, finance & enterprise***

- Beyond the limits of formal government, market led approaches may enable innovation, forward investment, enterprise of all kinds. Ecosystems markets, green finance, impact investment, or social return on investment may bridge the gap between ecological social & economic values. Public services and public procurement can also have a powerful effect, such as local / organic food policies or ecosystems reinvestment.

***Collaborative governance, civil partnerships***

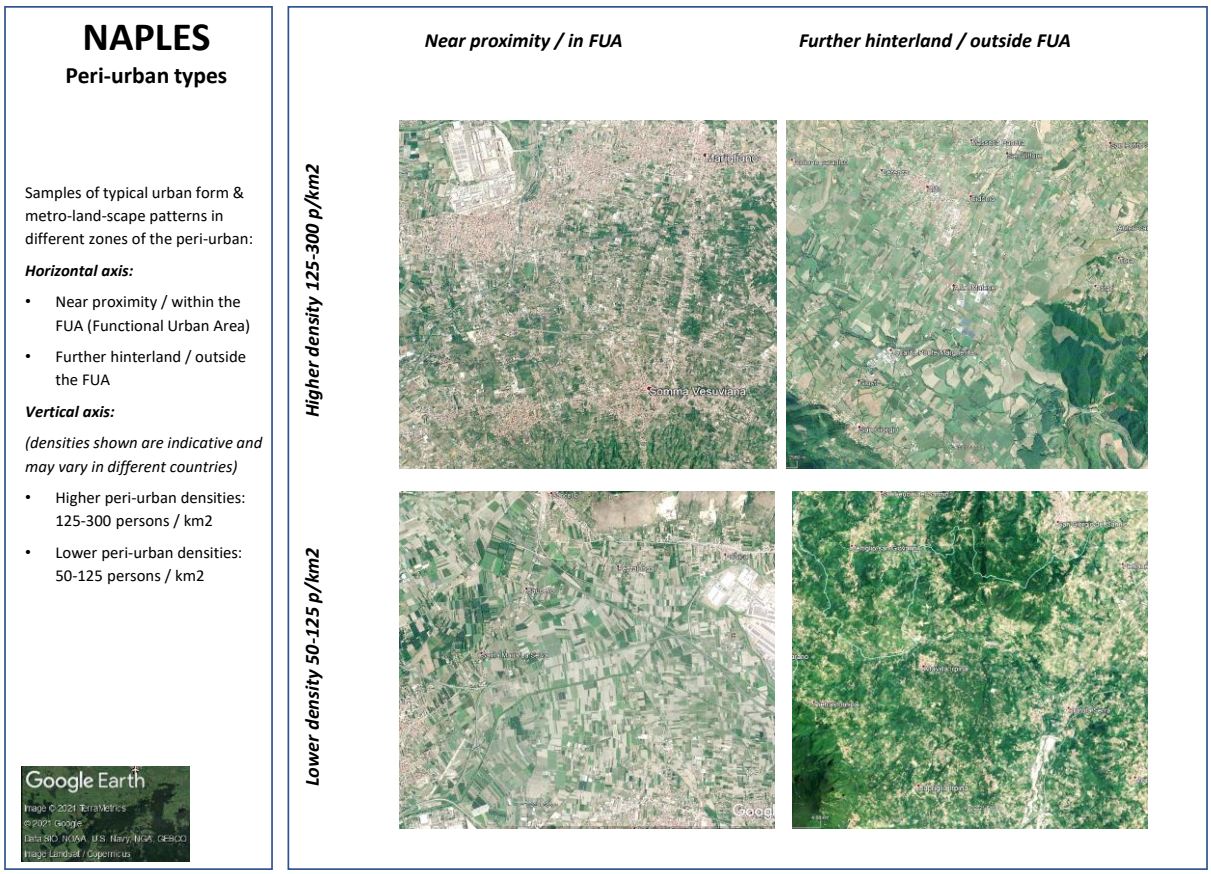
- As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones,

commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 13 Naples

***Scope**: this frame covers most of the Campania region, from the western coastal zone of Naples to the eastern coast on the Adriatic sea.*

***Figure 13.1: where is the peri-urban***




## *OVERVIEW*

Naples is at the centre of a post-industrial / agrarian region with dense rural areas & slow peri-urbanization, in a complex historic landscape: moderate levels of climate risk: cohesive but fractured society, with dynamic but problematic governance.

***Peri-urban syndromes:*** outward push of the metropolitan area, existing peri-urban patterns in the hinterland are unusually stable over 25 years. Ongoing slow gentrification of rural settlements in further hinterland: much new development is in high risk locations.

***Climate change risks***: riverine flooding in low lying areas & river valleys: sea level rise on both coasts: projected extreme heat & drought in Mediterranean basin, with forest fires, desertification & indirect impacts on ecosystems & farmland:

***Societal vulnerability***: ongoing landscape deterioration & forest loss: social tensions from gentrification & economic vulnerability in post-industrial areas: higher vulnerability to flooding with ageing & low-income populations:

***Governance syndromes***: government & public services are under-funded, fragmented in silos, pressure from informality & elite capture: active civil society is often not connected: growing climate awareness with policy catching up:

***Adaptive pathways***: urban-rural linkages with circular economy livelihoods: climate-wise development patterns & forms: ecosystems & real estate market innovations: integrated planning for water / drought / heat resilience: sea level management for low coastal areas:

***Adaptive governance***: continuing building of capacity & stability for multi-level government: new role for collaborative-associative civil society governance: potential for grassroots social innovations.

## Peri-urban issues

- Naples Metropolitan Area is home to more than 4 million people, one of the largest urban agglomerations in the South of Italy.
- Naples Metropolitan Areas developed from a monocentric spatial structure, with Naples being the growth centre surrounded by rural landscapes. In the last 50 years however, Naples has been growing rapidly with expansion of urban areas proliferating to the outskirts. Based on an observation conducted by Papa and Mazzeo (2014), Naples urban expansion was very intense in early 2000s, where the urban built up areas doubled within the inner peri-urban zone. Most of the urban investment proliferated to the north peri-urban, which brought massive land use conversion. Until recently, more than 50% of Naples' north peri-urban landscapes have been urbanised.
- According to an observation on the pattern of peri-urbanisation, it was found that Naples' peri-urban fabric has a low spatial fragmentation (OECD, 2018). However, this might not confirm the absence of socio-spatial fragmentation, or the observation was limited only at the inner peri-urban zones
- Lower density development was found in the further peri-urban zones where spatial fragments are prevalent, characterised by heterogeneity of economic activities. Indications of illegal peri-urban development were found apparently due to time gaps between periods where landscapes were urbanising and the delayed spatial regulation addressing strict zoning controls. Transport infrastructure was also built to respond to problems (e.g. congestion) instead of a result of deliberate peri-urban planning (Papa and Mazzeo, 2014)

## Climate issues

- Temperature shows an overall warming of 1.0 ± 0.1 °C. over the last century. Temperature is set to increase between 2.0 °C and 5.1 °C by 2099 (SRES A1B / RCP6.0 scenario, balanced energy source scenario 700 ppm by 2100). [1]
- Observed increase in daily precipitation events, even in areas with a decrease in mean precipitation. Predicted decrease in average precipitation of 4% to 26% by 2099. Predicted

decrease of cold days, increase of heatwaves duration, days with temperature 5 °C above normal value. Sea level rise of 3mm/year over the 1990's.

- Ecosystems expected to migrate north, [1]
- Predicted reduction in electricity generation from hydropower, generation already reduced by 23% between 2001 and 2005.
- Reduced availability of potable water, reduced water for thermoelectric power plants.
- Growing period increase of 10-15 days per °C increase in yearly average temp. 5% of floods caused by climate change will be occurring on the coast near Rome and Naples.
- Increases in summer heat related mortality. Decreases in winter cold related mortality. Changes in disease burden. Increases in risk of accidents from extreme weather. Impacts on mortality due to extreme events.
- Increase in water borne disease outbreaks could increase due to extreme rainfall (rainfall or drought). [1]
- A 1 °C, increase in summer temperature reduces agricultural land values by 62%, a 1 °C increase in spring increases land values by 37%. [2]
- In 2004 groundwater accounted for 99.7% of drinking water requirements in Campania (wider Naples region), groundwater recharge is decreasing due to decreased precipitation, and increased evapotranspiration due to warmer temperatures. Infiltration reduced by up to 30% from 1980s to 2000s, if the trend continues it is expected that in 50 years ground water resources will decrease by about 70%. If this trend continues by 2050 6 million people in Campania will face a water crisis. [3]
- Impact on Italian farmland value is estimated to be between +1.5% to -15.8% by 2100. [2]
- Uptake of air conditioners was expected to be 14 million units by 2011, if this electricity continues to be generate by fossil fuels, the summer temperatures will continue to rise. [1]
- Forest fires are frequent in Campania, but as a result of better citizen education the number of fires is decreasing. [1]
- White Certificates systems aim to promote energy efficiency and reducing emissions. [1]
- Campania region have run a 'save energy public campaign' [1]

## Governance issues

- until 2014, Italy does not have a national urban policy, but the role of the state has been quite strategic by promoting the restructuring of provincial government, which enables cities to take responsibilities for managing and authorizing development at local levels. To ensure a nation-wide control over local urban development agenda, an inter-ministerial panel for urban policy was established in 2012 aiming to address issues of (1) institutional cross-boundary matters and make necessary interventions for enhanced policy-making, (2) urban sprawl with close observation on the need to support the provision of regional infrastructure, and (3) to maintain strategic management with regards to the provision of housing (OECD, 2017)
- One of the biggest challenges for Italy's spatial governance is the longstanding organized crime and corruption. Another point to be raised is the prevalence of declining areas in the peri-urban (particularly in the former industrial sites in the east and west peri-urban). In respond to this, Italy has established a new town planning scheme in 2004 which aims to restore and regenerate the neighborhoods (Urbact, n.d).

***Figure 13.2: spatial mapping & analysis***

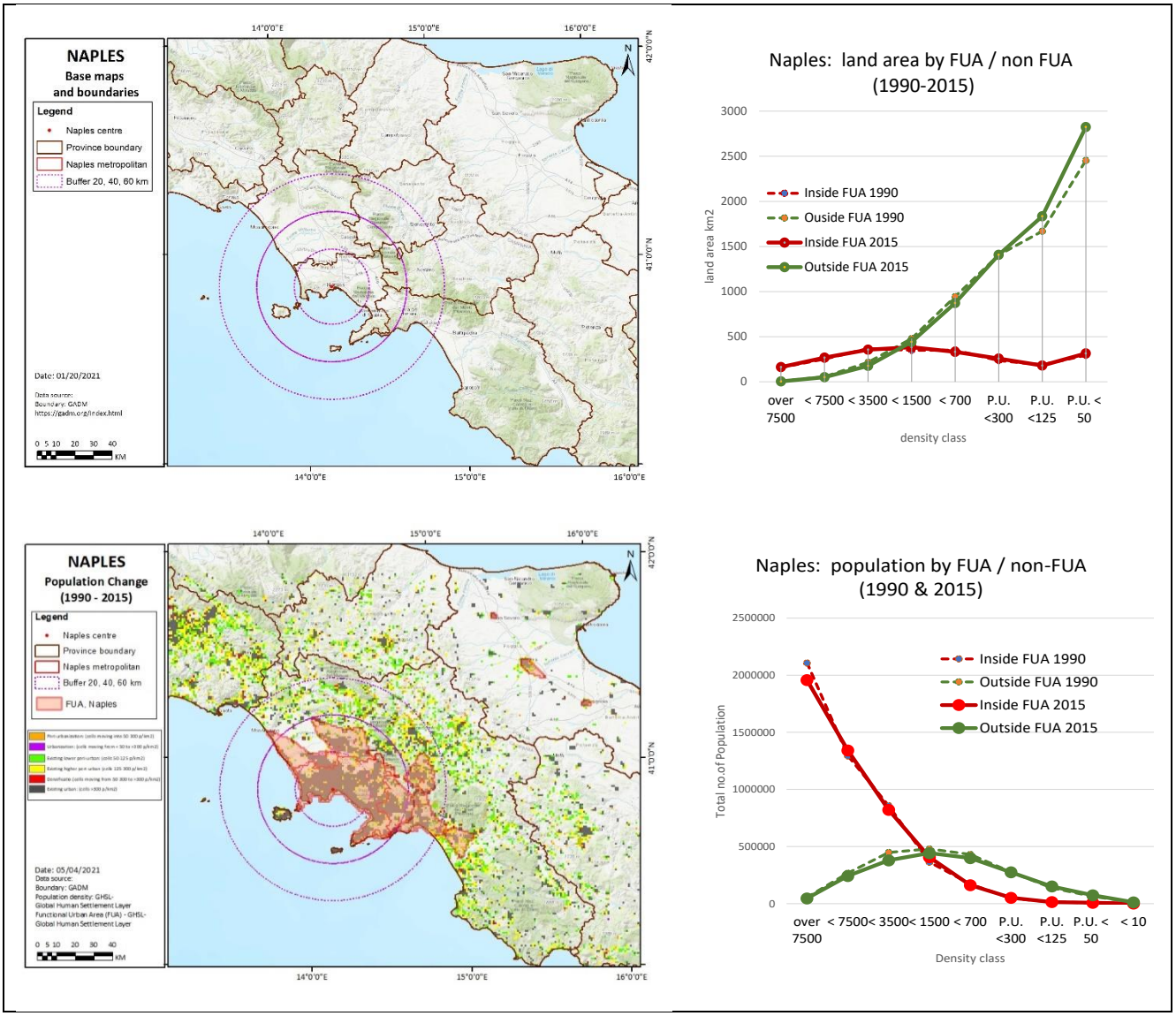


***Figure 13.3: climate effects mapping & analysis***

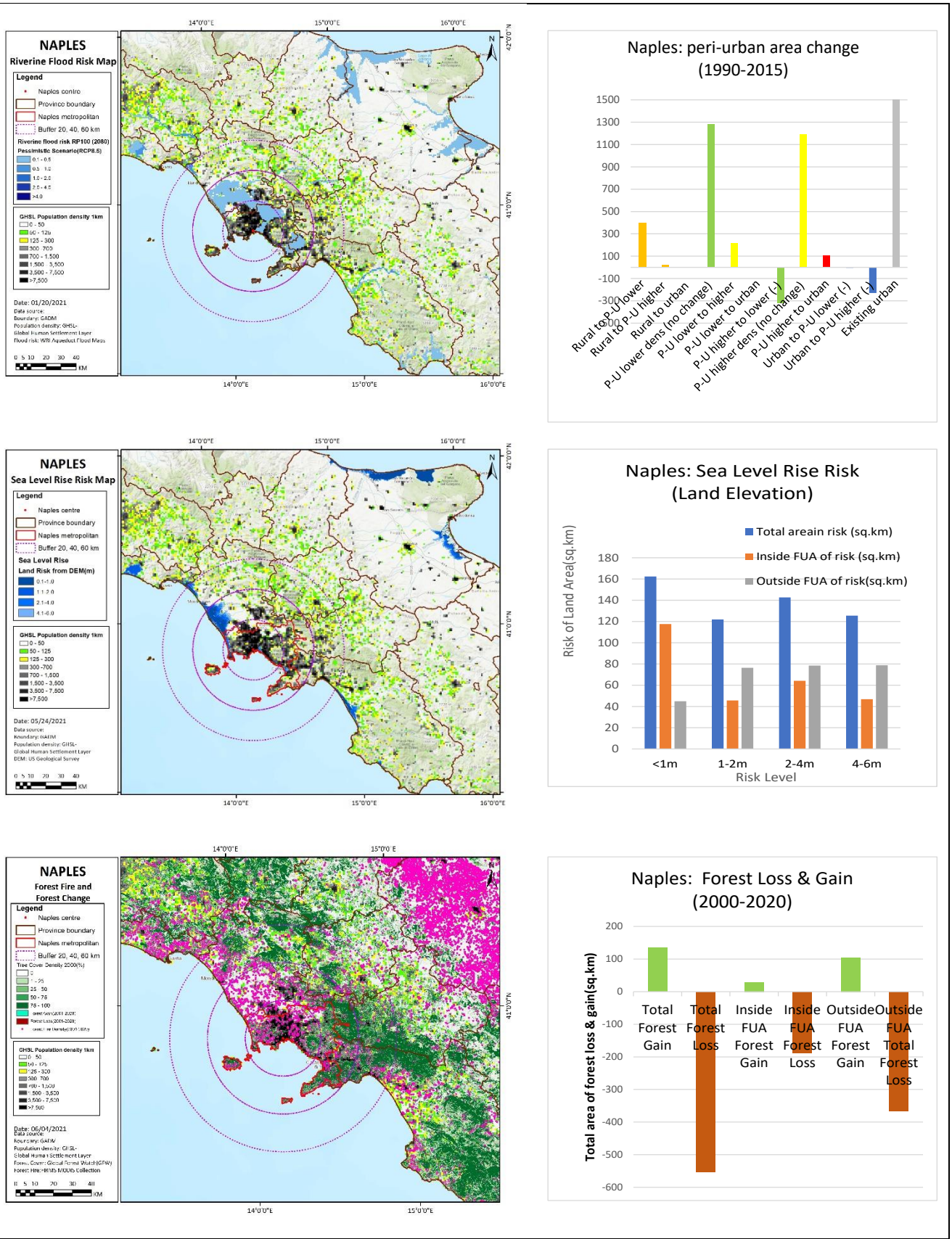
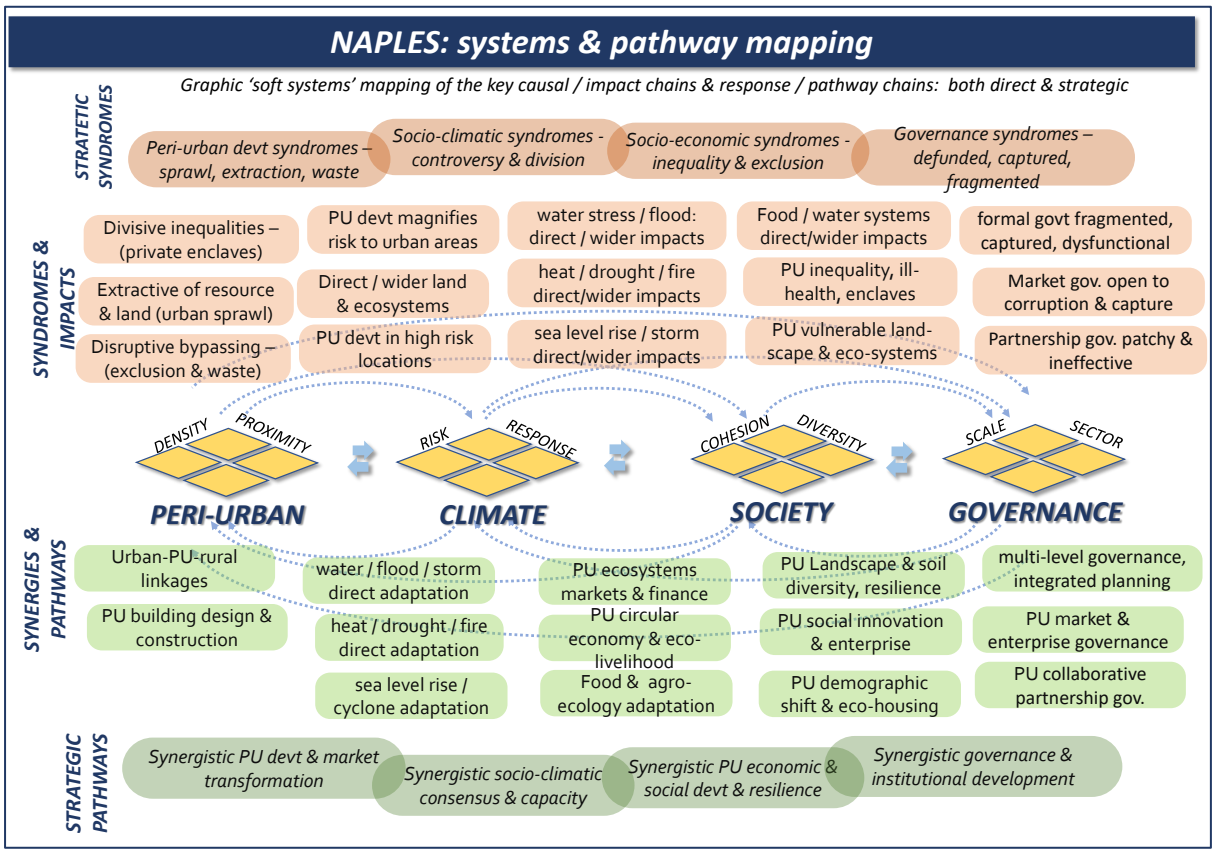


***Figure 13.4: system & pathway mapping***




## 13.1 Adaptive pathways

(A preliminary menu for debate and investigation)

***Climate pathways: heat / drought adaptation***

arid climate adaptation, calls for multi-level governance. Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence.

***Agro-ecology & food democracy***

Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

***New demographics & eco-housing***

While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-

entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***Eco-real estate markets***

Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.

***Circular economy & eco-livelihood***

The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

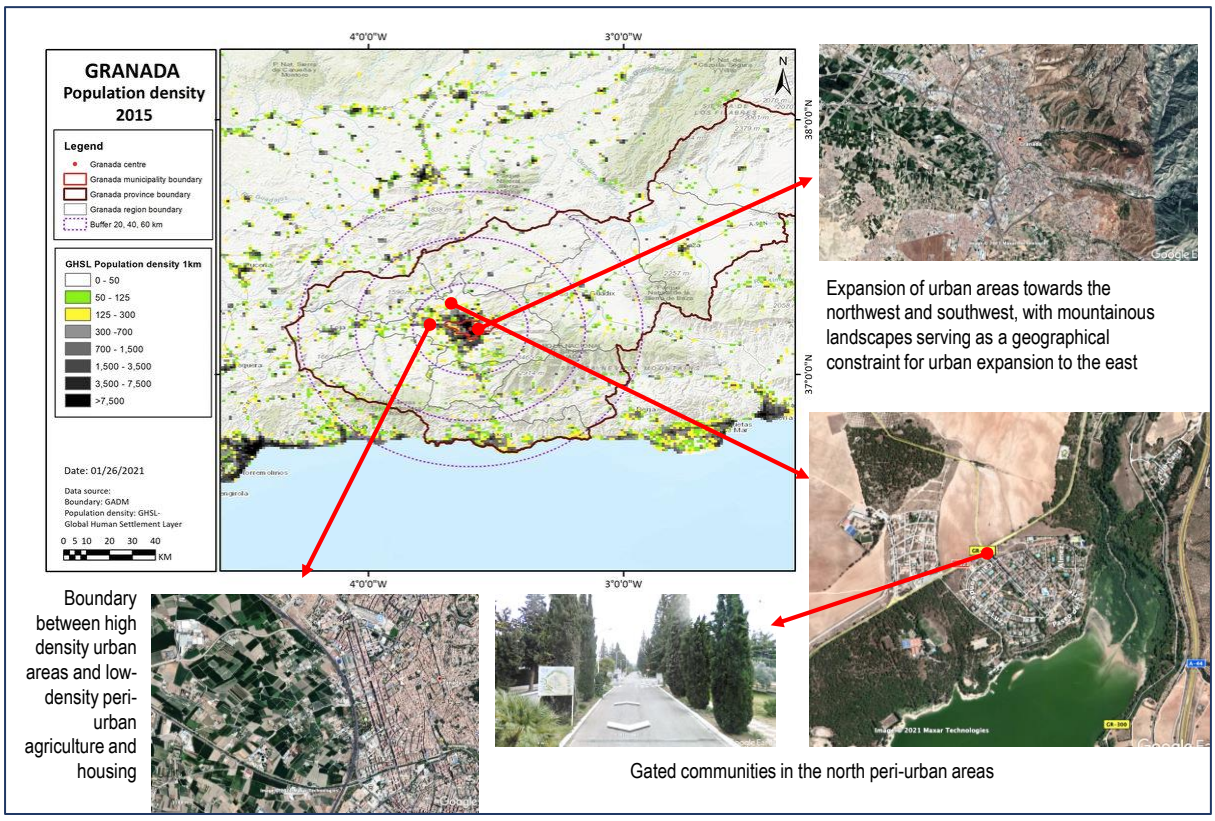
***Collaborative governance, civil partnerships***

Livelihood-based pathways: civil society / grassroots action / cooperatives (e.g. indigenous groups): new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 14 Granada

***Scope:*** *a wider region surrounding Granada: **(**a) a post-agrarian region in a semi-arid mountain landscape: and (b) coastal strip with rapid tourist & industrial development.*

***Figure 14.1: where is the peri-urban***




## *OVERVIEW*

Granada is a historic city-region of 1 million, in a fertile valley with mountainous surroundings: around 60km from the coastal strip of Malaga with intensive tourist and economic development. There is increasing drought, heat, fire & occasional flooding, overlaid on fragile landscape, still losing its remaining tree cover:

***Peri-urban syndromes:*** outward movement into peri-urban hinterland along river valleys: Ongoing gentrification of rural settlements in further hinterland: much new development is high risk locations.

***Climate change risks***: seasonal rivers are prone to flooding in low lying areas: limited sea level rise on coast: projected extreme heat & drought in Mediterranean basin, with water stress, desertification & forest fires: indirect impacts on ecosystems & farmland:

***Societal vulnerability***: ongoing landscape deterioration in arid conditions, historic cultivation systems are obsolete, continuing forest loss: housing stress / economic vulnerability in peri-urban / peri-rural settlements, general vulnerability of ageing & low-income populations:

***Governance syndromes***: government & public services are under-funded, fragmented & struggle with elite capture: active civil society lacks connections: growing climate awareness but policy still catching up:

***Adaptive pathways***: urban-rural linkages with agro-ecology, stewardship of land & ecosystems, circular economy livelihoods: climate-wise development patterns & forms: integrated water / drought / heat resilience:

***Adaptive governance***: policy integration & capacity building for multi-level government: new role for collaborative-associative civil society governance:

## Peri-urban issues

- Granada is one of the top three rapidly sprawling regions in Spain, along with Madrid and Victoria (Morollon et al., 2014). One of the compelling factors of urban expansion is the growing networks of Motorways connecting Granada urban centre with its surrounding regions.
- Granada's urban areas are expanding towards the northwest and southwest peri-urban, dominated by development of residential areas and road infrastructures. Meanwhile the mountainous landscapes serve as a constraint for urban expansion to the east.
- The economic sectors of the peri-urban are dominated by agriculture and tourism. Most of the peri-urban agriculture are located in the southwest peri-urban, while the south relies on coastal tourism. Meanwhile, some of the peri-urban villages are experiencing economic depression with insufficient water supplies.
- One of the problems to look at in the future is the agricultural sectors. With its role as a main economic sector for the southwest peri-urban and a provider of local foods, these faring parcels are threatened by imminent rural-urban transformation as the peri-urban population continues to grow alongside the declining population density in the urban centres.

## Climate issues

- 0.4 °C / decade winter temp increase, 0.7 °C / decade summer temp increase (A2 scenario). Increased frequency of days with extreme maximum temperatures.
- Reduction in rainfall in Andalucía region over latter half of C. 20th. [2]
- Longer flowering season [1]. Spread of parasite species to new territories, greater incidence frequency of pine caterpillars in Scots pine in Andalusian forests.
- Recession of cork oak. Recession of shrub lands. Bird, mammal, and reptile biodiversity loss.
- Decrease in soil organic carbon. Water erosion across almost half of soils.
- Heavy winter rains have historically caused hundreds of embankment failures on key roads in the Andalucía region. Historic Andalucía landslips have been caused by rainfall greater than historic 100 year maxima at 30% of monitoring sites.[2]
- Reduction in maize yield, increase in rain-fed spring wheat yield. [4]
- Logging, alterations of slope drainage increase hill side infrastructure failure due to slope / embankment failures. [2]
- Alhambra forest diversification increases forest resilience to climate change. [3] Bird populations around Granada are relatively diverse and resilient in a review of nine European cities. [5]
- Recession of cork oak, affects local economy and agriculture. Andalusian Tourism is a large industry concentrated in July, August, and September.[2]

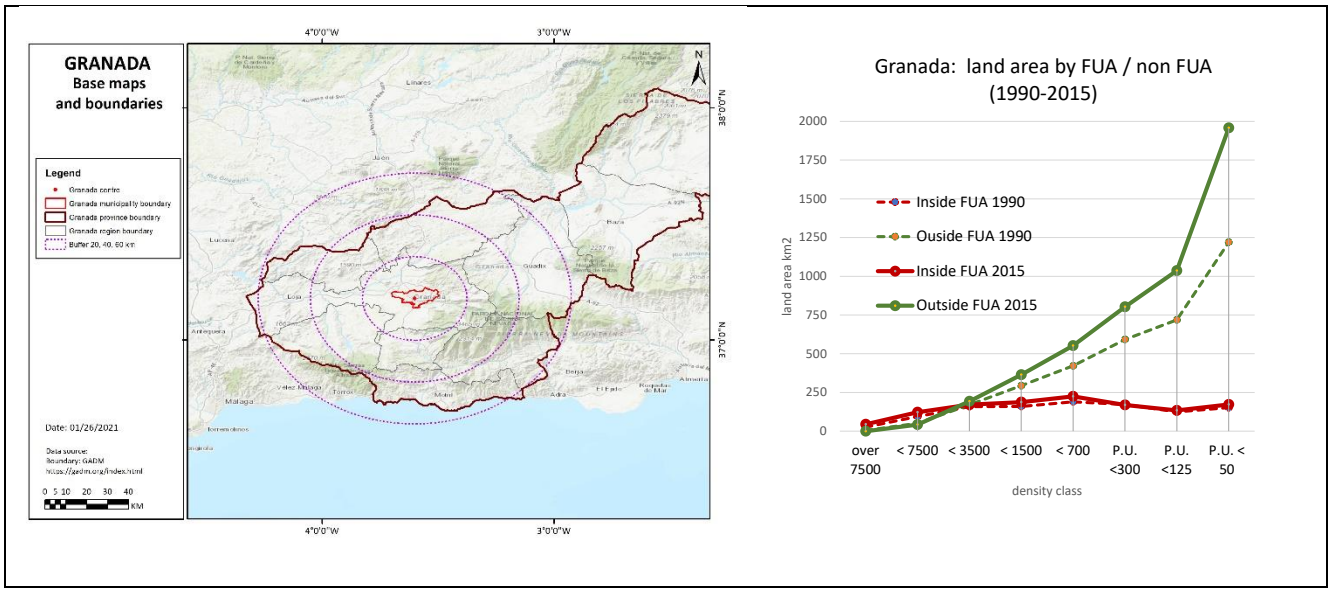
- Increased pollen count, many trees experiencing longer flowering periods, this has already caused increased incidence of allergies, this trend will potentially increase in future. [3]

## Governance issues

Some notes on the problems of peri-urban governance:

- Lack of communication among neighbouring authorities where planning is often in silos. This particular issue has made difficult in planning the peri-urban, especially in the management of green belt. This needs a more robust regional framework to ensure the connectivity of green belt areas. On the other hand, the concept of Bioregion is not fully engaged in the process of planning, which involve also controlling and managing the process of rural-urban transformation. With this problem, the future of Spain's green belt in particular, or the peri-urban areas in general are heading towards jeopardy.
- General context: The economic system is very vulnerable here, as in many others cities in Spain. Lack of entrepreneurship, telework without developping, inequality, precariousness, and lack of diversity in terms of economic sectors. There is an excess of tourism, construction and the service sectors Increasingly vulnerable, since there is a loss of adaptive capacity, there is no proposal of solutions in terms of centralities and / or locations of land uses. Non-existent support from regional or local gobernance (very weak). Corruption?

***Figure 14.2: spatial mapping & analysis***



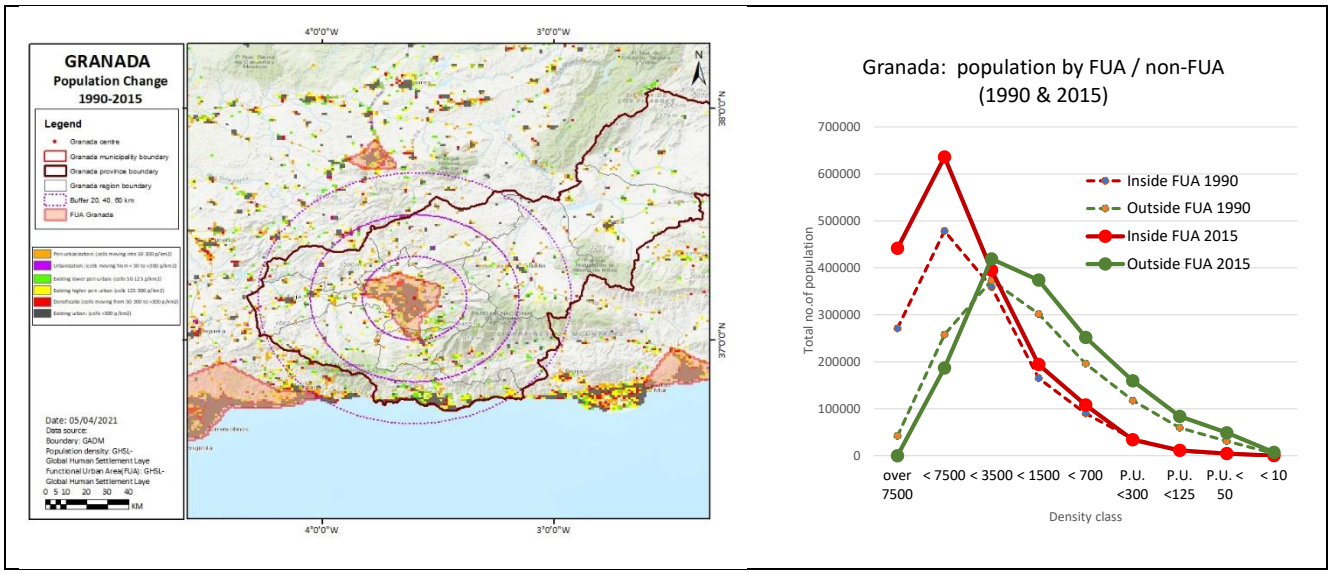
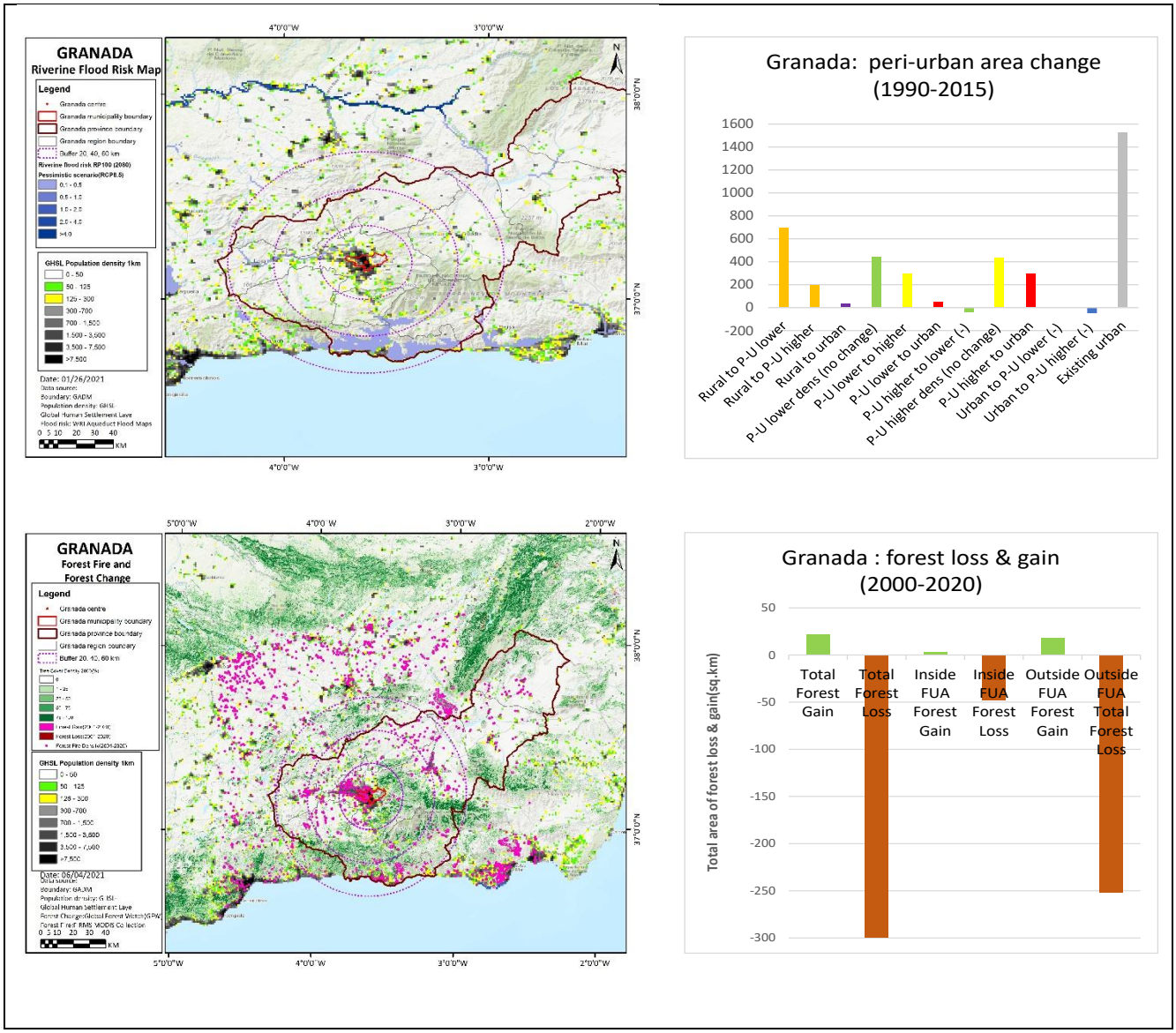



***Figure 14.3: climate effects mapping & analysis***



## 14.1 Adaptive pathways

(notes on discussion in 2021 around and at the Policy lab workshops.

We start with 4 challenges:

- CHALLENGE 1: Brutal Mobility - Origins/Destinations: Lack of centralities
- CHALLENGE 2: Agricultural Territory Without Success - Loss of Significance
- CHALLENGE 3: Landscape Will Be Definitely Forgotten
- CHALLENGE 4: Health Problems Generalized

Then follow practical applications to the challenges of climate-wise peri-urban development:

- Landscape strategy for Andalusia - starts with the watersheds: water system with large dams. Water scarcity problems: reducing water demand for agriculture? or artifical snow for ski stations. So, water around the city & peri-urban is at risk: aquifers are at risk: using groundwater from middle ages:
- air pollution, traffic etc: some new responses: new metro: local council plans: green belt of trees: not edible forest? better to increase forest land on hills & around the bio-region: climate change plans not really effecting pollution so far. proposals - new mobility strategies: new agri-ecology networks: heritage land protection: sustainable urban drainage systems proposals

Governance pathways:

- 1) co-learning pathways to create a culture?? maybe at meso level governance: e.g. province of Granada. experience in Colombia - integration of technical expertise with civil society meetings (urban acupuncture)
- pathway 2: local municipalities, e.g. orchard planting at grassroots level - agro-forestry - also ecological markets
- pathway 3: confront & critique mainstream old-fashoned urban planning

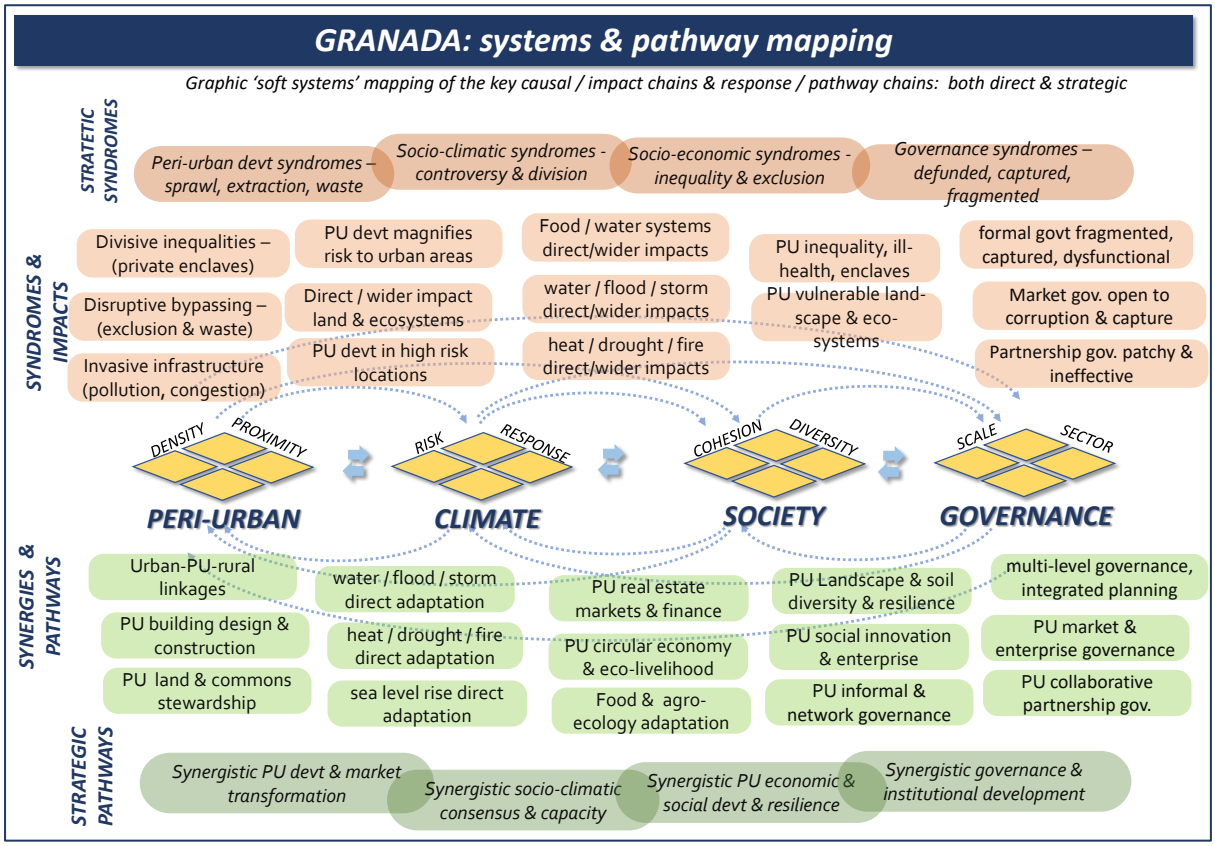
This forms a 3-leg combination: expert / political / civil society (multiple helix). Practical applications to agro-forestry needs pilot examples. Are there general principles for this example:

- ecological complexity & diversity = resilience & adaptive capacity
- social complexity & diversity = resilience & adaptive capacity
- economic complexity & diversity = resilience & adaptive capacity
- governance complexity & diversity = resilience & adaptive capacity

For the challenge of social integration in the peri-urban: beyond gated communities (is this the same as social complexity & resilience??). For public transport in a car dependent peri-urban - more autonomous centres? retrofitting the peri-urban. For control of expansion & sprawl - start with older towns?

Example of Chile system: strong at national & at community level: regional is a gap (from dictatorship years)

***Figure 14.4: system & pathway mapping***




(A preliminary menu for debate and investigation)

***Climate pathways: heat / drought adaptation***

arid climate adaptation, calls for multi-level governance. Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence.

***Agro-ecology & food democracy***

Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

***New demographics & eco-housing***

While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***Eco-real estate markets***

Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then

feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.

***Circular economy & eco-livelihood***

The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

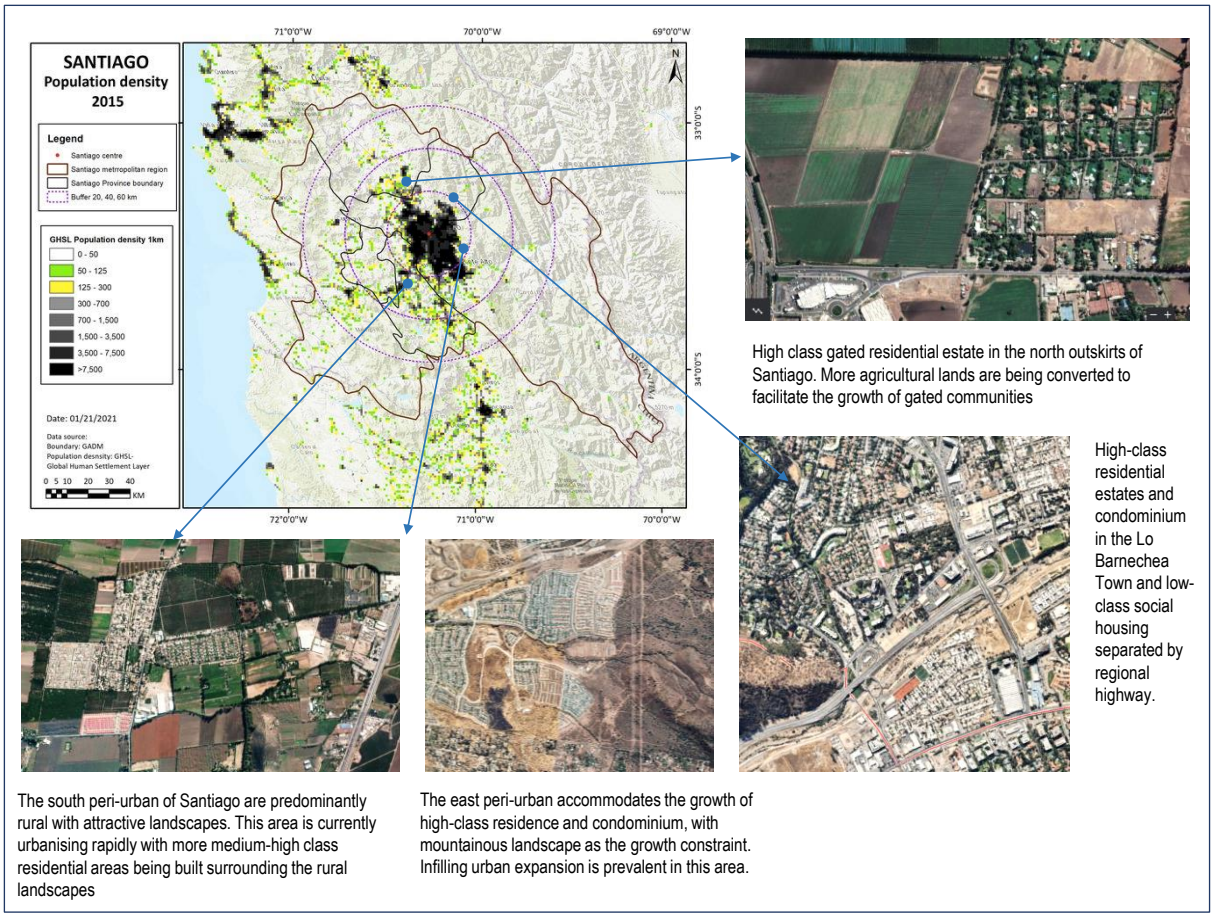
***Collaborative governance, civil partnerships***

Livelihood-based pathways: civil society / grassroots action / cooperatives (e.g. indigenous groups): new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 15 Santiago

***Scope**: the Santiago Province and Metropolitan Region is at the centre: the 200km frame also includes the Andes and Chilean Coast Range.*

***Figure 15.1: where is the peri-urban***




## *OVERVIEW*

Santiago is a post-industrial city expanding into complex fragile landscape: climate risks of heat, drought, flood from upstream mountain area: climate risks are overlaid on seismic risks & on patterns of peri-urban growth, decline & gentrification.

***Peri-urban syndromes:*** a formerly compact city with planned public housing is now expanding with higher-value enclave settlements, along with expansion of traditional towns, dispersed peri-urban development, & rural change in the hinterland.

***Climate change risks***: seasonal rivers are prone to flooding in low lying areas: sea level rise on low-lying coast: rapid increase in forest fires in drought & heat conditions, with desertification & rapid depletion of tree cover: indirect impacts on ecosystems & farmland:

***Societal vulnerability***: former cultivation systems fall obsolete in arid conditions, with disruption & loss of livelihoods: housing stress / economic vulnerability in peri-urban / peri-rural settlements, with tensions from decline & gentrification:

***Governance syndromes***: government & public services are in flux with new political change, meanwhile there is typical elite capture & fragmentation: active civil society lacks connections: peri-urban development & climate awareness not yet mainstream:

***Adaptive pathways***: urban-rural linkages with agro-ecology systems, new forms of land stewardship, circular economy livelihoods: climate-wise development patterns: market potential for eco-real estate: integrated water / drought / heat resilience:

***Adaptive governance***: policy integration & capacity building for multi-level government: new role for collaborative-associative civil society governance: potential for grassroots / social innovations.

## Peri-urban issues

- Santiago expanded rapidly during the dictatorship & since, organized on a grid plan. Low income housing was sited on transit corridors. Much recent near-peri-urban is disconnected gated enclaves with own services. In hinterland, peri-urban expansion of older towns & modernization of rural economy.
- urban real estate markets push out-migration to peri-urban, mainly car-based: more pressure due to geography. Enclaves get larger
- Middle class culture favours the peri-urban gated community. Rural areas want to be 'urban' & many urban areas want 'rural'.
- Santiago is a primate city with large N-S gravity pull. Recent political changes shift towards indigenous economic activity, but most real estate controlled by elite wealth.

## Climate issues

- Temperature rise projection to 2100: 1.5 – 5.5 degrees average
- Precipitation projection: summer 30-50% reduction, winter 20-30% reduction.
- Major seismic problems with San Ramon fault: link with climate change?
- urban flash flooding & drought events set to increase. Reduced water availability affecting hydroelectricity, mining, agribusiness, human consumption.
- Forest depletion to W, fire zone to NW. Generally arid landscape will increase in drought & heat. Major losses to agriculture in a high emissions scenario.
- Urban impacts on land-use & land cover combine with climate change, causing soil & ecosystems loss.

## Societal issues

- Santiago Metro region extends to near the coast, with fertile valleys & forested hills, against the Cordillera of the Andes. A generally dry climate is set to get much drier.
- Fragmented planning fails to connect with ecological patterns – or to provide infrastructure services & jobs in the right locations. Water / energy sectors lack integration of structure or policy.

- Social divisions on the S side, between high-class residential areas next to existing social housing & local long-term community. Displacementre of farming creates socio-economic problems with 'rural gentrification'. Urban poverty is rising & causes political pressures.
- Resilience through participatory processes has been explored, however this needs rolling out at a larger and continuous scale. [4]
- There is potential to increase the resilience to climate change by engaging with structural inequalities. Peri-urban is developing randomly around the system of rural residential plots: liberalisation policies bring transformations that policy makers cannot control.

***Figure 15.2: spatial mapping & analysis***

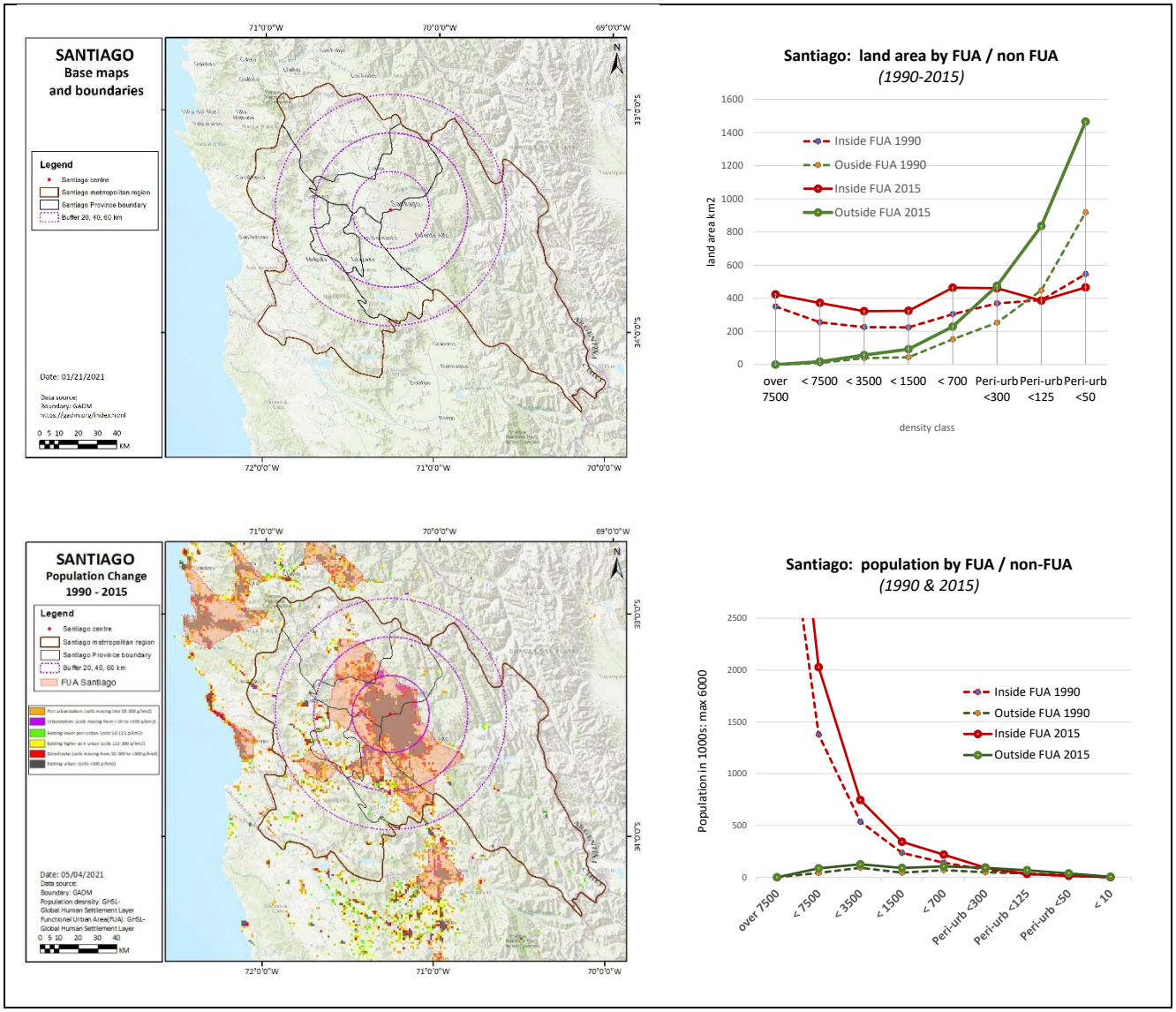
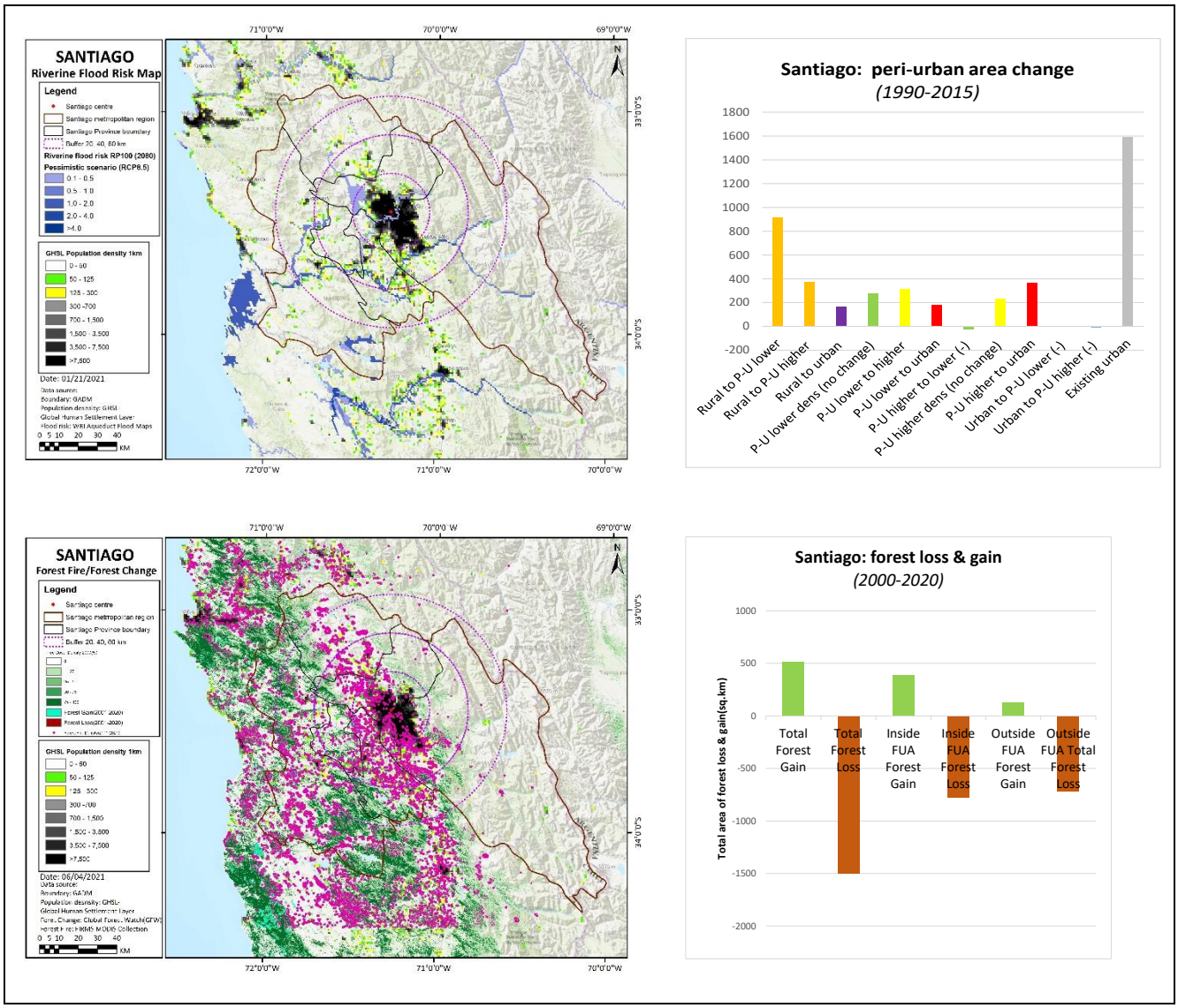


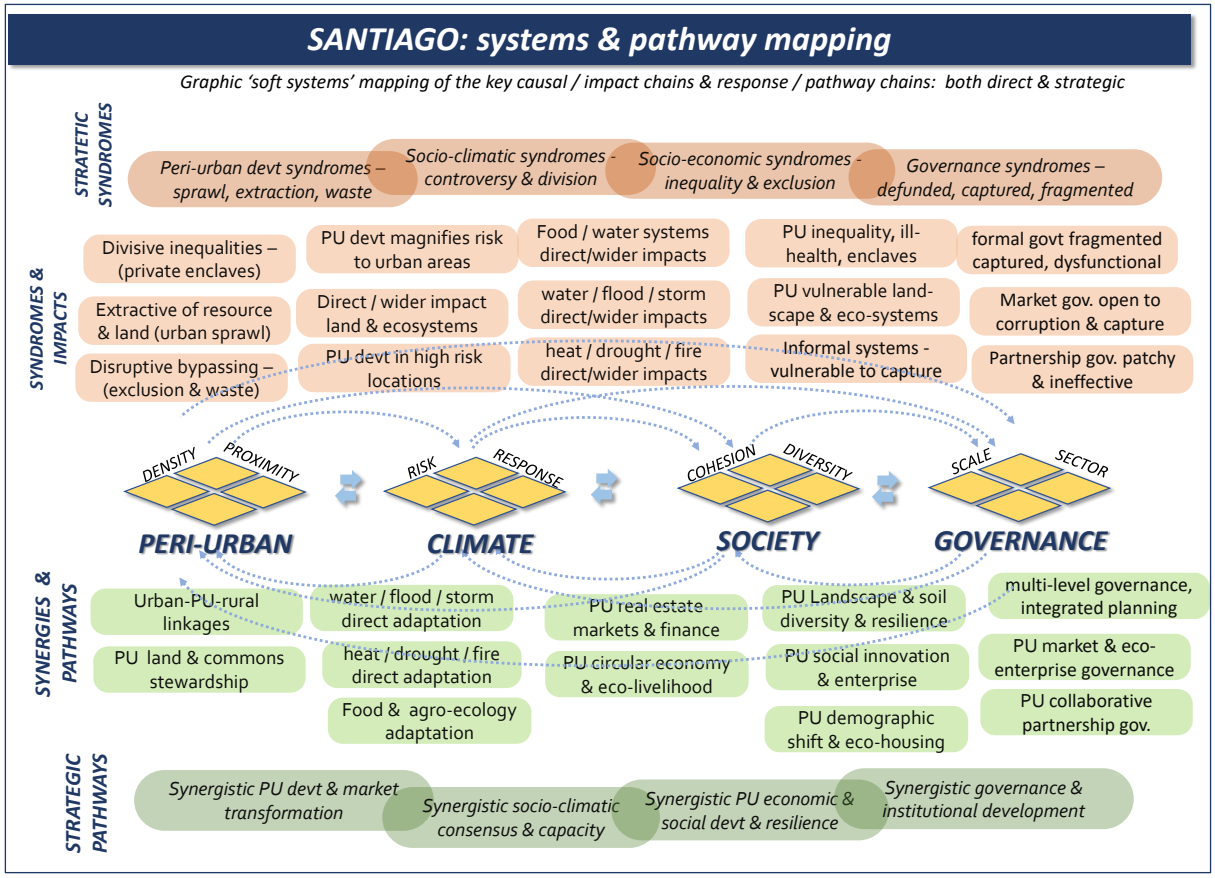
***Figure 15.3: climate effects mapping & analysis***




## Governance issues

- Spatial governance is fragmented between 52 boroughs. Metropolitan area was planned on grid pattern, but the speed of peri-urban expansion seems beyond the current capacity of planning. Local governments are generally inwards & short termist.
- Active civil society with pressure groups, lobby groups etc, however much is deeply embedded in structures of elite power
- The political elite merges into business / real estate / extractive industries, with widespread clientelism & nepotism.
- There may be underlying layers of cohesion and resilience, alongside with deep political-cultural divisions

***Figure 15.4: system & pathway mapping***




## 15.1 Adaptive pathways

There are new concepts of governance in Santiago at national and local level: new mayor aims to connect with all local districts. This could transform the urban & regional planning system: with very practical long running issues, e.g earthquake resilience on the San Ramon fault.

For the national policy for DRR - more social & gender participation: also ecological design: this addresses problems of social segregation, gated communities on agriculture land

Typical peri-urban problems: lack of public transport: national rail system may build more connections.

For urban development, how to envision alternatives to the gated community? many in Santiago want to live in a globalized way. We may need to rethink options e.g. social housing system: agenda for social integration from fragmentation: social insecurity, violence etc, is a driver for gated communities.

Locations to the west, new gated communities in older towns, with new jobs & businesses. Many international migrants living in poor conditions - can we propose a new kind of housing system? We should explore the potential of social change & possible new models of housing, co-housing etc.

Generally this needs both government combined with civil society governance - decentralized regional & local.

Meanwhile independent movements very popular, taking support from political parties. Independent mayors with local agendas not tied to parties - more bottom up planning. But complex problems also need top down regulation e.g. for seismic resistance. We need to look at Latin & Hispanic experience with policy transfer.

These are the most likely pathways for further debate and investigation:

***Climate pathways: heat / drought adaptation***

arid climate adaptation, calls for multi-level governance. Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence.

***Agro-ecology & food democracy***

Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

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While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***Eco-real estate markets***

Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.

***Circular economy & eco-livelihood***

The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

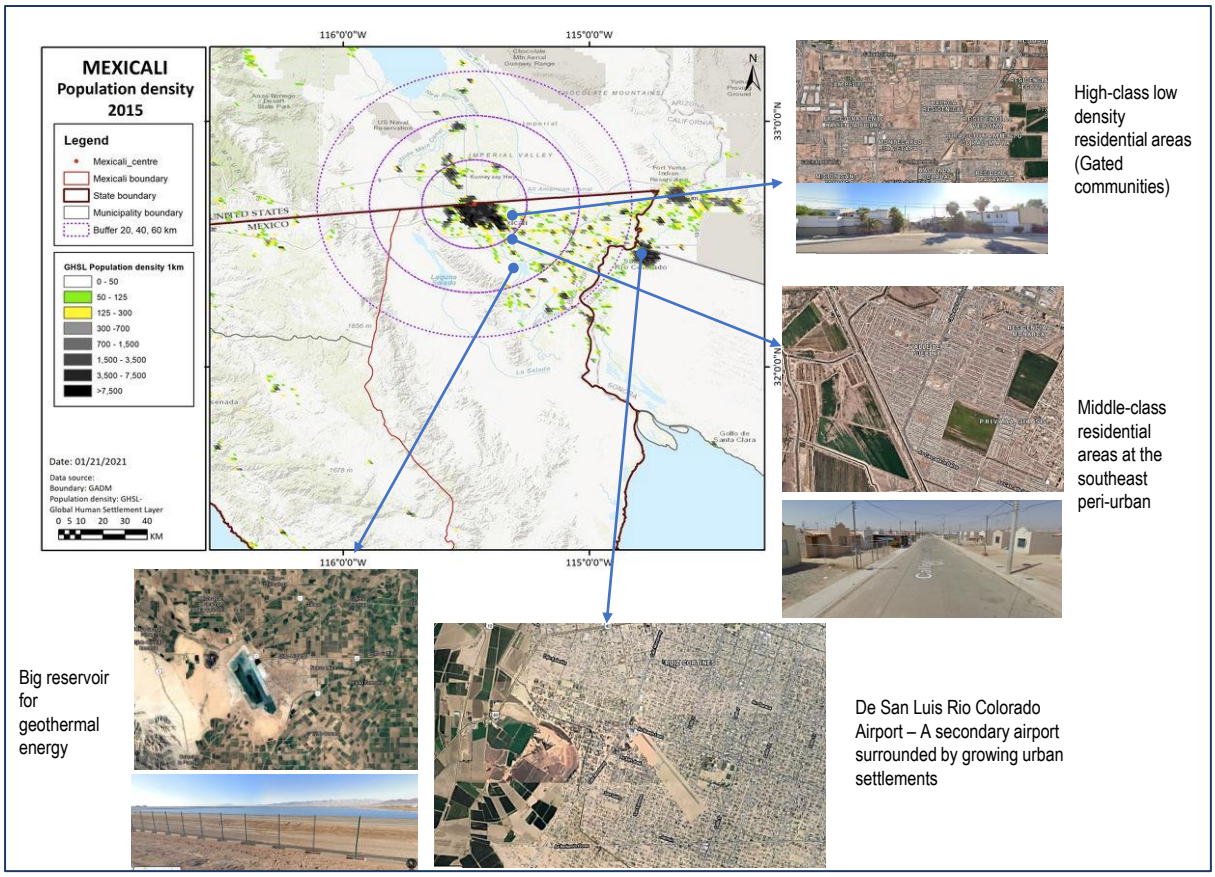
***Collaborative governance, civil partnerships***

Livelihood-based pathways: civil society / grassroots action / cooperatives (e.g. indigenous groups): new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 16 Mexicali

***Scope**: Mexicali is at the centre of this frame, which stretches from over the USA border, to the Gulf of California to the south.*

***Figure 16.1: where is the peri-urban***




## *OVERVIEW*

Mexicali is a border city with a historic role in the economy of Imperial Valley California, in a desert scrub landscape overlaid with water-intensive agriculture: high dependency on Colorado river on USA side, with extreme heat drought & water stress projected.

***Peri-urban syndromes:*** extensive car-based grid pattern city expanding adhoc into peri-urban areas, with higher value enclaves & lower-value housing: most new population is urban higher density, with smaller peri-urban developments: most hinterland is uninhabited desert.

***Climate change risks***: extreme heat & water stress is projected, with near total dependency on Colorado river water coming from USA western states. urban heat island. Occasional riverine & flash flooding, lacking water management: with rapid loss of remaining tree cover.

***Societal vulnerability***: water-intensive / industrial high input cultivation, with migrant farm workers in very poor conditions: economic vulnerability in peri-urban / peri-rural settlements: refugees from climate / conflict arriving from the south:

***Governance syndromes***: government & public services in flux between state & national anti-corruption programs, overlaid on widespread local elite capture: civil society & grassroots generally excluded: peri-urban & climate awareness not yet on the agenda:

***Adaptive pathways***: integrated planning & design for climate-wise water / drought / heat resilience: urban-rural linkages with agro-ecology systems, circular economy livelihoods: potential for eco-real estate markets & climate-wise development patterns:

***Adaptive governance***: policy integration & capacity building for multi-level government: new role for civil society governance: potential for grassroots / social innovations.

## Peri-urban effects

- Mexicali lies on the US-Mexico border with a dynamic growth of urban areas expanding towards the south and east. The outward spread of low-density development has caused the declining population density at the urban centres. Population are distributed to the east (for high-class peri-urban dwellers) and south / south east (middle-class dwellers). Meanwhile, the Laguna Salada, a mountainous area surrounded by agricultural lands, serve as a constraint for urban expansion towards the west / southwest.
- Besides housing, industrial development is also an emerging sector of the peri-urban
- The urban to peri-urban migration is caused mainly by the provision of housing that is spatially distributed towards the east and southeast peri-urban. In recent years, this migration has become more significant.
- Developers play a key role in developing an expanding structure of urban and regional development. Developers gain profit in the peri-urban property business by purchasing lands at lower prices and selling them at significantly higher prices. These developers have strong connection with authorities which they attempt to influence the direction of land use policies to accommodate the growth of residential development.
- A structure of bioregional south – reservoir, river basin and geothermal power plant at the south
- Peri-urban transformation: Abandoned low-class peri-urban residential areas are transforming to middle-upper class. At first, the low-class residential areas were part of the public housing agenda, which is to provide affordable housing for the low-income communities. In later development, the value of the area declined due to vandalism and rising crime. This have attracted developers to acquire these areas and rebuilt them to apartments, condominium and other middle-upper housing supplies.
- The remaining low-class residential areas are gradually declining. Most of these settlements do not have sufficient infrastructure services and are in high risk of crime which is exacerbated by the lack of facilities like police stations.
- For agriculture, most of the lands were owned by the states (before 1990). After 1990, the state granted private ownership status of these farming parcels. But as the value declines, labour farmers refused to return to faming. This subsequently caused further decline of agriculture. From this stage, landowners sell or rent their lands to private developers, which later being converted to residential, industrial and commercial activities

- This goes with the US-Mexican border and the interrelation of water resources influencing both sides. The agricultural lands in Mexicali's peri-urban areas rely on water supply that flows from the US. In general, Mexicali has extreme vulnerability of water supply. This is exacerbated by the government who is continuously encouraging FDI to invest more without appropriate measures of how to supply these industrial activities, let alone the construction process.

## Climate effects

- Temperature effects – 3 °C average temperature increase (A2 scenario – increased population, heterogeneous development), extreme max temperature increase of +9 °C in July by 2050 [1].
- Extreme weather – Reported in between 2000 - and 2010 there were 2.3 times as many heatwaves compared to 1970 – 1980 [2]. Heat associated deaths – As heatwaves increase, deaths associated with heat, "heatstroke", will increase. [2]
- Total Annual Rainfall has increased in the Mexicali region (1922 – 2004) [3]
- ENSO (El Niño Southern Oscillation) extremes likely to increase, resulting in drier climate during La Niña years, and wetter La Niño years [4].
- Water – 57% comes from the Colorado River, 37% comes from underground sources, 10% comes from coastal aquifers.
- As there is no current capacity to store rainwater the future La Niña years may be problematic for Mexicali. There will be increased water consumption across the USA-Mexico border from the Colorado river, water scarcity may increase in Mexicali. [6]
- Water consumption by farming in the Mexicali Valley uses more water than is provided by the Colorado river. [12] If underground sources are not recharged a water crisis in the Mexicali Valley will occur.
- Urban heat island – greater urbanisation and migration to urban areas results in higher exposure to extreme heat. An additional maximum intensity effect of 5.2 °C in the summer time further increases the impact of extreme heat in the region. [7]
- Urbanisation and transport emissions - By 2025 transportation will account for 44% of the state emissions [9]. 84% of daily trips are private cars, 68% of Mexicali air pollution is from transport, continued urbanisation may result in increased private car use, increasing city emissions, and worsening air quality. This growth and use of private vehicles may be a result of removing taxes and mandatory insurance. [10]

## Societal & governance effects

- Unregulated use of pesticides and fertilizers in agriculture, alongside water overuse have effects on the local flora and fauna.
- Use of recycled water is at 80% in the Mexicali valley, this improves resilience to water shortages. [6]
- Predicted population increases in urban areas of Baja California will be concentrated in border cities; Mexican urban centres are likely to increase from 44.6% of the population (2005) to 58.1% by 2030. [5]
- Farming vulnerability - water use changes upstream in the Colorado river will directly impact the availability of water in the Baja California area.
- Diversifying crop portfolios with low water consumption crops increases farmers resilience to water shortages. Investing in drip watering systems may improve irrigation and reduce water loss. Cement lining canals is also a consideration to improve water transportation to farm sites, cement lining however reduces the recharge ability of groundwater sources, potentially delaying but increasing the impact of a future water crisis. [13] [14]

- State Climate Action Plan – 3 HE institutions, 2 federal authorities, binational environ cooperation: they identified over 100 actions in mitigation and adaptation to climate change.
- there is a strong coalition between private developers with authorities. Through this political relation, developers were able to influence the land use policy, which became a factor to the rapid growth of peri-urban areas
- The government is transforming from an agent for people (e.g. through public housing agenda) to an agent who advantages from the profit of property markets.

***Figure 16.2: spatial mapping & analysis***

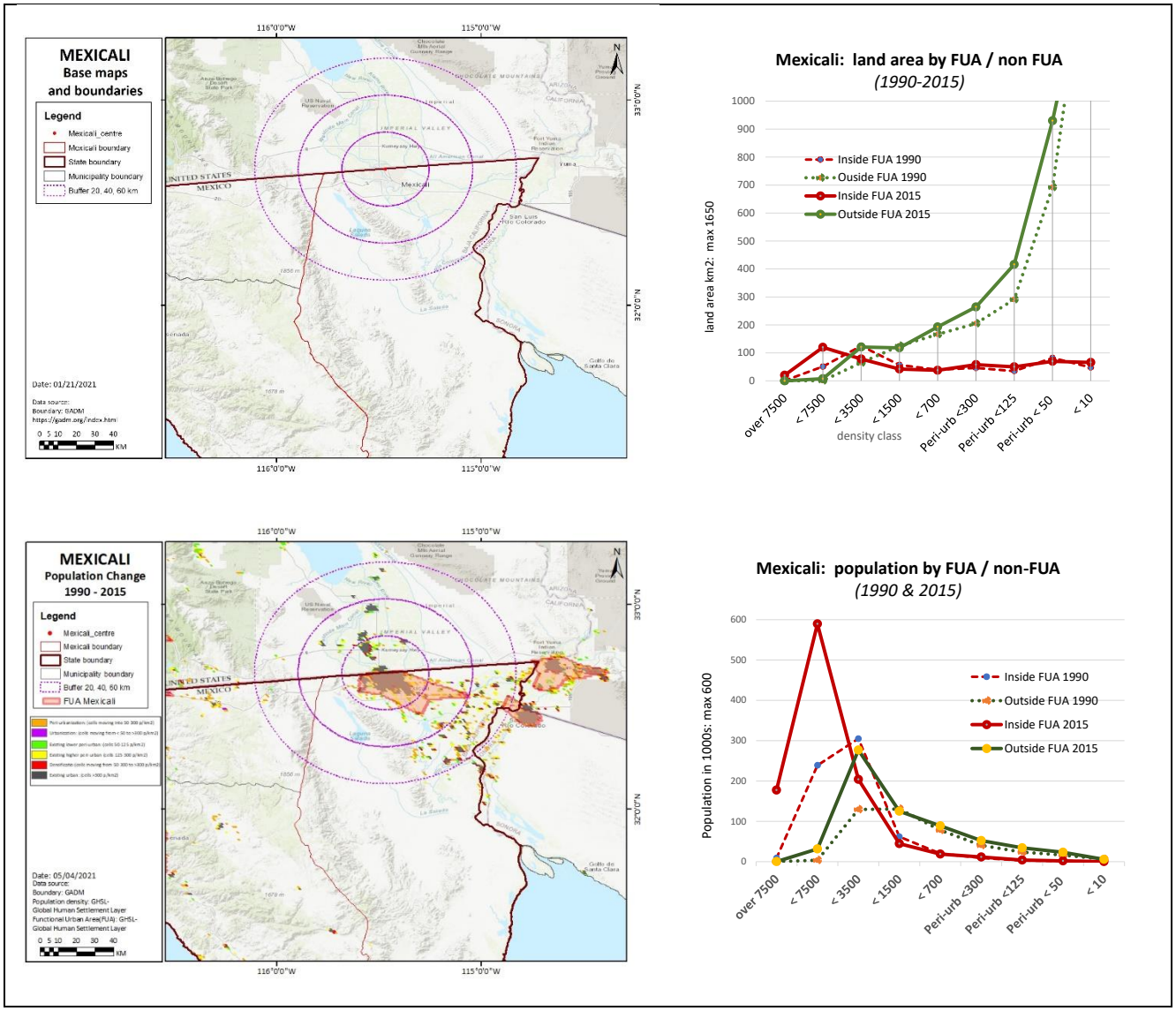
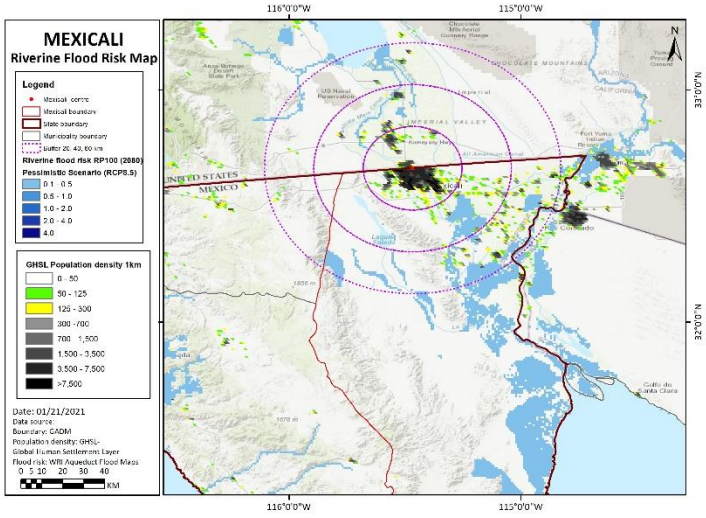
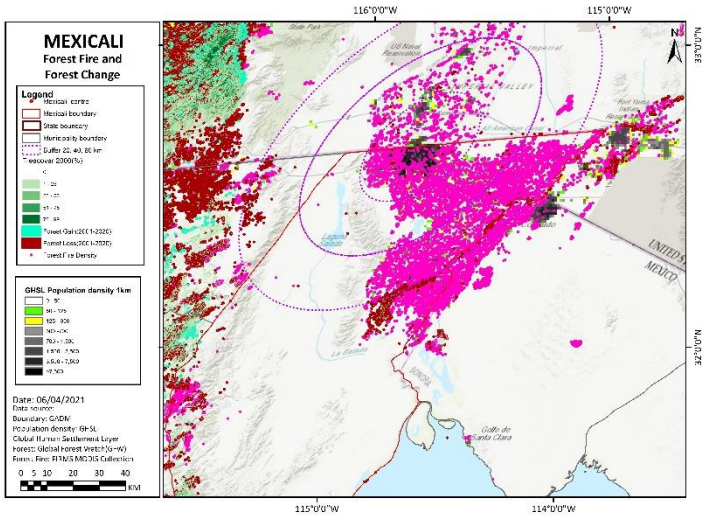
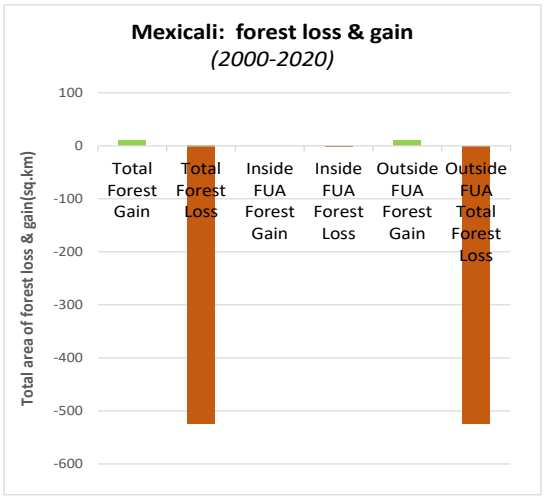
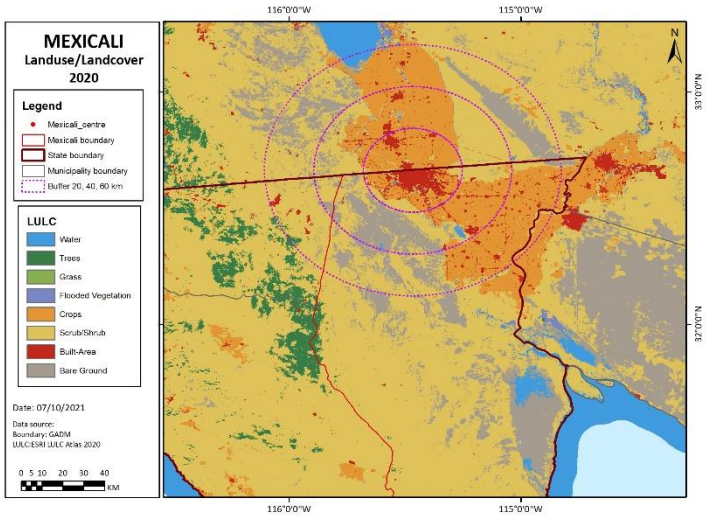


***Figure 16.3: climate effects mapping & analysis***



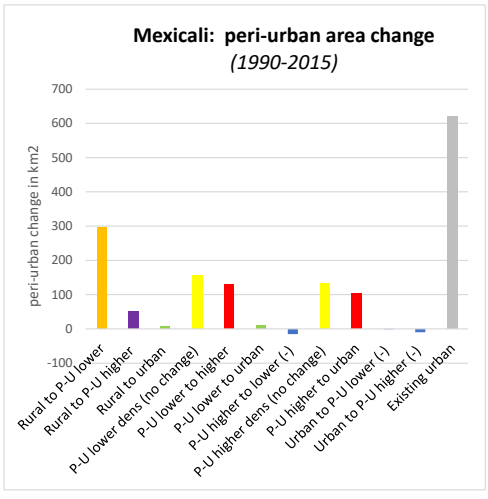
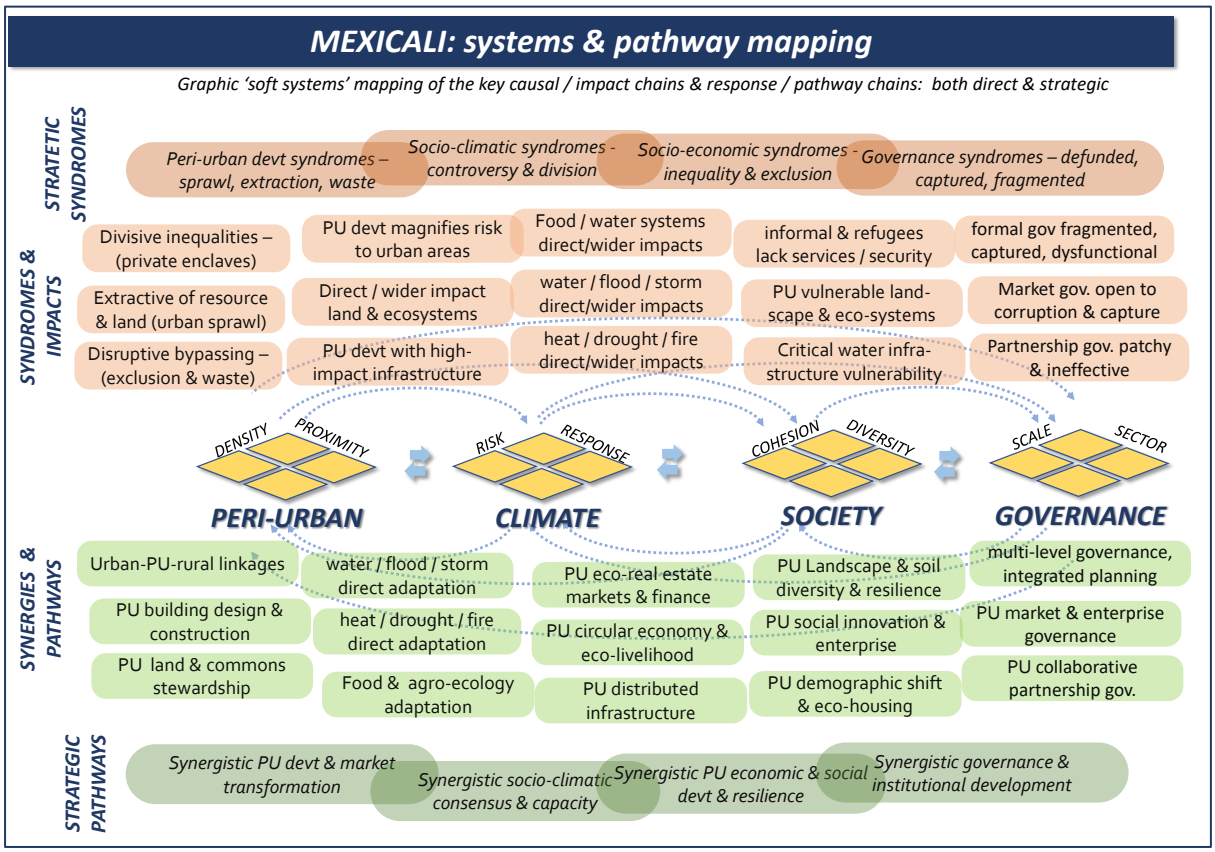



***Figure 16.4: system & pathway mapping***




## 16.1 Adaptive pathways

(a preliminary menu for debate & investigation)

***Bio-regional urban-rural linkages***

Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.

***Climate pathways: heat / drought / fire adaptation***

Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management.

Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence.

For extreme heat, a growing agenda for building eco-design, social welfare, health & safety, adaptation of livelihoods etc.

***agro-ecology & food democracy***

Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

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***peri-urban real estate markets***

Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.

***circular economy & eco-livelihood***

The practical question is how can businesses invest and create jobs from these peri-urban 'climate-wise' transitions and pathways. The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

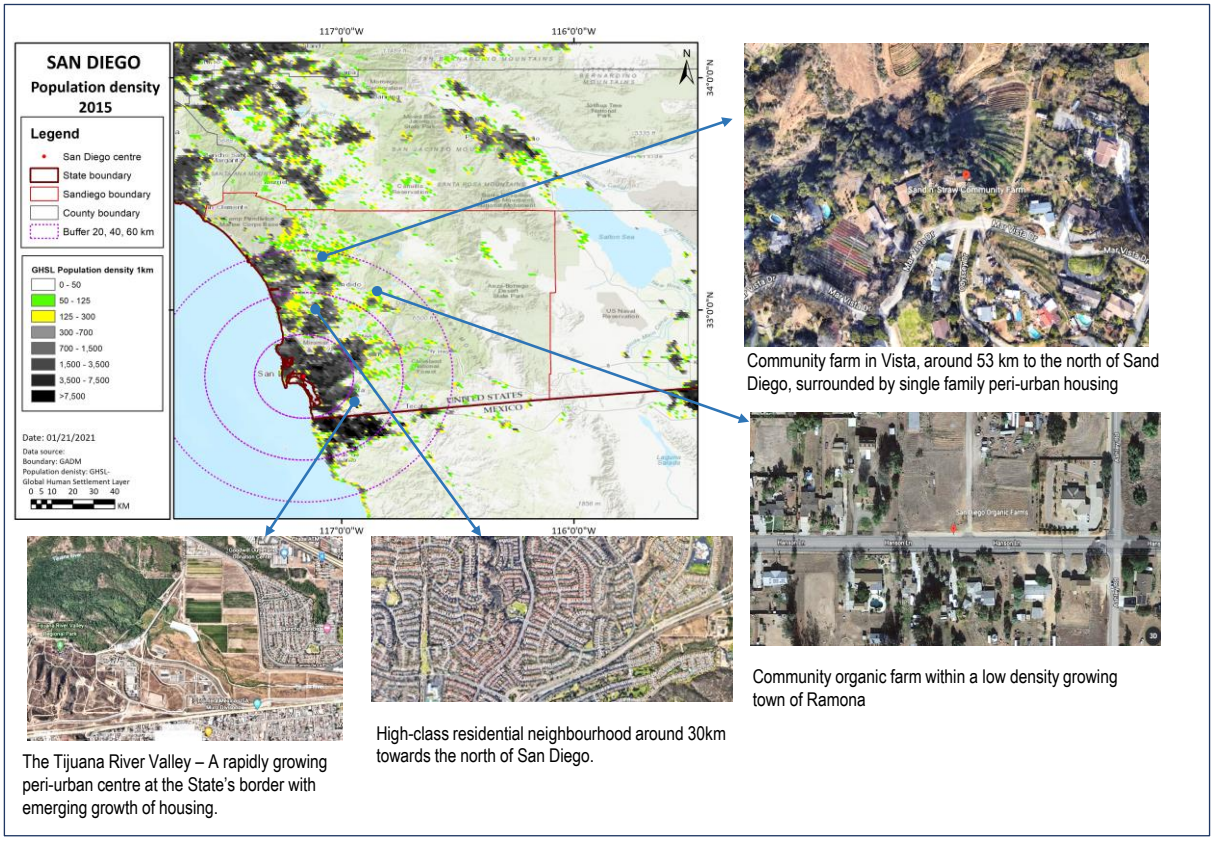
***Collaborative governance, civil partnerships***

As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

# 17 San Diego

***Scope**: this covers the dual conurbation of San Diego – Tijuana. The frame extends eastward along the international border, and northwards towards the LA outskirts.*

***Figure 17.1: where is the peri-urban***




## *OVERVIEW*

***San Diego*** is the high income side of the cross border conurbation of San Diego - Tijuana: intensive car-based urban form with slow growing peri-urban sprawl in the hinterland. Increasing vulnerability to water stress, heat, drought, desertification & rural depopulation.

***Peri-urban syndromes:*** extensive suburban car-based urban form within large FUAs: recent peri-urban growth is more gradual due to stronger controls: demographic change with sub-division of larger peri-urban housing: hinterland is mountainous arid landscape with declining small towns & patchy infrastructure.

***Climate change risks***: in a fragile geography, already under pressure on a narrow coastal strip: increasing heat, drought & water stress is projected, with direct impacts on intensive agricultural production & hinterland landscape, with rapid loss of remaining tree cover. Occasional riverine & flash flooding, lacking water management.

***Societal vulnerability***: fragile landscapes vulnerable to drought, desertification & fires to N&S: high inequality & exclusion of working poor, migrants, displaced, homeless, excluded minorities of many kinds, with high levels of housing & financial stress, economic vulnerability in peri-urban / peri-rural settlements: all magnified by cross border effects.

***Governance syndromes***: mainly effective government with urban / transport / environment policy, & (limited) public services: hardly keeping pace with the dynamics of urbanization & real estate logic, with typical sectoral fragmentation & multi-level disconnection: active civil society groups are typically not connected to the system: peri-urban & climate awareness is high with policy still catching up:

***Adaptive pathways***: integrated bio-regional strategic planning (crossing the border zone): urban-rural linkages with agro-ecology & circular economy systems: integrated peri-urban design for climate-wise water / drought / heat resilience: potential for eco-real estate markets & climate-wise development patterns:

***Adaptive governance***: policy integration & capacity building for multi-level government: new role for civil society governance: potential for grassroots / social innovations.

## Peri-urban issues

- Steady population growth leads to rapid PU expansion, from urban fringe to far hinterland, into the Sierra range. Extensive road networks have outstripped water provision, with high value housing in near desert conditions
- local 'rooted' farmlands are replaced by mobile farming, capital intensive & open to real estate dynamics of land appreciation. . Larger family houses are now shifting to multiple occupation, with growing automobile dependency.
- Policy aims towards transit-based compact urban form, but cannot contain urbanization & real estate economy. Larger campuses (business, health, education), relocate to the peri-urban, supported by a growing highway network. West coast lifestyle images are about open air & mobility.
- The US-Mexico border is a special situation, with SD-Tijuana basically as one functional system, but heavily segregated and unequal.

## Climate issues

- Temperature rise by 2060 between 2.2 and 5 degrees: >50% increase in heatwave days: drier and hotter summers with wetter and stormier winters.
- SLR of 2m could cost $400m per year. Extreme heat could reach 43 degrees. Already wildfires are rampant in the hills to the north, with many side-effects.
- Most water is from Colorado basin, now in crisis management: drastic effects on farm production & critical infrastructure.
- Development by 2100 on current trends will replace up to: 150 sq miles of agriculture, 75 sq miles of grassland, 200 sq miles of forest: all areas of carbon storage & ecosystems / species migration

- PU development tends to disrupt & deplete landscape quality & resilience: soils, water systems, land stability etc.
- The wider urbanization of the region & hinterland, shifts from a rural / small town system (vulnerable in some ways), to a conurbation system of mono-functional land-use, automobile systems, real estate logic of value
- Growing social & ecological awareness e.g. schools, colleges, unions: but not easy to translate this into systemic change.
- High level of civil / emergency services: but these tend to fall short with vulnerable populations in trailer parks, shacks & cars: migrant, homeless, excluded of many kinds.

***Figure 17.2: spatial mapping & analysis***

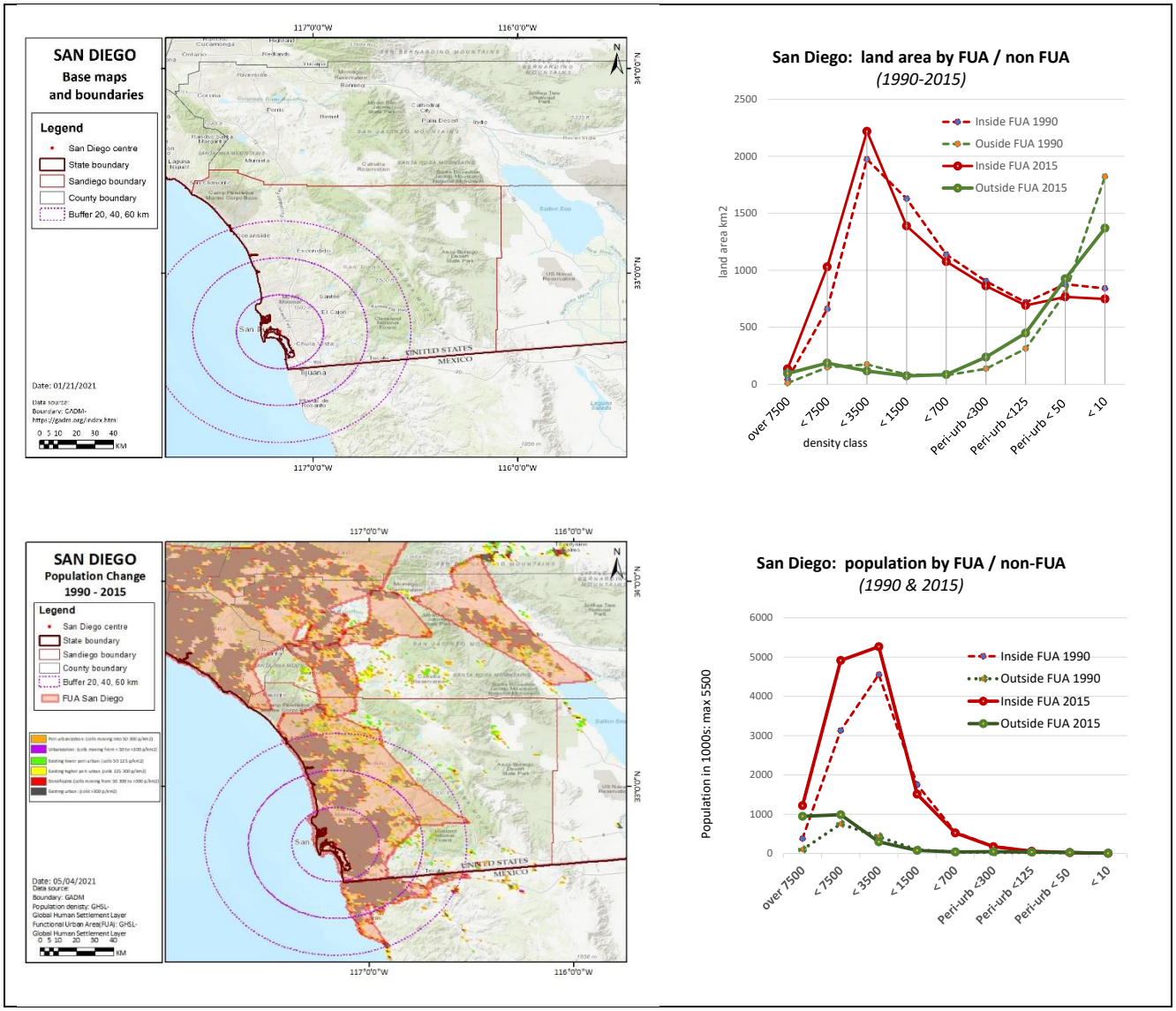
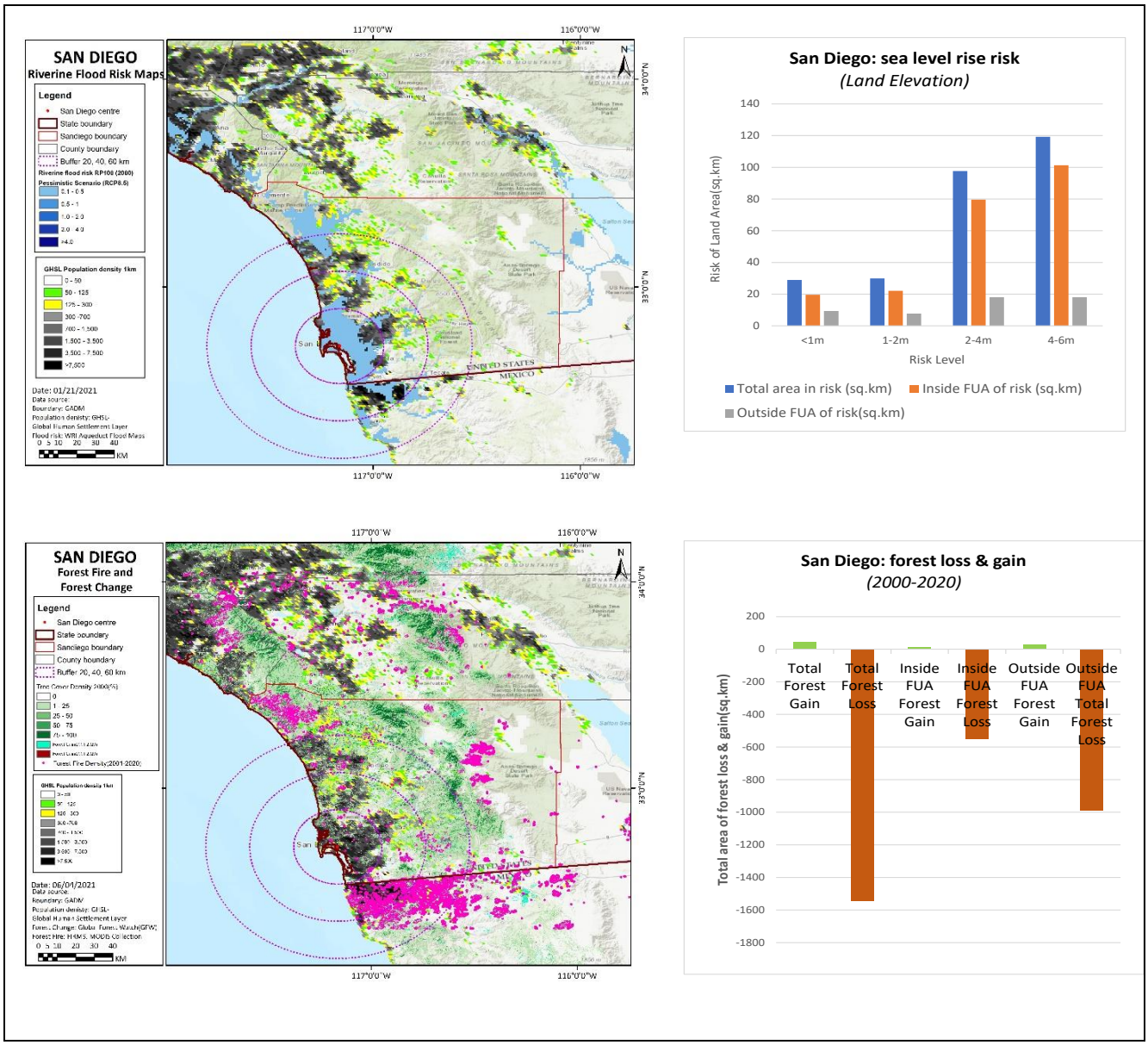


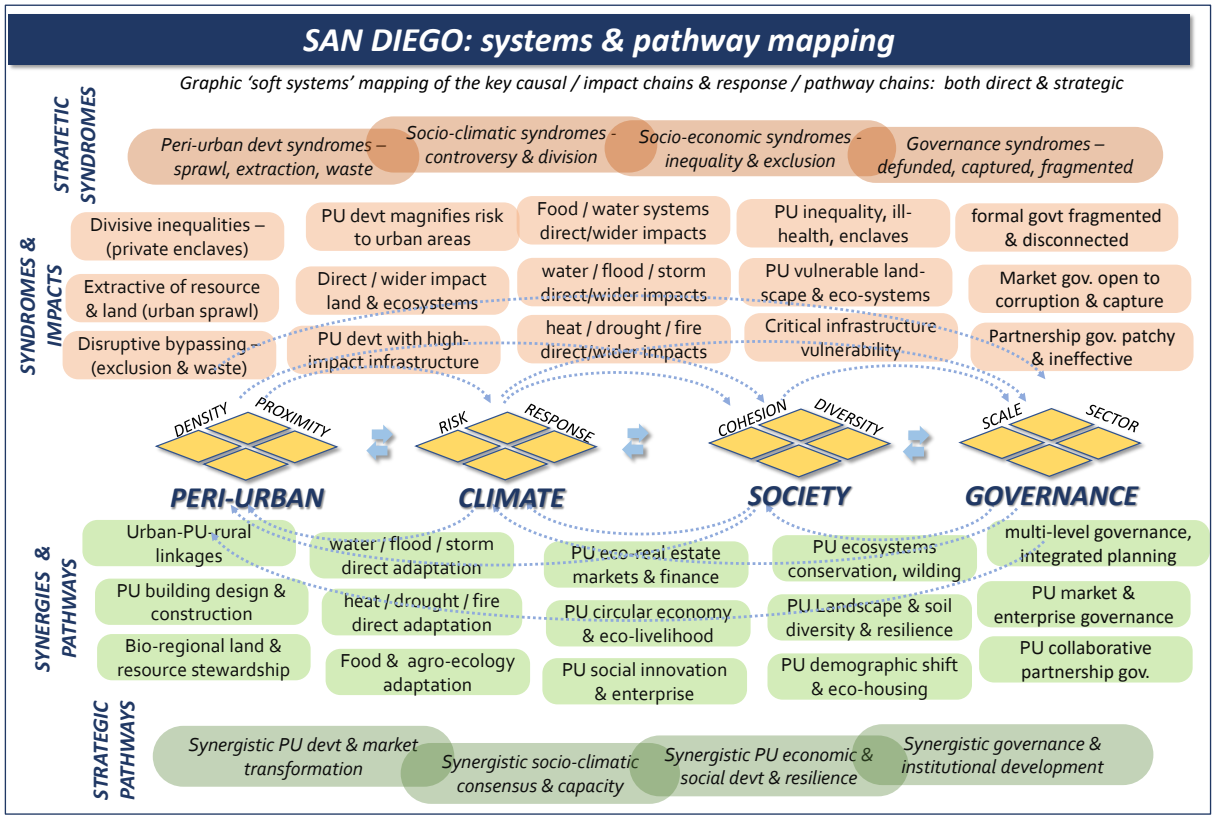
***Figure 17.3: climate effects mapping & analysis***




## Governance issues

- SD has many layers of strategic planning, including low-impact transport, environment & climate adaptation. It is debatable how far these can resist the forces of real-estate induced urbanization & financialization
- Active civic building in many forms: e.g. higher education & new agenda for the 'rooted' university, e.g. Bio-regional Centre.
- Food Alliance & similar grassroots action from local food & ecology projects. Much informal social capital in urban / peri-urban neighbourhoods is almost invisible. Meanwhile grassroots vigilantes are active on the desert border
- California may have a unique profile of individual awareness & empowerment, combined with a fragmented & displaced civic & public realm .

***Figure 17.4: system & pathway mapping***




## 17.1 Adaptive pathways

(preliminary menu for debate and investigation)

***Bio-regional urban-rural linkages***

Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.

***peri-urban stewardship of land & commons***

Many peri-urban territories include large areas of leftover 'lost space', and much of this (in some countries) is in common / public ownership. The community based stewardship of marginal land on edges or corridors, can be a powerful way to generate social synergies, e.g. by local food democracy, which can then manage ecosystems for resilience and adaptive capacity.

***Peri-urban infrastructure : roads, airports, industrial zones etc***

Large facilities in the peri-urban can cause disruption & depletion – or, contribute to positive transformation of the peri-urban as a zone of diversity, local-global linkages, and socio-ecological resilience. Airports, major roads or industrial plants can be designed as green corridors with built in adaptation capacity.

***Climate pathways: heat / drought / fire adaptation***

Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) a rethink of where are the settlements, what kind of forms, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence. For extreme heat, a growing agenda for building eco-design, social welfare, health & safety, adaptation of livelihoods etc.

***agro-ecology & food democracy***

Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.

***demographic shifts & new forms of eco-housing***

While much peri-urban expansion is in middle-upper income suburbs & gated communities, some areas see an influx of alternative lifestyle, ex-urban small-holders, local eco-entrepreneurs etc. This bring new opportunities for co-housing, housing with small-holdings, low impact development etc. This can change the social mix & increase the local diversity & resilience.

***peri-urban real estate markets, insurance***

Climate change brings a major rethink in the insurance industry, which now calculates the cost / benefit of adaptation as (global average) 7:1 net positive. Such principles can then feed into the real estate market, via green finance and the concept of 'positive insurance', which is re-invested to reduce risks & increase resilience.

***circular economy & eco-livelihood***

The practical question is how can businesses invest and create jobs from these peri-urban 'climate-wise' transitions and pathways. The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.

***Collaborative governance, civil partnerships***

As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.

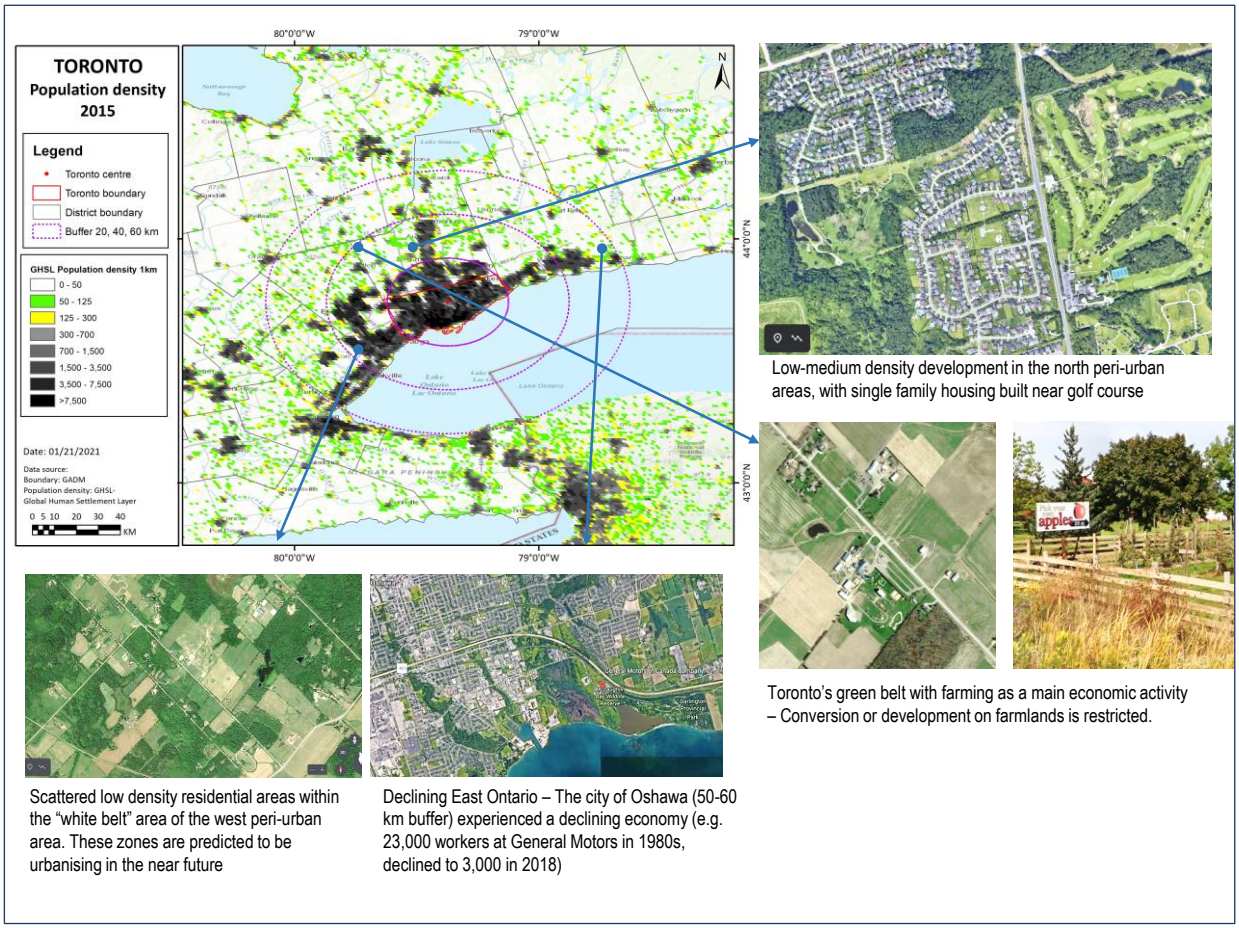
***Radical governance, grassroots networks***

Emerging forms of radical ecological democracy & the 'pluriverse': these are beginning to show real alternatives to the mainstream top-down neo-liberal consensus on development & livelihood. The peri-urban can be host to many creative variations on agro-ecology, local livelihoods, grassroots self-help, social mutual aid, stewardship of the commons etc.

# 18 Toronto

***Scope:*** *this area includes the Toronto metropolitan area with the 3 lakes 'horseshoe': the peri-urban hinterland here has a special focus on the green belt (map below)*

***Figure 18.1: where is the peri-urban***




## *OVERVIEW*

Toronto is an affluent expanding metropolis, with a highly protected greenbelt area in a thriving peri-urban hinterland. In this generally managed landscape there are growing climate risks from flooding & heat, with disruption of ecosystems: raising new challenges for a well-ordered governance system.

***Peri-urban syndromes:*** Typical N. American suburban development mixed with historic small villages, active farmland, natural areas (conservation areas, parks, forests, wetlands, etc.) Most peri-urban growth is managed in extensions & small towns: some demographic change in farming to commuting. Most landscape is multi-functional & diverse with distributed small settlements, on car-based development patterns.

***Climate change risks***: "warmer, wetter, wilder" - growing seasons change & fluctuations in freeze/thaw cycle: increasing riverine flooding, heat / drought, water stress is projected: leading to cycle of decline in natural systems function & resilience.

***Societal vulnerability***: High housing / land prices with strict controls leads to inequality, exclusion & financial stress, economic vulnerability in peri-urban / peri-rural settlements. Landscapes & farming patterns are diverse but vulnerable to ecosystems change.

***Governance syndromes***: generally effective government & public services, working on the potential for horizontal (sectoral) & vertical (multi-level) integration: active civil society e.g. Greenbelt Foundation: peri-urban & climate awareness is a priority & policy is near best practice:

***Adaptive pathways***: urban-rural linkages with agro-ecology & circular economy systems: integrated peri-urban design (green development standards), for climate-wise water / drought / heat resilience: potential for eco-real estate markets & climate-wise development patterns:

***Adaptive governance***: policy integration & capacity building for multi-level government: civic society role for citizens councils / direct democracy: potential for grassroots / social innovations. Toronto brings a global best practice in the Greenbelt Foundation, which aims to integrate urban, peri-urban and rural agendas.

However there may be wider forces which make this task more challenging, especially the 'game-changing' potential of climate change.

## Peri-urban issues

Toronto is situated in the 'golden horse shoe' area, a region where approximately 25% of Canada's population live. Toronto's urban areas continues to expand, mainly to the west and north of the region. Urban expansion is also prominent in the city of Hamilton where the request to extend the municipal boundary is now being negotiated over the potentiality of expanding to the green protected areas.

- Toronto's peri-urban areas consist of the green belt (which predominates the northern peri-urban) and the "white belt" zone, which situated in between the built-up areas and the green belt. (see map below)
- The green belt is the 'protected countryside' where urban development, especially on agricultural lands, is highly restricted. The only acceptable urban development is alongside the main roads forming a linear urban spatial structure. Meanwhile, the 'white belts' (zones in between the urban built up and the green belt) are zones already under negotiation to be transformed into urban areas. Most of the lands within these zones are likely to be owned already by private companies or individuals who are not farmers.
- Toronto targeted their urban population to be around 50 million in 2040. This projection considers the growth and further potential increase of international in-migration.
- With the growth of population and potential in-migration, Toronto's housing market prices have tripled in the last 10 years, hence there will be more people preferring to live in the peri-urban rather than the CBD
- Some problems/issues with regards to peri-urbanisation - Inequality in terms of infrastructure services (e.g. more highways are being constructed but none of them are useful for the low-income people), commuting time as more people reside in peri-urban areas, unequal distribution of public services (e.g. insufficient schools in low income neighbourhoods). There is

also a trend of peri-urban hollowing in the city of Oshawa due to the declining activities in the car manufacturing industry.
- There are also dynamic changes in the farming sectors – Consolidation of a number of small and medium farm sites. Some of the farm houses are being converted to single family homes

## Climate impacts

- Heavy downpours may result in combined sewer overflows, damaged infrastructure, erosion of stream and rive banks, and flushing of pollutants into waterways. Hydroelectric production will be affected by drop in lake water levels. Nuclear and coal generating stations efficiency will decrease due to reduced efficiency of condensers. Summer energy demand increased, greater electrical energy strain may lead to brownouts or blackouts. Transport may be affected by blackouts due to traffic light outage. Shipping activity at the Port of Toronto will face significant costs if water levels in the Great Lakes Basin drops, ships will have to reduce loads to navigate shallower channels. Flights may be affected more due to increased incidence of extreme weather events. Storm damage to buildings is likely to increase. Milder winters have brought more freeze-thaw cycles leading to greater building material wear, increases in extreme weather events will damage infrastructure. [1]
- Increased urban development that does not mitigate for increased rainfall intensity through flood mitigation will increase the flood risk in the city of Toronto due to decreased surface permeability leading to more surface flooding. Though compared to other major Canadian cities climate change will be the dominant effect of flooding as development in Toronto has maintained some green and blue infrastructure to combat flooding [3].
- Greater urbanisation will increase the urban heat island effect, putting greater pressure on residents health during times of extreme heat [6].

## Governance issues

- Land use planning is conducted at municipal levels, while areas of strategic development which involve cross-boundary partnership is guided by the provincial development planning.
- While the framework promotes inclusive planning, there is a gap of knowledge particularly in formulating the green belt policy – local people and farmers have insufficient knowledge on policies regulating the green belt.
- There is an emerging framework for environmental planning. For instance, the clean air partnership which focuses on promoting sustainable cities. However, protecting the green belt does not seem to be the main agenda of this framework.
- There is obvious donation from political party, but nothing is known about corruption
- There is a long history of mafia that links to construction industries. (Anecdote: they drive to people's houses to make decisions).
- The minister who is responsible for the spatial plan could change the direction of plan if the is an agreement from the majority of people.

***Figure 18.2: spatial mapping & analysis***

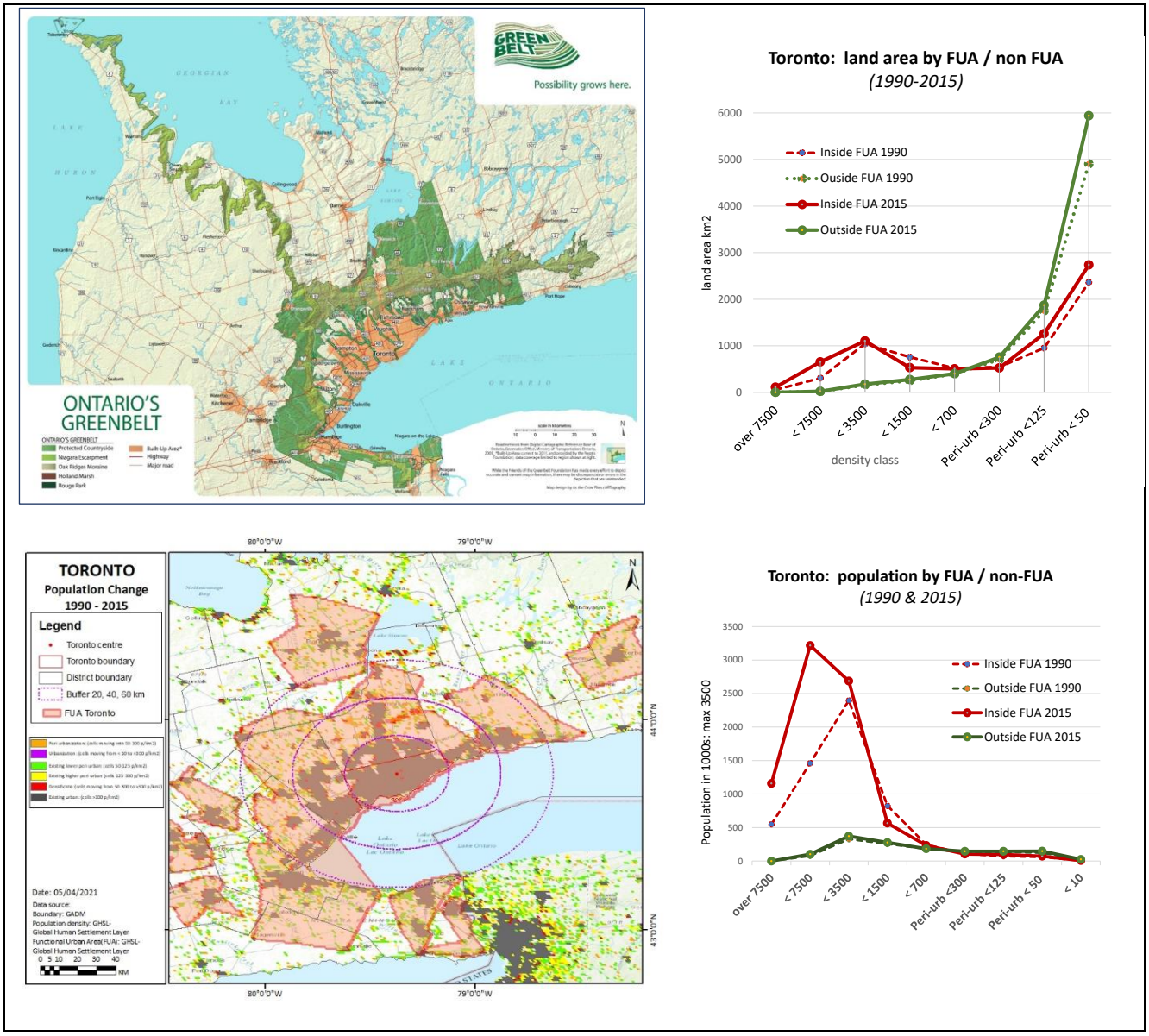
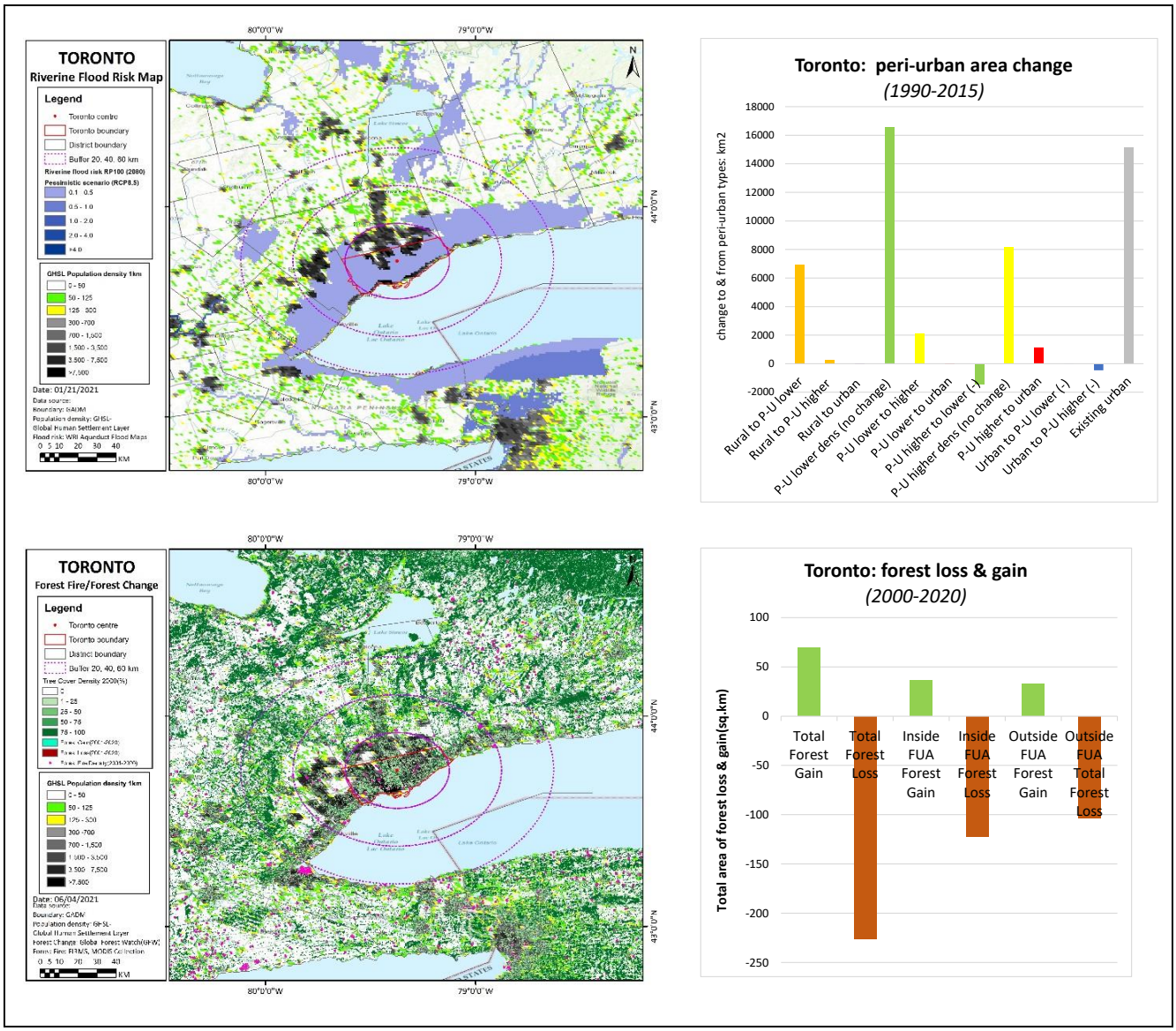


***Figure 18.3: climate effects mapping & analysis***



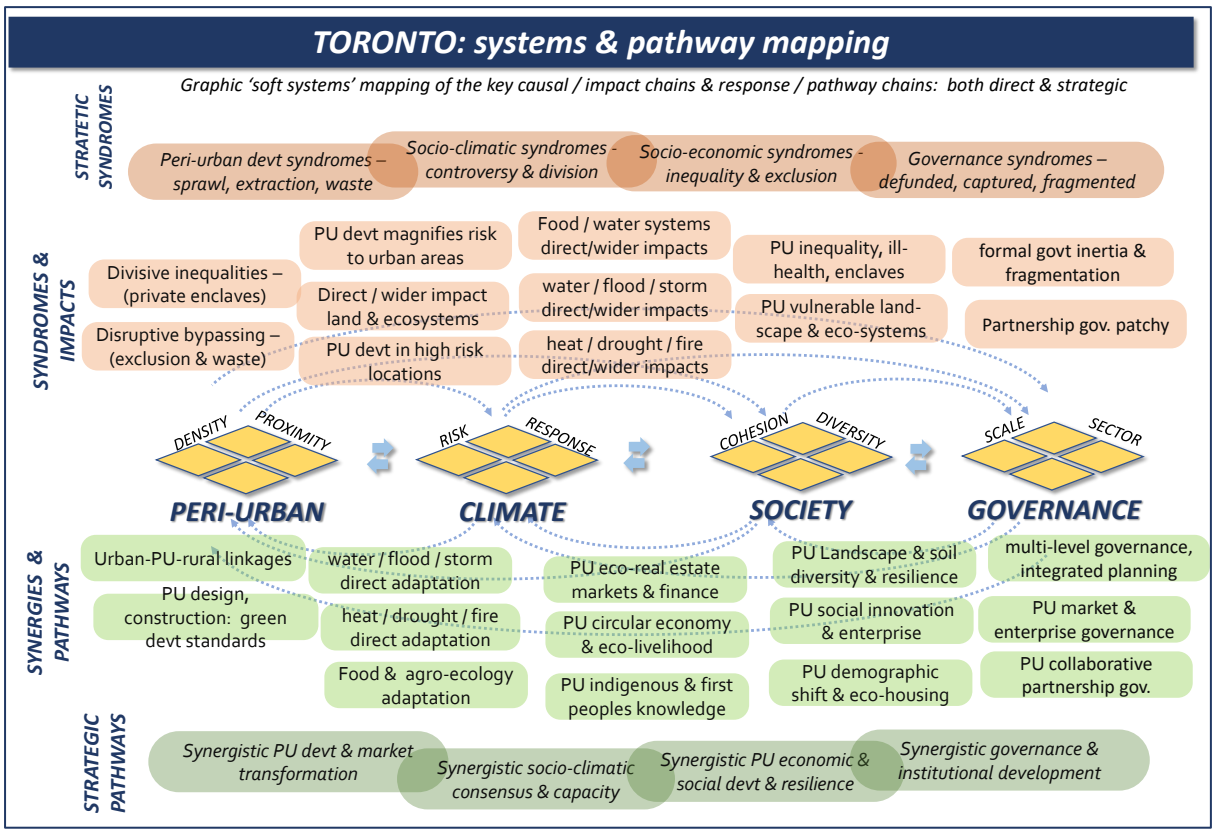

## 18.1 Adaptive pathways

### *urban-rural linkages in the peri-urban*

> *Urban & rural areas are highly inter-dependent, in resources, infrastructure, housing, travel, leisure, ecosystems services etc. The peri-urban adds another dimension to that mix. The aim of the 'PURL' is to maximize opportunities and minimize negative impacts on each kind of territory. 'Sprawl repair' & similar ideas aim to mobilize the local synergies wherever possible.*

The Greenbelt Foundation is already promoting urban-rural linkages very successfully. The question is then how to scale up and across, to include for the great mass of suburban development, in a globalized industrialized economy and lifestyle.

***Figure 18.4: system & pathway mapping***




Possibly there are multiple trends which may coincide and could be mobilized for this pathway:

- climatic events will force the issue
- demographic changes with growth in third age, young sustainabl-istas etc
- growth in niche food & eco-lifestyle awareness
- emerging sub-cultures in the metropolitan area with territorial aspirations

***water / flood / storm adaptation***

> *Short term: we need ways to manage rising floodwaters and extreme events, via SUDS, walls, canals, basins etc. Longer term: (in some areas) we need to rethink – where are the settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a water-friendly co-existence.*

The Toronto wider region shows high vulnerability to flooding under various models. The practice of integrated water management in building design, urban form, infrastructure development is just taking shape.

***heat / drought / fire adaptation***

> *Short term: arid zone water management in buildings and land: fire defence via forest breaks and natural fire cycle management. Longer term: (in some areas) we need to rethink – where are the*

*settlements, what kind of forms & surroundings, how can low impact eco-design manage a transformation towards a drought / fire-friendly co-existence.*

For extreme heat, a growing agenda for building eco-design, social welfare, health & safety, adaptation of livelihoods etc. (From recent events in Canada), heat is expected to be a quite serious problem - population and communities not as well adapted to hot climates, has gotten far less attention than flood risk.

***agro-ecology & food democracy***

*Agro-ecology may be the most important pathway: first by challenging the chemical-intensive industrial production of global agri-business, and its disruption / depletion of ecosystems & adaptive capacity. Then it aims to rethink the relations of producers, markets and the ecosystems resilience in a changing climate. With the dimension of 'food democracy' it can mobilize social / cooperative enterprise on a large scale, which then fits with the adaptive pathways for landscape, soil, water, local livelihoods etc.*

In the Toronto area a bio-regional agro-ecology is a powerful agenda which can draw in many different interests. The question is how far it can scale up and across, as it would involve major changes and transformations in many parts of the system. This pathway depends on building synergies across different sectors:

- local producers, with potential conflicts between small and larger scale intensive
- regional food industries so far based on a more industrialized model
- logistics which could adapt to a more localized / regionalized / seasonal model
- retail systems with a different concept of quality and value
- demand side with increased awareness of organic, low chemical, hand-grown foods
- demand side shift from meat / sugar diets towards vegetable / pulse diets

***landscape diversity & resilience***

*A wider agenda is for sustainable / adaptive / resilient landscapes, soils, forests, water bodies & wetlands etc, both within / without formal designations. Policies for forestry, farming, infrastructure, housing, business, leisure & tourism etc, can steer towards adaptive planning & design for the surroundings of housing, industry, farming etc. These may be strengthened by eco-systems markets, green finance, carbon offsets etc.*

The landscape around Toronto & the Horseshoe already shows great diversity – however – this is under increasing pressure from commercial development, globalized lifestyles etc.

***circular economy & eco-livelihood***

*how can businesses invest and create jobs from these peri-urban 'climate-wise' pathways? The peri-urban can be a vital part of a city-region circular economy, with a continuous flow of re-use recycling & recovery. This may include shift from mainstream business models, towards cooperative, mutual or similar forms of social-eco business. These can then work in sectors such as food & forestry, biodiversity & ecosystems, education & health, leisure & well-being of all kinds.*

In some other countries the peri-urban is seen as an essential part of the wider circular economy. This means many things to many, and Toronto is potentially a site for some leading experimentation:

- material circulation of resources, construction, industrial, consumer packaging etc
- social recirculation particularly for the young, niche cultures, differently abled, senior
- financial recirculation in ecosystem markets, forest carbon credits, inter-generational carbon finance etc.

***indigenous & first people knowledge***

There is growing awareness and acknowledgment of Indigenous Knowledge Systems (First Nations, Metis and Inuit in Toronto) and the transformational role they can play in resilience

***Market-led governance, finance & enterprise***

> *Beyond the limits of formal government, market led approaches may enable innovation, forward investment, enterprise of all kinds. Ecosystems markets, green finance, impact investment, or social return on investment may bridge the gap between ecological social & economic values. Public services and public procurement can also have a powerful effect, such as local / organic food policies or ecosystems reinvestment.*

***Collaborative governance, civil partnerships***

> *As the peri-urban agenda crosses many boundaries & involves many sectors, new forms of civil society partnerships, networks, forums, dialogues can emerge. These may be based on water catchments, bio-regions, or terrestrial eco-regions, as well as economic zones, commuting patterns etc. Government can enable these with round table structures, deliberative processes, core subsidies, rules for transparency & accountability.*

- The Canadian / Ontario formal government system is already quite elaborate and specific: so the pathways proposed here focus on other kinds of potential.
- Market led governance is one possible option for rethinking the system. There may be potential for extending market systems to social and ecological values, which in turn can enable alternative patterns of development and stewardship.
- Collaborative governance and partnerships are already advanced, in the form of government funded organizations like the Greenbelt Foundation. How much further these can go, given the pressures of commercial development, is up for discussion.

# 19 Annex

## Adaptive pathways menu - summary list

This is an outline of potential pathways, generated through the workshop series. The cases above contain more detail, for discussion on which options are most relevant and viable.

| ***EASTERN ZONES*** | ***Melbourne*** | ***Surabaya*** | ***Changsha*** | ***Bangkok*** | ***Dhaka*** | ***Chennai*** | ***Doha*** | ***Cairo*** | ***Joburg*** | ***Kumasi*** |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Peri-urban pathways*** | | | | | | | | | | |
| urban-rural linkages in peri-urban | Y | Y | | Y | Y | Y | | | Y | Y |
| peri-urban building design & form | | Y | Y | | | | Y | | | |
| peri-urban stewardship of land | | | | | Y | Y | | | | Y |
| peri-urban major infrastructure, | | Y | | Y | | | | Y | | |
| | | | | | | | | | | |
| ***Climate / environment pathways*** | | | | | | | | | | |
| water / flood / storm adaptation | | Y | Y | Y | Y | Y | | | | |
| heat / drought / fire adaptation | Y | Y | | | | | Y | Y | Y | |
| sea level rise / cyclone adaptation | | Y | | Y | Y | Y | | Y | | |
| agro-ecology & food democracy | | Y | | Y | Y | Y | | | Y | Y |
| | | | | | | | | | | |
| ***Vulnerability / resilience pathways -*** | | | | | | | | | | |
| ***Ecological*** | | | | | | | | | | |
| ecosystems conservation | | | Y | | | Y | | | | |
| Landscape diversity & resilience | Y | | | | | | | Y | Y | |
| ***Social*** | | | | | | | | | | |
| social innovation enterprise | | | | | | Y | | | | Y |
| demographic shifts & eco-housing | Y | | Y | | | | | Y | | |
| ***Economic*** | | | | | | | | | | |
| peri-urban real estate | | Y | | Y | Y | Y | Y | | Y | |
| ecosystems markets & finance | | | Y | | | | | | | |
| circular economy & eco-livelihood | Y | Y | | | Y | | | | Y | Y |
| ***Technology*** | | | | | | | | | | |
| new distributed infrastructure | Y | | | | | Y | | | Y | |
| digital platforms & monitoring | | | Y | | | | | | | |
| ***Cultural*** | | | | | | | | | | |
| indigenous & first peoples | Y | | | | Y | Y | | | | Y |
| culture of learning & deliberation | | | Y | | | | | Y | Y | |
| ***Governance pathways*** | | | | | | | | | | |
| Multi-level governance, planning | Y | | | Y | Y | | | Y | | Y |
| Market-led governance & enterprise | | | Y | | | Y | Y | | Y | Y |
| Collaborative governance, civic partnerships | Y | Y | | Y | | | | Y | | Y |
| Radical, grassroots networks | | | | | Y | Y | | Y | Y | |

| ***WESTERN ZONES*** | ***Helsinki*** | ***Manch-ester*** | ***Naples*** | ***Granada*** | ***Santiago*** | ***Toronto*** | ***Mexicali*** | ***San Diego*** |
|---|---|---|---|---|---|---|---|---|
| ***Peri-urban pathways*** | | | | | | | | |
| urban-rural linkages in the peri-urban | | **Y** | Y | | Y | Y | | Y |
| peri-urban building design & form | Y | | | | | | Y | |
| peri-urban stewardship of land & commons | | **Y** | | Y | | | | Y |
| peri-urban infrastructure, airports etc | Y | | | | | | | Y |
| | | | | | | | | |
| ***Climate / environment pathways*** | | | | | | | | |
| water / flood / storm adaptation | Y | **Y** | | | | Y | | |
| heat / drought / fire adaptation | | | | Y | Y | | Y | Y |
| sea level rise / cyclone adaptation | | | Y | | | | | |
| agro-ecology & food democracy | | | | Y | | Y | | |
| | | | | | | | | |
| ***Vulnerability / resilience pathways -*** | | | | | | | | |
| ***Ecological*** | | | | | | | | |
| ecosystems conservation | | | | | Y | | | Y |
| Landscape diversity & resilience | | **Y** | Y | | | | Y | |
| ***Social*** | | | | | | | | |
| social innovation enterprise | | | Y | | Y | | | |
| demographic shifts & eco-housing | Y | **Y** | | Y | | | | Y |
| ***Economic*** | | | | | | | | |
| peri-urban real estate development | Y | | Y | | Y | | | Y |
| ecosystems markets & green finance | Y | **Y** | | Y | | Y | | |
| circular economy & eco-livelihood | | | Y | | | Y | | Y |
| ***Technology*** | | | | | | | | |
| distributed infrastructure & services | Y | | | Y | | | Y | |
| digital platforms & monitoring | | **Y** | | | | Y | | Y |
| ***Cultural*** | | | | | | | | |
| indigenous & first people knowledge | | | | | Y | | | |
| culture of learning & deliberation | | | | Y | Y | | | Y |
| | | | | | | | | |
| ***Governance - pathways*** | | | | | | | | |
| Multi-level governance, integrated planning | | | Y | Y | Y | | Y | |
| Market-led governance & enterprise | | **Y** | | | | Y | | |
| Collaborative governance, civic partnerships | Y | **Y** | Y | Y | Y | | Y | |
| Radical governance, grassroots networks | | | Y | | Y | | | Y |