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Mapping the Future

Leveraging Predictive Models for Sustainable Recovery in Post-War Syria

Technical Session: Housing, land and property solutions for displacement and crisis

OLA HATOUM, Beijing Jiaotong University

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ROYAUME DU MAROC
وزارة إعداد التراب الوطني والتعمير والإسكان وسياسة المدينة

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Arab Land Initiative

BEIJING JIAOTONG UNIVERSITY

OLA HATOUM

- Student in Urban and Rural Planning –Master Programme– Beijing Jiaotong University - China
- Master Degree in Planning and Environmental Science – Damascus University – Syria.
- Professor Assistant in Planning and Landscaping science in Syria's Universities.
- Member of the Transportation and Land LAB – BJTU.
- Regional Plans Manager – Syria

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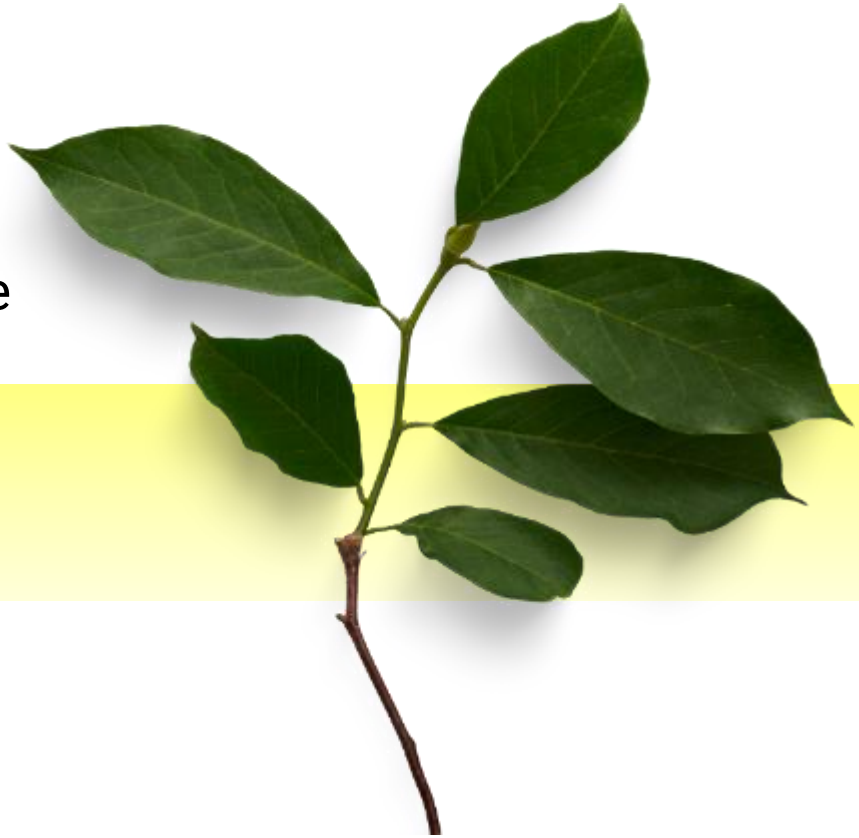
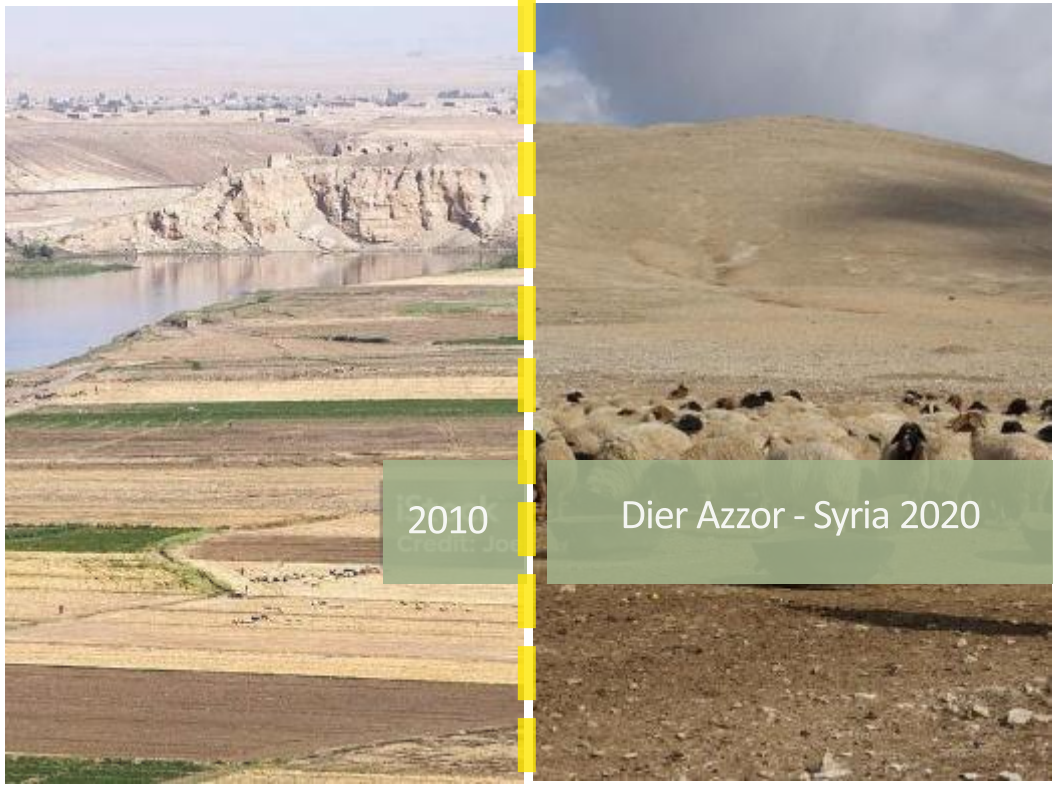


Introduction

Land use planning is a vital instrument for shaping the urban landscape of our cities,

- Post-war Syria presents a complex challenge in spatial planning and land management. The war has significantly disrupted the delicate balance of land use, resulting in population displacement, diminished land capacity.



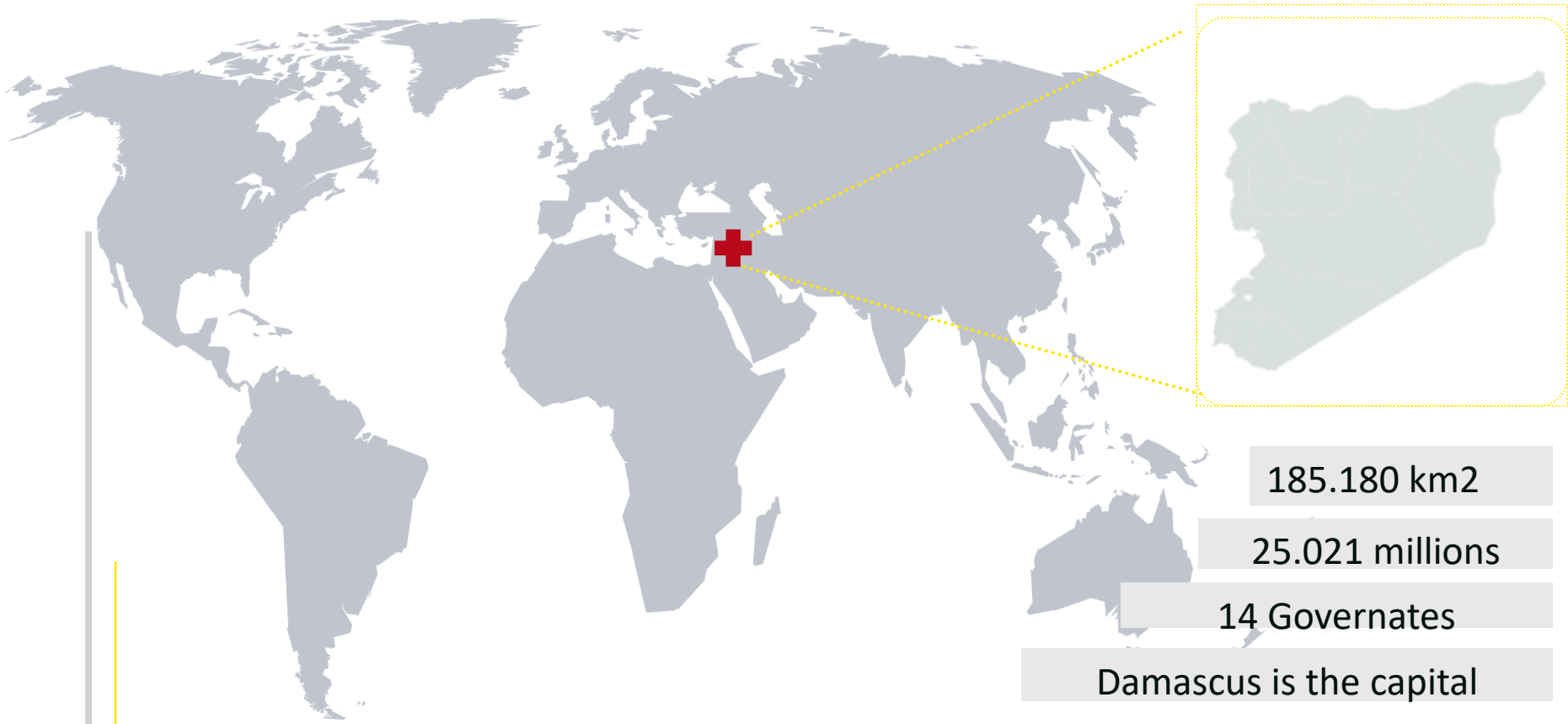
How can we simulate future land-use scenarios?

How can we simulate future land-use scenarios?

Leveraging Predictive Models ⟶

- How predictive models can simulate future land-use scenarios, emphasizing the importance of spatial balance and effective land management. By analyzing historical land-use patterns, socio-economic drivers, and spatial constraints, this research highlights actionable insights for policymakers to foster sustainable recovery and development in Syria.

location



185.180 km2

25.021 millions

14 Governates

Damascus is the capital

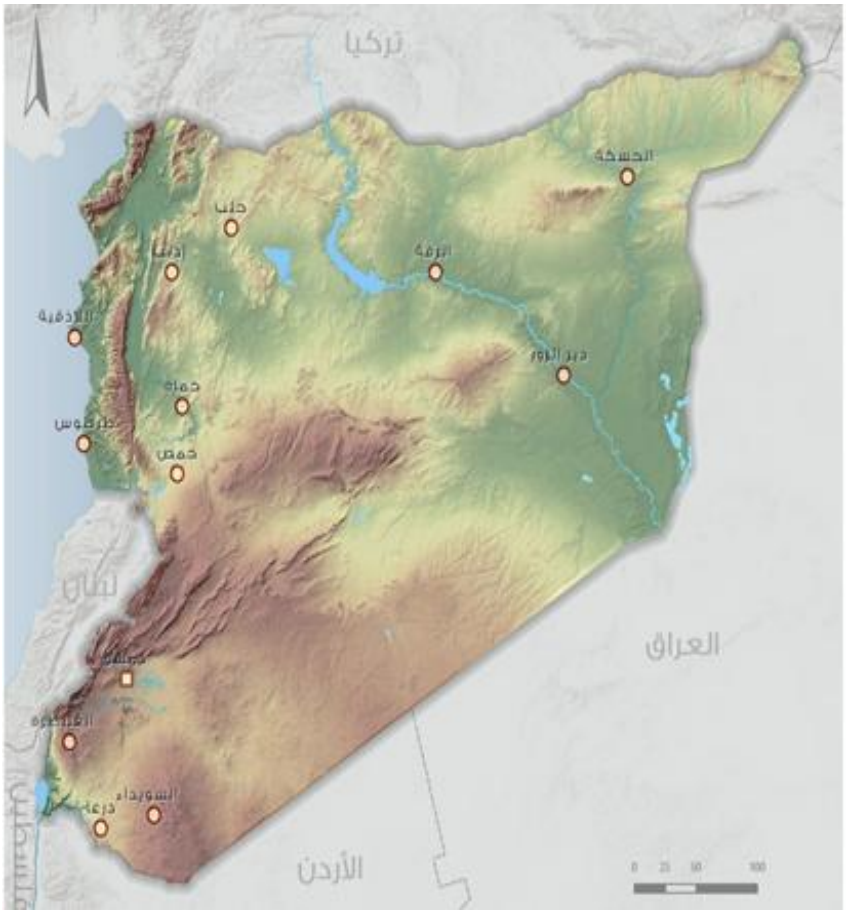
Vision & Mission

01. VISION

To create a future where balanced land management ensures sustainable growth, resource equity, and resilience, enabling post-conflict regions like Syria to rebuild with long-term spatial and social cohesion.

02. MISSION

To develop and implement predictive models for spatial planning and land management that support sustainable recovery and equitable development in post-war Syria.



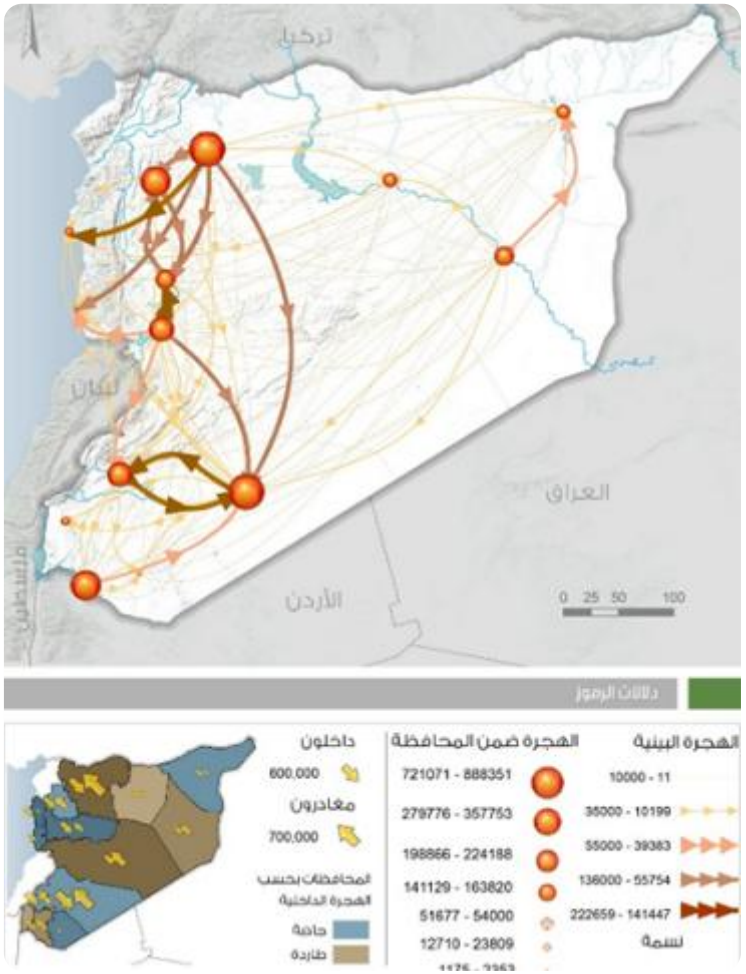
Why?

Syria had experienced many complex crises through the past decade and this put a lot of pressure on the natural resources and manage it was crucial issue:

- Large-scale destruction of urban and rural areas.
- Displacement of over 13 million people internally and externally.
- Severe damage to infrastructure and public services.

Spatial inequalities have deepened, with:

- Urban centers facing overcrowding due to population influx.
- Rural areas being neglected, worsening development gaps.



migration patterns

6 million people resided outside their areas

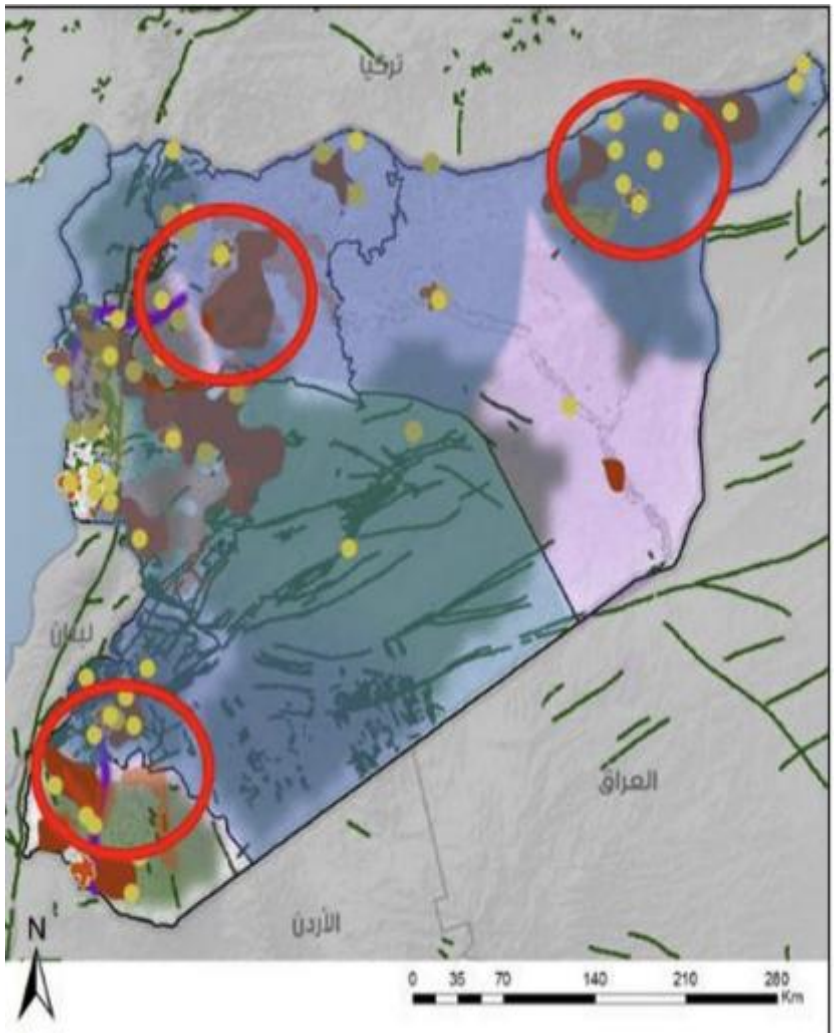
(2.8-3.3%) of them lived in temporary housing

Impact on Spatial Balance and Land

Massive land disputes due to unclear ownership records.

Destruction or loss of cadastral data and property documentation.

Rise in informal land transactions and illegal occupations.



Key Impacts of the Syrian Conflict

RESOURCES Soil degradation, natural risks

ECONOMIC Decline in production, damaged structures

URBAN Informal housing, urban quality decline, damaged units

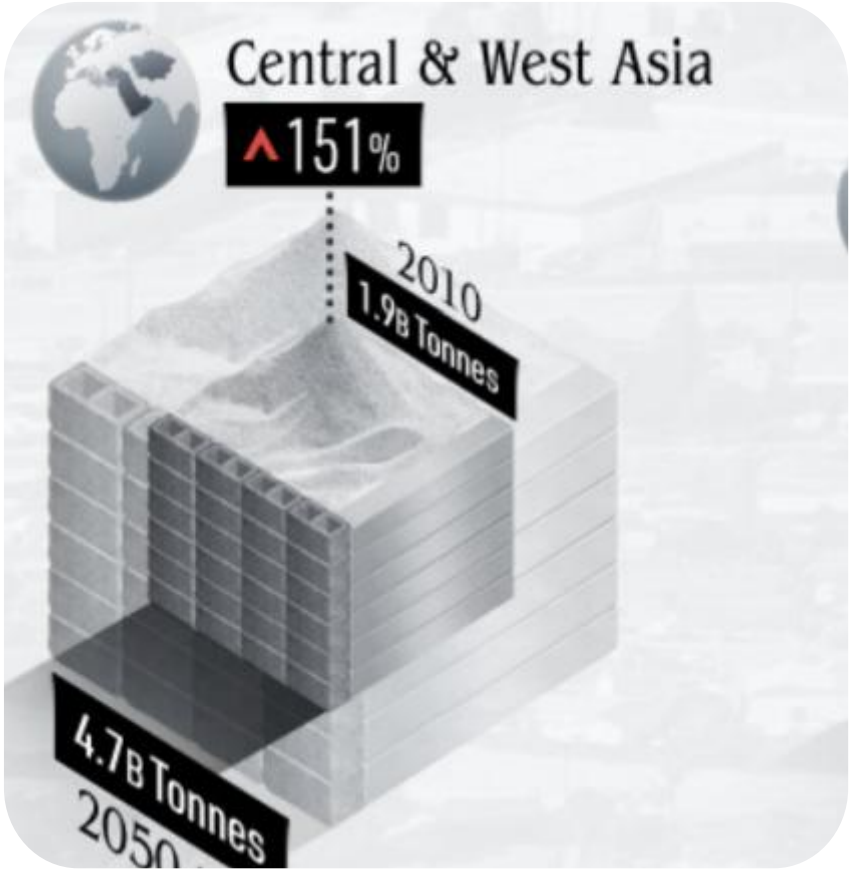
DEMOGRAPHIC Population imbalance, migration

CULTURAL Heritage site damage

THE CHALLENGES

GLOBAL CHALLANGES

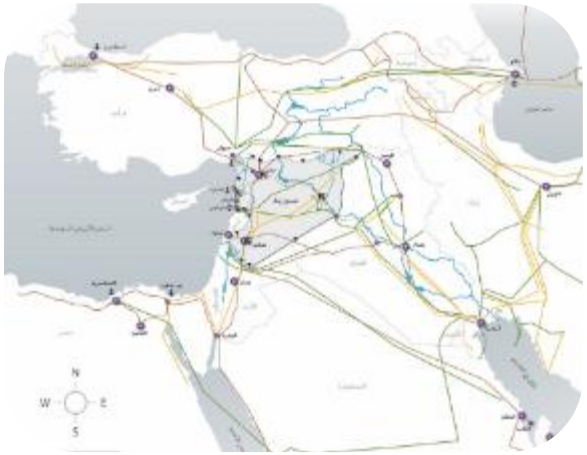
- **Quality of life**
- **Air pollution**
- **Massively growing demand of urban infrastructure**
- **Resources and social question of inequality**

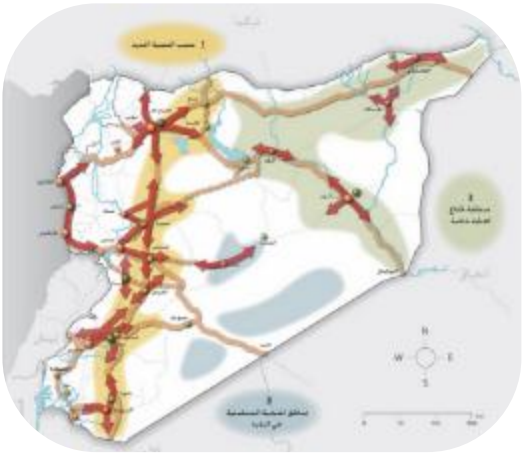


People Living in Cities:

Cities only cover 2% of the world's land surface, but activities within their boundaries consume over 75% of the planet's material resources

GLOBAL Market CHALLANGES





- **Foreign Direct Investment (FDI) Infrastructure Development**
- **Regional Benefits Economic Growth**
- **Poverty Reduction Increased Trade**

THE CHALLENGES IN SYRIA

SLIDE TITLE

Demographic challenges

Recognizing these services highlights the need for conservation and sustainable practices.

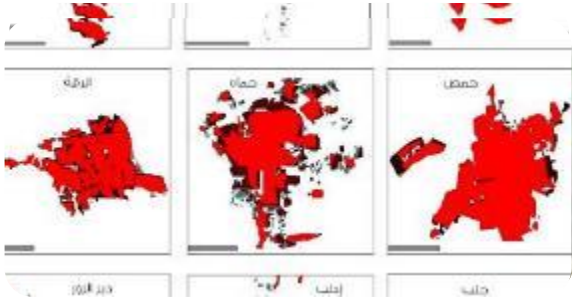
Housing challenges

Increased demand for housing and the lack of adequate housing for low-income and vulnerable people Informal settlements

Challenges in the services

Unbalanced distribution between different regions.
Inadequate financial allocations and poor quality of government health services

SLIDE TITLE



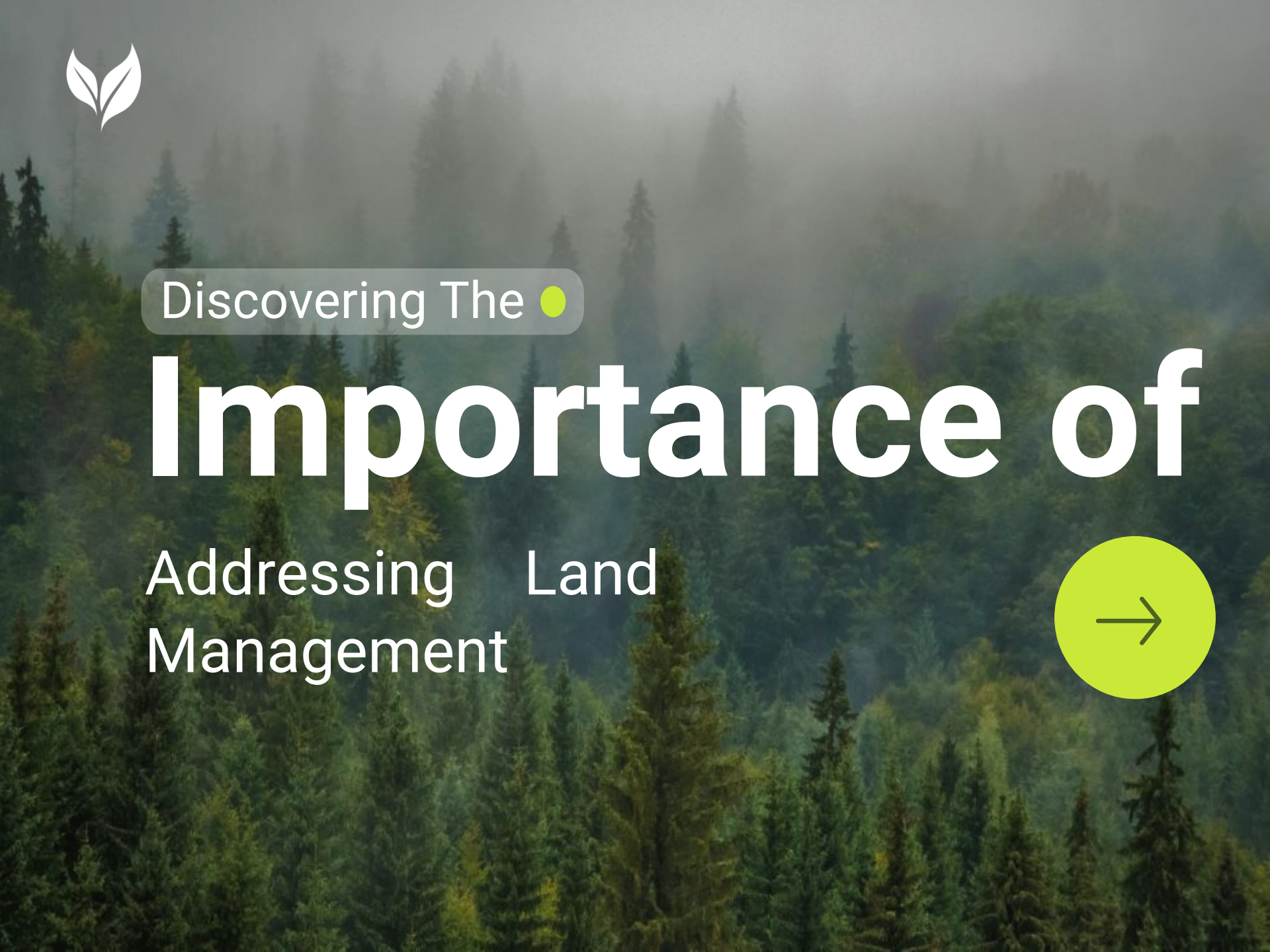
Challenges in terms of spatial prevalence and disparities in the size of urban settlements

Organizational challenges

The irregular spread of housing, services, and even industrial services around large cities.

Economic& social challenges

The imbalance in the distribution of resources, and the imbalance of development efforts at the spatial level,


Discovering The
Importance of
Addressing Land Management

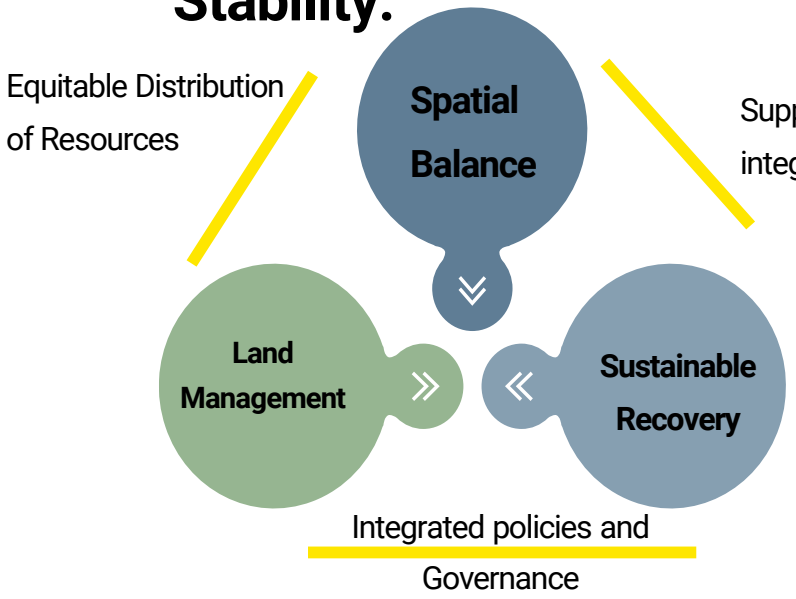
Linking .. between

O1 Foundation for Sustainable Recovery:

A Equitable land policies can foster social cohesion and reduce conflict.

B Proper land management ensures fair access to resources and rebuilding opportunities.

O2 Promoting Long-Term Stability:



A Transparent governance of land resources rebuilds trust in institutions

B Balanced spatial planning mitigates urban sprawl and revitalizes neglected rural areas rebuilding opportunities.

HOW

LESSONS

learning from other countries

Rwanda
civil war

★★★★★

- social cohesion and conflict resolution to rebuild trust among communities.
- Comprehensive land reform programs to address ownership disputes and equitable access.
- Community-based recovery initiatives accelerated housing reconstruction.

Bosnia
civil war

★★★★★

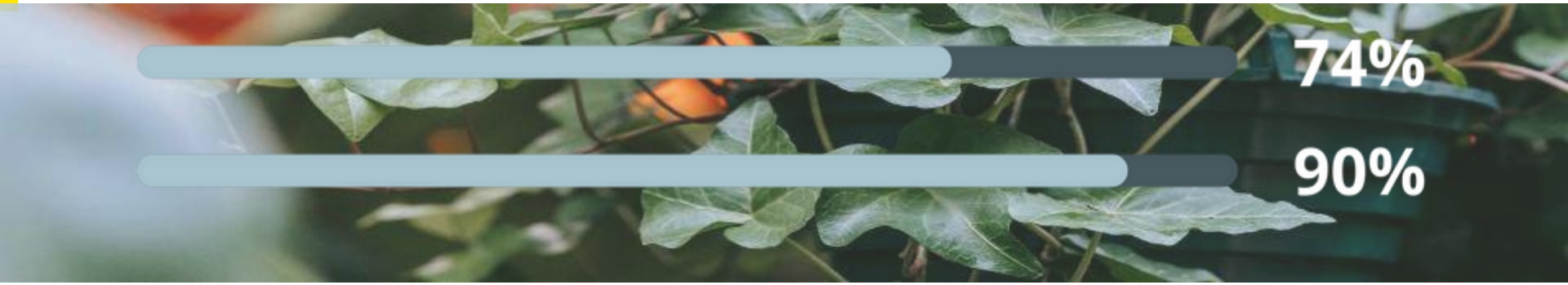
- decentralized governance and local empowerment.
- Successful integration of displaced populations through equitable land allocation.
- International assistance enabled rebuilding of housing and infrastructure.

Ukraine
war

★★★★★

- Digitalization of land records and cadastral systems for transparency.
- Public-private partnerships for infrastructure restoration.
- Community engagement to align recovery with local needs

Lessons Applicable to Syria

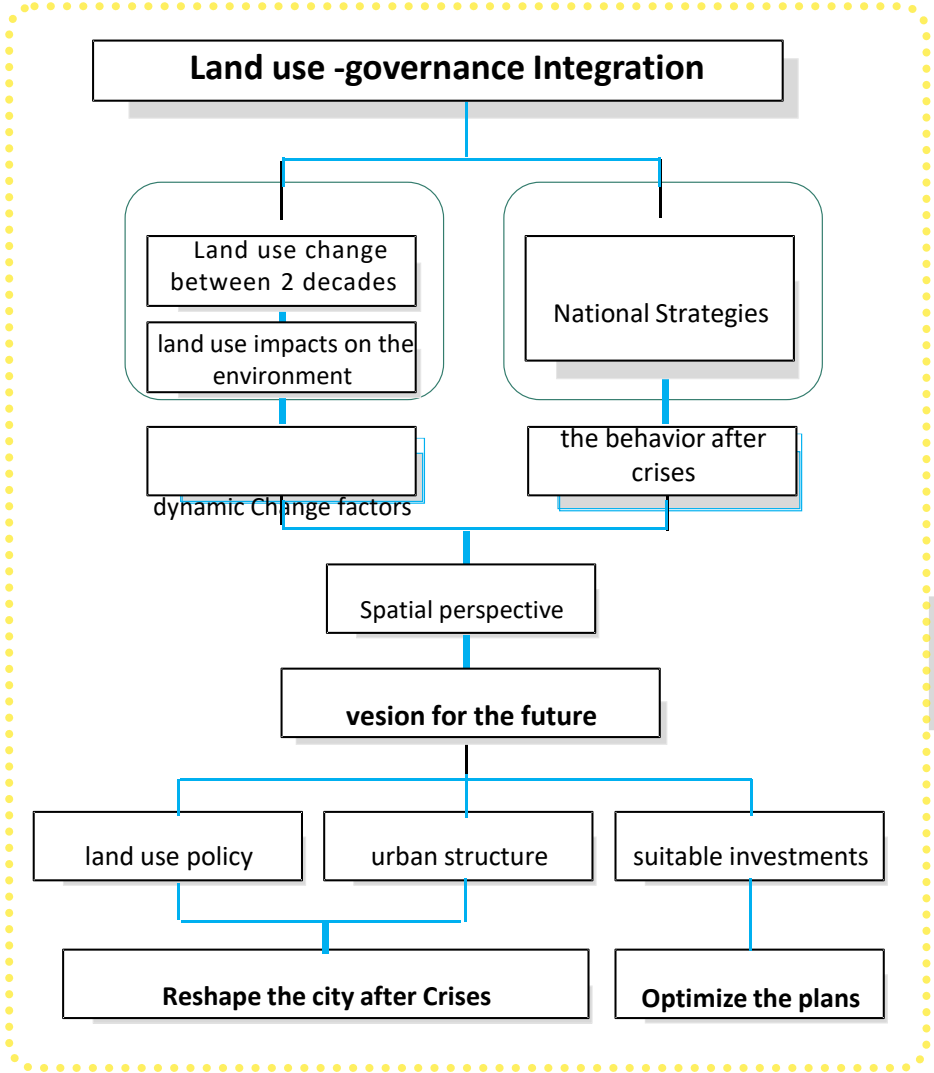


- Prioritize equitable land management to reduce disputes.
- Foster inclusive governance for balanced recovery.
- Utilize international aid for sustainable rebuilding.
- Promote community-based solutions for trust and resilience.
- Adopt digital systems for land and resource management.

HOW

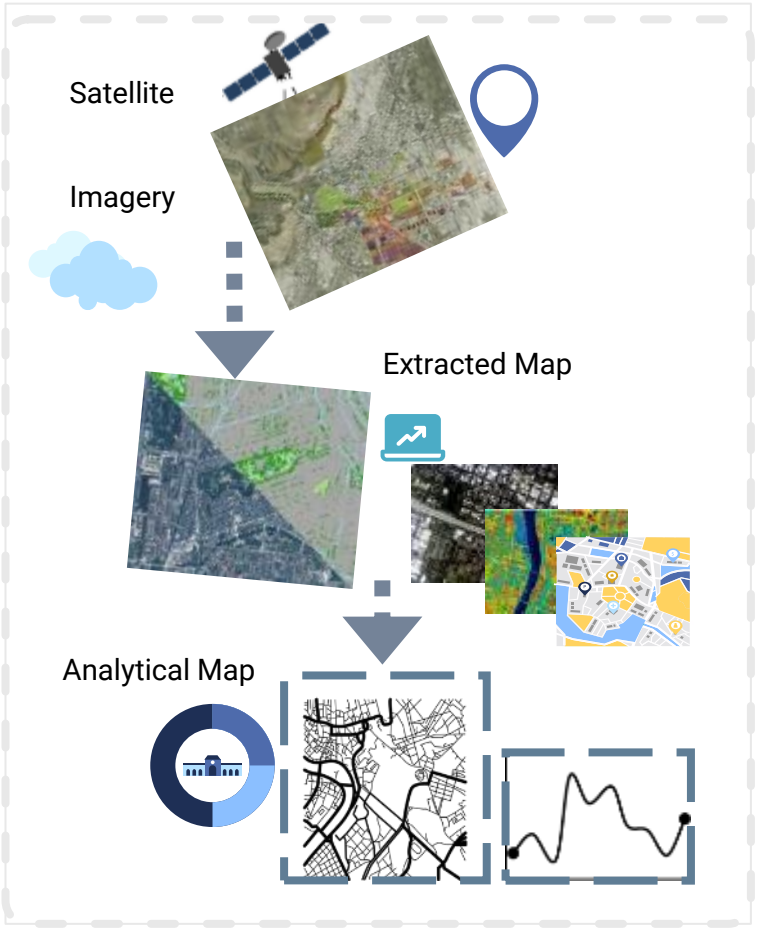
METHODOLOGY

METHODOLOGY



METHODOLOGY

OBSERVATORY



UP

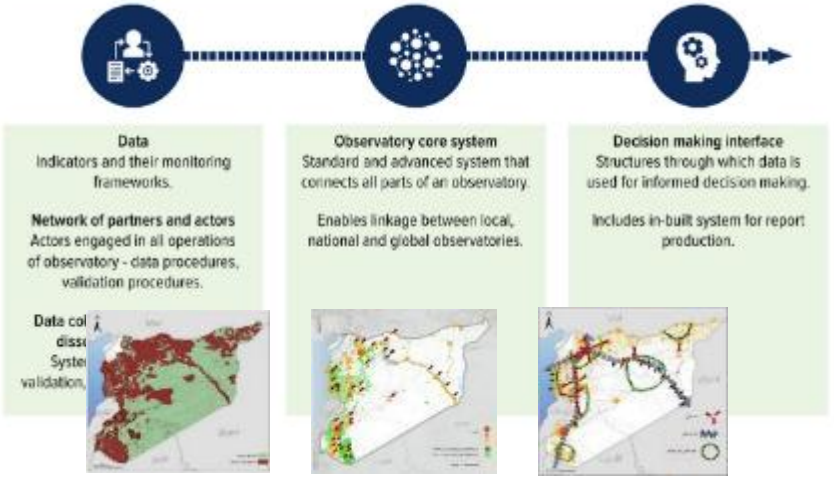
DOWN

buttom

top

Regional Observatory Decision maker

Urban



Data center

governance

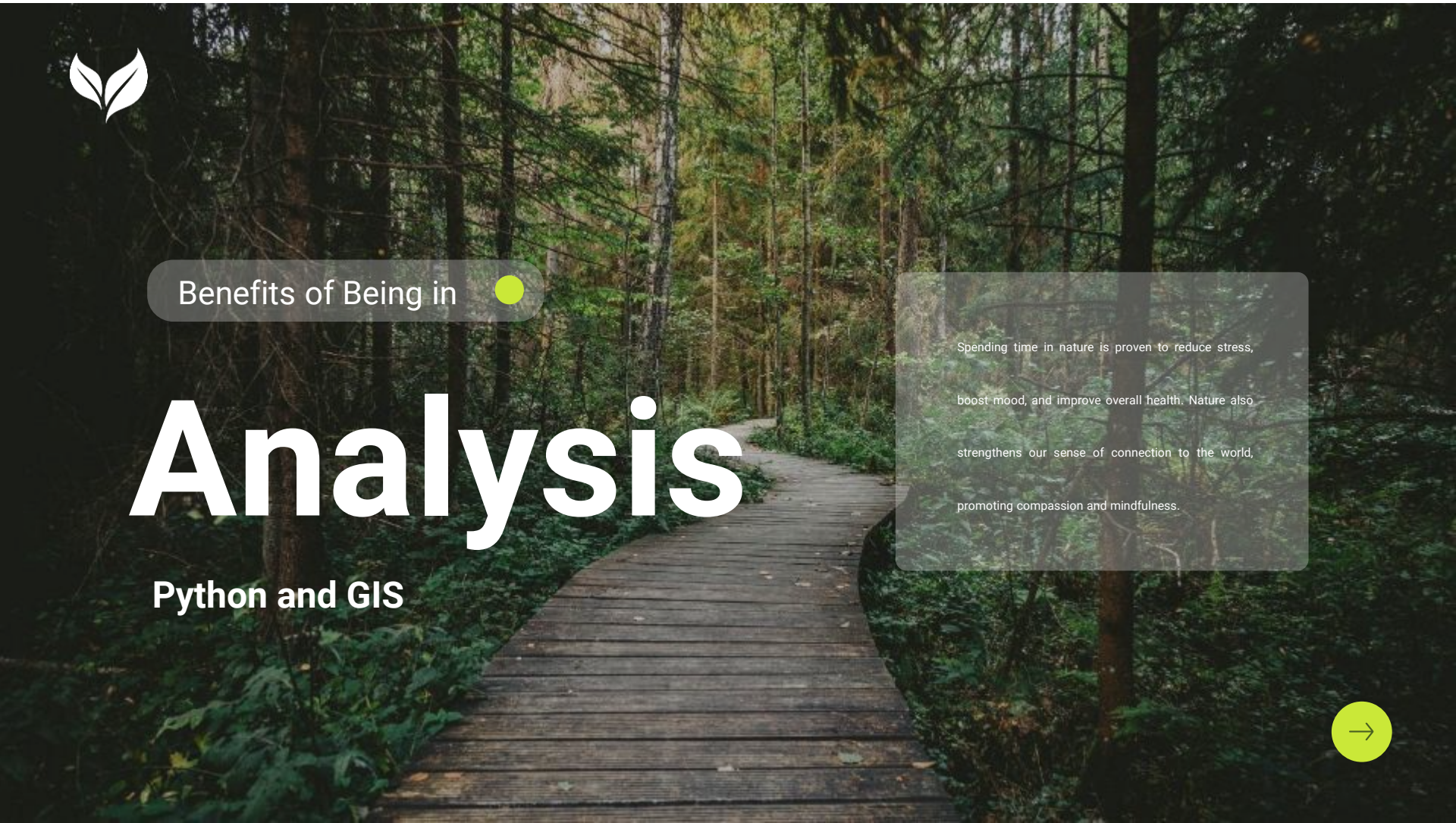
Planners

Policy makers

community

DATA DRIVEN DECISIONS AND ACTIONS

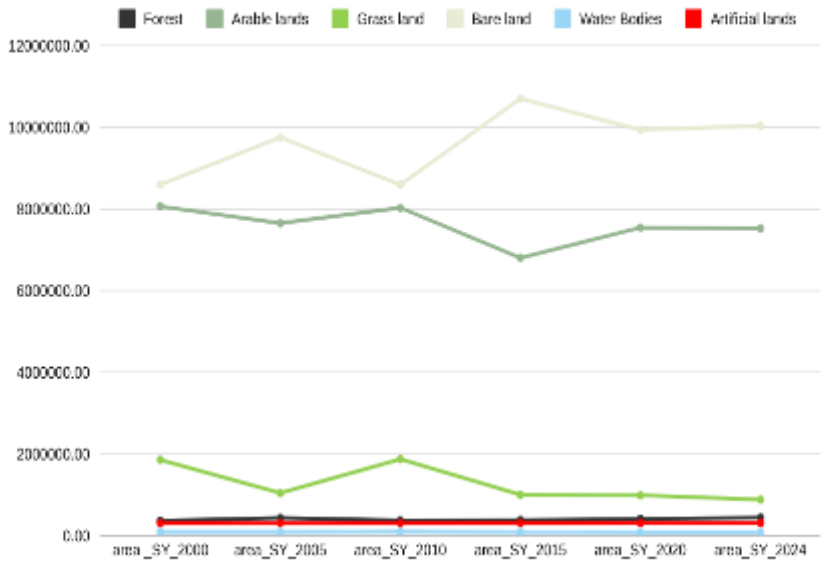
Analysis


Benefits of Being in
Analysis
Python and GIS
Spending time in nature is proven to reduce stress, boost mood, and improve overall health. Nature also strengthens our sense of connection to the world, promoting compassion and mindfulness.

land use change

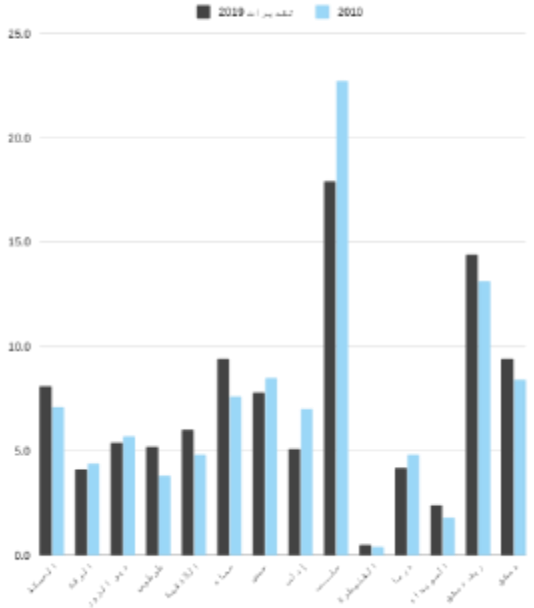
- Syrian cities have witnessed rapid urban expansion during the last decades, accompanied by the spread of random construction, which represents one of the most important problems facing urban development in our cities, which are divided into two main sections: urban sprawl on agricultural lands and the environmental impacts caused by this sprawl.

- It witnessed rapid growth in urbanization and population, which led to the expansion of the city and an increase in population demand for basic services and housing. This growth was reflected in land use patterns and their spatial distribution, leading to an overall deficit in meeting needs and services in cities.

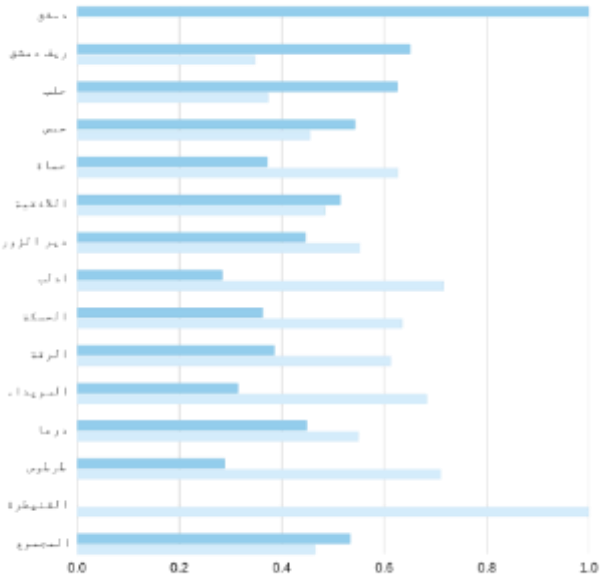


Demographic change

- The urbanization rate in the Syrian Arab Republic reached 53.2% with a population growth rate of 2.6
- The results of the 2000 migration survey showed that the lack of ownership of agricultural land, or its small areas or low productivity was the reason behind the migration of only (2.6%) of the total migrants, in addition to (2.7%) who migrated for other reasons.
- In 2010, the population living in urban areas constituted about (55.8%) compared to about (44.2%) of the population living in rural areas. The urbanization rate decreased to reach 52% in 2014, and to (49.1%) in 2018.



Relative distribution of population in Syria by governorate according to the crisis scenario
(Regional Planning Authority - Central Bureau of Statistics 2019)

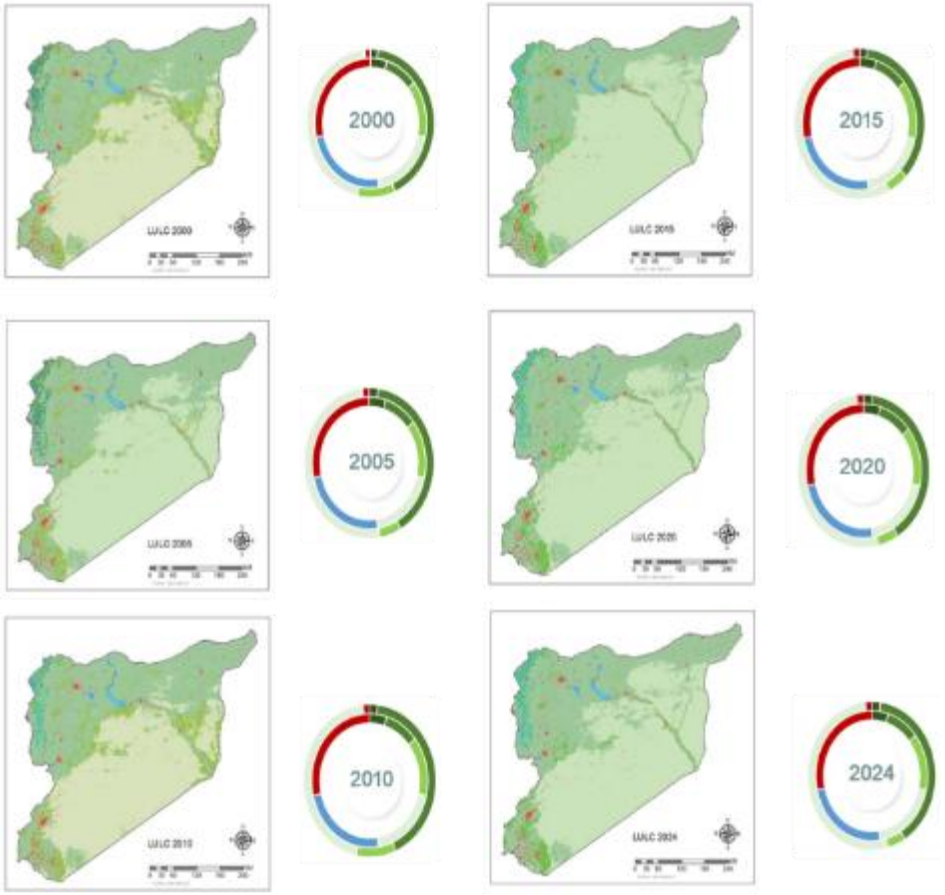


Ratio of urban to rural population in Syrian governorates
(Central Bureau of Statistics - Regional Planning Authority 2021)

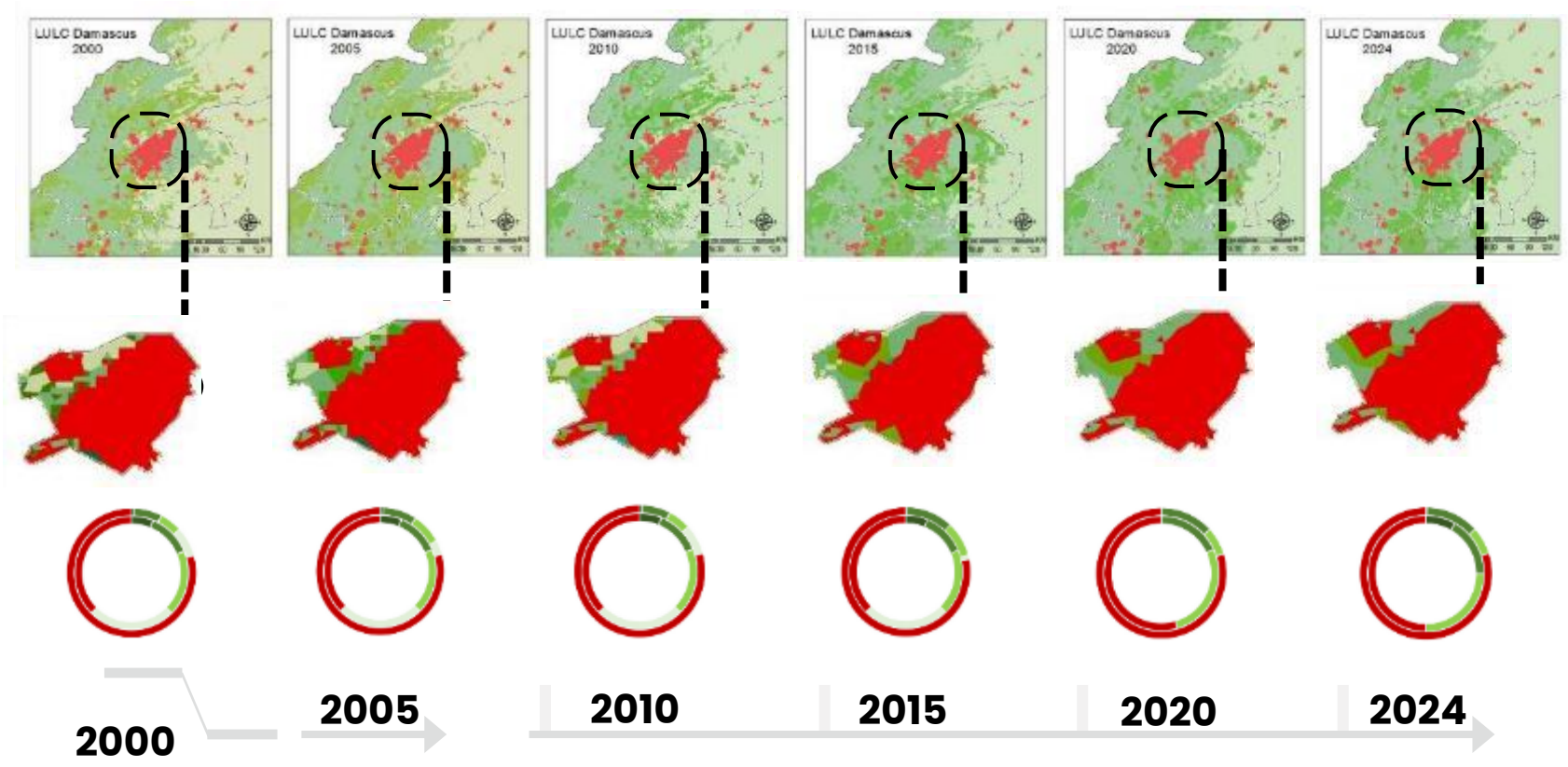
LULC change 2000-2025

- Over the past few decades, land use in Syria has undergone significant transformations, particularly influenced by the ongoing conflict that began in 2011. Prior to the crisis, agricultural land dominated the landscape, accounting for a substantial portion of land use; however, as the conflict escalated, urban areas expanded dramatically due to the influx of internally displaced persons and refugees seeking safety and resources.

- As Syria moves towards recovery, understanding these land use changes is critical for developing sustainable management strategies that balance urban growth with agricultural viability and environmental conservation.



LULC change 2000-2025



- Between 2000 and 2024, Damascus has experienced significant land use changes driven by conflict and urban redevelopment initiatives. The onset of the Syrian civil war led to rapid urban expansion as displaced populations migrated to the city, resulting in a notable increase in built-up areas.

City.. Example

Remote Sensing Data → **GIS Data** → **Change Detection Techniques (PCC, LULCC Analysis, Hotspot Analysis)**

2000

2005

2010

2015

2020

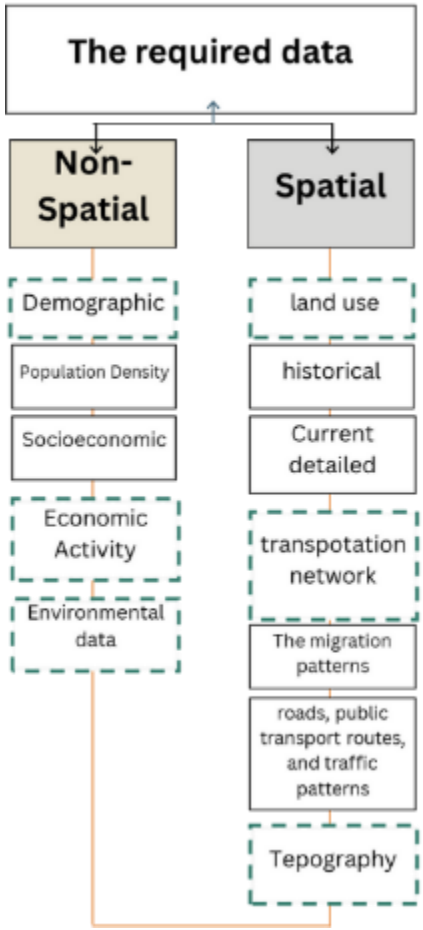
2024

HOW

PROCESS AND FINDINGS

process of the prediction 2035

01 Input Data



02 CA Model Setup

- Cellular Automata Grid
- Each cell represents a land use class (10m based on Landsat)
- Specify probabilities for transitions between land use classes based on:
- Historical trends.
- Proximity to urban centers (e.g., higher chance of urban expansion near roads).
- Environmental constraints (e.g., forests near protected areas remain unchanged).

```
import numpy as np
import rasterio
from sklearn.ensemble import RandomForestClassifier
from matplotlib import pyplot as plt

# Step 1: Load Historical LULC Data
with rasterio.open("lulc_2020.tif") as src:
    lulc_2020 = src.read(1)

with rasterio.open("lulc_2024.tif") as src:
```

03 Scenario Simulations

- Each number (1, 2, 3) corresponds to a specific land-use category.
- ESRI and NASA database/open resources.

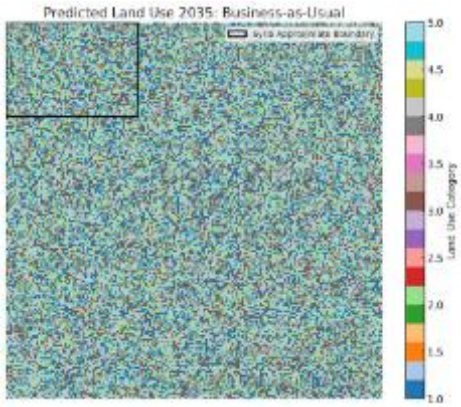
three scenarios depends on the spatial framework 2035 in Syria:

- As Usual
- Development
- Urbanization

Land Use Scenarios 2035

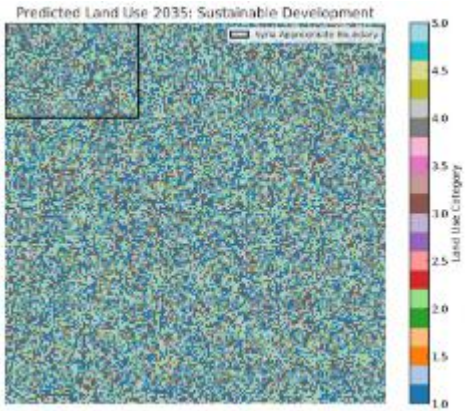
01 As-Usual

- Continuation of current trends with minimal policy changes.
- Moderate urban expansion, gradual conversion of agricultural land.
- Highlights risks of perpetuating pre-war spatial imbalances



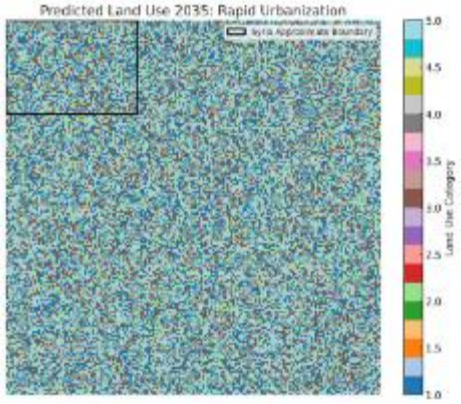
02 Sustainable Development

- Prioritizes conservation and balanced urban-rural development.
- Urban sprawl is controlled, protecting critical natural resources.
- Demonstrates benefits of equitable and sustainable governance



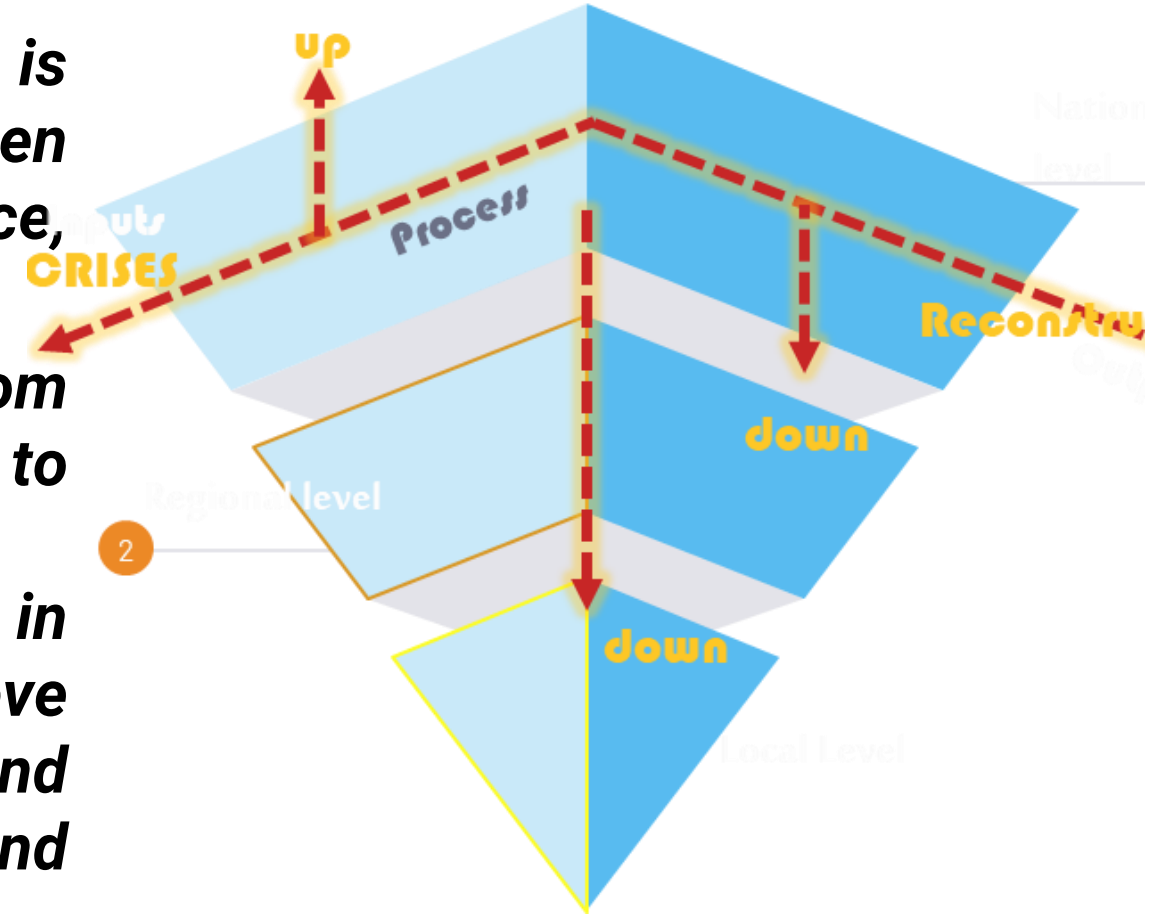
03 Rapid Urbanization

- Accelerated urban growth due to population and infrastructure demands.
- Significant loss of agricultural and natural lands.
- Reflects risks of unregulated development.



Governance

Effective governance is the bridge between policy and practice, ensuring that every level of planning—from national strategies to community-driven actions—works in harmony to achieve equitable and sustainable land management.



Integration for Effective Land Management

Vertical Integration:

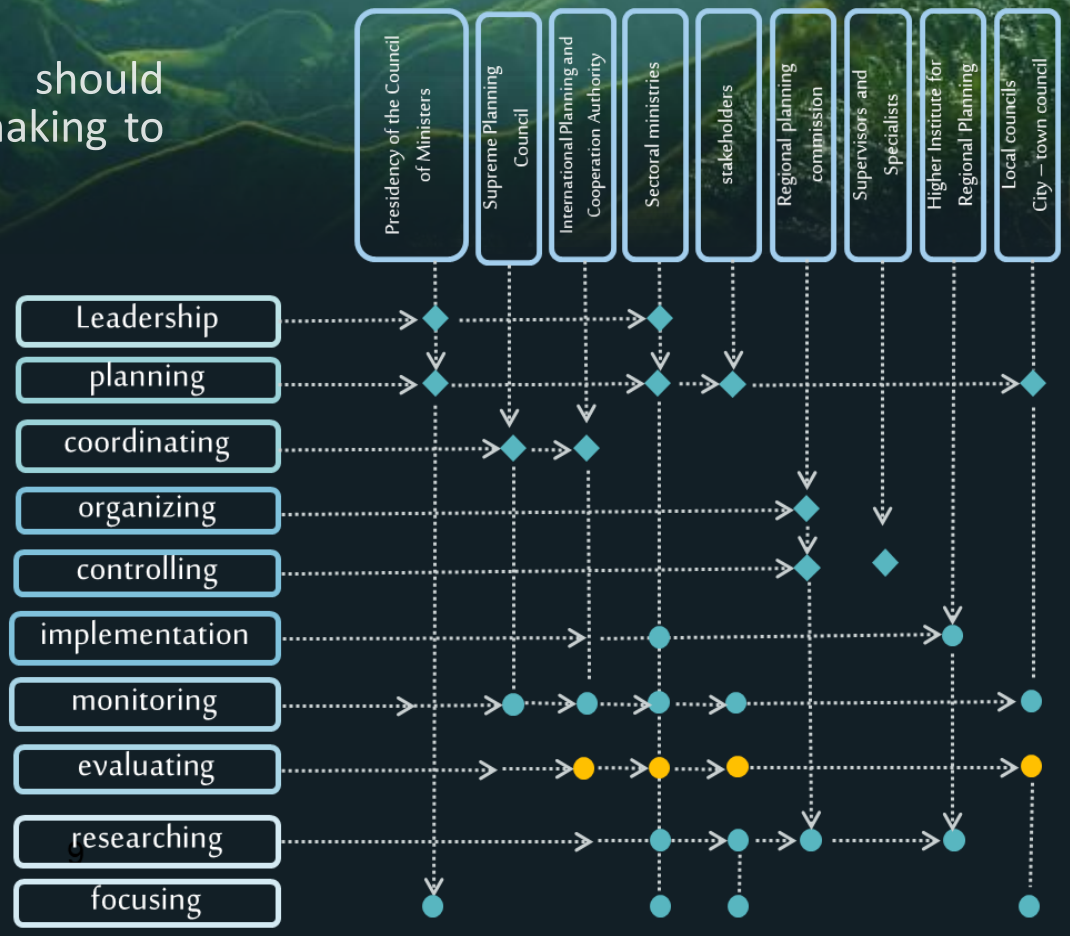
- National policies should guide regional and local actions while being flexible enough to address local needs.
- Regional and local feedback should inform national-level decision-making to ensure relevance and inclusivity.

Horizontal Coordination:

- Municipalities and neighboring regions should coordinate on shared resources (e.g., water, forests) and infrastructure (e.g., roads, transportation networks).

Community Involvement:

- Engaging communities ensures that land management plans are inclusive.



Conclusion and Recommendations

Adopt Predictive Models in Planning:

- Utilize advanced tools like Cellular Automata (CA) and machine learning to forecast land-use changes and test policy outcomes.
- Integrate these models into national and regional planning frameworks to ensure data-driven decision-making.

Strengthen Multi-Level Governance:

- Foster collaboration between national, regional, and local authorities to align spatial planning efforts.
- Ensure participatory planning by involving communities in decision-making processes to address local needs.

Conclusion and Recommendations

Focus on Sustainable Development:

- Prioritize the protection of critical resources such as agricultural land, forests, and water bodies.
- Encourage compact and efficient urban growth to minimize environmental degradation and optimize infrastructure.

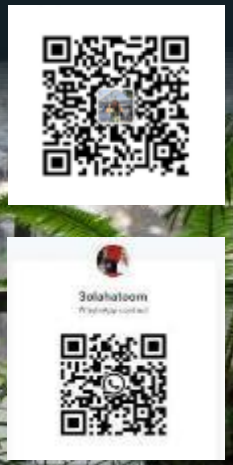
Address Population Displacement:

- Develop land management policies that accommodate displaced populations and ensure equitable access to resources.
- Promote resettlement in underutilized rural areas to balance population density.

Leverage International Support.

Implement a Monitoring Framework.

For more information visit:
www.linkedin.com/in/oula-hatoom
or contact:
ola-hatoom@outlook.com



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