



MICRO-CREDENTIAL

LAND MANAGEMENT IN CENTRAL ASIA

6.- Rational Land Use and Efficiency

Efficiency Review

LM-W06-V42



Co-funded by
the European Union





Building a Sustainable Future

As global populations surge and cities expand, the way we use land determines the quality of life for billions. This presentation explores evidence-based strategies, case studies, and technologies that can help us build smarter, greener, and more resilient communities.



Unprecedented urbanization is reshaping our planet. As cities grow faster than ever before, the decisions we make about land — where to build, how densely, and at what environmental cost — will define the sustainability of our civilization for generations to come.

A World Turning Urban

According to UN projections, **68% of the global population** will live in urban areas by 2050 — up from just over half today. This unprecedented demographic shift places immense pressure on land resources, infrastructure systems, housing supply, and environmental carrying capacity worldwide.

What This Means in Practice

- Demand for housing intensifies in dense corridors
- Transportation and energy infrastructure must scale rapidly
- Economic activity concentrates in megacities and urban clusters
- Periurban and rural land faces increasing conversion pressure

When land is consumed without strategic planning, the consequences ripple across ecosystems, economies, and communities. Sprawling, uncoordinated development is not a neutral choice — it actively undermines the foundations of sustainable growth.



Environmental Degradation

Extensive, low-density land use accelerates habitat destruction, soil erosion, and the contamination of water systems, pushing ecosystems beyond recovery thresholds.



Loss of Cultivated Land

Agricultural land is irreversibly converted to urban uses, threatening food security for growing populations and eliminating biodiversity corridors.

Energy & Pollution

Sprawl increases per-capita energy consumption, vehicle miles traveled, and greenhouse gas emissions — compounding the climate crisis at every scale.

Unchecked Growth: A Threat to Sustainability



Cities that expand without rational planning create landscapes defined by congestion, pollution, and lost natural capital. The visible haze over many major metropolitan areas is a tangible symbol of the hidden costs that inefficient land use imposes on residents, economies, and the planet.

Beijing-Tianjin-Hebei Urban Agglomeration: A Case Study

Study Scope

Researchers examined **197 counties** across the Beijing-Tianjin-Hebei (BTH) urban agglomeration in 2018, measuring Urban Land Use Efficiency (ULUE) through a comprehensive multi-input, multi-output framework. This mega-region, home to over 110 million people, represents one of China's most critical development zones.

What Was Measured

- Capital investment and built-up land area as key inputs
- GDP output alongside environmental and social desirable outputs
- Undesirable outputs including carbon emissions and industrial waste
- Significant disparities in ULUE identified across development tiers

The study revealed that efficiency levels varied dramatically depending on a county's administrative classification and geographic position within the agglomeration.

Complexity at Middle & Low Levels

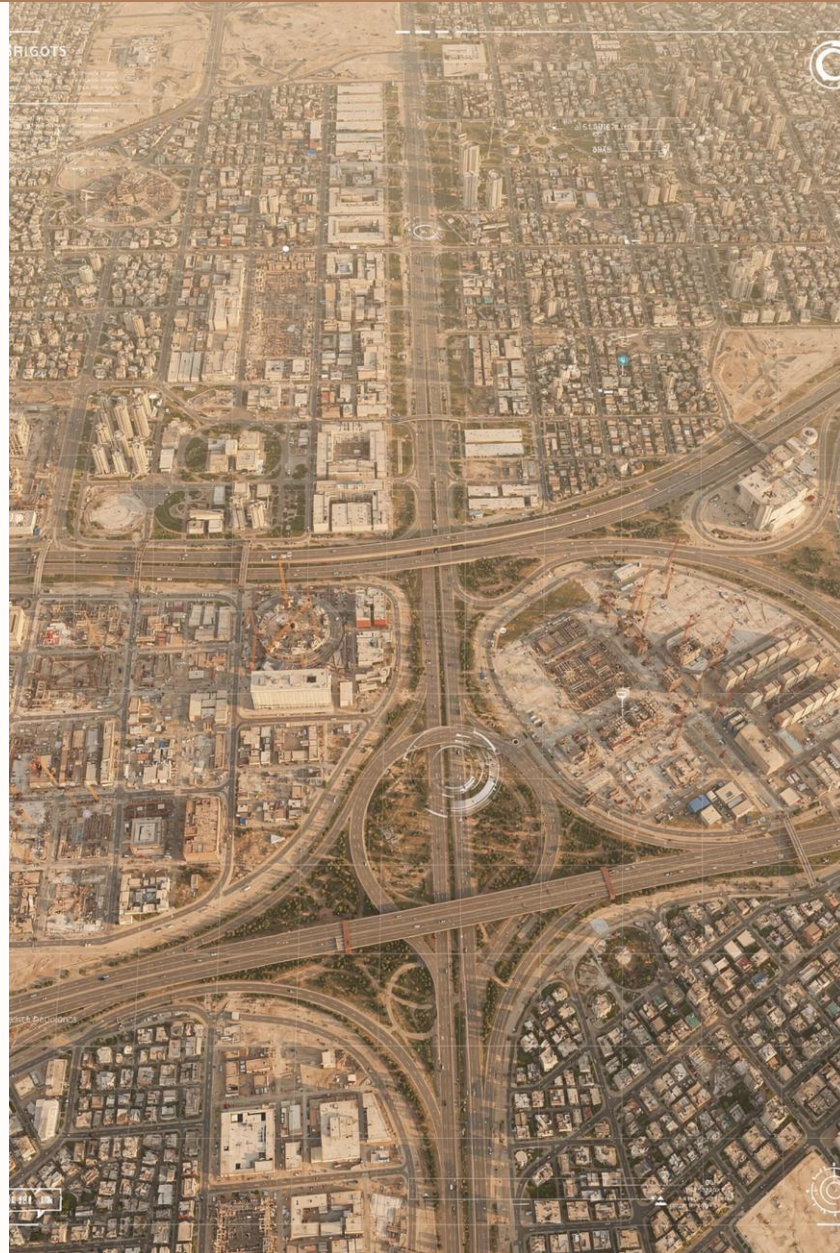
Counties operating at middle and low efficiency levels face the most complex improvement challenges. They must simultaneously optimize economic outputs, reduce environmental externalities, and improve social welfare metrics — often with constrained fiscal capacity.

Environmental Benefits Are Non-Negotiable

Efficiency gains cannot be achieved by focusing on economic outputs alone. Environmental and social benefits — including reduced emissions, improved livability, and equitable resource access — are integral components of a truly efficient land use system.

Tailored Benchmarks Matter

A one-size-fits-all efficiency target fails to account for structural differences between counties. Context-dependent benchmarks yield more actionable, realistic, and ultimately achievable improvement pathways for local governments.



Modern geospatial technology has transformed how planners understand and manage land. From real-time satellite data to predictive modeling, digital tools are making it possible to design cities that are both functionally efficient and ecologically responsible.

GIS-Based Zoning and Spatial Analysis: The Power of Precision

What GIS Enables

Geographic Information Systems (GIS) provide planners with unprecedented analytical depth. By integrating data layers — demographic patterns, infrastructure capacity, environmental sensitivity, and economic activity — GIS enables decisions that are grounded in empirical reality rather than assumptions.

- Density mapping identifies underutilized parcels and infill potential
- Green space allocation models optimize ecosystem service delivery
- Spatial clustering tools reduce commute burdens and infrastructure costs

From Data to Action

GIS-based analysis translates complex spatial relationships into clear, actionable zoning policies. Cities using GIS-informed planning report measurable reductions in sprawl, improved transit efficiency, and better alignment between housing supply and demand — resulting in more livable, competitive urban environments.



Advanced geospatial visualization tools allow planners to see the invisible — how population density, infrastructure, green space, and economic activity interact across a landscape. Precision mapping is the foundation of rational, evidence-driven land use decisions that balance growth with sustainability.

Addressing Biodiversity Degradation and Resource Exploitation



Protecting Natural Corridors

Strategic land-use planning designates buffer zones and ecological corridors that prevent habitat fragmentation, allowing wildlife populations to remain connected and resilient against urban encroachment.



Preventing Unregulated Expansion

By establishing clear urban growth boundaries and prioritizing brownfield redevelopment over greenfield conversion, planners can protect both agricultural land and biodiverse ecosystems from unregulated development pressure.

Sustainable Resource Use

Efficient land-use frameworks embed resource stewardship principles directly into zoning regulations, discouraging extractive practices and encouraging circular approaches to materials, water, and energy at the site level.



The movement of goods is the backbone of the modern economy — yet its spatial demands are often overlooked in conventional land use planning. Integrating freight considerations into urban and regional planning is essential for building supply chains that are resilient, cost-effective, and environmentally sound.

Freight as a Land Use Force

Land-use planning has always shaped economic activity — but the inverse is equally true. The location of warehouses, distribution centers, ports, and industrial zones directly determines traffic patterns, emissions levels, and neighborhood quality of life. When freight is ignored in planning decisions, the result is congestion, pollution, and cascading inefficiencies throughout the supply chain.

Integrating freight activity into land use frameworks can dramatically improve logistics performance, reduce last-mile costs, and minimize the externalities borne by surrounding communities.

The Economic Stakes

- Freight accounts for **~10% of GDP** in advanced economies
- Poorly planned logistics zones add significant per-unit transport costs
- Urban freight contributes disproportionately to local air pollution
- Supply chain resilience depends on smart spatial organization

The Engine of Commerce: Optimizing Freight Flow

Ports, rail yards, and distribution hubs are the arteries of the global economy. Strategic siting and zoning of freight infrastructure — informed by FELU principles — can dramatically reduce transportation costs, emissions, and community impacts while strengthening supply chain performance and regional competitiveness.



Community Impact Assessment

Freight-intensive land uses — warehouses, truck depots, intermodal yards — can generate noise, traffic, and air quality burdens for nearby residents. Decision-makers must conduct rigorous community impact assessments before approving major logistics developments in or near residential areas.

Strategic Buffer Zones

Establishing transitional land uses and green buffers between freight corridors and sensitive receptors (schools, homes, hospitals) is a proven strategy for mitigating negative externalities while preserving logistical functionality.

Inclusive Planning Processes

Effective FELU implementation requires meaningful engagement with affected communities, not just industry stakeholders. Transparent, participatory planning builds trust, surfaces local knowledge, and leads to more durable policy outcomes that balance economic and social priorities.

Recognizing inefficiency is only the first step. The harder — and more consequential — challenge is charting actionable, context-sensitive pathways from where a region is today to where it needs to be. Data-driven analytical tools are making this possible at unprecedented scale and precision.

What is DEA?

Data Envelopment Analysis (DEA) is a non-parametric efficiency measurement technique that compares each decision-making unit — such as a county — against a frontier of best-performing peers. Unlike simple ratio-based metrics, DEA handles multiple inputs and outputs simultaneously, making it ideal for complex land use systems.

Why Context-Dependence Matters

Standard DEA models benchmark all units against the same frontier. Context-dependent DEA refines this by creating tiered benchmarks — each inefficient county is evaluated against peers at a comparable development level. This yields **practical, realistic improvement targets** that are genuinely achievable rather than aspirational abstractions.

- Identifies the specific inputs to reduce or outputs to increase
- Provides step-by-step progression pathways through efficiency tiers
- Adapts to the structural constraints of each administrative type

Across the BTH urban agglomeration, research consistently found that no single improvement prescription applies universally. The optimal path forward varies significantly based on administrative classification, geographic location, and existing resource endowments.

Municipal Core Counties

Urban core areas typically need to reduce land consumption per unit of economic output — focusing on densification, mixed-use redevelopment, and transit-oriented development to improve efficiency ratios without sacrificing economic productivity.

Suburban & Periurban Areas

Suburban counties often face a dual challenge: managing rapid growth pressure while preserving agricultural and ecological land. Targeted zoning reforms and infrastructure investments help channel development into designated growth areas.

Rural & Peripheral Counties

Rural areas require solutions that enhance economic output from existing land without resorting to extensification. Sustainable intensification of agriculture and eco-tourism can improve ULUE scores while protecting natural assets.



The difference between a degraded, over-extended landscape and a thriving, integrated urban environment is not inevitable — it is a product of deliberate choices. Cities and regions that have committed to rational land use planning demonstrate that reversal and renewal are achievable, even in the most challenging contexts. The path begins with data, strategy, and political will.



Urban Planners & Policymakers

Municipal planners and regional authorities are the frontline implementers of efficient land use. Their decisions on zoning, density bonuses, and growth boundaries set the structural conditions within which all other actors operate.

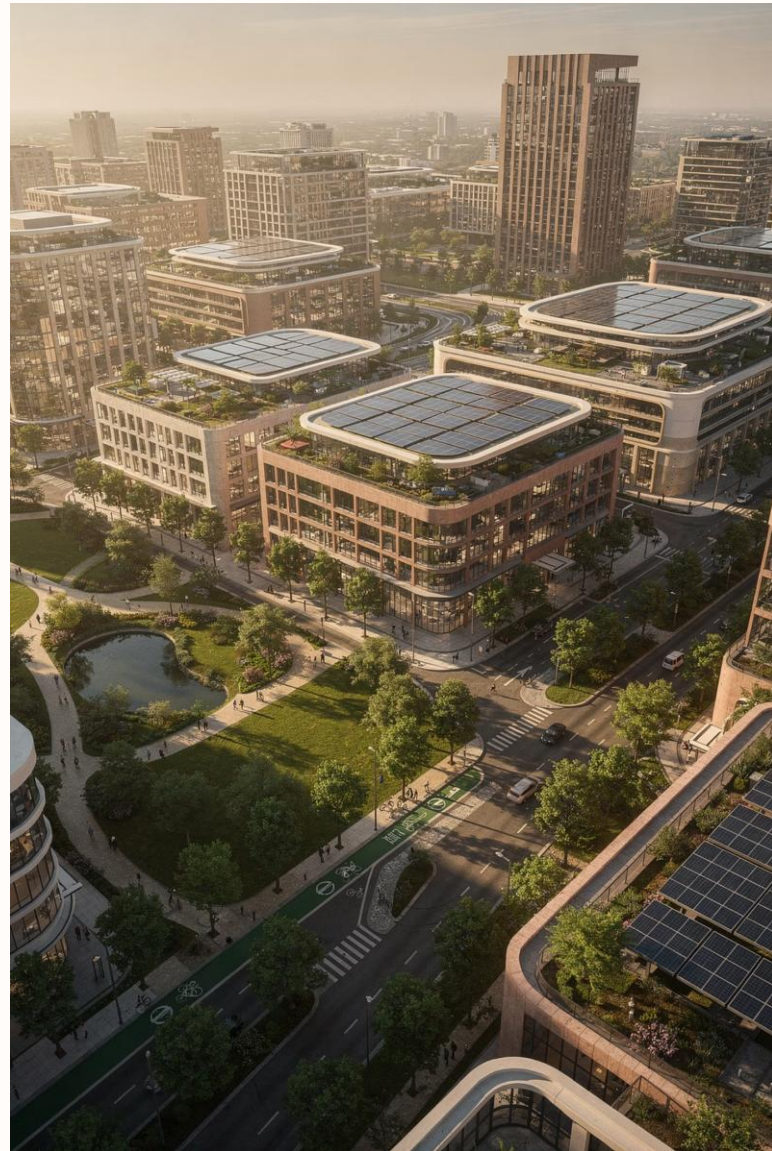


Private Sector & Developers

Real estate developers, logistics companies, and industrial operators shape land use outcomes through investment decisions. Aligning their incentives with public efficiency goals — through regulations, tax structures, and partnership frameworks — is essential for systemic change.

Communities & Civil Society

Residents, community organizations, and environmental advocates bring local knowledge and accountability to planning processes. Meaningful participation ensures that efficiency gains translate into genuine improvements in quality of life for all members of society.



Rational land use is not merely a technical exercise — it is a moral and strategic imperative. The vision ahead is one of cities and regions that grow in harmony with their natural environments, where economic vitality, social equity, and ecological integrity are mutually reinforcing rather than competing forces.

Achieving genuine sustainability requires reconciling goals that have historically been treated as trade-offs. The most advanced planning frameworks demonstrate that **environmental stewardship, economic competitiveness, and human livability** can be pursued simultaneously — but only through deliberate, coordinated, and data-informed land use strategies.

Site-Level Efficiency

Optimized building density, mixed uses, and reduced impervious cover

Neighborhood Integration

Walkable, transit-connected communities with accessible services

City-Wide Coordination

GIS-informed zoning, growth boundaries, and infrastructure alignment

Regional Prosperity

Enhanced ULUE driving long-term economic competitiveness and ecological resilience — the ultimate precondition for urban sustainable development

Implementing rational land use and efficiency strategies is not just an option — it is a necessity for a thriving planet.

□ **Measure**

Deploy DEA and GIS tools to quantify current efficiency and identify gaps

□ **Plan**

Develop context-specific, data-driven land use strategies for every tier

□ **Collaborate**

Engage all stakeholders — planners, developers, and communities — in co-creating solutions

□ **Sustain**

Embed efficiency and sustainability metrics into long-term governance frameworks



MICRO-CREDENTIAL

LAND MANAGEMENT IN CENTRAL ASIA

6.- Rational Land Use and Efficiency

Efficiency Review

LM-W06-V42



Co-funded by
the European Union

