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LESLIE

LAND MANAGEMENT ENVIRONMENT & SOLID-WASTE

Co-funded by the European Union

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LAND MANAGEMENT IN CENTRAL ASIA

10.- Introduction to Remote Sensing

Applications of Remote Sensing in Land Studies

LM-W10-V69

What counts as "land studies"?

Physical surface
land cover, soil, terrain, water

Biological surface
vegetation, crops, forest, rangeland

Human use
settlement, farming, transport, industry

Change
growth, decline, pressure

join → into → view

Land-studies perspective
Remote sensing helps describe the land itself and also how people use and transform it.

Why it matters
Land studies support inventory, monitoring, planning, and sustainable management.

Why remote sensing is valuable for land analysis

Observe large areas → Repeat through time → Compare locations → Support decisions

Better spatial coverage

A single image can show a full district, watershed, or region instead of a few field points.

Better time coverage

Repeated observations make it possible to track crop seasons, urban growth, flooding, or land degradation.

Better consistency

Digital data can be classified, compared, and integrated with GIS for mapping and planning.

Field data are still needed for validation.

Land cover and land use are related but different

Land cover
Physical material on the surface

- forest
- grassland
- bare soil
- water
- built surface

Land use
Human purpose or activity

- farming
- housing
- industry
- transport
- recreation

Why the distinction matters
One land use class can contain several land cover types. A residential area, for example, may include buildings, roads, trees, and open ground.

Typical workflow for land-oriented remote sensing

Acquire	Prepare	Interpret	Validate	Deliver
satellite, drone, or aerial images	geometric and radiometric correction	classification, indices, or visual reading	field checks and reference data	maps, statistics, and decision support

Key idea
Land studies need both image analysis and ground knowledge.

Common outputs
land cover maps, crop status maps, wetness maps, urban growth layers, DEM-based terrain products

Land cover mapping is one of the core applications

Image evidence
Spectral differences, texture, shape, pattern, and context help separate classes.

classify → check → map

Forest	Cropland	Water
Bare soil	Urban	Wetland

Typical uses of a land cover map

- baseline inventory
- land management planning
- habitat and watershed studies
- change detection through time
- input to GIS and models

Agriculture: crops can be monitored through the season

What can be mapped?

crop type
plant vigor
water stress
disease or pest impact

Useful signals

visible and near-infrared response
thermal patterns
multidate observations

Why it matters

yield estimates
targeted field visits
better input management

Reminder

remote sensing guides action, but field inspection confirms causes

Planting — Growth — Peak canopy — Stress — Harvest

Soil, moisture, and land degradation

Bare soil	Moisture	Salinity clues	Vegetation loss	Erosion risk
surface exposure	wetness differences	bright crusts / stress	reduced cover	slope and gullies

Typical outputs
degraded land zones • drought-sensitive fields • salinity-prone areas

Best practice
interpret optical, thermal, radar, terrain, and field evidence together

Water, irrigation, and drainage in land management

Water presence
surface water, wet soils, ponding, channel condition

detect

Land-management meaning
irrigation demand, leakage clues, poor drainage, flood impact

support

Action
schedule
repair
prioritize

Common products

- wetness maps
- water-body change layers
- irrigated area maps
- canal and drainage monitoring

Why important for land studies

Water controls crop performance, soil condition, and the long-term suitability of land for use.

Vegetation, forests, and rangelands

Observe condition

- greenness
- canopy density
- seasonal change
- disturbance signs

interpret

Link to land questions

- forest loss
- rangeland pressure
- fire or drought effects
- restoration priority

apply

Support decisions

- inventory updates
- conservation zoning
- grazing management
- monitoring through time

Multidate observations are especially useful because vegetation changes with season, rainfall, and human pressure.

Urban growth and land planning

Rural / peri-urban zone
cropland
open land
new roads
scattered buildings

expansion

Urbanizing landscape
construction
denser transport
less open soil
more sealed surface

planning

Planning outputs
growth boundary review
infrastructure support
hazard-aware siting
protection of productive land

High-resolution imagery is often preferred for parcel-scale urban interpretation.

Hazards and environmental monitoring in land studies

Floods
extent, wetness, affected land

Drought
vegetation stress, moisture loss

Erosion
bare slopes, gully expansion

Fire / disturbance
burn scars, recovery

Shared value of remote sensing
It gives fast area-wide evidence after events and supports repeated monitoring during recovery. This is important when field access is difficult or conditions change quickly.

Best practice: combine remote sensing, terrain data, and field verification.

Change detection: land is studied across time, not only in one image

T1 → T2 → T3

What can change?

cropland extent
urban area
forest cover
surface water
bare land

Seasonal change

Normal and expected changes within a year, such as crop growth or leaf-on / leaf-off conditions.

Longer-term change

More permanent change, such as urban expansion, deforestation, shoreline shift, or persistent degradation.

Regional relevance: why these applications matter in Central Asia

Irrigation and canal management
repeated observation helps identify change in water distribution

Salinity and soil degradation
land quality can decline where drainage is weak or water is mismanaged

Pasture and vegetation condition
seasonal monitoring supports rangeland assessment

Delta, wetland, and water-body change
multidate imagery shows expansion, shrinkage, and fragmentation

Urban growth and land conversion
productive land can be converted to built-up land over time

Mountain and hazard-sensitive areas
remote sensing helps where access is difficult or change is fast

Regional message
The region benefits from repeated land observation because water availability, vegetation condition, and land-use pressure vary strongly across space and time.

Conclusion and references

Key takeaways

• Remote sensing is central to modern land studies.
• It supports mapping, monitoring, and planning.
• Strong applications include land cover, crops, water, vegetation, urban growth, and change detection.
• The best results come from combining image analysis with GIS and field verification.

References

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For deeper study, review the references and compare how different sensors are chosen for different land-management questions.

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