ERASMUS-EDU-2023-CBHE
Project number: 101129032

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(01/01/2024 – 31/12/2026)

LESLIE
LAND MANAGEMENT ENVIRONMENT & SOLID-WASTE

MICRO-CREDENTIAL

LAND MANAGEMENT IN CENTRAL ASIA

15.- Integrated Applications of Remote Sensing

Agricultural and Crop Monitoring

LM-W15-V101

Co-funded by the European Union

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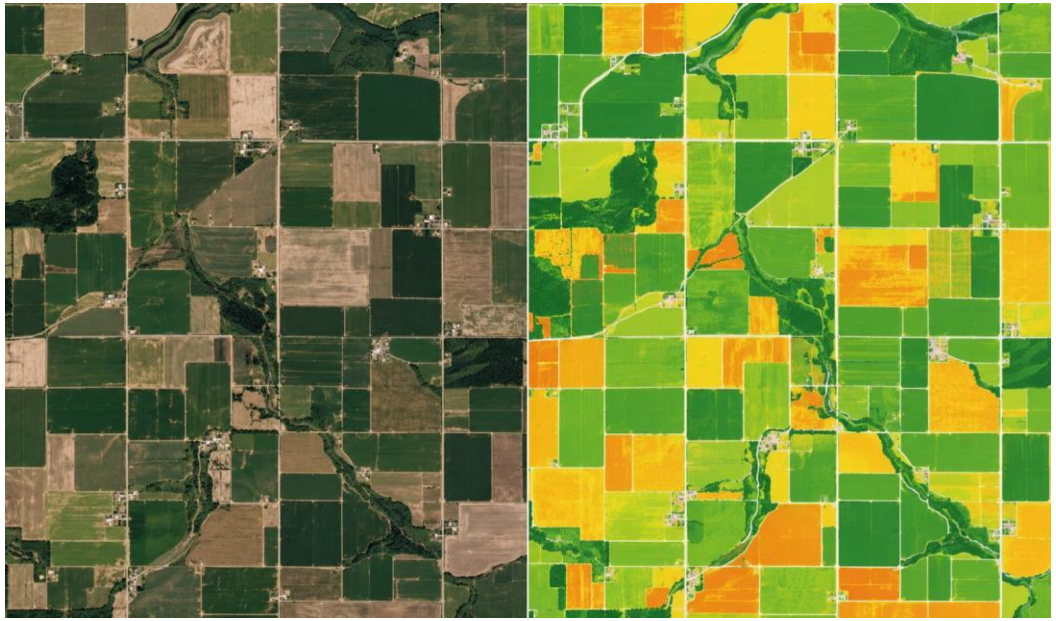
Learning objectives

Explain why agricultural and crop monitoring is important for land management.

Identify the main satellite, UAV, GIS, and field data used for crop monitoring.

Interpret vegetation indices, crop phenology, and field-level crop condition maps.

Connect crop monitoring outputs with irrigation, yield risk, and decision support.



Key idea: crop monitoring is not only about producing maps; it supports timely agricultural decisions before stress becomes visible in the field.

Why Crop Monitoring Matters

Agriculture changes quickly during the season, so one image is rarely enough.

Monitoring helps identify crop emergence, growth, stress, maturity, and harvest timing.

Field-level maps support irrigation scheduling, input planning, and early warning.

Regional monitoring supports food security analysis and agricultural reporting.

10–30 m
common field-level monitoring scale with Sentinel-2 and Landsat

Time series
tracks crop change through the growing season

Main Monitoring Questions

Agricultural monitoring usually answers four practical questions:

Where?

Crop area and field boundaries

What?

Crop type and land-use class

How well?

Growth condition, stress, water status

When?

Planting, peak growth, maturity, harvest

Good crop monitoring links these questions to crop calendars, irrigation systems, local agronomy, and field observations.

Data Sources for Crop Monitoring

Remote sensing data

Landsat and Sentinel-2 optical images

MODIS for broad-scale seasonal trends

Sentinel-1 radar for cloud-prone periods

UAV multispectral imagery for detailed field checks

GIS and field data

field boundaries and land parcels

crop calendar and planting dates

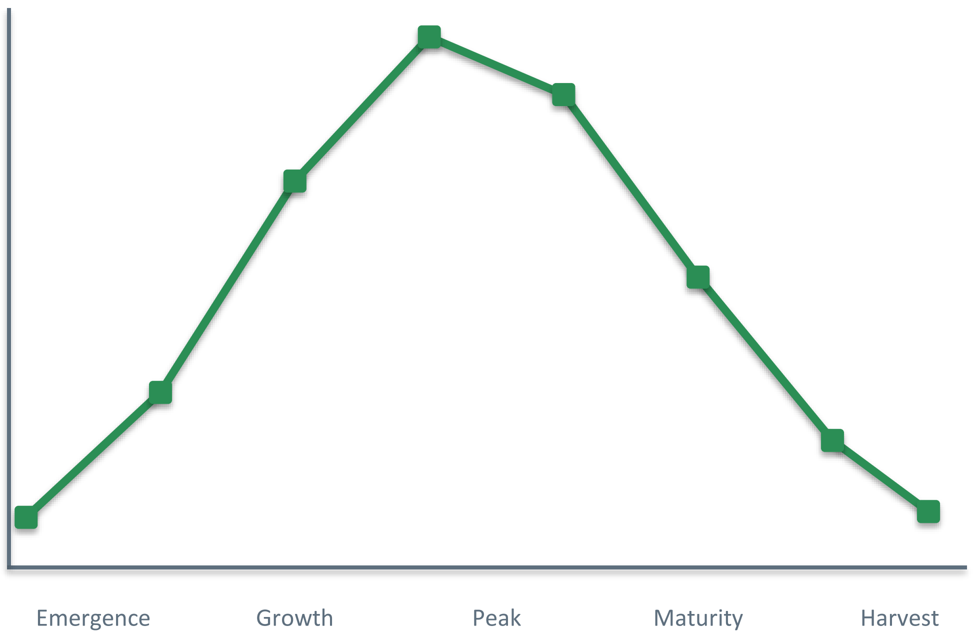
soil, irrigation, and drainage data

ground control points and field photos

The best monitoring result comes from combining satellite observations with local field knowledge. Satellite data show patterns; field data explain causes.

Crop Phenology: Reading the Season

NDVI / vegetation index curve



Crop growth follows a seasonal curve that can be monitored using repeated images.

Different crops often show different timing, peak greenness, and decline patterns.

Phenology helps separate crop types and detect abnormal stress or delayed growth.

Interpretation rule: compare the same crop and same season across multiple years before labeling an area as stressed.

Vegetation Indices for Crop Condition

NDVI

(NIR – Red) / (NIR + Red)

Used to estimate vegetation greenness and change in plant health.

EVI

Enhanced Vegetation Index

Useful where dense canopy and atmospheric effects need more careful interpretation.

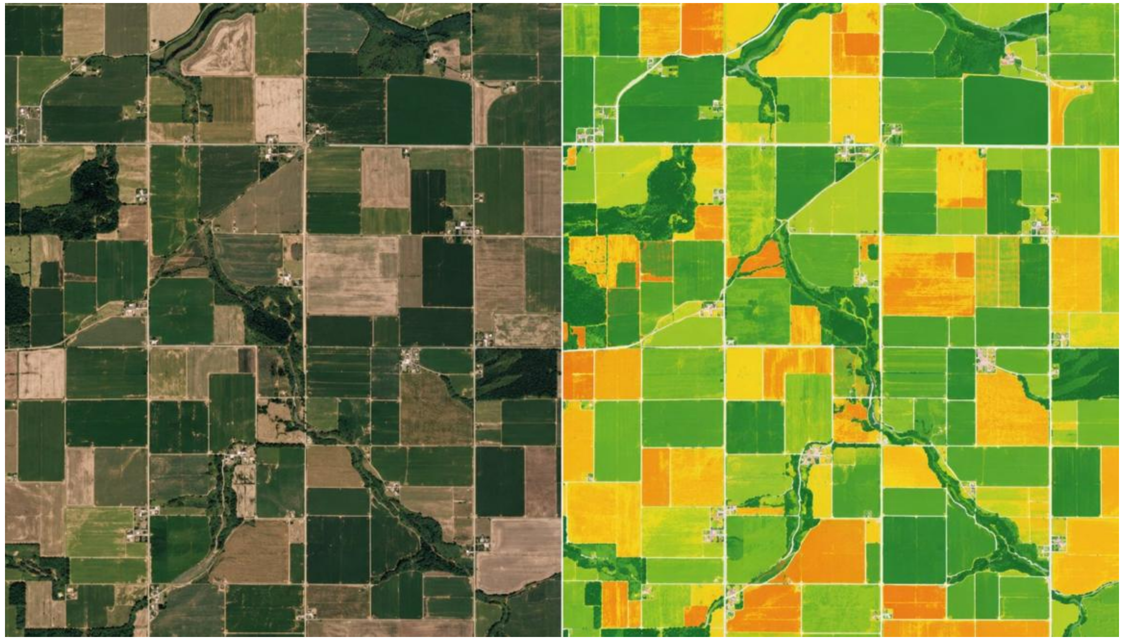
SAVI

Soil Adjusted Vegetation Index

Useful in sparse vegetation areas where bright soil influences the signal.

Indices should be interpreted together with crop type, crop calendar, soil background, irrigation status, and field observations.

Crop Type Mapping and Classification



Crop type maps can be created from multi-date images because crops have different seasonal signatures.

Common approaches include supervised classification, machine learning, and object/parcel-based mapping.

Training samples must represent real field variation: crop type, growth stage, soil background, and irrigation condition.

Parcel boundaries can improve interpretation by summarizing pixel values at field level.

Good classification depends more on clean training data and seasonal image selection than on software alone.

Detecting Crop Stress

Possible stress signals

low or declining NDVI compared with similar fields

patchy within-field variation

delayed greening or early senescence

abnormal thermal or moisture response

repeated low productivity across seasons

Possible causes to verify

water shortage or uneven irrigation

soil salinity or waterlogging

pests, disease, or weeds

nutrient deficiency or management differences

crop rotation or harvest timing

A stress map is a screening tool. It shows where to look first, not the final cause by itself.

Irrigation and Water Productivity Monitoring

In irrigated agriculture, crop condition is closely linked with water delivery, drainage, and soil moisture.

Remote sensing helps detect uneven growth, under-irrigated fields, waterlogging, and seasonal water stress.

FAO WaPOR provides open-access remote-sensing-derived data for monitoring water productivity.

Water productivity analysis can support more efficient irrigation planning and sustainable land use.

Uzbekistan and Central Asia relevance: irrigation networks, canal timing, drainage quality, and crop calendars must be included in interpretation.

UAV and Field Validation

UAV imagery can provide very high spatial detail for selected fields.

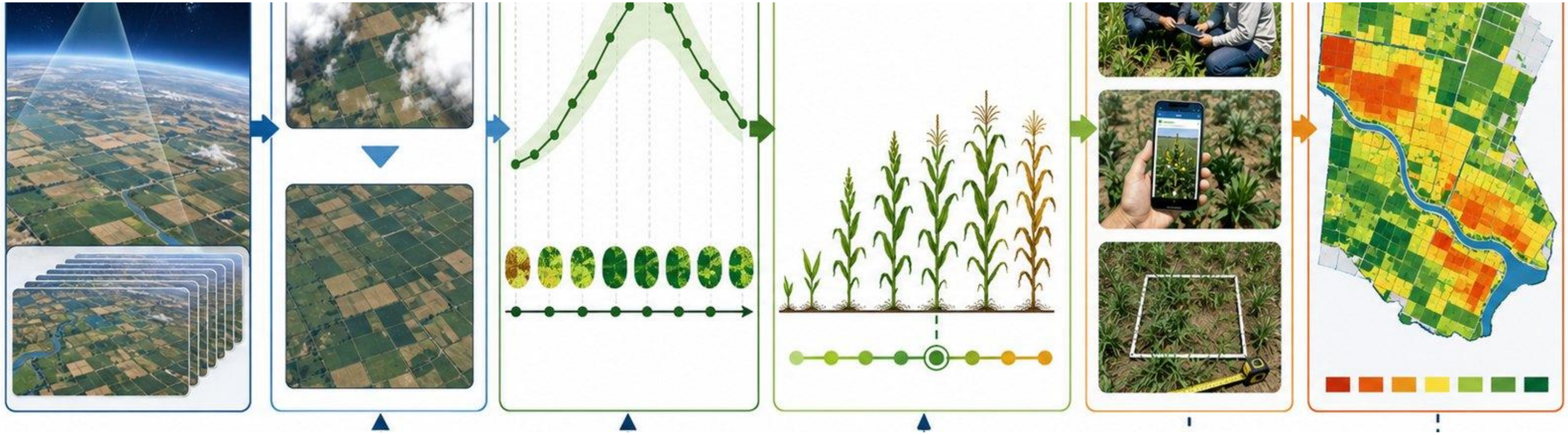
Field measurements help explain why a satellite signal is low or high.

Validation should include GPS points, crop type, growth stage, photos, and field notes.

Ground truth must be collected close to the image date, especially during rapid crop growth.

Field validation turns a remote sensing product into reliable agricultural information.

Crop Monitoring Workflow



Images → Cloud mask → Indices → Time series → Field check → Crop map → Decision

The workflow should be repeated during the season so that monitoring becomes a continuous decision-support process.

Central Asia Example: Field-Level Monitoring

Select cotton, wheat, rice, orchard, or vegetable fields using parcel boundaries or field survey data.

Build a seasonal time series from Sentinel-2 or Landsat images after cloud masking.

Calculate NDVI, SAVI, and water-related indices for each field and compare them with expected crop calendars.

Identify fields with delayed growth, uneven condition, or sudden decline and plan field inspection.

Use the final map to support irrigation advice, land management reporting, or research analysis.

Practical output: a field table with crop type, vegetation index trend, stress flag, and recommendation for field verification.

Limitations and Good Practice

Common limitations

clouds and atmospheric effects

mixed pixels in small or narrow fields

confusion between crop stress and crop rotation

limited ground truth or inaccurate parcel boundaries

index saturation in dense vegetation

Good practice

use multi-date images and crop calendars

validate with field observations

combine optical, radar, GIS, and local data where useful

report uncertainty and map limitations

interpret outputs with agronomic context

A scientifically useful map should be transparent about data source, date, method, and accuracy.

Key Takeaways and References

Key takeaways

Crop monitoring depends on repeated observations, not single images.

Vegetation indices are useful but must be interpreted with crop calendars and field data.

Field-level monitoring supports irrigation, crop stress detection, and land management decisions.

References

NASA Earthdata. NDVI and vegetation monitoring resources.

NASA HLS project. Harmonized Landsat Sentinel-2 vegetation index products.

USGS Landsat Missions. Landsat NDVI and agricultural applications.

ESA / Copernicus. Sentinel-2 mission and Sentinel-2 for Agriculture.

FAO WaPOR. Remote Sensing for Water Productivity portal.

Shokirov, S., Musaev, I., & Akbarov, M. Masofadan zondlash. Tashkent, 2015.

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