

EARTH SCAN SYSTEMS | B2B & B2C PRODUCT PORTFOLIO

Redefine Agriculture with ESS

Merging Remote Sensing with Digital Applications

AI-Driven One-Stop Solution for Sustainable Agriculture and Natural Resources

SELECTED INTERNATIONAL PROJECTS

ACIAR	**Improving Groundwater Management for Agriculture & Farming Livelihoods**	Pakistan · Lead researcher
ACIAR	**Canal Water & Groundwater Optimization (LWR-2005-144)**	Pakistan & Australia · Crop mapping & ET
ACIAR	**Groundwater & Econometric Models Training for End Users**	Pakistan · Curriculum & GIS training
ACIAR	**Adapting to Salinity in the Southern Indus Basin (LWR-2017-027)**	Pakistan & Australia · Charles Sturt University
ADB	**Coastal Communities & Climate Change: Thatta & Badin**	Pakistan · Lead Scientist
FAO	**Training Workshop on Water Resource Management**	2015
INTL	**Lead Trainer: ISNET Dakar & ICT Applications Workshop, Rabat**	Senegal & Morocco

Dr Mobushir Riaz Khan

Founder

- **Ph.D. Remote Sensing for Agriculture**
  ITC, University of Twente, Netherlands
- **Grad Certificate in Crop Production and Resource Conservation**
  Wageningen University, Netherlands
- **M.Sc (Hons.) Agriculture**
  University of Agriculture, FSD
- **B.Sc (Hons.) Agriculture**
  University of Agriculture, FSD
- **Professional Trainings in Crop Growth Modeling – Building Expert Applications**
  Thailand – Netherlands

EARTH SCAN SYSTEMS

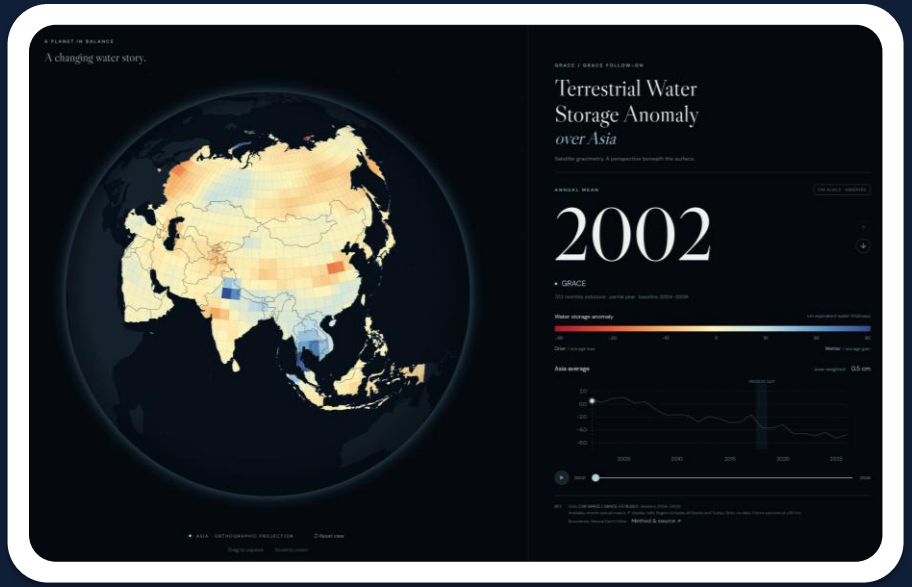
Agricultural Intelligence for Enterprise Decisions

- An integrated B2B & B2C portfolio spanning crop mapping, monitoring and Yield estimation using remote sensing and crop growth modeling
- Crop Insurance
- AI driven crop advisory
- IoT enabled agriculture sensors
- ERP systems for farm management and traceability
- Climate & Water Resource intelligence

11
Products

5
Portfolio categories

B2B & B2C
Enterprise-ready



PORTFOLIO CATEGORIES

01 **Remote Sensing, Climate & Water Intelligence**

02 **Advisory & AI Delivery**

03 **Vegetation, Climate & Risk Intelligence**

04 **IoT & Sensor Intelligence**

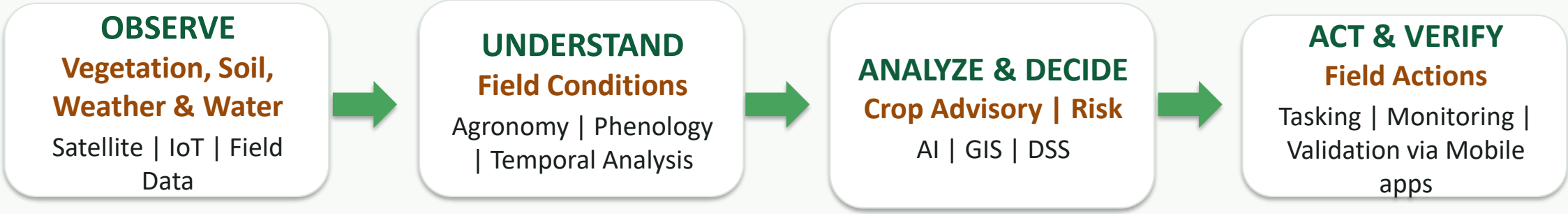
05 **ERP & Enterprise Operations**

Strategic Positioning

Integrating observation, agricultural understanding and intelligence for better decisions

From data collection to field action

Earth Scan Systems is an agricultural intelligence infrastructure company far more than a satellite map provider. Our platform combines remote sensing, IoT, weather, soil data, field records and decision support.



From observation to verified action, ESS converts complex geospatial and environmental data into measurable operational value.

One Platform. Multi-Scale Crop Intelligence

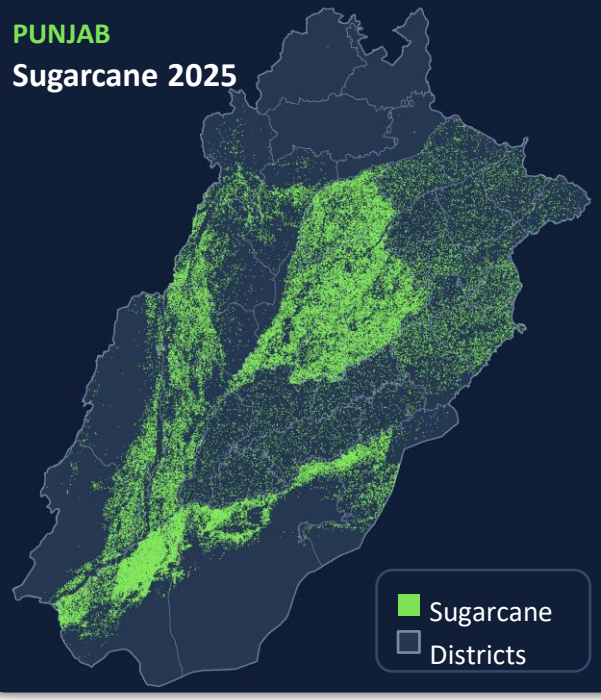
EARTH SCAN SYSTEMS

From regional crop intelligence to individual field management, supporting better planning and operational decisions

Large-Scale Crop Monitoring

Region · Mill command area · District

Big-picture insights for planning and operations



Crop mapping
Specific Crop Maps

Location of Crop types
Spatial distribution

How much is grown?
Acreage estimation

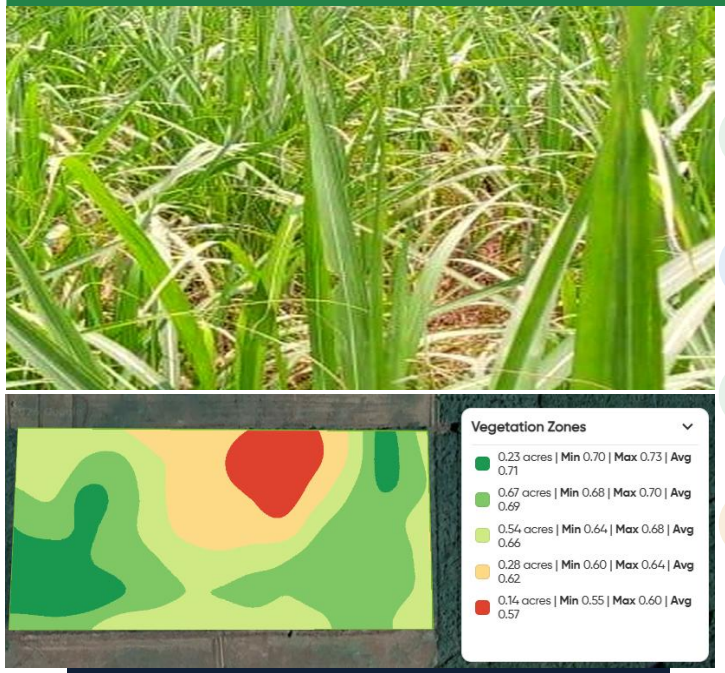
How is it performing?
In-season monitoring

Crop production
Estimation near harvest

Field-Scale Crop Monitoring

Farmer level · Farm level · Field level

Detailed insights for better management



AI Driven Field Zoning & Stress Insight

Crop condition
NDVI, NDMI, NDRE, SAVI

Water status
Irrigation & moisture monitoring

Crop growth & vigour
Throughout the season

Management support
Timely advisory for farmers

The Crop Monitoring Process

From mapping to management, turning data into decisions

1. What is grown?
Identify the crop type

2. Where is it grown?
Map distribution, field to region

3. How much is grown?
Estimate area in acres / hectares

4. How is it performing?
Monitor condition over time

5. Production estimate
Yield and total production

ESS Portfolio Architecture

Eleven products in five solution groups, backed by region-level mapping, international case studies and agri robotics, from field intelligence to enterprise operations.

01

Remote Sensing, Climate & Water Intelligence

1 product

- **Crop Precision Monitoring**
  - Region-level maps & national bulletins
  - Sugarcane & wheat area mapping.
  - Cotton: Pakistan & Uzbekistan
  - Case Studies: Australia & Tunisia

02

AI Driven Advisory with Actionable Insights

2 products

- **ESS GeoFarm**
  - Farmer guidance in the field
- **GreenBot LLM**

03

Vegetation, Climate & Risk Intelligence

3 products

- **Vegetation Monitoring**
  - Carbon MRV
- **Crop Insurance**
  - Agri financing & farm verification
- **Climate & Water Intelligence**
  - DSS for crop water use
  - Crop water productivity
  - Groundwater visualization
  - 3D groundwater modelling

04

IoT Enabled Sensor Intelligence

3 products

- **CropKonnect UNO** (Portable Soil Sensors)
- **CropKonnect Mega** (Weather Station Integrated with Portable Soil Sensors)
- **GW Konnect**
- **Agri Robotics & Geo-Automation**

05

ERP for Management & Traceability

2 products

- **Crop ERP**
- **Herd ERP**

Enterprise solution flow

Observe & analyze fields → Connect sensors & telemetry → Run operations & ERP → Deliver advisory, AI and last-mile action

Remote Sensing, Climate & Water Intelligence

Vegetation monitoring at Regional & Field Level, crop insurance, and climate intelligence from observation to risk assessment for mitigation and long-term resilience.

Products / Services

Product 01: Region-Level Mapping & Monitoring

Product 02: Crop Precision Monitoring

Implemented Projects / Services

Region-Level Mapping & Monitoring of Sugarcane

Cotton Monitoring in Pakistan & Uzbekistan (Regional and Field Level)

Carbon MRV – Australia

Olive Orchard Monitoring - Tunisia

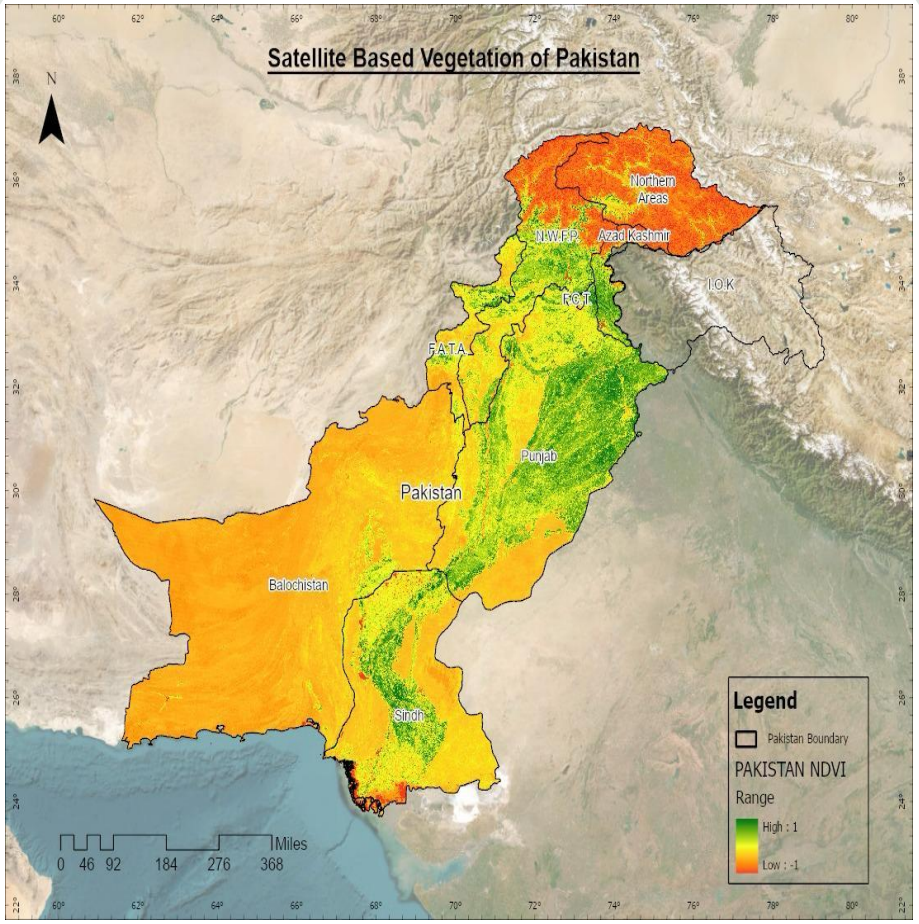
Region-Level Mapping & Monitoring

Country and province-scale satellite monitoring that comes before zooming into individual fields.

This is an important information for policy makers and businesses & industries requiring large scale procurement of agri-produce.

Region-Level Vegetation Monitoring

Monitoring starts at national and provincial scale, then zooms into individual fields and farms.



Vegetation vigor (NDVI) of Pakistan · 2013–2023

National baseline

Satellite based mapping and monitoring of Vegetation condition across Pakistan from the irrigated Indus plains to arid Balochistan and the northern mountains.

Who uses it

Government departments, Insurers, Sugar industry, Rice industry, Allied food industry, and development programmes.

Spatial Scale
Country → Field

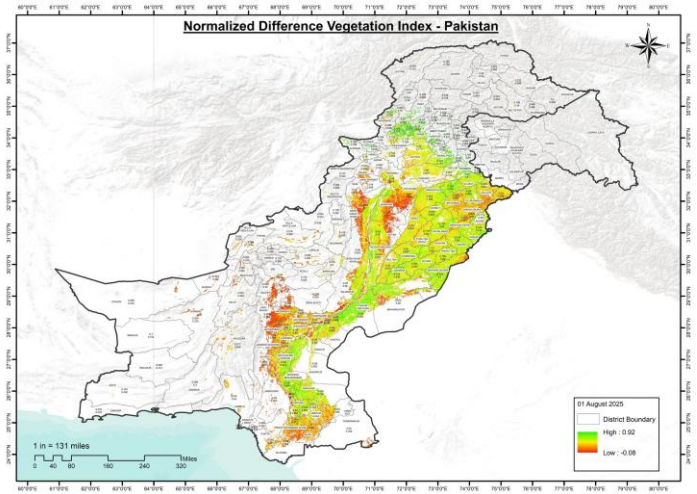
One analytics engine at every scale

Temporal Scale
Bi-Monthly

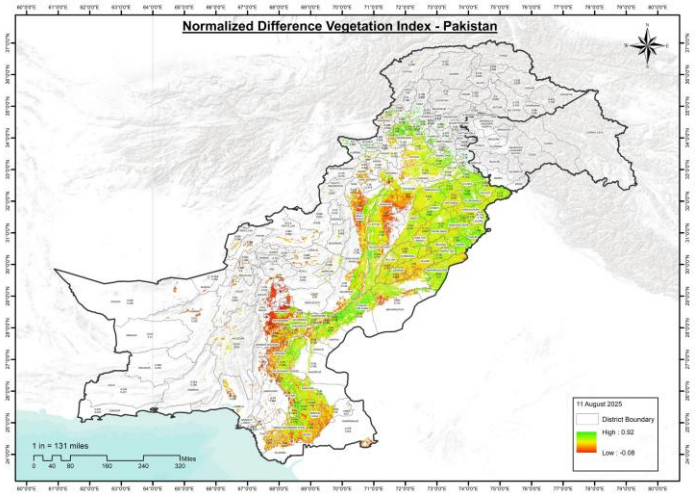
Composites for regional time series

Temporal Vegetation Vigor Monitoring at Regional Scale

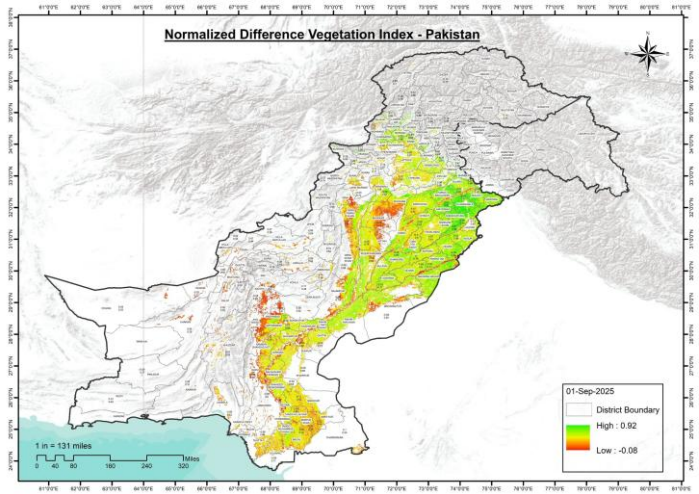
Monitor Monthly Changes in Vegetation Regularly with ESS at Regional Scale



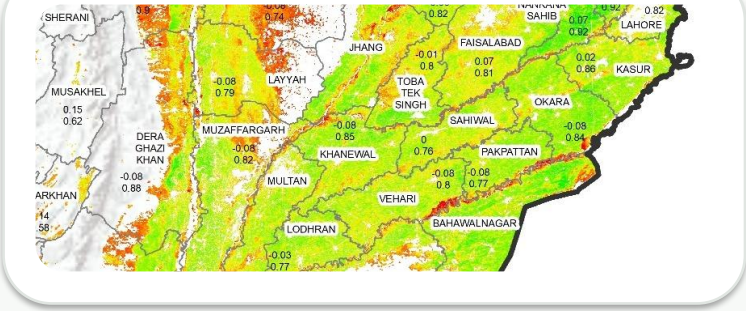
NDVI · 01 August 2025



NDVI · 11 August 2025



NDVI · 01 September 2025



Every ROI Quantified

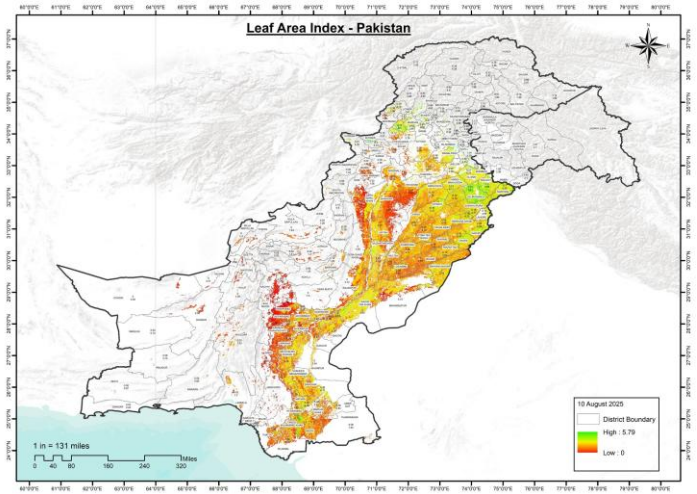
Each Region carries its own minimum and maximum NDVI, turning the national map into a ready reporting table.

Seasonal Crop Condition

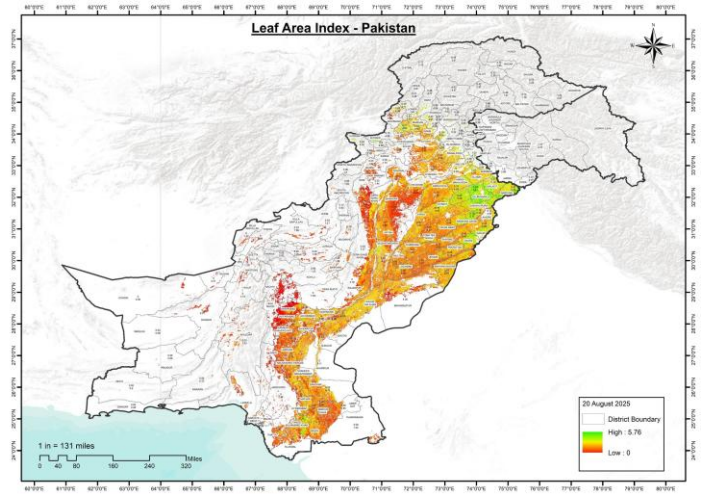
The irrigated plains of Punjab and Sindh are mapped through the season, with north-eastern Punjab strengthening into September.

Tracking Crop Establishment after Sowing at Regional Scales

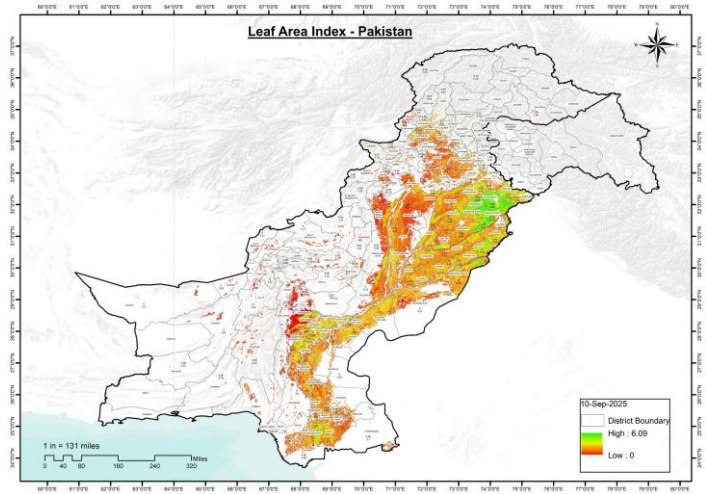
LAI measures how much leaf covers the ground, adding canopy density and biomass to the NDVI greenness signal.



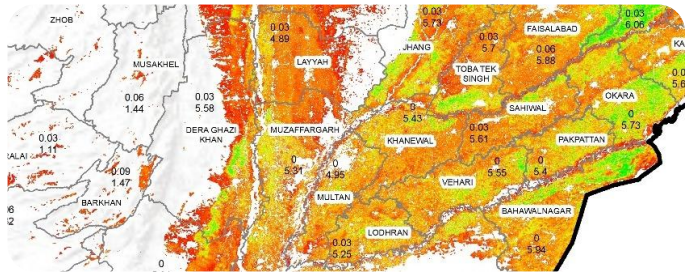
LAI · 10 August 2025



LAI · 20 August 2025



LAI · 10 September 2025



What LAI adds

Leaf area per unit of ground (m^2/m^2) stays sensitive in dense crops where NDVI levels off ideal for biomass and yield models.

5.79 → 6.09

Peak LAI on the map · 10 Aug to 10 Sep 2025

Yield & biomass

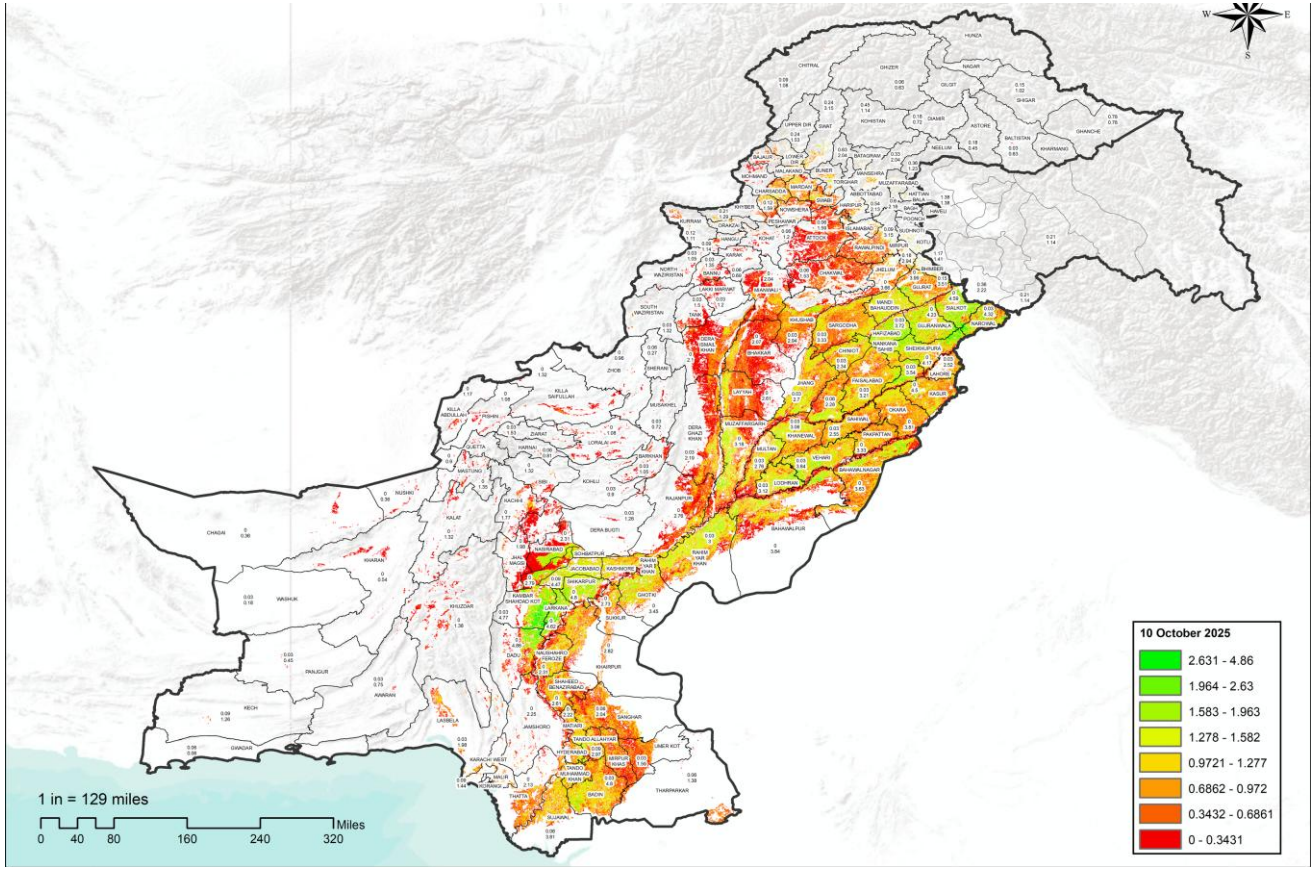
District-scale inputs for crop-growth and yield estimation

Leaf Area Index by District: 10 October 2025

Canopy density at district level extends the vegetation series past the Kharif harvest and into Rabi preparation.

Leaf area index by district

10 October 2025 · m² leaf per m² ground



0 – 4.86

District LAI range on 10 October 2025

Dense canopy remains

LAI above 2.63 persists along the central Punjab rice and cane corridor, where late-sown crops are still standing.

Harvested and cleared

Values below 0.35 across southern Punjab, Sindh and the arid west show fields cleared after the cotton and rice harvest.

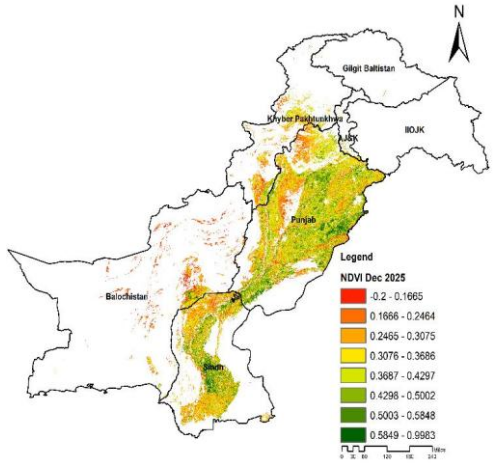
Every district quantified

Each district carries its own minimum and maximum LAI, so wheat sowing readiness can be compared district by district.

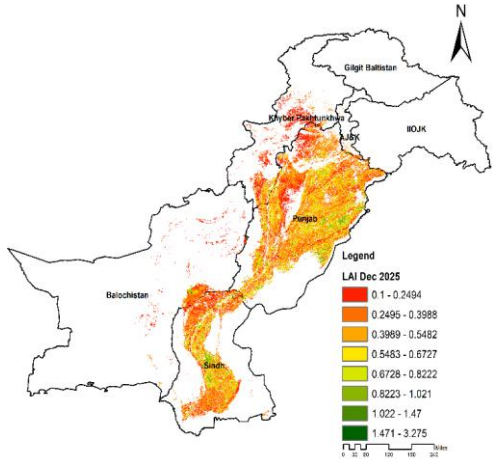
Crop Condition & Regional Summary: December 2025

NDVI and LAI confirm that December vegetation is irrigation-supported, with clear differences between provinces.

Vegetation vigour
NDVI



Canopy density
Leaf area index



REGIONAL SUMMARY · DECEMBER 2025

Province	ETa mm/mo	NDVI	Interpretation
Punjab	14–22	0.40–0.45	Early Rabi establishment under irrigation
Sindh (North)	11–18	0.42–0.48	Irrigated crops; moisture stress emerging
Sindh (South)	18–23	0.35–0.40	High evaporative demand, sparse vegetation
Khyber Pakhtunkhwa	8–15	0.28–0.33	Mixed crop emergence; cooler, lower ETa
Balochistan	0.3–5	0.20–0.25	Very low activity; cold and arid

What the maps show

High NDVI (0.45–0.80) and moderate LAI (1.5–3.0) in irrigated Punjab and parts of Sindh, **reflecting early wheat, fodder and standing sugarcane**. Moderate values in the KP plains; low NDVI (≤0.20) and LAI (<0.5) in Balochistan and Gilgit-Baltistan.

PRIORITY ACTIONS

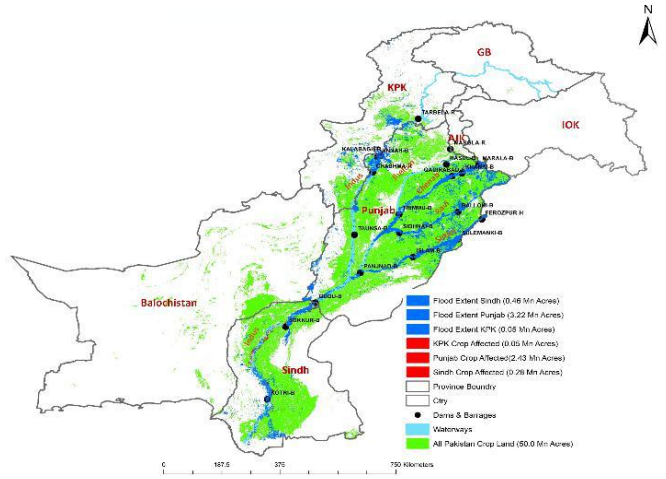
- Align canal releases with NDVI–ETa signals to protect wheat germination zones.
- Protect early wheat zones as food-security assets over the next 4–6 weeks.
- Apply region-specific responses for irrigated Punjab, stressed Sindh and arid Balochistan.

Weather Intelligence for Crop Monitoring

Monsoon withdrawal, the 2025 floods and above-normal temperatures set the conditions for the Kharif harvest and Rabi preparation.

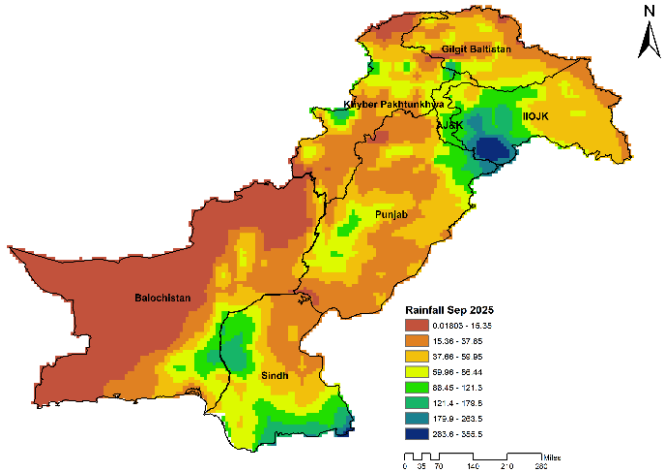
Flood extent

August–September 2025 · 3.73 Mn acres inundated



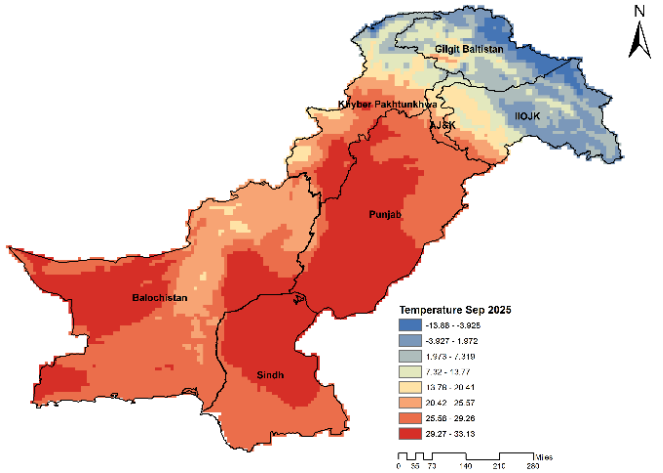
Rainfall

September 2025 · mm



Average temperature

September 2025 · °C



Example of Weather & Vegetation Monitoring at Kharif Maturity

KEY OBSERVATIONS · AUGUST TO SEPTEMBER 2025

Rainfall	Temperature	ETa	NDVI	Soil moisture
30–50% below normal in Sindh and Balochistan, near-normal in Punjab	+2.5 °C above average across southern Pakistan	70–240 mm/month, highest in irrigated Punjab	Declined from 0.82 → 0.68, signalling crop maturation	Falling in Sindh, moderate retention in northern zones

Integrated Insights

Five ways decision makers use this information and what the transition into the Next Cropping (Rabi / Kharif / Autumn / Spring) season will need

01

Crop Monitoring

Combine NDVI and ETa to identify zones with excessive or insufficient irrigation.

02

Water Management

ETa maps guide real-time water allocation and canal scheduling.

03

Yield Forecasting

Integrate NDVI and LAI with weather data for early yield estimates in major crops.

04

Credit & Insurance

ETa and NDVI trends give objective indicators for loss assessment and credit risk profiling.

05

Research & Innovation

Time-series NDVI, LAI and ETa correlations refine regional crop models and estimate water productivity.

EXAMPLE: OUTLOOK FOR OCTOBER 2025 BASED ON THE MAPS SHOWED EARLIER

The season turns: Kharif clears and Rabi establishment begins.

Transition to Rabi

The Rabi season is expected to take over in late October as the Kharif harvest completes.

Harvest signature

Declining ETa and NDVI will mark crop harvest and field clearance across the plains.

Next Month Analysis Be:

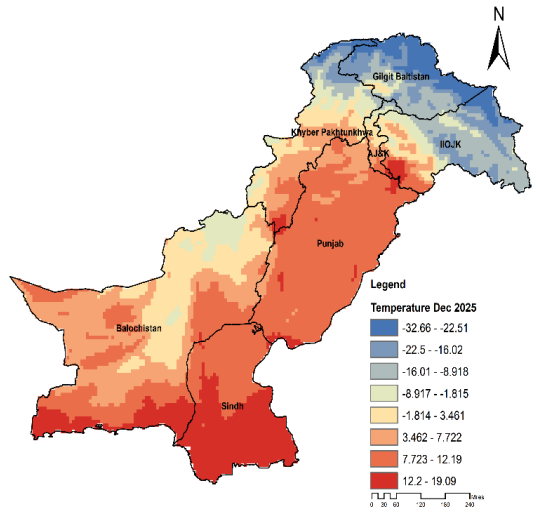
Focused on soil moisture recovery, early wheat sowing zones and irrigation readiness.

Weather & Water Analytics at Regional Scales

Monthly national monitoring of temperature, rainfall and actual evapotranspiration helps policymakers and industries to act as per situation throughout the season.

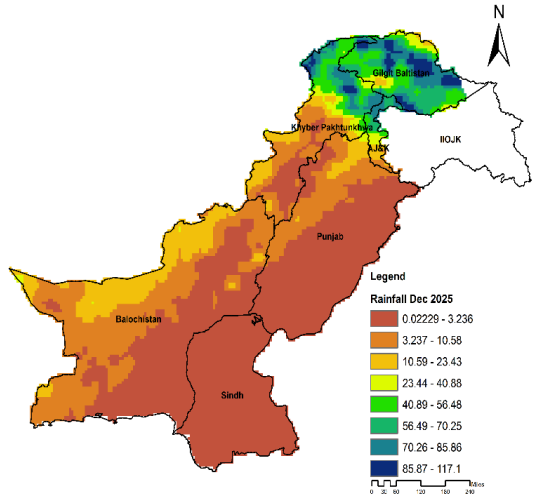
Average temperature

December 2025 · °C



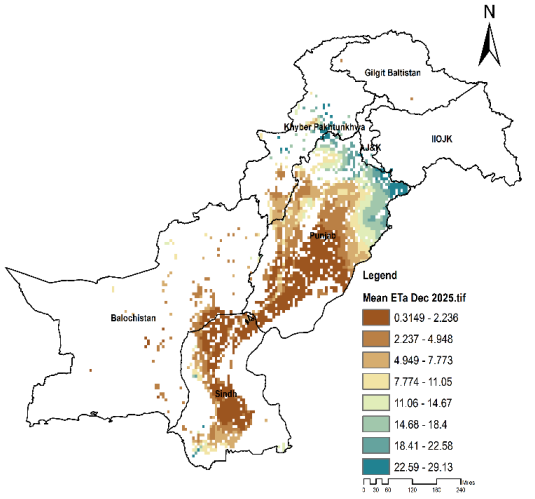
Rainfall

December 2025 · mm



Actual evapotranspiration (ETa)

December 2025 · mm/month



Cold and dry across the plains

Below-normal rainfall nationwide. Cooler temperatures favour wheat emergence in Punjab and KP, with frost risk in the north.

Irrigation drives every crop zone

Negligible rain in the plains makes canal and groundwater supply the main driver of Rabi growth.

ETa confirms the Rabi transition

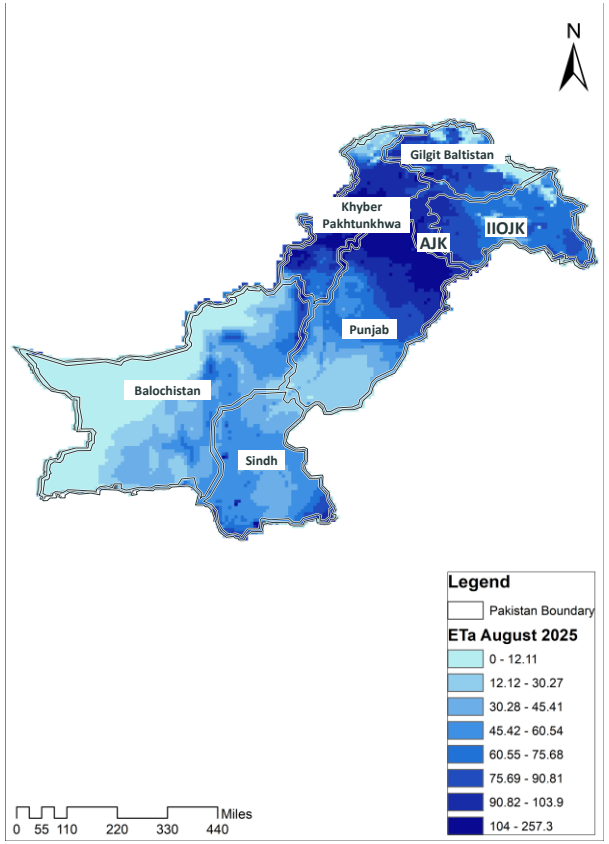
ETa of 0.3–29 mm/month: moderate (11–22) in Punjab and KP wheat belts, very low (<8) in Balochistan.

Crop Water Use At Regional Scales

Tracking how much water is used by crops, where they use it, and how it translates into crop performance

Mean actual evapotranspiration

August 2025 · mm/month



REGIONAL SUMMARY · AUGUST TO SEPTEMBER 2025

Province	ETa mm/mo	NDVI	LAI	Interpretation
Punjab	180–220	0.70–0.85	3.0–4.0	High crop vigour; adequate irrigation; good yield prospects
Sindh (North)	150–200	0.60–0.75	2.5–3.5	Strong monsoon support; cotton in flowering to boll stage
Sindh (South)	90–140	0.40–0.60	1.5–2.5	Moderate vegetation; moisture stress increasing
Khyber Pakhtunkhwa	120–160	0.50–0.70	2.0–3.0	Stable growth; good rainfall response
Balochistan	50–100	0.20–0.40	0.5–1.5	Dry conditions; limited vegetation activity

70–240 mm
ETa range across Pakistan, per month

0.83
ETa to NDVI correlation in Punjab

0.82 → 0.68
National NDVI decline through September

DECISION SUPPORT

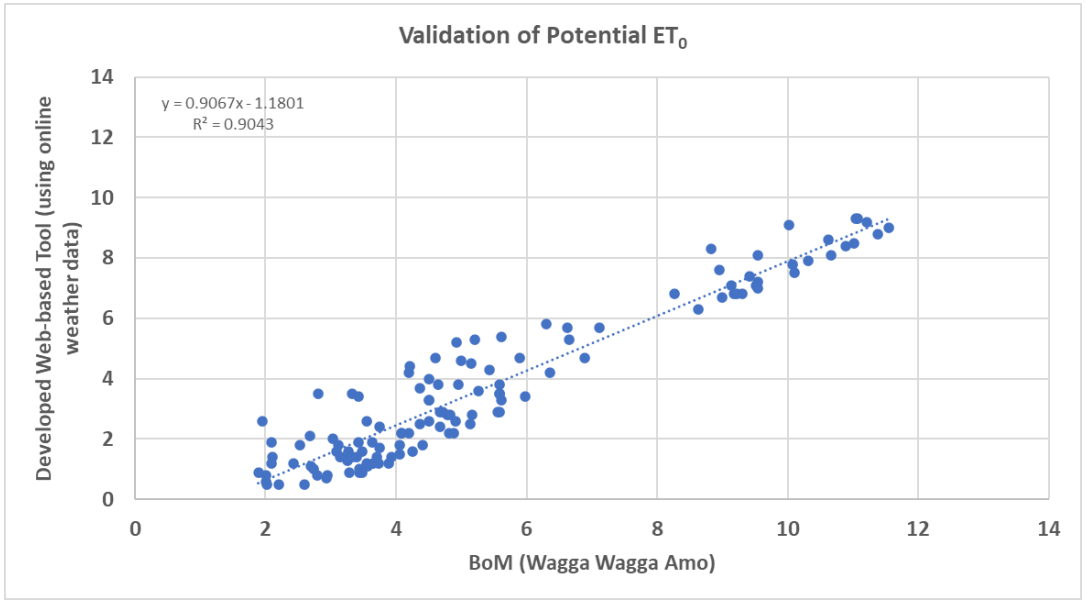
Irrigation authorities
Prioritize canal rotation in high-ETa command areas.

Farmers & extension
Match irrigation scheduling to ETa and conserve late-season moisture.

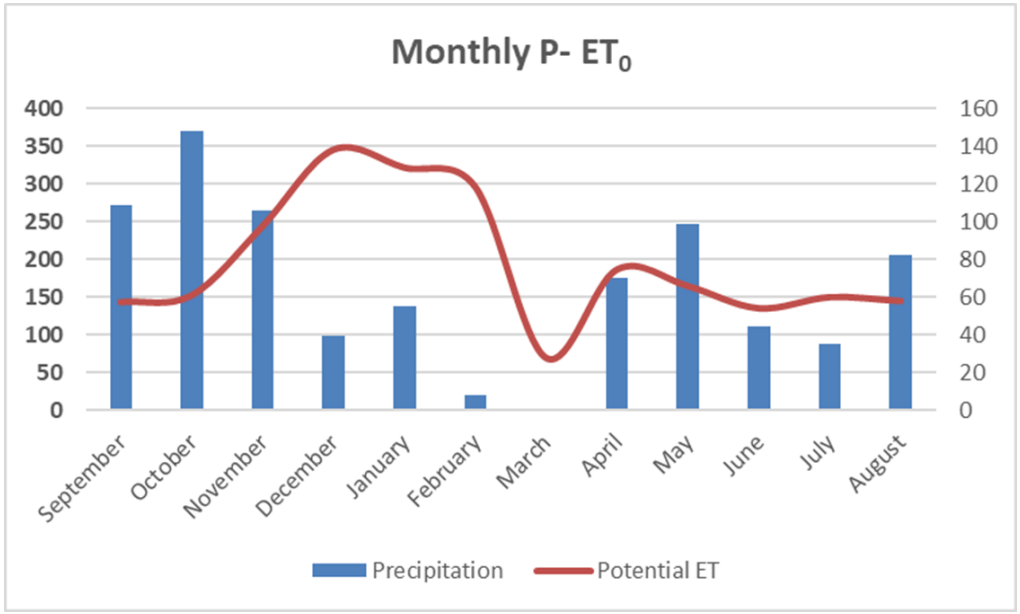
Water policy planners
Use the ETa to rainfall balance to refine provincial allocations.

Validation of Weather Intelligence against Ground Stations

Potential evapotranspiration from the ESS weather tool closely tracks Bureau of Meteorology station data at Wagga Wagga, Australia.



ESS tool vs Wagga Wagga station · potential ET_o



Monthly precipitation and potential ET_o

$R^2 = 0.90$

Agreement with station data

0.91

Regression slope

Utility for growers

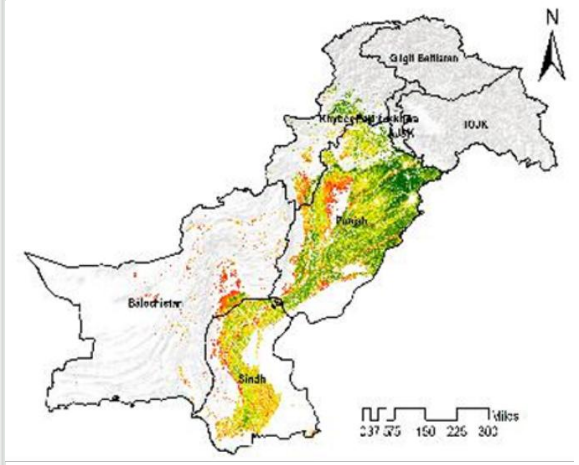
Monthly rainfall set against potential evapotranspiration shows when conditions are conducive for crop growth and when irrigation is required. This saves waste of water and crop

Monitoring Crop Vigour/establishment Status at Regional Scales

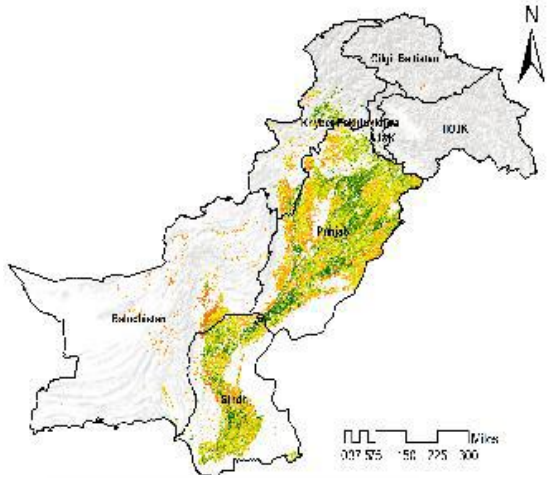
Tracking changes in crop vigour to identify spatial and seasonal differences in potential nitrogen status

NDVI

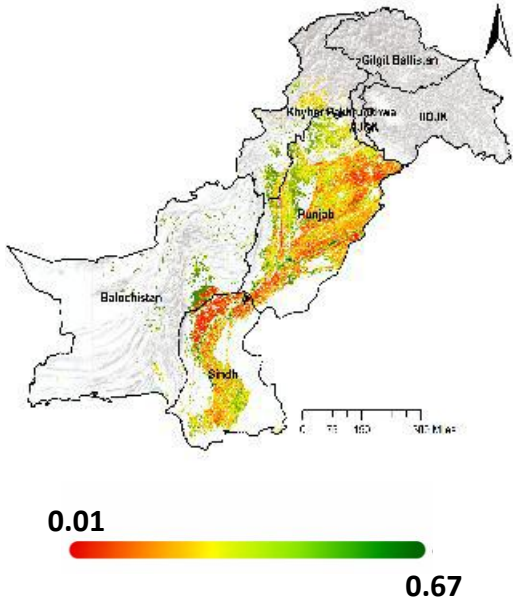
Sep
2025



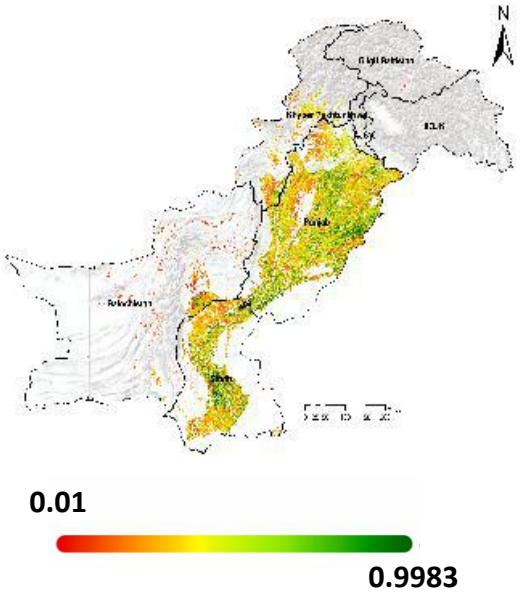
Oct
2025



Nov
2025



Dec
2025



Monitoring Germination & Early Establishment of Rabi Crops

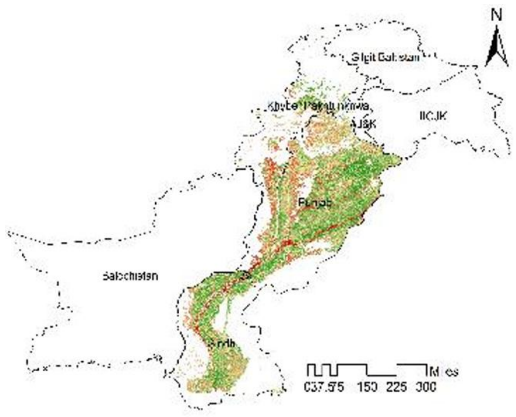
Clear recovery in irrigated Punjab and KP from early wheat sowing; weak in Sindh and Balochistan.
Early growth of Wheat crop is strong in Punjab and the KP plains, while Sindh and arid regions lag under moisture stress

Monitoring Crop Nitrogen Status at Regional Scales

Tracking changes in canopy chlorophyll and crop vigour to identify spatial and seasonal differences in potential nitrogen status

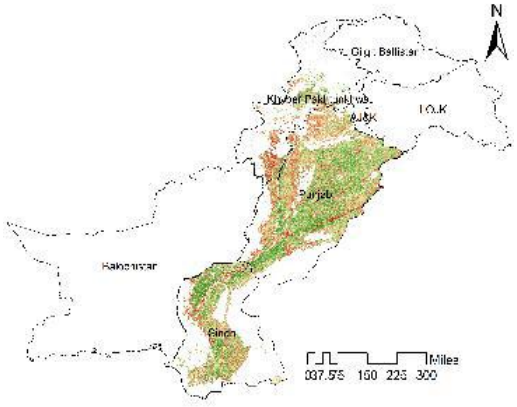
NDRE

Sep
2025



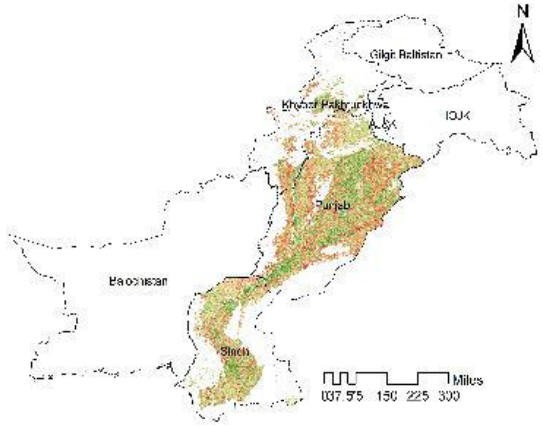
0.01 — 0.63

Oct
2025



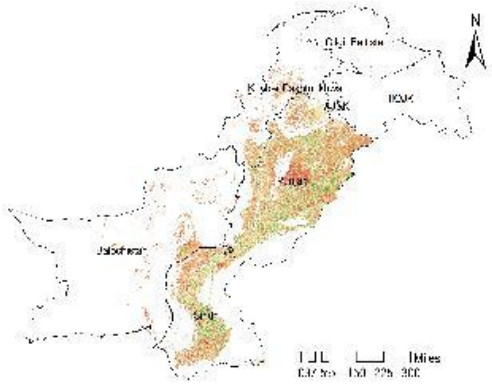
0.01 — 0.64

Nov
2025



0.43 — 0.57

Dec
2025



0.01 — 0.653

Fertilizer demand grows with wheat emergence; timely basal application is critical in the coming weeks

Emerging Nutrient Demand

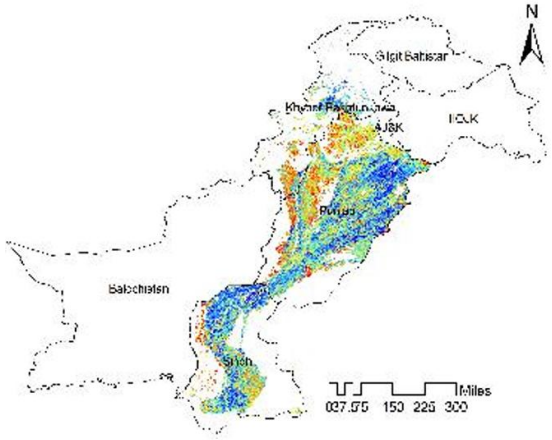
As the crop establishes and canopy develops, NDRE helps identify areas of differing crop vigour and potential nitrogen response, supporting more targeted field assessment and nutrient management.

Monitoring Crop Water Status at Regional Scales

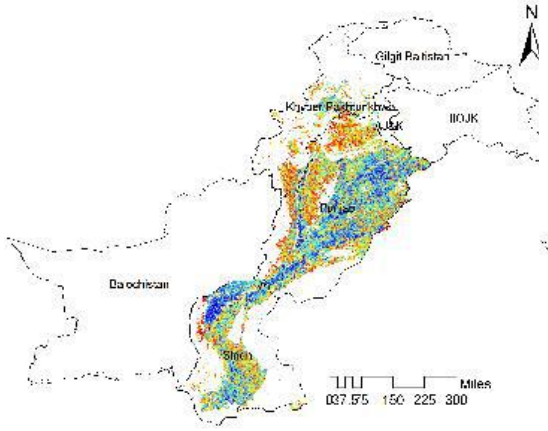
Tracking seasonal changes in vegetation moisture to identify emerging water stress and support timely irrigation decisions.

NDMI

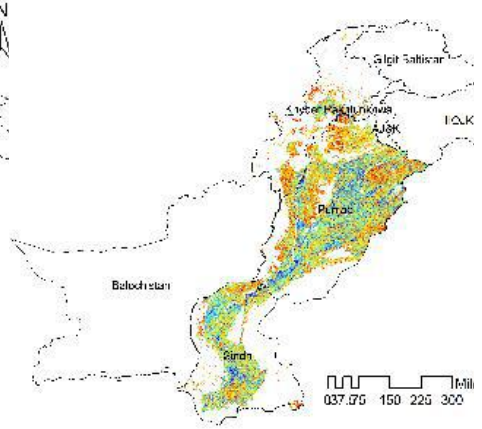
Sep
2025



Oct
2025



Nov
2025



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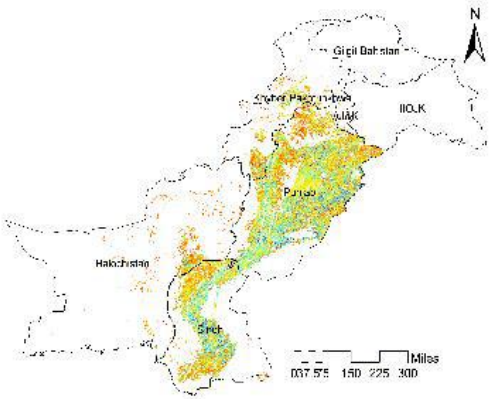


Seasonal Moisture Decline

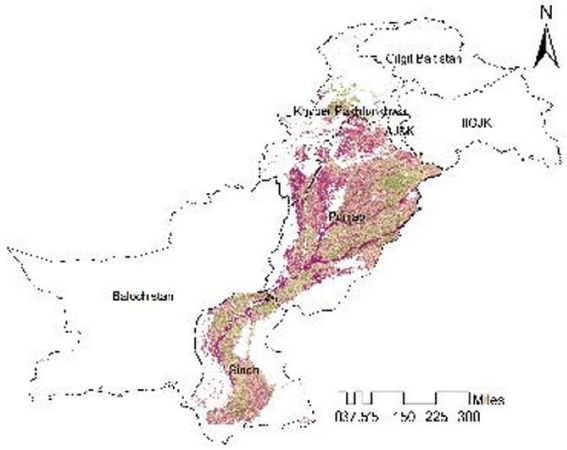
Declining NDMI indicates reduced vegetation moisture as residual monsoon influence recedes, helping identify areas where crop water stress may be emerging and irrigation becomes increasingly important.

Monitoring Crop Growth at Regional Scales

Tracking canopy chlorophyll and photosynthetic activity to follow crop establishment, growth and changing crop performance through the season.

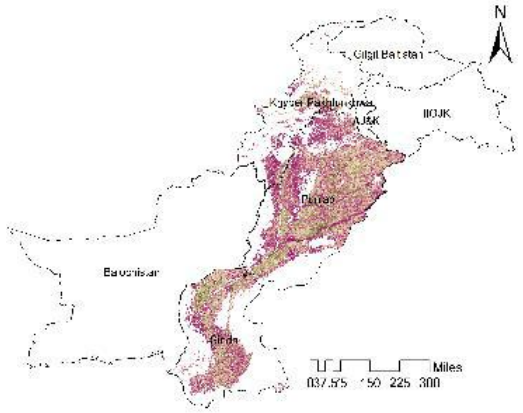
RECI

Sep
2025



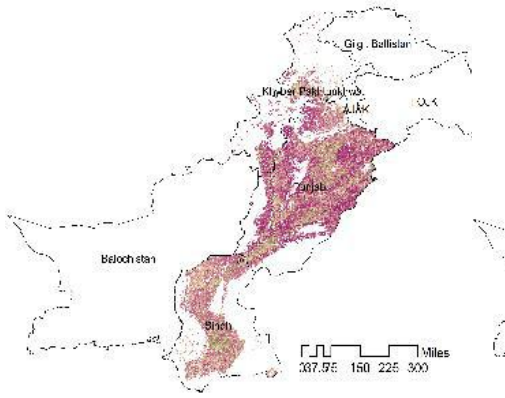
0.01 — 3.04

Oct
2025



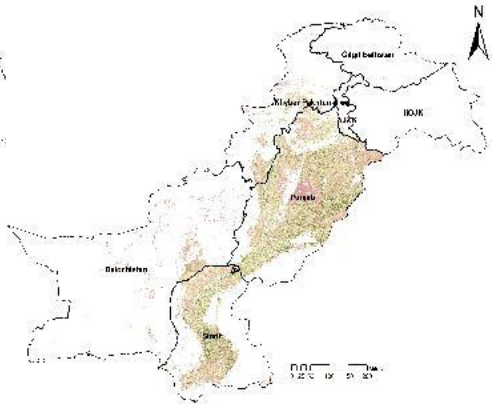
0.01 — 3.56

Nov
2025



0.01 — 2.709

Dec
2025



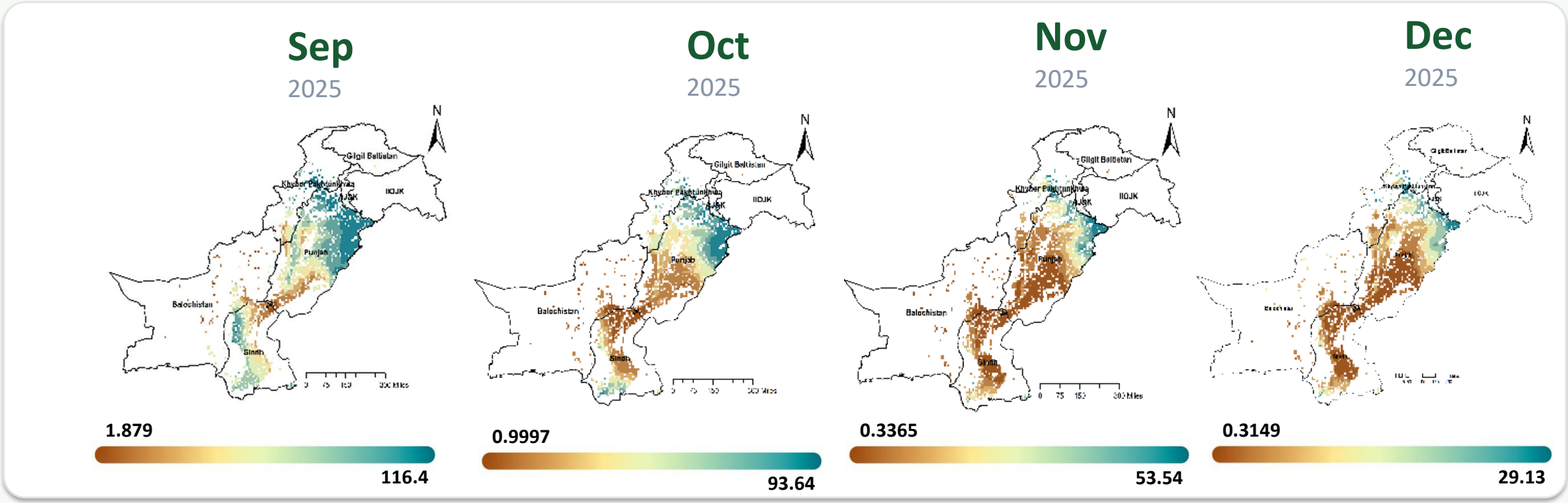
0.01 — 3.763

Crop Growth & Photosynthetic Activity

Changes in RECI reflect the development of chlorophyll rich canopy as crops establish and grow, helping identify areas of stronger growth, delayed development and potential crop stress.

Monitoring Crop Water Requirement at Regional Scales

Tracking how crop water demand changes with weather, crop development and location to support timely and efficient irrigation planning.



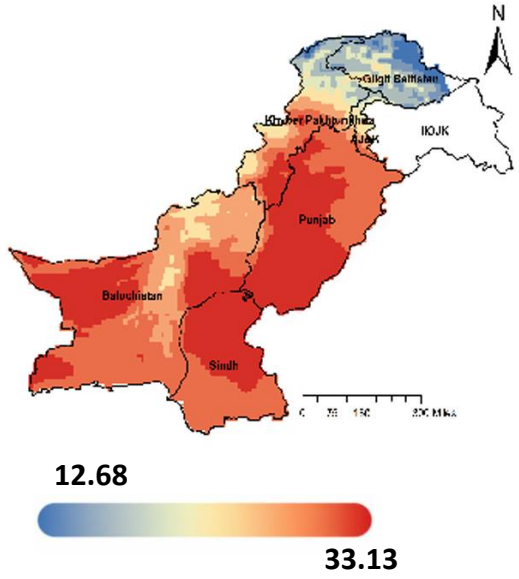
Water Demand Changes Through the Season

Crop water requirement varies with crop growth stage and atmospheric demand. Monitoring these changes helps identify when and where irrigation becomes critical, supporting better irrigation scheduling and water allocation.

Monitoring Temperature Conditions at Regional Scales

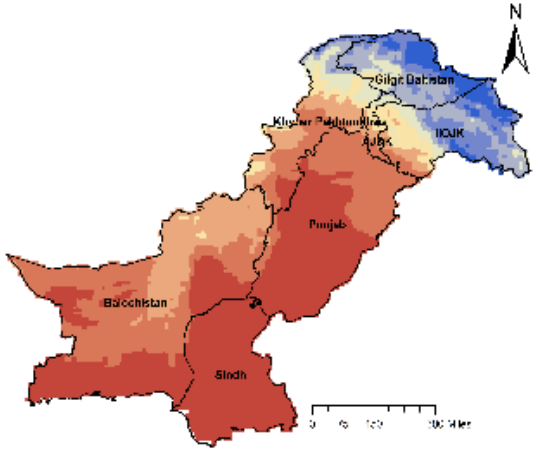
Tracking seasonal temperature patterns to understand their influence on crop establishment, development and temperature related risk.

Sep
2025



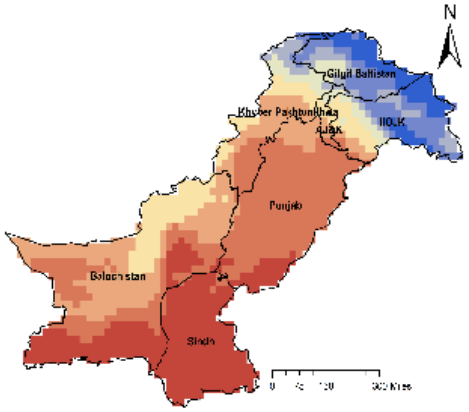
12.68 — 33.13

Oct
2025



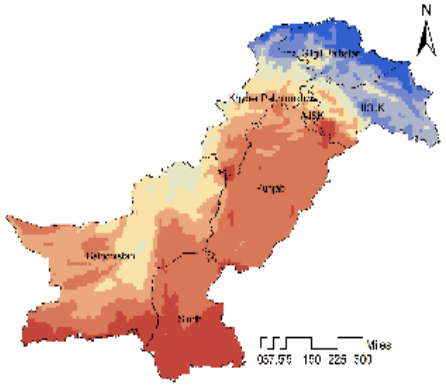
-23.65 — 29.97

Nov
2025



-27.35 — 25.36

Dec
2025



-32.66 — 19.09

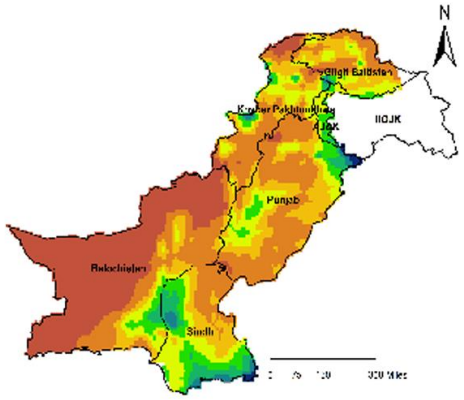
Temperature Shapes Crop Development

Cooling conditions through the Rabi season influence crop establishment and development, while spatial temperature differences help identify areas potentially exposed to heat or cold stress. For wheat, monitoring temperature alongside crop phenology helps assess whether conditions are favourable for establishment and subsequent growth stages.

Monitoring Rainfall & Crop Water Supply at Regional Scales

Tracking when and where rainfall contributes to crop water availability and where irrigation dependence is likely to increase.

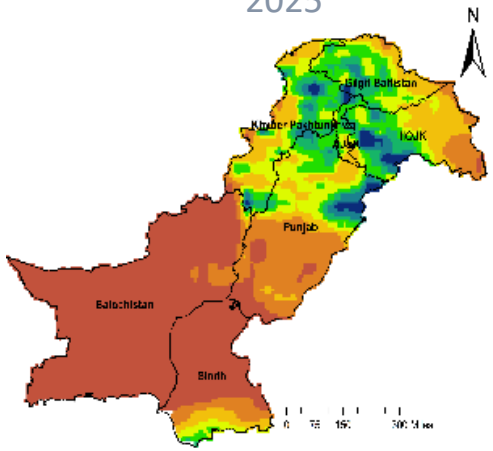
Sep
2025



0.0227

318.9

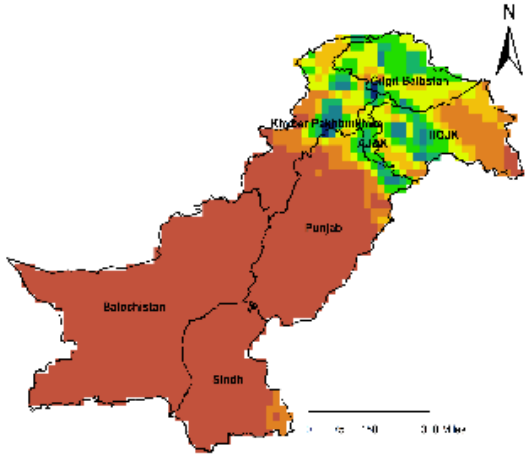
Oct
2025



0.02962

120.1

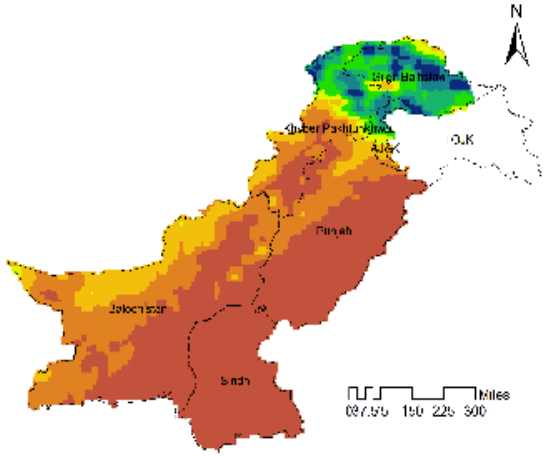
Nov
2025



0

1.291

Dec
2025



0.02228

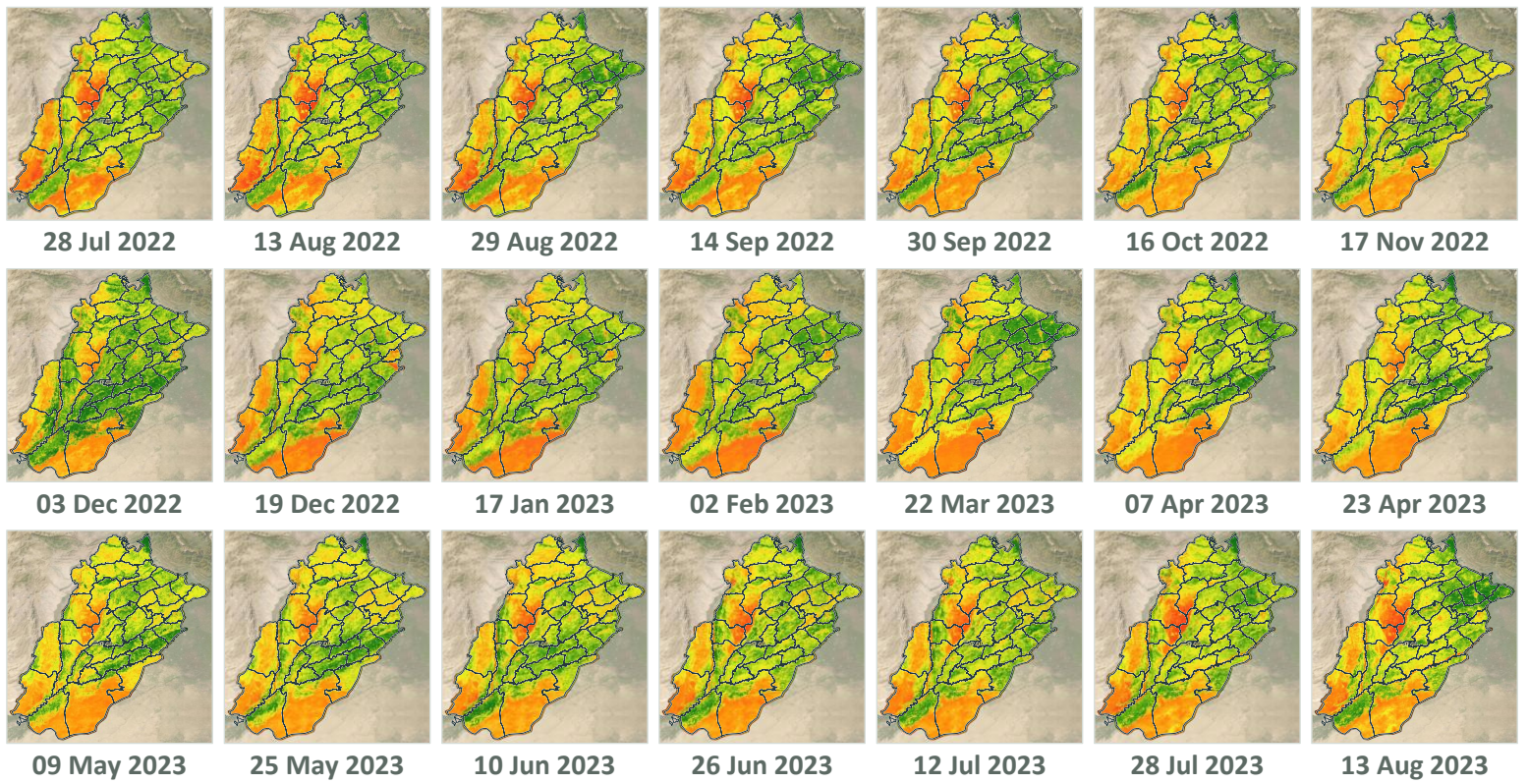
117.1

Rainfall Support Varies Across the Region

Combining rainfall with crop water requirement and crop moisture indicators helps identify where supplementary irrigation is most critical. Seasonal rainfall is unevenly distributed, providing greater moisture support in some areas while leaving major cropping zones increasingly dependent on irrigation.

Tracking the Crop Season as It Unfolds

Continuous year-round monitoring tracks crop establishment, growth, peak performance and seasonal transition across complete Kharif and Rabi cycles.



Follow the Season

Repeated observations reveal crop establishment, canopy development, peak growth and seasonal decline across the agricultural landscape.

Detect Change & Anomalies

Comparing each observation through time highlights areas developing differently from expected seasonal patterns and helps identify where closer assessment is needed.

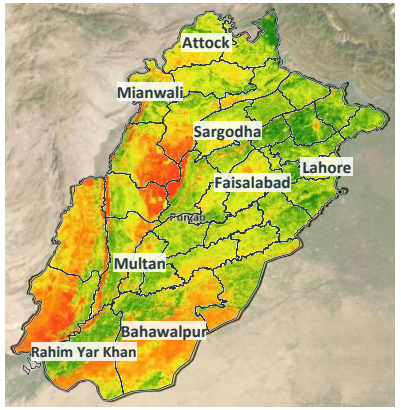
Build Production Intelligence

Seasonal vegetation trajectories, combined with crop area, phenology, weather and historical performance, provide evidence for crop condition assessment and later yield and production estimatio

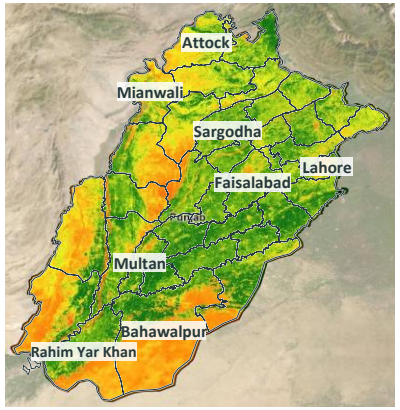
Crop Intelligence for Critical Seasonal Windows

Selected seasonal windows reveal crop establishment, peak performance, harvest transition and year on year change across the production landscape.

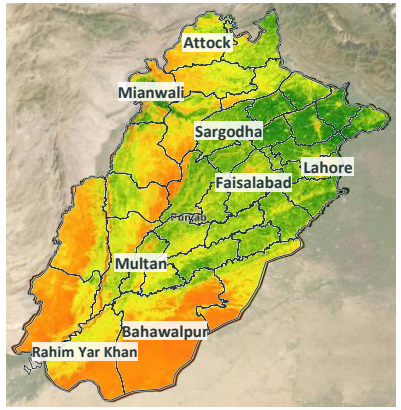
Combined VI



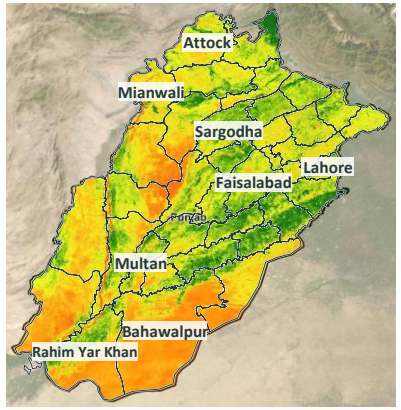
13 Aug 2022 · Kharif Dev.



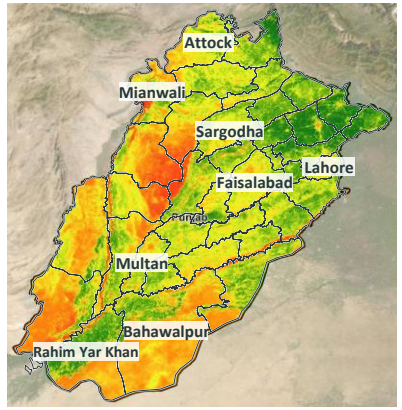
03 Dec 2022 · Rabi Est.



22 Mar 2023 · Rabi peak



09 May 2023 · Harvest Transition



13 Aug 2023 · Kharif Comparison

Low −1 — High +1

The Thal and Cholistan deserts and the main river channels stay low all year, separating genuine crop change from background conditions.

Crop Establishment

Identify where the season is establishing normally and where crop development may be delayed or weaker than expected.

Peak Performance

Assess crop vigour at critical growth stages and compare performance across districts, production zones and seasons.

Harvest & Year on Year Change

Track seasonal decline towards harvest and compare equivalent seasonal windows to identify changes in crop performance between years.

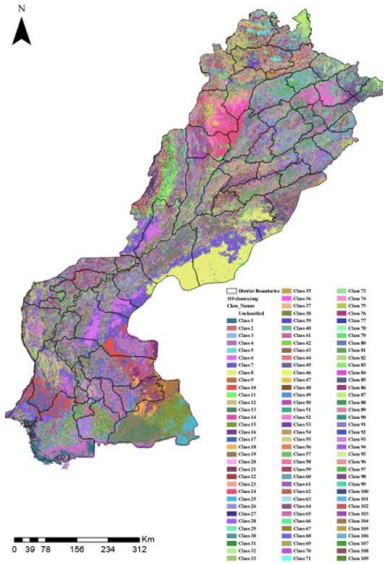
REGIONAL INTELLIGENCE

Region-Level Mapping & Monitoring of Sugarcane

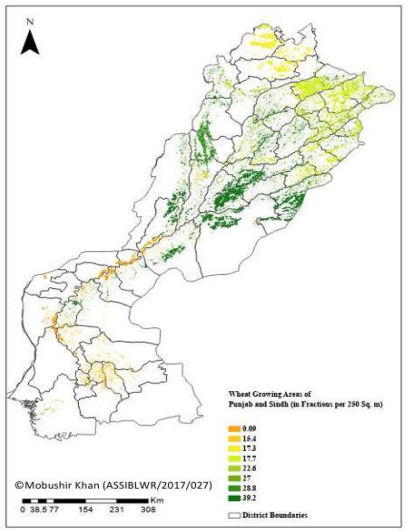
Regional Level satellite monitoring of sugarcane areas which is an excellent information for sugarcane industry that helps in identifying areas where sugarcane is getting ready for harvesting besides tracking health of sugarcane crops.

Mapping Sugarcane within the Complete Cropping Landscape

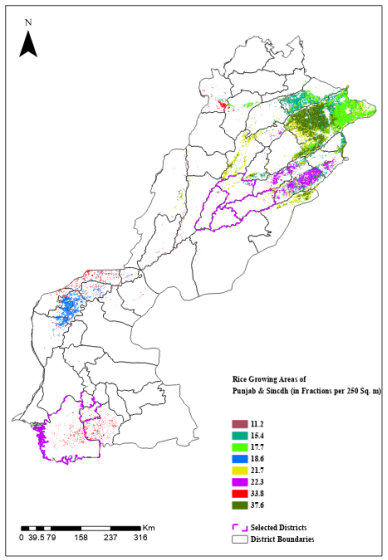
Multi-Crop Classification Distinguish sugarcane from other crops for reliable picture of where sugarcane is actually grown across Sindh and Punjab



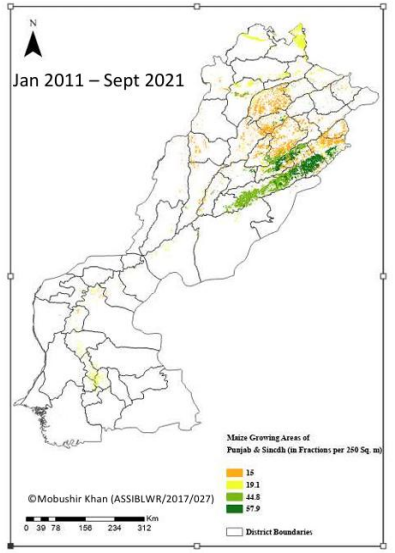
Complete Agri-Landscape



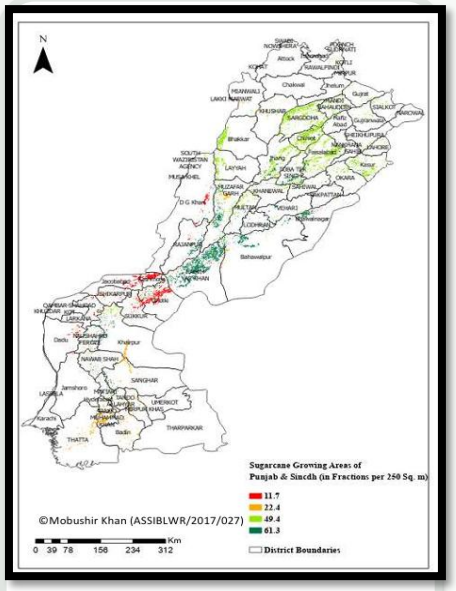
Wheat
Punjab and Sindh



Rice
Punjab and Sindh



Maize
Punjab and Sindh



Sugarcane
Punjab and Sindh

110 Distinct
Land cover and cropping patterns identified

20,676,008 acres
Wheat area mapped

8,636,000 acres
Validated for Punjab and parts of Sindh

3,370,400 acres
Maize area mapped

2,303,878 acres
Sugarcane area mapped

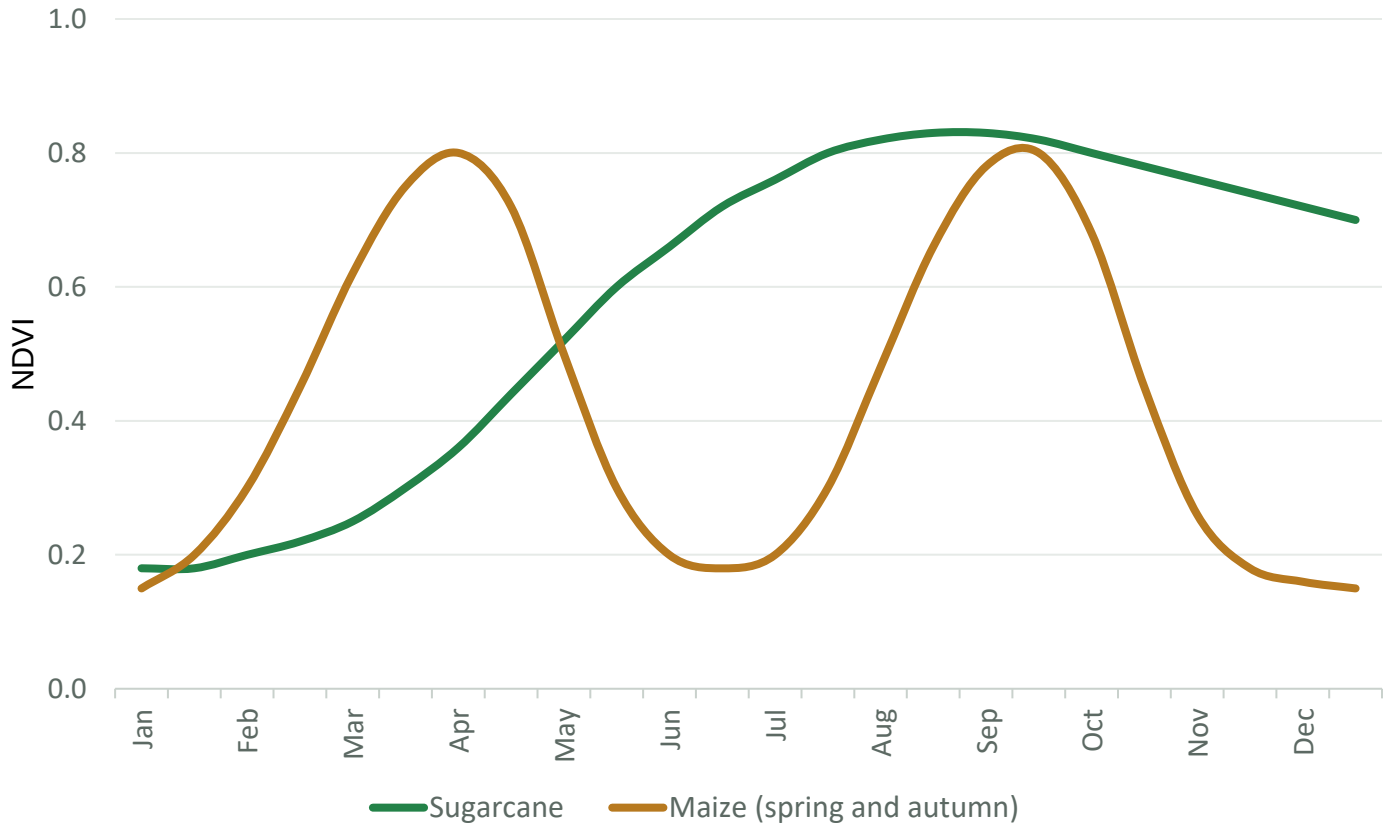
Sugarcane does not exist in isolation. ESS maps the wider cropping landscape first, allowing sugarcane to be distinguished from maize, rice, wheat and other vegetation classes rather than treating all green agricultural areas as cane.

The Time Signature that Separates Crops

Following each field through the year reveals sugarcane's long, continuous canopy against maize's short seasonal peaks.

Typical NDVI through the year

Schematic crop calendar for Punjab, for explanation only, not measured data



Season length

Sugarcane stays green for most of the year; maize rises and falls within about four months.

Timing of peaks

Maize peaks and is harvested while sugarcane is still building its canopy.

Ratoon regrowth

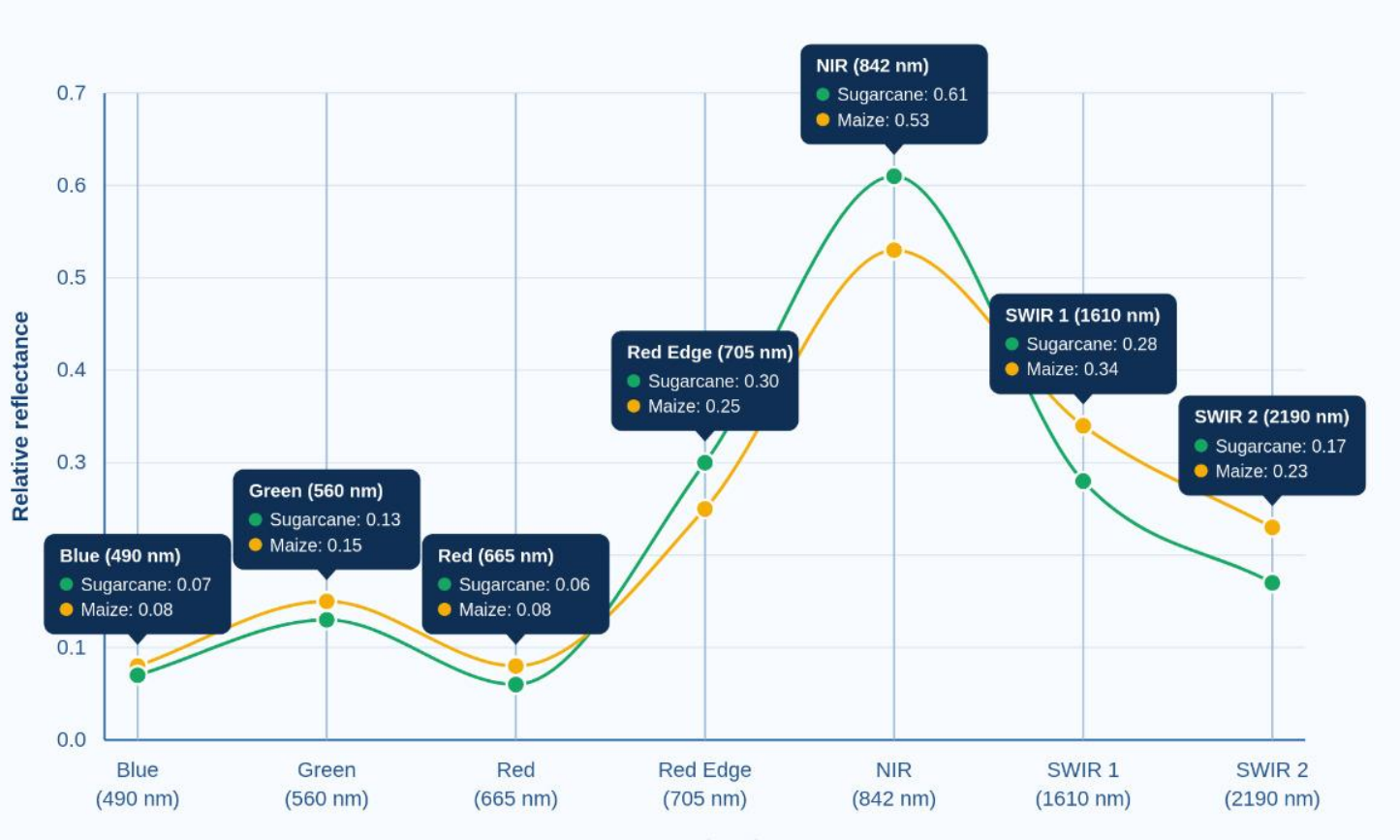
After cutting, sugarcane regrows from the same stubble without replanting, a pattern maize never shows.

Typical Spectral Response Across Key Bands

Conceptual spectral profile for explanation only, not measured reflectance data.

Typical NDVI through the year

Schematic crop calendar for Punjab, for explanation only, not measured data



Canopy Structure

NIR response captures differences in canopy density and leaf structure.

Chlorophyll Sensitivity

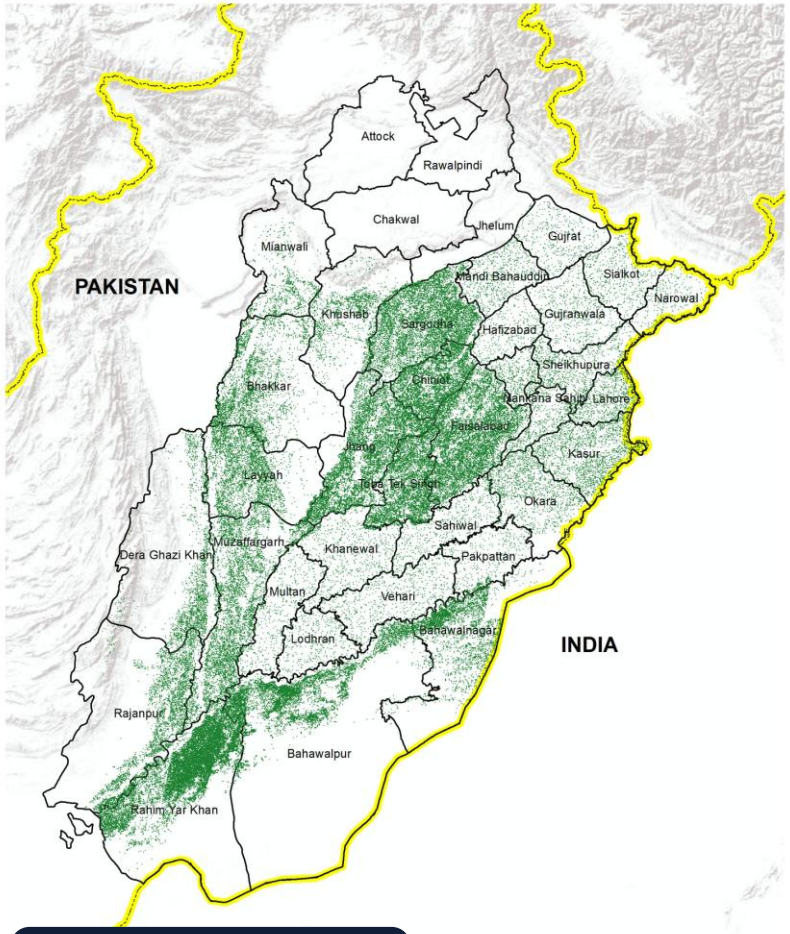
Red and Red Edge responses add information on chlorophyll and canopy development.

Canopy Moisture

SWIR response adds sensitivity to vegetation water content and moisture differences.

Sugarcane Area Mapping: Punjab 2025

Satellite classification validated with field samples maps every sugarcane field across the province's districts.



Sugarcane area · June 2025

2,303,878 acres
Sugarcane area mapped in Punjab

≈ 932,300 ha
Equivalent area in hectares

70 field samples
52 for classification · 18 for validation

Where sugarcane is grown

The crop concentrates in the Rahim Yar Khan belt, the Jhang, Toba Tek Singh, Faisalabad corridor, Sargodha and Chiniot, and along the Thal edge in Bhakkar and Layyah.

Field-validated classification

Ground samples train the classifier and a separate validation set checks it, so area figures stand up to scrutiny.

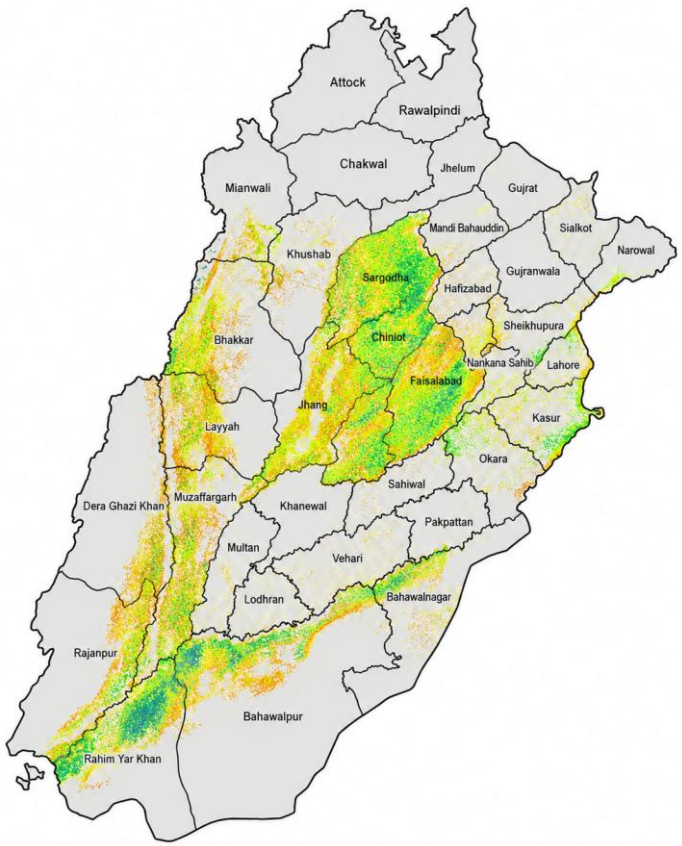
Built for the sugar industry

District acreage supports mill command-area planning, cane supply forecasts and crushing-season logistics.

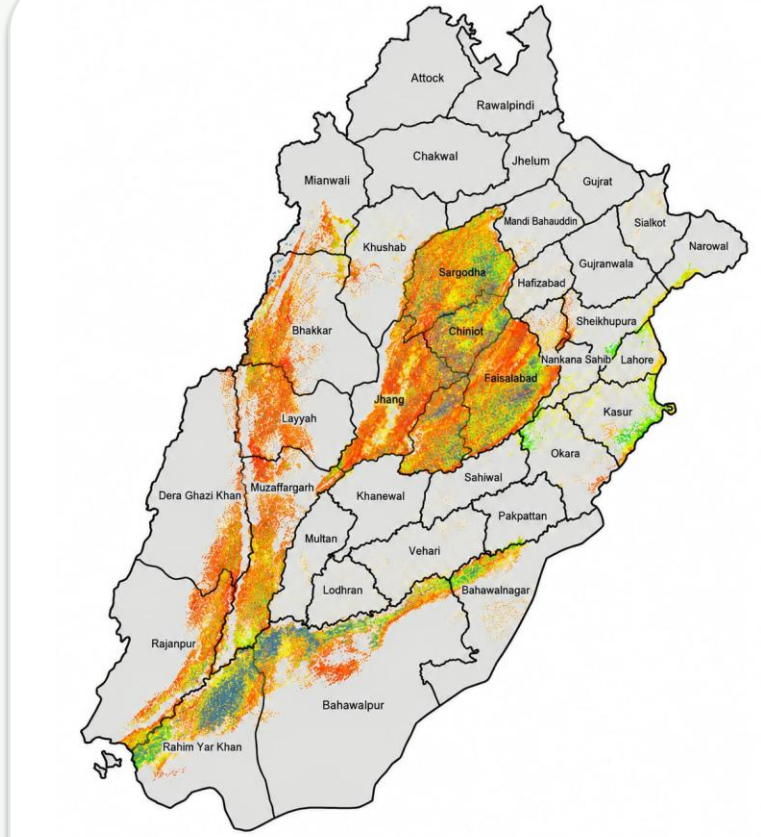
Where Sugarcane Grows, Mapped Against How It Performs

EARTH SCAN SYSTEMS

The 2025 sugarcane layer concentrates in central Punjab across Sargodha, Faisalabad and Jhang and in the southern Rahim Yar Khan belt, and overlaying it on district NDVI and LAI gives mills and planners per-district minimum and maximum values they can track from Rabi through the wheat harvest into early summer.



NDVI · May 2025



LAI · May 2025

NDVI −0.08 0.94 LAI 0 5.07

Sugarcane 2025 layer

Mapped cane fields concentrate in central Punjab Sargodha, Faisalabad, Jhang and the southern Rahim Yar Khan belt.

District statistics

Minimum and maximum NDVI and LAI for every district let mills and planners compare cane-growing districts.

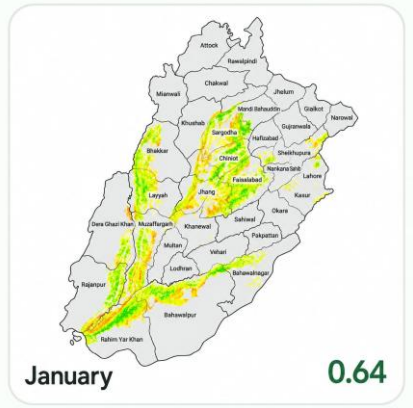
Season-long tracking

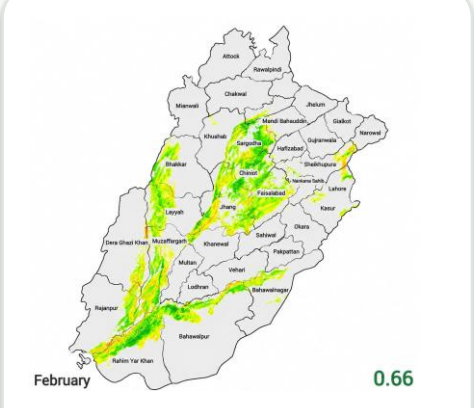
Monthly maps follow the cane districts from the Rabi season through the wheat harvest into early summer.

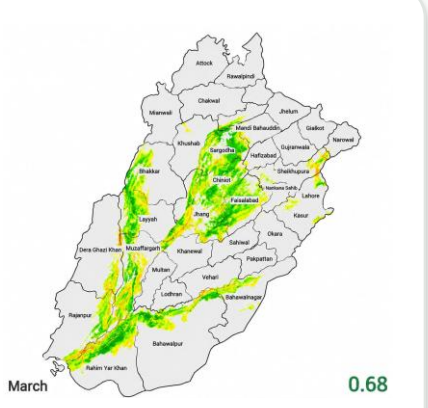
Industry gets this information twice a month

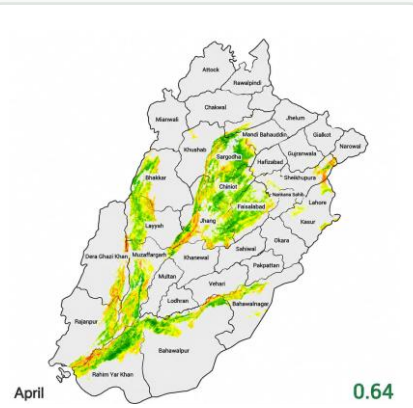
Tracking the Sugarcane Throughout the Season : Example 2025

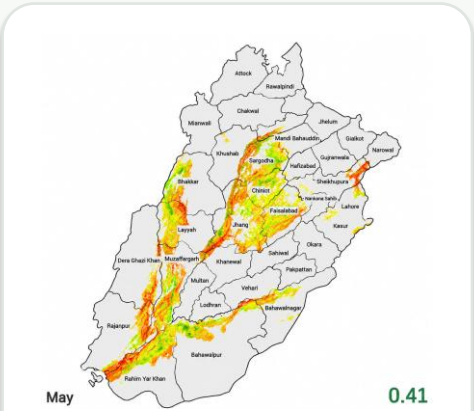
NDVI rises through the growth phase, peaks in March, and falls to 0.41 by May, A full season of crop vigor captured in six satellite passes.

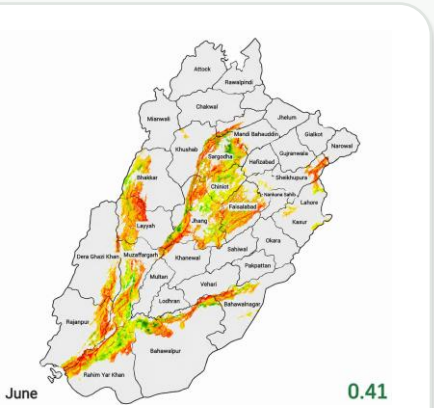






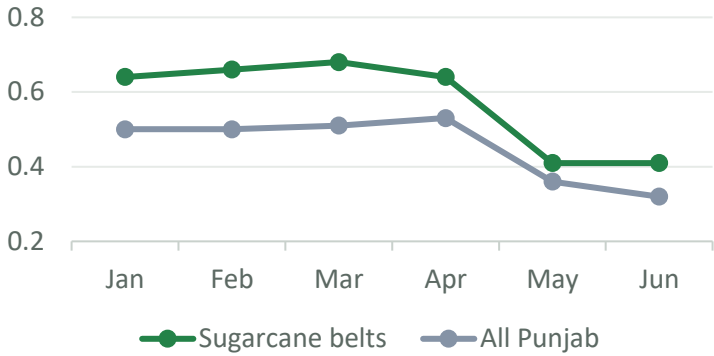






NDVI · low -0.08 to high 0.94

SUGARCANE BELTS vs ALL PUNJAB



REMARKS

Greener than Punjab every month

Sugarcane belts average 0.64 to 0.68 from January to April, against 0.50 to 0.53 for Punjab overall.

Highest in March, lowest in May

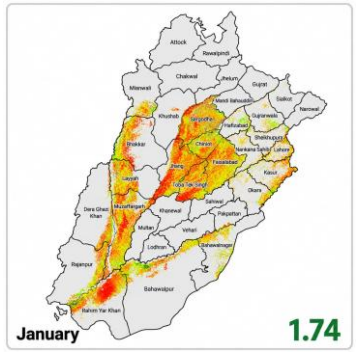
Belt NDVI peaks at 0.68 in March and falls to 0.41 by May.

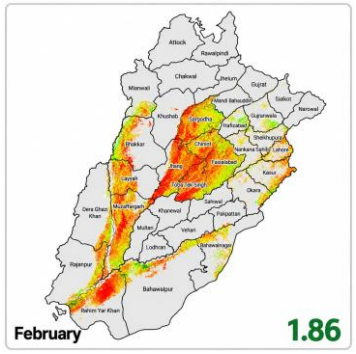
Where crop is near harvest and where crop is under vegetative growth

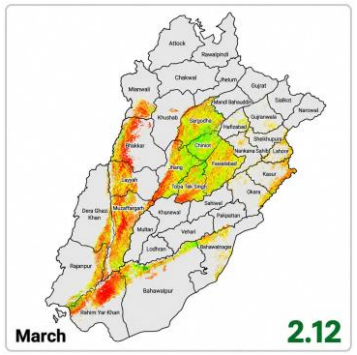
Sugarcane Canopy Peaks in March, Then Rebuilds by June

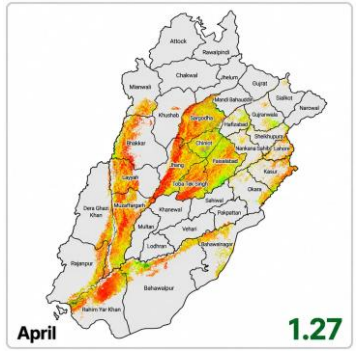
EARTH SCAN SYSTEMS

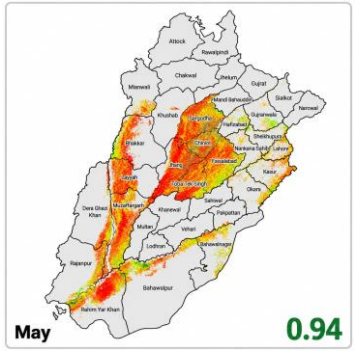
Leaf area in the mapped belts climbs to 2.12 in March against 1.59 for Punjab overall, falls to 0.94 by May, and recovers to 1.38 in June as the southern belts regrow faster than the north.

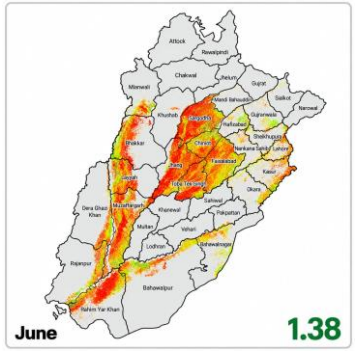






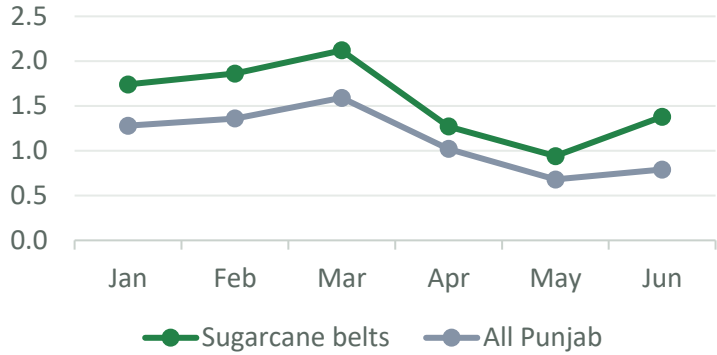






LAI · low 0 to high about 5.5

SUGARCANE BELTS vs ALL PUNJAB



REMARKS

Densest canopy in March

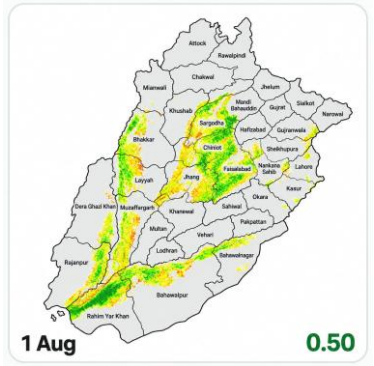
Belt LAI rises to 2.12 in March, against 1.59 for Punjab overall.

Southern belts regrow faster

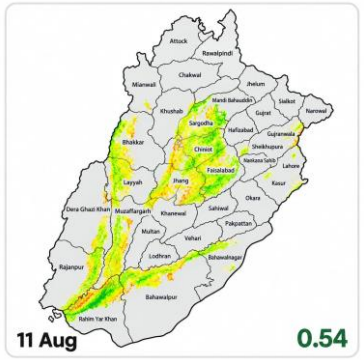
By June, LAI is 1.57 in the belts south of 30°N and 1.26 in the northern belts.

Sugarcane Leads in August, then September Cultivation and other Kharif Crops Catch Up

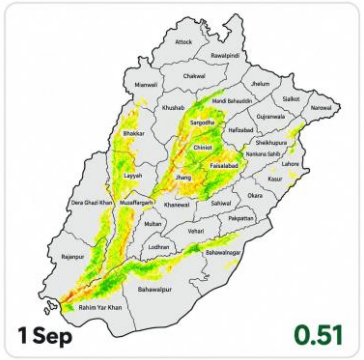
Belt NDVI holds 0.50 against 0.43 for the rest of Punjab on 1 August, but the gap closes by 1 September and canopy density falls behind at 1.92 versus 2.18 as other Kharif crops reach full cover.



NDVI

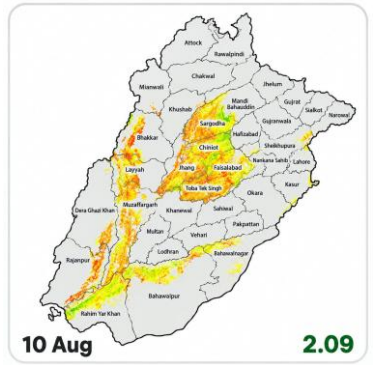


NDVI

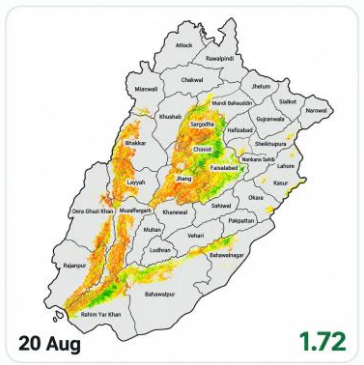


NDVI

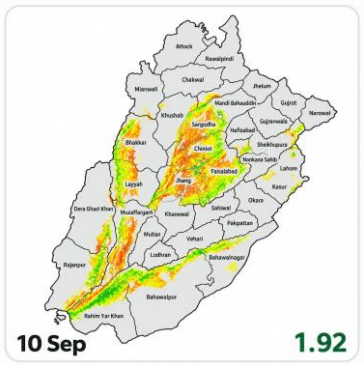
NDVI · low -0.08 to high 0.94



LAI



LAI



LAI

LAI · low 0 to high about 5.5

BELT AVERAGE vs REST OF PUNJAB

Date	Sugarcane	Rest
NDVI 1 Aug	0.50	0.43
NDVI 11 Aug	0.54	0.48
NDVI 1 Sep	0.51	0.53
LAI 10 Aug	2.09	2.05
LAI 20 Aug	1.72	1.87
LAI 10 Sep	1.92	2.18

REMARKS

Sugarcane greener in August

Belt NDVI 0.50 on 1 August against 0.43 for the rest of Punjab; the gap closes by 1 September.

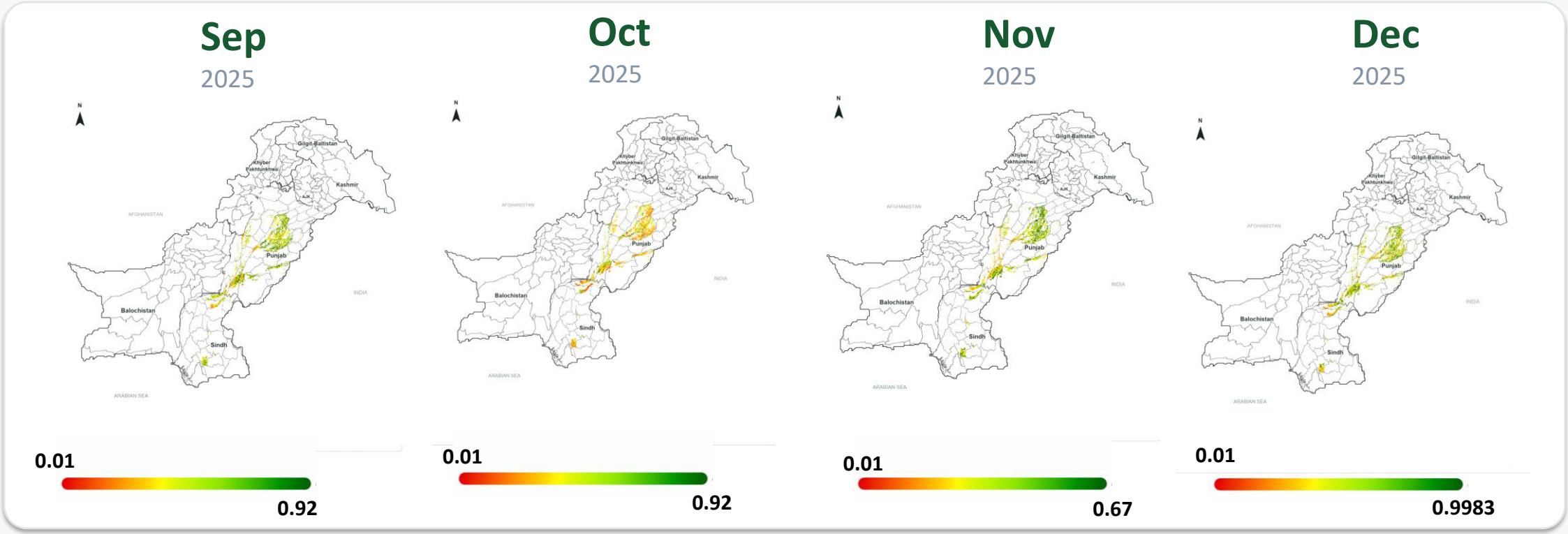
Kharif canopy overtakes by September

LAI on 10 September is 1.92 in the belts and 2.18 elsewhere, as other Kharif crops reach full canopy.

Tracking Sugarcane Growth Across Planting Cycles

Seasonal vegetation patterns reveal the development of autumn planted, spring planted and ratoon sugarcane across the growing belt.

NDVI



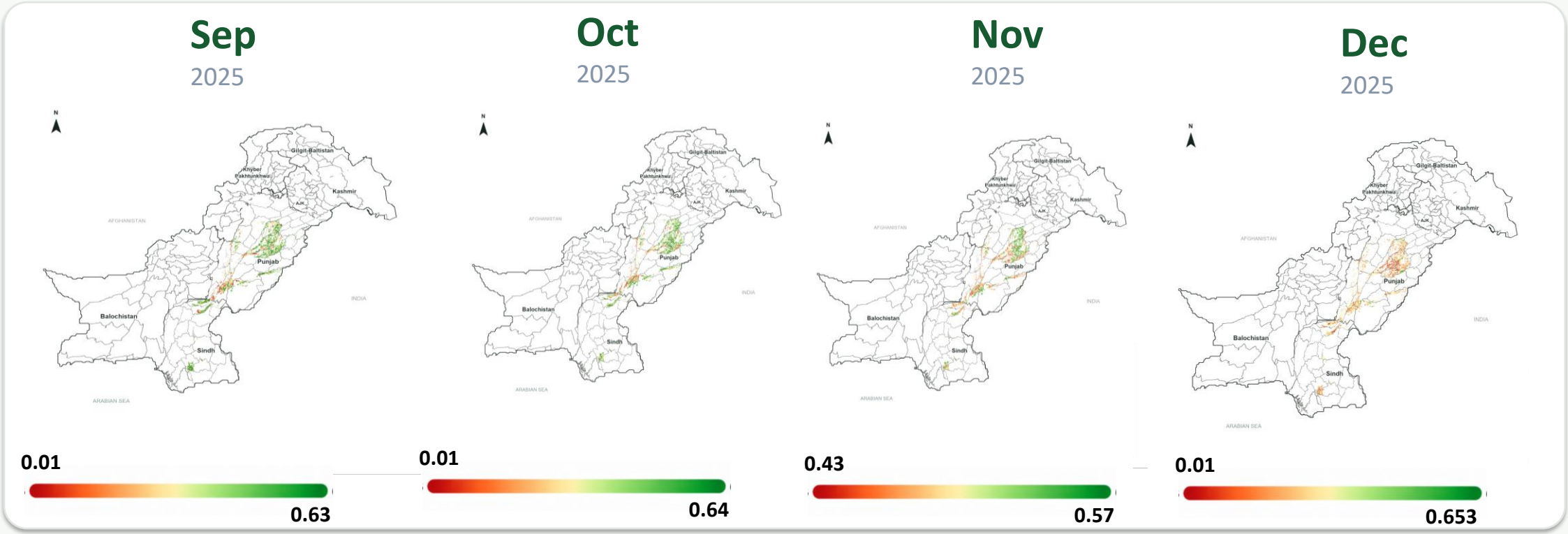
Different Planting Cycles, One Regional Picture

From October to December, the maps capture different stages of the sugarcane cycle, including established spring cane, emerging autumn plantations and ratoon regrowth. Their changing vegetation strength provides an early view of crop establishment, canopy development and spatial differences across the sugarcane belt.

Monitoring Sugarcane Nitrogen Status

Tracking canopy chlorophyll and crop vigour through the season to identify spatial differences in potential nitrogen status across sugarcane growing areas.

NDRE



Nitrogen Response Varies Across the Cane Belt

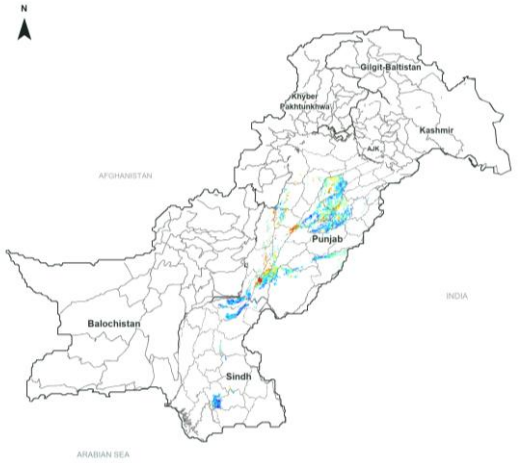
Changes from October to December reflect differences in crop stage, canopy development and nutrient response across spring planted, autumn planted and ratoon sugarcane. Areas showing persistently weaker response can be prioritised for closer field assessment and nutrient management.

Monitoring Sugarcane Water Status

Tracking changes in canopy moisture through the season to identify emerging water stress and spatial differences across sugarcane growing areas.

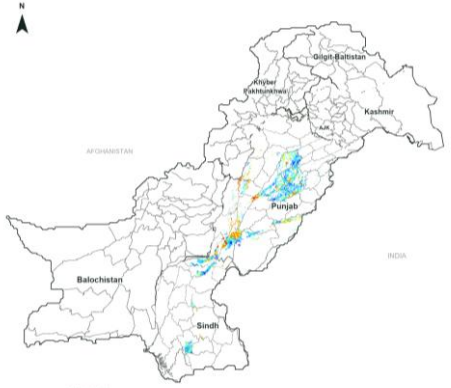
NDMI

Sep
2025



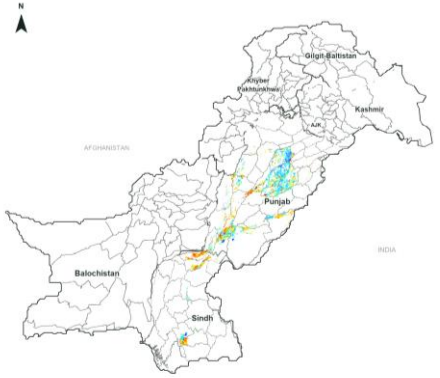
0.01 — 0.583

Oct
2025



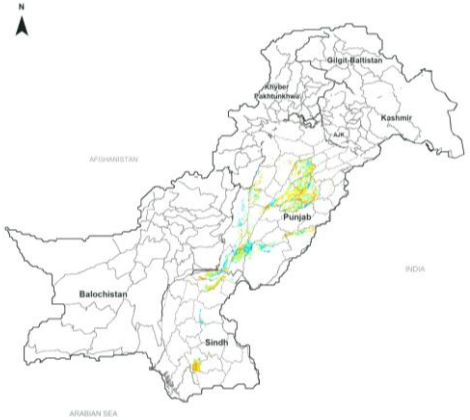
0.01 — 0.75

Nov
2025



0.01 — 0.74

Dec
2025



0.01 — 0.732

Seasonal Moisture Conditions Are Changing

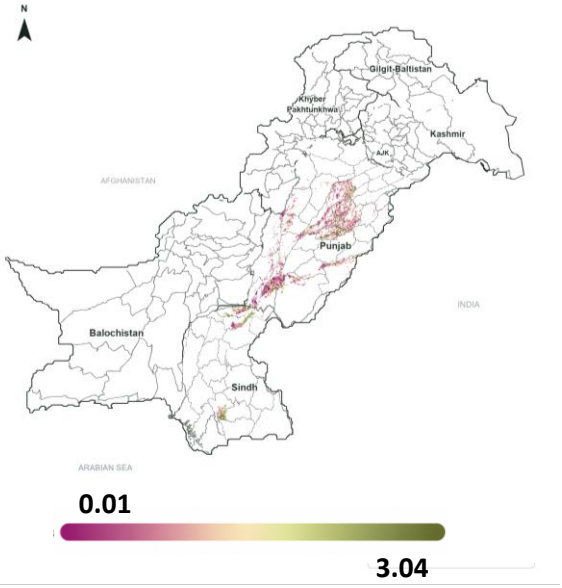
From October to December, changing moisture response reflects differences in crop stage, irrigation, weather and canopy development across spring planted, autumn planted and ratoon sugarcane. Persistently lower moisture response can help identify areas requiring closer assessment.

Monitoring Sugarcane Growth

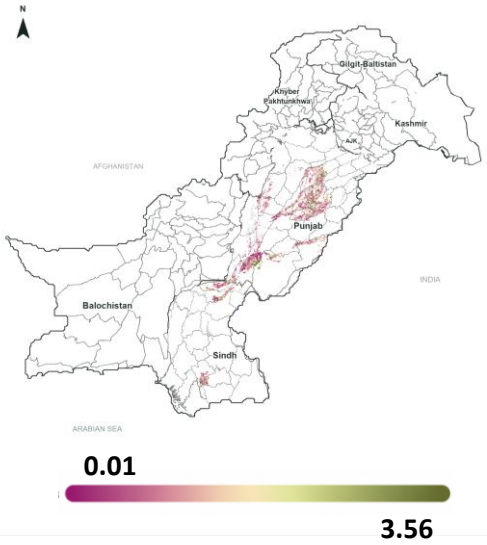
Tracking canopy chlorophyll development and photosynthetic capacity to follow sugarcane growth across different planting and ratoon cycles.

RECI

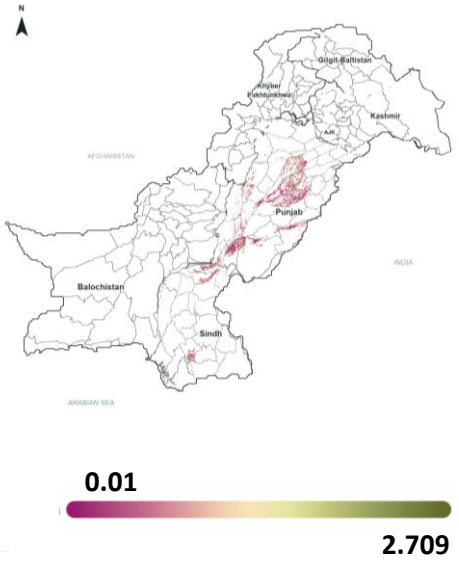
Sep
2025



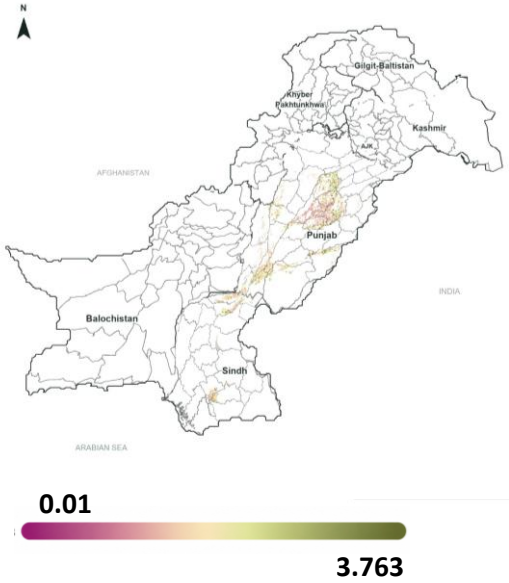
Oct
2025



Nov
2025



Dec
2025



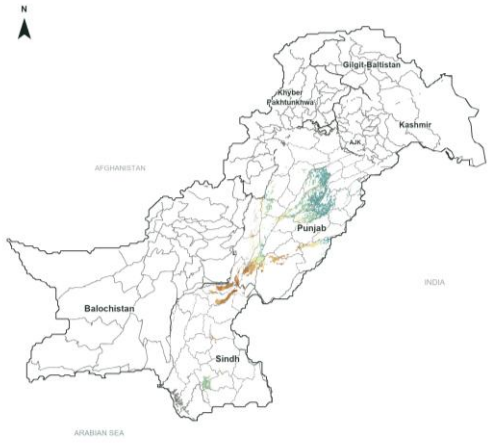
Tracking Growth Across the Cane Belt

Seasonal changes in canopy development reveal where sugarcane is progressing strongly and where growth may be lagging, supporting targeted field assessment and early identification of areas that could affect future cane supply.

Sugarcane Crop Water Requirement

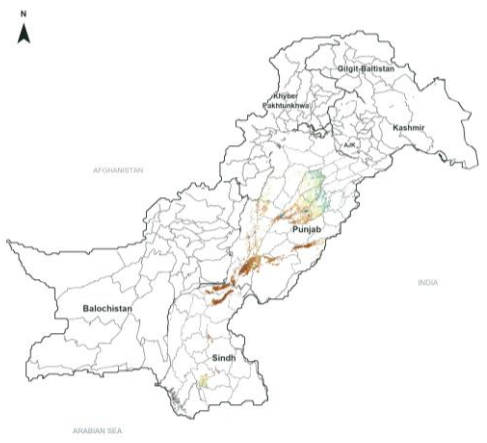
Tracking how sugarcane water demand changes across the season with crop stage, canopy development and atmospheric conditions.

Sep
2025



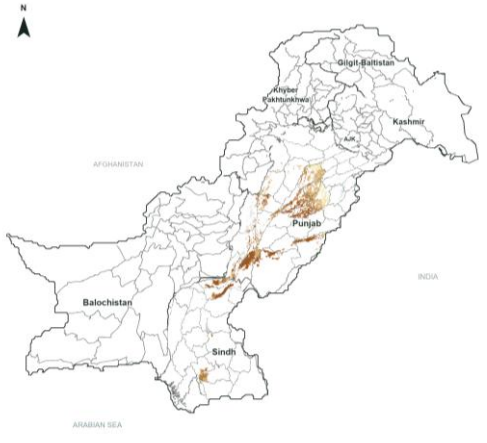
1.879 — 116.4

Oct
2025



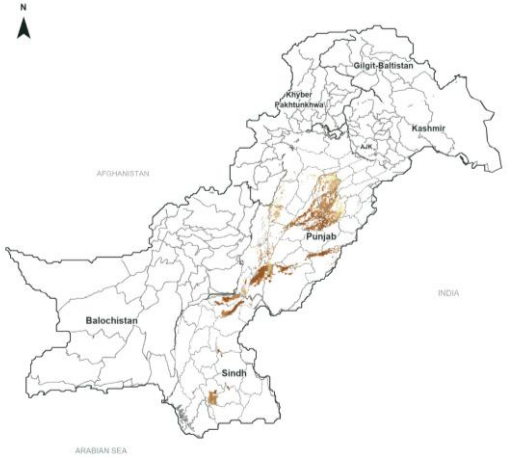
0.9997 — 93.64

Nov
2025



0.3365 — 53.54

Dec
2025



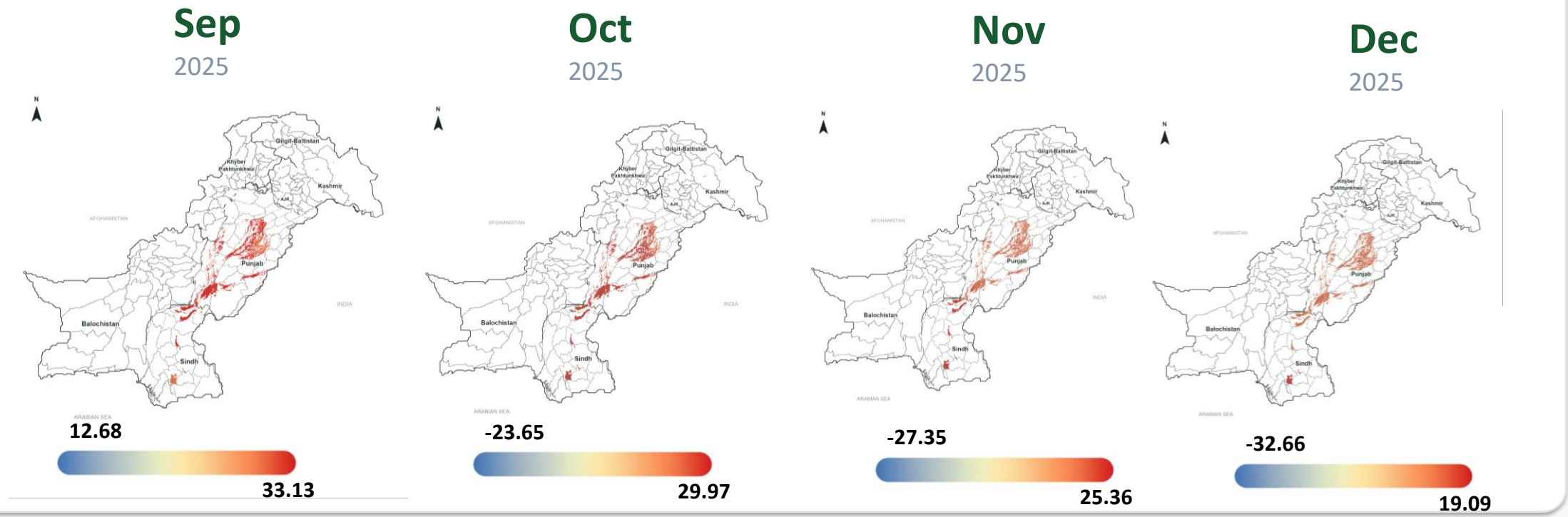
0.3149 — 29.13

Water Demand Changes Through the Season

Water requirement varies across spring planted, autumn planted and ratoon sugarcane as crop development and weather conditions change. Mapping this variation helps identify where and when irrigation demand is greatest across the cane belt. Supporting irrigation planning, water allocation and identification of areas where water availability may constrain crop performance.

Monitoring Temperature Conditions

Tracking seasonal temperature patterns to understand their influence on crop establishment, development and temperature related risk.



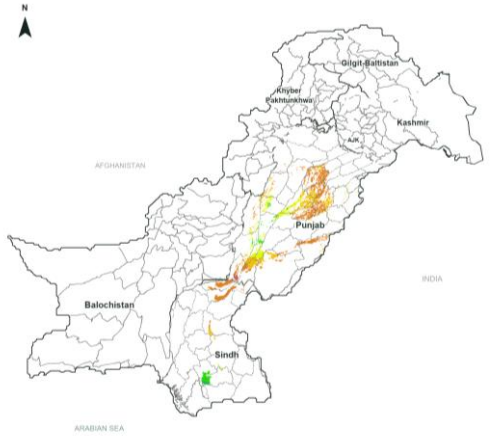
Cooler, as elsewhere

December temperature in the belts averages about 10 °C, close to the rest of Punjab.

Monitoring Rainfall & Crop Water Supply

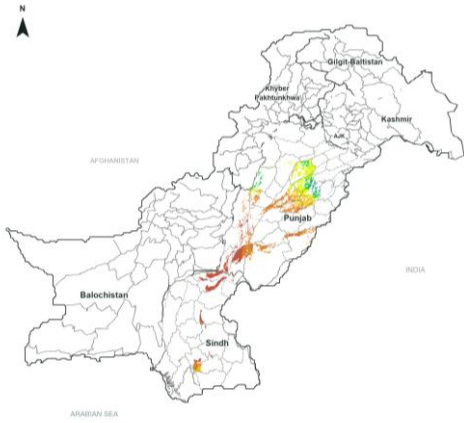
Tracking when and where rainfall contributes to crop water availability and where irrigation dependence is likely to increase.

Sep
2025



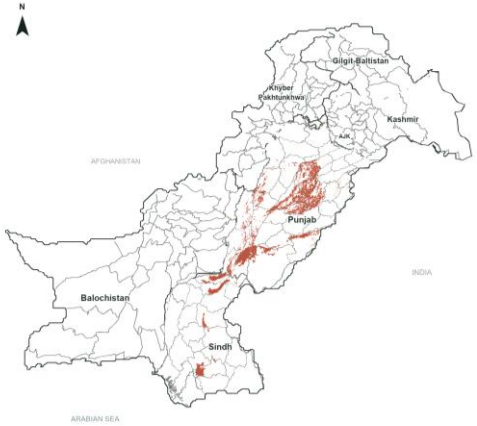
0.0227 — 318.9

Oct
2025



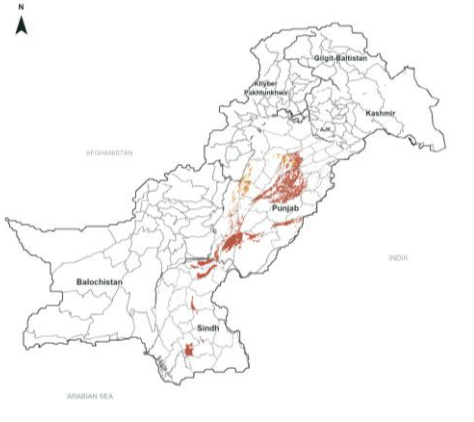
0.02962 — 120.1

Nov
2025



0 — 1.291

Dec
2025



0.02228 — 117.1

Rainfall offers no buffer

Rainfall over the belts stays in the lowest bulletin classes in November and December, so irrigation drives the crop.

FOR THE MILL

Irrigation and nutrients decide the next weeks

With growth and moisture falling in the belts, irrigation timing and nutrient checks for ratoon and autumn-planted cane matter most.

Harvest Planning & Supply Forecast

Satellite time series tell the mill how old each crop is and when its fields will be ready, circle by circle.

WHAT THE SATELLITE MEASURES

Mapped sugarcane area
Field-level sugarcane layer, totalled for every circle and buffer.

Planting or ratoon start
Green-up in the time series dates each plant crop and ratoon crop.

Crop condition
NDVI and LAI show vigour and canopy density through the season.

Crop age and maturity
Months since planting place every field on its path to harvest.

WHAT THE MILL PLANS WITH IT

1. **Harvest readiness by circle**
   Fields grouped by crop age and maturity show which circles are ready to cut first.

2. **Cutting sequence**
   Older, mature fields are scheduled first, so cane reaches the mill at the right age.

3. **Supply estimate**
   Mapped area and crop condition give an estimate of cane supply as harvest approaches.

PROVEN ON A REAL SUGARCANE AREA

Harvest (25 Dec to 1 Jan) and ratoon regrowth (30 Mar) were quantified from satellite.

Our Sugarcane Classification Method

Every pixel is labelled from its full-season behaviour, then trained and checked against real field samples.

1

Satellite time series

Sentinel-2 imagery every five days, cloud-filtered across the full season.

2

Crop indices

NDVI, NDMI, NDRE and SAVI computed for every pixel on every clear date.

3

Season features

Green-up, peak timing, season length, harvest and ratoon regrowth read from each curve.

4

Field samples

Geotagged ground points of sugarcane and other crops train the classifier.

5

Classification

Each pixel is assigned to sugarcane or another crop from its full-season signature.

6

Validation

A separate set of field samples, held back from training, checks the map before release.

PROVEN AT PROVINCIAL SCALE · PUNJAB 2025

2,303,878 acres
Sugarcane mapped across Punjab

70 field samples
52 for training & 18 for validation

Every district
Sugarcane acreage summarised by district

WHAT THE MILL RECEIVES

- A sugarcane-only field layer
- Acreage for every circle and buffer
- Doubtful fields sent to E-Survey teams

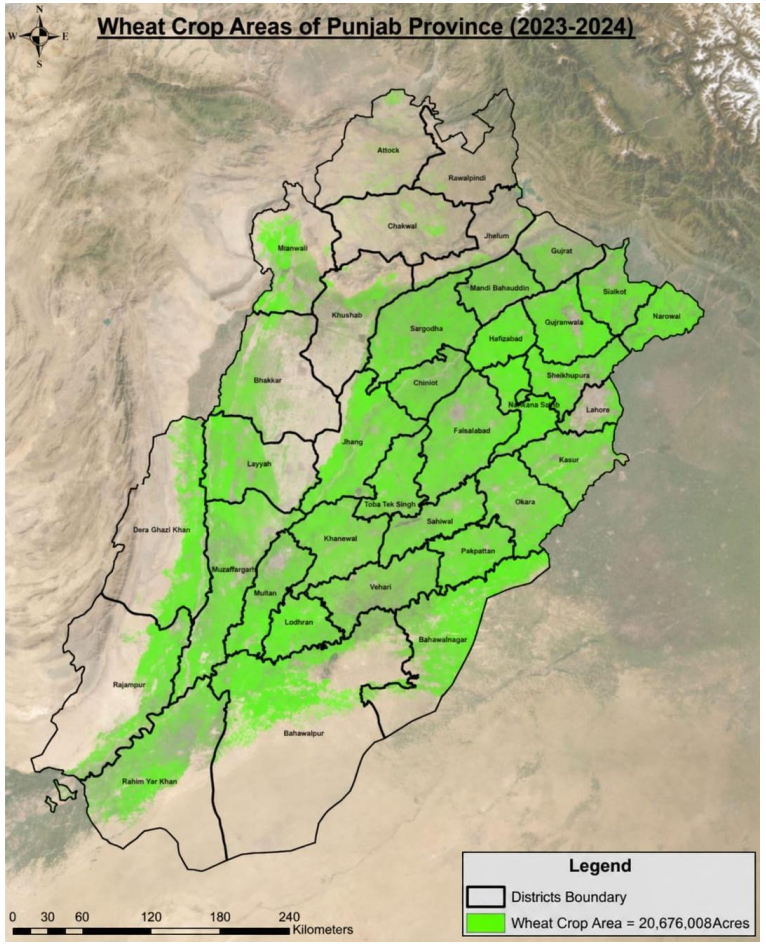
REGIONAL INTELLIGENCE

Region-Level Mapping & Monitoring of More Crops

Country- and province-scale satellite monitoring the wide-area view that comes before zooming into individual fields.

Wheat Crop Area Mapping: Punjab 2023–24

Satellite classification maps every wheat field in the province, summarized within district boundaries.



Wheat crop area · Punjab · 2023–24

20,676,008 acres

Wheat area mapped across Punjab · 2023–24

≈ 8.37 million ha

Equivalent area in hectares

Satellite crop classification

Wheat is separated from other land cover on satellite imagery and mapped field by field, then aggregated within every district boundary.

Where wheat is grown

Cultivation concentrates on the irrigated central and southern plains, from Sargodha and Gujranwala to Bahawalnagar and Rahim Yar Khan, and thins out in the Pothohar north and the Thal and Cholistan deserts.

From area to production

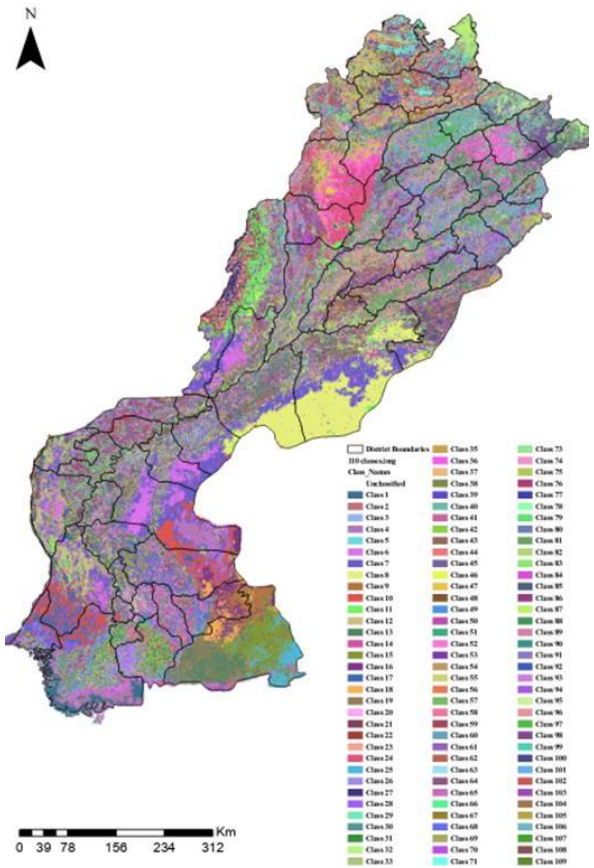
The crop-area layer is the foundation for district-level production estimates, shown on the next slide.

Land Cover Mapping from Hypertemporal Signatures, 2011–2022

A decade of twice-monthly satellite observations separates land cover and cropping classes across Punjab and Sindh.

Land cover and land use

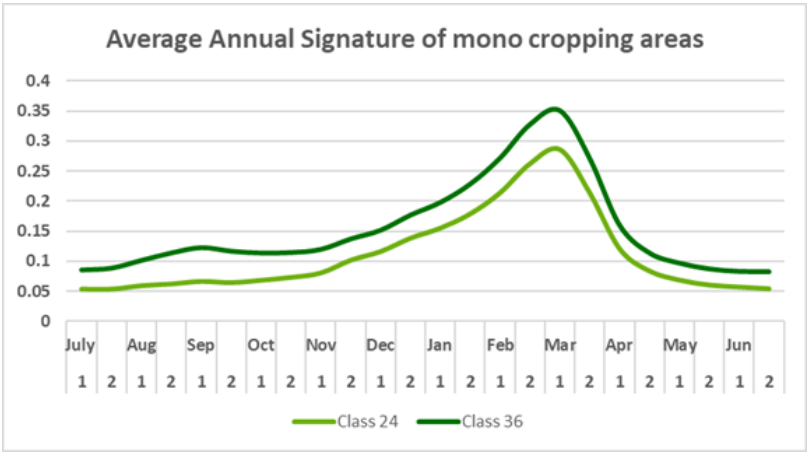
Pakistan · 2011 to 2022 · 110 classes



Every class has its own annual signature

Average annual profile of two mono-cropping classes, July to June.

Shape, timing and amplitude identify the crop.

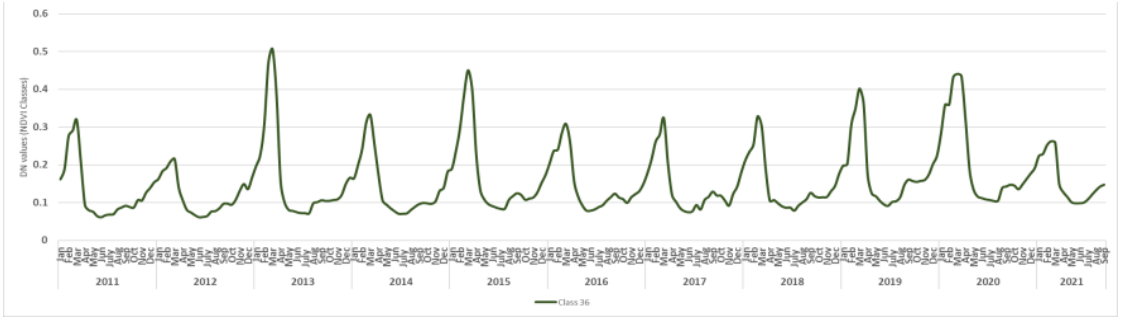


Twelve years of one class

Rabi mono-cropping, 2011 to 2021, twice-monthly observations.

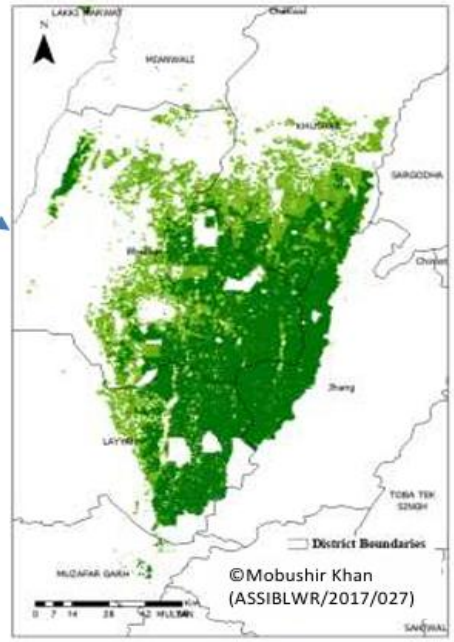
A stable, repeating cycle supports long-term monitoring.

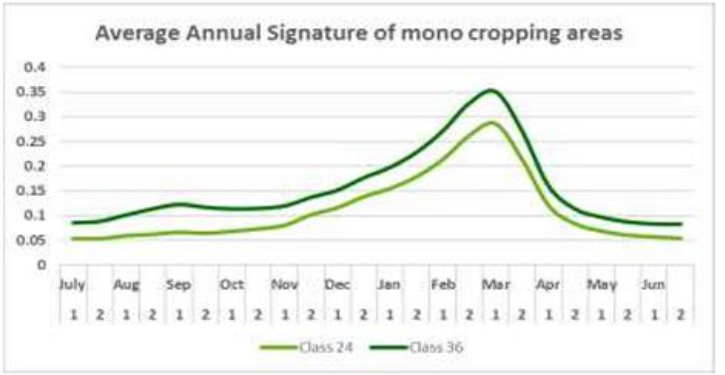
Temporal Behavior of Mono Cropping (Rabi Only) areas represented by class 36 (2011-2021)



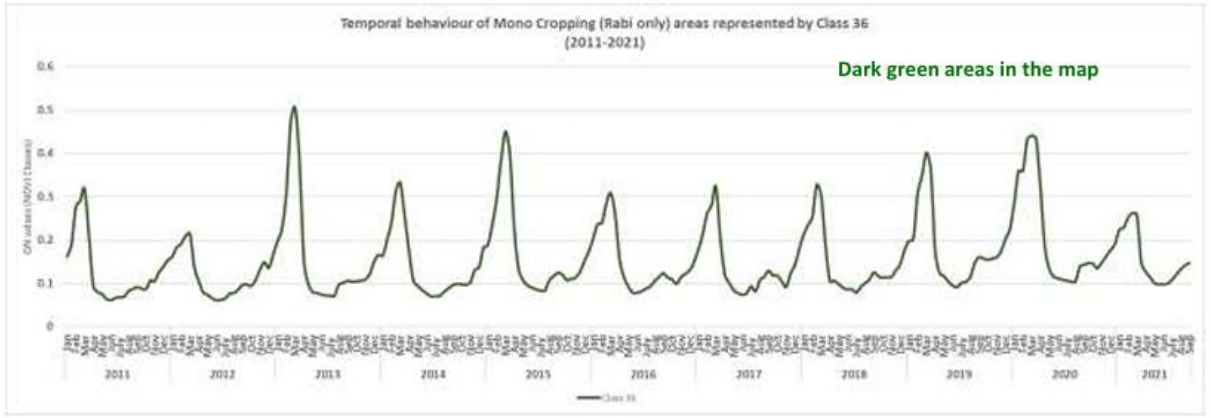
Gram/Chickpea (Rabi Pulses): 2011–21

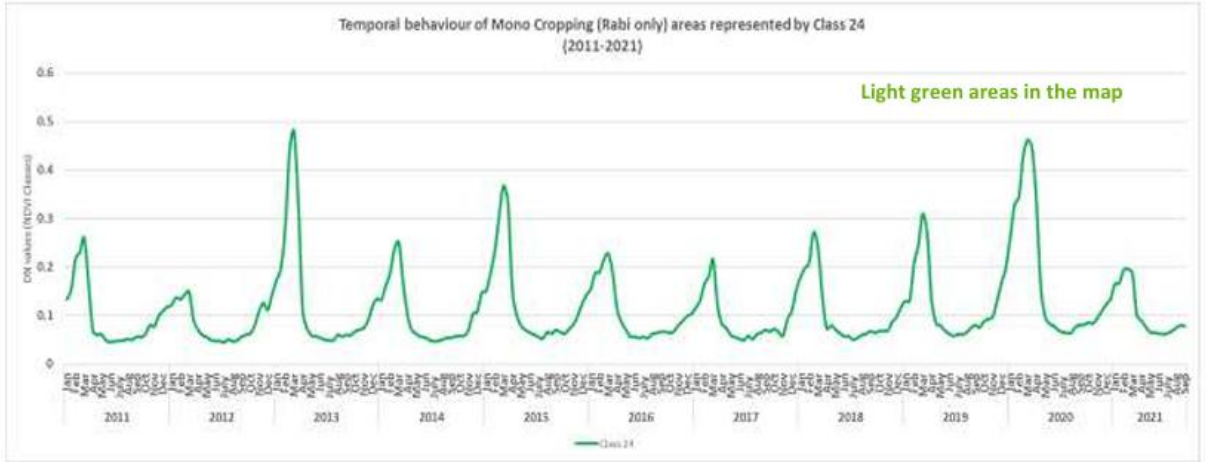


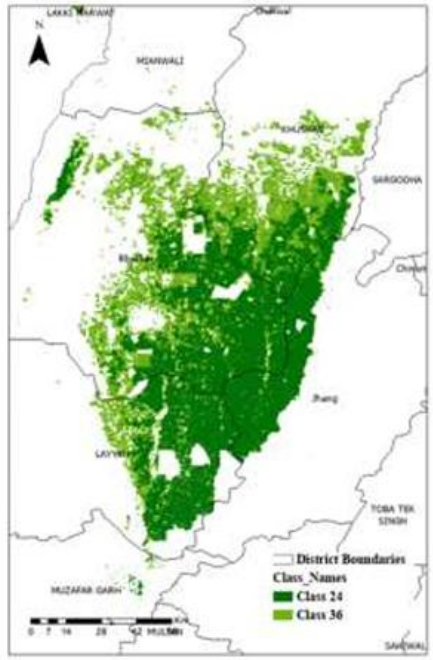




Long-term monitoring of Gram/chickpea (2011-21)

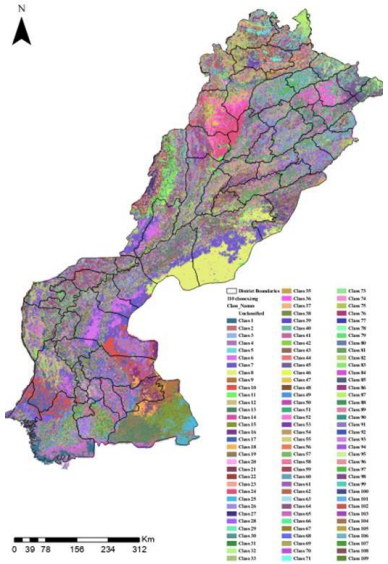




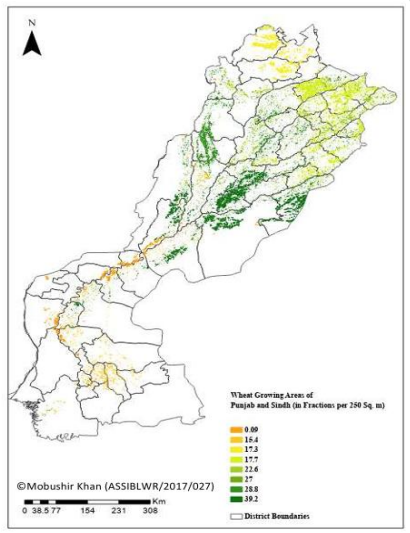


Mapping Rice within the Complete Cropping Landscape

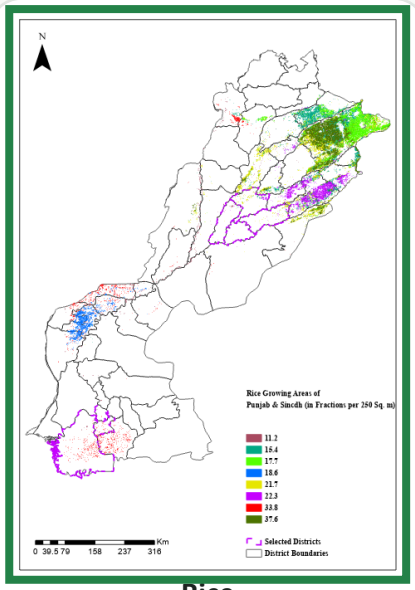
Multi-crop classification distinguishes rice from other crops, showing where rice is grown across Punjab and Sindh.



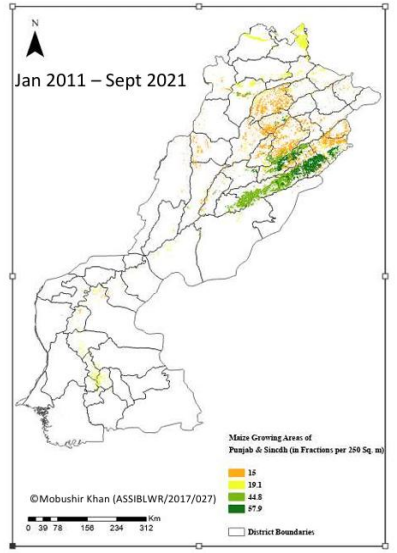
Complete Agri-Landscape



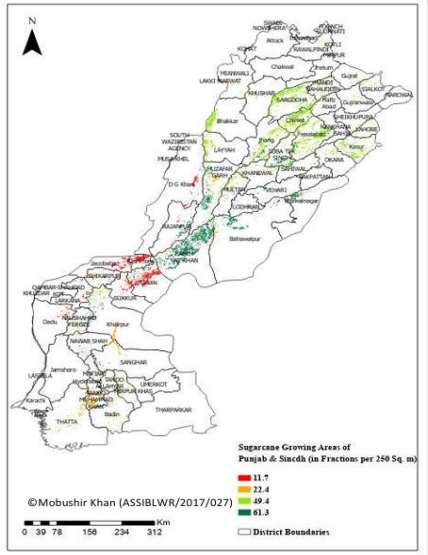
Wheat
Punjab and Sindh



Rice
Punjab and Sindh



Maize
Punjab and Sindh



Sugarcane
Punjab and Sindh

110 Distinct
Land cover and cropping patterns identified

20,676,008 acres
Wheat area mapped

8,636,000 acres
Validated for Punjab and parts of Sindh

3,370,400 acres
Maize area mapped

2,303,878 acres
Sugarcane area mapped

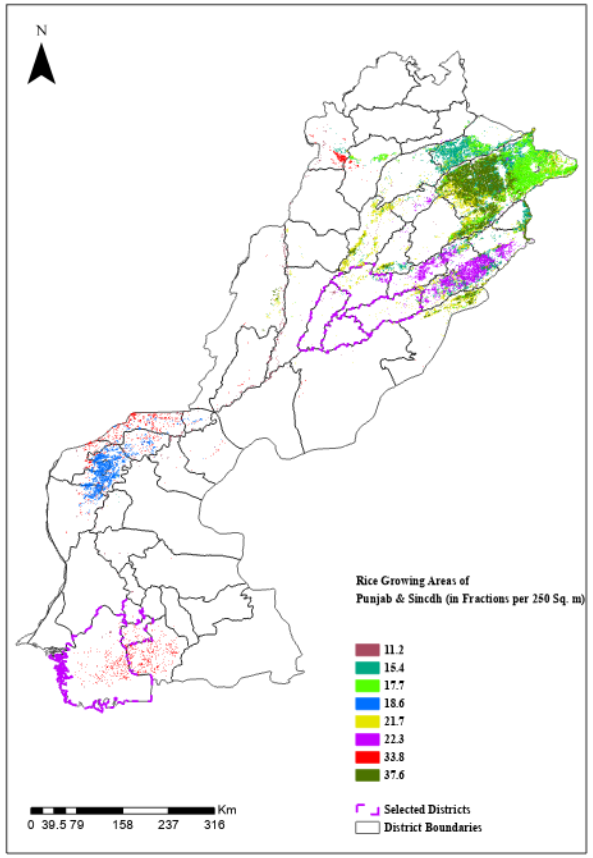
Rice does not exist in isolation. ESS maps the wider cropping landscape first, distinguishing rice from sugarcane, maize, wheat and other vegetation classes to support rice-area mapping and procurement planning.

Rice Mapping & Monitoring: Punjab and Sindh, 2011–2022

The same time-series method maps rice area for 2022 and tracks how each rice belt has behaved for over a decade.

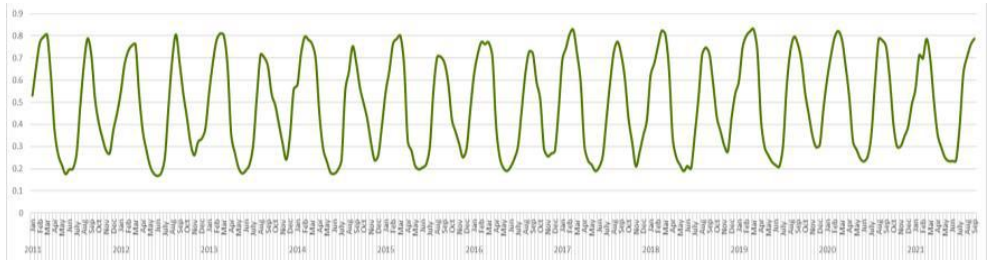
Rice area

2022 · validated for Punjab and parts of Sindh



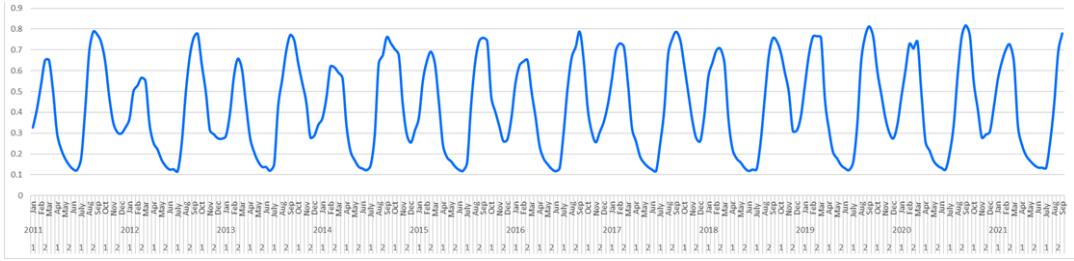
Established rice in Punjab

Strong, regular annual cycle since 2011.



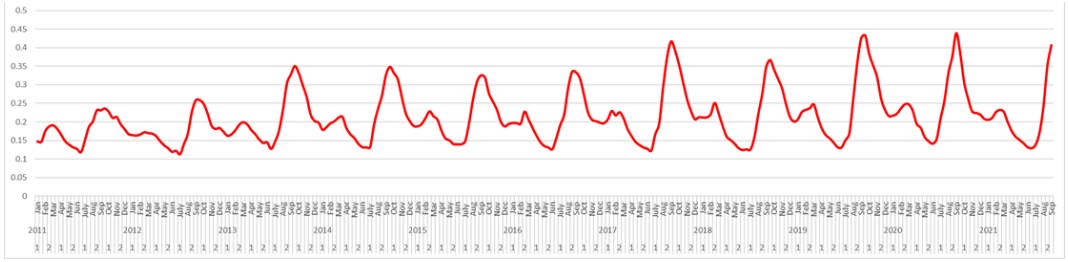
Established rice in Sindh

A deeper seasonal swing in the southern belt.



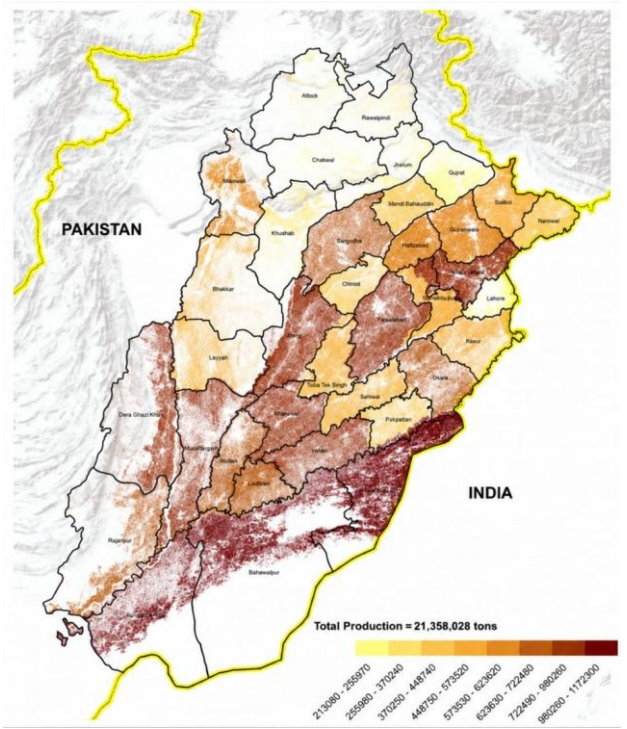
Rice moving into new areas

Amplitude climbs from 2017, where farmers began growing rice.

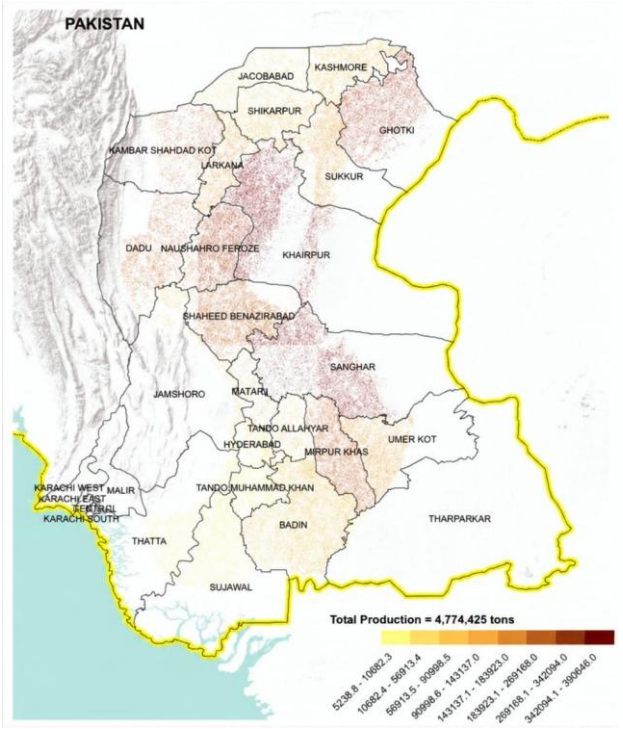


Wheat Production Estimates by Province

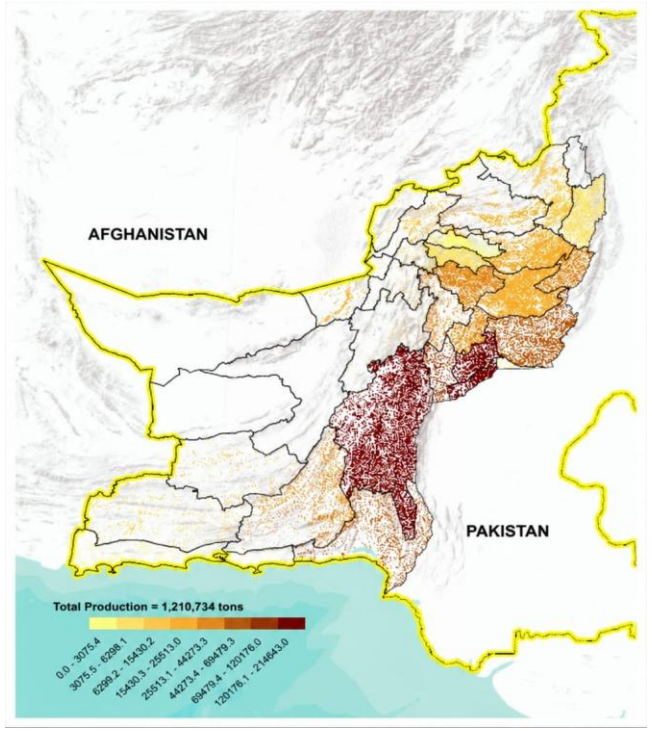
District-level wheat production mapped across Punjab, Sindh and Balochistan darker districts produce more.



Punjab · district production



Sindh · district production



Balochistan · district production

21.36 million t
Punjab · 78% of the three-province total

4.77 million t
Sindh total production

1.21 million t
Balochistan total production

27.34 million t
Combined · Punjab, Sindh & Balochistan

ESS can provide yield estimates for all crops grown in Pakistan.

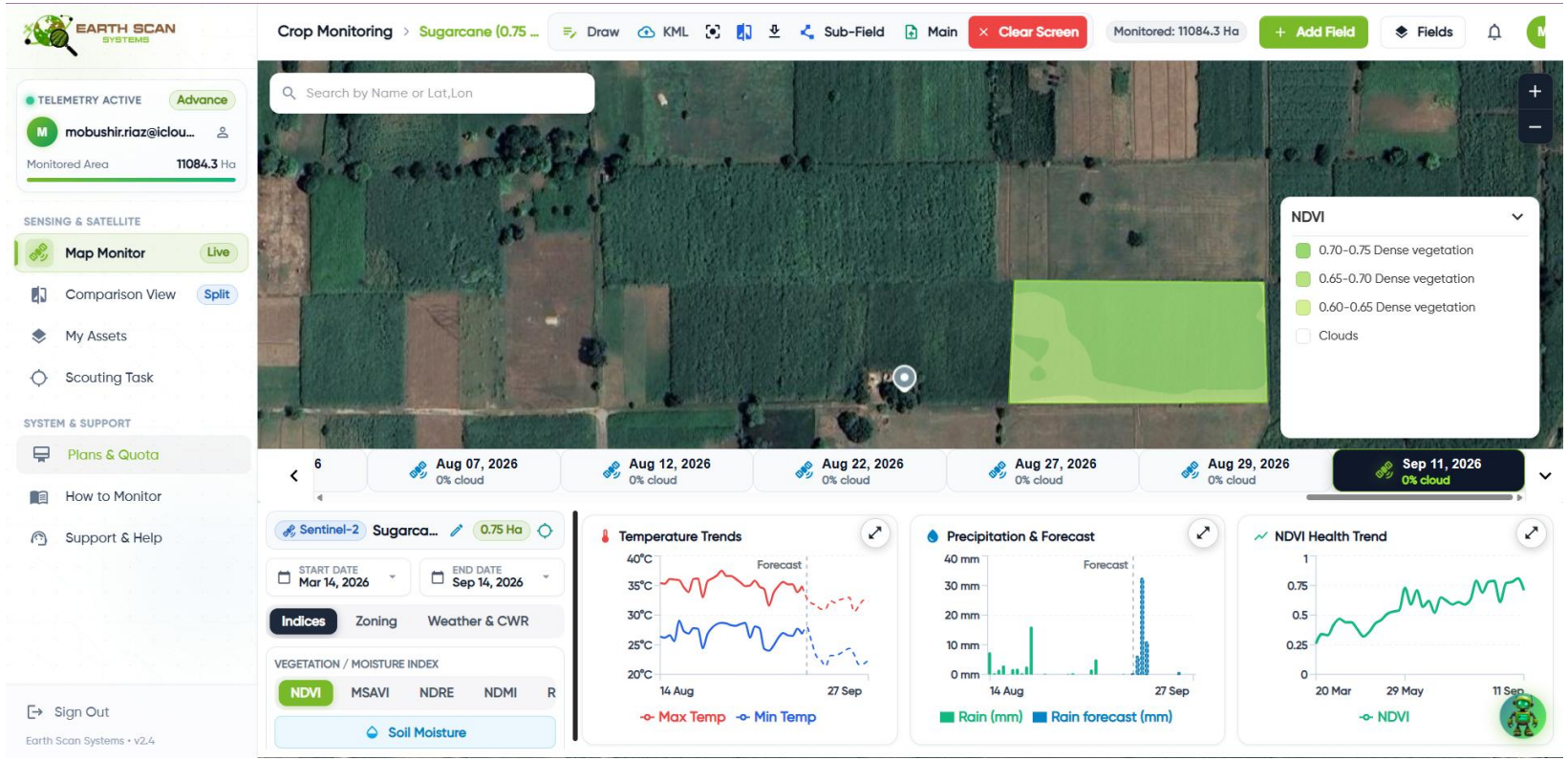
Crop Precision Monitoring

Field maps, vegetation indices, weather analytics, CWR, comparison, scouting, and satellite phenology.

Open the live platform ↗

Crop Precision Monitoring Platform

A live monitoring workspace combining field boundaries, satellite indices, weather and time-series crop signals.



Live field monitoring dashboard

Real-time visibility

Map-based monitoring with field boundary, satellite index overlay, date selector, and operational controls.

Integrated analytics

Temperature, precipitation, and NDVI trend cards appear within the same monitoring workspace.

Enterprise use

Designed for crop supervision across large farms, supply chains, and institutional monitoring programs.

Growth Trends & Weather Context

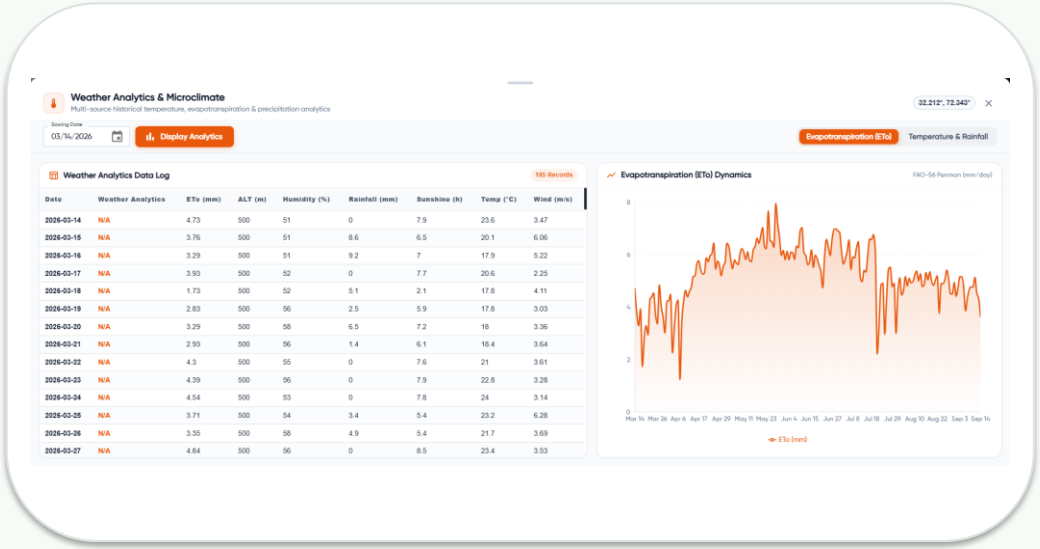
Crop vigour trends become stronger when interpreted with rainfall, temperature, and forecast context.



NDVI trend with crop-stage timeline







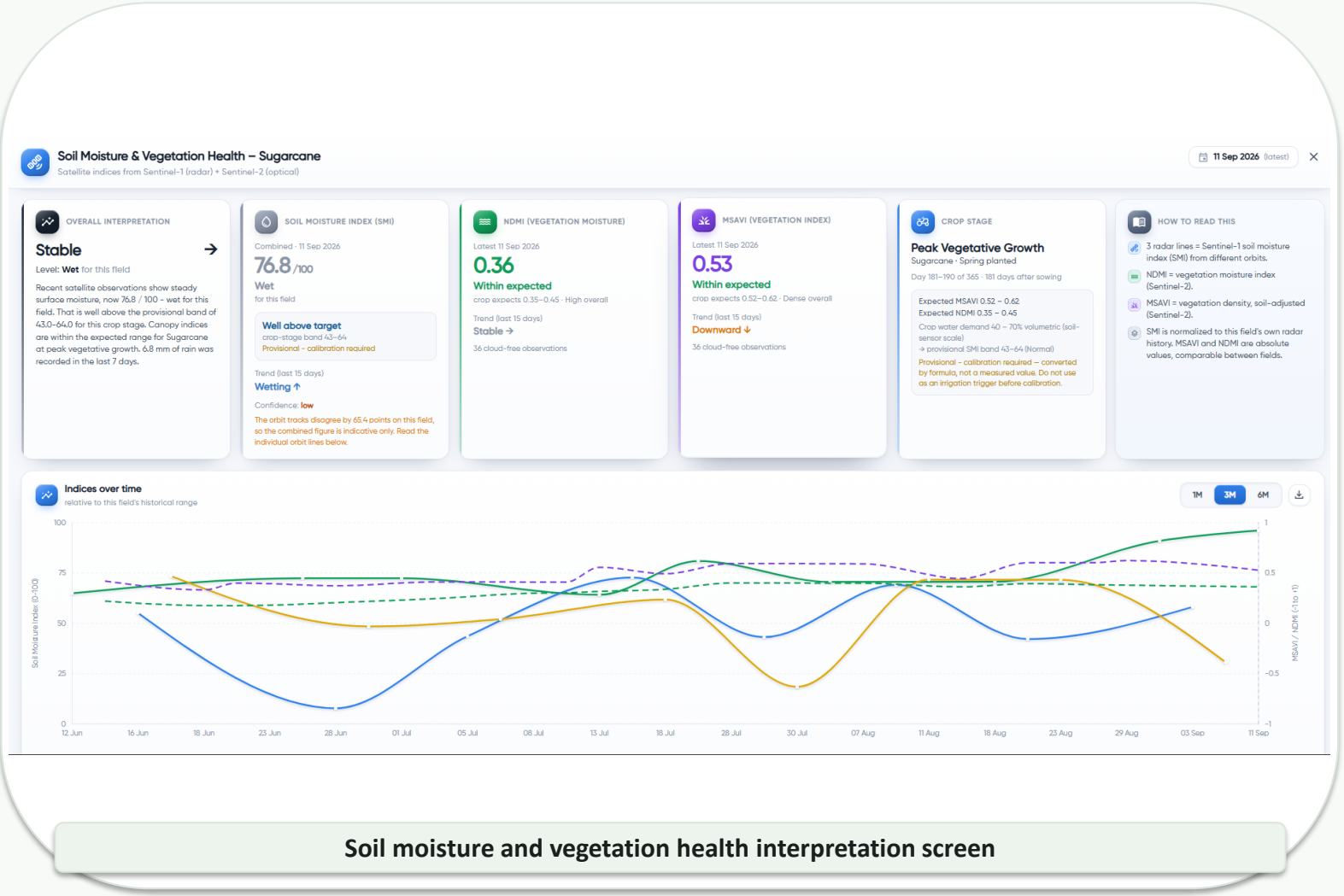
Temperature

Rainfall

Business value: early warning, irrigation planning, climate-aware advisory and confident tracking of crop development.

Interpreted Multi-Index Crop Intelligence

The platform explains what each index means at the current crop stage, not only the values observed.



Soil moisture and vegetation health interpretation screen

What it detects

Soil moisture, canopy moisture, vegetation density, and stage-specific expected ranges.

What it means

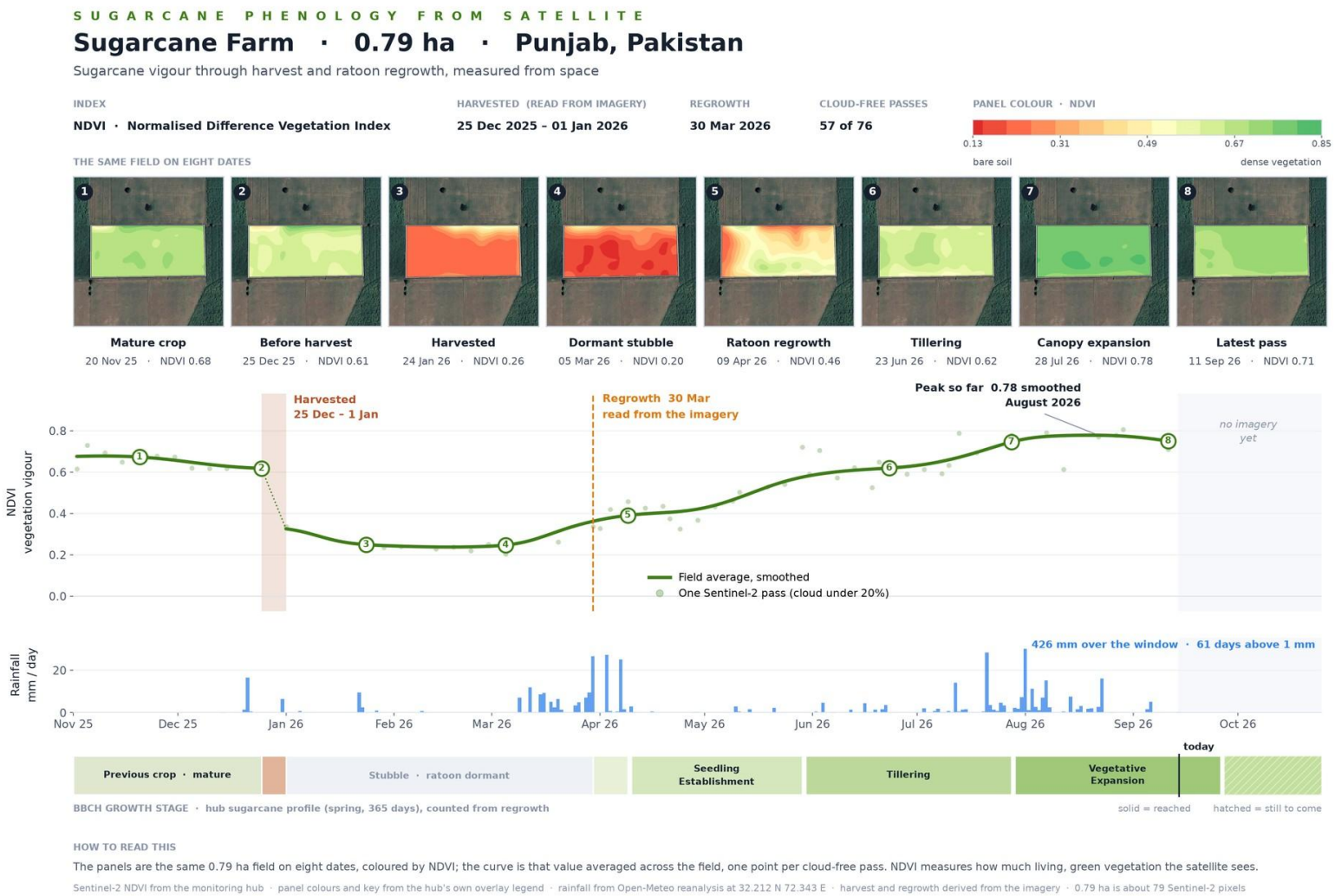
The interpretation panel translates technical values into field status and confidence level.

What users do

Prioritize scouting, irrigation review, advisory delivery, and crop-risk response.

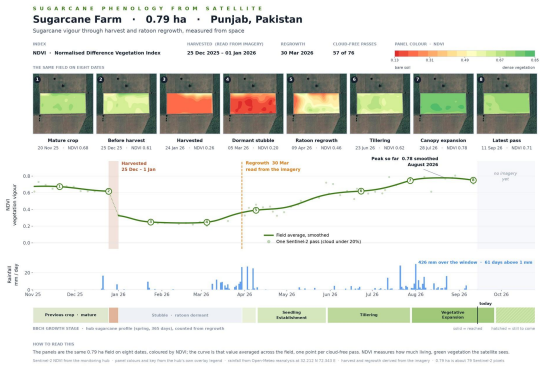
Satellite Phenology Case View

Satellite evidence of harvest, ratoon regrowth, rainfall and crop-stage progression across a full season.

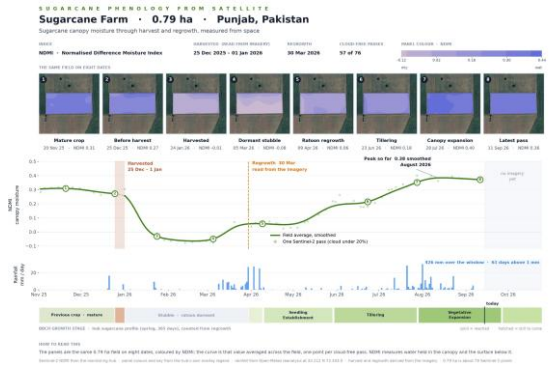


Multi-Index Phenology Comparison

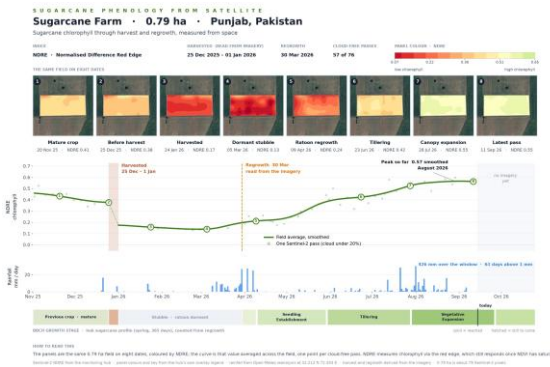
The same sugarcane field interpreted through vigour, moisture, chlorophyll, and vegetation-density indicators.



NDVI: Vegetation vigour



NDMI: Canopy moisture



NDRE: Chlorophyll response



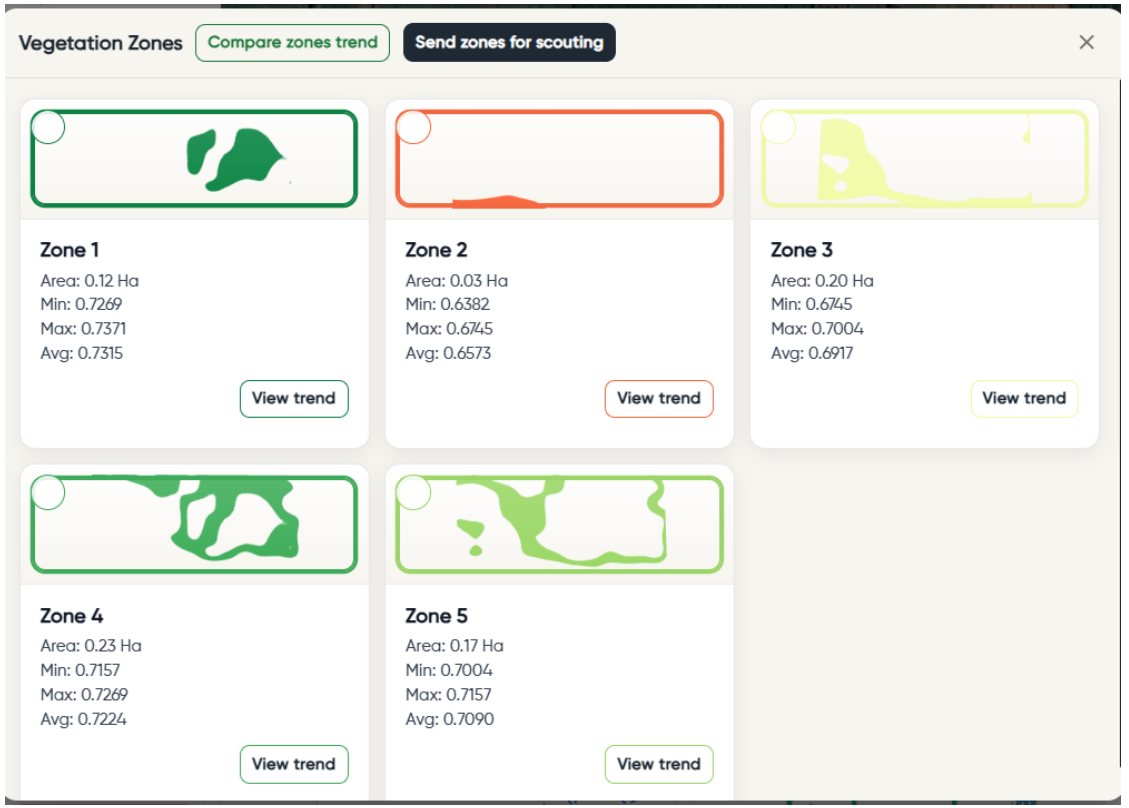
MSAVI: Vegetation density

Zoning & Precision Scouting

Turning field variability into action zones for targeted scouting and intervention.



Vegetation zoning map



Zone cards with area, min, max, and average values

Business value

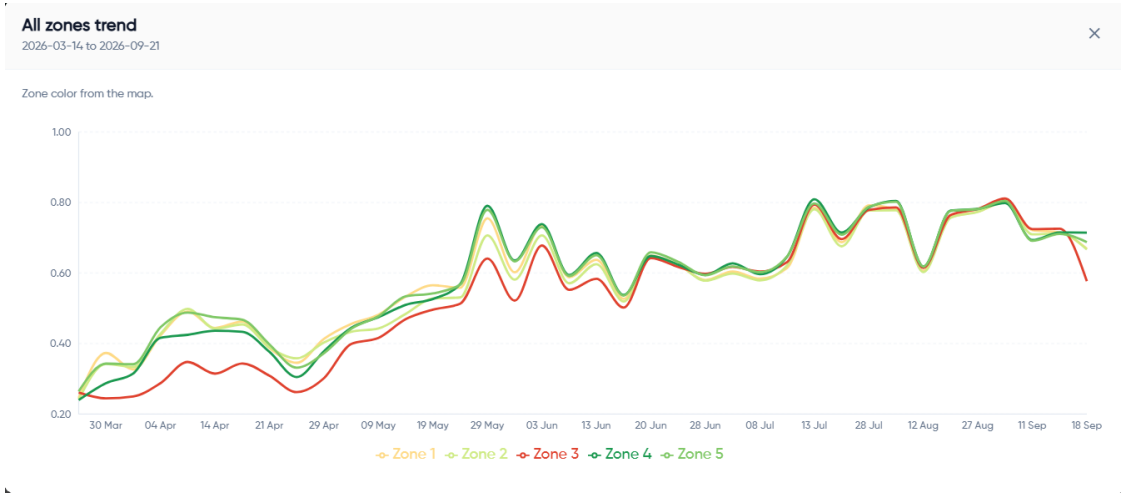
Field teams can move from blanket treatment to targeted scouting, saving time and focusing interventions where variability is visible.

Zoning Trend

Turning field variability into action zones for targeted scouting and intervention.



Vegetation zoning map



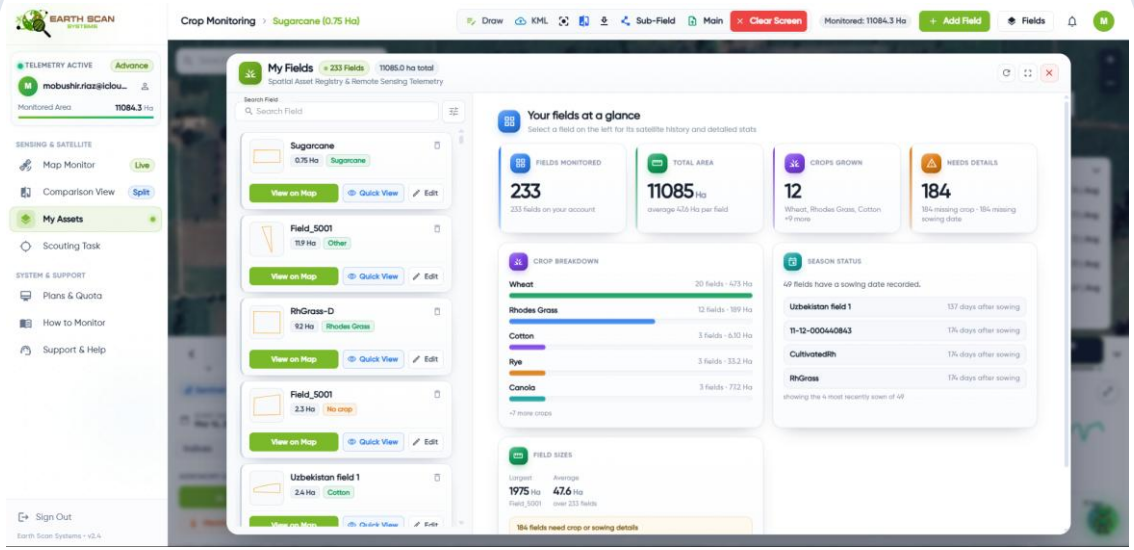
Each Zone Trend

Business value

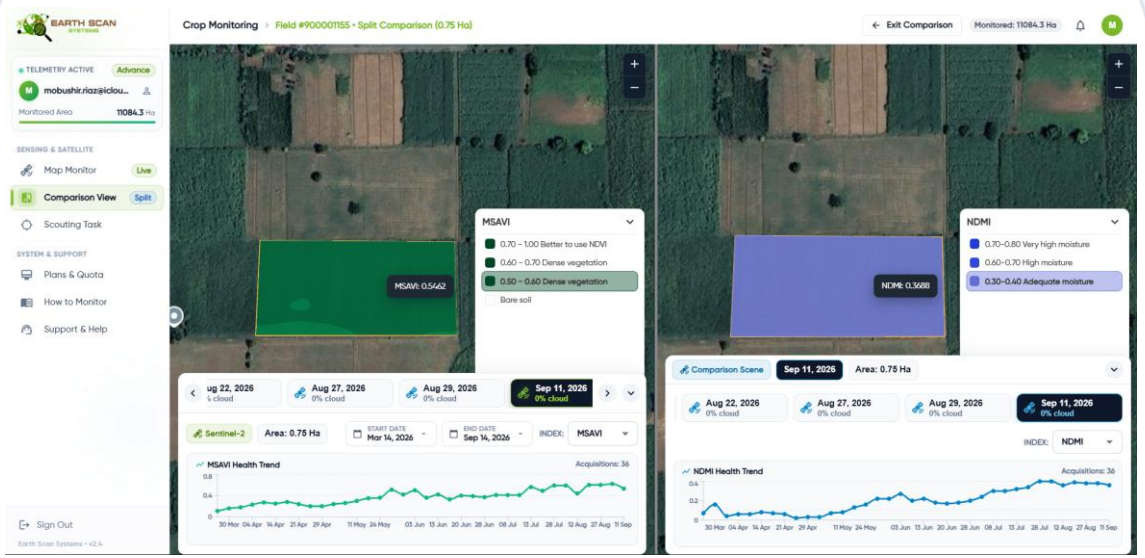
Field teams can move from blanket treatment to targeted scouting, saving time and focusing interventions where variability is visible.

Crop Precision Monitoring: Asset Registry & Split Comparison

The platform combines field portfolio visibility with index-based comparison views for faster analysis across monitored farms.



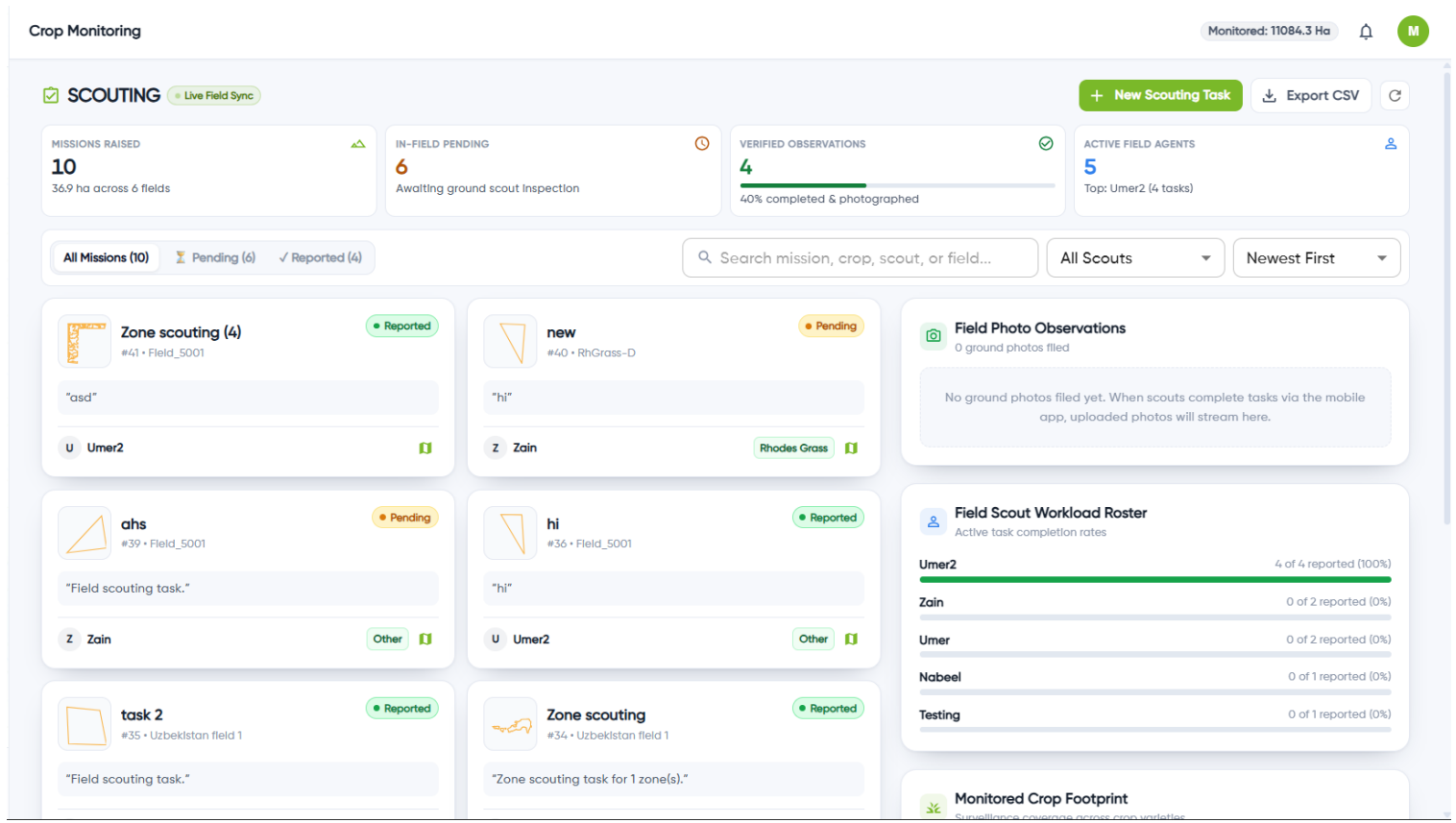
My Assets view: field inventory, crop mix, area totals, and season status



Comparison View: side-by-side index comparison with date history and trend charts

Crop Precision Monitoring: Scouting & Field Operations

Scouting workflows link remote sensing with on-ground task execution, helping teams turn imagery into verified field action.



Scouting dashboard: mission management, pending inspections, reported tasks, and scout workload roster

Scouting module

Raise missions, assign scouts, review pending and reported missions, and track task completion and field photos ideal where satellite alerts need physical validation and rapid follow-up.

- Mission queue management
- Scout workload visibility
- Reported vs. pending tracking
- Field photo observation stream

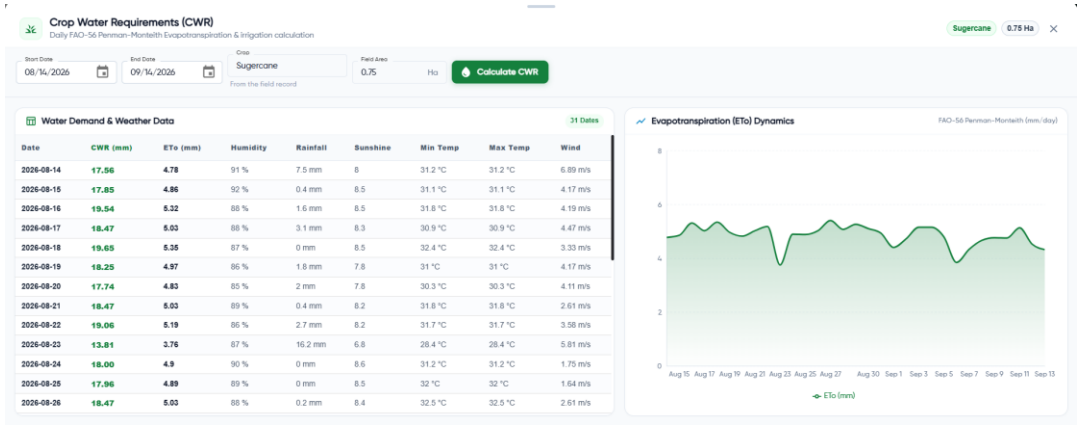
Crop Precision Monitoring: Water Demand & Weather Intelligence

Irrigation planning with daily Crop Water Requirements (CWR), FAO-56 ETo calculations and 14-day weather forecasts.

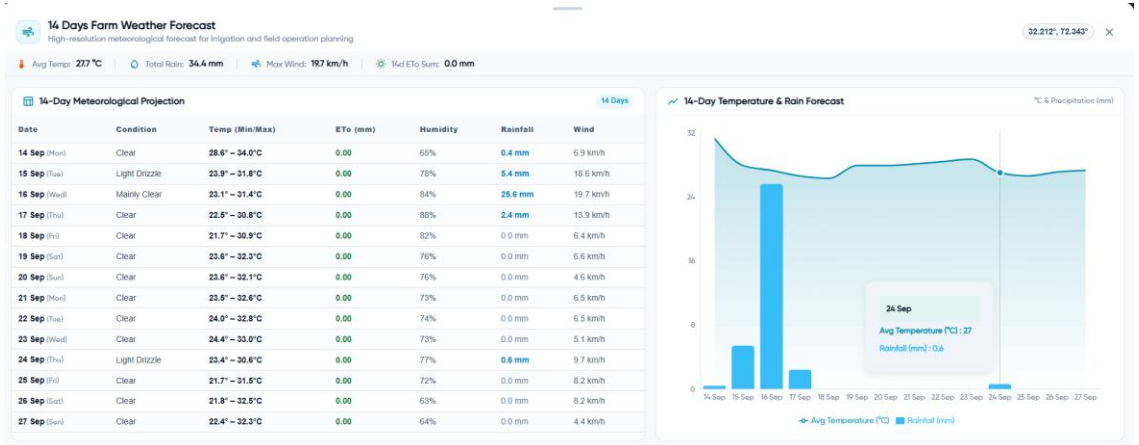
Key value

Beyond satellite views, Crop Precision Monitoring supports decisions on irrigation timing, evapotranspiration and short-term weather planning.

- Daily crop water requirement (CWR) calculation
- FAO-56 Penman Monteith ETo dynamics
- Table- and chart-based irrigation planning
- 14-day forecast for rain, wind, and field operations



Crop Water Requirements (CWR) with evapotranspiration dynamics and water demand table



14-day weather forecast with rainfall, temperature, wind, humidity, and ETo planning view

Cotton Monitoring: Pakistan & Uzbekistan

Field-proven cotton intelligence: stress and pest detection in Punjab, varietal tracking in Cholistan and 398 monitored fields in Uzbekistan.

Cotton Crop Area Mapping: Punjab 2025

Satellite classification maps every cotton field in the province, summarised within district boundaries.



Cotton area · Punjab 2025

3,370,400 acres
Cotton area mapped in Punjab

≈ 1,364,000 ha
Equivalent area in hectares

Southern Punjab
Where the mapped area concentrates

Where cotton is grown

The mapped area concentrates in southern Punjab, with Lodhran, Bahawalpur, Bahawalnagar and Rahim Yar Khan carrying the largest cotton acreage in the province.

District-level acreage

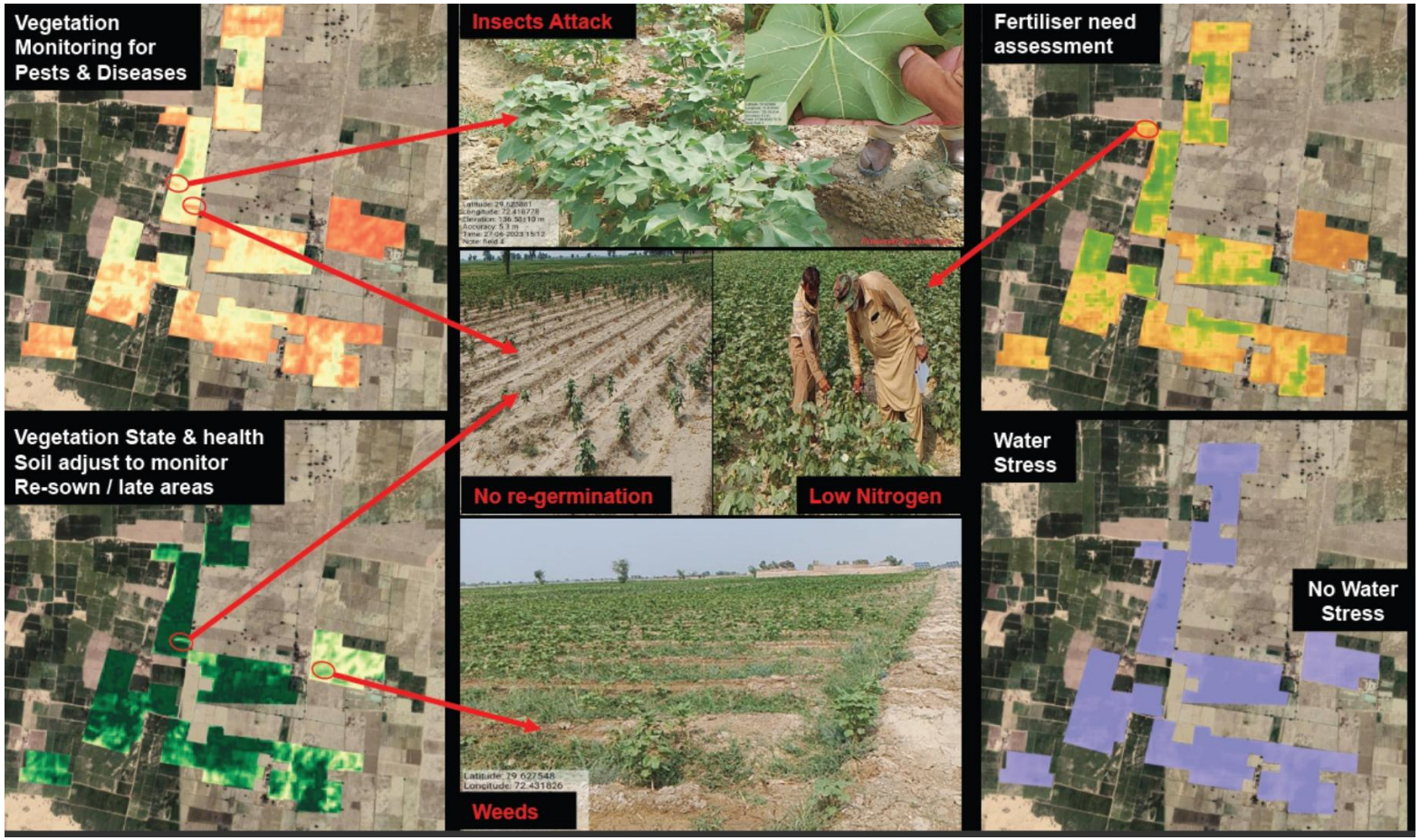
Every district carries its own mapped cotton area, so ginners, textile buyers and planners can compare districts directly.

Baseline for the cotton programme

Provincial acreage anchors the stress, pest and varietal monitoring that follows, turning field-level intelligence into provincial totals.

Cotton Stress Detection: Verified on the Ground

Satellite anomaly maps direct scouts to the exact spot, where geotagged photos confirm the cause and the response.



Satellite stress maps linked to geotagged field observations · cotton, Punjab

1 · Detect

Index maps flag pest and disease stress, fertiliser need, water stress and re-sown or late areas.

2 · Verify

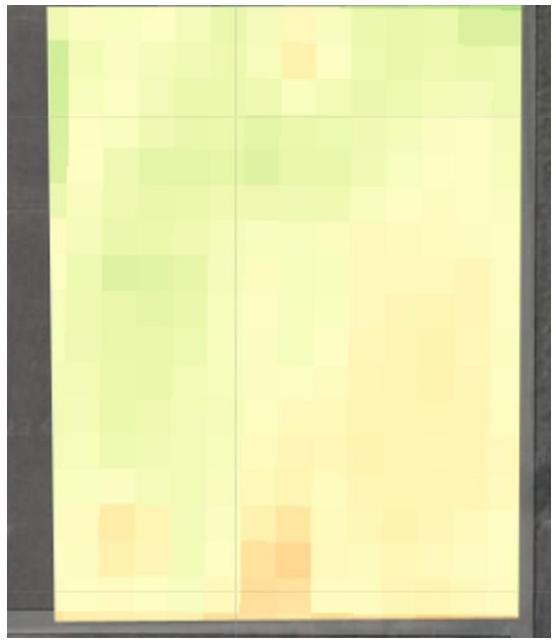
Scouts visit the flagged points and confirm the cause: insect attack, poor germination, low nitrogen or weeds.

3 · Act

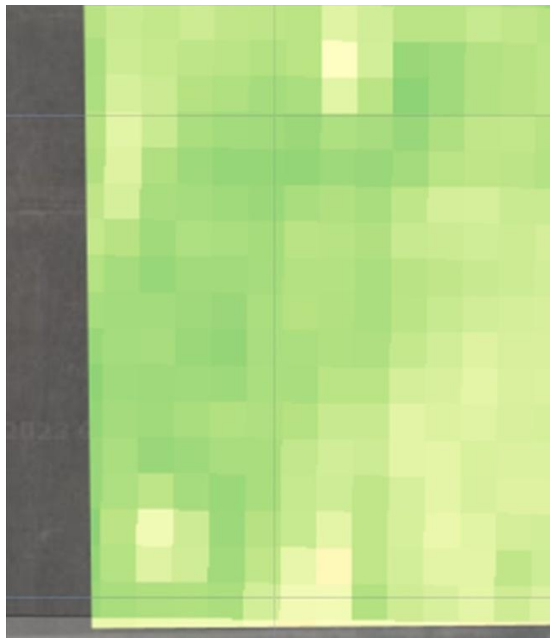
Treatment, fertiliser and irrigation go only where they are needed, with a geotagged record of every visit.

Case Study: Targeted Scouting in Rajanpur

A stressed cotton field was flagged, scouted and treated, and the recovery was confirmed from space ten days later.



22 Jun 2023 · stress index 0.40



02 Jul 2023 · stress index 0.55

The alert

On 22 June the crop-stress index flagged a weak zone. Low moisture and a high risk of whitefly were identified as the likely causes.

The response

Precise locations were sent to the farmer for scouting and remedial action, supported by agro-met data for the same period.

The result

By 2 July the index rose to 0.55 and the canopy turned visibly greener, measurable proof that the intervention worked.

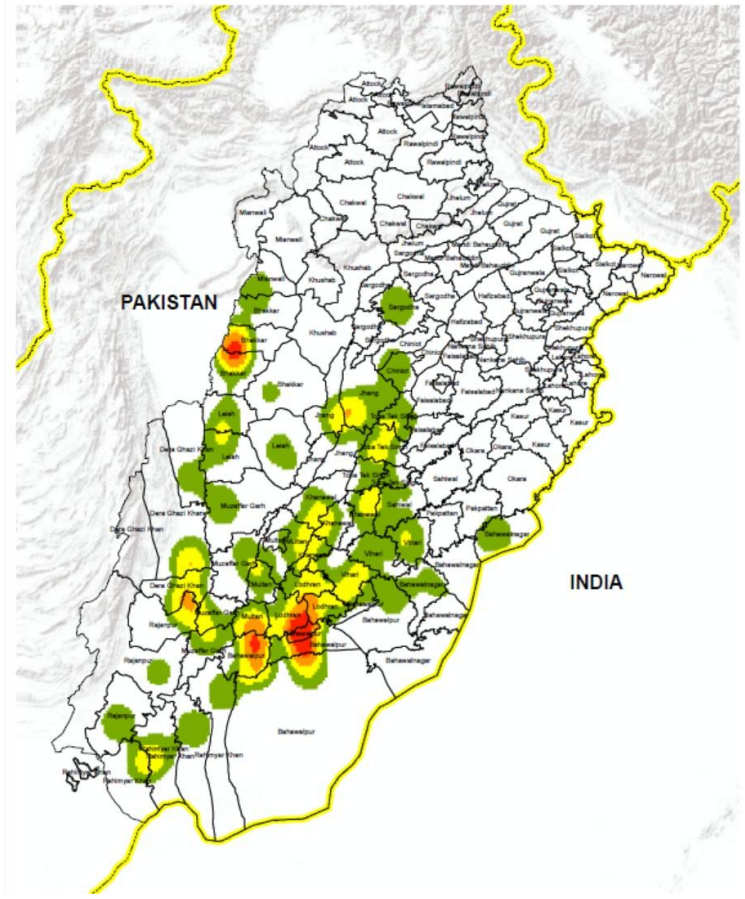
0.40 → 0.55
Crop stress index in 10 days

0.60–0.65
Target for this crop stage

10 days
From alert to confirmed recovery

Cotton Pest Intelligence: Hotspots & One-Week Forecast

Infestation hotspots are mapped across Punjab and whitefly risk is forecast a week ahead for the cotton belt.



Insect infestation hotspots · Punjab



Whitefly forecast · 21–28 Sep · Bahawalpur, Multan & Sahiwal

Hotspot analysis

Reported infestations are turned into hotspot surfaces, showing where pest pressure concentrates.

One week ahead

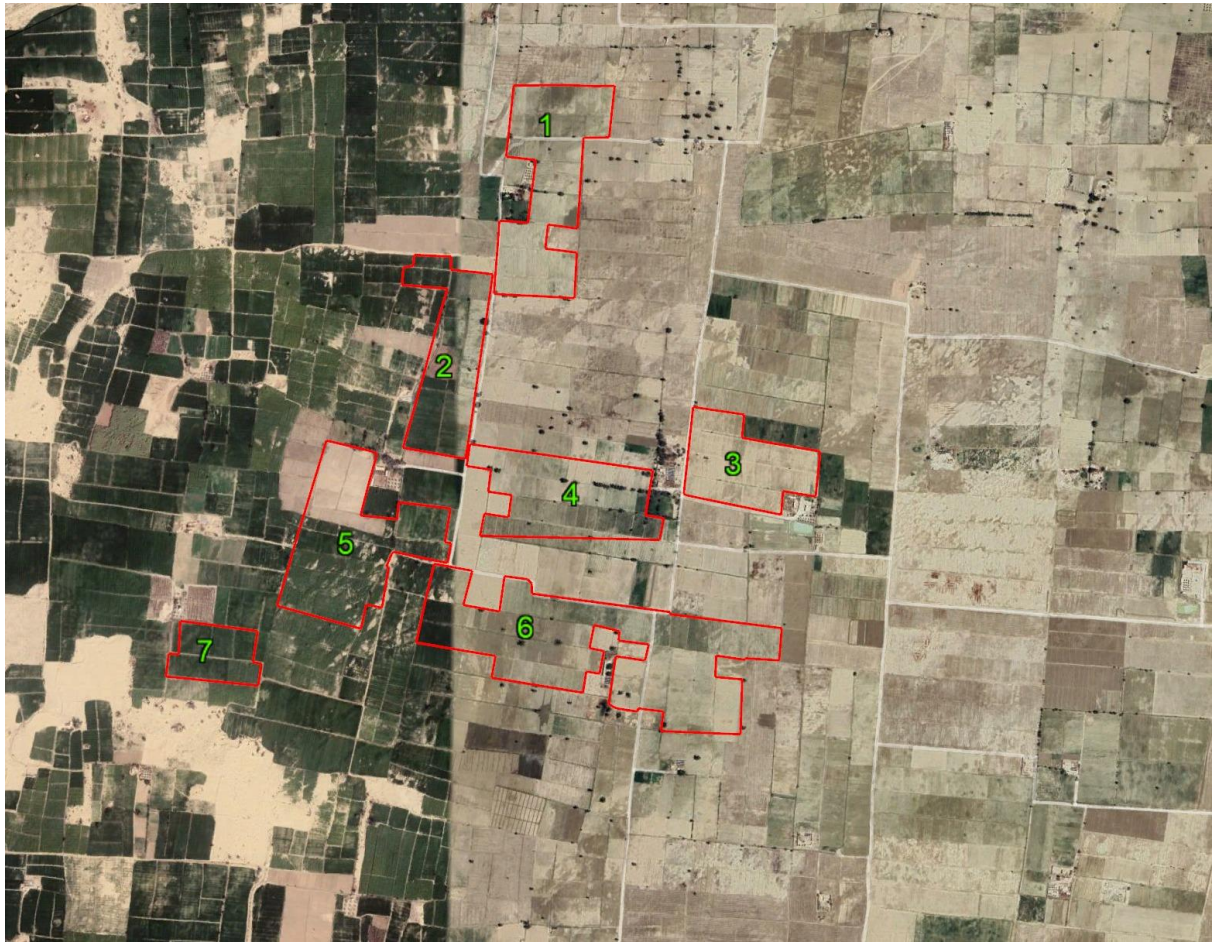
Forecast maps rank risk as high (red) or medium (beige) for the coming week, before damage spreads.

Where to act first

Highest risk ran along Multan, Bahawalpur and Rahim Yar Khan, with medium risk in Khanewal, Sahiwal and Vehari.

Varietal Performance from Space: Rohi, Cholistan

Seven cotton blocks under three varieties are monitored side by side, so performance is compared field by field.



Rohi Cholistan cotton blocks · fields 1–7

Field	Variety	Area (acres)
1	FH-333	26.75
2	SS-102	19.26
3	NSS-32	16.26
4	SS-102	22.97
5	FH-333	28.80
6	FH-333	49.77
7	FH-333	8.03
Total	**3 varieties**	**171.84**

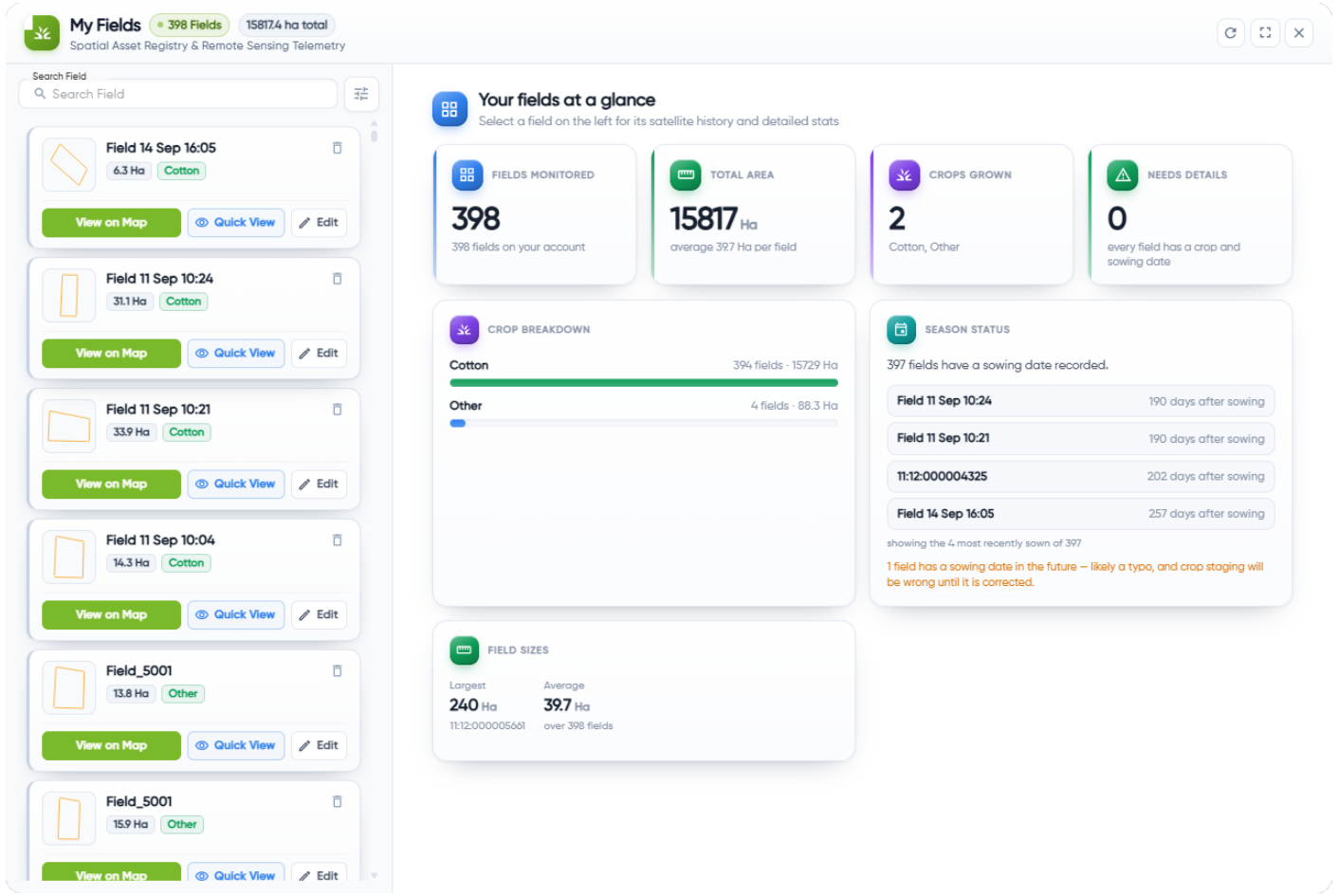
113.35 ac
FH-333 · 4 fields

42.23 ac
SS-102 · 2 fields

16.26 ac
NSS-32 · 1 field

Cotton Monitoring in Uzbekistan: 398 Fields

An operational Sentinel-2 monitoring programme covering 15,817 hectares of cotton fields in Uzbekistan.



My Fields · field registry and season status · Uzbekistan 2026

398
Fields registered and monitored

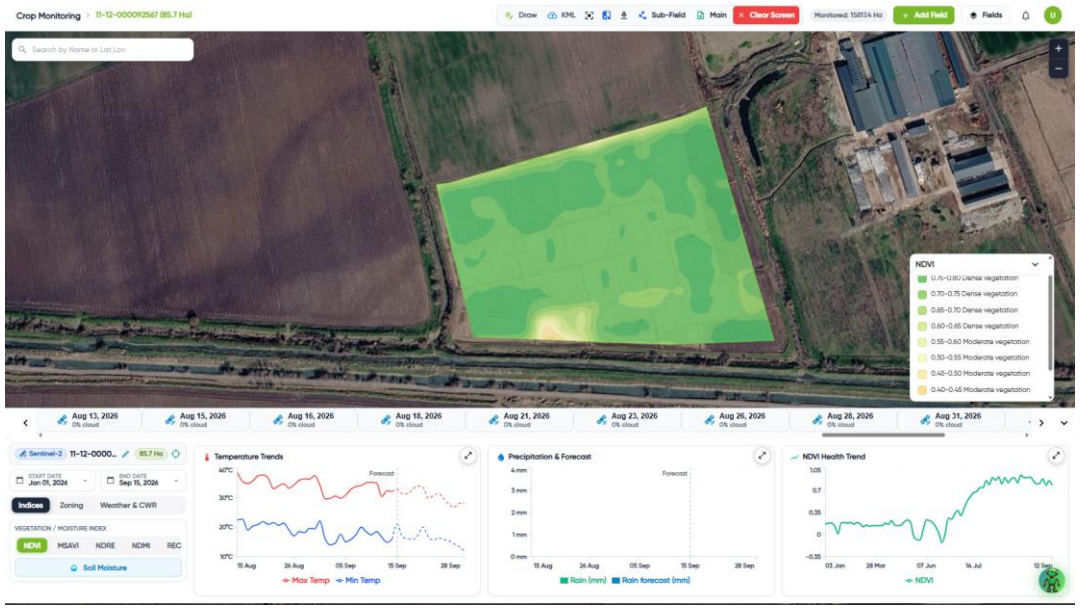
15,817 ha
Total area · average 39.7 ha per field

394 fields
Cotton · 15,729 ha of the monitored area

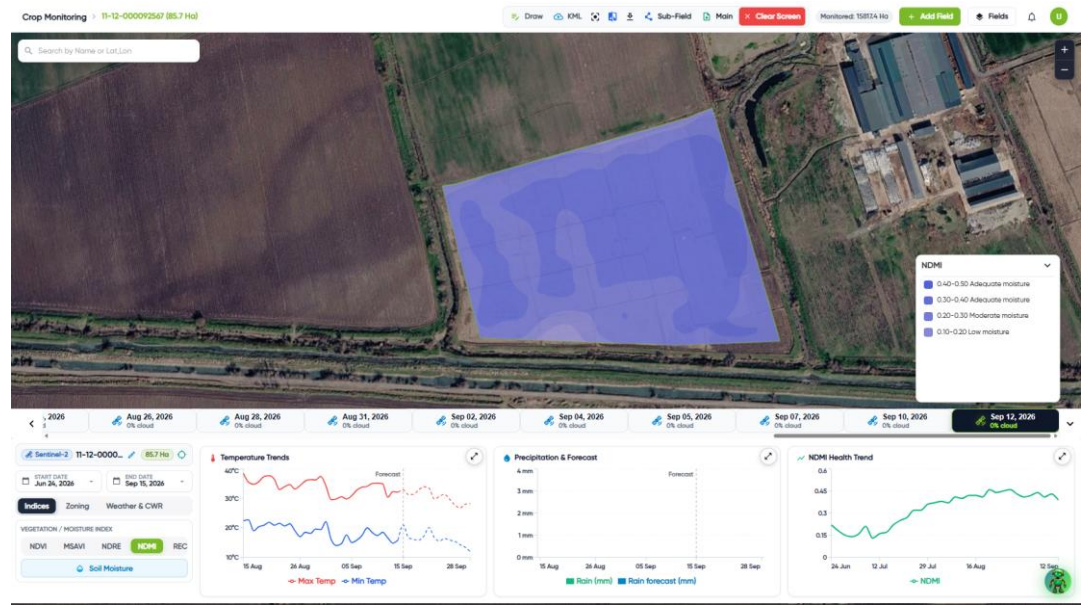
Sentinel-2
Clear-sky imagery every few days

Uzbekistan: Within-Field Vigour & Moisture

NDVI and NDMI maps for an 85.7-hectare cotton field, read together with temperature, rainfall and index trends.



NDVI · crop vigour · August 2026



NDMI · canopy moisture · 12 Sep 2026

Within-field variability

Most of the field shows dense vegetation (NDVI 0.60–0.80), with a weaker patch on the southern edge to scout.

Moisture status

Canopy moisture sits mainly in the adequate classes (NDMI 0.30–0.50), with lighter patches to check first.

Irrigation-led season

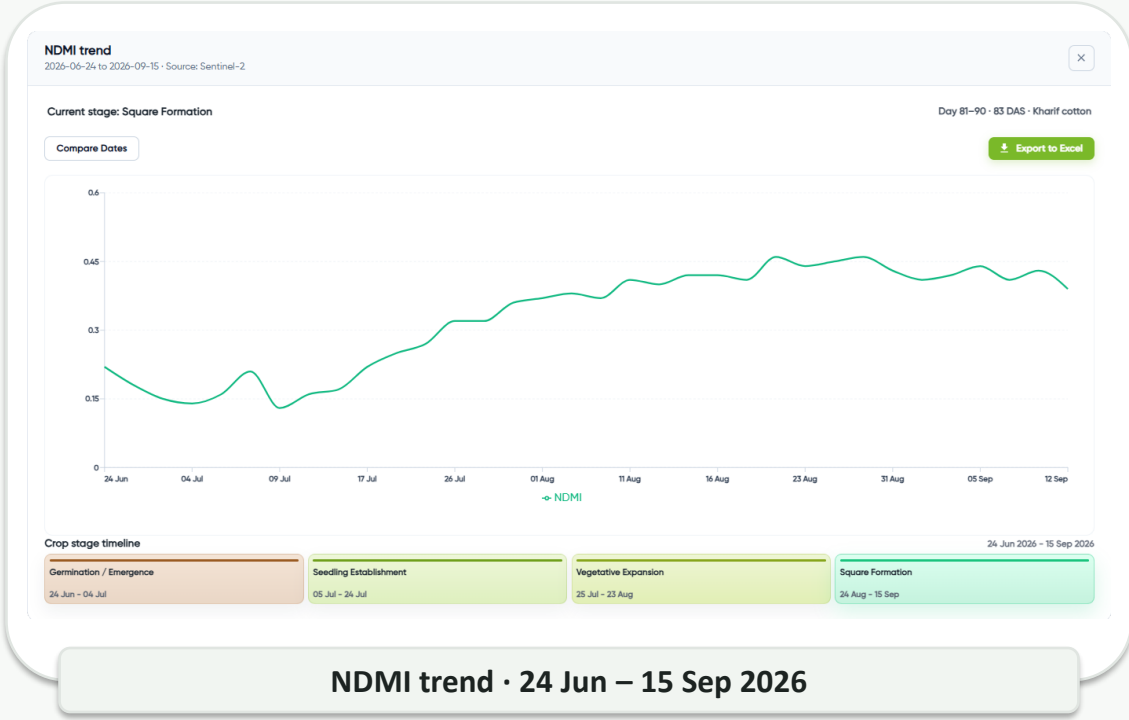
Daytime highs of 30–38 °C and no measurable rain from mid-August, so moisture reflects irrigation.

Uzbekistan: Cotton Growth Tracked by Crop Stage

Every observation is linked to days after sowing, so vigour and moisture are read against the expected cotton stage.



NDVI trend · 24 Jun – 15 Sep 2026



NDMI trend · 24 Jun – 15 Sep 2026

Emergence

24 Jun – 04 Jul

NDVI 0.24–0.38

Seedling

05 – 24 Jul

NDVI 0.30 → 0.74

Vegetative

25 Jul – 23 Aug

NDVI peak 0.93

Square formation

24 Aug – 15 Sep

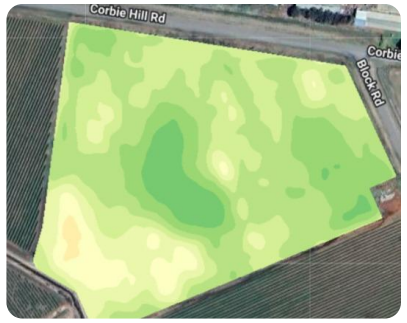
NDVI 0.78–0.91 · day 83

Field Monitoring Case Studies: Australia & Tunisia

Citrus, Pasture, Olive and Mango Orchards monitored with satellite and drone imagery, from vigour alerts to site-specific management zones.

Citrus Orchard, Australia: Daily Vigour Monitoring

A 9.5-hectare citrus orchard tracked through September 2024, where a sudden NDVI drop was flagged and followed up within days.



NDVI 0.64
06 Sep 2024



NDVI 0.63
13 Sep 2024



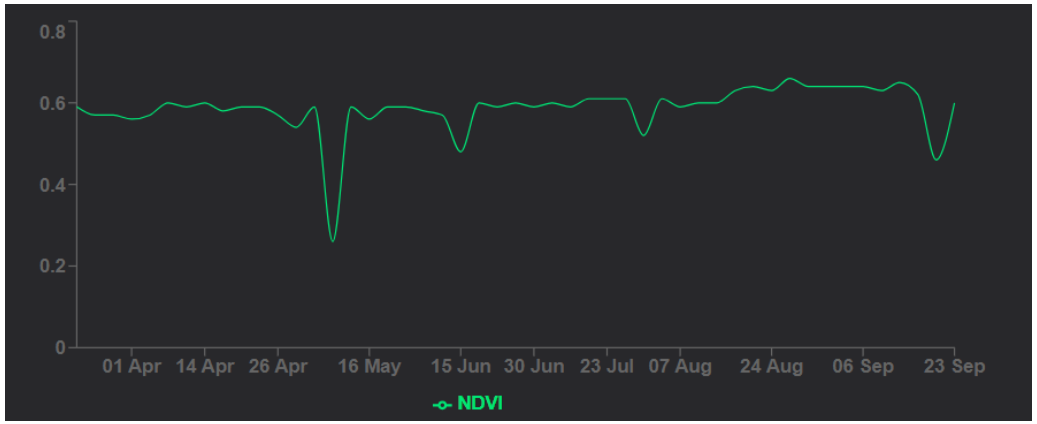
NDVI 0.65
16 Sep 2024



NDVI 0.46
21 Sep 2024



NDVI 0.60
23 Sep 2024



NDVI history of the orchard, April to September 2024

Expected range

NDVI in this orchard should sit between 0.40 and 0.55 in September.

Alert on 21 September

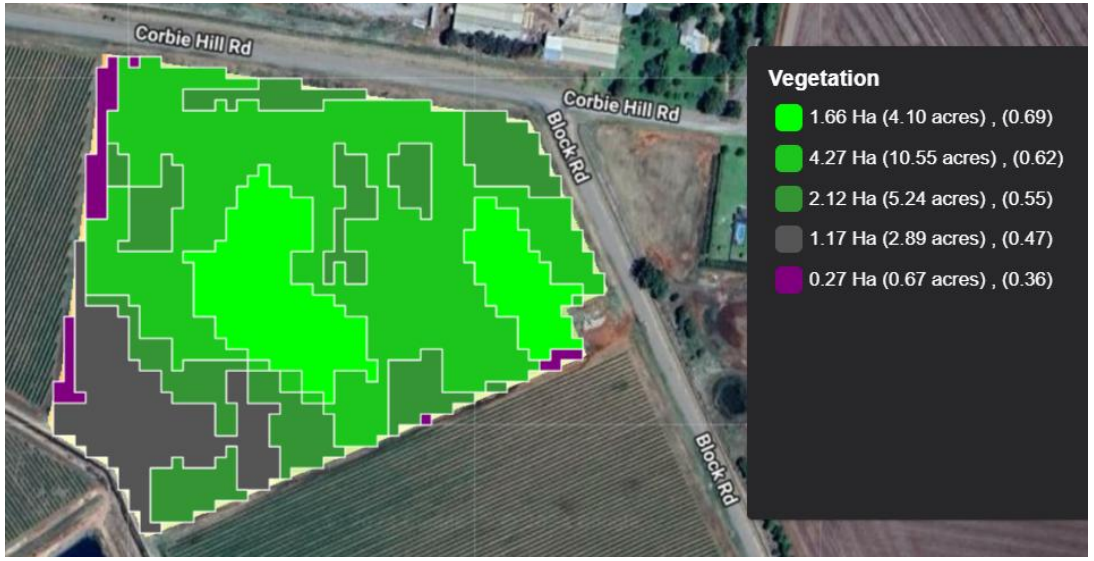
NDVI fell by 0.19 to 0.46, so the patch was flagged for attention.

Recovery on 23 September

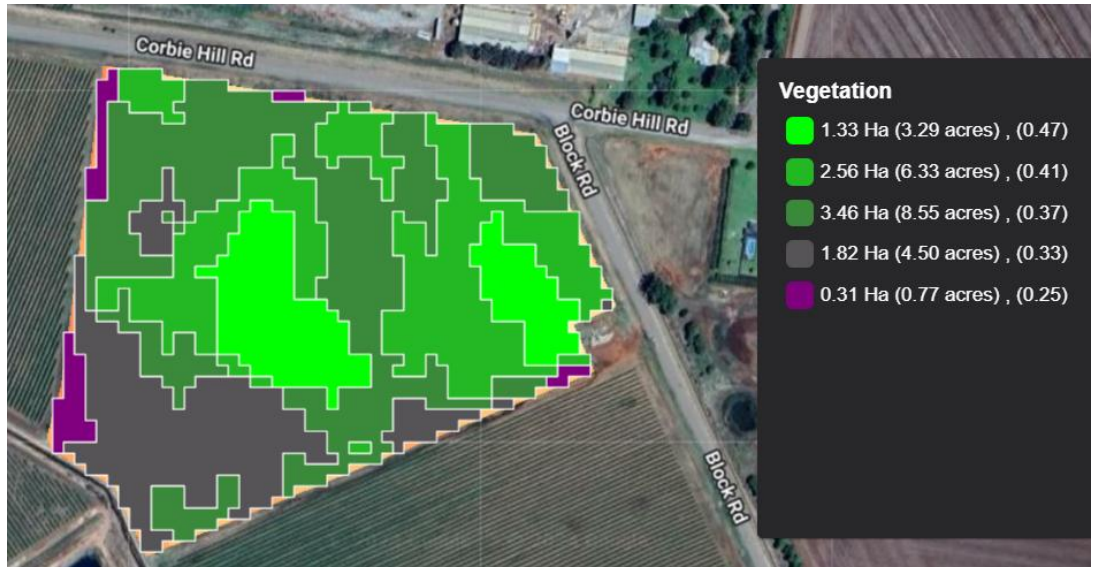
Back to 0.60; the next image is checked before any action.

Citrus Orchard, Australia: AI Management Zones

The ESS expert system separates good and weak patches of the orchard, so each zone gets site-specific management.



NDVI zones · 13 September 2024 · area and mean value per zone



NDRE zones · 13 September 2024 · chlorophyll response

Healthy

Bright green zones: vigorous trees with greener canopies.

Moderate

Dark green zones: moderate canopy that needs attention and can improve readily.

Low / sparse

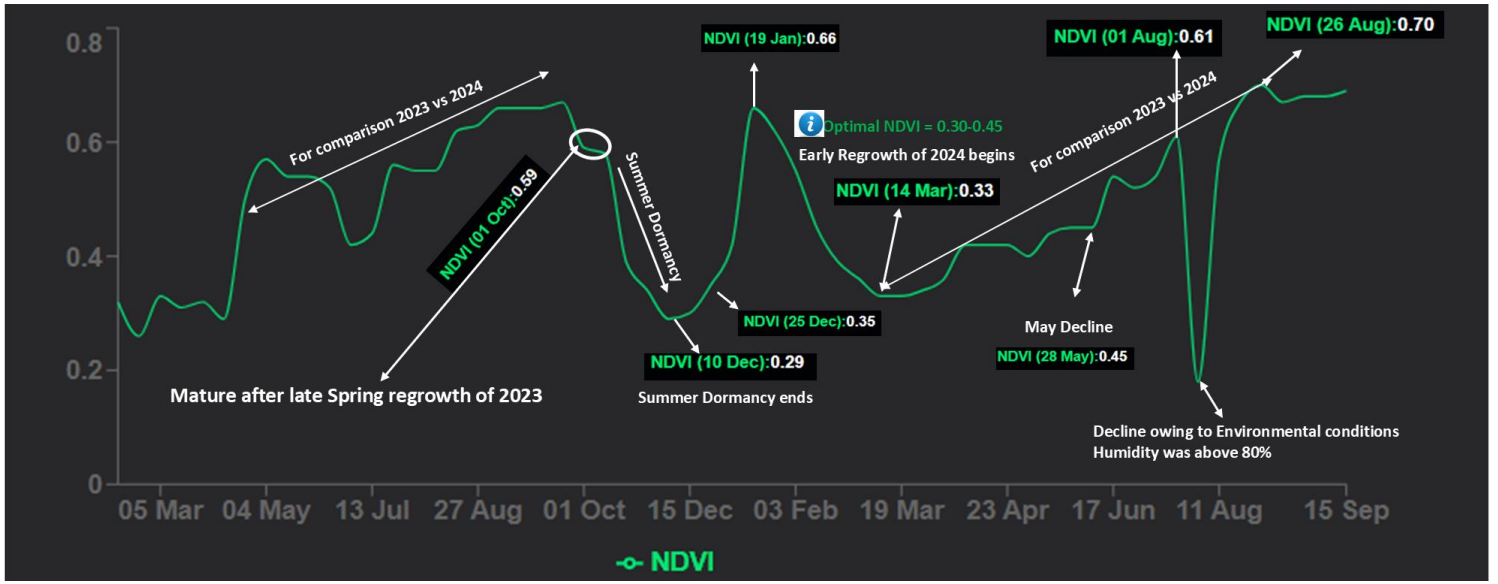
Purple zones: smaller or less green canopy. Here it is the field edge, so no concern.

Pasture Paddock, Australia: Two Seasons of Vigour

NDVI from February 2023 to September 2024 follows maturity, summer dormancy, early regrowth and spring growth.



Paddock NDVI · 20 September 2024



NDVI time series · February 2023 to September 2024

0.33
14 Mar 2024 · early regrowth, within the 0.30–0.45 optimum

0.70
26 Aug 2024 · peak regrowth

0.67
20 Sep 2024 · spring growth continues

80%+
Humidity behind the sharp August dip

Olive Orchard, Tunisia: Water Management in MENA

A 6.9-hectare olive orchard in a water-scarce region, monitored with moisture, chlorophyll and vegetation indices alongside weather since 2021.

OPTIMAL WATER MANAGEMENT · TUNIS



NDMI canopy moisture with weather and index history



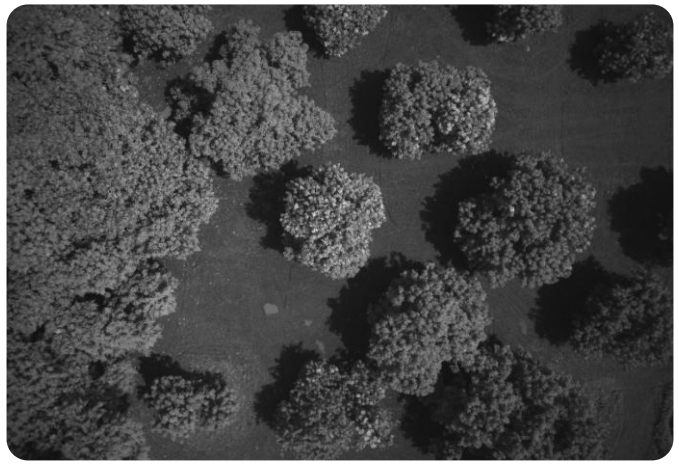
NDRE chlorophyll response



MSAVI vegetation density

High-Precision Mango Orchard Mapping

Drone multispectral imagery and a deep learning pipeline map individual mango trees, published as an Editor's Choice paper in Remote Sensing (2024).









Platform

DJI Matrice 300 RTK drone with a MicaSense Dual Altum-PT multispectral sensor.

Method

A deep learning pipeline that combines object detection and segmentation for each tree.

PUBLISHED RESEARCH · EDITOR'S CHOICE

Use of the right technology with a thoughtful research programme

Afsar, M. M. et al. (2024). High-Precision Mango Orchard Mapping Using a Deep Learning Pipeline Leveraging Object Detection and Segmentation. Remote Sensing 16(17), 3207.

AI Driven Advisory

Farmer-facing advisory and conversational AI products for last-mile knowledge delivery.

ESS GeoFarm

GreenBot LLM

ESS GeoFarm

Localized mobile advisory, field digitization, farmer support, weather context, and exportable recommendations.

ESS GeoFarm: Localized Advisory for a Sugarcane Field

Mobile-first advisory built for farmers and field teams, with Urdu guidance and practical action sections.

Why it matters

ESS GeoFarm completes the journey from monitoring and interpretation to last-mile guidance that growers and field officers can use directly.

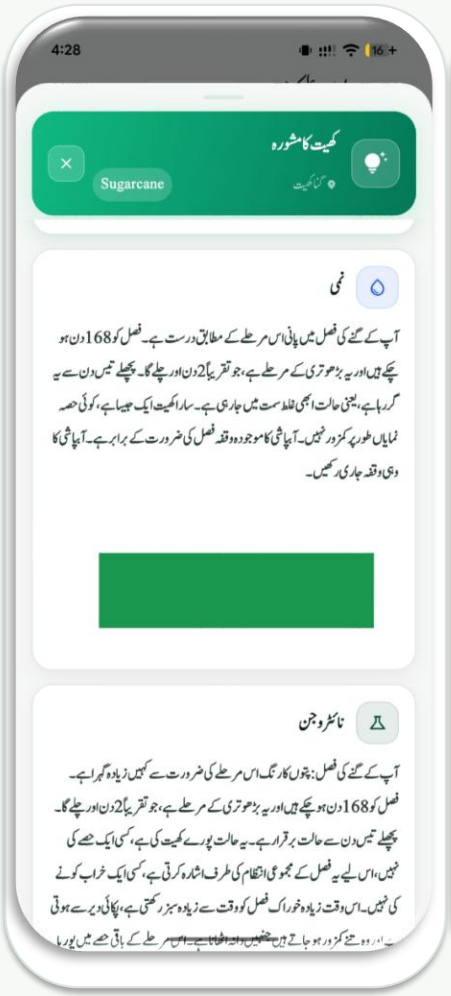
- Urdu-language advisory
- Weather and farm details
- Crop-stage recommendations
- Downloadable PDF / Word outputs

Mark a field by walking it

Farmers and field officers capture a boundary by walking the edge of the field with the phone, so plots are digitized on the spot.



Home + weather



Moisture + nitrogen



Vigour advisory



Pest guidance

ESS GeoFarm Advisory Workflow

A clear delivery model: crop intelligence is converted into localized advisory outputs.

1

Field + Crop Context

Crop, sowing date, stage, location

2

Monitoring Intelligence

Moisture, vigour, nitrogen, pests, weather

3

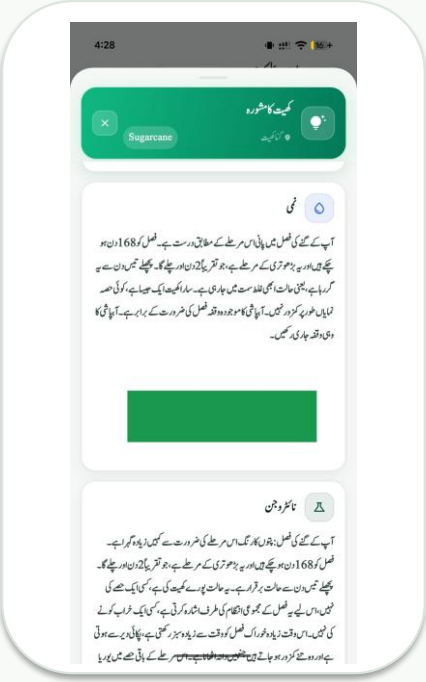
Localized Advisory

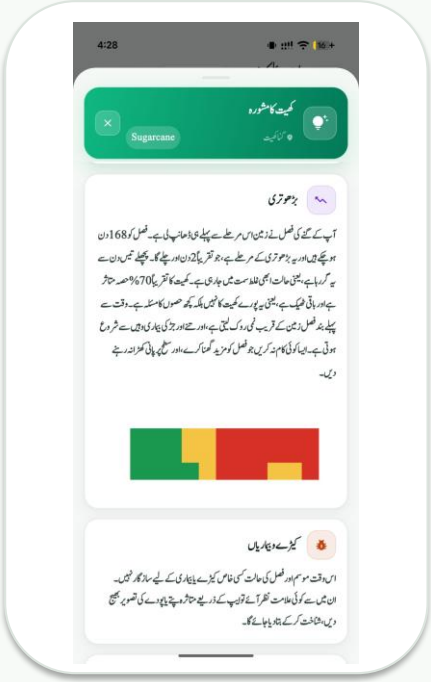
Urdu recommendations with practical instructions

4

Export & Share

PDF / Word outputs for records and field teams





Who it serves

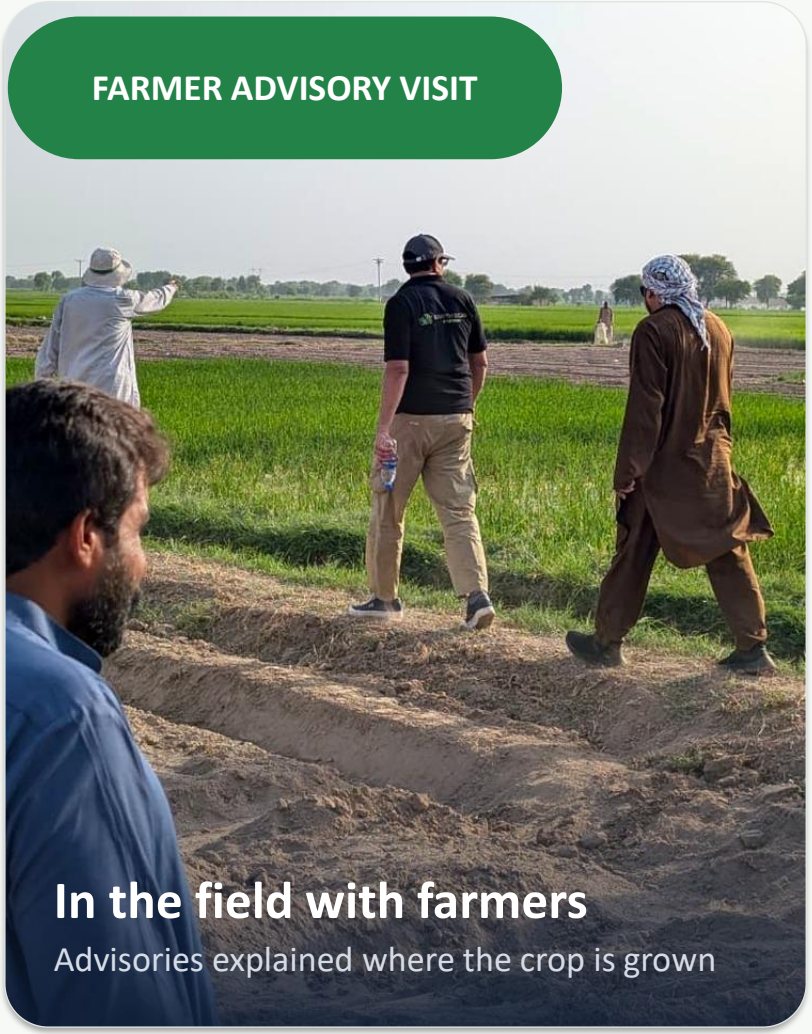
Supports sugar supply chains, corporate farms, public extension programs, and donor-backed field advisory projects.

Product synergy

Works with Crop Precision Monitoring, DSS rules, GreenBot, farmer digitisation and field-service workflows.

ESS GeoFarm: Guidance on the Ground

Our team works with farmers in their own fields, showing how to read GeoFarm advisories and turn them into action.



Walk the field together

Field teams visit farms and assess crop conditions side by side with the farmer.

Explain the advisory

Farmers learn to open GeoFarm and read Urdu advisories, weather and crop-stage guidance.

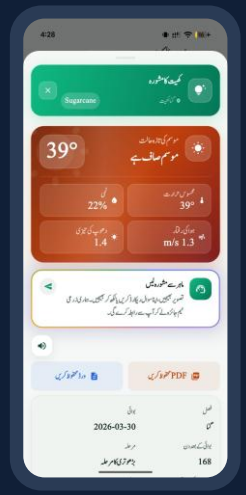
Act and follow up

Recommended actions are agreed on the spot and followed through the season.

FROM APP TO ACTION

Technology farmers actually use

- Hands-on onboarding for farmers and field officers
- Urdu advisories explained in the context of the field
- Field feedback strengthens future recommendations



GreenBot – ESS LLM

Conversational crop intelligence for multilingual, voice-enabled, farmer-friendly agricultural advisory.

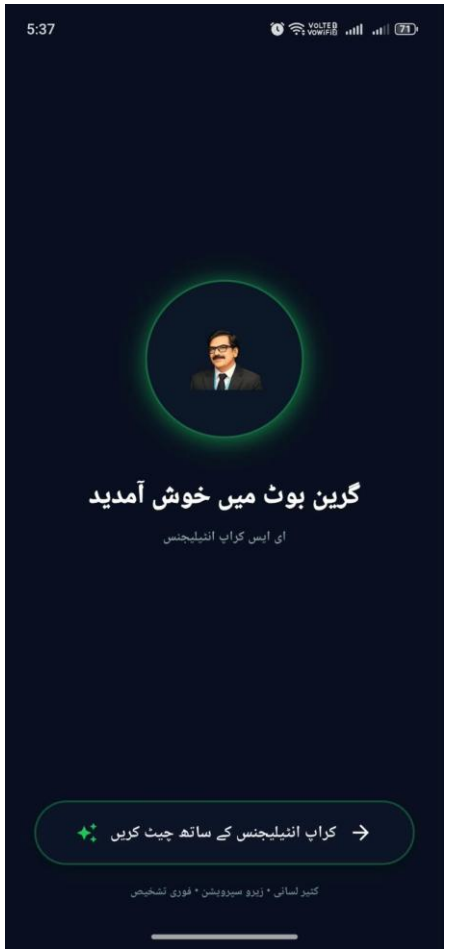
GreenBot: Conversational Crop Intelligence Assistant

An LLM-based mobile assistant where farmers and field teams can ask agriculture questions in natural language.

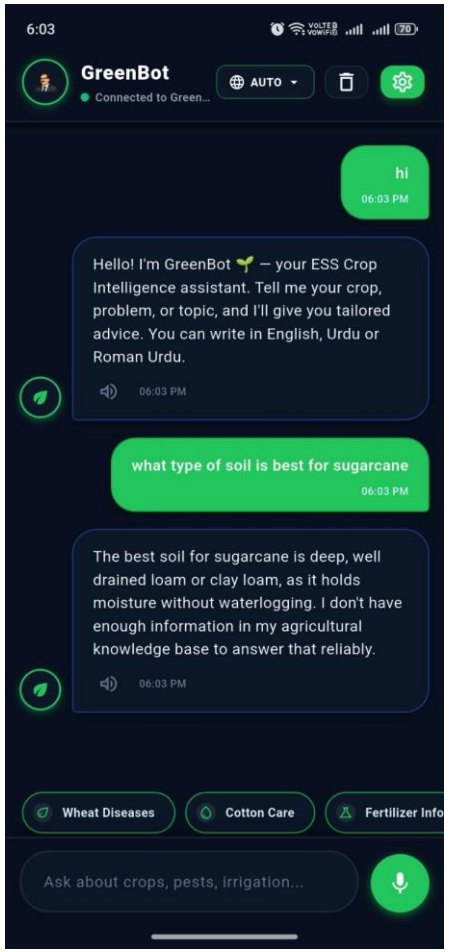
Product summary

GreenBot brings ESS intelligence into a chat-based interface. Users can ask questions about crops, pests, irrigation, fertilizer, diseases, and field decisions, then receive practical advisory responses.

- Ask any crop or farm question
- Supports Urdu / auto language experience
- Voice input for farmer-friendly use
- Connects with advisory and monitoring outputs



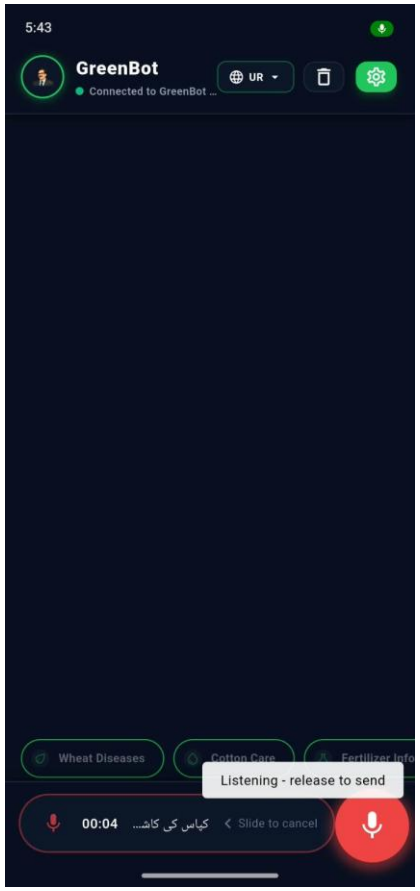
Welcome screen



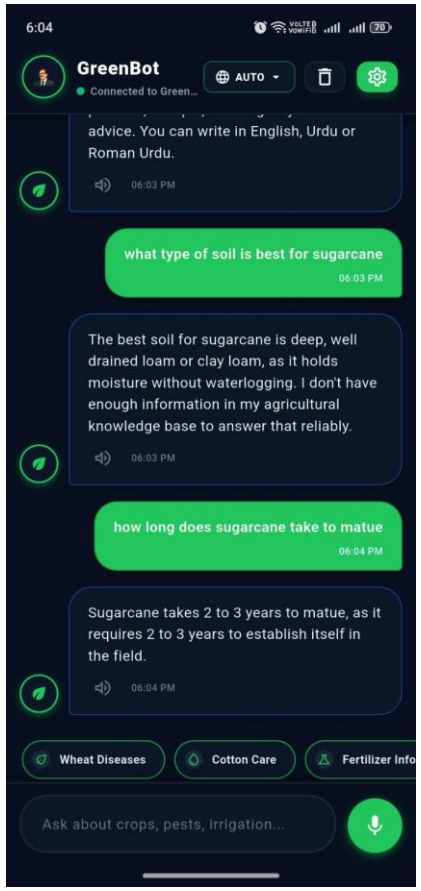
Question-answer advisory conversation

GreenBot: Multilingual Voice & Farmer-Friendly Interaction

The interface supports typed and voice-driven interaction, making advisory delivery more accessible for field users.



Voice input interaction in Urdu



Sugarcane advisory with follow-up questions

Voice-first usability

Farmers can speak questions instead of typing, improving accessibility for advisory use in the field.

Multilingual advisory

Language switching and auto mode allow GreenBot to support localized crop communication.

Contextual response

The assistant keeps the conversation context, so farmers can ask follow-up questions without repeating their crop.

How GreenBot Fits the ESS Portfolio

GreenBot turns ESS data and agronomic knowledge into a simple question-answer experience for farmers, advisors, and field teams.

1. Last-mile intelligence

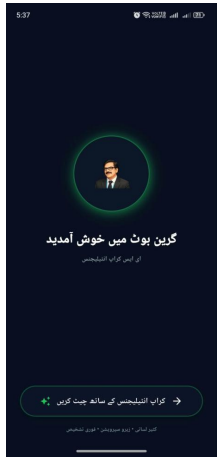
Converts technical monitoring and advisory data into conversational guidance that farmers can understand quickly.

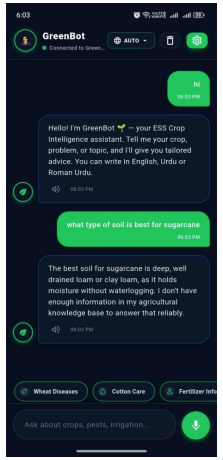
2. Cross-product assistant

Can support Crop Precision Monitoring, GeoFarm, CropKonnect, Crop ERP, and DSS workflows through natural-language interaction.

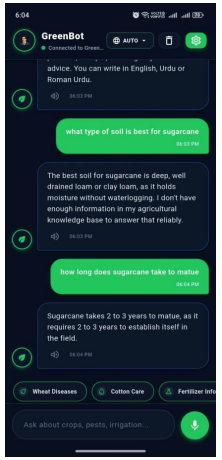
3. Strong adoption value

Voice, Urdu support, and simple mobile chat make the system easier to use beyond technical teams.









Positioning statement

GreenBot: LLM-powered crop intelligence assistant for multilingual, voice-enabled, farmer-friendly agricultural advisory.

Vegetation, Climate & Risk Intelligence

Vegetation and carbon monitoring, crop insurance, agri financing and climate intelligence, from observation to risk and long-term resilience.

- **Vegetation Monitoring**
- **Crop Insurance & Agri Financing**
- **Climate & Water Intelligence**

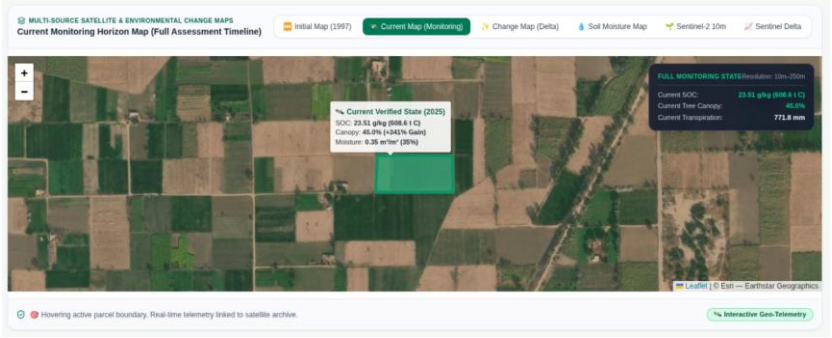
Vegetation Monitoring

Vegetation, land-cover, soil-hydrology and environmental change intelligence, powered by Carbon MRV analytics.

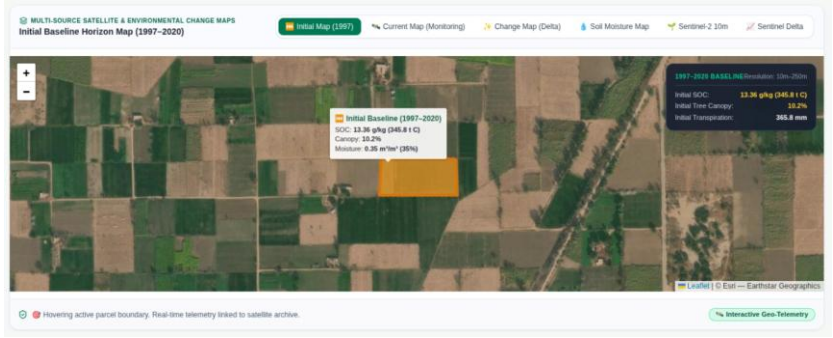
Open the Carbon MRV dashboard ↗

Vegetation Monitoring Overview

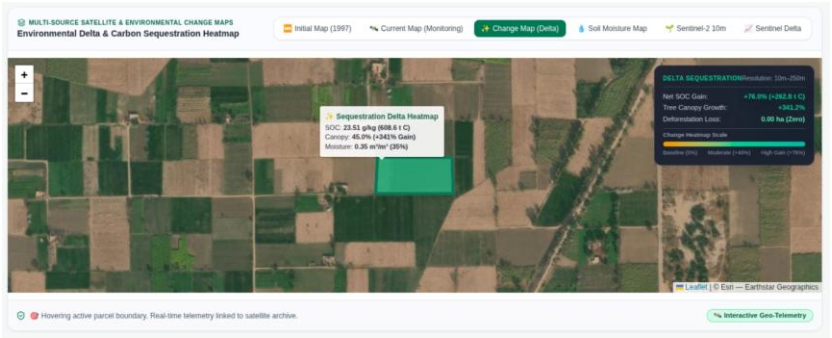
A multi-source monitoring environment for baseline, current state, delta change, soil moisture, and land-cover evidence.



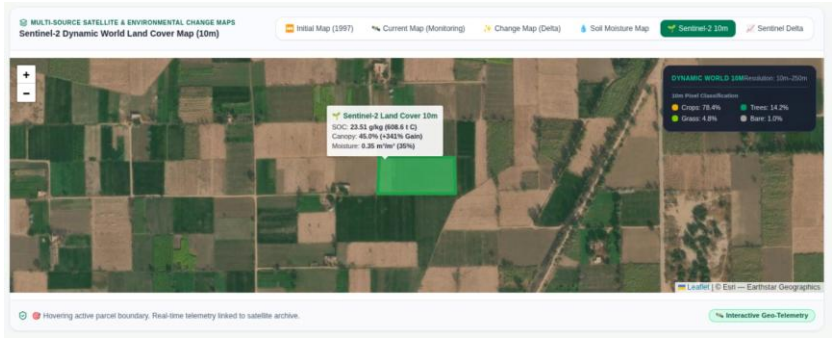
Current verified monitoring state



Initial baseline horizon



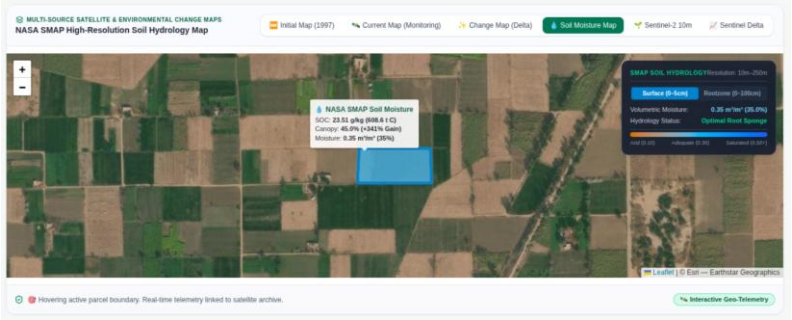
Environmental delta and sequestration



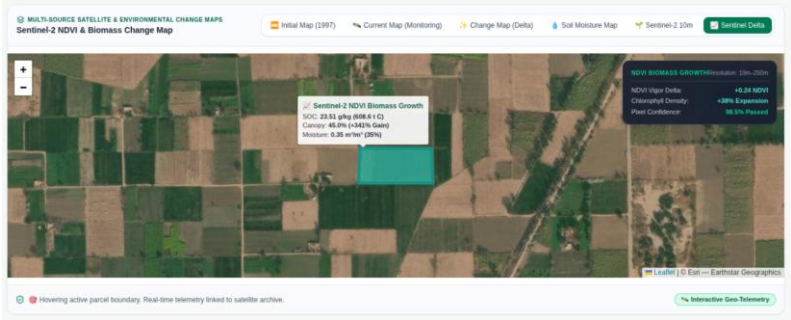
Sentinel-2 dynamic land cover

Vegetation Monitoring Layers

The platform connects carbon, canopy, soil hydrology, land cover, biomass, and terrain indicators.



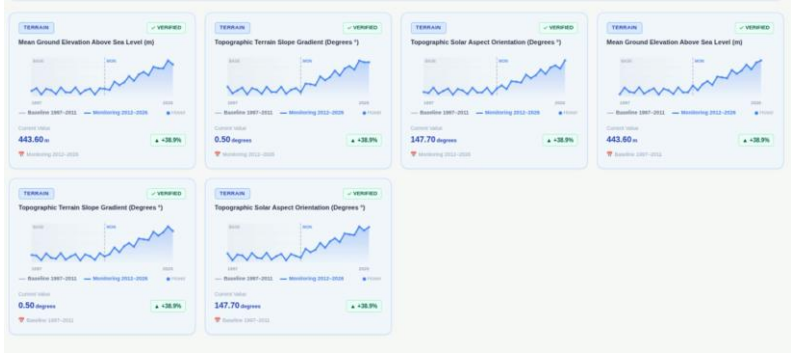
NASA SMAP soil hydrology



Sentinel-2 NDVI biomass change



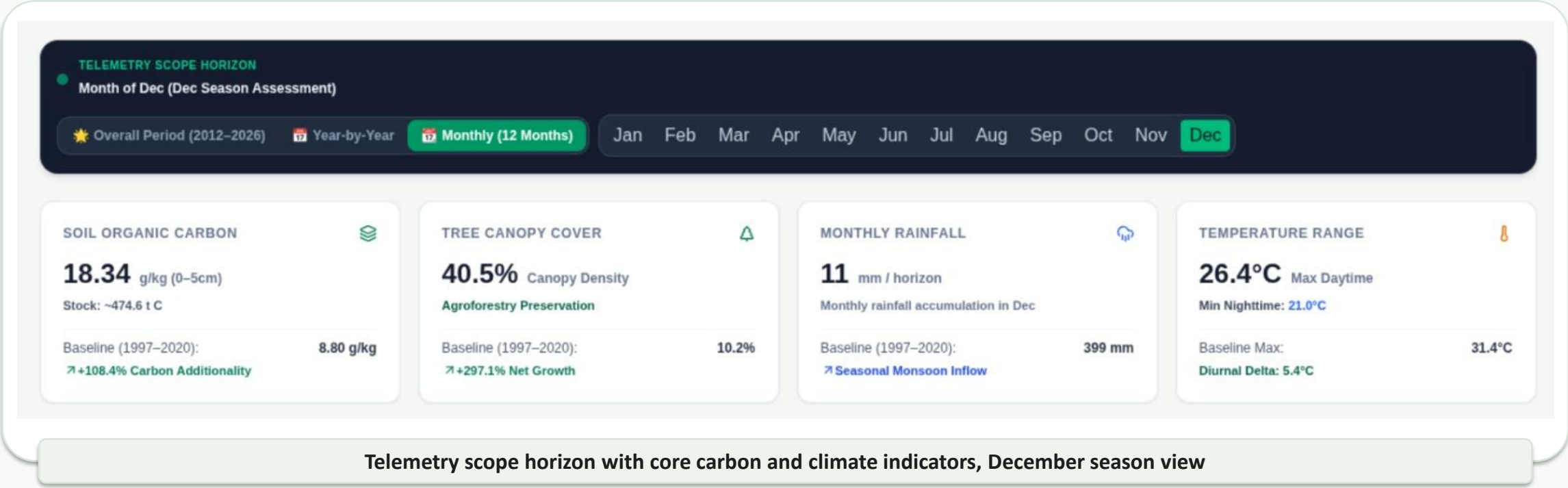
SOC, temperature, moisture and CO_2e progression



Terrain verification analytics

Carbon MRV: Monitoring Horizon & Core Indicators

A telemetry horizon selector moves analysts between full-period, year-by-year and monthly views of the same project.



Telemetry scope horizon with core carbon and climate indicators, December season view

Flexible time horizons

Switch between the overall 2012–2026 period, year-by-year results or any single month of the season.

Carbon & canopy at a glance

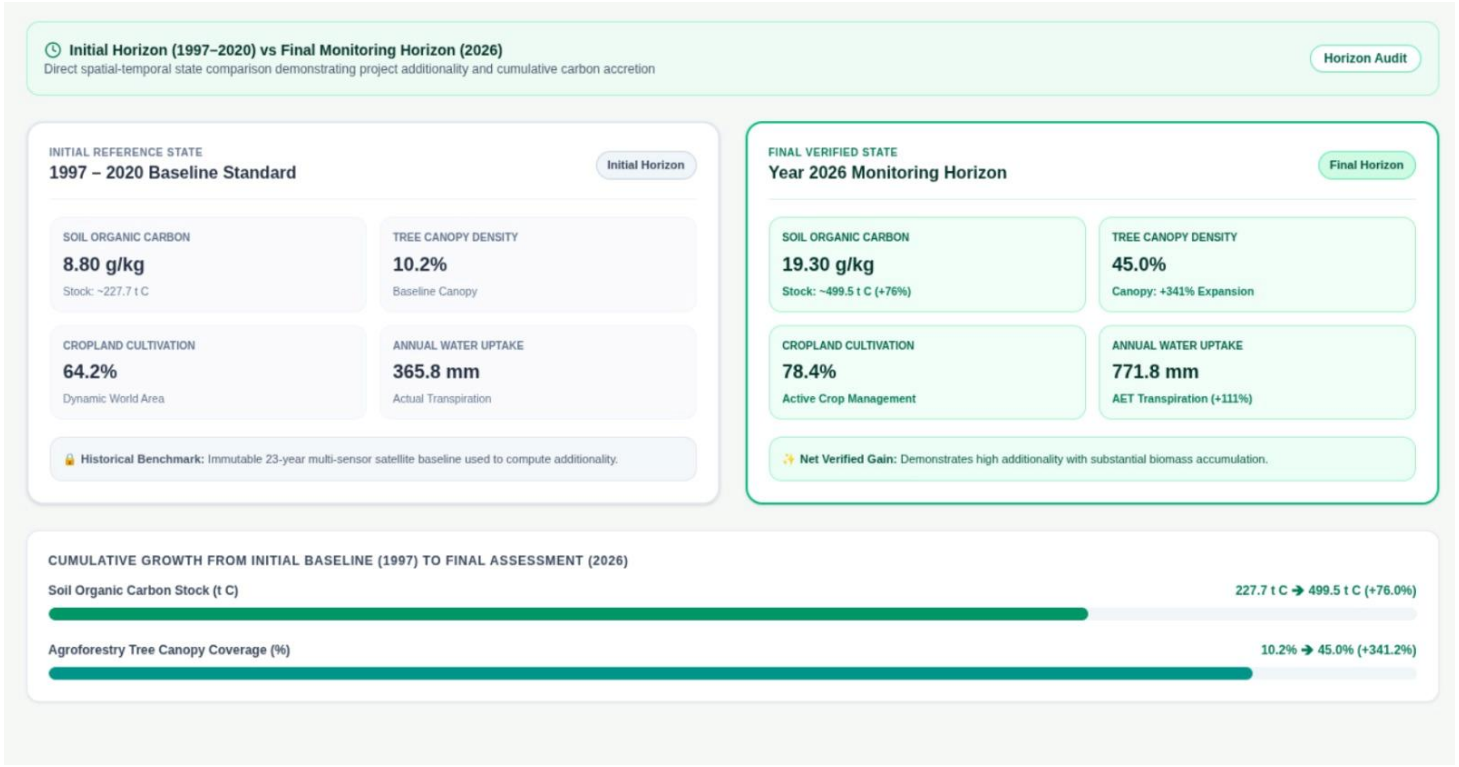
Soil organic carbon and tree canopy are compared with the 1997–2020 baseline, flagging additionality and net growth.

Climate context built in

Rainfall and temperature range sit alongside, so seasonal effects are not mistaken for project impact.

Carbon MRV: Baseline vs Final Monitoring Horizon

Additionality is demonstrated by comparing the 1997–2020 reference state directly with the verified 2026 state.



Initial horizon (1997–2020) vs final monitoring horizon (2026)

Soil carbon additionality

Soil organic carbon rises from 8.80 to 19.30 g/kg, lifting the estimated stock from about 227.7 t C to 499.5 t C (+76%).

Canopy & land-use change

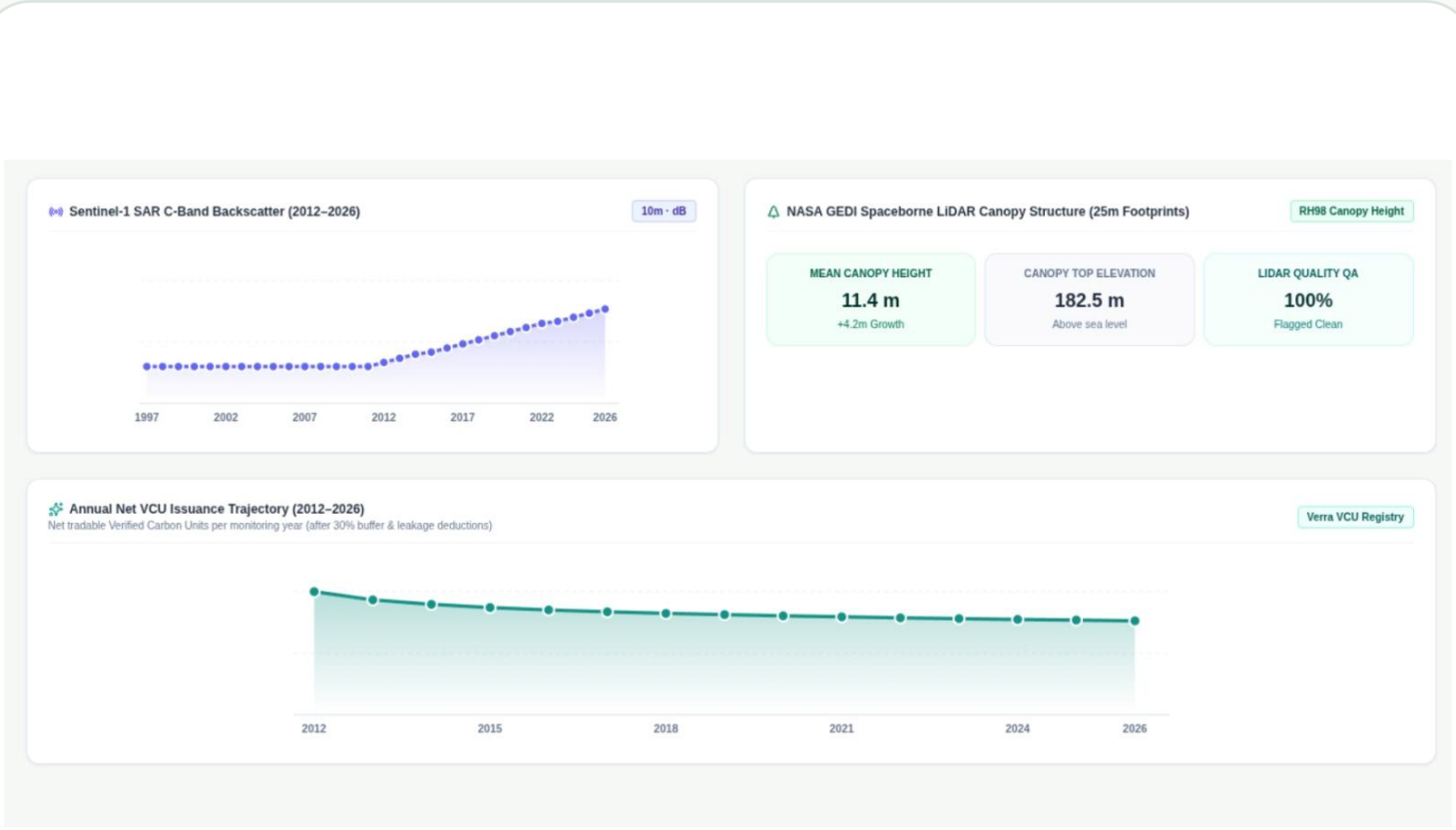
Tree canopy density expands from 10.2% to 45.0%, while active cropland grows from 64.2% to 78.4% of the project area.

Water use & audit trail

Actual water uptake rises from 365.8 to 771.8 mm (+111%), backed by an immutable 23-year multi-sensor baseline.

Carbon MRV: Multi-Sensor Evidence Stack

Radar, spaceborne LiDAR and registry-aligned credit tracking combine into independent lines of evidence.



Sentinel-1 SAR, NASA GEDI LiDAR and annual VCU issuance

Sentinel-1 SAR backscatter

C-band radar at 10 m sees through cloud and tracks biomass structure; the signal climbs steadily from 2012 to 2026.

NASA GEDI LiDAR

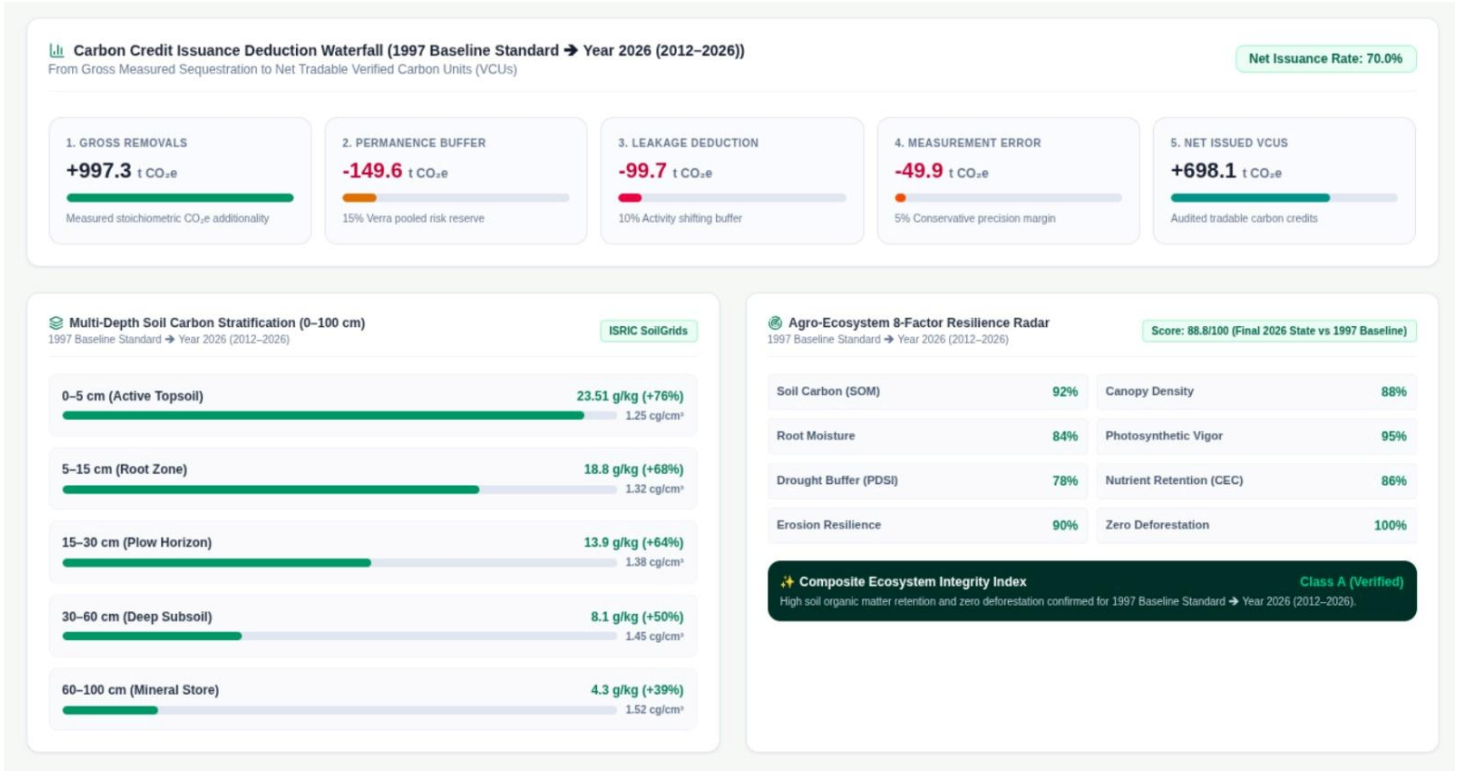
Spaceborne LiDAR measures a mean canopy height of 11.4 m (+4.2 m growth), with 100% of footprints passing quality checks.

VCU issuance trajectory

Net tradable Verified Carbon Units are tracked for each monitoring year after the 30% buffer and leakage deductions.

Carbon MRV: Credit Accounting & Ecosystem Integrity

Gross removals are converted into audited, tradable credits and backed by soil-depth and resilience evidence.



Credit deduction waterfall, soil carbon stratification and resilience radar

Transparent credit waterfall

997.3 t CO_2e of gross removals becomes 698.1 t CO_2e of net issued VCUs after permanence, leakage and uncertainty deductions, a 70% net rate.

Soil carbon by depth

ISRIC SoilGrids stratification shows carbon gains in every layer, from +76% in the 0–5 cm topsoil to +39% at 60–100 cm.

Ecosystem integrity

An 8-factor resilience index scores the site 88.8/100 (Class A, Verified), including 100% zero-deforestation compliance.

Carbon MRV: Climate & Water Balance Context

Monthly temperature extremes and the rainfall–evapotranspiration balance place carbon gains in climate context.



Monthly temperature extremes and water balance, calendar year 2025

Temperature extremes

Daytime maximum and night-time minimum are tracked for all 12 months; December records 26.4 °C by day and 21.0 °C at night.

Water balance

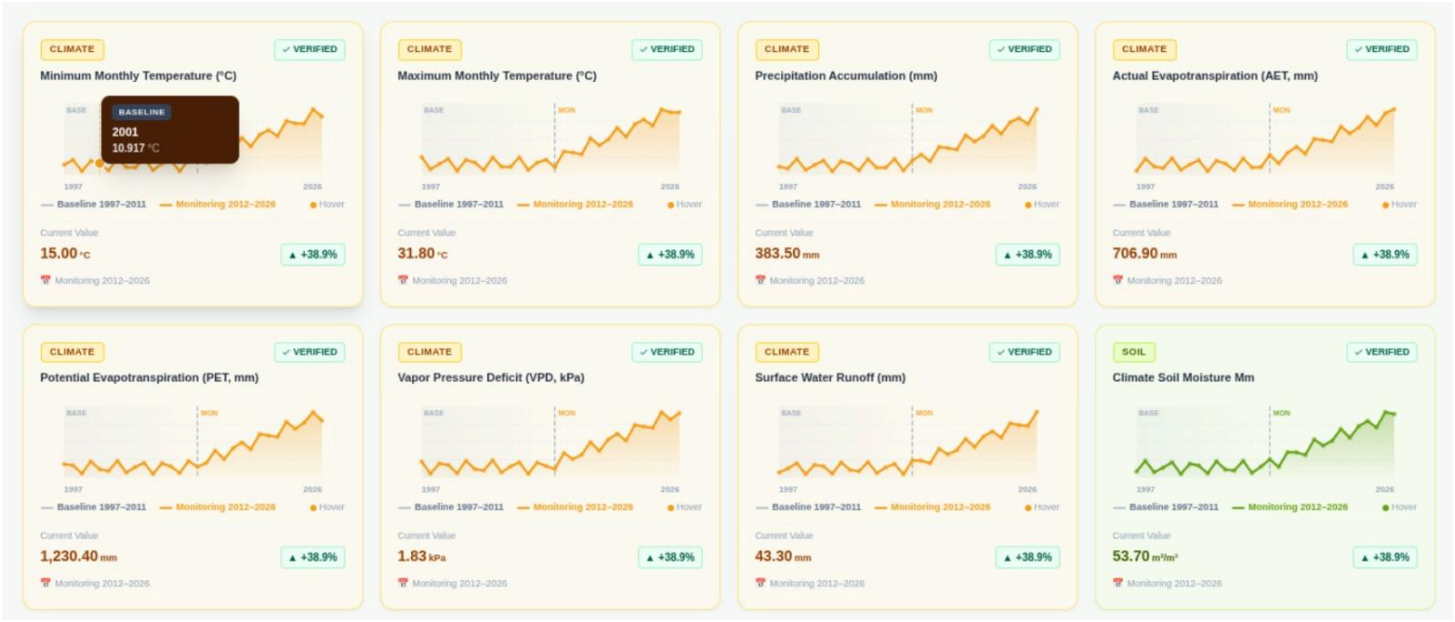
Monthly rainfall is set against actual evapotranspiration, showing how much water the vegetation uses. Both peak in the July monsoon.

Why it matters

Separating climate-driven variation from project impact strengthens the additionality case and supports conservative credit claims.

Carbon MRV: Verified Climate & Soil Indicator Cards

Each indicator is traced from the 1997–2011 baseline through the 2012–2026 monitoring period and marked as verified.



Verified climate and soil indicator cards: baseline vs monitoring

Eight tracked indicators

Minimum and maximum temperature, precipitation, actual and potential evapotranspiration, vapour pressure deficit, runoff and soil moisture.

Baseline vs monitoring

Every card plots the 1997–2011 baseline against the 2012–2026 monitoring period, with hover values for any year.

Verification-ready

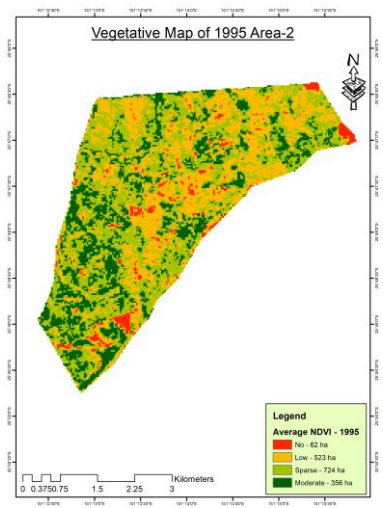
Verified status badges and current values make each indicator ready for audit packs and third-party verification.

Carbon MRV: Historical Baselines from 1990

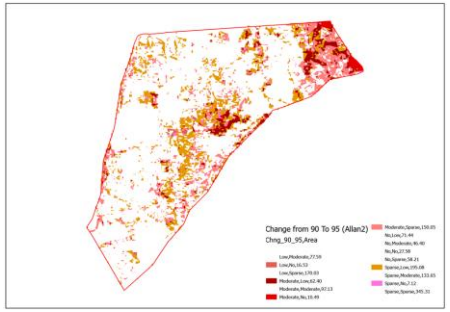
Archive satellite analytics reconstruct vegetation back to 1990, revealing decline and land clearing long before a project starts.



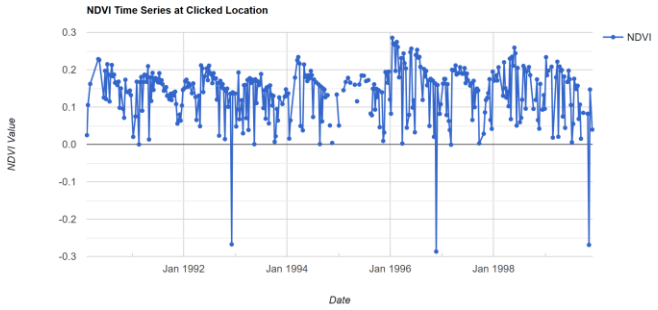
NDVI analytics app · 1990 to 2000 archive



Vegetation map, 1995



Change, 1990 to 1995

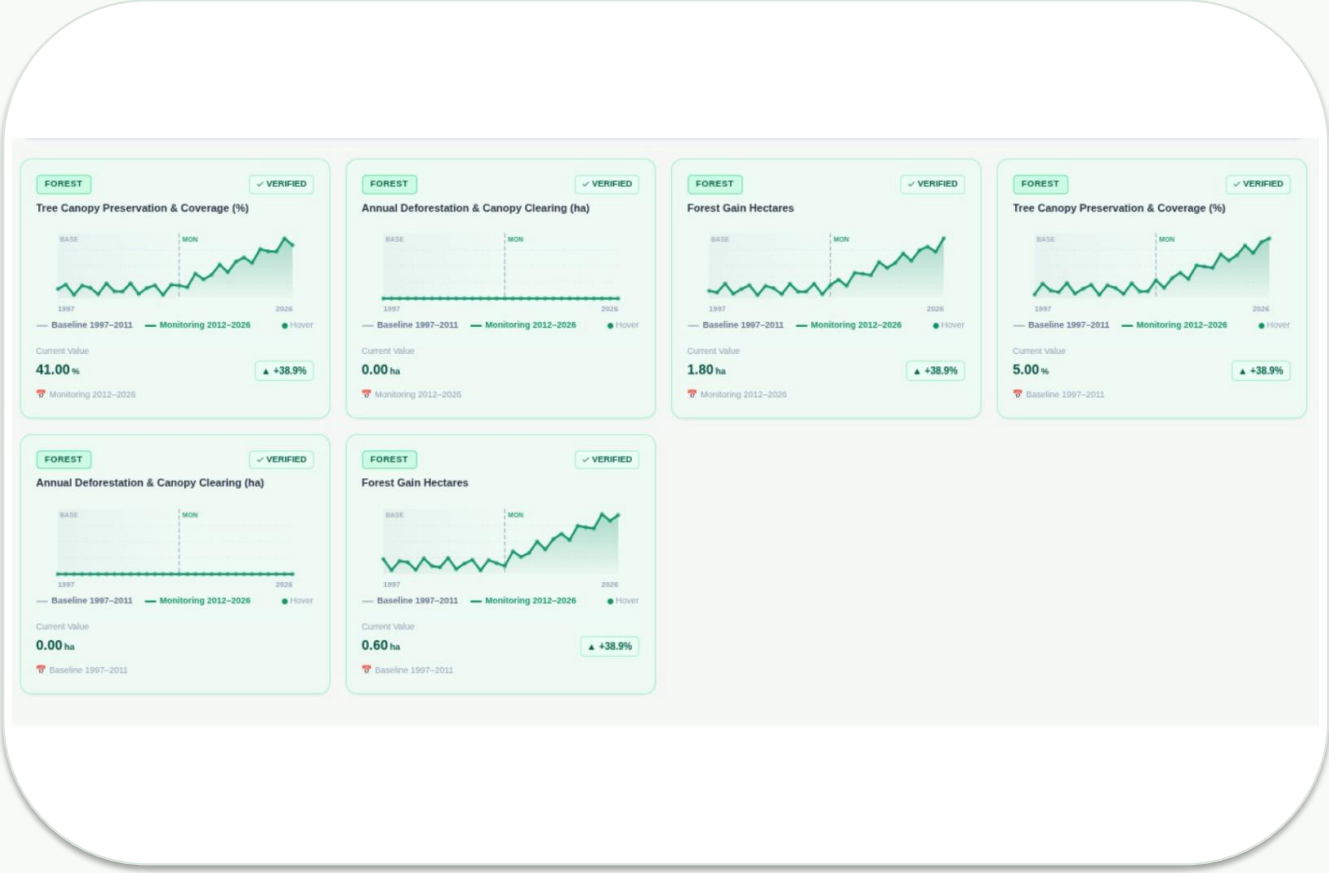


Land clearing detected

Areas highlighted as 1 showed vegetation decline and land clearing from 1990 to 1993–94, evidence that sets a credible baseline for carbon projects.

Verified Analytics & Business Value

Vegetation Monitoring delivers clear business insight, with Carbon MRV analytics providing the technical depth underneath.



What it measures

SOC stock progression, canopy preservation, forest gain, deforestation, biomass change, moisture trajectory, and CO_2e sequestration.

Who needs it

Carbon programs, ESG teams, governments, NGOs, nature-based projects, and environmental monitoring clients.

Product proposition

Vegetation Monitoring powered by Carbon MRV analytics, clear for decision-makers, rigorous for technical validation.

One platform serves carbon projects, ESG reporting and a wide range of environmental monitoring programmes.

Crop Insurance

Digital farmer onboarding, boundary capture, satellite monitoring, and weather-stress risk visibility.

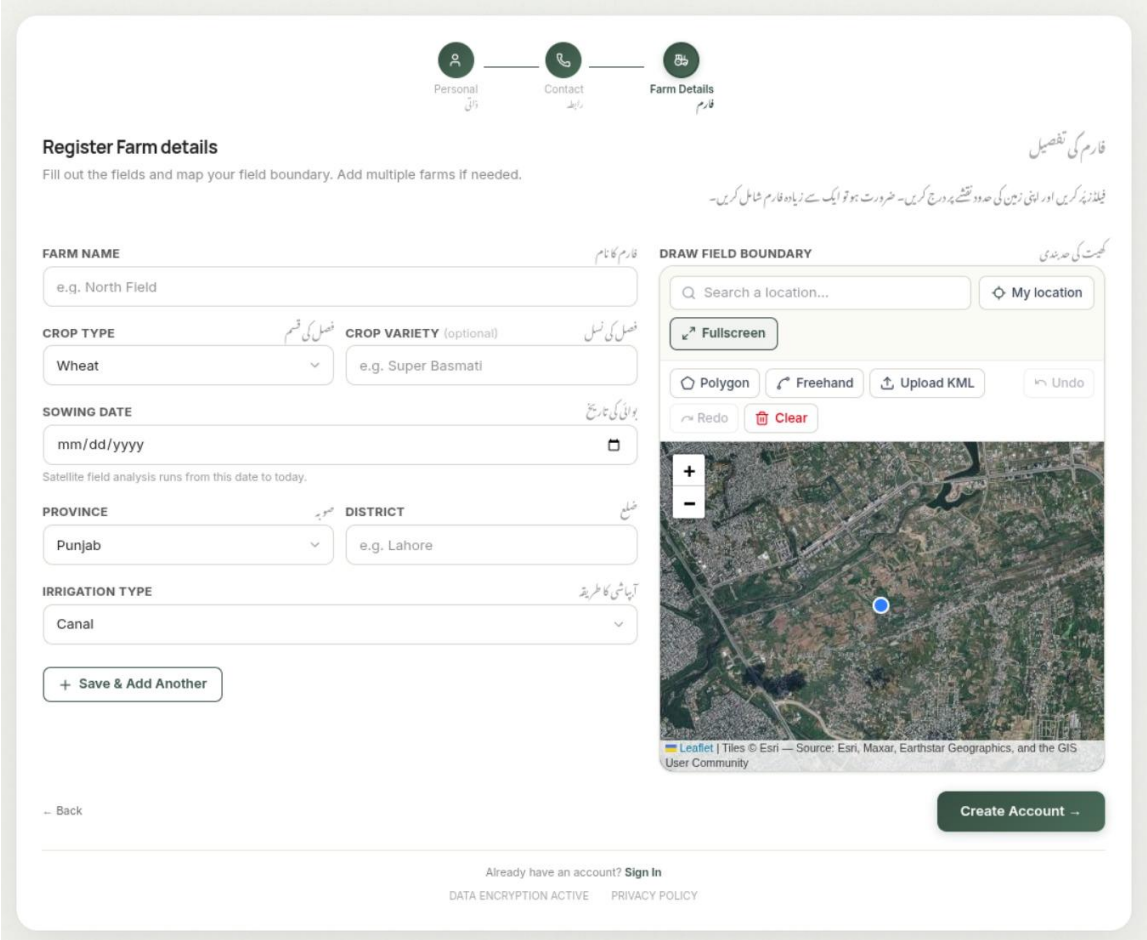
Crop Insurance: Digital Onboarding & Registration

A structured insurance journey for farmer enrolment, field capture and plot-level farm information.

Product summary

Crop Insurance helps digitize farmer onboarding and insured field registration. Users can capture farm details, map field boundaries, record crop information, and create a structured foundation for coverage and claims.

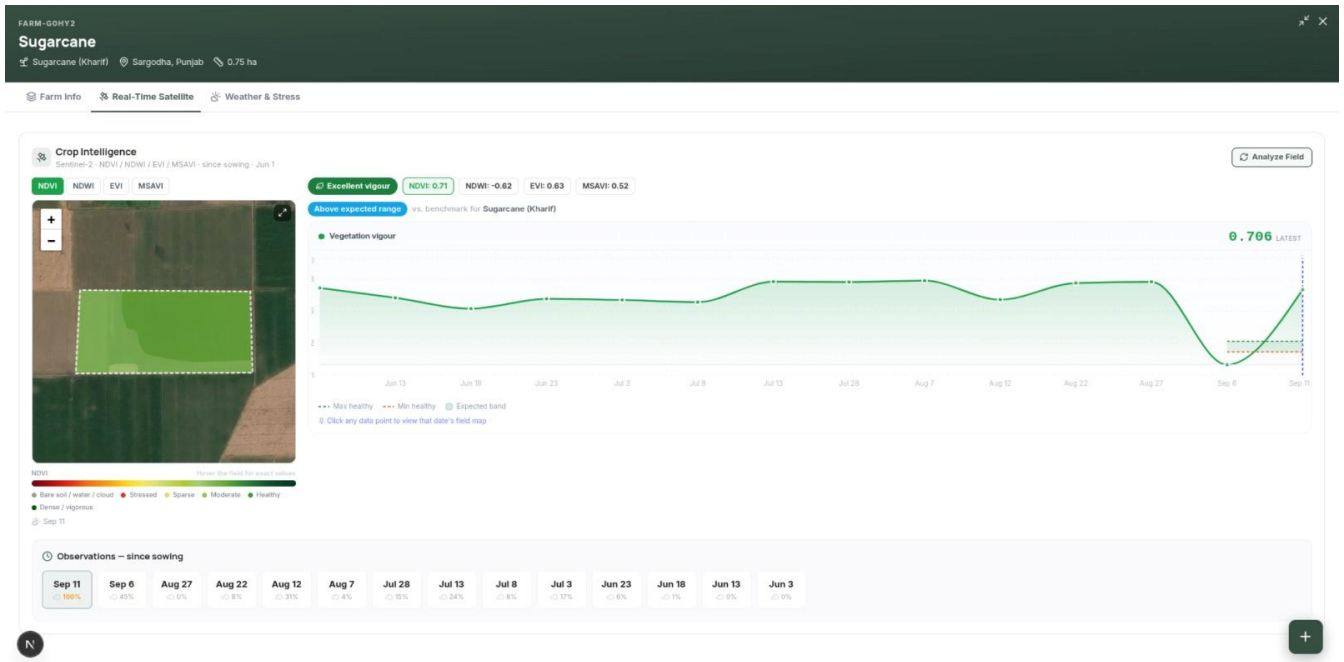
- Farmer and field registration workflow
- Boundary drawing or KML upload for plot capture
- Crop, sowing date, province, district and irrigation details
- Bilingual registration for local usability



Farm registration and boundary mapping

Crop Insurance: Satellite Monitoring for Risk Visibility

Remote sensing supports crop-condition assessment, underwriting insight and evidence-backed monitoring of insured fields.



Real-time satellite crop intelligence

Remote-sensing view

Plot-level vegetation intelligence NDVI, NDWI, EVI and MSAVI trends supports every stage of the insurance workflow.

Decision support value

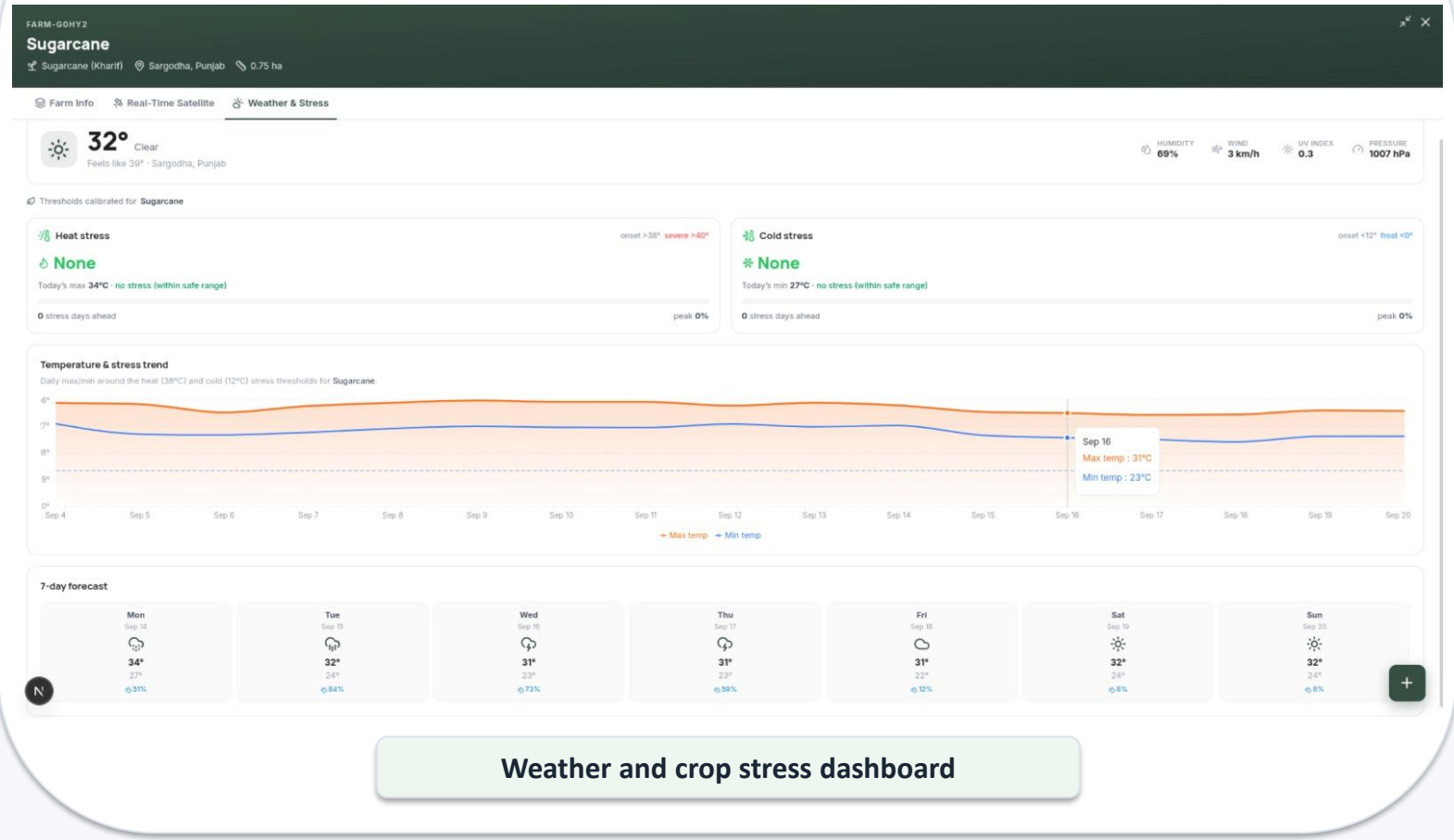
Historical and current signal patterns help review crop performance, detect deviations and strengthen portfolio visibility.

Field evidence layer

Observation dates and time-series signatures provide a structured visual record for insured plots.

Crop Insurance: Weather & Stress Monitoring

Weather-linked visibility helps track heat stress, cold stress, forecast patterns, and environmental risk conditions around each insured field.



Weather and crop stress dashboard

Weather layer

The interface combines current conditions, humidity, wind, UV, and pressure with a forecast outlook.

Stress diagnostics

Heat and cold stress cards give a clear operational indicator for early risk detection.

Insurance relevance

This strengthens pre-claim and in-season awareness by pairing field condition monitoring with weather context.

How Crop Insurance Fits the ESS Product Portfolio

Crop Insurance extends ESS capabilities from monitoring and advisory into insurtech-ready farmer enrollment, field verification, and risk support.

1. Digital farmer onboarding

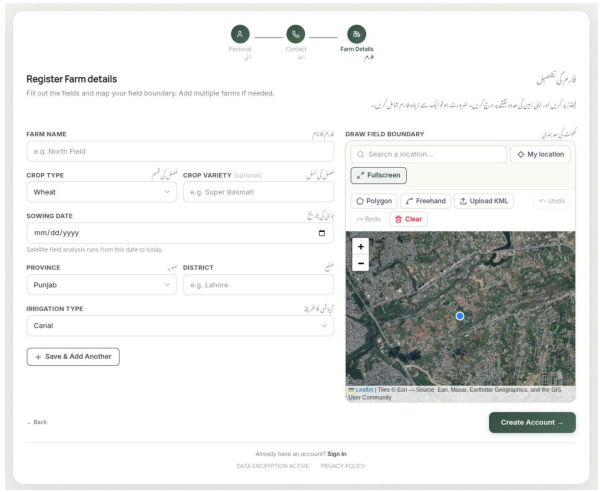
Creates a structured intake workflow for insured farms, crop details, and boundary capture.

2. Evidence-backed monitoring

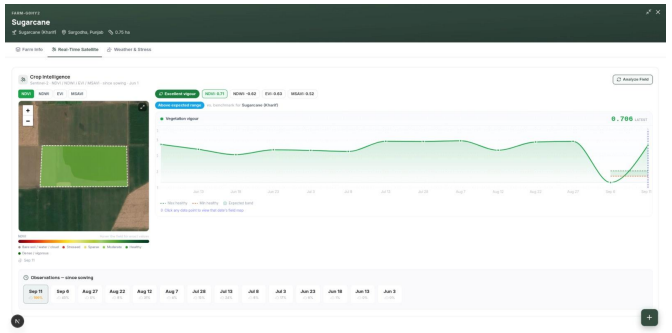
Adds satellite and weather context that can support underwriting insight and portfolio supervision.

3. Claims support

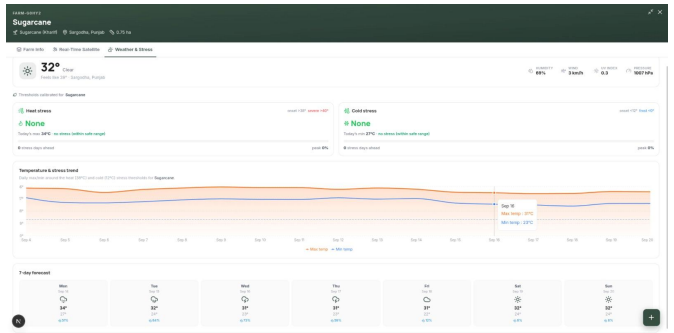
Traceable field intelligence that supports claim review and loss-assessment workflows.



Enrollment & field mapping



Satellite field intelligence



Weather risk context

Agri-Fintech: Farm Verification

Satellite verification of every farm before financing, then season-long advisories delivered for the Federal Agri Financing Program (NSFSI).

Twelve Satellite Checks on Every Farm

Every loan application passes the same deterministic geospatial and statistical checks, with no black-box model involved.

01 Type of water source

Canal versus rain-fed share for the tehsil, cross-checked with the farmer's declaration.

02 Farmer's estimated income

District average farmer income, found by matching the farm to the income layer.

03 Productivity · national zone

Farm matched to the national crop-zone layer for a productivity percentile band.

04 Productivity · regional zone

The same match on the provincial layer; canal-irrigated land moves up one tier.

05 Cultivation & vegetation growth

The NDVI series is normalised into a growth-vigour band, from under 50% to over 75%.

06 Sowing timing · average

Sowing date estimated from the NDVI germination crossing, less a crop-specific lag.

07 Sowing timing · median

The estimate is compared with the regional median for the crop: early, normal or late.

08 Average rainfall

Rainfall over the farm is read against the crop's own band: suitable or unfeasible.

09 Average temperature

Temperature is checked the same way against the crop's tolerance range.

10 Flood mapping

The farm is tested against the 2022, 2023 and 2025 flood extents for exposure history.

11 Irrigation efficiency (ETo)

Three-year actual evapotranspiration against the district optimum, on a 0–10 scale.

12 Accumulative / truth index

Sixteen checks compare declared sowing and harvest dates with what the satellite saw.

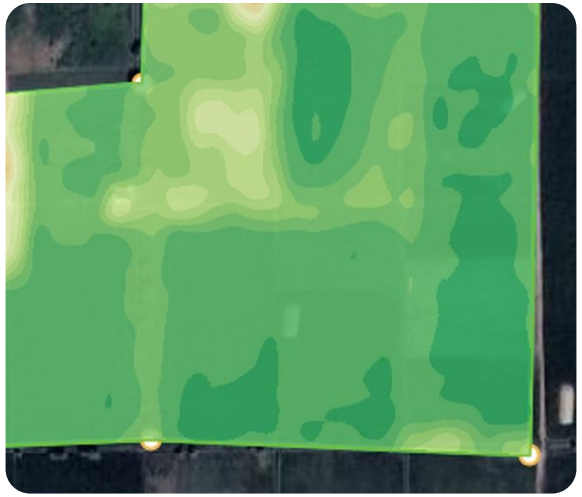
Running alongside Land verification against province-wise area caps, and a water-bodies check confirming the farm is not inside water.

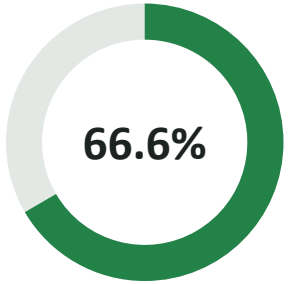
Farm Verification Report: Sample Result

Each application returns a one-page verdict: what the satellite confirms, what needs review and whether the land is valid.

SAMPLE FARM

Rahim Yar Khan · Sugarcane





Truth index
4 of 6 accuracy checks passed

WATER SOURCE
Canal

ESTIMATED INCOME
PKR 173,247
Historical average

CROP ZONE
PZN 70–90%
PZR 90–100%

VEGETATION GROWTH
60–75%
2026 season

SEED & SOWING TIME
Late
Average and median

CLIMATE STATUS
Optimal
25.59 °C · 12.75 mm rain

FLOOD MAPPING HISTORY
No flood history
2022, 2023 and 2025 extents

IRRIGATION EFFICIENCY
Below average
Against district optimum

Land verified
Farm area 12.5 acres, valid to proceed

Water bodies status
Marked area is not in water, valid to proceed

Programme Scale & Farmer Advisories

After approval, the same satellite feed becomes season-long crop guidance in the farmer's own language.

FARMS EVALUATED

31,987

Each scored on all twelve parameters and sixteen accuracy checks before submission.

ADVISORIES DELIVERED

103,963

Sent to farms approved for financing, repeating as the crop moves through its stages.

HOW ADVISORIES ARE GENERATED

1. **Loan approved** — Farm enters the advisory cycle with its crop and sowing calendar.
2. **Growth stage detected** — Days since sowing for annual crops; calendar window for perennials.
3. **Stage-relevant indices** — Only the indices that matter now: NDVI, NDMI, NDRE, RECI, MSAVI.
4. **Rule engine applied** — Harvest, re-sowing and colour-composition rules pick the advisory.
5. **Delivered in Urdu** — Written in Urdu and sent to the farmer with the index maps.

What every advisory carries

- Crop health and canopy cover
- Moisture and irrigation guidance
- Nitrogen and chlorophyll status
- Disease and pest watch for the stage
- Action items for the coming days
- False-colour index maps of the farm

Climate Intelligence & El Niño Watch

Climate projections, adaptation planning and El Niño early warning for agriculture.

Open the projection platform ↗

Open El Niño Watch

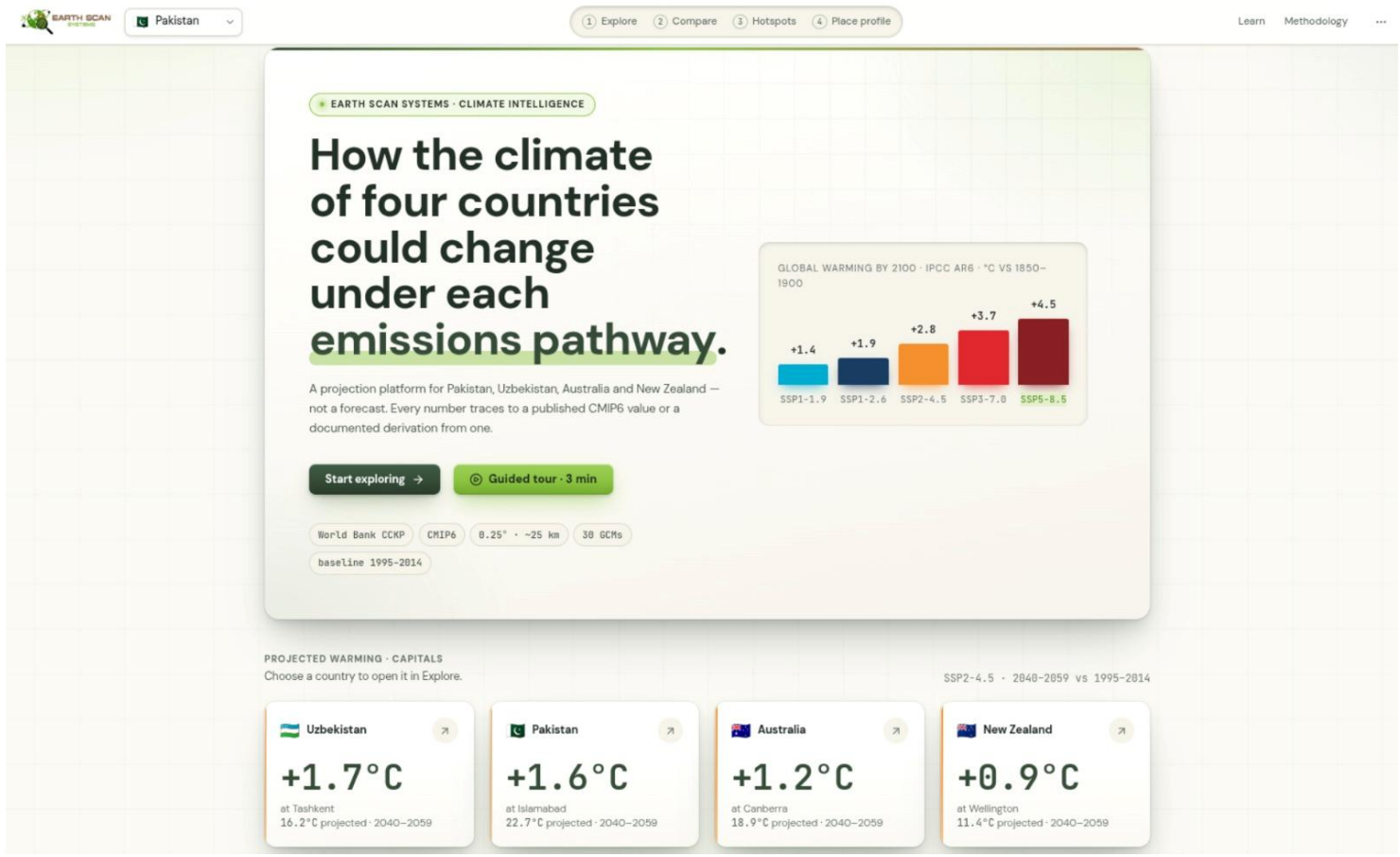
Climate Intelligence: Projection Platform

A projection platform that communicates future climate change under emissions pathways in a clear, interactive, decision-ready format.

Product overview

ESS Climate Intelligence is an interactive platform for governments, institutions, researchers, development programmes and climate-risk teams to explore projections by country, city, pathway and time horizon.

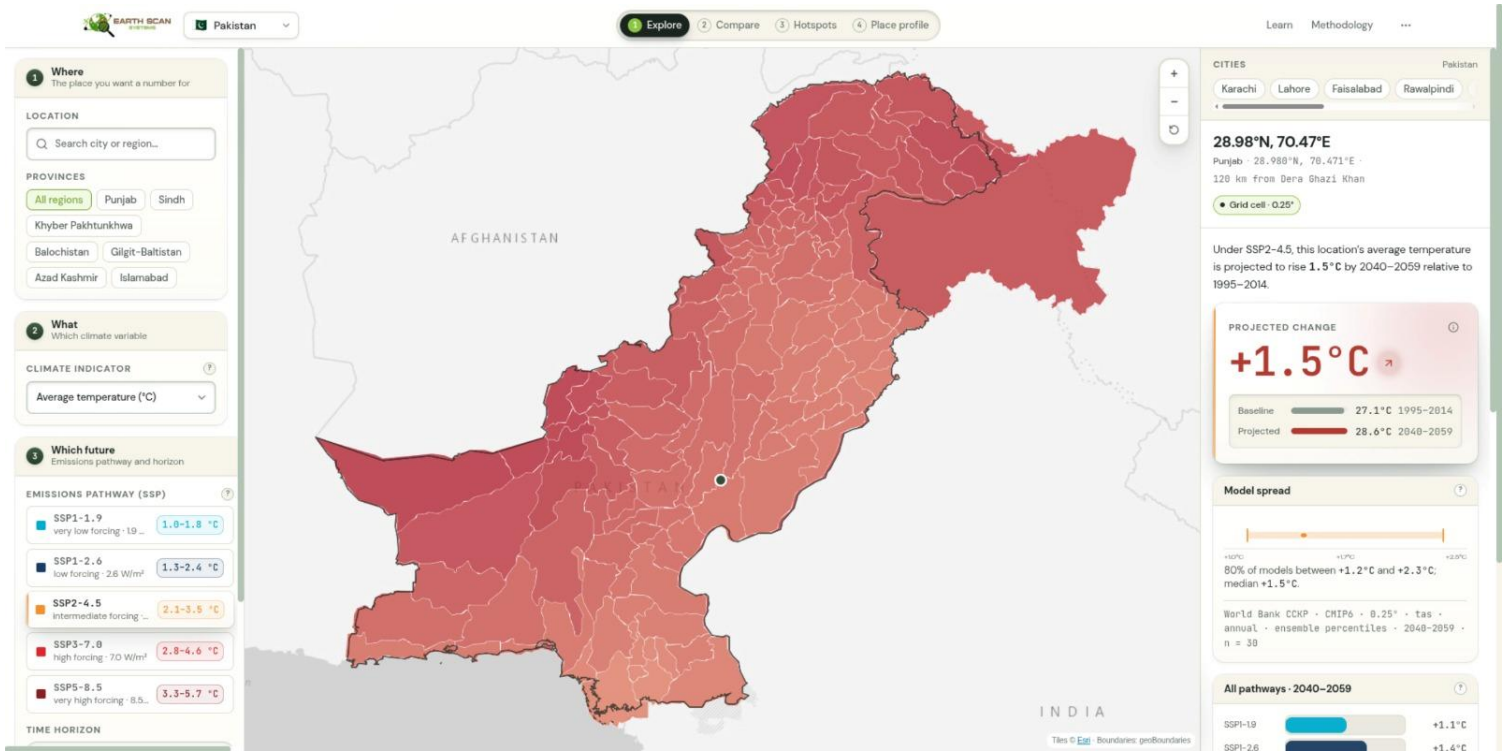
- Country-level climate projection interface
- Emissions pathway comparison
- Temperature and precipitation indicators
- Interactive exploration for planning and risk awareness



Climate intelligence landing interface with emissions pathway summary

Interactive Climate Projections Map

Spatial climate intelligence enables users to select regions, variables, pathways, and time horizons.



Interactive map view with projected temperature change and pathway controls

What it shows

A map-based interface for Pakistan with climate indicator selection, emissions pathways, and projected change values.

Decision value

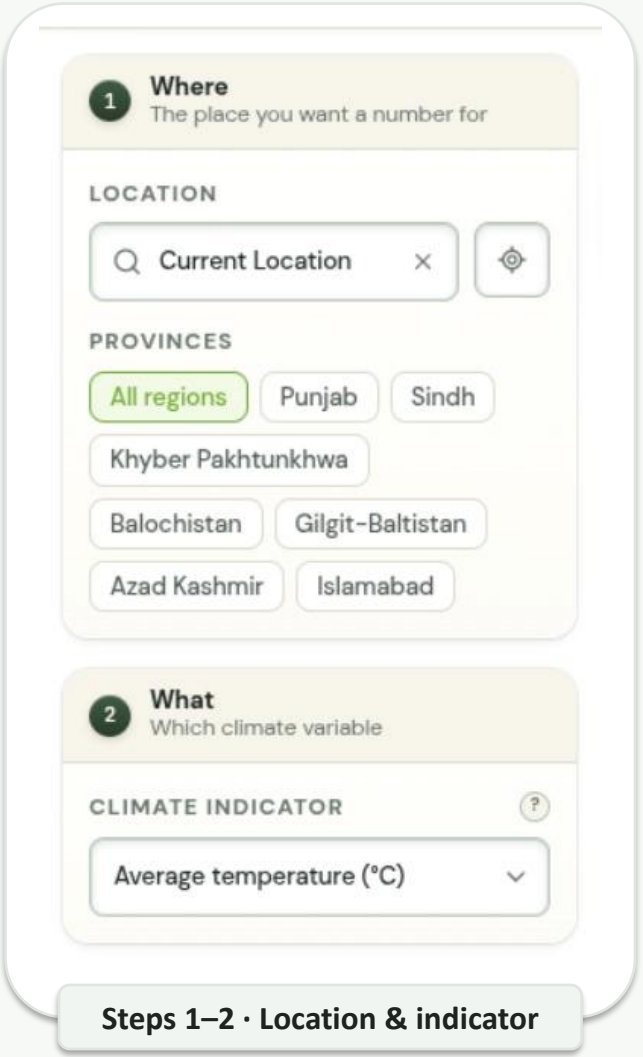
Useful for identifying warming exposure, comparing scenarios, supporting adaptation planning, and communicating climate risk.

Who it serves

Relevant for government planning, climate services, agriculture adaptation, risk models, ESG, and donor-funded programs.

Climate Intelligence: Scenario Builder

Every question is framed in three guided steps (where, what and which future) before a projection is returned.



Steps 1–2 · Location & indicator



Step 3 · Pathway & horizon

1 · Where

Search any place, use the device location, or filter by province: Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan, Gilgit-Baltistan, Azad Kashmir and Islamabad.

2 · What

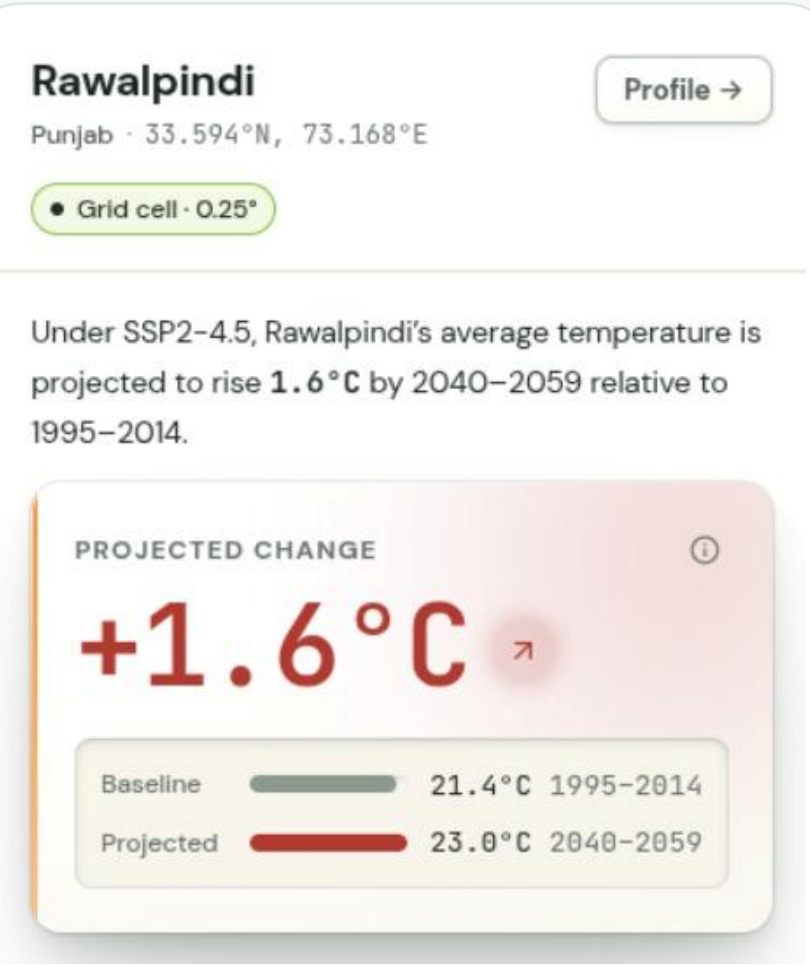
Select the climate indicator to analyse, such as average temperature. Built-in help explains each variable in plain language.

3 · Which future

Choose one of five IPCC SSP pathways (SSP1-1.9 to SSP5-8.5) and a 20-year horizon from 2020–2039 to 2080–2099, measured against the 1995–2014 baseline.

Local Projection Result: Rawalpindi

Each query returns a plain-language answer, a headline change and the baseline-to-projection evidence behind it.



Location result · SSP2-4.5 · 2040–2059



Seasonality · baseline vs projected monthly temperature

Headline projection

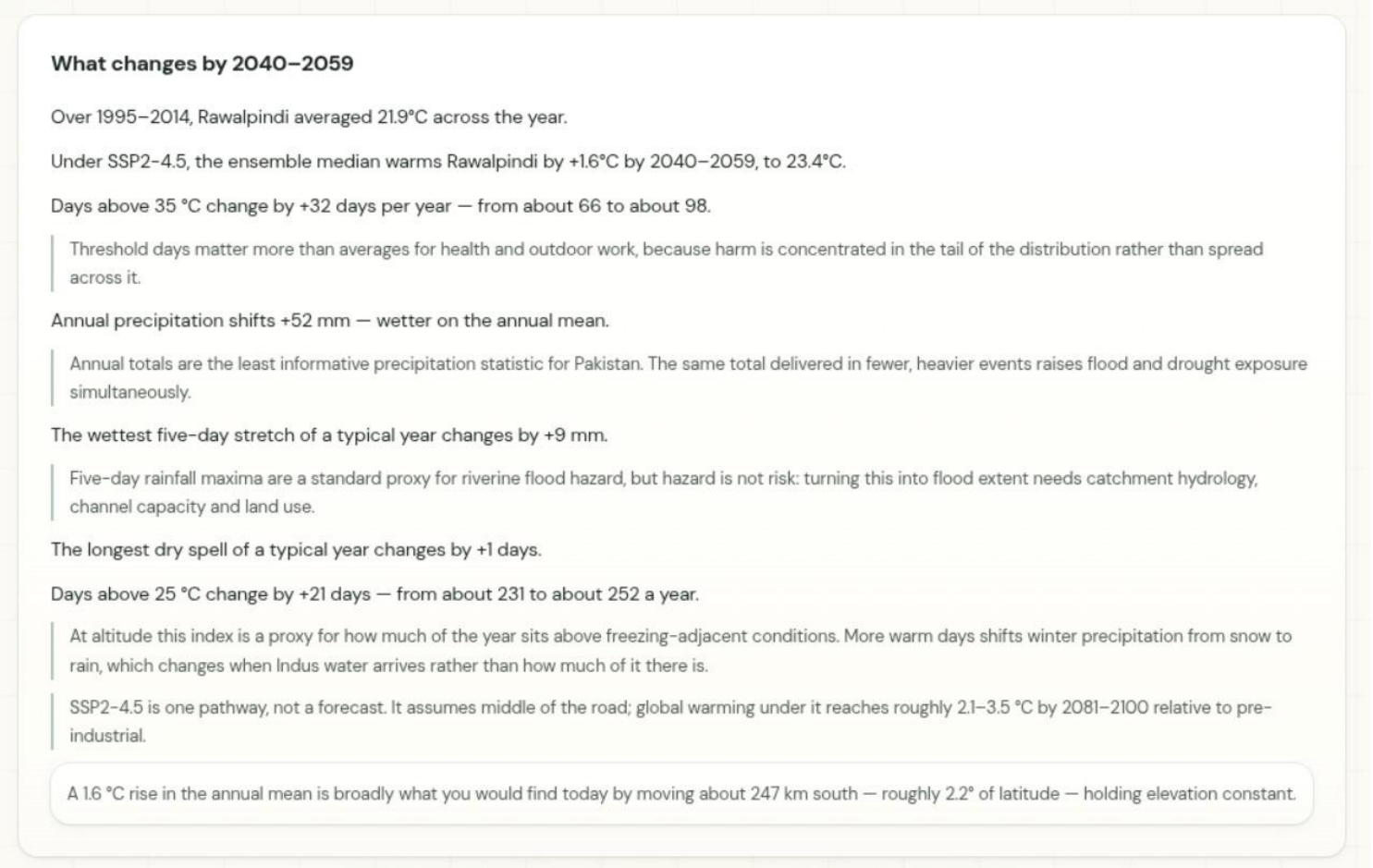
Under SSP2-4.5, Rawalpindi's average temperature rises +1.6 °C by 2040–2059, from 21.4 °C to 23.0 °C against 1995–2014, at 0.25° grid resolution.

Seasonal signal

Every month warms. The warmest month moves from 30.5 °C to 32.2 °C, with the July–September monsoon window marked for context.

What Changes by 2040–2059: Impact Narrative

Projections are translated into plain-language impacts, with expert notes explaining why each statistic matters.



What changes by 2040–2059

Over 1995–2014, Rawalpindi averaged 21.9°C across the year.

Under SSP2-4.5, the ensemble median warms Rawalpindi by +1.6°C by 2040–2059, to 23.4°C.

Days above 35 °C change by +32 days per year — from about 66 to about 98.

> Threshold days matter more than averages for health and outdoor work, because harm is concentrated in the tail of the distribution rather than spread across it.

Annual precipitation shifts +52 mm — wetter on the annual mean.

> Annual totals are the least informative precipitation statistic for Pakistan. The same total delivered in fewer, heavier events raises flood and drought exposure simultaneously.

The wettest five-day stretch of a typical year changes by +9 mm.

> Five-day rainfall maxima are a standard proxy for riverine flood hazard, but hazard is not risk: turning this into flood extent needs catchment hydrology, channel capacity and land use.

The longest dry spell of a typical year changes by +1 days.

Days above 25 °C change by +21 days — from about 231 to about 252 a year.

> At altitude this index is a proxy for how much of the year sits above freezing-adjacent conditions. More warm days shifts winter precipitation from snow to rain, which changes when Indus water arrives rather than how much of it there is.

> SSP2-4.5 is one pathway, not a forecast. It assumes middle of the road; global warming under it reaches roughly 2.1–3.5 °C by 2081–2100 relative to pre-industrial.

A 1.6 °C rise in the annual mean is broadly what you would find today by moving about 247 km south — roughly 2.2° of latitude — holding elevation constant.

Automated impact narrative with expert context notes

+1.6 °C
Annual mean warming

+32 days
Days above 35 °C a year

+52 mm
Annual precipitation

+9 mm
Wettest five-day total

Why it matters

Threshold days drive health and outdoor-work risk more than averages do. Rain arriving in fewer, heavier events raises flood and drought exposure at the same time, and the narrative makes this clear for non-specialist decision-makers.

Climate Indicator Dashboard

Twelve location-level indicators compare 1995–2014 with 2040–2059 under SSP2-4.5: heat, rainfall, dryness and energy demand.

Indicators

Baseline 1995–2014 against 2040–2059 under SSP2-4.5.

INDICATOR	1995–2014	2040–2059	CHANGE
Average temperature at this location	21.9°C	23.4°C	+1.6°C
Maximum temperature at this location	28.0°C	29.6°C	+1.6°C
Hot days above 35 °C at this location	66 days	92 days	+32 days
Very hot days above 40 °C at this location	15 days	26 days	+14 days
Warm nights above 23 °C at this location	96 days	121 days	+23 days
Summer days (above 25 °C) at this location	231 days	252 days	+21 days
Precipitation at this location	1050 mm	1096 mm	+52 mm
Wettest day of the year at this location	50 mm	52 mm	+3 mm
Wettest 5 days of the year at this location	119 mm	128 mm	+9 mm
Share of rain from very wet days at this location	22.8%	25.3%	+2.5%
Consecutive dry days at this location	36 days	36 days	+1 days
Cooling degree days at this location	3540 °F-days	4184 °F-days	+653 °F-days

Indicator table · baseline, projection and change

Heat stress

Hot days above 35 °C rise by 32 a year, very hot days above 40 °C by 14, and warm nights above 23 °C by 23, critical for labour, livestock and crop heat stress.

Rainfall concentration

Annual rainfall grows by 52 mm, while the share falling on very wet days climbs from 22.8% to 25.3%, meaning more intense events rather than evenly spread rain.

Energy & cooling demand

Cooling degree days rise from about 3,540 to 4,184 °F-days, a direct signal for cooling loads, cold-chain planning and storage infrastructure.

The Shape of the Year: Monthly Climatology

Monthly temperature and precipitation profiles show when change arrives during the year, not only how much.



Monthly climatology at Rawalpindi · 1995–2014 vs 2040–2059 (SSP2-4.5)

31.3 °C → 33.0 °C

Warmest month (June)

47.8% → 48.1%

Share of annual rain in July–September

All 12 months

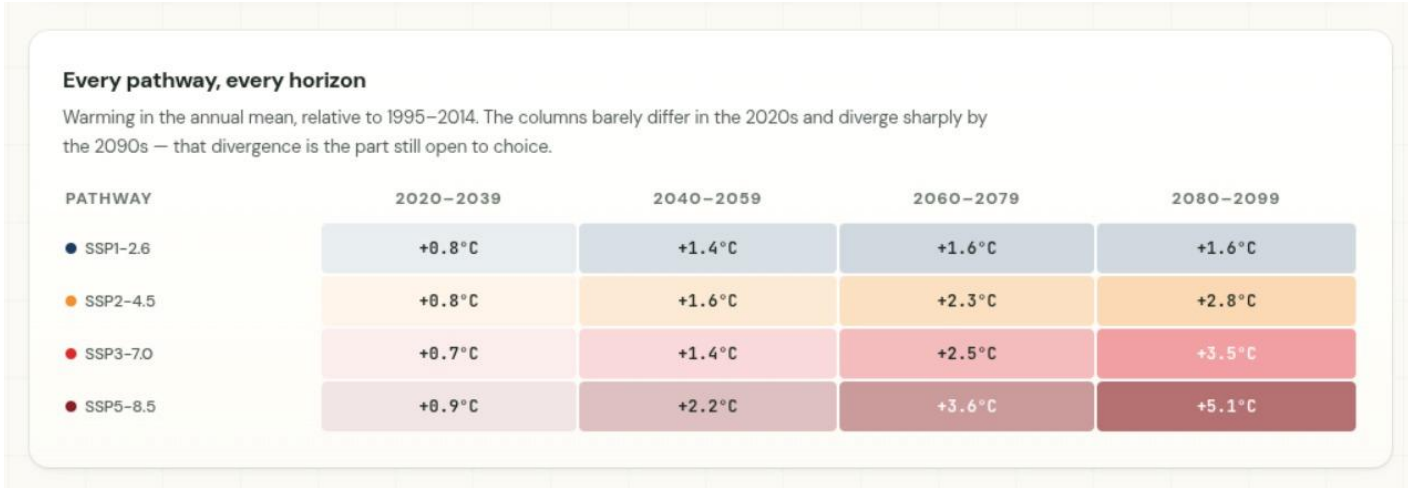
Projected temperature sits above the baseline year-round

Scenario Comparison: Every Pathway, Every Horizon

Side-by-side views separate the warming already locked in from the share still determined by emissions choices.



All pathways · 2040–2059



Warming by pathway and time horizon

Near term is locked in

In 2020–2039 every pathway sits between +0.7 °C and +0.9 °C, so near-term adaptation is needed regardless of mitigation.

Divergence by the 2090s

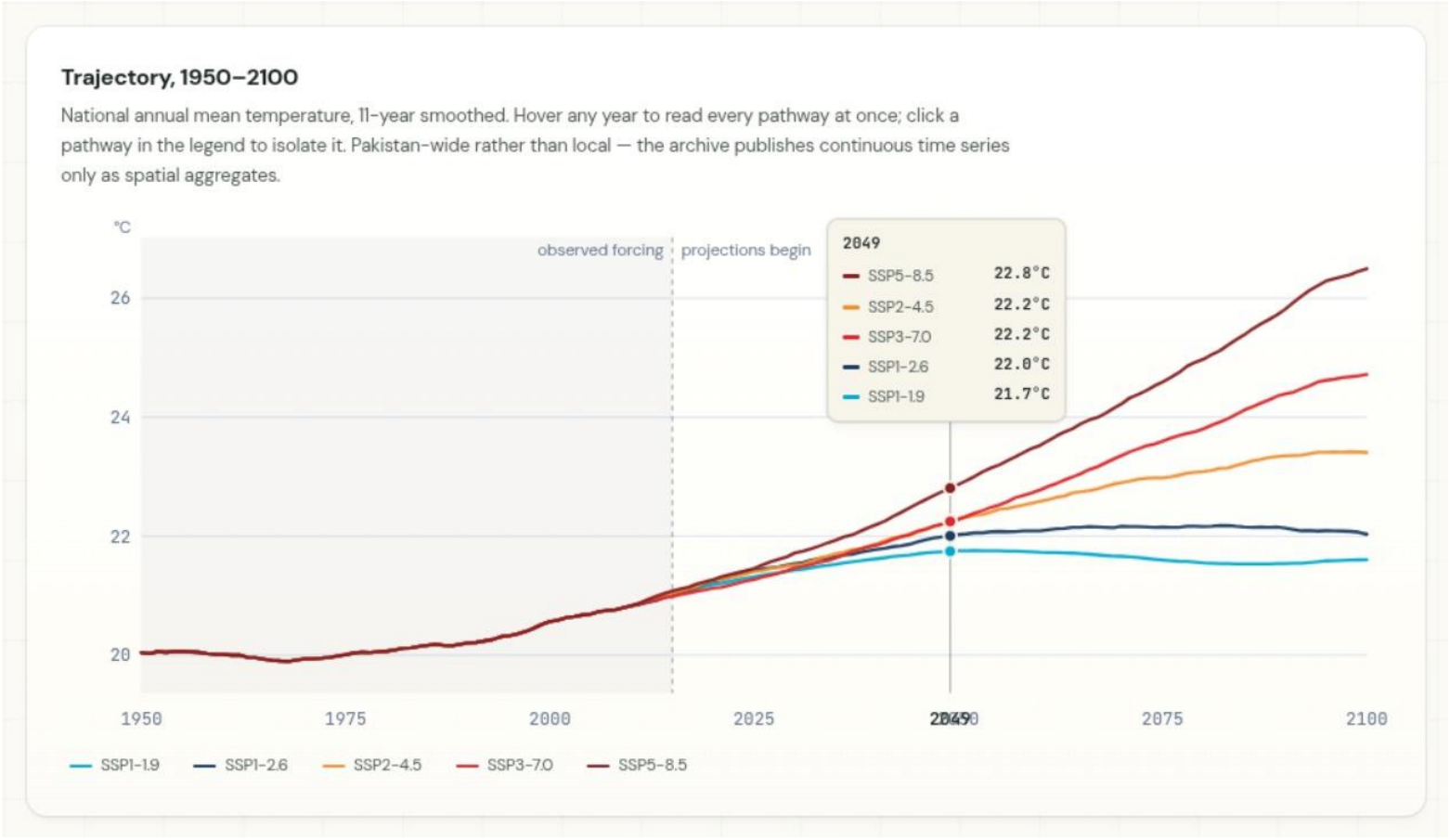
By 2080–2099 warming ranges from +1.6 °C under SSP1-2.6 to +5.1 °C under SSP5-8.5, more than three times higher.

Decision relevance

The gap between pathways is the part of the outcome still open to policy choice, essential for long-horizon investment and resilience planning.

Long-Term Trajectory, 1950–2100

A continuous national view links observed warming with every future pathway in one interactive chart.



Pakistan annual mean temperature · 11-year smoothed

Observed to projected

Historical forcing to 2014 flows straight into the projections, so past trend and future scenarios read as one continuous line.

Interactive reading

Hover any year to compare all pathways, or click one to isolate it. In 2049 the national mean spans 21.7–22.8 °C.

End-of-century spread

From about 20 °C in 1950, the national mean reaches roughly 26.5 °C by 2100 under SSP5-8.5, while SSP1-1.9 levels off near 21.6 °C.

El Nino and Climate Intelligence

A concise view of how Pacific Ocean warming becomes an agricultural early-warning signal.

What El Nino means

El Nino is the warm phase of ENSO, marked by abnormal warming in the central and eastern equatorial Pacific.

The signal can shift rainfall patterns, temperature extremes and seasonal circulation well beyond the Pacific basin.

ESS connects this global signal with local agricultural indicators for Pakistan.

PRIMARY SIGNAL	TRACKING INDEX	USE CASE
ENSO	**RONI**	**Warning**



Monitoring ENSO Strength and Direction

RONI, Nino 3.4 and probability outlooks help distinguish short-term noise from a developing seasonal event.

What the Pacific view provides

Current ocean-temperature anomalies show where the Pacific is unusually warm or cool.

Historical index charts place the present signal in context against previous ENSO episodes.

Seasonal probabilities indicate whether El Nino, Neutral or La Nina conditions are becoming more likely.

HORIZON	CONTEXT	OUTPUT
9 seasons	**History**	**Signal**



ENSO outlook and probability view

Turning ENSO Into District Climate Watch

The dashboard translates a global ocean signal into rainfall, temperature, water-demand and vegetation layers.

Why the local layer matters?

ENSO impacts are not uniform across Pakistan; risk depends on province, crop calendar and local baseline climate.

District anomaly layers help identify where conditions are moving away from normal.

This supports earlier targeting of irrigation planning, field monitoring and advisory communication.

RESOLUTION	VARIABLES	AUDIENCE
District	**5 layers**	**Agri teams**



Pakistan district climate map

Crop Intelligence for Advisory Decisions

Crop-specific views connect climate pressure with practical monitoring and response priorities.

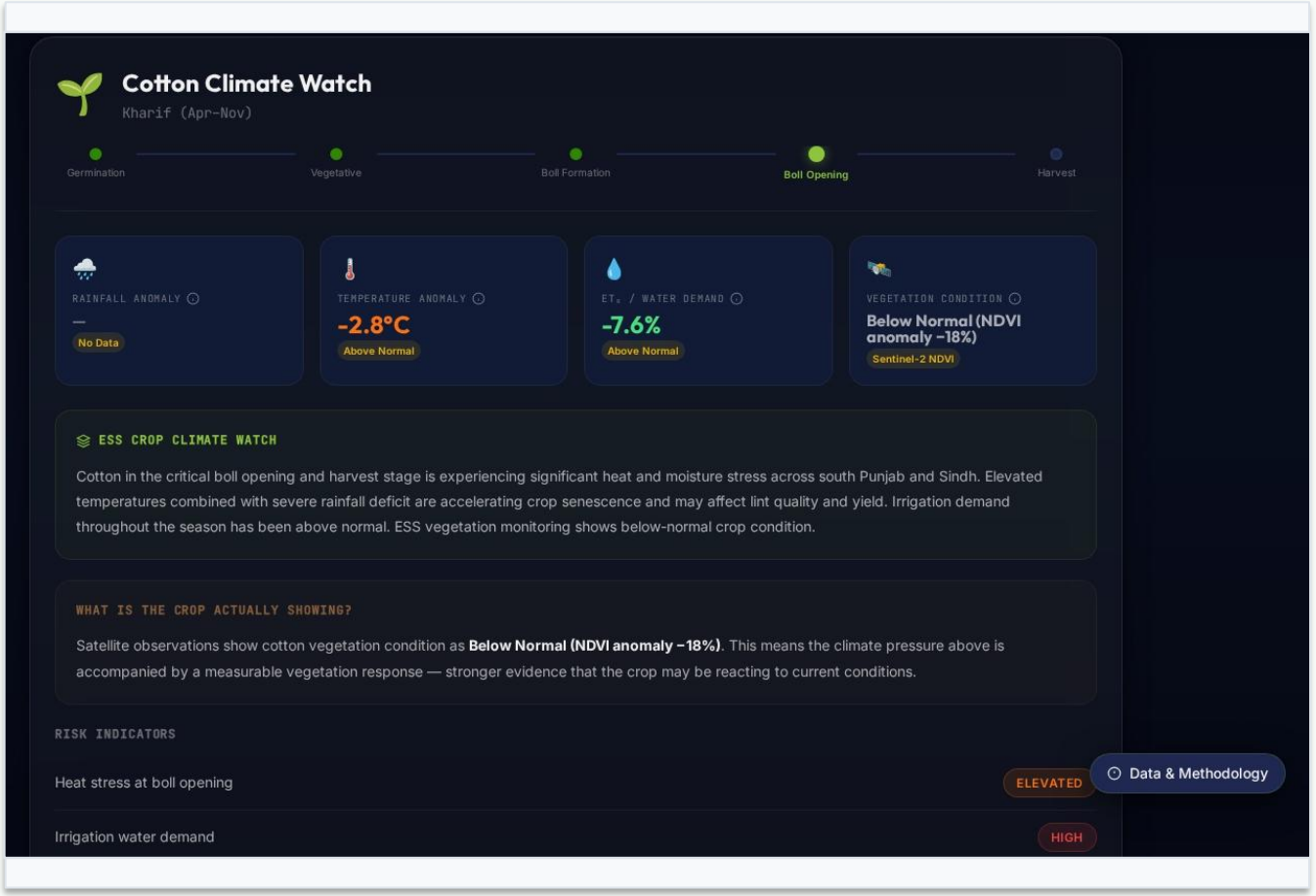
How teams use the output

Compare crop sensitivity with current rainfall, heat, ET0 and soil-moisture signals.

Prioritize provinces and crops where climate stress is most likely to affect growth stages.

Use vegetation response as ground-facing evidence that risk is emerging or easing.

CROPS	DECISION	FOCUS
Staples	**Advisory**	**Risk**

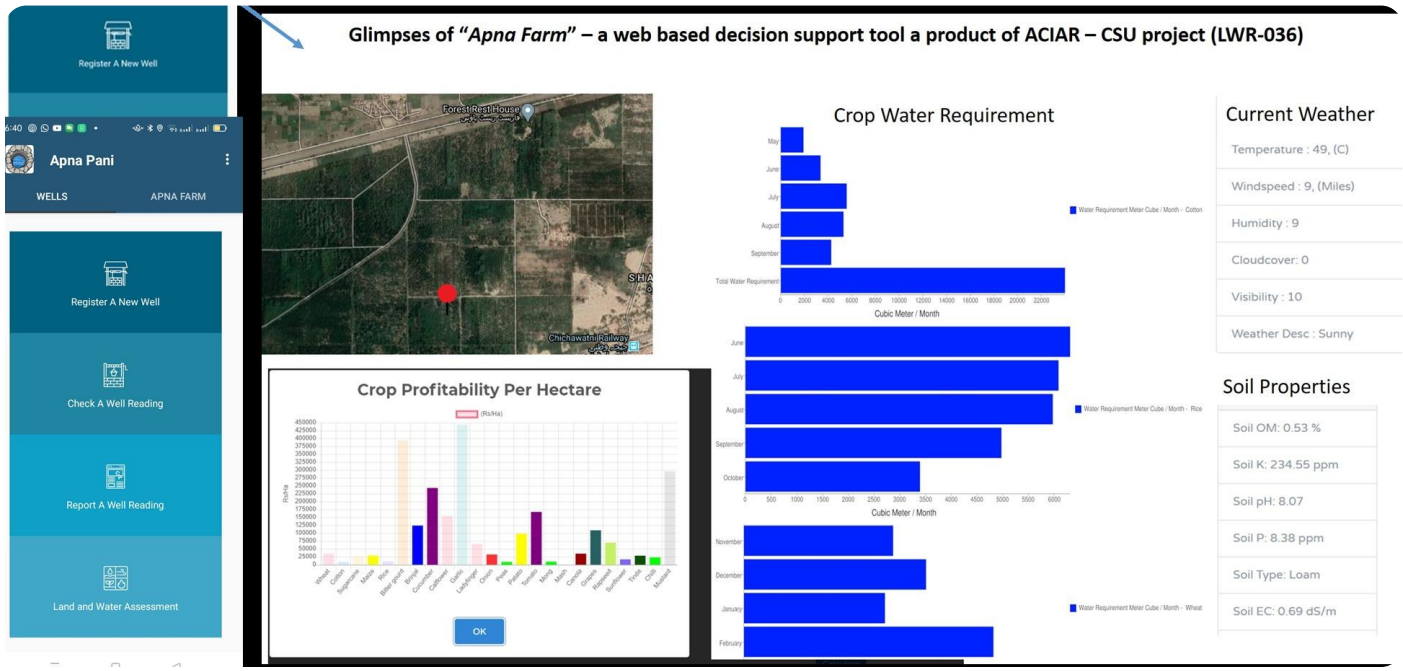


Crop Intelligence section

AI Driven Mobile & Web Application for Decision Support

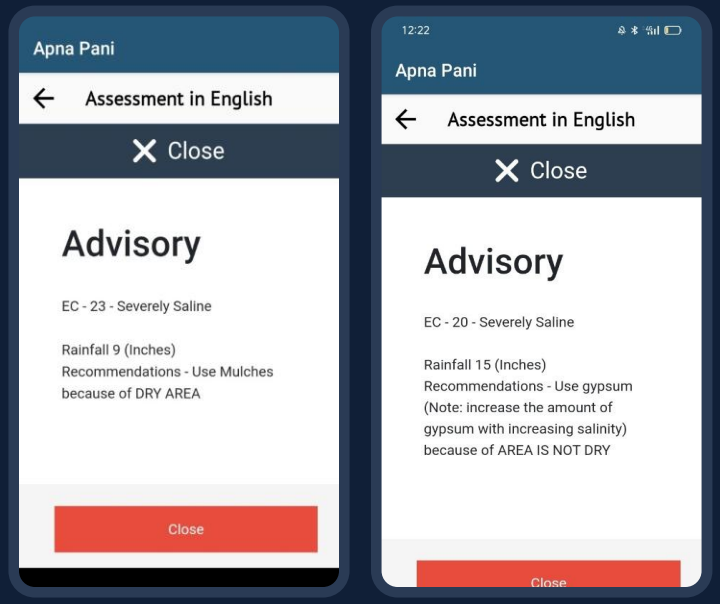
Land and Water Decision Support

Web and mobile decision support developed for the ACIAR–CSU project LWR-036, helping farmers use scarce water resources optimally.



Apna Farm · crop water requirement, crop profitability, weather and soil properties

APNA PANI · REAL-TIME FARM ADVISORIES



Advice from land and water evaluation

Salinity (EC), rainfall and dry-area conditions drive recommendations such as mulches or gypsum, in English and Urdu.

Wells & readings

Register wells and record water readings

Crop water

Requirement per crop and month

Profitability

Crop profit per hectare

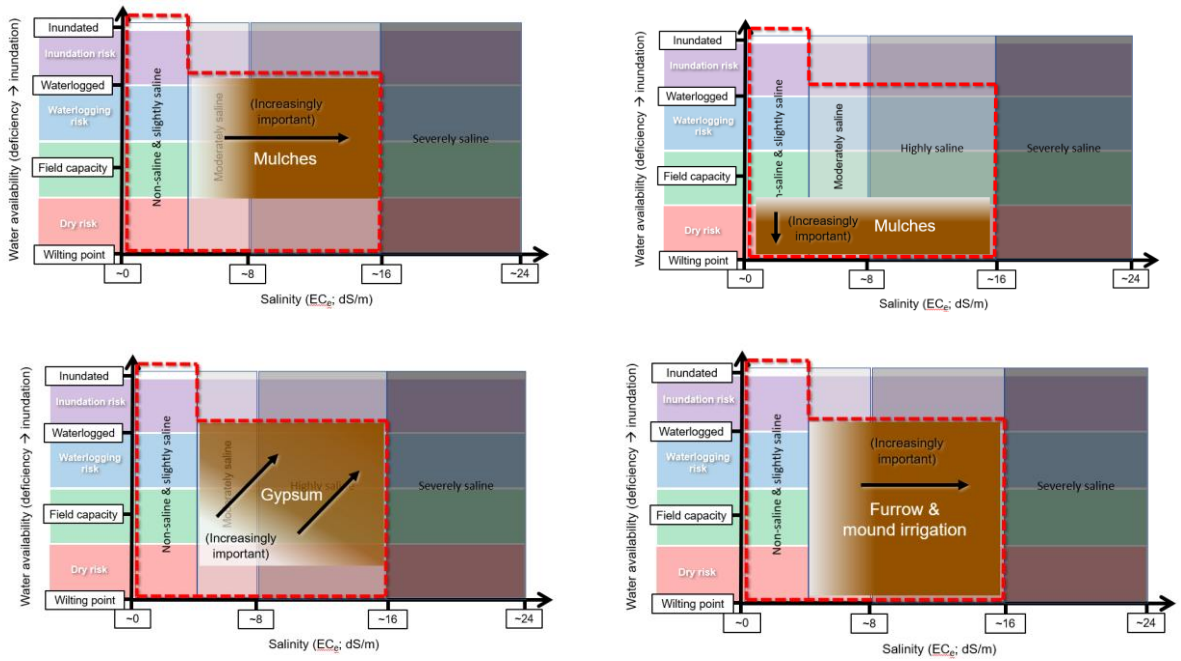
Soil & weather

Soil properties and current weather

Embedding Expert Knowledge in Decision Support

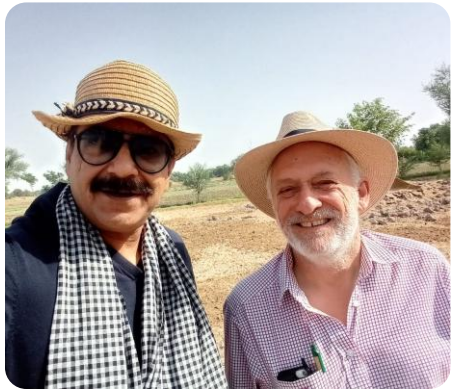
Learn from the expert, the owner or custodian and government officials, and treat their knowledge as the power that drives the inference engine.

SALINITY AND WATER AVAILABILITY RULES



Recommendations by salinity class and water availability

Expert rules decide when mulches, gypsum or furrow and mound irrigation matter most, from waterlogged to dry fields.



The expert



The farmer



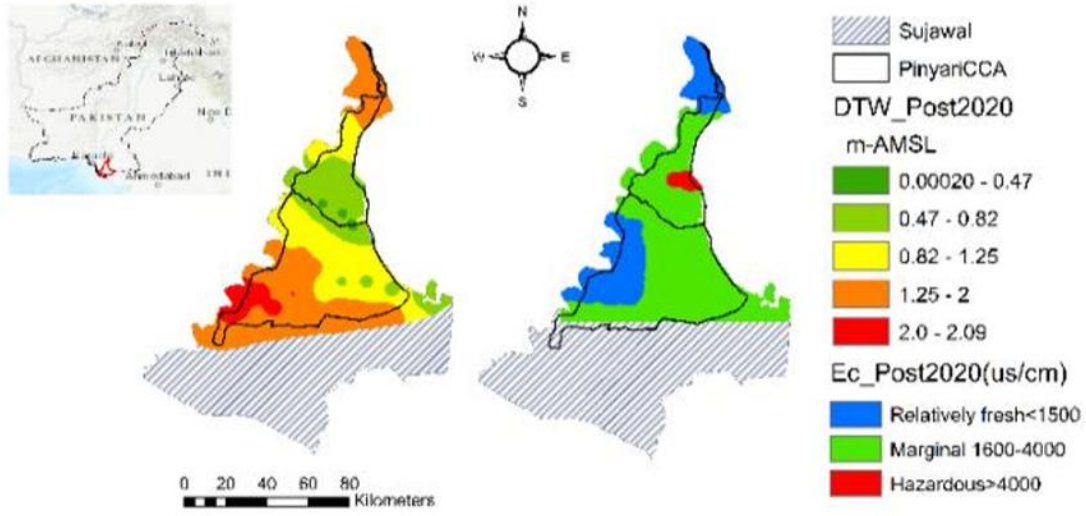
Decision makers: agri bank



Government department

3D Groundwater Modelling: ASSIB Project, Sindh

Depth-to-water and salinity modelling for the Indus delta guides adaptation to waterlogging and salinity under climate change.



Depth to water and EC, post-monsoon 2020 (m)



Surface salinity, Jongo Jalbani village, Sujawal · photo: Dr Abdul Latif Qureshi

Adapting to a changing climate

Waterlogging and salinity under projected climate change require new adaptation strategies for a sustainable future.

Revitalizing the coastal economy

Scenario modelling guides mitigation strategies that raise coastal farm productivity and preserve the Indus delta ecosystem.

How Climate Intelligence Fits the ESS Portfolio

Climate Intelligence extends ESS from farm-level insight into national and regional climate-risk intelligence.

1. Strategic climate layer

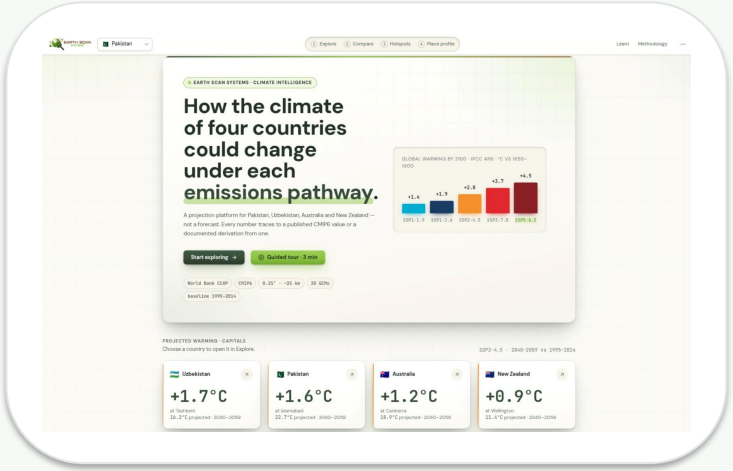
Adds macro-level climate context that can support agricultural planning, water strategy, resilience programs, and policy analysis.

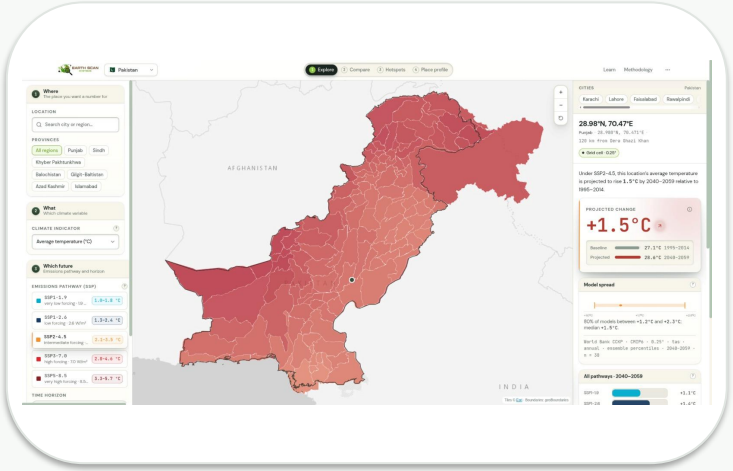
2. Strong institutional relevance

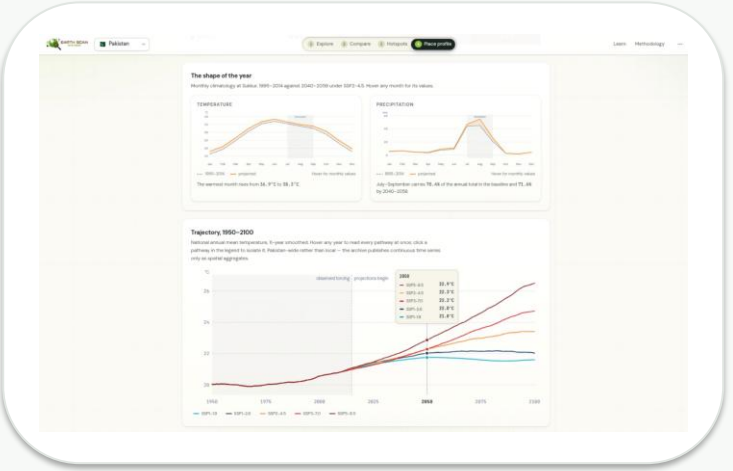
Useful for governments, development agencies, universities, ESG teams, and climate-risk organizations.

3. Complements farm intelligence

Links with crop monitoring, water intelligence, vegetation monitoring and advisory systems to explain long-term risk.







Positioning statement

Climate Intelligence: Interactive climate intelligence for emissions pathways, future warming, local climate profiles, and adaptation planning.

IoT & Sensor Intelligence

Ground-truth measurement products for soil, weather-station telemetry, and groundwater monitoring.

- **CropKonnect UNO**
- **CropKonnect Mega**
- **GW Konnect**
- **Agri Robotics & Geo-Automation**

CropKonnect UNO

Smart soil-sensor monitoring for nutrients, pH, moisture, temperature, conductivity, and sample locations.

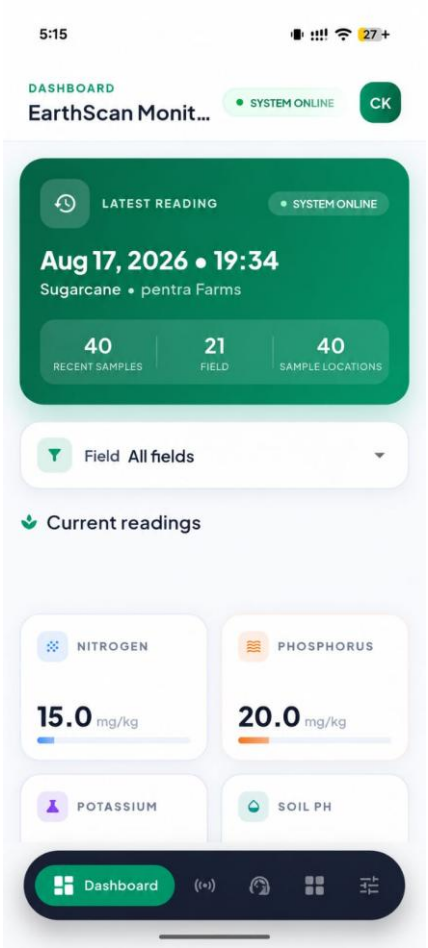
CropKonnect UNO: Soil Sensor Intelligence

A field-connected sensor dashboard for soil chemistry, physical parameters, and location-based sampling insight.

Product overview

CropKonnect UNO is a practical soil-sensor product for real-time field readings. It turns measurements into a clear operational dashboard for soil assessment and data-backed agronomy.

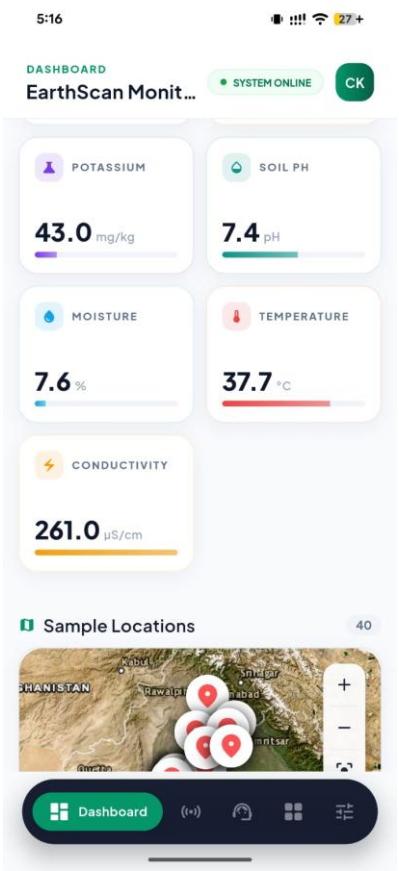
- Soil nutrient visibility (N, P, K)
- pH, moisture, temperature, and conductivity tracking
- Field/sample filtering and operational dashboards
- Mobile-first monitoring for field use



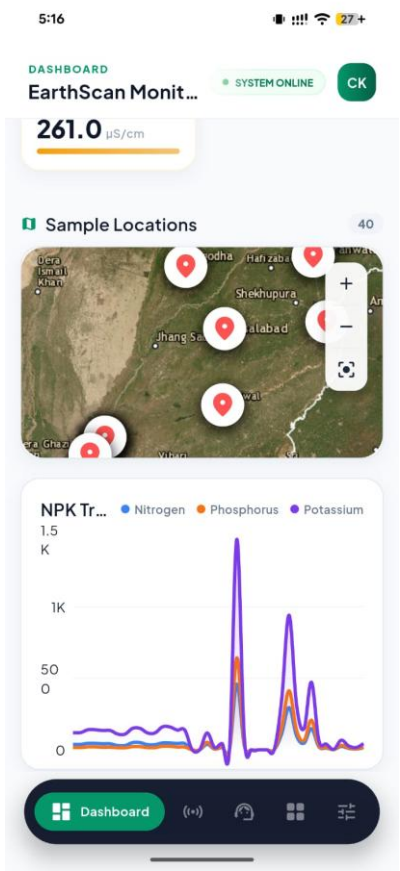
Mobile dashboard with latest reading summary and nutrient cards

Sensor Readings, Sample Locations & Trends

Individual measurements, field geography and trend visualisation come together in one view.



Sensor cards + sample location map



Map and NPK trend visualization

Core data points

Nitrogen, phosphorus, potassium, pH, moisture, temperature, and conductivity are presented as clean sensor cards.

Spatial context

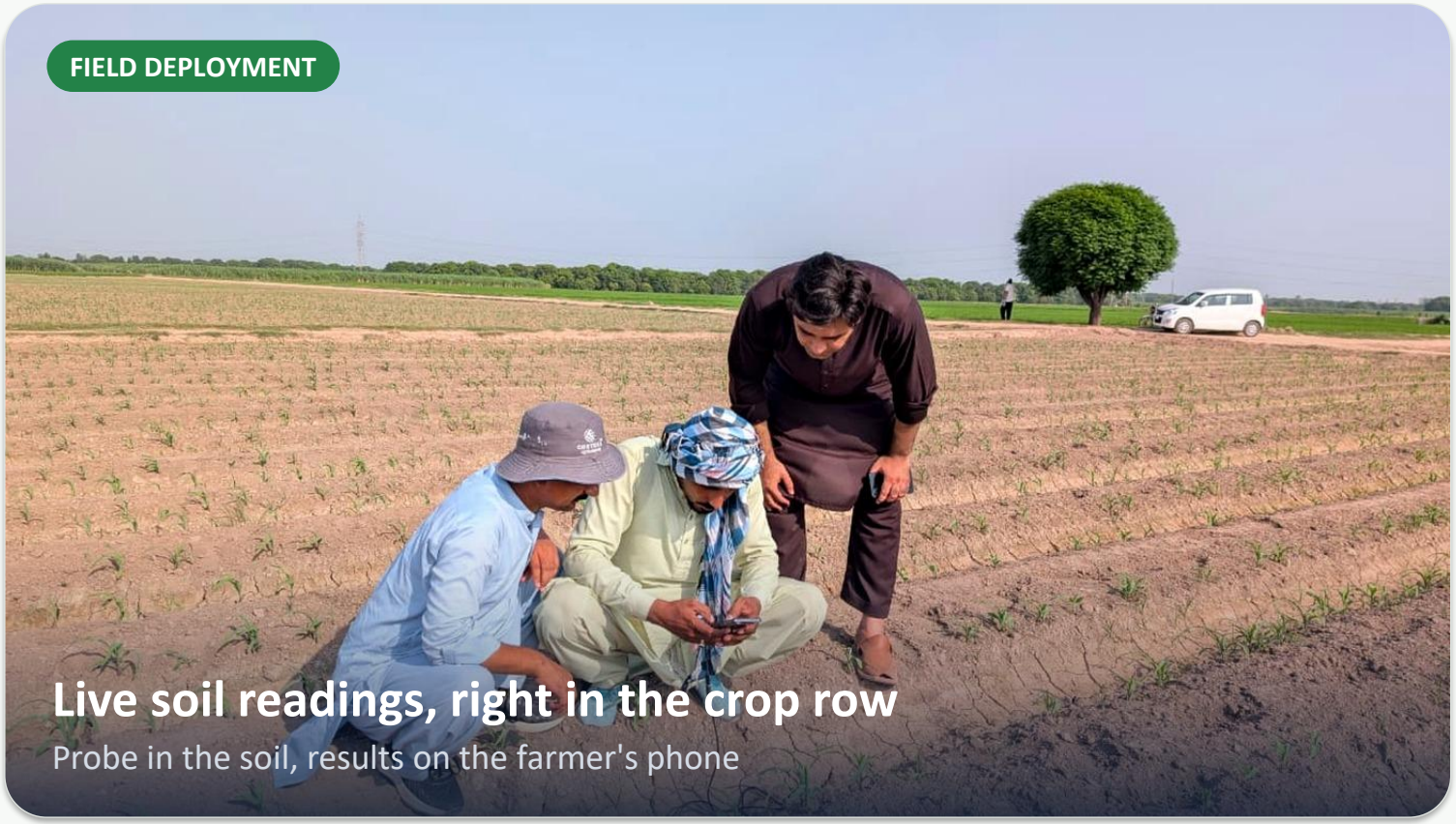
Sample locations add field geography and monitoring coverage, helping users understand where readings originate.

Business value

Useful for agronomy teams, corporate farms, extension networks, input companies, and integrated farm intelligence programs.

CropKonnect UNO: Deployed in the Field

The soil probe goes into the root zone, readings arrive on the phone in seconds and are reviewed with the farmer on the spot.





HOW A READING IS TAKEN

1. **Insert the probe**
   Placed directly in the root zone of the field.
2. **Read on the phone**
   Nutrients, pH, moisture and temperature in the app.
3. **Review with the farmer**
   Explained on the spot and saved to the field record.

- **Soil nutrients**
  Nitrogen, phosphorus, potassium
- **Soil chemistry**
  pH and electrical conductivity
- **Soil physical**
  Moisture and temperature
- **On-the-spot results**
  Shared with farmer and agronomist

How CropKonnect UNO Fits the ESS Portfolio

CropKonnect UNO adds the ground-truth sensor layer to the wider ESS monitoring and advisory ecosystem.

1. Complements satellite monitoring

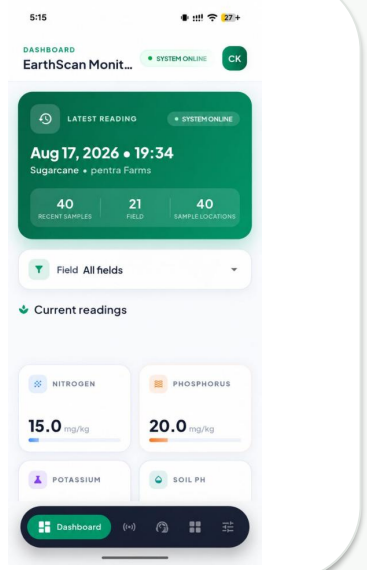
It adds on-ground measurements that support interpretation alongside remote-sensing products.

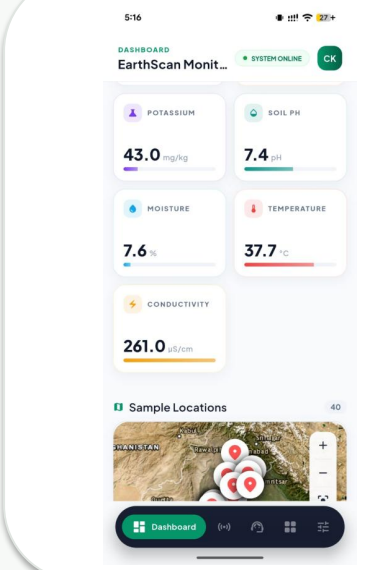
2. Strengthens advisory logic

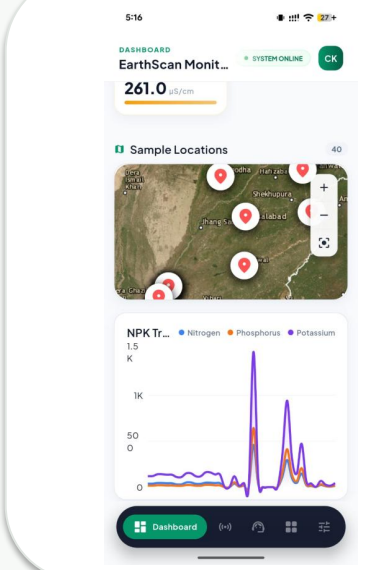
Sensor data can help explain nutrient, moisture, and soil-condition recommendations inside advisory workflows.

3. Supports agronomy operations

It is operationally valuable for diagnostics, field audits, and targeted interventions.







Positioning statement

CropKonnect UNO Smart Soil Sensor Monitoring: ground-based soil intelligence for nutrient, moisture and field-condition monitoring.

CropKonnect Mega

Integrated soil sensing, weather-station telemetry, 14-day outlooks, and advisory decision support.

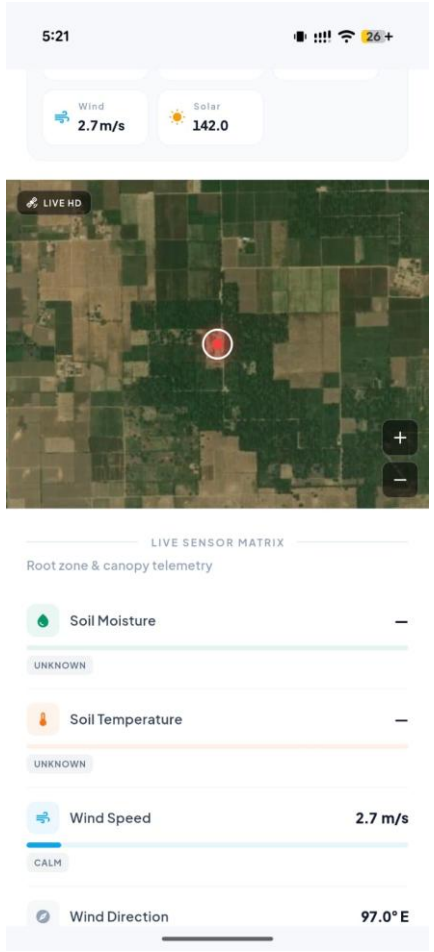
CropKonnect Mega: Soil + Weather Station Intelligence

A complete field-station solution combining environmental telemetry, weather outlooks and advisory decision support.

Product overview

CropKonnect Mega is the advanced field-station layer of the ESS product stack. It extends soil sensing with live weather telemetry, outlooks and operational field decisions in one mobile experience.

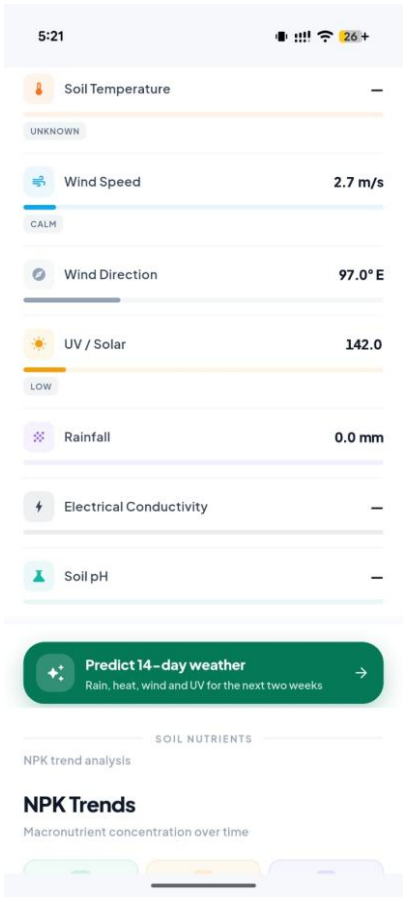
- Integrated soil and weather station data
- Live telemetry dashboard with spatial context
- 14-day weather outlook and field actions
- Decision support tied to farm advisory workflows



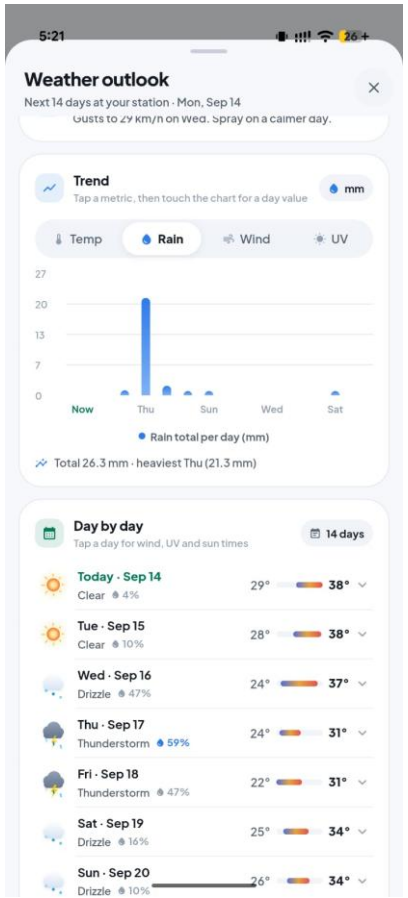
Live sensor matrix with field map and weather-station indicators

Telemetry, Weather Forecasting & Field Conditions

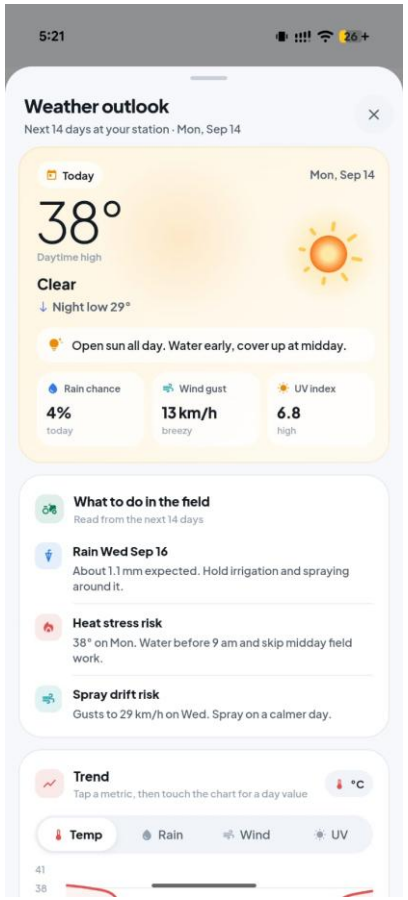
CropKonnect Mega turns raw station data into a usable field-operating interface for monitoring and short-term action.



Sensor metrics, forecast prompt and nutrient trends



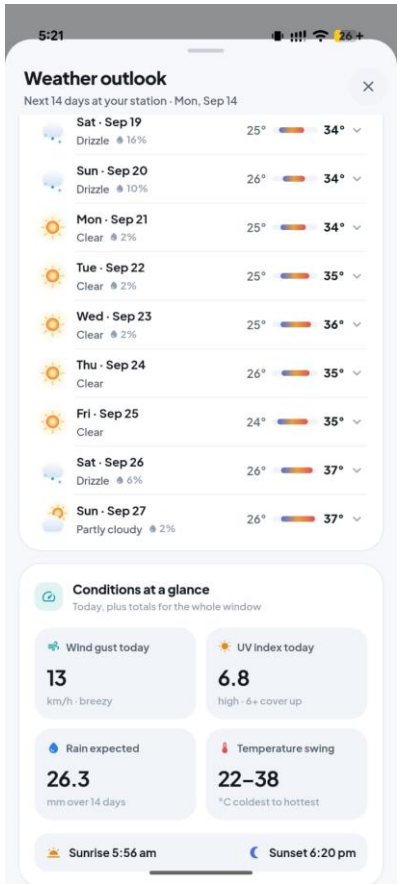
14-day outlook with rainfall trend



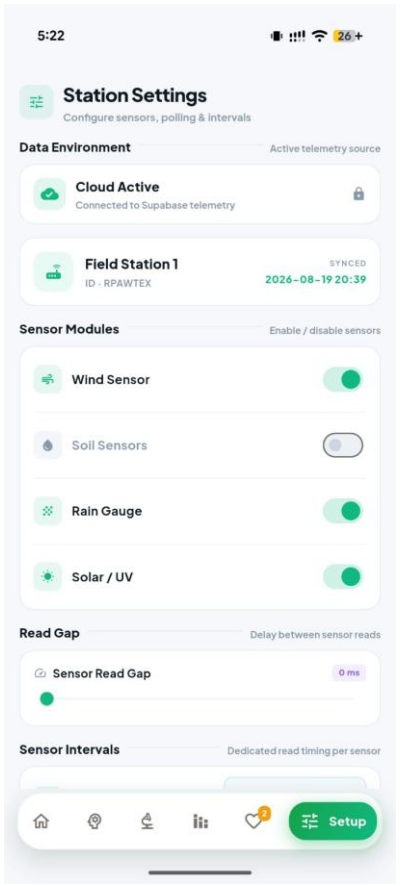
Daily weather and what-to-do guidance

Operational Controls & Advisory Integration

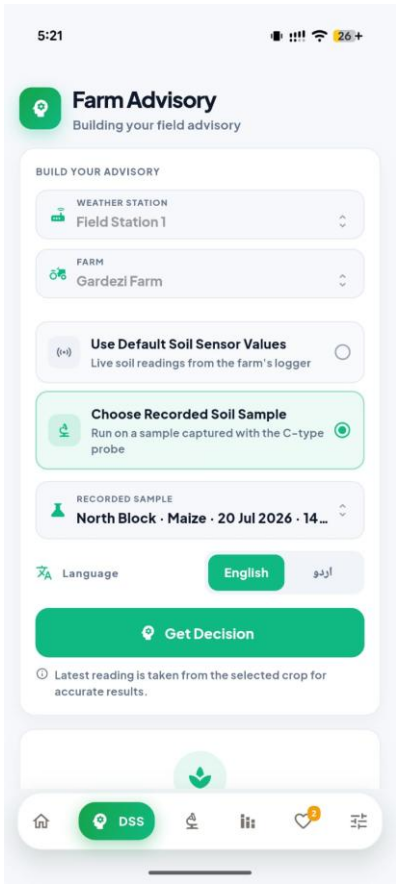
Beyond monitoring, CropKonnect Mega supports station configuration and advisory generation across farm workflows.



Forecast continuation + conditions at a glance



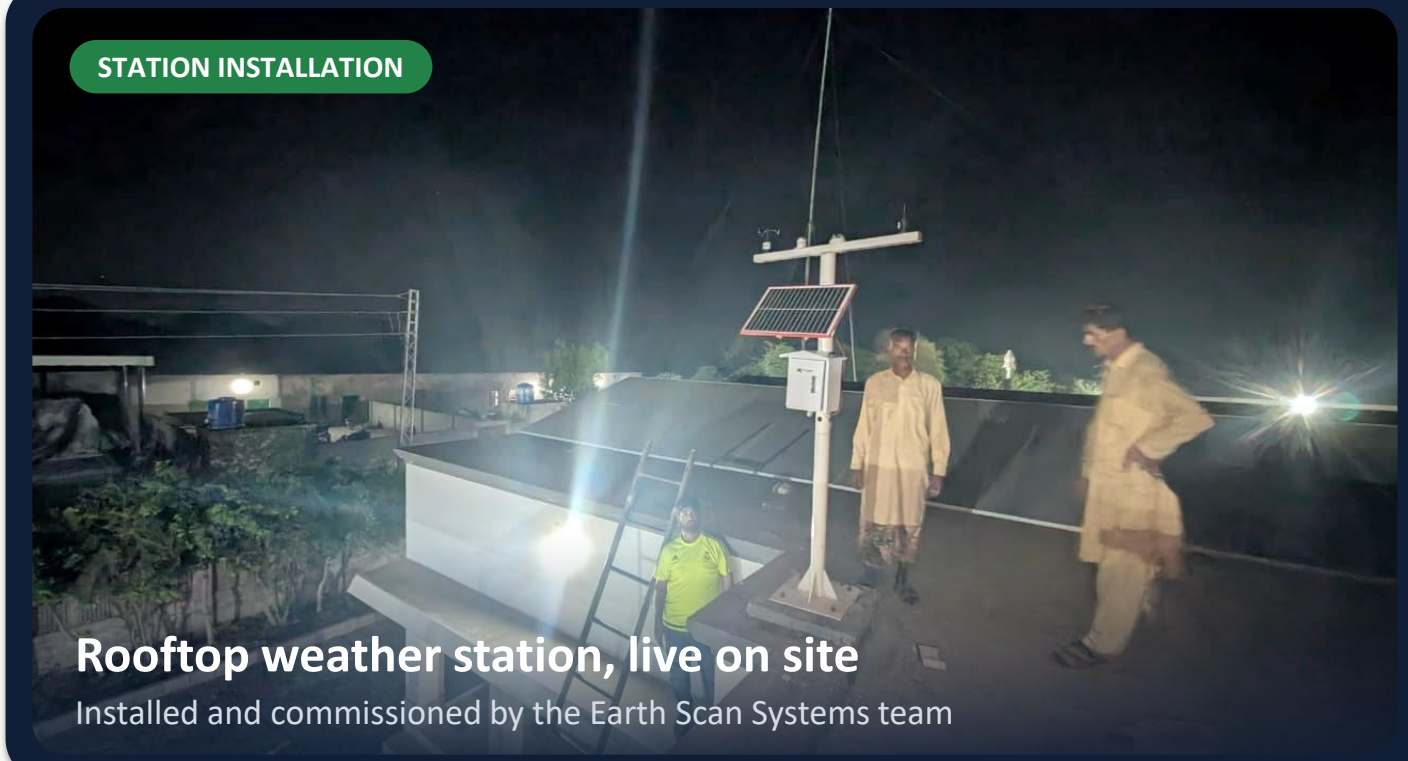
Station settings and module controls



Farm advisory / decision workflow

CropKonnect Mega: Field Station Installation

Solar-powered soil and weather stations installed on site and commissioned, with live readings verified on the phone.







Solar powered
Runs off-grid in the field

Weather sensors
Mast-mounted sensor cross-arm

Data gateway
Weatherproof telemetry enclosure

Verified at install
Live readings confirmed on the phone

How CropKonnect Mega Fits the ESS Portfolio

CropKonnect Mega brings sensing, weather intelligence and decision support together in one high-value operational offering.

1. Sensor + station convergence

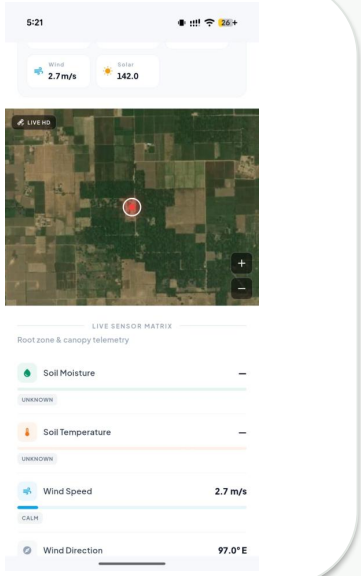
It merges soil readings with weather-station telemetry, giving a broader field-status picture than a sensor-only product.

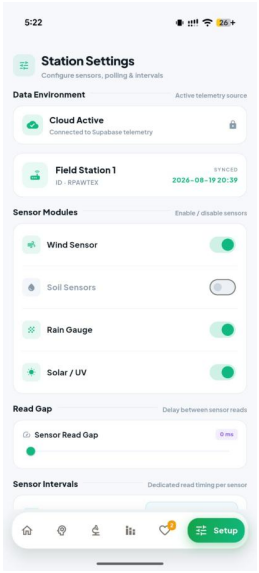
2. Practical weather intelligence

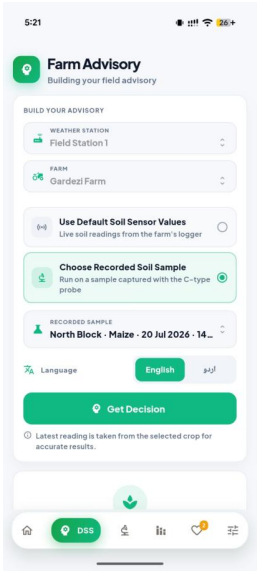
Its 14-day outlooks, condition summaries, and trend views make the product immediately useful for operations and agronomy planning.

3. Decision support

The built-in advisory builder makes CropKonnect Mega a decision-support product, not just a telemetry viewer.







Positioning statement

CropKonnect Mega Smart Field Station Intelligence: integrated soil sensing, weather-station telemetry and advisory support for smarter field decisions.

GW Konnect

Groundwater level sensing with device setup, bore calibration, cloud sampling, and live mobile monitoring.

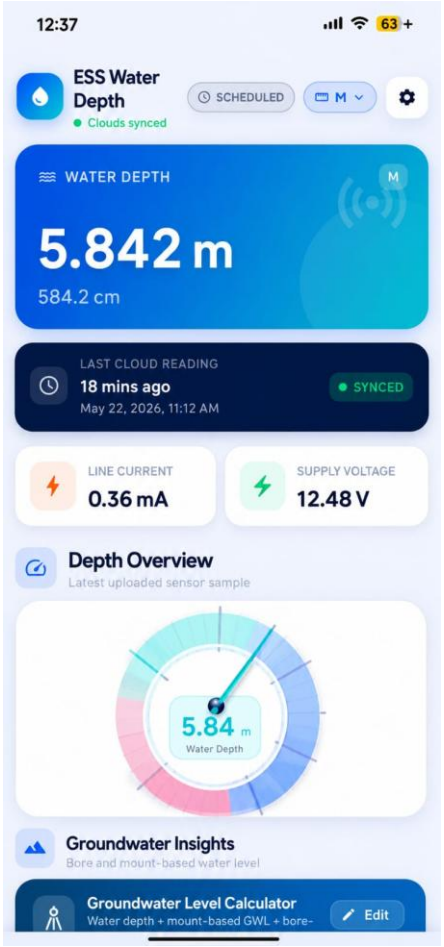
GW Konnect: Groundwater Level Sensor Platform

ESS GW Konnect monitors bore / well water depth with cloud sync, configurable sampling, and operator-ready dashboards.

Product summary

GW Konnect is a dedicated groundwater level sensor product. It helps users configure the sensor kit, define well geometry, schedule sampling intervals, and monitor water depth through a clean mobile interface.

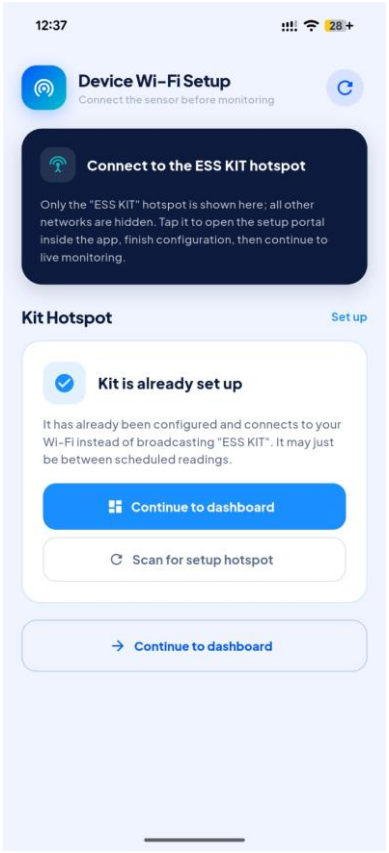
- Groundwater level measurement
- Bore and mount-depth based setup
- Cloud-synced scheduled monitoring
- Mobile dashboard and field-friendly UX



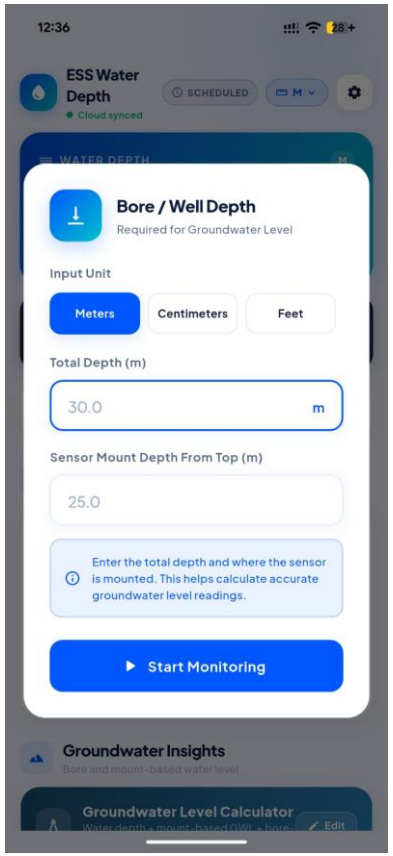
GW Konnect live monitoring dashboard showing water depth, sync status, power metrics, and visual depth overview

GW Konnect: Onboarding & Sensor Configuration

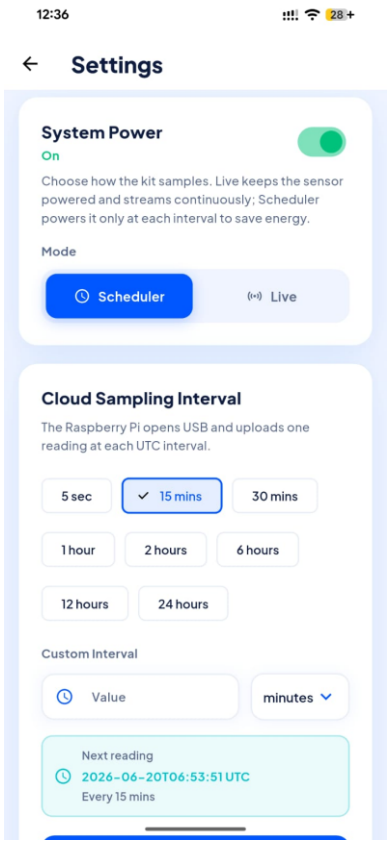
The setup flow is designed for fast field deployment, from Wi-Fi pairing to bore geometry input and device configuration.



Wi-Fi / kit hotspot setup



Bore / well depth calibration



Sampling mode & interval settings

How GW Konnect Fits the ESS Portfolio

GW Konnect complements ESS crop, advisory, and climate products by bringing direct groundwater intelligence into the platform portfolio.

1. Water intelligence

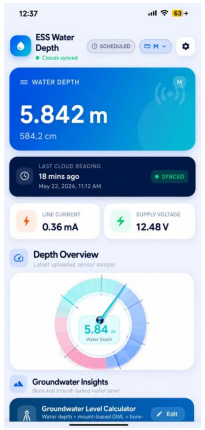
Tracks bore / well depth and supports groundwater-aware decisions for irrigation planning, sustainability, and farm monitoring.

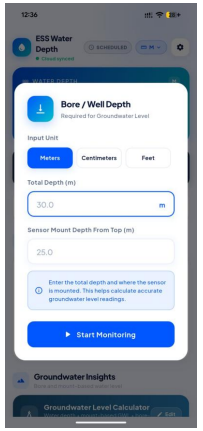
2. Configurable deployment

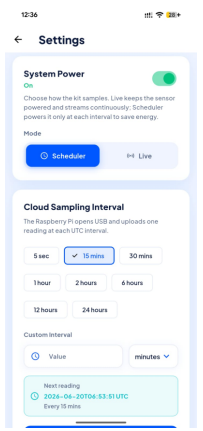
Supports hotspot setup, mode selection, interval scheduling, and bore / mount input for accurate depth calculation.

3. Enterprise relevance

Useful for farms, estates, irrigation operators, groundwater programs, and institutions monitoring water security.







Positioning statement

GW Konnect: Groundwater level sensing with device setup, bore calibration, cloud sampling control, and live mobile monitoring.

Innovation Pipeline: Agri Robotics & Geo-Automation

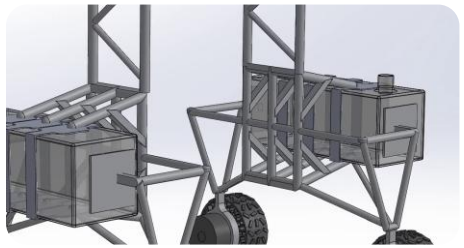
Extending IoT sensing into automation: field robots and satellite-guided spraying are the next stage of ESS field intelligence.



Field robot trial



Satellite-guided spraying simulation



Robot platform design



Autonomous spray path

> **We are at the edge of the next big wave of technology, where geo-automation is written on the wall.**
>
> Dr Mobushir Riaz Khan

ERP systems for farm management and traceability

Operational management platforms for crop farms and livestock enterprises.

Crop ERP

Herd ERP

Crop ERP

End-to-end crop farm operating system for planning, execution, harvest, inventory, sales, and commercial workflows.

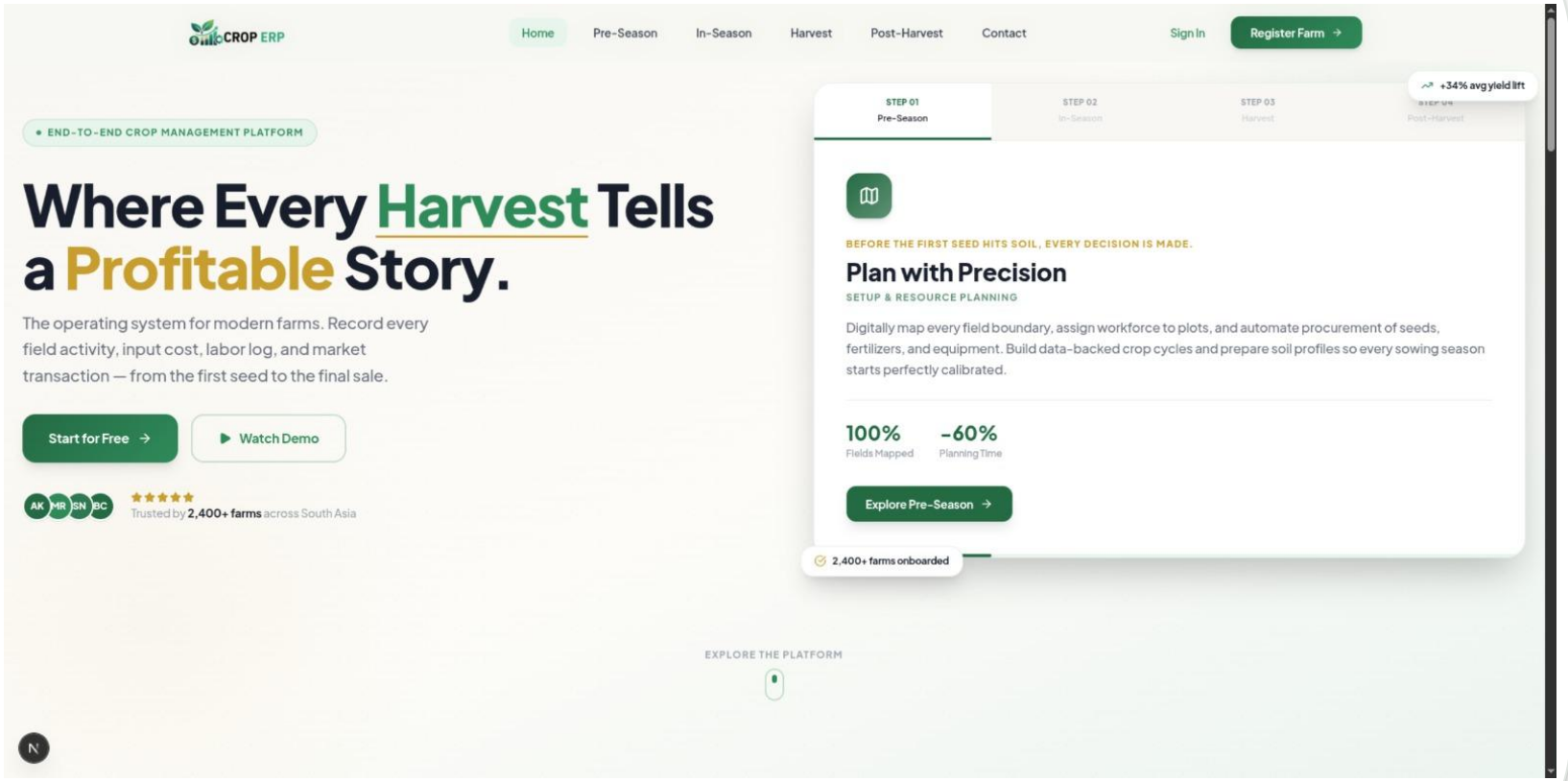
Crop ERP: End-to-End Farm Operating System

The operational backbone for modern farms, integrating planning, execution and commercial workflows.

Product overview

Crop ERP turns farm activity into a structured operating system. It supports the full crop cycle from pre-season planning to post-harvest sales, helping agribusinesses manage operations in one connected environment.

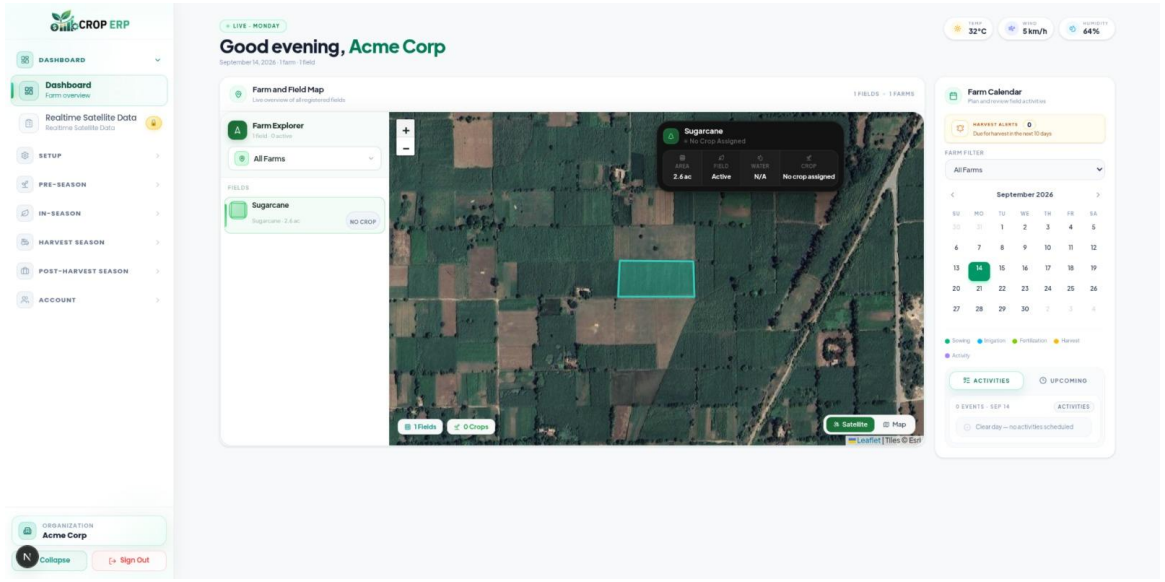
- Pre-season planning and setup
- In-season execution tracking
- Harvest and post-harvest workflows
- Commercial and sales management



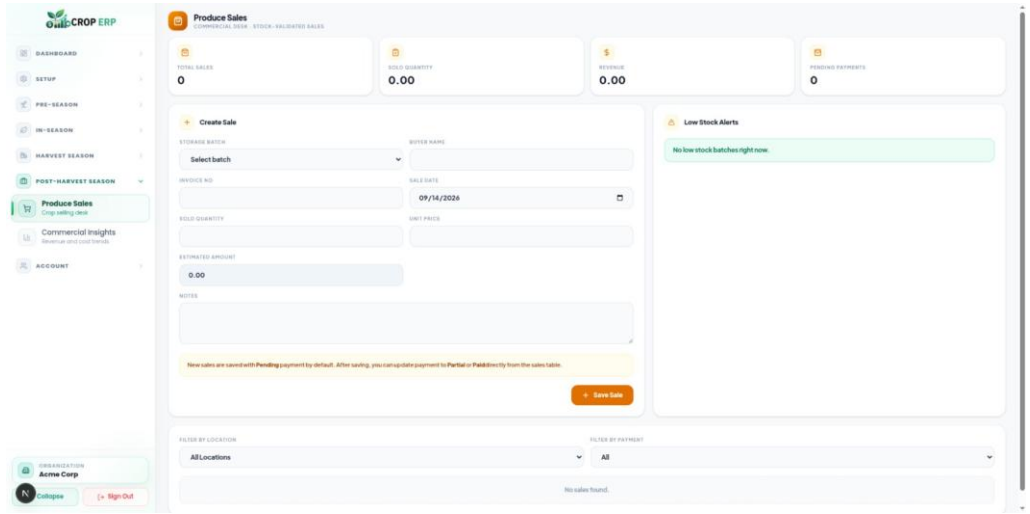
Crop ERP platform overview

Crop ERP: Operational Workflows

Field mapping, dashboard management, commercial transactions and multi-stage farm administration in one system.



Farm overview dashboard with field map and calendar



Produce sales and post-harvest commercial desk

Commercial execution

Extends beyond farm records into commercial execution and operational control.

Built for scale

Built for large farms, processors, agri-enterprises and contract-farming operations.

Portfolio synergy

Connects with monitoring, advisory and vegetation intelligence across the ESS portfolio.

Herd ERP

Enterprise livestock management for farms, sheds, animals, health, milk, meat, warehouse, and finance.

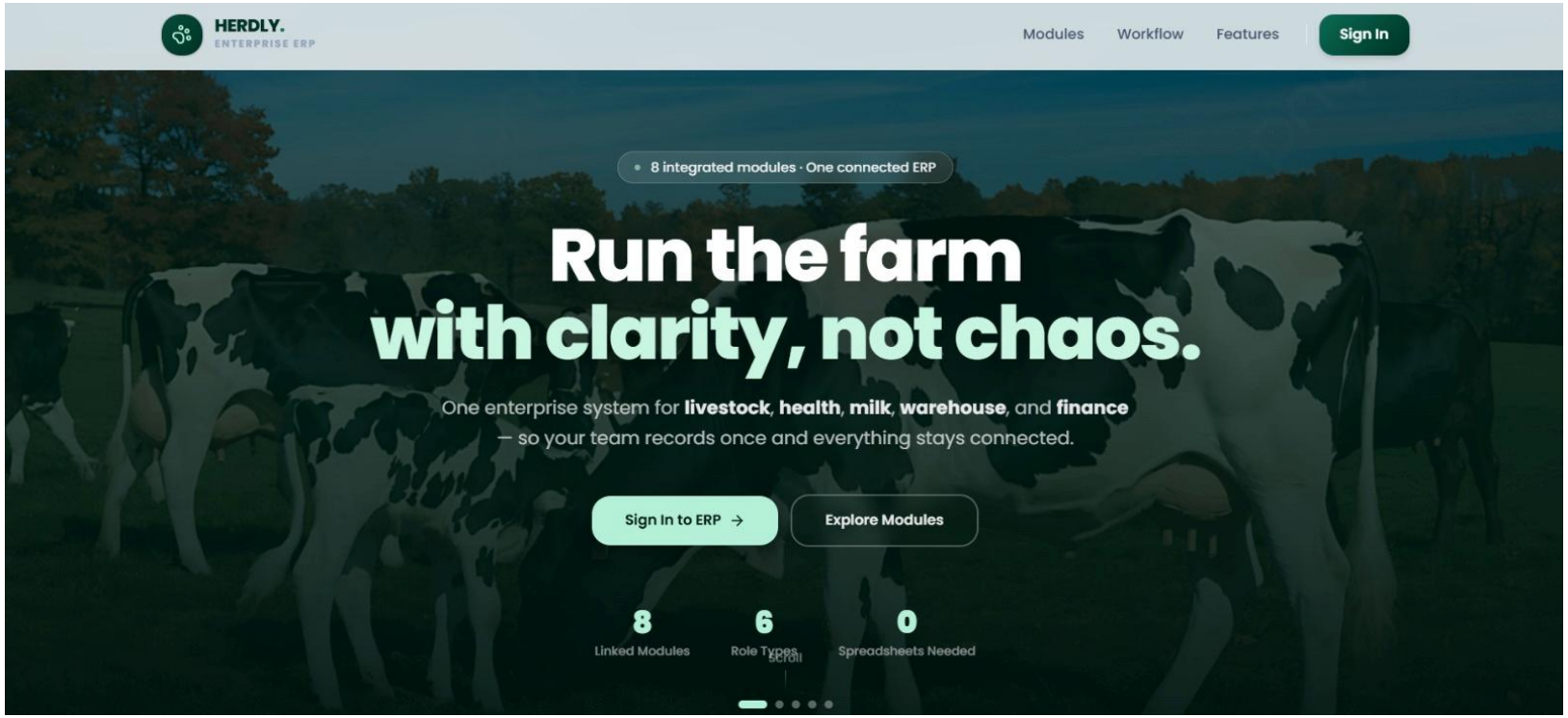
Herd ERP: Livestock Enterprise Operating System

A connected management platform for livestock, health, milk, warehouse, and finance workflows.

Product overview

Herd ERP extends ESS from crop and land intelligence into livestock enterprise management. It gives large dairy and livestock operations one connected system to manage assets, production, health, inventory, and revenue.

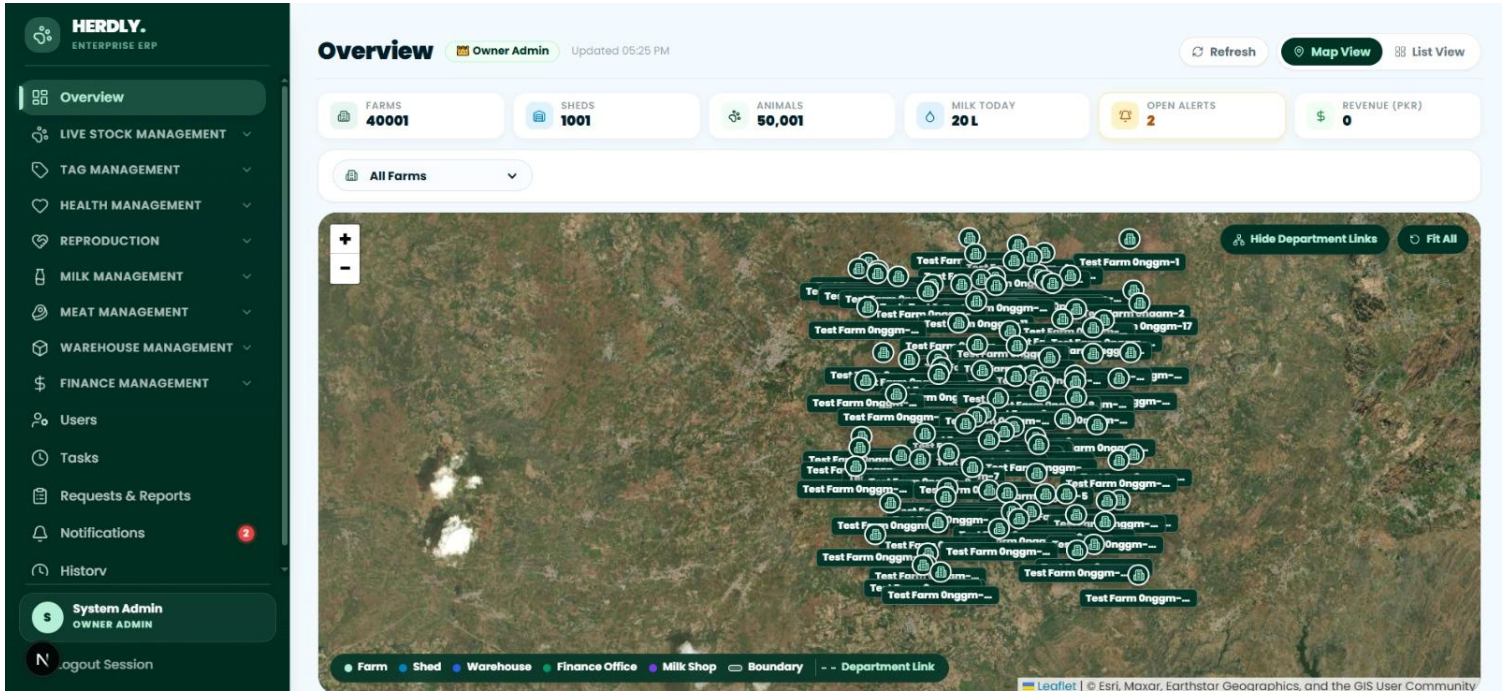
- Livestock and shed management
- Animal tags, health, reproduction, milk, and meat workflows
- Warehouse and finance modules
- Enterprise overview for managers and owners



Herd ERP landing page and enterprise value proposition

Herd ERP: Farm Network Overview

A geospatial dashboard for livestock enterprise visibility across farms, sheds, animals, alerts, and revenue.



Map-based livestock enterprise overview

What it shows

Map view of farm assets with location markers, farm counts, sheds, animals, milk today, open alerts, and revenue indicators.

Operational value

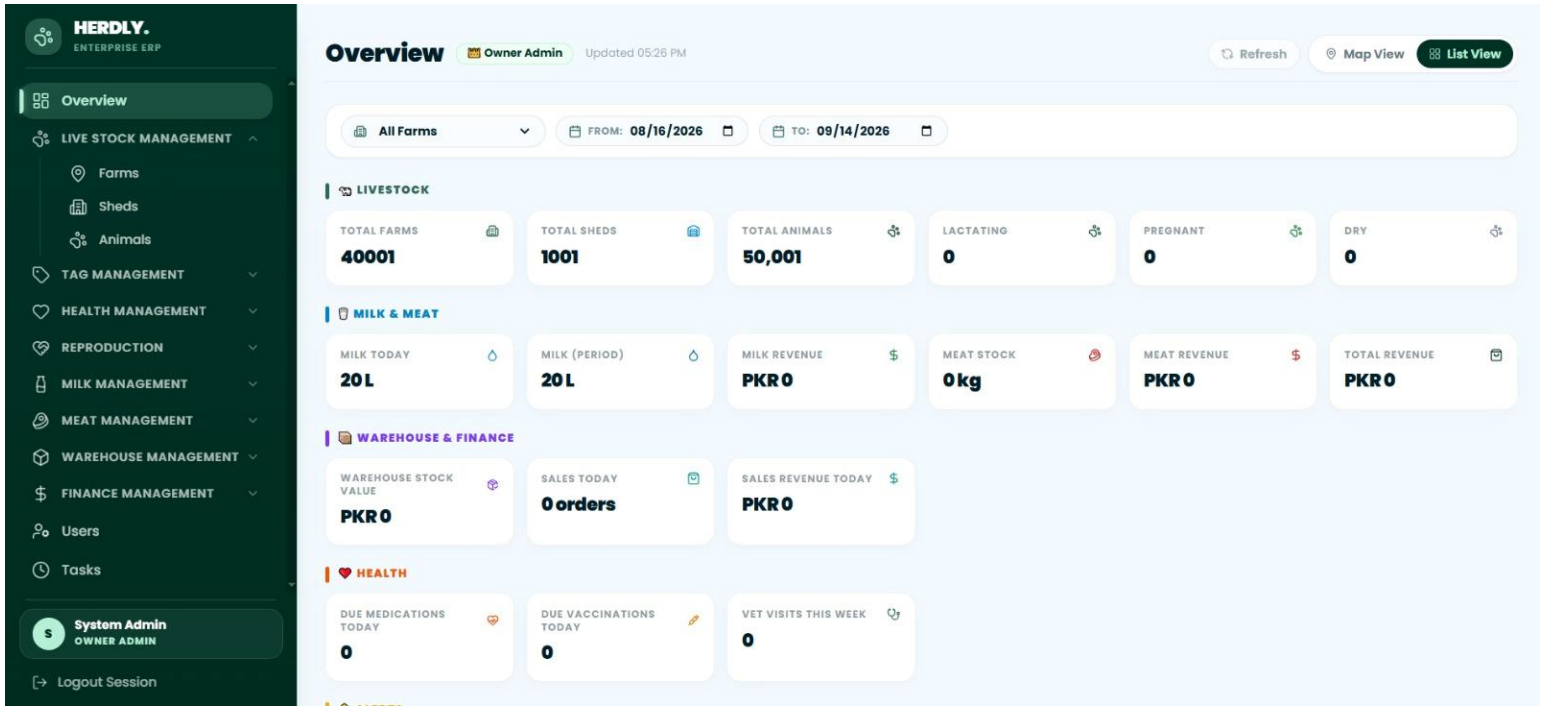
Managers can view distributed livestock infrastructure and monitor enterprise activity from a central dashboard.

Who it serves

Useful for dairy groups, livestock companies, government livestock programs, and large integrated farm operations.

Herd ERP: Operational Modules & KPI Intelligence

List view converts the livestock operation into measurable modules for production, health, warehouse, and finance.



List view with operational KPIs and module categories

Livestock KPIs

Total farms, sheds, animals, lactating, pregnant, dry, and animal-category status.

Milk, meat & finance

Milk today, period milk, milk revenue, meat stock, meat revenue, and total revenue.

Health workflows

Due medications, due vaccinations, vet visits, alerts, requests, reports, and task-driven follow-up.

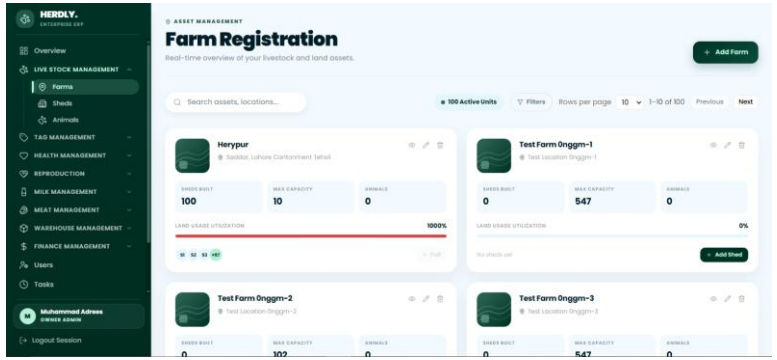
Herd ERP: Farm, Shed & Animal Registry

The core registry structures the enterprise from farms to sheds to individual animals, with live capacity tracking.

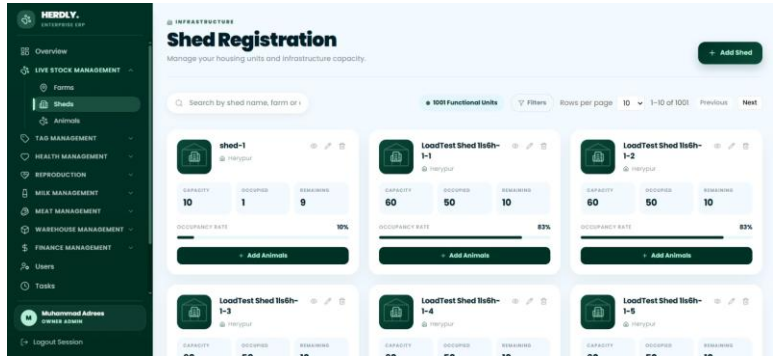
Livestock registry

Every animal is linked to a shed and every shed to a farm, giving managers one reliable record of assets and capacity.

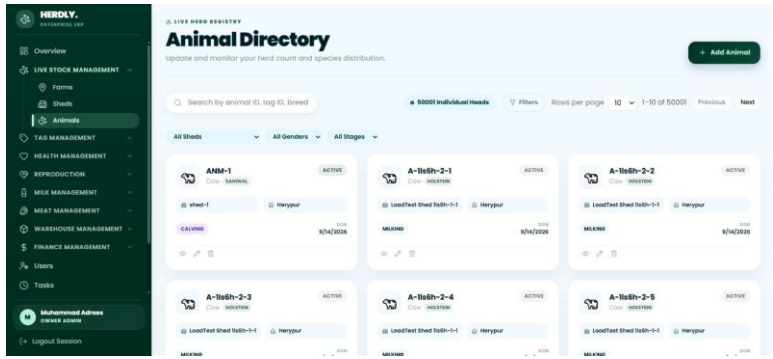
- Farm registration with land-use utilization
- Shed capacity, occupancy and space
- Animal directory by breed, gender and stage
- Search and filters at enterprise scale



Farm registration



Shed registration & occupancy



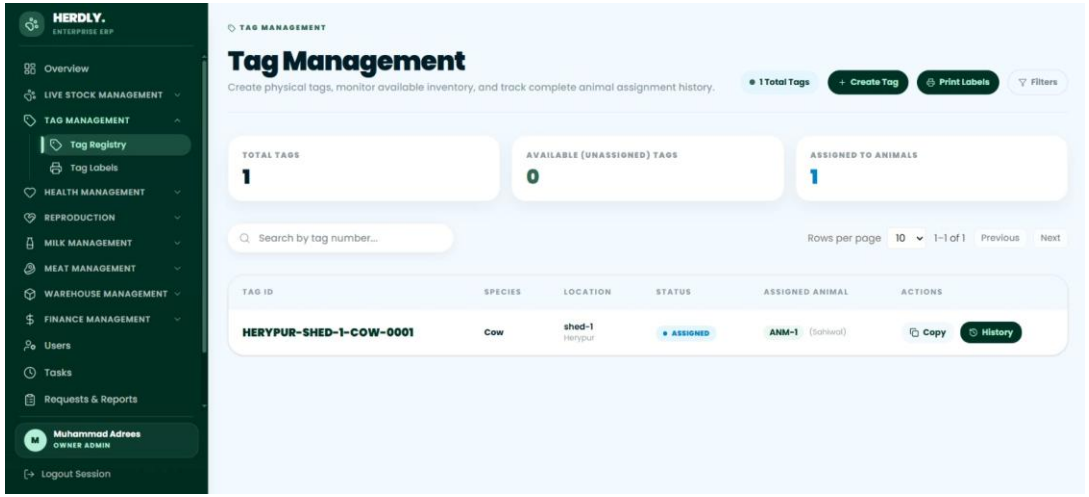
Animal directory

Built for scale

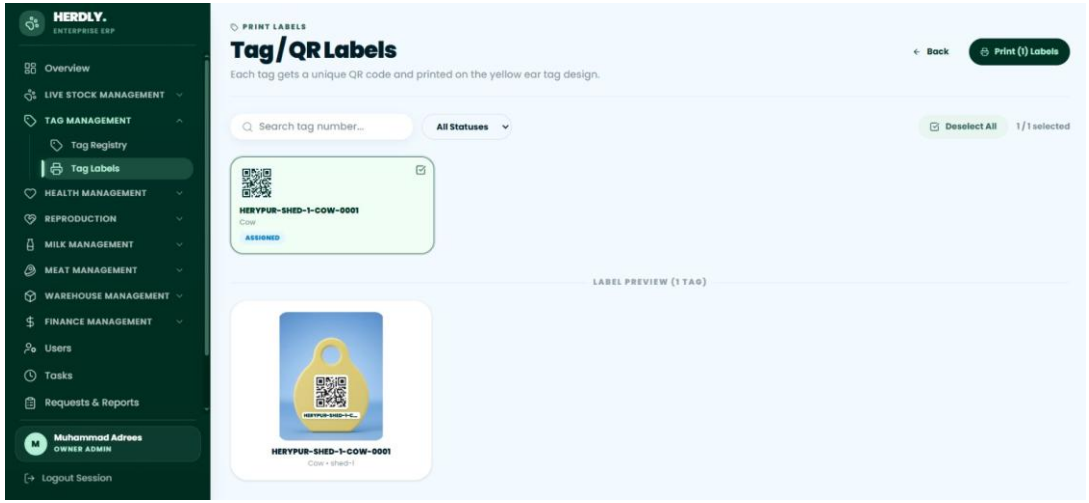
Registry views page, search and filter across 100 farms, 1,001 sheds and 50,001 animal records.

Herd ERP: Tag & QR Identification

Physical ear tags with unique QR codes connect every animal to its digital record and assignment history.



Tag registry with assignment history



Printable QR ear-tag labels

Unique identity

Each tag receives a structured farm, shed, species, number ID and its own printable QR code.

Tag inventory control

Total, available and assigned tags are counted automatically, so unused stock is always visible.

Full traceability

Tag history links each animal to its location and records, forming the base for health, milk and sales traceability.

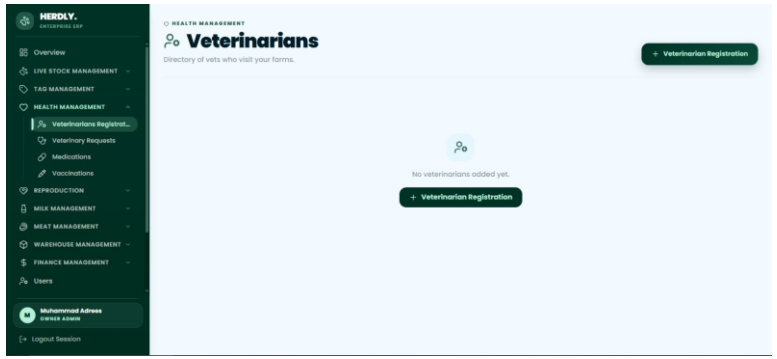
Herd ERP: Health & Veterinary Management

Clinical workflows cover vet registration, sick-animal requests, prescriptions and vaccination schedules.

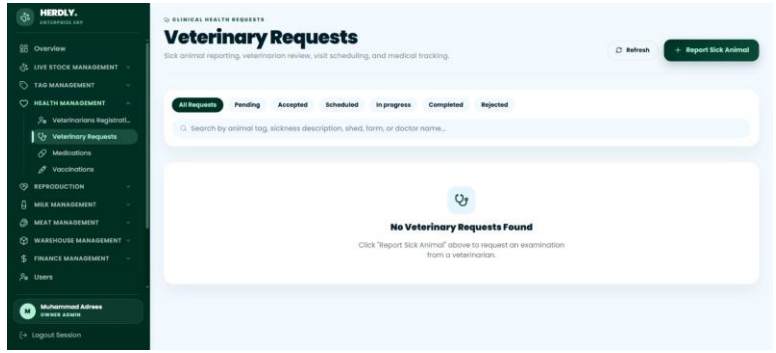
Animal health

Health events are recorded against each animal, so treatments, withdrawal periods and vaccinations are not missed.

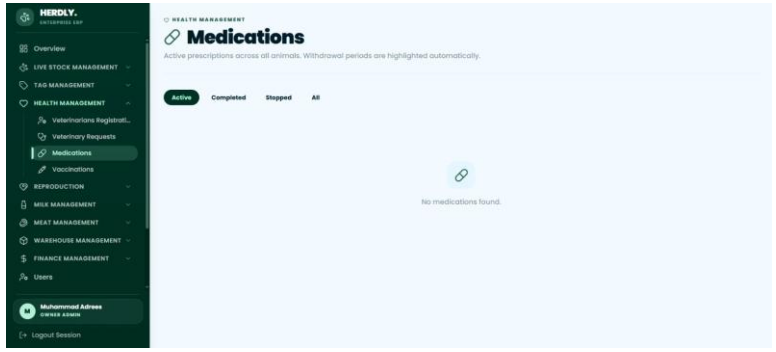
- Veterinarian directory per farm
- Sick-animal requests with status tracking
- Prescriptions with withdrawal alerts
- Vaccination history and due doses



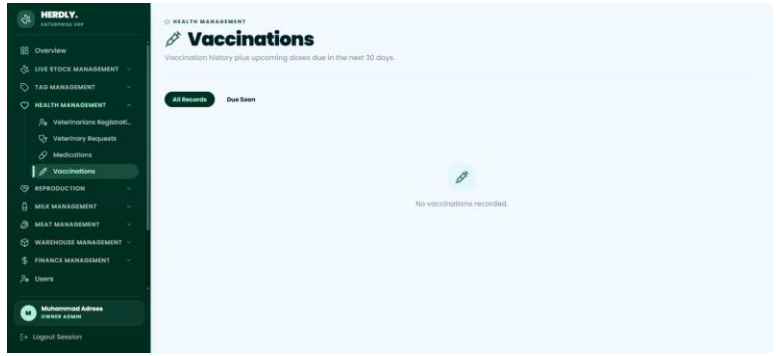
Veterinarian directory



Veterinary requests



Medications & withdrawal periods



Vaccination schedule

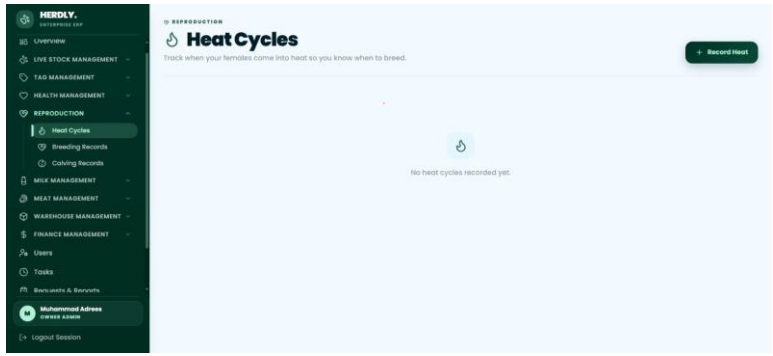
Herd ERP: Reproduction Management

Heat detection, breeding and calving are tracked as one cycle, with expected calving dates calculated automatically.

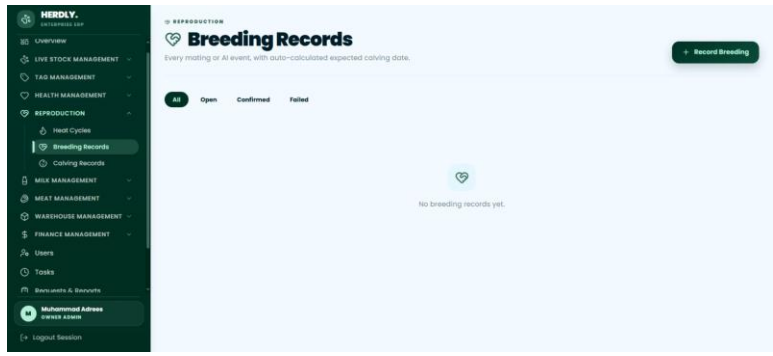
Breeding cycle

Reproduction records help farms shorten calving intervals and plan milk production ahead.

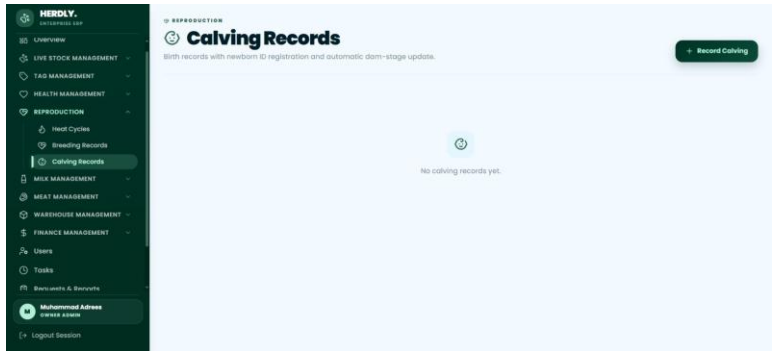
- Heat cycle recording
- Natural mating and AI breeding events
- Auto-calculated expected calving date
- Calving records with newborn ID



Heat cycles



Breeding records



Calving records

Automatic herd updates

Recording a calving registers the newborn and updates the dam's stage, keeping the animal directory current.

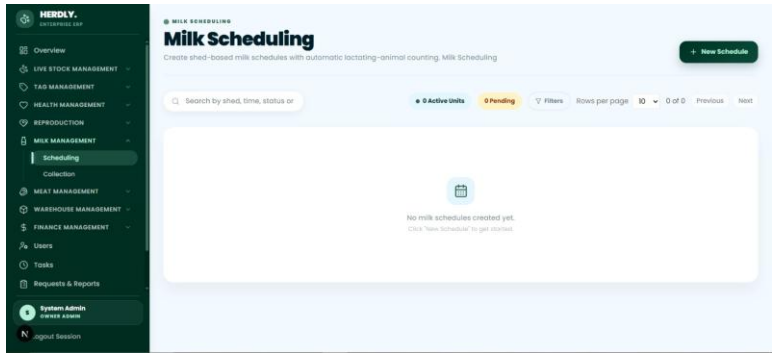
Herd ERP: Milk & Meat Production

Production modules schedule milking by shed, record daily yields and manage cold-storage meat inventory.

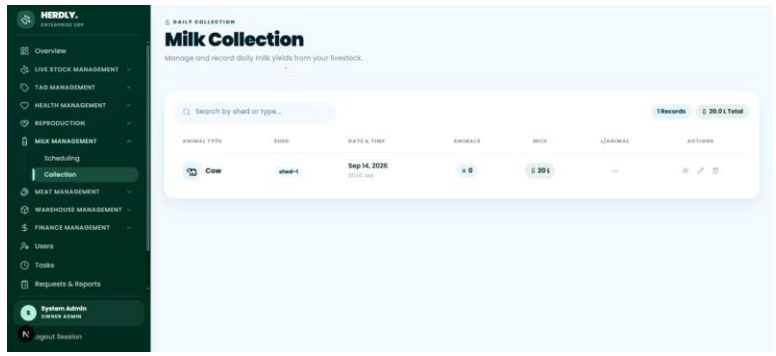
Production control

Daily output is captured at the source and linked to sheds, animals and sales.

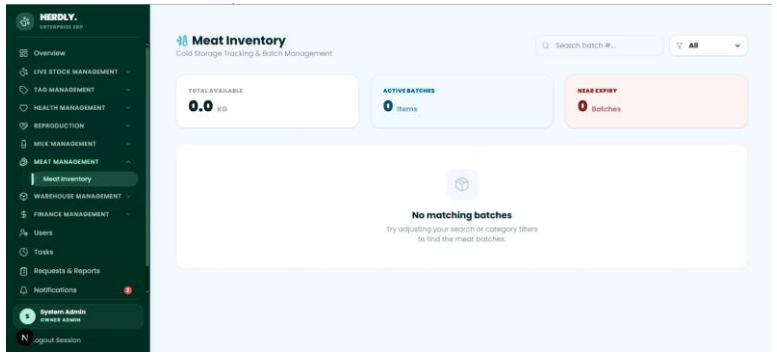
- Shed-based milk schedules
- Automatic lactating-animal counts
- Daily milk collection records
- Meat batches with near-expiry alerts



Milk scheduling



Daily milk collection



Meat inventory & cold storage

Connected workflow

A completed milking task, its 20 L collection record and the milk POS stock all stay in step across modules.

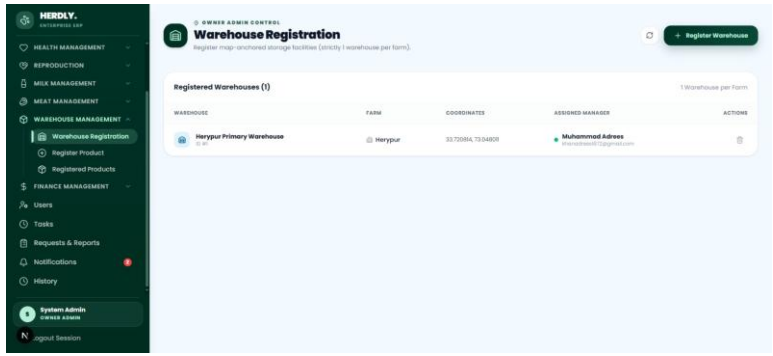
Herd ERP: Warehouse & Inventory

Map-anchored warehouses manage medicine, vaccine, feed and product stock with packaging and supplier details.

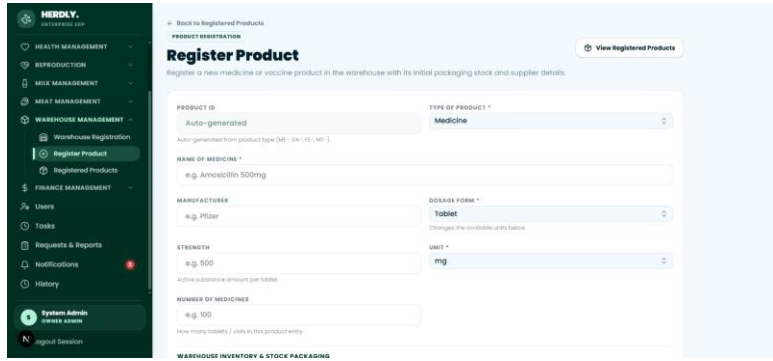
Inventory control

Each farm operates one registered warehouse, keeping stock, supplies and costs accountable.

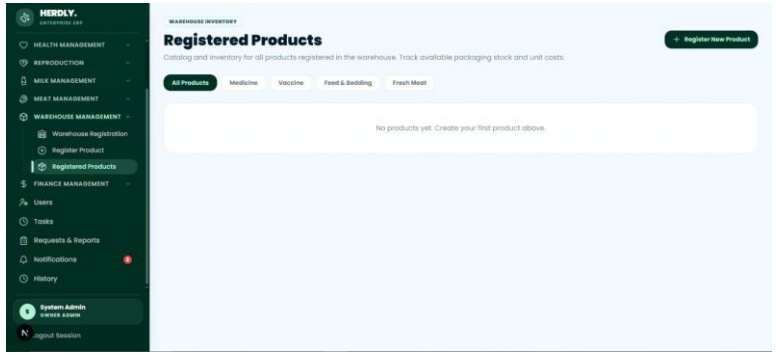
- Warehouse registration with GPS location
- Medicine and vaccine product registration
- Feed, bedding and fresh-meat categories
- Packaging stock and unit costs



Warehouse registration



Product registration



Registered products catalogue

Structured product data

Medicines and vaccines are registered with dosage form, strength and quantity for use across health workflows.

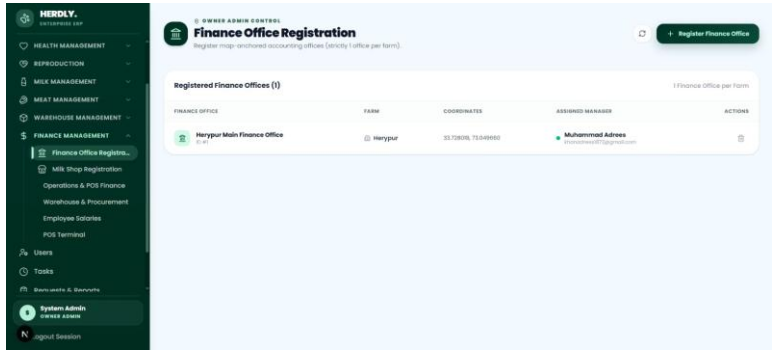
Herd ERP: Finance, Retail & POS

Finance offices, milk shops and POS terminals turn production into tracked revenue at every farm.

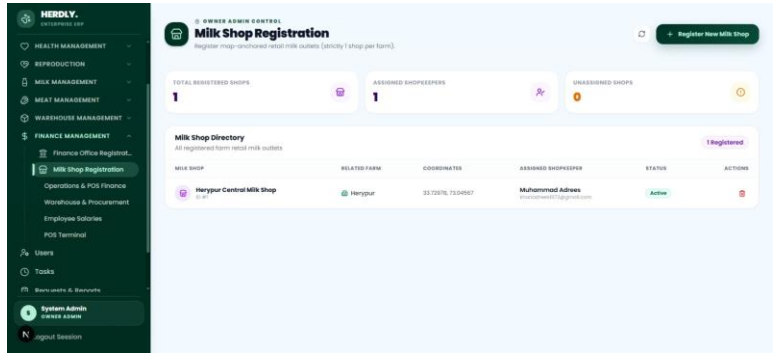
Revenue operations

Sales are recorded at the point of sale and reconciled daily, giving owners real-time revenue visibility.

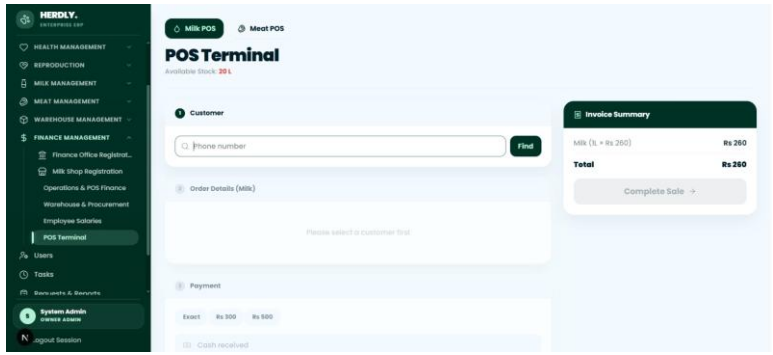
- One finance office per farm
- Retail milk shop directory
- Milk and meat POS terminals
- Daily shift closings and receipts



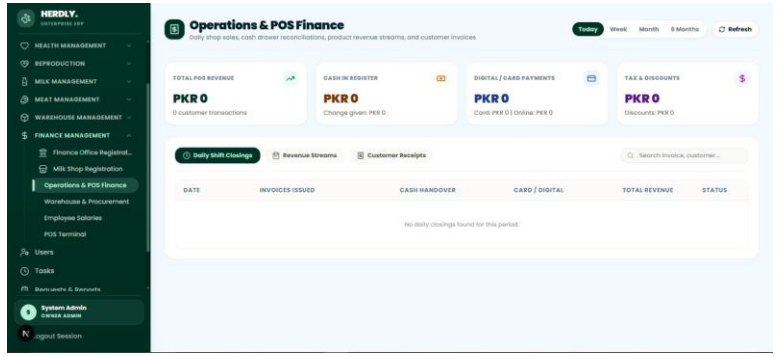
Finance office registration



Milk shop registration



Milk & meat POS terminal



Operations & POS finance

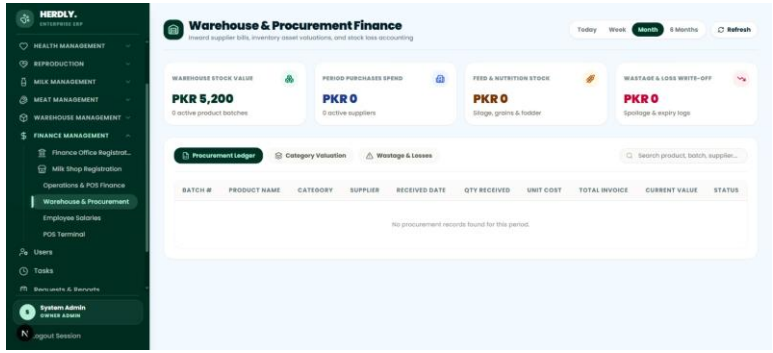
Herd ERP: Cost Control, Payroll & Team Governance

Procurement, salaries, roles and daily tasks give owners control over costs and workforce accountability.

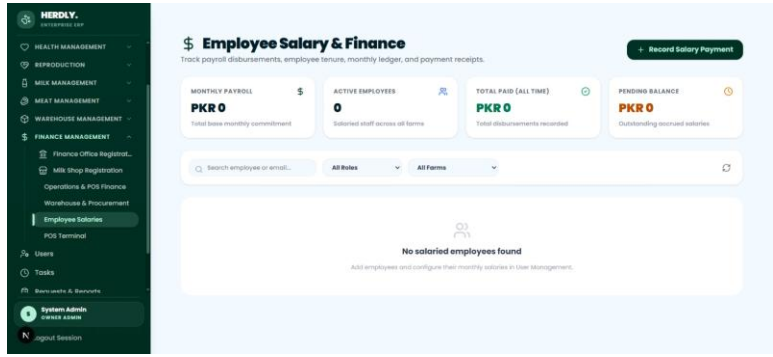
Enterprise control

Owners see what is spent, who is responsible and which work has been completed.

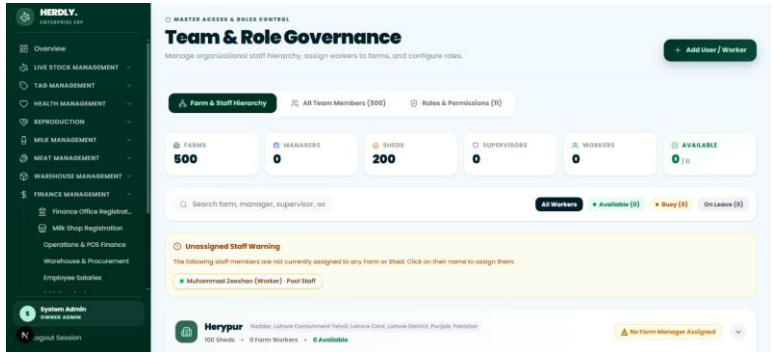
- Supplier bills and stock valuation
- Wastage and loss write-offs
- Payroll and outstanding salaries
- Role-based access and daily task board



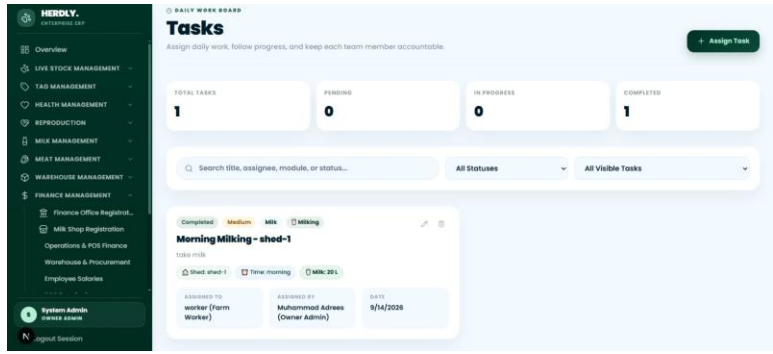
Warehouse & procurement finance



Employee salaries



Team & role governance



Daily task board

How Herd ERP Fits the ESS Portfolio

Herd ERP extends ESS into livestock enterprise operations with the same intelligence-led approach.

1. Enterprise operations

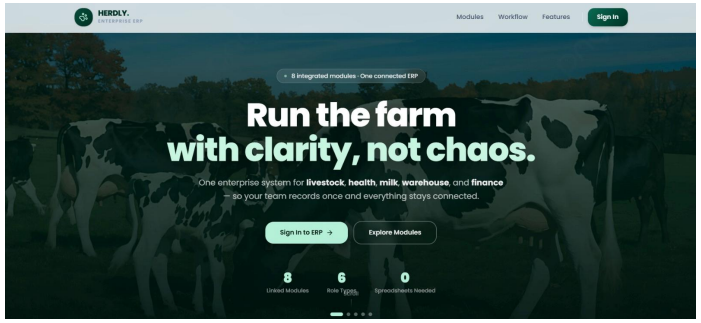
Herd ERP goes beyond record-keeping, organising livestock, assets, production, alerts and revenue in one management environment.

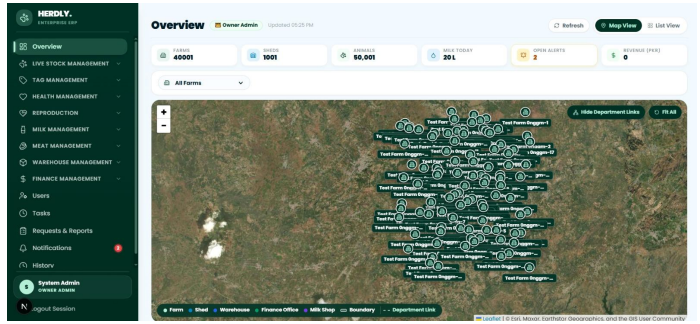
2. Multi-module control

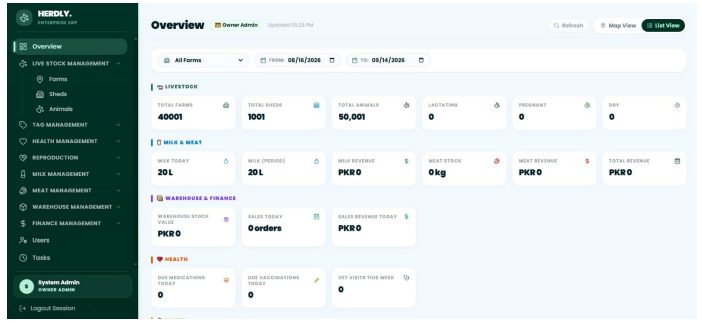
The product covers livestock, tags, health, reproduction, milk, meat, warehouse, finance, users, tasks, and reports.

3. Strong B2B & B2C fit

Relevant for commercial dairy farms, livestock operators, government programs, and enterprise agriculture clients.







Positioning statement

Herd ERP: Enterprise livestock management for farms, sheds, animals, health, milk, meat, warehouse, and finance.

Why Earth Scan Systems

One portfolio connecting satellite intelligence, IoT sensing, ERP operations, climate risk, insurance workflows, and AI advisory.

1. Integrated intelligence

Remote sensing, weather, soil sensors, groundwater, climate projections and advisory work together as one connected ecosystem.

2. Operational depth

ERP products cover crop and livestock workflows, taking ESS from analytics into daily enterprise operations.

3. Ground-to-space evidence

Satellite indices, field scouting, IoT sensors, and registration workflows build traceable evidence for decisions and monitoring.

4. Last-mile adoption

Urdu advisory, mobile interfaces, voice interaction, and LLM support make the system usable beyond technical teams.

Who we are

Earth Scan Systems is an agricultural intelligence company delivering platform products for farms, agribusinesses, governments, insurers, sustainability programs, and enterprise operators.

EARTH SCAN SYSTEMS

Your Need. Our Technology. A Tailored Solution.

Every industry, organisation and operation has different challenges. Tell us what you need, and we will tailor the right right combination of ESS technologies, data and operational operational solutions for you.

Have a challenge in mind? Let's discuss it.

contact@escan-systems.com
mrkhan@escan-systems.com

For the following, please:

Contact Us

01

Define Your Need

Tell us the challenge, objective and operational requirements.

02

Tailor the Solution

We configure the relevant technologies, analytics and applications around your needs.

03

Demonstrate & Deploy

See it working through a focused demonstration or pilot, then scale it into operations.