



**LEARNING
INNOVATIONS
SUMMIT ~2024**



13.09.2024, Nicosia, CYPRUS

Leveraging AI and QGIS for Precision Agriculture: The **INSAC AGRIS** Project

Dr.Eng. Daniel AMARIEI,

PAMEA, Austria

Prof.Dr. Gabor MILICS, Dr. Krisztina TOTH

Hungarian University of Agriculture and Life Sciences

MATE, Hungary



Leveraging AI and QGIS for Precision Agriculture

- Introduction to Precision Agriculture and Emerging Technologies
- Current Research and Gaps
- **INSAC AGRIS**: Data Collection and AI-GIS Integration
- Key Findings from the **INSAC AGRIS** Project
- Training Initiatives: Hungarian Projects and MATE University
- Conclusion and Future Directions

Introduction to Precision Agriculture and Emerging Technologies

- Importance of precision agriculture in modern farming
- AI and QGIS: Key tools in enhancing decision-making and resource efficiency
- **INSAC AGRIS** project: A case study showcasing integration of AI and QGIS.



Importance of Precision Agriculture in modern farming

PA - innovative method in modern farming which uses advanced technologies to improve the effectiveness of agricultural practices, utilizing data-driven methods like **satellite imagery, drone surveillance, ground sensors,** and **GIS systems** in order to evaluate and optimise variability in crops and fields.

PA - improve crop yields and reduces waste and environmental impact by allowing farmers to utilize resources such as water, fertilizer, and pesticides with a very high accuracy.



AI and QGIS: Key tools in enhancing decision-making and resource efficiency

- essential in improving PA by allowing for even more precise and efficient decisions regarding farm management, their incorporation transforming substantially conventional farming methods, offering farmers tools for instant analysis, insight based on data, and automatic decision-making.
- AI offered the opportunity to create predictive models for crop yields forecasting, to identify plant diseases in their early stages, and to optimize irrigation schedules.
- Machine learning algorithms examined extensive datasets, such as weather patterns, soil conditions, and past yield information, allowing accurate suggestions for sowing, pesticides and fertilisers spraying, and, finally, harvesting.





Current Research and Gaps

Research gaps: Limited studies on the combined use of AI and GIS

Even the current paper highlights significant advancements in both AI and GIS technologies, yet there remains a notable gap in studies that explore their combined potential in precision agriculture.

This limited research **restricts a comprehensive understanding of how these two powerful tools can synergistically enhance agricultural decision-making**, particularly in optimizing crop management and resource allocation.

Further investigations into the integration of AI and GIS are essential to unlock their full potential and to develop innovative solutions for modern agricultural challenges.



Biggest obstacles in combining AI and GIS

- Data Integration Challenges
- Technical Complexity
- Computational Resources
- Data Accessibility
- Interoperability of Tools
- Adoption and Training

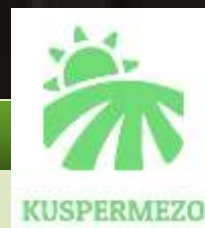
Integrated System for Automatized Control of Experimental Crops through Aerial/Ground Remote Sensing for Precision Farming



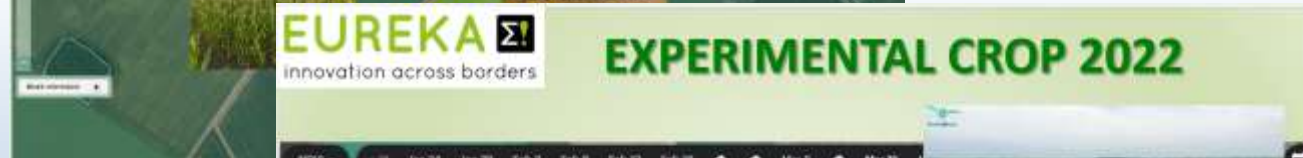
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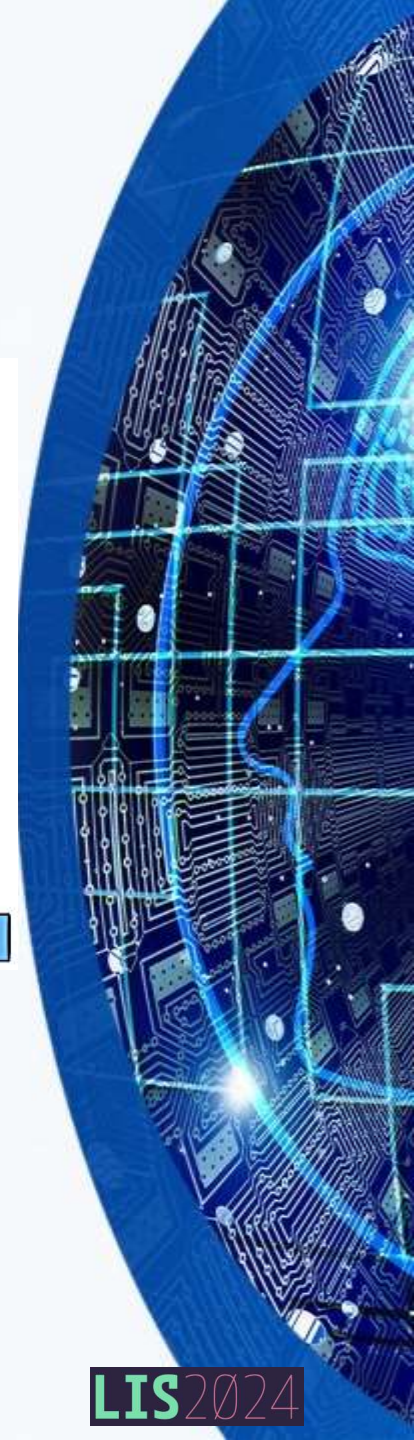
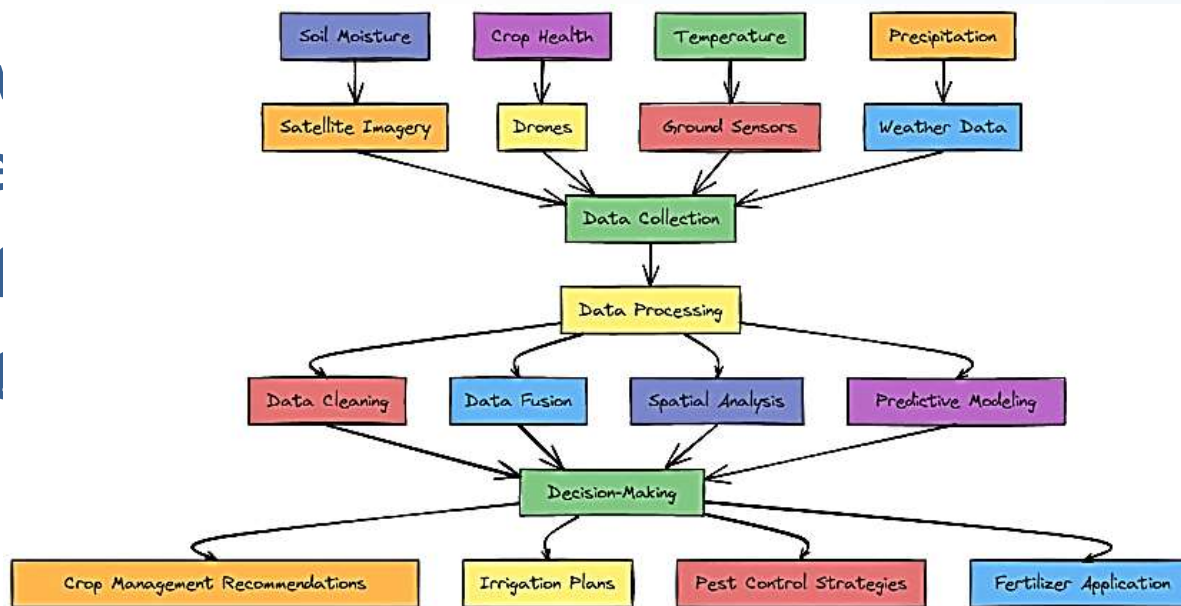


Experimental crops



Data Collection and Integration

- Data collected from drones, satellites, IoT sensors
- AI-driven and real-time
- Use of machine learning for crop management



SOIL CHARACTERISATION

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Kuspermezo - 086_8 - 2022



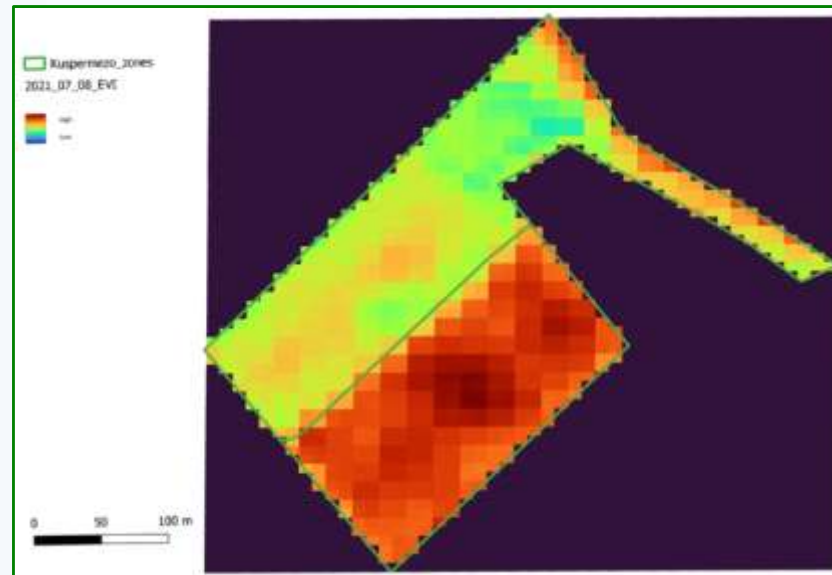
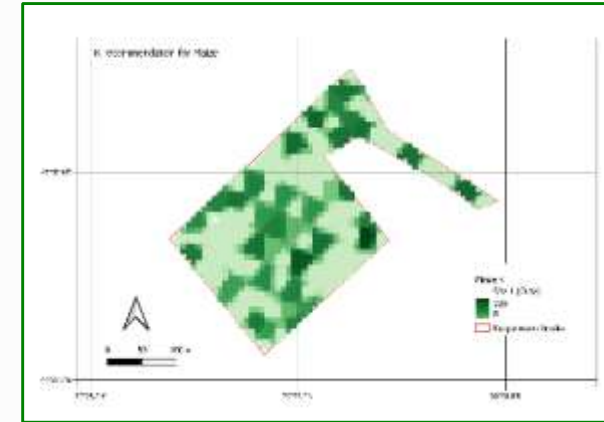
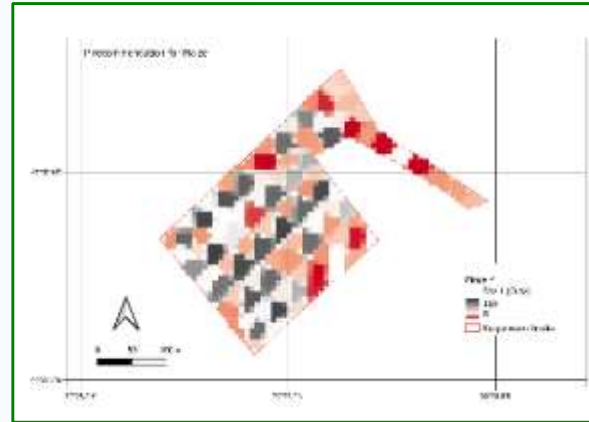
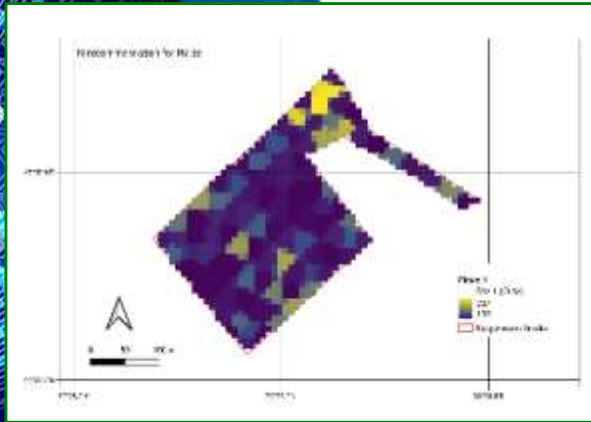
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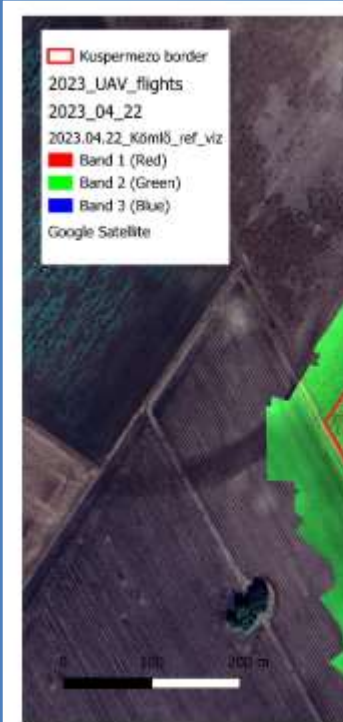
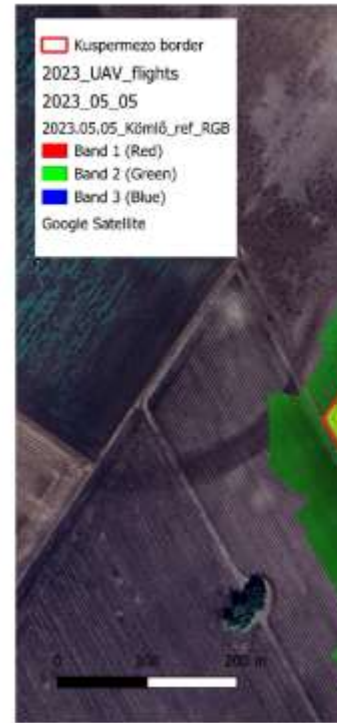
FERTILISATION MAPS AND CROP POTENTIAL



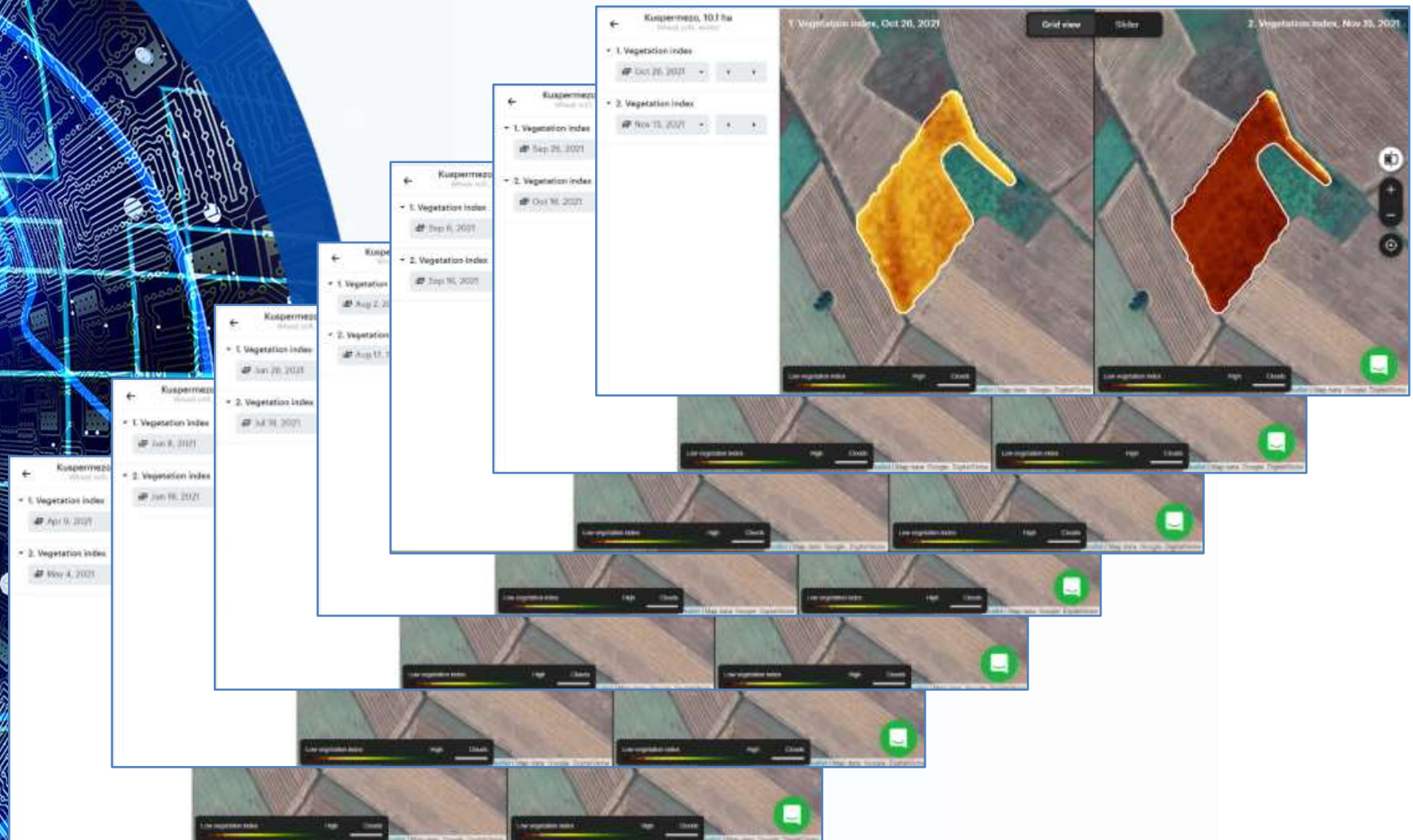
ORTHO-PHOTO PLAN



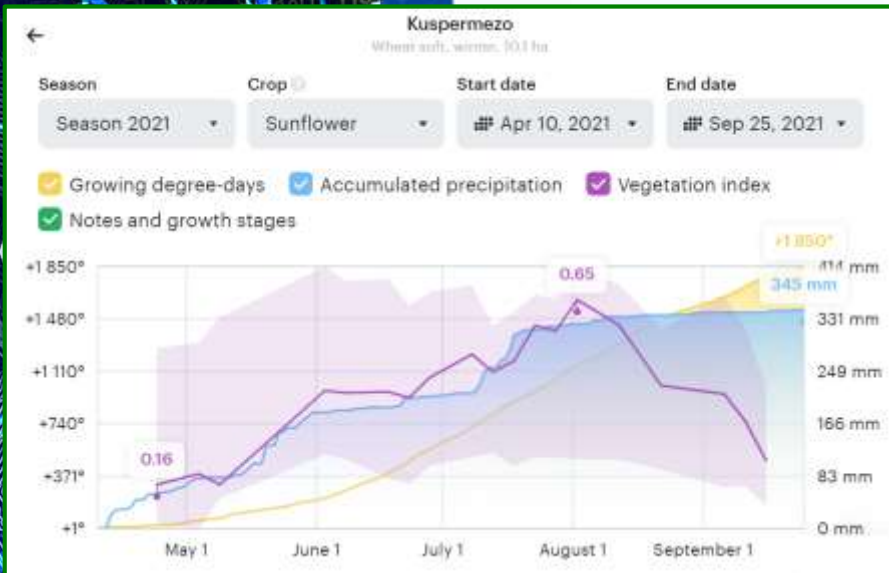
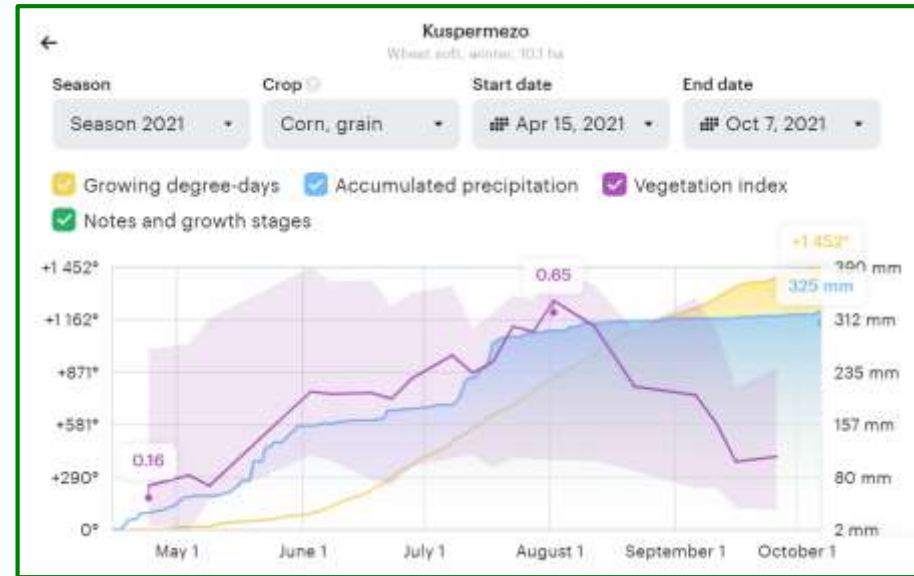
AERIAL IMAGERY

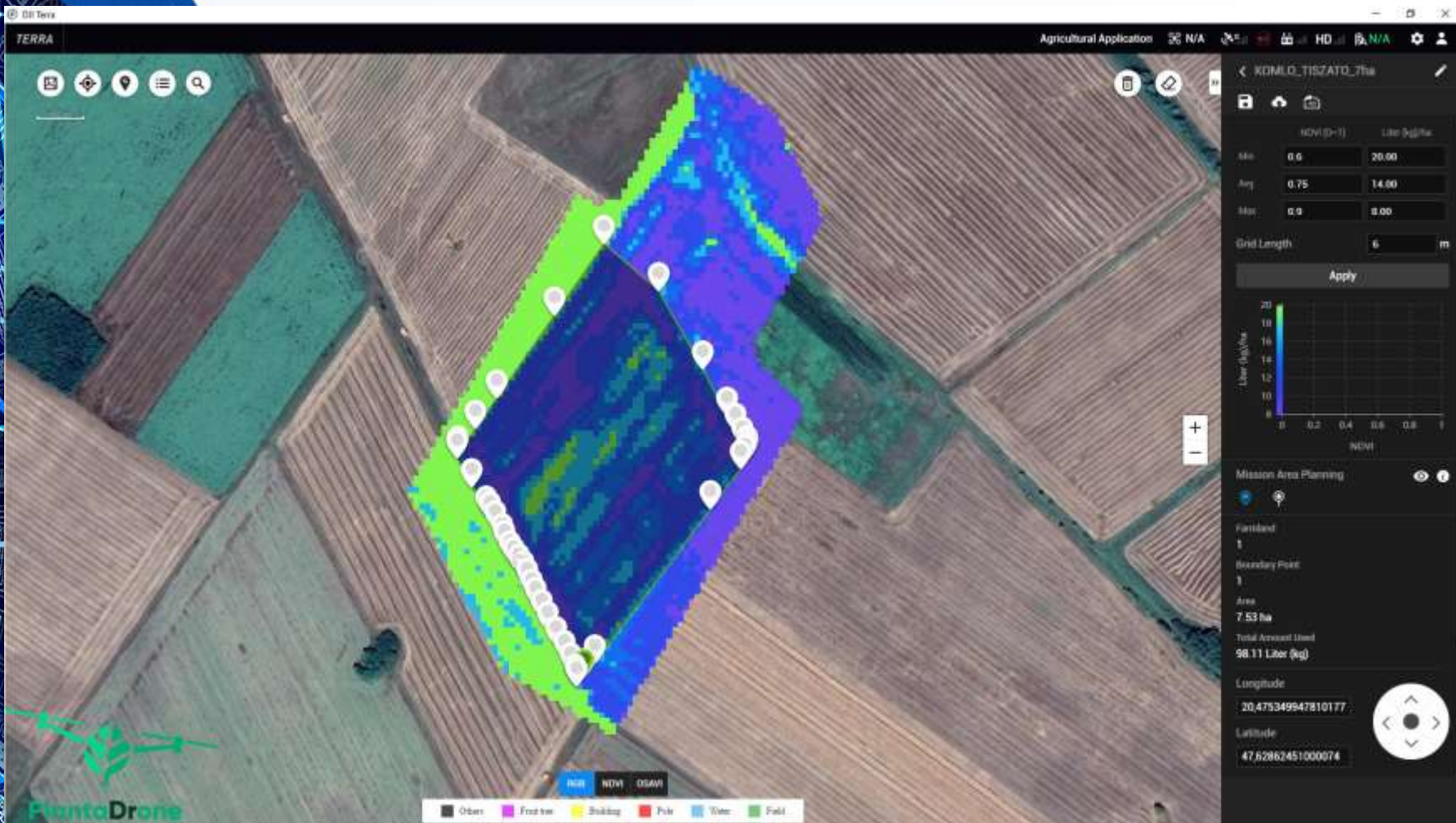


VEGETATION INDEX



WHEATER MONITORING





AERIAL IMAGERY



FERTILISATION ITINERARY

DIFFERENTIATED FERTILISATION

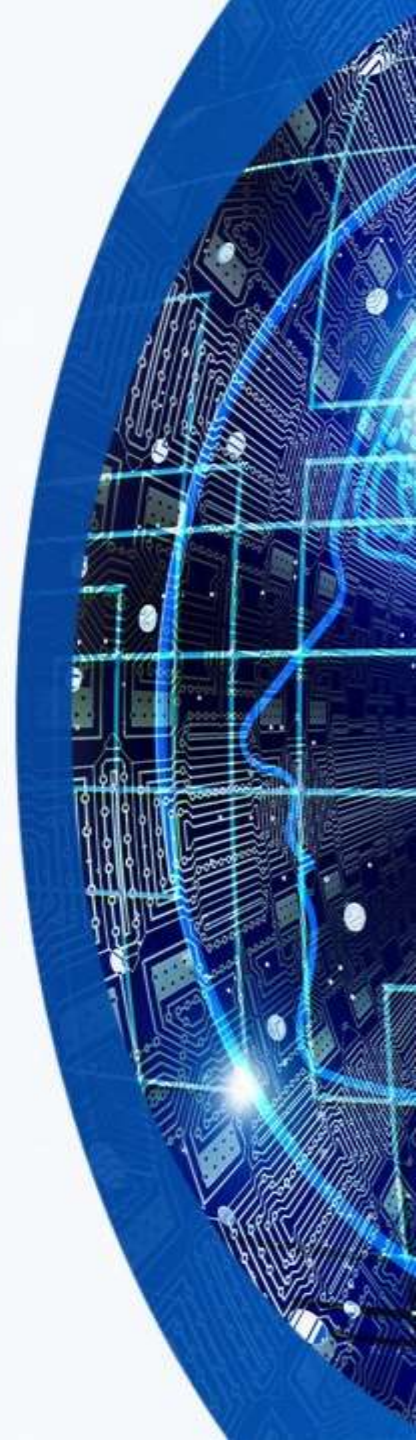
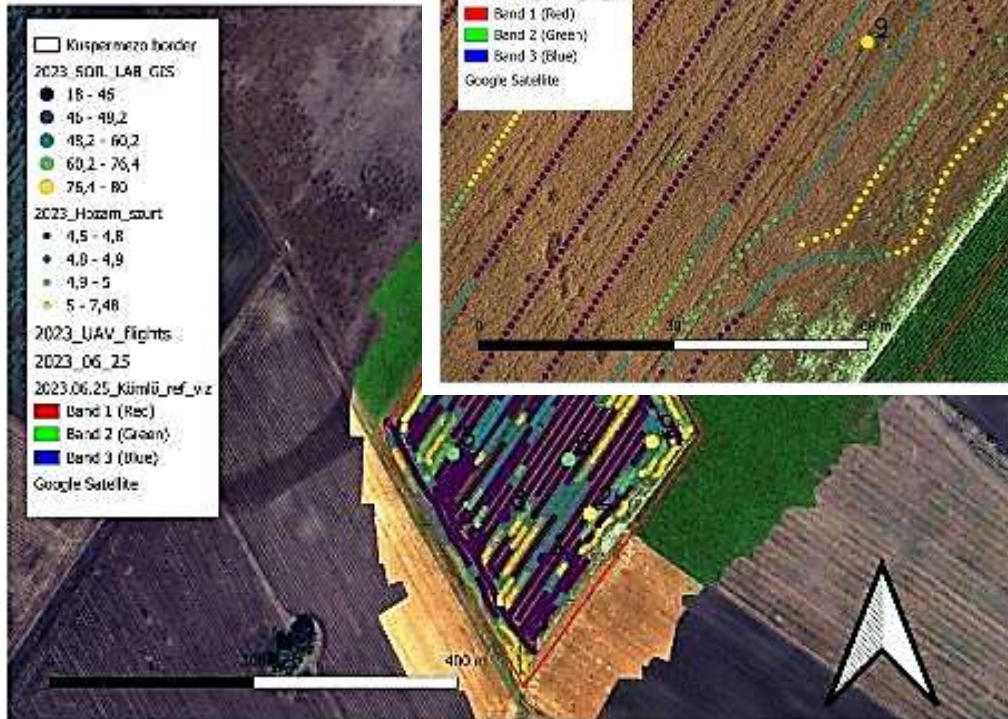


DIFFERENTIATED FERTILISATION



Key Findings of INSAC AGRIS Project

- differences in field positioning between 2021 and the last drone photo captured can be attributed to the non-utilization of GPS during the sowing process of rapeseed. This is an evident deviation in field boundaries and field boundaries in farming.



Key Findings of INSAC AGRIS Project

- overlaying the accurate initial field delimitation with the drone photo and harvesting map, the variations in field boundaries can be precisely determined and correcting these variations is essential to ensure that NDVI values and other remote sensing data accurately reflect the condition of the crop within the correct field area, leading to better-informed agricultural decisions and improved outcomes

Crop	Variety / hybrid	Sowing date	Harvesting date	Estimated production	Realised production
Wheat	MV NADOR	20.10.2021	30.06.2022	4,65 T/Ha	39,36 T / 9,6 ha = 4,1 T/Ha

Crop	Variety / hybrid	Sowing date	Harvesting date	Estimated production	Realised production
Winter Rapeseed	LG Constructor	04.10.2022	03.07.2023	2.8 T/ha	2.6 T/ha

Key Findings of INSAC AGRIS Project

Studying those year-over-year patterns gave us a valuable window into what's really going on underground, allowing us to connect the dots between the farming decisions and the soil's response. With that knowledge, we were able for smarter calls for managing crops and applying fertilizers. The end goal was to maintain that soil vibrancy for the long haul through sustainable

Point Index	Code 2023	Ph(KCl) 2021	Ph(KCl) 2023	NO ₃ -N 2021	NO ₃ -N 2023	K ₂ O 2021	K ₂ O 2023	P ₂ O ₅ 2021	P ₂ O ₅ 2023	Humus 2021	Humus 2023
1	6575	5.30	5.14	13.00	18.00	414	168	92	269	3.85	3.74
2	6576	5.04	4.74	15.20	77	483	329	135	314	3.72	4.13
3	6577	5.34	4.72	13.10	43	430	386	101	245	4.02	3.68
4	6578	5.40	4.96	14.45	48	360	366	91	289	4.01	4.41
5	6579	5.03	4.59	14.50	76	403	578	90	206	3.37	3.71
6	6580	5.85	5.21	14.30	63	403	606	143	239	3.46	3.59
7	6581	5.72	4.74	13.10	49	500	427	171	325	3.85	4.50
8	6582	5.17	6.31	13.75	48	447	371	95	397	3.99	3.89
9	6583	5.99	6.78	13.47	80	404	527	156	320	3.82	3.73
		5.43	5.24	13.87	55.78	427.08	417.56	109	289.33	3.79	3.93

Key Findings of INSAC AGRIS Project

Performing a rough estimation, assuming a yield goal and the uptake requirements per ton of rapeseed to define the maximum fertilizer inputs. We focused on nitrogen since it was mentioned specifically for the autumn application

```
Fertilizer economy.py - C:\Users\khaman\Fertilizer economy.py (3.123)
File Edit Format Run Options Window Help

# Define the number of zones and recommended quantities for each zone type
zones = {
    'low_N': {'count': 398, 'recommended_qty': 120},
    'mid_N': {'count': 330, 'recommended_qty': 80},
    'high_N': {'count': 302, 'recommended_qty': 50}
}

# Calculate the total amount of fertilizer for uniform application at the highest
# Assuming the highest recommended rate is used uniformly across all zones
uniform_application_qty = 120 # As the high recommended quantity for low zones
total_zones = sum(zones['count'] for zone in zones.values())
total_uniform_fertilizer = uniform_application_qty * total_zones

# Calculate the total amount of fertilizer for differentiated application
total_differentiated_fertilizer = sum(zone['count'] * zone['recommended_qty'] for zone in zones.values())

# Calculate the potential fertilizer economy due to differentiated fertilization
fertilizer_economy = total_uniform_fertilizer - total_differentiated_fertilizer
fertilizer_economy, total_uniform_fertilizer, total_differentiated_fertilizer
```

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Key Findings of INSAC AGRIS Project

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Create bulk VRA maps

Parera

Sample rate ②

1 kg/ha l/ha

Productivity zone	Rate, l/ha
Zone 5 +2% high potential	1.06
Zone 4 +5% high potential	1.05
Zone 3 Medium potential	1
Zone 2 -4% low potential	0.96
Zone 1 -11% low potential	0.89

Create bulk VRA maps

Tolosa

Sample rate ②

0.3 kg/ha l/ha

Productivity zone	Rate, l/ha
Zone 5 -0% high potential	0.26
Zone 4 +3% high potential	0.29
Zone 3 Medium potential	0.3
Zone 2 -4% low potential	0.28
Zone 1 -11% low potential	0.25



Key Findings of INSAC AGRIS Project

- Improved crop yields - through AI-predicted interventions
- Resource efficiency - (fertilizers, pesticides) optimized by QGIS mapping and developed models
- Sustainability - Reduced environmental impact

Training Initiatives: Hungarian Projects and MATE University

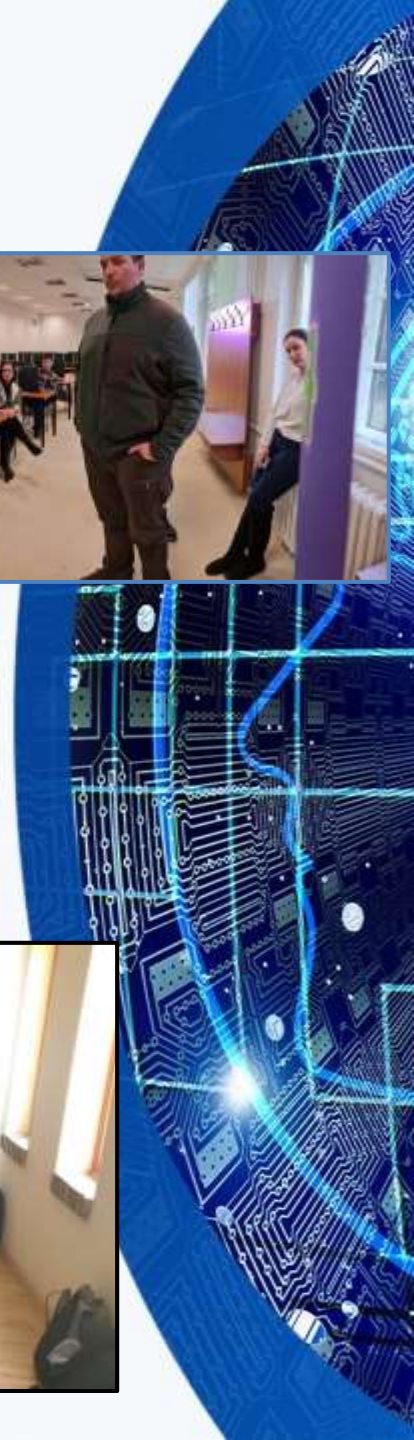
- Several training programs conducted for farmers and students.

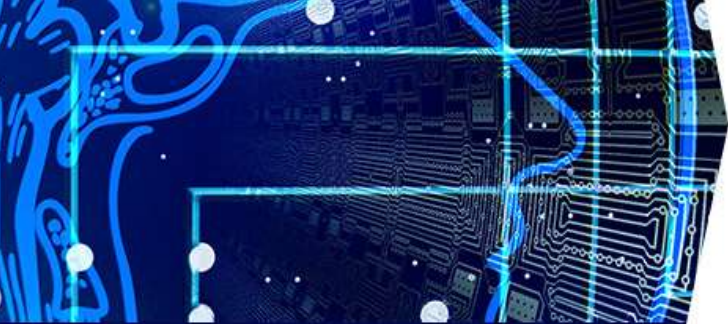
Digital Agrar Academy - DIA, Agrar European Digital Innovation HUB - AEDIH, Bring your Parents in MATE.

- Core components: AI-based analysis, QGIS hands-on sessions.
- Impact: Enhanced substantially precision agriculture skills among participants



Training Initiatives: Hungarian Projects and MATE University





Training Initiatives in figures

- Digital Agrar Academy - DIA: **860 farmers from which 80 students**
- Agrar European Digital Innovation HUB - AEDIH: **250 farmers from which 20 students**
- Bring your Parents in MATE: **10 students with 10 Parents**



Thank you very much for your attention !

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