

ResKuh - Efficacy of satellite based monitoring of dry matter yield per hectare (DMY/ha) in grassland: A case study in the Upper Rhine Region

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Figure 1: Project Area: Upper Rhine Region

ANDVI from 08 Aug 2025 to 20 Sep 2025

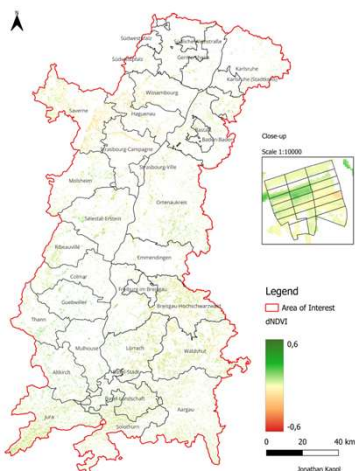


Figure 3: ANDVI map (20 Sep 2025 – 08 Aug 2025) including a close-up example area

Background

- Climate change increases drought frequency in Central Europe.
- Grassland-based livestock farming depends on stable forage supply.
- Copernicus Sentinel-2 provides open-access, high-resolution satellite data.
- Normalized Difference Vegetation Index (NDVI) tracks vegetation greenness.

Aim

- Build a reproducible QGIS workflow for cloud-masked Sentinel-2 NDVI time series (2025).
- Describe and development seasonal patterns and spatial variability across the Upper Rhine Region.
- Compare NDVI with weekly dry matter yield/ha (DMY/ha) from a test farm and evaluate correlations.

Material & Method

Data

- Copernicus Sentinel-2 Level-2A (surface reflectance), 2025 growing season
- Copernicus High Resolution Layer Grassland (mask, 1= grasslands; 0= no grasslands)
- Test farm Antwil: weekly DMY / ha + paddock polygons + management notes

Processing (QGIS)

- Cloud and cloud-shadow masking (Scene Classification Layer)
- NDVI calculation; $NDVI = (NIR - RED) / (NIR + RED)$ (near-infrared band, red band; 0=dry, 1=high vegetation density & vitality)
- Mosaic and align tiles; clip to area of interest and grassland mask

Analysis (10 x 10 meters)

- Zonal statistics: NDVI median per paddock and date
- Spearman rank correlation (NDVI vs dry matter yield per hectare) with Excel

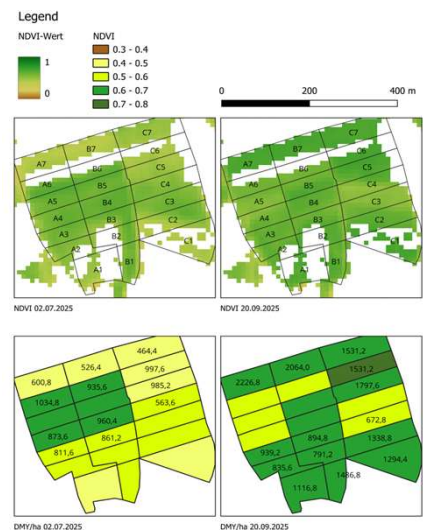


Figure 2: Spatial comparison at the Antwil test farm: NDVI (Sentinel-2) and paddock-level dry matter yield (DMY/ha) for two observation dates.

Sentinel-2 date	Spearman ρ (NDVI vs. DMY)	p-value	N (yield)	Spearman ρ (NDVI vs. GGR*)	p-value	N (growth)
08.04.2025	0,20	0,412	19	0,31	0,203	19
10.05.2025	0,53	0,027	17	0,07	0,867	8
12.06.2025	0,40	0,152	14	0,29	0,385	11
02.07.2025	0,47	0,124	12	0,02	0,955	8
08.08.2025	0,74	0,002	14	0,33	0,318	11
20.09.2025	0,81	0,000	14	-0,54	0,057	13

Table 1: Spearman correlations: NDVI ↔ dry matter yield (DMY) and NDVI ↔ grass growth rate* (GGR) by date (management cases excluded)

Key Findings

- NDVI time series show clear seasonal dynamics; strongest contrasts in summer
- Cloud cover and small field sizes limit precision in fragmented landscapes
- Cutting/silage changes NDVI and yield relationship → events must be recorded
- After filtering/quality correction, NDVI and DMY/ha showed a positive association in the case study (Spearman $\rho \approx 0.74$)

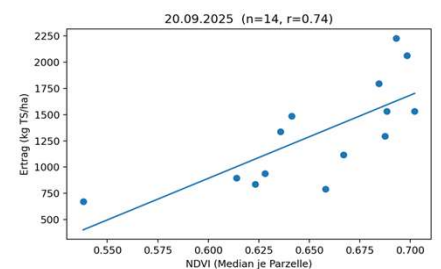


Figure 4: NDVI (median per parcel) vs. dry matter yield on 20 Sep 2025 (management cases excluded)

Discussion

- NDVI serves as an indicator for vegetation status, not a direct yield measurement.
- Management (grazing/cutting) and mixed pixels should be accounted for in the statistical framework.
- Combining multi-year satellite records with consistent farm data can strengthen monitoring and early warning

Conclusion

- In the case study, NDVI correlated with DMY/ha when management effects were considered.
- A QGIS-based workflow can generate robust, cloud-masked NDVI time series for regional grassland monitoring.
- Next steps: multi-year analysis, improved management-event logging and integration of additional indicators, e.g. the vegetation condition index (VCI), red and red-edge normalized difference vegetation index (NDVired&RE).

Acknowledgements

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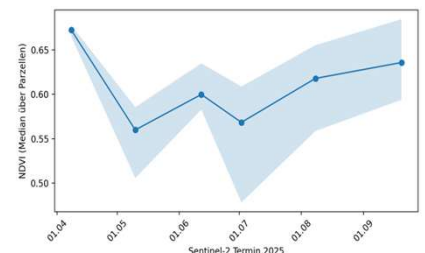


Figure 5: NDVI time series in the test area (median per date) with a variability measure.