Normalized Difference Moisture Index (NDMI)

The Normalized Difference Moisture Index (NDMI) detects moisture levels in vegetation using Near-Infrared (NIR) and Short-Wave Infrared (SWIR) spectral bands. It is a reliable indicator of water stress in crops, helping optimize irrigation and prevent environmental hazards like wildfires.

Why NDMI Matters?

Early Detection of Water Stress

- Identifies water stress before it significantly impacts crop yield.

Irrigation Monitoring

- Essential for regions where natural water supply is insufficient, ensuring optimal crop growth.

Wildfire Prevention

- Helps monitor dry conditions and assess vegetation combustibility in fire-prone areas.

NDMI vs. NDWI: Understanding the Difference

NDMI is sometimes confused with NDWI (Normalized Difference Water Index), but they serve different purposes.

NDMI (Gao's NDWI version) uses NIR and SWIR to measure vegetation moisture content. NDWI (McFeeters's version) uses Green and NIR to detect water bodies and their turbidity.

Thus, NDMI is vegetation-focused, while NDWI is used for surface water detection.

NDMI Formula

NDMI is calculated using the reflectance values of Near-Infrared (NIR) and Short-Wave Infrared (SWIR) bands:

NDMI = (NIR - SWIR) / (NIR + SWIR)

For Sentinel-2 satellite data:

NDMI = (B08 - B11) / (B08 + B11)

Why These Bands?

SWIR is sensitive to vegetation water content and leaf mesophyll structure.
NIR reflects from leaf structure and dry matter content.
Combined use provides highly accurate vegetation water content data.

Compared to NDVI (Normalized Difference Vegetation Index), NDMI is a better deforestation indicator due to its less abrupt decrease in values.

Interpretation of NDMI Values

NDMI values range between -1 and +1, providing an intuitive scale.

Negative values (-1 to -0.2) indicate bare soil or low canopy cover, often signaling water stress.
Zero to positive values (0 to 0.4) suggest increasing canopy cover, with some water stress present.
Higher values (0.4 to 1) represent healthy vegetation with no water stress, but extremely high values may indicate waterlogging.

NDMI value interpretation:
-1 to -0.8: Bare soil
-0.8 to -0.6: Almost absent canopy cover
-0.6 to -0.4: Very low canopy cover
-0.4 to -0.2: Low canopy cover (dry or wet)
-0.2 to 0: Mid-low canopy cover, high or low water stress
0 to 0.2: Average canopy cover, high or low water stress
0.2 to 0.4: Mid-high canopy cover, high or low water stress
0.4 to 0.6: High canopy cover, no water stress
0.6 to 0.8: Very high canopy cover, no water stress
0.8 to 1: Total canopy cover, no water stress or waterlogging

Key Considerations

NDMI values fluctuate throughout the growing season as plant reflectance changes.
NDMI and NDVI can be correlated, meaning water stress in NDMI can be confirmed by lower-than-average NDVI values.

When Is NDMI Used?

NDMI is useful for:

- Monitoring water content in crops regularly
- Identifying farm zones experiencing water stress
- Planning tree harvest logistics effectively
- Assessing fire risk by determining combustibility in dry areas

NDMI Visualization

NDMI values are commonly represented through maps and graphs.

Maps show the spatial distribution of water stress across fields.
Graphs illustrate how NDMI changes over time.

NDMI Color Interpretation

Low NDMI (white to pale brown) indicates low vegetation water content and potential water stress.
High NDMI (blue shades) indicates high vegetation water content and healthy crops.
Sudden NDMI decreases can serve as a warning for potential water stress.
Abnormally high NDMI values may indicate waterlogging.