

Banana OSAVI Canopy–Soil Background Analysis Report

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Executive Summary

Across the surveyed banana field, the Optimized Soil-Adjusted Vegetation Index (OSAVI) averages **0.123** (median 0.124, standard deviation 0.045) within the field's canopy extent (2,755,116 pixels, 54.9% of the raster). OSAVI response is concentrated in a moderate range: about 63% of canopy-extent pixels fall between 0.10 and 0.20, roughly 33% register below 0.10, and under 4% reach 0.20 or higher. Relative variability is moderate (coefficient of variation $\approx 36.4\%$), and spatial autocorrelation is strong (Moran's $I \approx 0.78$), indicating the soil-adjusted vegetation signal changes gradually across the field. A modest west-to-central rise is present in the OSAVI surface (thirds-of-field means: west 0.112, central 0.129, east 0.123), while the north-south direction is comparatively flat. The remaining 45.1% of the raster carries the exact value 0.0, consistent with a uniform fill value outside the analyzed canopy extent rather than measured vegetation response; this report analyzes the canopy-extent OSAVI values on their own terms and does not claim the index measures soil properties directly — only that its formulation is designed to reduce the influence of soil background reflectance on the vegetation signal.

Data & Methodology

This assessment uses only the New OSAVI raster layer from the project's QGIS workspace (vegetation.qgz): a single-band OSAVI raster, $2,155 \times 2,329$ pixels at a native ground resolution of approximately 5 cm/pixel, projected in WGS 84 / UTM Zone 51N (EPSG:32651) — consistent with a high-resolution multispectral drone (UAS) orthomosaic collected over a banana plantation. The raster carries no explicit no-data flag; instead, 2,263,821 pixels (45.1% of 5,018,995 total) hold the exact value 0.0, forming a distinct cluster separated from the smoothly varying remainder of the distribution. This proportion and spatial pattern are consistent with a uniform background or fill value applied outside the analyzed canopy extent, rather than a measured near-zero vegetation response, though the raster itself does not distinguish the two. To avoid conflating this fill value with measured OSAVI response, all statistics and spatial analysis in this report (apart from the full-raster note above) are computed over the 2,755,116 pixels (54.9%) with OSAVI values greater than zero, referred to here as the canopy-extent pixels.

All statistics, value-range descriptions, and spatial observations in this report are computed directly from this single raster's pixel values. No vector layers, polygons, or additional spatial layers were created, and no other project layers (NDVI, NDRE, GNDVI, MSAVI, SAVI, chlorophyll indices, RGB or multispectral composites, or any external GIS dataset) were used. Local spatial variability was assessed using a 5×5 -cell moving-window standard deviation computed on a $4 \times$ spatially downsampled version of the canopy-extent raster (582×538 cells) for computational tractability; large-scale spatial clustering was estimated with an approximate global Moran's I on the same downsampled grid. The descriptive OSAVI bands used later in this report (below 0.10, 0.10–0.20, 0.20 and above) are fixed cut points applied only to label the existing pixel values — they are not derived classes, clusters, or spatial products.

OSAVI Statistical Summary

All values below are measured from the 2,755,116 canopy-extent OSAVI pixels (values greater than zero); the full raster, including the 0.0 fill cluster, ranges from -0.022 to 0.288 with a mean of 0.068.

Statistic	Value
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Minimum	0.0001
Maximum	0.288
Mean	0.123
Median	0.124
Standard deviation	0.045
Coefficient of variation	36.4%
Skewness	0.05
Excess kurtosis	-0.68

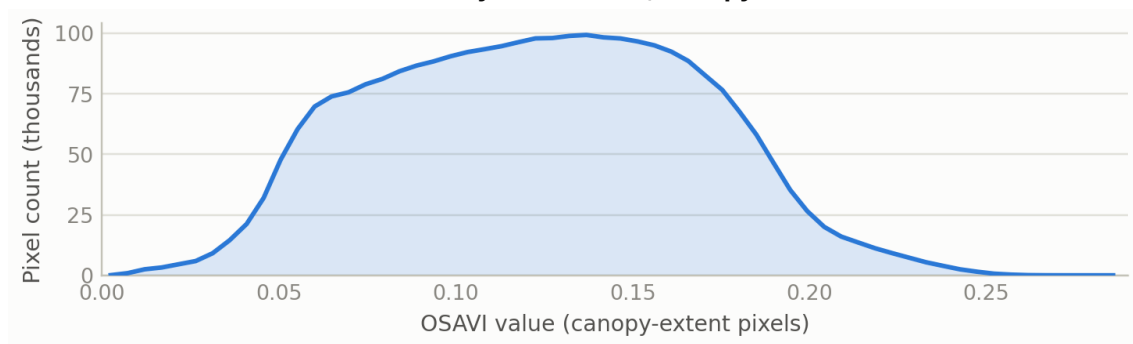
Percentile distribution

Percentile	OSAVI
5th	0.053
10th	0.063
25th	0.088
50th (median)	0.124
75th	0.157
90th	0.181
95th	0.194

The gap between the 5th and 95th percentile (about 0.14 OSAVI units) is narrow relative to the canopy-extent range, and the interquartile range (25th–75th percentile, 0.088 to 0.157) spans about 0.07 units. Near-zero skewness (0.05) and negative excess kurtosis (-0.68) describe a distribution that is close to symmetric and flatter-than-normal (fewer extreme values, more spread near the center) rather than sharply peaked or one-sided, examined further below.

OSAVI Distribution and the Soil-Adjustment Function

OSAVI density distribution, canopy extent



Pixel count by OSAVI value, smoothed as a continuous density curve · New OSAVI raster · 2,755,116 canopy-extent pixels

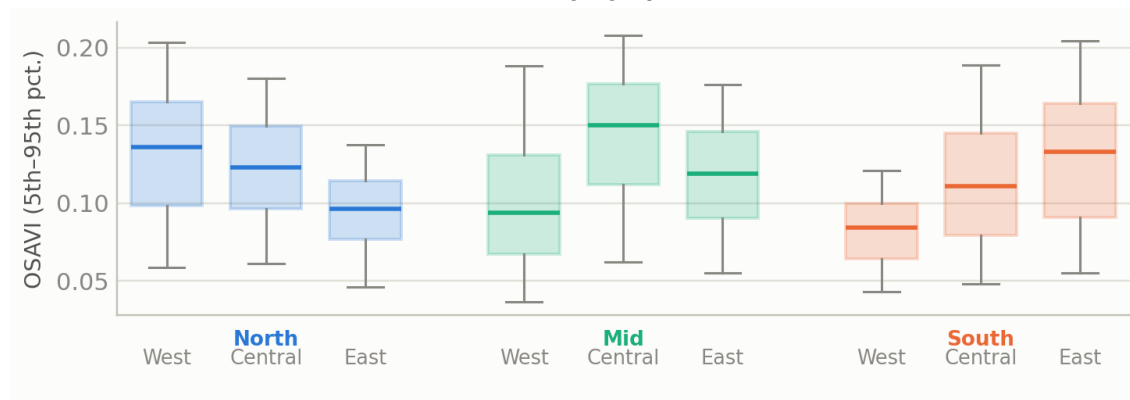
Within the canopy extent, the distribution is unimodal and moderately broad, rising from near zero, reaching its peak density around OSAVI 0.13–0.14, and tapering off toward the upper end of the measured range. The

plateau spanning roughly 0.10 to 0.16 accounts for about half of all canopy-extent pixels. Using the fixed descriptive bands introduced above, about 33.1% of canopy-extent pixels register below 0.10, 63.2% fall in the 0.10–0.20 band, and only 3.7% reach 0.20 or higher. OSAVI is formulated as $(\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red} + L)$, with a soil-adjustment constant L (commonly 0.16) added to the denominator specifically to reduce the influence of soil-background brightness on the vegetation signal, an effect that is most pronounced where the canopy is sparse, discontinuous, or interspersed with visible ground. In practical terms, this means OSAVI values across this field are already adjusted to dampen — though not eliminate — the effect of exposed soil showing through gaps in banana canopy cover, which is particularly relevant given the plant's broad, separated leaves and inter-row spacing.

Because of this soil-adjustment design, lower OSAVI values within the canopy extent (the approximately one-third of pixels below 0.10) are more reasonably read as areas where the soil-adjusted vegetation signal itself is weaker — which can reflect variable canopy coverage, more exposed soil background between plants, or lower vegetation density — rather than as residual soil brightness contaminating the measurement. This raster does not measure soil reflectance, soil moisture, or any soil property directly; OSAVI's soil-adjustment term is a mathematical correction built into the index formula, not a separate soil observation, and this report interprets it only in that capacity.

Spatial Pattern Analysis

OSAVI variability by spatial zone



Median, interquartile range (box), and 5th–95th percentile (whiskers) by 3×3 field zone · New OSAVI raster · canopy-extent pixels

The chart above splits the field into a 3×3 grid of zones (thirds by row and by column) and summarizes the canopy-extent OSAVI values within each zone as a box (median and interquartile range) with whiskers extending to the 5th and 95th percentile, making both the typical level and the spread of values in each part of the field visible at once. Local variability is low overall (mean 5×5-cell-window standard deviation ≈ 0.023 , 90th percentile ≈ 0.035 on a 4× downsampled grid) and only about 1.4% of the field area shows local variability more than twice this average, indicating sharp, localized transitions are confined to a small share of the canopy extent. Spatial autocorrelation is strong (Moran's $I \approx 0.78$ on the same downsampled grid), meaning neighboring areas have systematically similar OSAVI values rather than varying at random.

The zone breakdown shows measurable differences in both level and spread: the Mid-Central zone has the highest median (0.150) and the widest interquartile spread (0.112 to 0.177), while the South-West zone has the lowest median (0.084) and the narrowest spread (0.064 to 0.100); the North-East zone is similarly low and comparatively narrow (median 0.097, interquartile range 0.077 to 0.114). The remaining six zones fall between these extremes, generally in the 0.09–0.13 median range. Two zones — North-East and South-West — also contain far fewer canopy-extent pixels (18,573 and 16,262, respectively) than the other seven zones (each above 238,000 pixels), meaning those two corners of the field carry markedly less canopy-extent area; this is

consistent with those corners bordering the raster's zero-fill margin, and their statistics should be read with that smaller sample in mind. Overall, the pattern is one of a higher, more variable response concentrated in the field's central band and a lower, more consistent response at two opposing corners, rather than a simple edge-to-interior gradient — this reading of the pattern is an interpretation, not a direct measurement.

Interpretation: Canopy Coverage, Soil Background, and Field Consistency

OSAVI is a spectral index, not a direct measurement of canopy biomass, plant health, or soil condition; it is interpreted here strictly as a soil-adjusted indicator of vegetation response. Within that framing, the measured record supports the following observations: mean and median OSAVI (0.123 / 0.124) sit near the center of the canopy-extent distribution, and about 66.9% of canopy-extent pixels register 0.10 or higher, indicating the soil-adjusted vegetation signal across most of the surveyed area is in the moderate portion of the observed range rather than concentrated at the low end. The roughly one-third of pixels below 0.10 are not scattered evenly through the field but concentrated in specific zones, most notably the South-West and North-East corners identified in the zone analysis, which register the lowest medians (0.084 and 0.097 respectively) of the nine field zones examined.

On spectral consistency: strong spatial autocorrelation (Moran's $I \approx 0.78$) together with low local variability (only about 1.4% of the canopy extent showing sharply elevated local variability) indicate the soil-adjusted vegetation signal is spatially coherent — it changes gradually across the field rather than in an erratic, speckled pattern that would be more typical of scattered gaps in canopy cover or patchy exposed soil. At the same time, the field is not perfectly uniform: the zone analysis shows a measurably higher and more variable response concentrated in the Mid-Central zone, and a lower, more tightly clustered response at the South-West and North-East corners. Because OSAVI is designed to dampen soil-background brightness in its calculation, this pattern is best read as variation in the soil-adjusted vegetation signal itself — plausibly related to canopy coverage or density where the canopy is less continuous — rather than as evidence of a specific soil condition, which this index does not measure.

These statements describe what the OSAVI values and their spatial arrangement show. They do not identify a specific cause: OSAVI alone cannot distinguish between explanations such as planting density, plant age or canopy maturity, row spacing and orientation, or incidental shading, and no such diagnosis is made in this report.

Uncertainty & Limitations

This is a single-date, single-raster OSAVI assessment: no repeat imagery, ground reference, or other spectral/index layers (NDVI, NDRE, GNDVI, MSAVI, SAVI, or individual spectral bands) were used to corroborate the findings, so temporal trend and independent confirmation both fall outside this report's scope. The most significant data-quality caveat is the absence of an explicit no-data flag in the New OSAVI raster: the 45.1% of pixels holding the exact value 0.0 are treated in this report as a background fill rather than measured vegetation response, based on their proportion and the sharp, distinct break between that cluster and the smoothly varying remainder of the distribution; this is an inference about the data's structure, not a certainty, and a small number of genuinely very-low OSAVI pixels could in principle be excluded along with the fill value.

Spatial variability statistics (local standard deviation, Moran's I) were computed on a 4× downsampled grid for computational tractability and are approximate rather than full-resolution measures. The acquisition, sensor, radiometric calibration, and processing workflow behind the raster are not documented in the QGIS project metadata available to this analysis. Finally, the descriptive OSAVI bands (0.10, 0.20) used earlier are fixed cut points chosen for this report and are not calibrated to this crop's phenological stage or to any validated vegetation-density threshold.

Conclusion

On this date, the banana field's OSAVI record shows a soil-adjusted vegetation signal that is moderate and fairly consistent across the canopy extent (mean 0.123, median 0.124), with about 67% of canopy-extent pixels at 0.10 or above and under 4% reaching 0.20 or higher. The field is spatially coherent — OSAVI varies gradually and predictably across space (Moran's $I \approx 0.78$) with only about 1.4% of the canopy extent showing sharp local transitions — and its absolute level is not uniform across the nine field zones examined: the Mid-Central zone stands out with the highest and most variable response (median 0.150), while the South-West and North-East corners register the lowest and most tightly clustered response (medians 0.084 and 0.097). Because OSAVI's formulation already reduces the influence of soil-background brightness on the vegetation signal, this zone-level pattern is best understood as variation in the soil-adjusted vegetation response itself, potentially linked to differences in canopy coverage or density across the field, rather than as a direct measurement of the soil beneath the canopy, which this index does not provide.

Overall, the soil-adjusted vegetation signal varies across the banana field in a spatially coherent but zone-dependent pattern rather than a simple directional gradient or a fragmented, highly heterogeneous one: canopy-extent OSAVI values are highest and most variable in the field's central band, lowest and most consistent at the South-West and North-East corners, and intermediate elsewhere, with gradual rather than abrupt transitions between zones. Further observation is best directed at three things: confirming, on the ground or with follow-up imagery, whether the lower OSAVI readings at the South-West and North-East corners correspond to genuinely reduced or less continuous canopy cover there, keeping in mind their smaller canopy-extent pixel counts; verifying, independently of this raster, whether the 45.1% zero-value area is entirely non-canopy background rather than partially representing real field conditions; and treating this report's descriptive OSAVI bands as a soil-adjusted spectral reference only, since OSAVI by itself does not identify a specific cause for the pattern observed and no such determination is made or implied here.