



Smart Farming Through Drone Technology



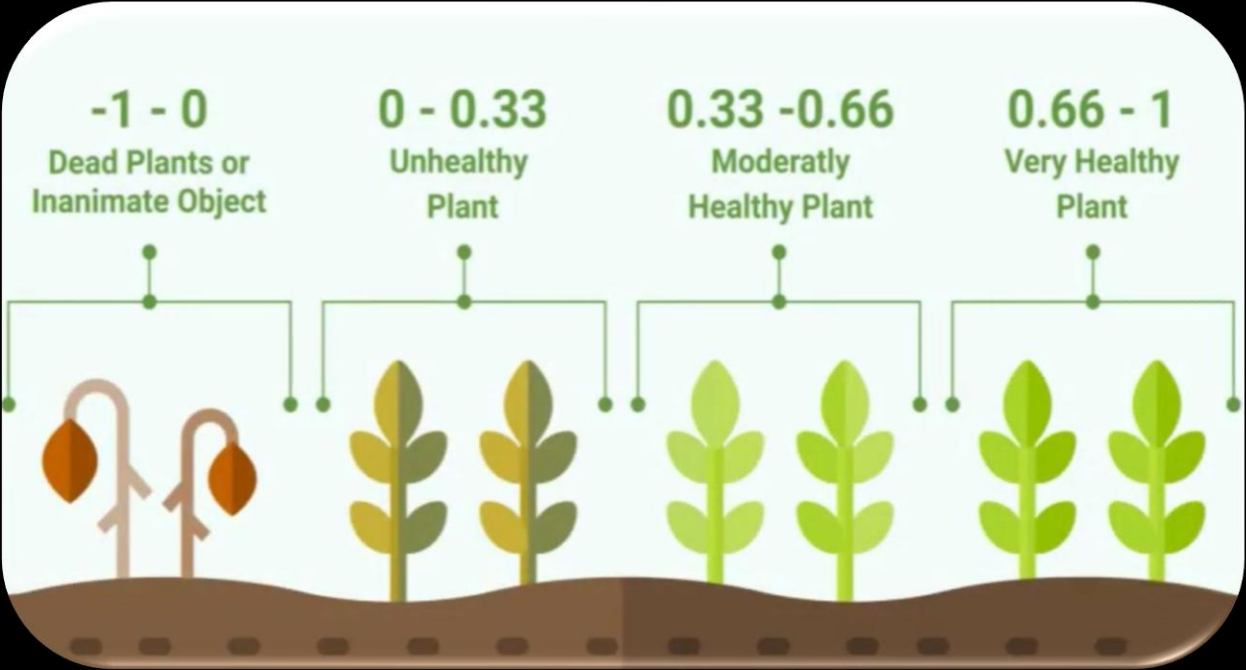
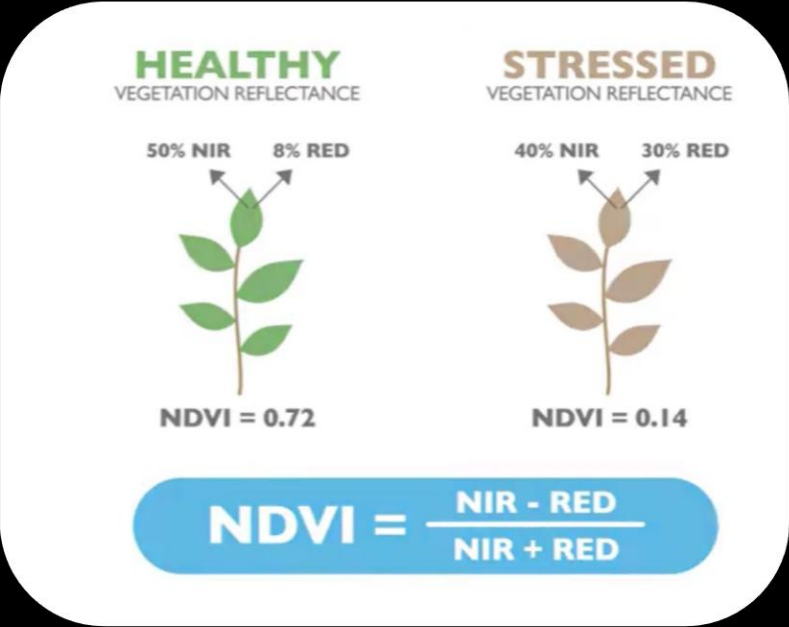


Smart Farming Through Drone Technology is transforming the way modern agriculture is managed by giving farmers a faster, more accurate, and data-driven understanding of their crops. Through the use of multispectral drone imaging, we are able to identify plant stress, irrigation problems, nutrient deficiencies, soil variability, and uneven crop growth before these issues become visible to the human eye. Technologies such as NDVI, NDRE, LCI, VARI, and TGI help us monitor chlorophyll activity, canopy development, plant vigor, and overall crop performance across the entire field. This allows farmers to make quicker and more precise decisions regarding irrigation, fertilization, and crop management. By combining drone technology with practical agronomic knowledge, sap analysis, soil interpretation, and field scouting, we can improve crop uniformity, maximize production, reduce unnecessary input costs, and support more sustainable farming practices.



Before we start with NDVI and all the maps, we first need to understand the basic concept behind multispectral technology and what the drone is actually measuring. The drone is not simply taking normal pictures like a cellphone camera. A multispectral drone measures how plants reflect different wavelengths of light. Healthy plants absorb most of the red light for photosynthesis and reflect more near-infrared light because of their internal leaf structure and chlorophyll activity. Stressed plants reflect light differently, and this is what allows us to detect problems before we can physically see them in the field. By comparing these different light reflections, we can create vegetation indices such as NDVI, NDRE, LCI, VARI, and TGI, which help us understand crop vigor, chlorophyll concentration, canopy development, water stress, nutrient uptake, and overall plant activity. The main goal is not just to create colorful maps, but to convert these images into practical farming decisions that improve production, irrigation management, fertilizer efficiency, and crop uniformity.

Each vegetation index gives us different information about the crop, and this is why understanding the concept is very important. NDVI mainly shows overall plant vigor and biomass, helping us identify weak and strong growing areas. NDRE focuses more on chlorophyll activity and nitrogen-related stress, making it very useful in mature crops where NDVI sometimes becomes saturated. LCI helps us better understand chlorophyll concentration and plant activity, while VARI gives a good indication of vegetation cover using normal visible light. TGI is more focused on estimating greenness and chlorophyll response from the canopy surface.



The important part is that no single map gives all the answers. We need to compare different indices together with field observations, soil conditions, irrigation systems, weather conditions, sap analysis, and crop stage. For example, if one area shows low NDRE and low LCI, it may indicate nutrient stress or poor chlorophyll activity. If the same area also shows poor growth on NDVI, then we know the stress is already affecting biomass and canopy development. This allows us to identify problems much earlier and take corrective action before production is affected.

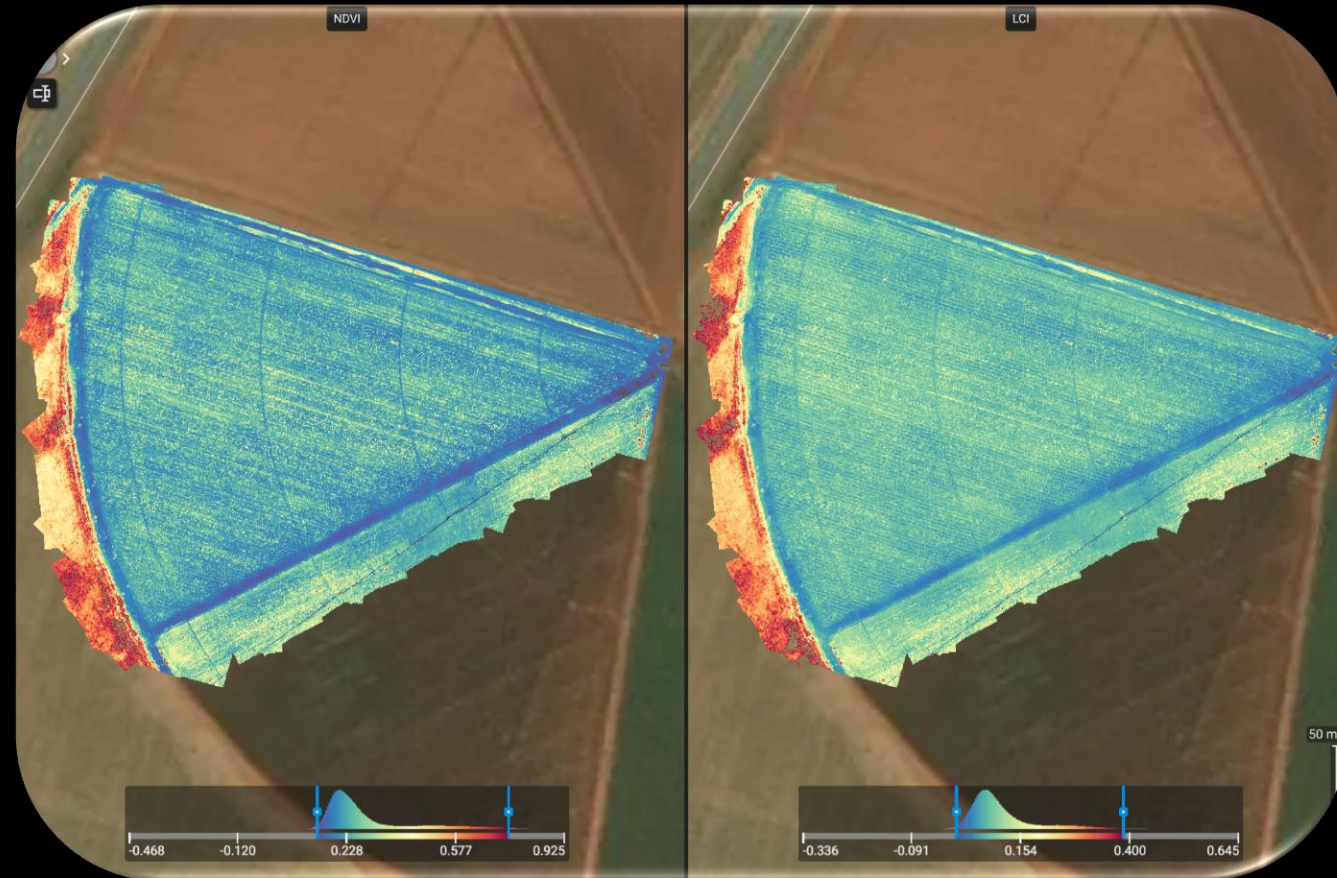
Vegetation Reflectance



Some examples

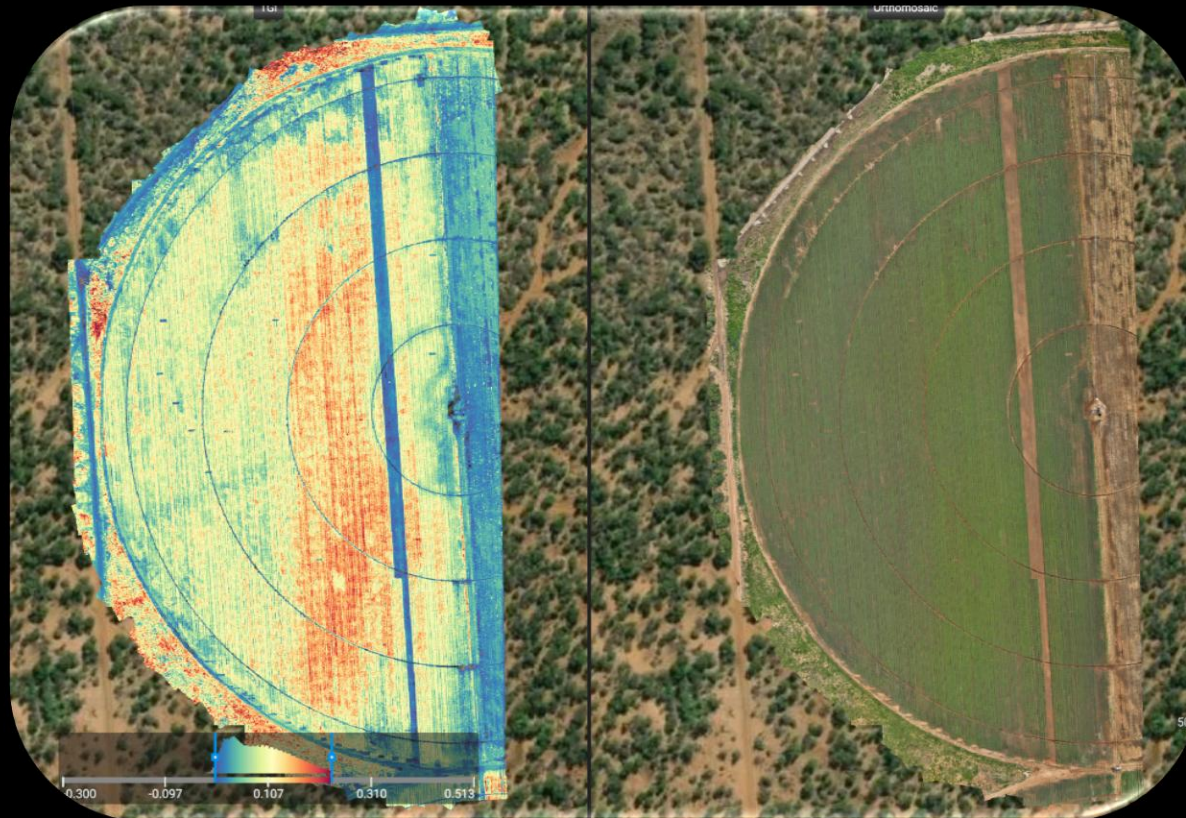
Example 1 – Onion Field (NDVI & LCI)

In this onion field, both NDVI and LCI show that most of the field is under moderate stress, represented mainly by the light blue and green colors. We would normally prefer to see more orange and red colors, which indicate stronger chlorophyll activity and better plant vigor. The darker blue areas specifically show weaker growth and lower plant activity, which may be linked to uneven irrigation, compaction, poor root development, salinity, or nutrient uptake issues. LCI helps us better understand chlorophyll concentration, while NDVI gives a broader understanding of overall biomass and canopy development. By comparing both maps together, we can identify which areas require more attention and focus our management practices more accurately.



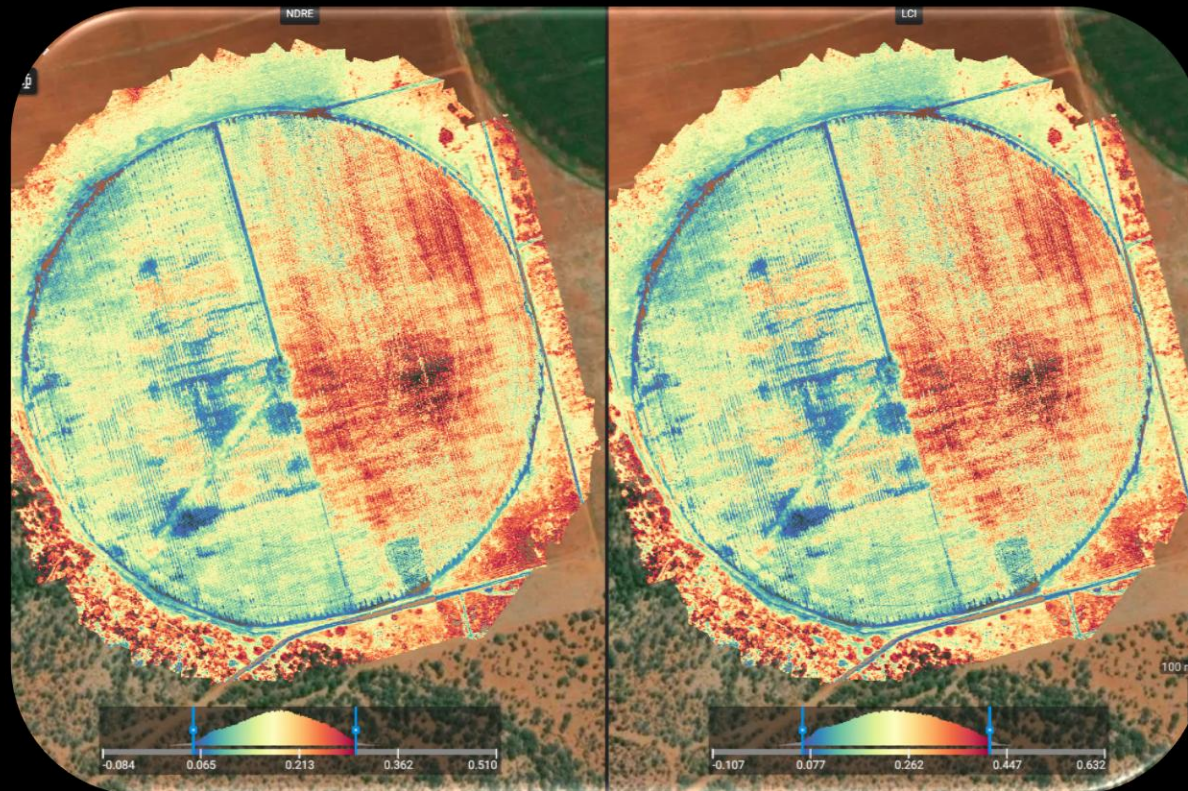
Example 2 – Onion Pivot (TGI & Orthomosaic)

In this example, TGI clearly highlights variability across the onion pivot that is not easily visible in the normal orthomosaic image. The orange and red zones represent areas with stronger chlorophyll activity and healthier crop development, while the blue zones indicate weaker growth and stressed plants. We can also clearly see irrigation patterns and uneven field performance across the pivot. This type of analysis helps us quickly identify problem zones related to irrigation uniformity, nutrient distribution, soil variability, or compaction. The orthomosaic image gives us the visual field appearance, while TGI gives us deeper insight into the actual crop activity happening inside the field.



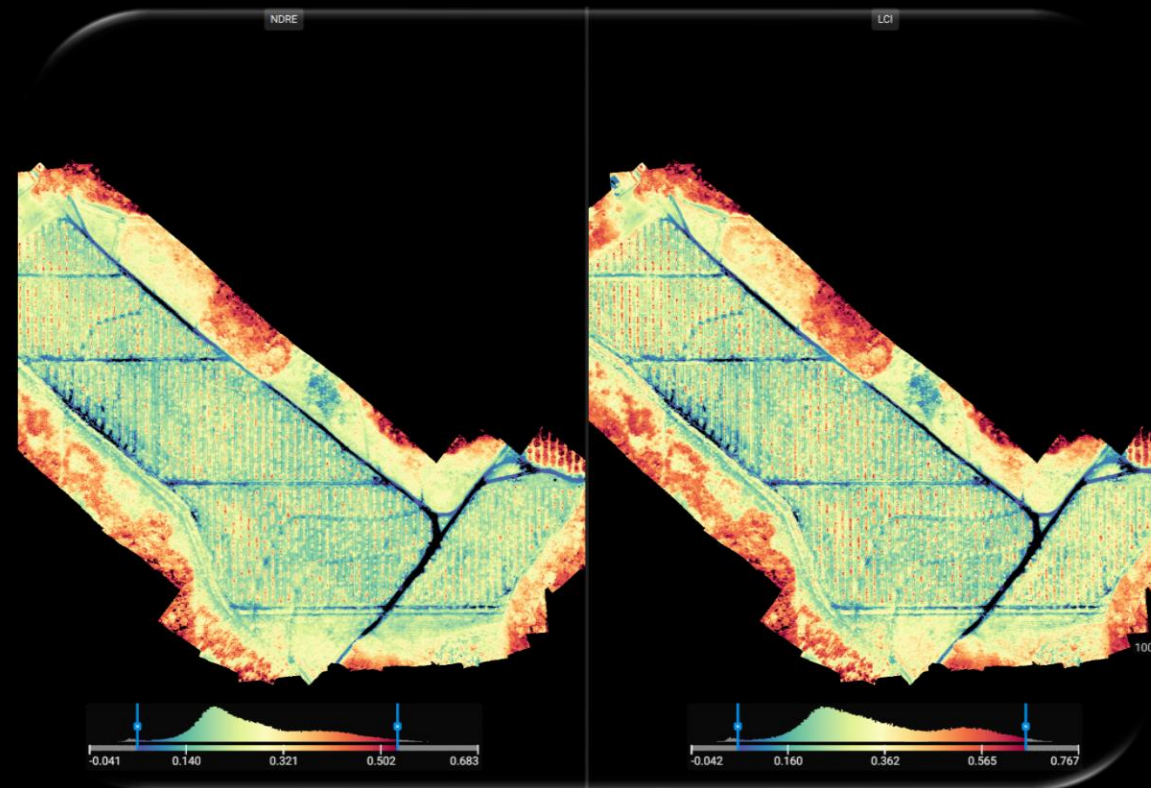
Example 3 – Potato Field (NDRE & LCI)

In this potato field, NDRE and LCI both show strong variability between different parts of the pivot. The red and orange areas indicate stronger chlorophyll activity and healthier canopy growth, while the blue and light green areas show weaker plant activity and stress. NDRE is especially useful in mature crops like potatoes because it can better detect nitrogen status and chlorophyll differences even when the canopy is already fully developed. The maps also show distinct management zones inside the field, which may be caused by irrigation differences, soil conditions, nutrient availability, or root stress. These maps allow us to focus directly on weaker zones before yield losses become visible.



Example 4 – Avocado Field (NDRE & LCI)

In this avocado field, both NDRE and LCI show overall moderate plant activity, but there are still clear stress zones visible around the edges and in some specific areas inside the block. The blue and darker zones indicate lower chlorophyll activity and weaker tree performance, while the orange and lighter colors represent healthier and more active trees. Because avocados are highly sensitive to root stress, irrigation management, salinity, and soil conditions, these maps help us identify problem areas much earlier before visible symptoms become serious. NDRE helps us understand canopy activity and chlorophyll response, while LCI gives a better indication of chlorophyll concentration and overall plant health. By monitoring these zones regularly, we can improve irrigation management, nutrient applications, and overall orchard uniformity.





Thank You



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