THE USE OF UAS-BASED IMAGING AND VEGETATION INDEX FOR PRECISION FODDER MANAGEMENT

KEMENTERIAN PERTANIAN DAN KETERJAMINAN MAKANAN

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INTRODUCTION

Monitoring the health of crops is a fundamental component of sustainable agriculture, as it enables farmers and agronomists to make informed decisions and take timely actions to maintain or improve crop productivity. The use of Unmanned Aircraft System (UAS) orthophoto has been known for its effectiveness in overviewing crop health and condition in response to agriculture inputs and environmental changes. Normalized Different Vegetation Index (NDVI) is the most widely used vegetation index. It is calculated by taking the difference between the reflectance of the near-infrared (NIR) and red bands of the electromagnetic spectrum and dividing it by their sum [1]. This study aims to evaluate the use of UAS based orthomosaic and vegetation index (NDVI) in precision fodder management.

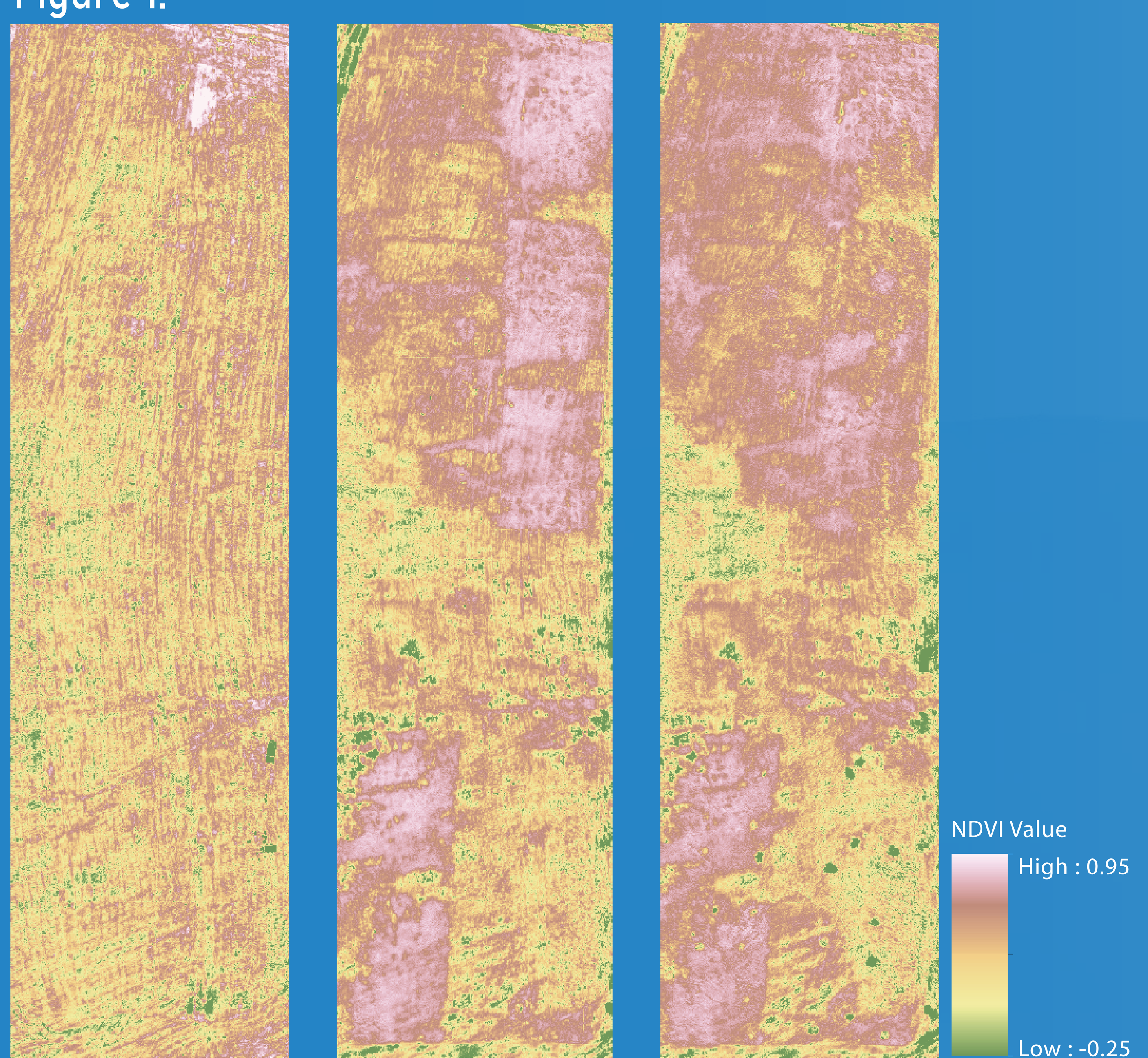
METHODOLOGY

One (1) hectare study site was develop to compare the effect of fertilizer application towards growth via aerial imagery assessment. The study plot were sown with mix pasture of *Brachiaria humidicola* and *Brachiaria decumbens*. Standard rate of 300kg N fertilizer was applied at Day-0. Aerial imagery was accomplished using a DJI Mavic 3 Enterprise Multispectral UAS at Day-0, Day-35 and Day-45. RGB images and multispectral orthomosaic images was built using DJI Terra software. Variable rate prescription map was produced based on the computed NDVI measurement to measure the total requirement of fertilizer for the study site.

CPU SPECS: 64GB RAM, Intel® Core™ i9-14900K Gen CPU @ 3.20GHz processor, NVIDIA GeForce RTX 4070 TI Graphics, 64Bits Windows 11 Pro operating system and 1TB hard drive disk

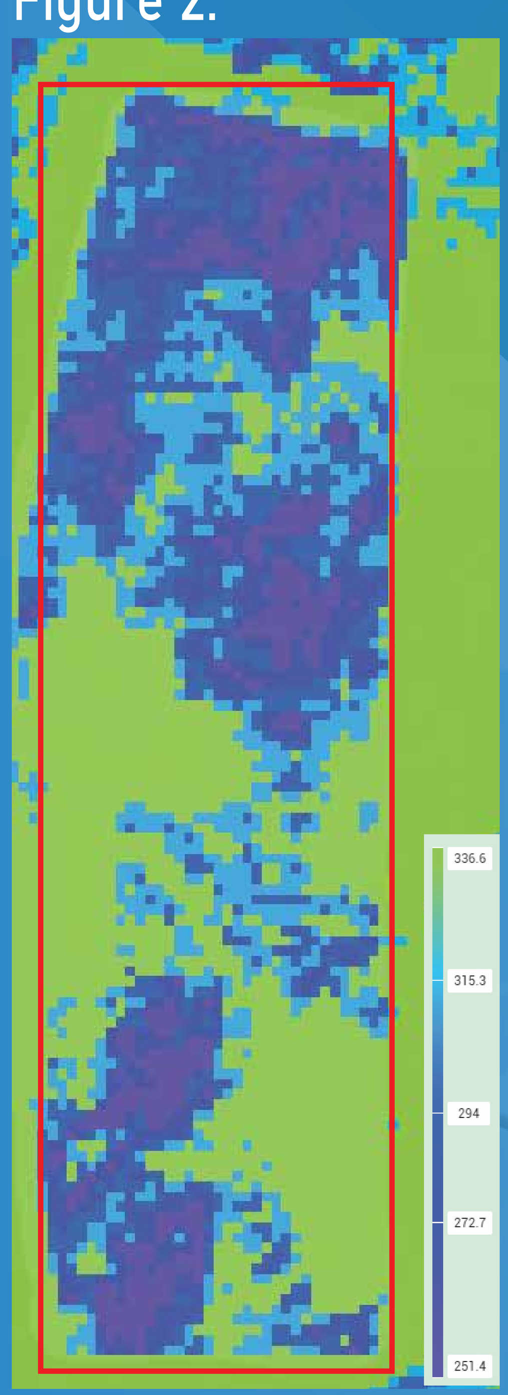
RESULT & DISCUSSION

Figure 1.



Day-0 Day-35 Day-45

Figure 2.



NDVI was calculated using following equation from the wavelength measurements in the near infrared (790 nm) and red (660 nm) portion of the electromagnetic spectrum [4] and the band values ranging from -1.0 to 1.0.

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

Results shows that different color band (NIR, Red, Green, Red-edge) can determine different properties of land cover condition including live vegetations, bare soil, water bodies and man-made features such as roads and buildings [2]. Figure 1 distinguished the NDVI measurement according to different stage of growth. Healthy crops have an NDVI value ranges from 0.7-1.0, while unhealthy crops have an NDVI value of < 0.5. From the computation of NDVI, there is approximately 47.7% variability in terms of healthy and unhealthy above ground crop coverage throughout the study site.

Figure 2 represent the prescription rate of fertilizer based on different NDVI index in accordance of low, intermediate and high dossage. It is estimated 43% percent reduction of fertilizer applied based on variable rate application to compare with conventional blanket amount method.

While NDVI provides valuable information about canopy reflectance, it also has some limitations in crop health monitoring which may affect the high and low NDVI values. Among the limitations includes non-vegetation factors such as soil brightness, atmospheric condition, cloud cover, shadows and brightness. Thus, timing of aerial photo mission during the operation day is vital to reduce the atmospheric effect. Besides that, further scrutiny should be done through continous ground truthing and crop sample analysis must be done to affirm the effect of stress towards overall yield and nutrient quality.

CONCLUSION

Overall UAS based imaging has proven to be a useful tools in monitoring fodder growth and quality with the adaptation of specified vegetation indices such as NDVI. Further exploration and adaptation of this technology in livestock industry mainly would benefits farm managers and decision makers as part of their decision support system (DSS) as a mechanism for better understanding as well as future planning for an optimal and sustainable fodder production system.