Assessing the Effectiveness of UAV-based Weed Burden Solution: A Case Study of Sapperton Wilder

Ayokunle Oluwasanwo, MSc Agricultural Technology and Innovation, 2024

Summary

Sapperton Wilder is a land restoration project that focuses on restoring the soil health, natural habitats, ecosystem processes, and biodiversity of previously intensively farmed land through regenerative farm practices. Drawing from the pool of research and empirical evidence that confirms the heterogeneity of land, this research explored the feasibility of using unmanned aerial vehicles (UAVs) as a precision weed management tool for achieving targeted site-specific minimal herbicide application in the transition to regenerative farming in the Cotswold as against the use of the conventional blanket application.

The research carried out on three fields (Badger, Otter, and Oak fields) sought to determine the variables of resolutions (spatial and spectral resolutions) of the UAV for effective weed detection, production of weed maps that highlight the spatial distribution of weeds across the landscape, and modelling the cost of deploying a UAV-based weed burden solution. Although high-resolution RGB images were acquired from each field and multispectral images were obtained from the Oak field, only the RGB images acquired from the Otter field were analysed.

The weed maps showed a disparity in the spatial distribution of weeds across the landscape of the Otter field. The weed map generated from the flight altitude of 5m showed an evenly distributed weed across the field while the 10m flight altitude showed high concentration of weed along the edge of the field. However, there is a noticeable pattern. Both maps showed weed detection in strips that run from top to bottom.

Methods

Three fields were purposively selected. A drone outfitted with RGB, and multispectral sensors was flown over the fields at 5m and 10m altitudes. The images acquired were orthorectified using Pix4D software. The orthomosaics were analysed to differentiate the weeds from the plants and to generate the corresponding weed maps for the field using Agremo software.

The cost of deploying the UAV-based weed burden solution was estimated using two frameworks: inhouse model and outsourcing model.

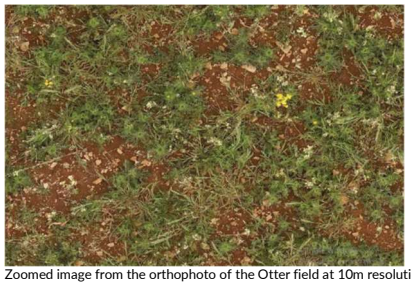
Orthophoto of Otter field at 5m spatial resolution

Orthophoto of Otter field at 10m spatial resolution

Results – Spatial Resolution

Images captured at 5m flight altitude had higher resolution than those obtained at 10m. The result showed 48.39% weed detection at 5m and 47.5% at 10m flight altitude. The 5m flight altitude had a higher percentage of weed detection.

Zoomed image from the orthophoto of the Otter field at 5m resolution

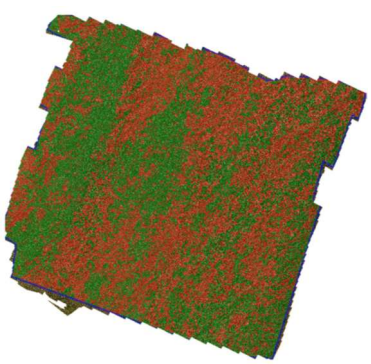


Zoomed image from the orthophoto of the Otter field at 10m resolution

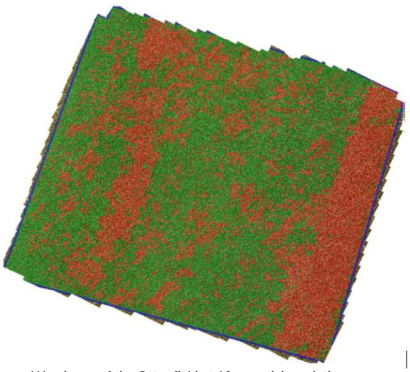
Results – Estimation of the Cost of Deployment

The cost of deploying the UAV-based weed burden solution was estimated using two frameworks: (i) the in-house model and (ii) the outsourcing model.

The in-house model is capital-intensive, and outsourcing is more economical.



Weed map of the Otter field at 5m spatial resolution



Weed map of the Otter field at 10m spatial resolution

Weeds Non-weeds

Conclusion

Spatial resolutions corresponding to 5m and 10m flight heights are practicable for an UAV outfitted with RGB sensor to acquire high-resolution images for creation of weed maps. This weed burden solution is best economically deployed using the outsourcing model.

The UAV-based weed burden solution aligns with and can facilitate Sapperton Wilder's goal of sustainable weed management. However, the data for Badger and Oak fields should be analysed.

STRESS LEVEL TABLE

Stress level	%	Hectare
Fine	51.61%	0.16
Low Weed Pressure	0%	0
High Weed Pressure	48.39%	0.15

Stress Level Table at 5m spatial resolution

STRESS LEVEL TABLE

Stress level	%	Hectare
Fine	52.5%	0.21
Low Weed Pressure	0%	0
High Weed Pressure	47.5%	0.19

Stress Level Table at 10m spatial resolution