# New applications of UAV technology in agriculture: estimating carbon sequestration and water repellency

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**Keywords:** Above-ground biomass, UAV, classification, saltbush, remote sensing

**Abstract:**
In broad-acre agriculture it is often impossible to gather data to allow site specific decisions due to the cost of manual methods of acquisition. This paper will describe two applications of UAV technology from the WA wheatbelt which are more broadly applicable to land management.

Revegetation is a major approach used to mitigate increasing atmospheric carbon dioxide, however direct ground-based measurement of accumulated carbon is a time-consuming and expensive task. High resolution airborne digital imaging has been broadly used for estimating above-ground biomass of vegetation and our previous research at Wickepin, W.A., has demonstrated the application of Digital Multi Spectral imagery (DMSI) on carbon estimation in a *Atriplex nummularia* revegetated site using only the red-green-blue (RGB) spectrum. However, the pixel size of DMSI imagery (0.5 m) is still relatively too large compared to the size of saltbush canopies (mean diameter 1.8 m). This makes the pixels in boundary areas consist of both soil background and saltbush branches, especially in high density plots. Moreover, airborne imaging is much more expensive than unmanned aerial vehicle (UAV). We thus evaluated the utility of UAV to estimate carbon in revegetation.

Aerial imagery was acquired at Wickepin on 23 March 2017 with a DJI Inspire 1UAV. The resolution of obtained images by UAV was 1.00 cm/pixel. Four machine learning algorithms (Gaussian Mixture Model (GMM), Random Forest (RF), K-Nearest Neighbours (KNN) and Support Vector Machine (SVM)) were used for vegetation classification. The results show that SVM has the highest overall classification accuracy (95%). The classification accuracy for GMM, RF, and KNN are 87%, 90%, and 92%, respectively. We are now evaluating the performance of UAV imagery to estimate biomass and carbon sequestration both at individual plant and plot scales. The technique will also have applicability for the estimation of fodder value and in arid pasture management more generally.

Soil water repellency is a major issue in sandy surfaced soils in southern Australia, however its spatial distribution is unknown at the paddock scale. This precludes the precise application of ameliorants. Here, UAV technology has also applied to investigate crop responses on water repellent soils. Crop responses are imaged and mapped to characterise spatial and temporal variation of water repellence and interactions with other soil factors affecting crop performance. Imaging has initially been with the RGB spectrum but will also include

multispectral imagery. These outcomes will be applied to develop paddock scale maps of water repellence which will potentially be integrated with on farm variable rate technologies.