

## Title: Deep Learning and Pleiades Images for Sandalwood Forest Inventory Generation

Forest inventory is critical for effective management of plantation farms. A detailed, accurate and up-to-date inventory can help forestry companies make informed decisions and improve efficiency. Inventory components such as trees stocking, weed infestation and gaps between trees could be measured in direct way through sampling or via remote sensing. In general, direct methods are very labour intensive and costly, and subject to sampling error.

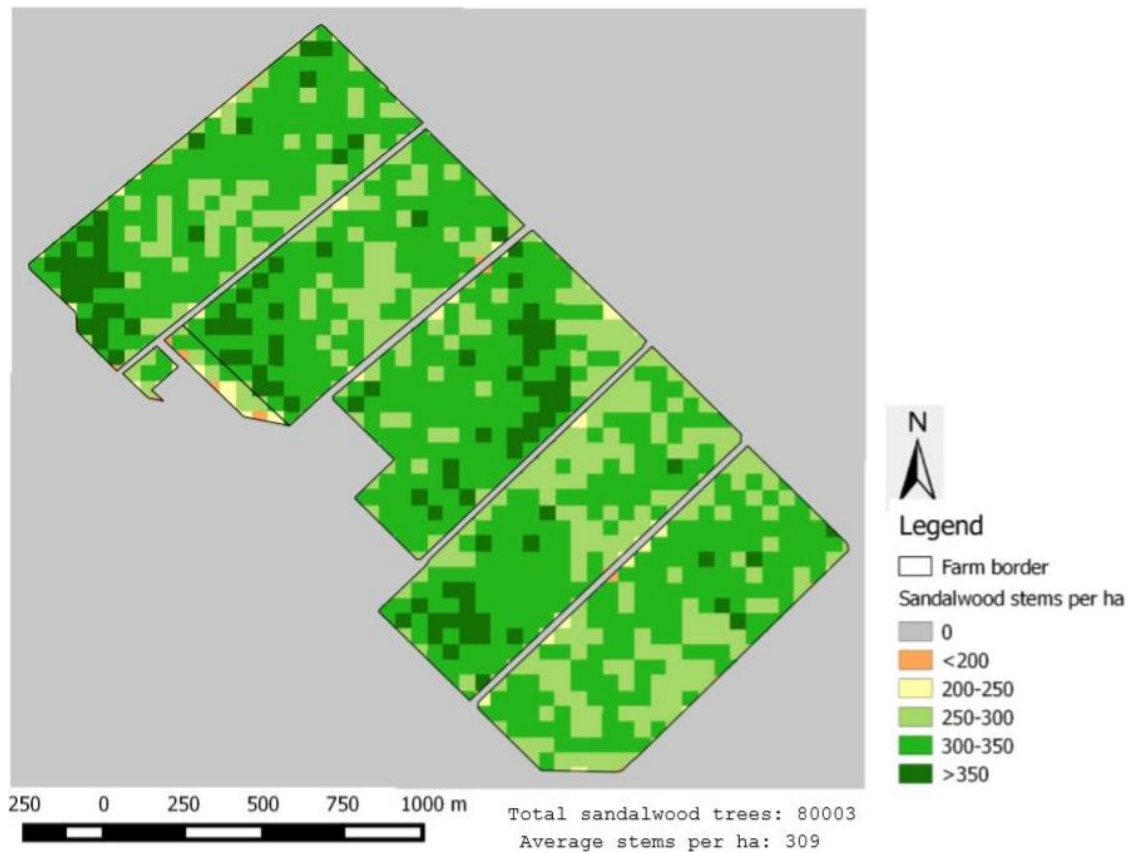
Image-based remote sensing combined with the powerful deep learning technology offer an affordable solution to this problem. While old generation satellite sensors lack sufficient spatial resolution necessary for accurate inventory survey, the latest very high resolution sensors such as Pleiades developed by AIRBUS with an unprecedented 50cm spatial resolution could be regarded ideal for this purpose.

Recently, Mapizy was engaged by a Sandalwood company in Australia to process Pleiades images provided by AIRBUS to produce inventory for Sandalwood plantations. Our team processed an area of over 3,000 hectare and produced a range of forest analytics (see Fig. 1), these being stocking assessment, crown size and trees health classification of both host and Sandalwood trees.

Stand	Stand area (ha)	Count	Stems/ha	Crown area (m2)	Crown area/ha (m2)
5	54.90	17184	313	105197.61	1916.05
3	50.15	15787	315	97570.74	1945.49
2	50.26	15468	308	95690.21	1904.04
1	54.88	16570	302	101547.87	1850.34
4	44.39	13805	311	85036.13	1915.82
4	1.44	399	278	2496.75	1739.42
4	3.17	790	249	4830.73	1524.14
sum	259.18	80003	309 (average)	492370.04	1827.90 (average)

**Figure 1** : Inventory analytics for Sandalwood farms extracted from Pleiades images

We also produced grid maps for every analytics at 50m grid size showing spatial density of distribution of trees and their health indicators. In the Fig. 2, an example grid map in which Sandalwood stocking has been quantified is shown.



**Figure 2 :** Sandalwood tree stocking grid map at 50m grid size

We produced inventory twice per year and provided our client with change detection maps and analytics so that informed decisions can be made early enough to avoid potential losses. These measures could be thinning the trees where over-stocking has occurred or replanting trees in the areas where gaps have been reported to ensure an optimal growth for Sandalwood trees.

The inventory result produced through our proprietary software solution, *XTree*, were independently verified through ground-truth measurements conducted by our client's field staff and proved to be accurate.

This study demonstrated that high resolution images captured by Pleiades sensor combined with deep learning technology has a great potential for discovery of changes to the natural environment at tree species level. In the future, we intend to include biomass estimation in our software solution through height extraction in stereo satellite images.

## About Mapizy:

Mapizy is a UWA spin-out company focused on change detection through image data. We are a team of thinkers and doers who are passionate about solving real-world problems with technology. Our software solutions were recognised by the American and UK Society of Photogrammetry and Remote Sensing through technology awards.