'Due diligence' soil assessment for Indian Sandalwood plantations across northern Australia

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Introduction

Approximately 13,000 ha of Indian sandalwood (*Santalum album*) plantations have been established across northern Australia. The main developer has been Tropical Forestry Services (TFS), re-branded in March 2017 as Quintis. The sandalwood trees are produced under irrigation, mainly using drip systems. Because *S. album* is a parasitic plant, it must be grown alongside nitrogen-fixing host plants such as *Sesbania formosa*, *Cathormium umbellatum* and *Acacia* spp.

By 2013, about 40% (approx. 3,500 ha) of the Ord Irrigation Area, Western Australia was planted to *S. album*. Large plantations of *S. album* also have been established in the Northern Territory (Douglas Daly and Katherine regions) and north Queensland (Dalbeg district in the Burdekin Valley).

In 2016 the value of timber from *S. album* plantations was estimated by TFS to be approximately $1.5 million per hectare, at harvest time 15 years after planting. Over-harvesting of native stands of *S. album* in India has created a global shortage of sandalwood timber. The aromatic wood is used for carving and incense products, and provides an essential oil that is an important component of perfumes, cosmetics and medicine.

TFS was the only tree plantation company in Australia using a 'managed investment scheme' (MIS) business model to survive the agribusiness MIS collapses in 2009. The Australian Government Senate enquiry into the failure of Timbercorp and Great Southern (Parliament of Australia 2009) received evidence of poor quality work by commercial soil surveyors associated with some of their projects. TFS worked hard to develop a professional approach to their soil assessment and management that could withstand scrutiny from regulators and investors.

Description of TFS soil survey methodology

A protocol for assessment of potential new plantation sites, 'SALADD; Soil assessment for land acquisition due diligence', was developed by TFS for use across northern Australia (Tropical Forestry Services 2011). The main components were as follows:

1. Initial collation of information by TFS staff was undertaken where a new property was thought to be available for purchase. This included preparation of a soil map based on available information from state government soil surveys.
2. If the property was identified as having good potential for sandalwood, a soil assessment was undertaken and signed off by an independent accredited soil surveyor.
3. Where the soil survey indicated presence of a significant area of land suitable for sandalwood production, the property was purchased by TFS and a soil operations map was prepared with assistance from an accredited soil scientist.

To improve TFS's understanding of what constitutes an ideal soil for Indian sandalwood and its hosts, a sandalwood growth model was developed via detailed soil sampling in existing sandalwood plantations near Kununurra in 2009. A stepwise regression procedure was used to relate tree performance to a broad range of topsoil and subsoil constraints and surface architecture parameters (McKenzie 2009). Soil conditions exist which strongly restrict sandalwood growth.

The TFS soil survey work undertaken by Soil Management Designs had the following features:

- Soil inspection pits were on a flexible grid with a spacing of approximately 400 m; in complex areas with high spatial variability, the pit spacing was reduced to 100 m.
- Soil profile description and photography to a depth of 1.3 m.
- Soil sampling for chemical analysis; 0-10cm, 10-30cm, 30-60cm, 60-90cm, 200cm, 300cm.
- There was a focus on quantification of soil water holding capacity based on field assessment of soil structural form (SOILpak score), soil texture and coarse fragment content (McKenzie *et al.* 2008).

- Subsoil and topsoil constraints under consideration included compaction, dispersion/sodicity, pH imbalances, salinity and nutrient deficiencies/toxicities.

Other inputs included landscape modeling to predict water erosion hazards at NT sites (Ian Hollingsworth, pers. comm. 2013) and airborne EM survey data to assess deep subsoil salinity.

Application of the SALADD system: 'Ord West Bank' soil survey
The most recent pre-development soil assessment for Quintis involving Soil Management Designs was carried out by McKenzie *et al.* (2017) in the 'Ord West Bank' area near Kununurra WA. Parts of the site had severe scalding and gully erosion caused by over-grazing. One hundred and four soil pits on a flexible grid spacing of about 400 m were inspected and sampled. The most valuable layers of information for planning of the proposed *S. album* plantation were elevation/slope, profile plant available water, depth to waterlogged layer, electrical conductivity, pH, dispersion (ESP, ESI), compaction severity (SOILpak score) and cation exchange capacity. A soil amelioration plan was prepared, in conjunction with a map showing contrasting 'irrigation management units'.

Pre-existing state government soil information for the area, and predictions from 'Soil and landscape grid of Australia', lacked the required accuracy for plantation development.

Recent events and conclusions
Soon after their rebranding as Quintis in March 2017, TFS Corporation unfortunately went into receivership. The collapse was triggered by an adverse assessment of the business by Glaucus Research Group, a US activist short seller. Their director of research, Soren Aandahl, stated in an ABC radio interview (Borello 2018) that: "*This story is all about Wall Street, not about the soil*". Glaucus was concerned about financial management issues rather than the quality of Quintis sandalwood assets.

The future of the Quintis sandalwood plantations is uncertain. However sandalwood timber continues to be a scarce and valuable commodity, so a very significant resource is in place. It is heartening to know that unlike ill-conceived plantations associated with MIS failures of 9 years ago (Timbercorp, Great Southern), existing sandalwood plantations mostly are on professionally selected soil types. The routinely collected plantation performance data are confidential, but the soil management systems in place appear to be appropriate.

Although the soil science consulting community in Australia has very few members, it was possible to assemble a series of CPSS-accredited soil survey teams with the capacity to quickly and skillfully address the soil-related challenges identified by TFS/Quintis in a cost-effective manner between 2009 and 2017.

Keywords: *Santalum album*, soil survey, root growth, subsoil constraints, soil amelioration

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