Assessment of soil sampling for the creation of high resolution maps of soil acidity and nutrition

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Choosing the best product and then applying it only where it is required is the most efficient way to treat soil constraints. Precision SoilTech has just concluded a South Coast Natural Resource Management funded project, assessing the required resolution of direct soil sampling for creating high resolution maps of pH (to 30cm) and also phosphorus and potassium. Other techniques such as proximal sensing (EM and Gamma Radiometrics), biomass imagery and yield mapping will also be assessed for their ability to supplement the soil mapping process. 14, 50 ha paddocks (from Frankland to Wellstead) were sampled at a resolution of 1 site per hectare. At each site, topsoil (0-10cm), midsoil (10-20cm) and subsoil (20-30cm) samples were collected.

Soil Sampling for High Resolution Information Layers –

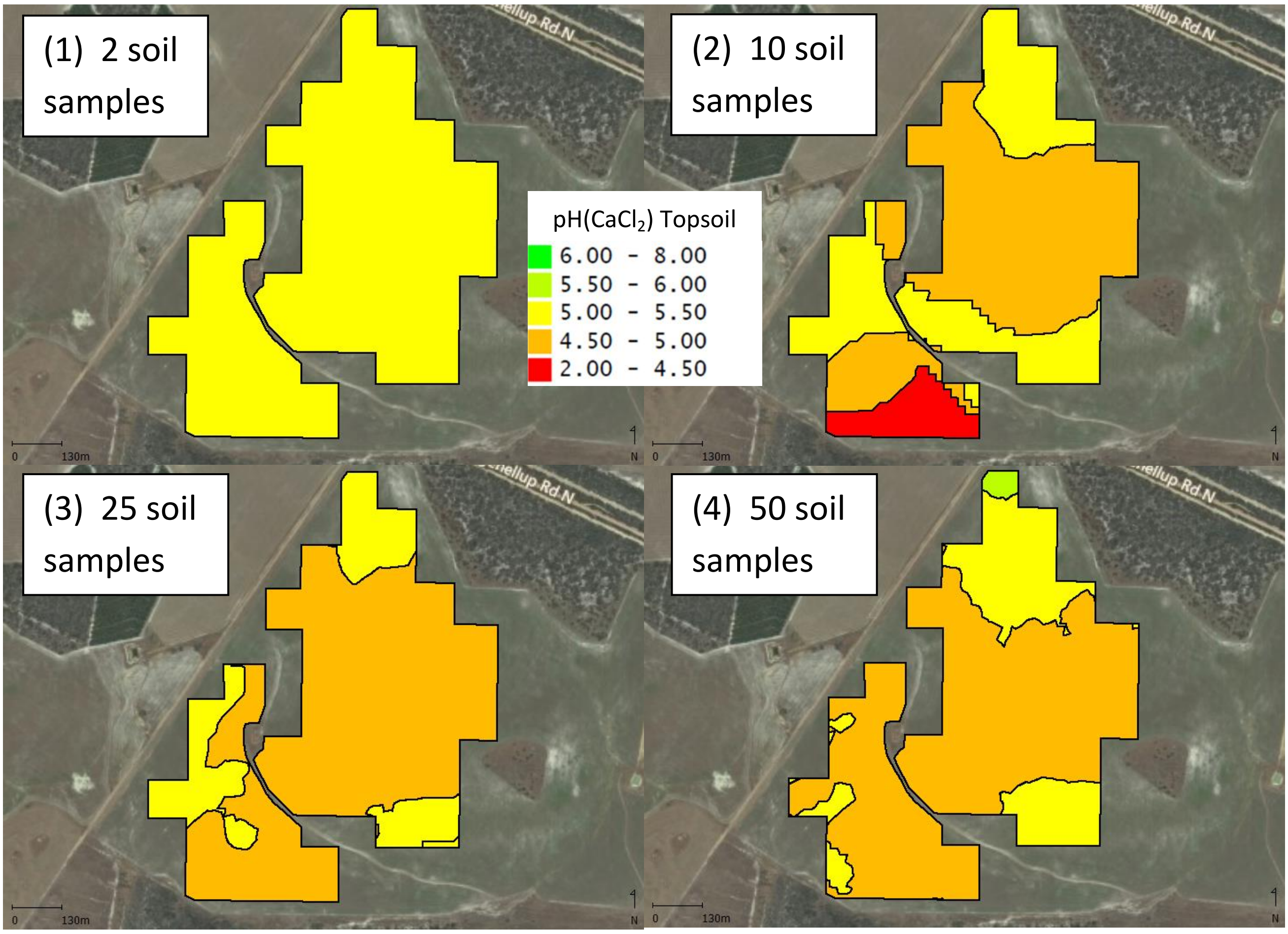

Figure 1: The number of soil sampling sites can significantly influence the accuracy of any particular acidity or nutrition layer. For this topsoil pH Map at Woogenellup, map 1 was created with 2 topsoil pH samples only, map 2 was created with 10 samples, map 3 used 25 samples and map 4 used 50 samples (1 per ha).

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pH and nutrition layers varied significantly according to the number of soil samples used to create the map. For instance map 1 (figure 1), was created with only 2 soil samples and did not identify any variation across the site. When 10 soil samples were used to create the map (map 2; figure 1), variation was identified however this was significantly different to the map created with the full data set (map 4; figure 1). Map 3 was created with 25 soil sampling sites and was the closest in accuracy to the full data set (map 4). Further analysis concluded that for an r^2=0.7 with the full data set, roughly about 30 samples was required per 50ha (1 per 1.7ha). This illustrates that under sampling for high resolution maps can have large effects on accuracy of the layer being created.

Soil Sampling For High Resolution Prescription Maps -

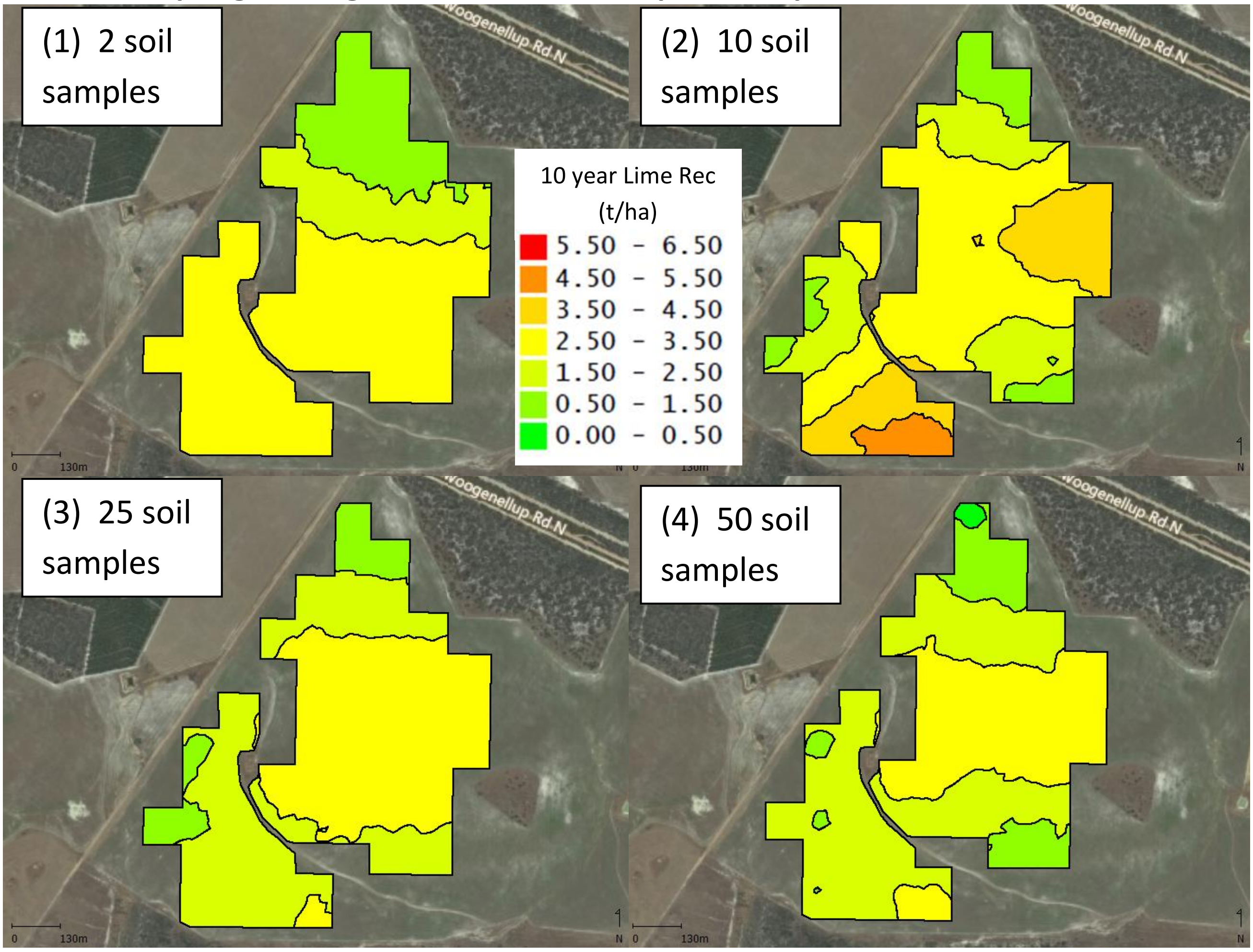

Figure 2 How an input layer can change depending on the number of soil samples used. Lime Recommendations for maps 1-4 were created with varying levels of information. Map 1 was created with 2 soil samples, map 2 with 10 soil samples, map 3 with 25 soil samples and map 4 used 50 soil samples.

Figure 2, like Figure 1 demonstrates how under soil sampling has large implications on the creation of prescription maps. Further analysis indicated that in map 1 and map 2 that around 30 – 40 tonnes of lime was incorrectly allocated across the site. However with the addition of extra soil samples in map 3, only approximately 15 tonnes of lime was misallocated, compared to the complete lime prescription in map 4.

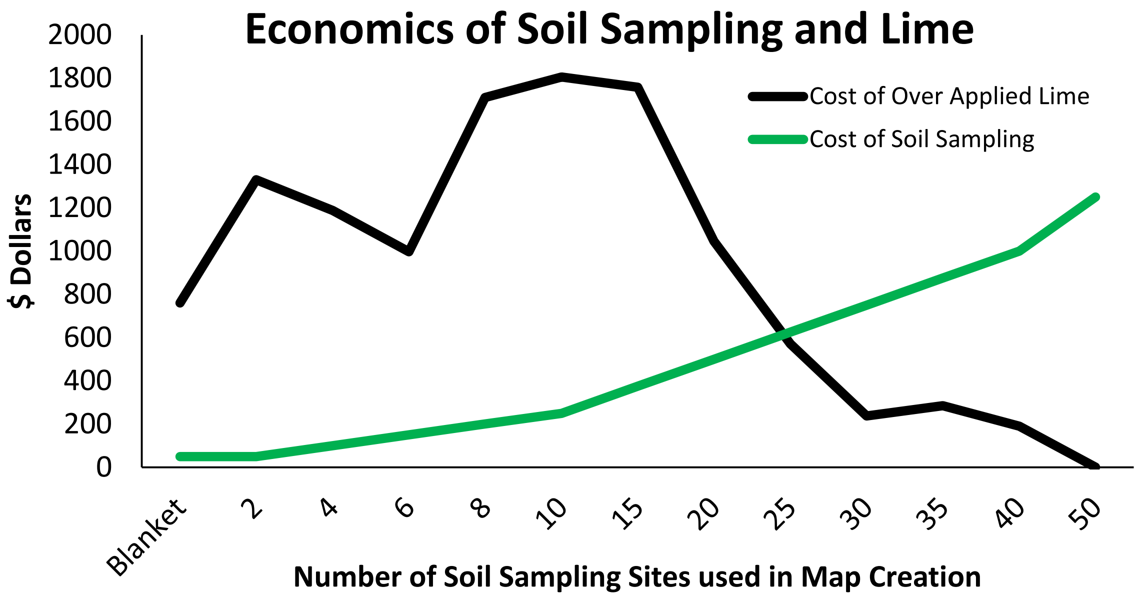

Figure 3: Analysis of cost of misallocated over application due to inaccurate maps against the cost of obtaining extra information the site at Woogenellup.

Figure 3 explains that for maps created with 25 soil sampling sites or less, the cost of soil sampling to depth for pH is less than the associated misallocated over supplied lime. The cost of misallocated under suppled lime was not taken into account as it was difficult to predict the opportunity cost of lost yield. Therefore realistically the black line in figure 3 should be higher than it actually is. Overall, figure 3 illustrates how relatively cheap soil information is relative to the associated cost of misallocated inputs.

Summary of Supplementary Mapping Techniques

- Satellite Imagery; can assist provide boundaries for visible soil types.
- Biomass Imagery; relationships with 30m imagery were extremely poor ($r^2 <0.2$)
- Proximal Sensing; Relationships with Proximal Sensing (EMI & γ-ray spectrometry) were poor, especially for identifying soil acidity.
- Yield Mapping; pH correlation slightly higher in Canola, needs to be used on small management zone scale.

It is critical to understand the performance of supplementary mapping techniques on your soil types before paying to obtain the data.

Key Messages

- Under soil sampling can have significant effects on information layer accuracy, leading to poor input maps.
- Paying for actual information is relatively cheap compared to inefficiency of misallocation of inputs.
- Understand the performance of additional information before paying to obtain the data is critical.

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