Predictive modelling of eucalyptus tree metrics using Stump Measurements

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SUMMARY

Estimating diameter at breast height (DBH) from stump measurements can be used for calculating tree diameter distributions and predicting tree height (H) and other tree metrics. Stump data in terms of stump diameter (SD) and stump height (SH) often provides a foundation for reconstructing pre-harvest stand conditions, particularly in cases of unplanned or unauthorised tree removals.

To enable these estimations, two regression equations were developed to predict DBH from outside-bark stump measurements. These DBH estimates were subsequently used in an additional equation tailored to determine tree height (H). This approach could support applications in carbon stock assessments, habitat quality evaluations, and biodiversity monitoring where rapid yet accurate tree dimension data is needed.

The equations were derived from data collected from 35 mature Eucalyptus tereticornis (Forest Red Gum) trees, with heights ranging between 23 to 42 meters. This eucalyptus species, widespread in Southeast Queensland, Australia, offers sustainable, resilient timber that is both cost-effective and ecologically advantageous due to its fast growth and carbon-sequestering properties.

Stump diameters were measured at heights above ground level from 0.20 m to 1.30 m to reflect likely SH below the DBH which was conventionally measured at 1.30 m. Data collection involved capturing scaled images of the tree trunks at close range, delineating sections, and processing them using open-source image software. The resulting equations, based on SH and SD, provided DBH estimates with an RMSE of ±0.027 m, translating to an average discrepancy of 2.14% relative to measured DBH values. Additionally, the equation that estimated tree H and derived from these DBH values had an RMSE of ±1.85 m, equating to a 3.62% discrepancy from the average of all tree H investigated in this work.