

# Assessing Sediment Accumulation and Nutrient Sequestration in a Riparian Restoration Site Adjacent to a Macadamia Farm

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# Background

Under the Marine Estate Management Strategy (MEMS) NCLLS are delivering onground works to mitigate diffuse pollutants and enhance the health of the marine estate.

NCLLS has engaged Southern Cross University (SCU) to analyse the benefits of on-ground works:

## Riparian restoration monitoring:

- Soil accumulation, as well as nutrient and carbon capture within riparian vegetation

## Bank protection and mangrove nursery monitoring:

- Sediment accretion, and carbon, nitrogen and phosphate accumulation within mangrove nursery structures.
- Spatial and temporal mangrove seedling recruitment patterns

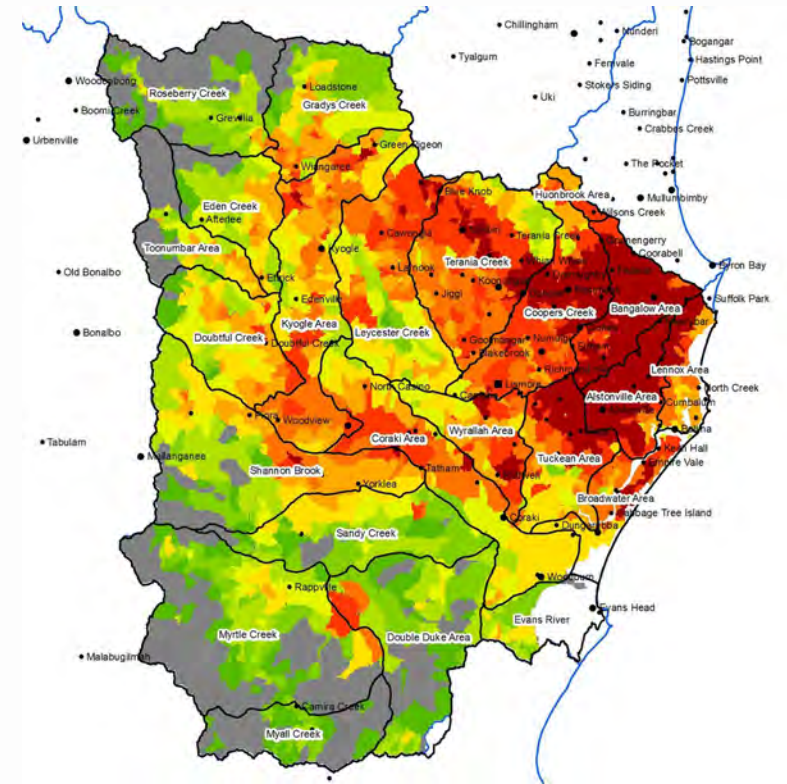


Figure 1: MCAS –S Map showing export loads (TS/TN/TP) in the Richmond River Catchment

# Orchard Floor Erosion: A Significant Contributor

- Macadamia production in the Northern Rivers region contributes to water pollution through sediment, nutrient, and chemical runoff.
- Soil loss from orchard floor erosion is a major issue exacerbating water quality concerns.
- In orchards with 8 by 4-meter tree spacing, soil movement can reach up to 3.8 tons per hectare annually.
- Insufficient riparian buffers exacerbate the problem, leading to excessive sediment and nutrient runoff into waterways.

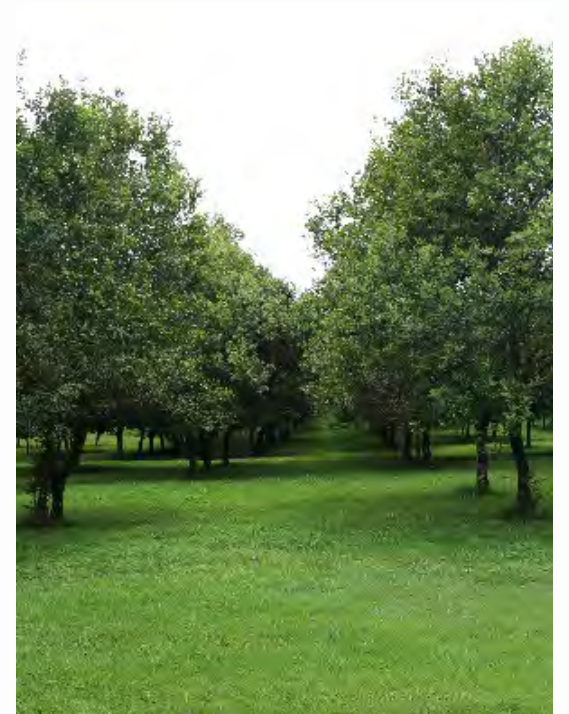
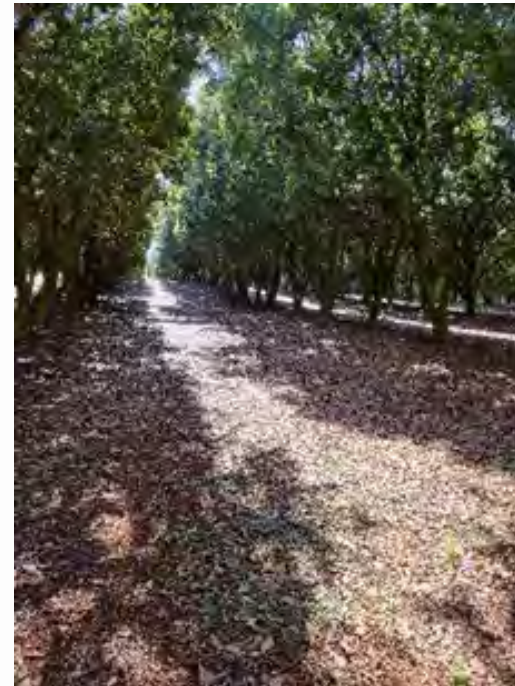


Figure 2: Macadamia orchards exhibiting varying levels of ground cover, influencing soil erosion and nutrient runoff

# Soil Erosion in Macadamia Orchard

- First year (March 2022) 0.104 centimeters of soil was lost.
- Second year (March 2022) a loss of 0.488 centimeters (March 2022)
- Second year (November 2022) addition of about 0.41 centimeters
- Third year (March 2023) 0.375 centimeters soil was lost

Overall, between May 2021 and May 2023, the total soil lost around the trees amounted to approximately 0.56 centimetres.



Figure 3: Macadamia Orchard with erosion pins installed.

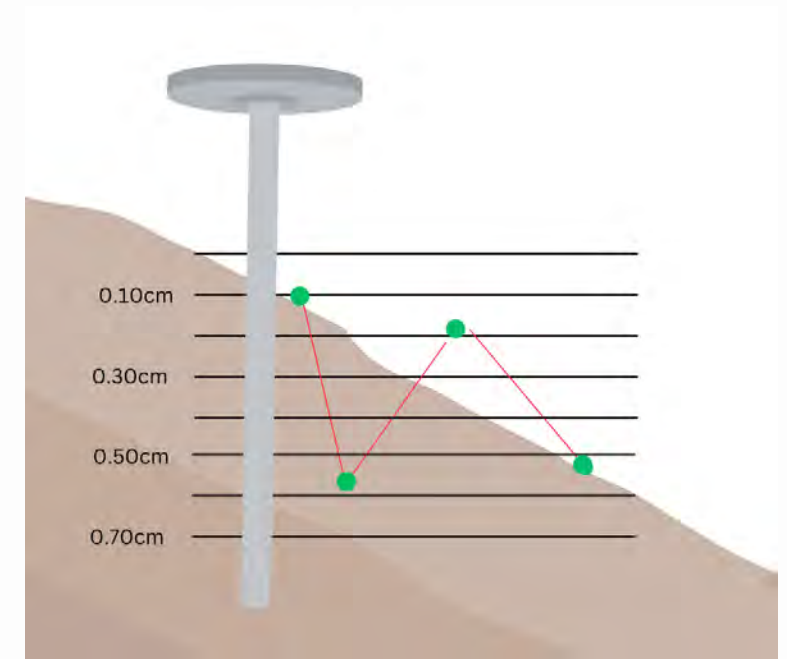


Figure 4: Sediment accretion rate under macadamia trees from May 2021 to May 2023



# Sediment Accretion Rates in Riparian Zone

- Mesh horizons and erosion pins installed at 21 sites within the riparian zone
- Overall, the riparian zone captured an average of 7.39 cm of soil from the macadamia farm runoff between May 21 and May 23.

This equates to approximately 15 cubic meters of sediment or the volume of about six standard parking spaces filled with soil stacked one meter high.

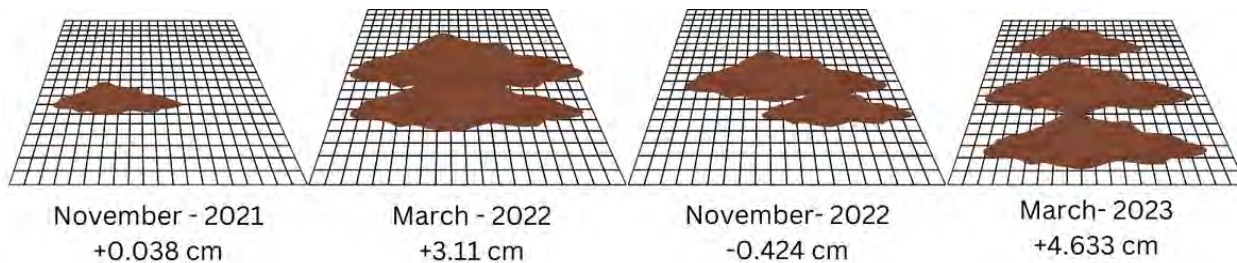


Figure 5 : Conceptual diagram of mesh horizons showing soil capture.

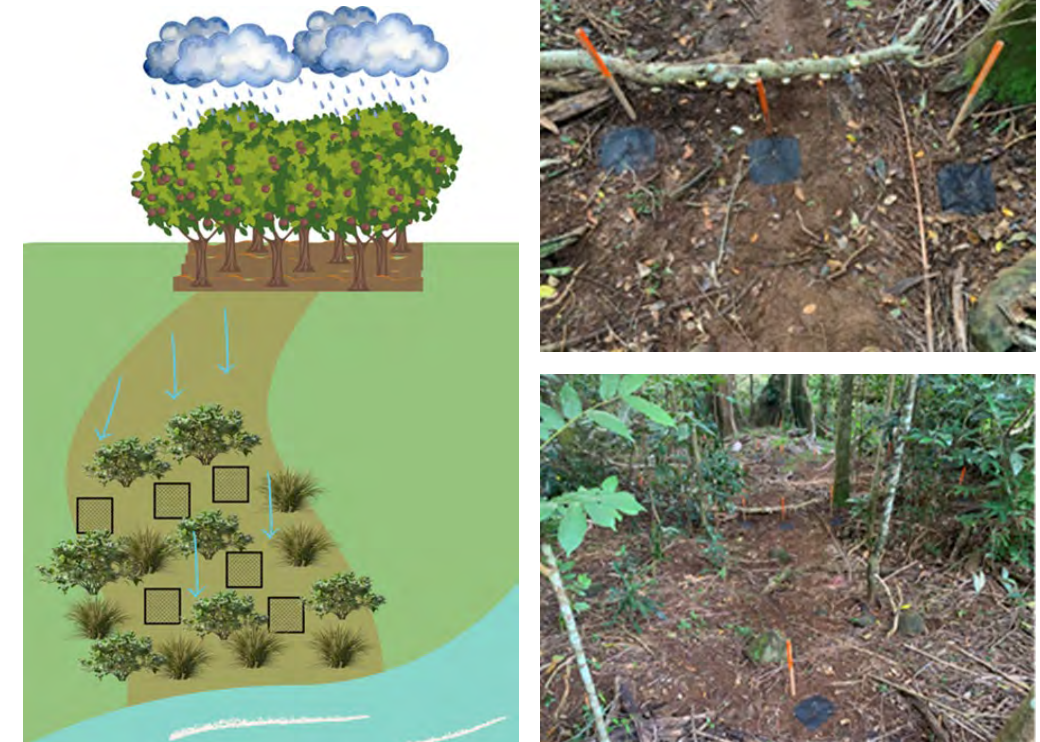


Figure 6 & 7: Conceptual diagram & mesh horizons within the riparian zone.

# Nutrient Sequestration Rates

- Post-flood peak accumulation rates observed for organic carbon (6000 g/m<sup>2</sup>/yr), nitrogen (912 g/m<sup>2</sup>/yr), and phosphorus (57 g/m<sup>2</sup>/yr).
- Accumulation rates return to pre-flood levels 6 months post event, demonstrating soil ecosystem resilience.

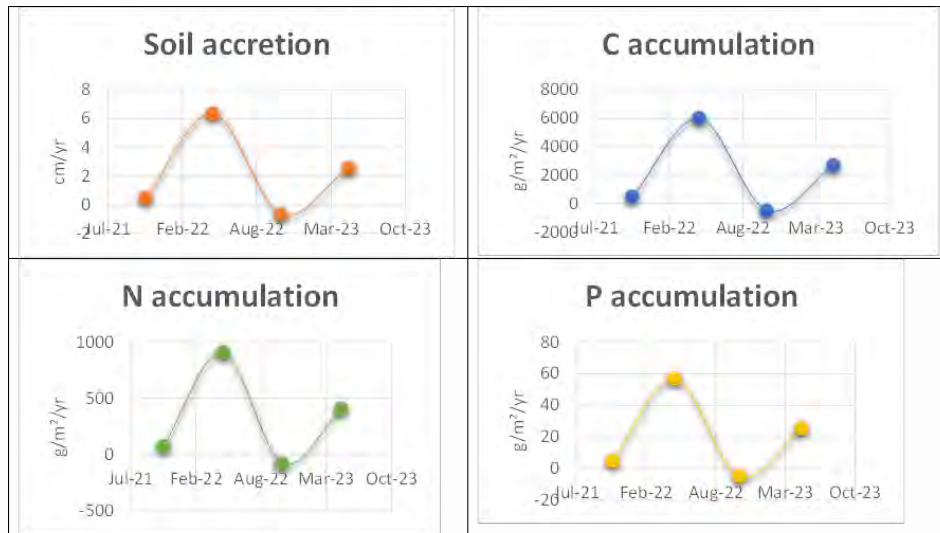


Figure 8: Average of relative accretion, organic carbon, nitrogen and phosphorous accumulation each year of this study; FY2021, FY2022, and FY2023 in g/m<sup>2</sup>/yr.

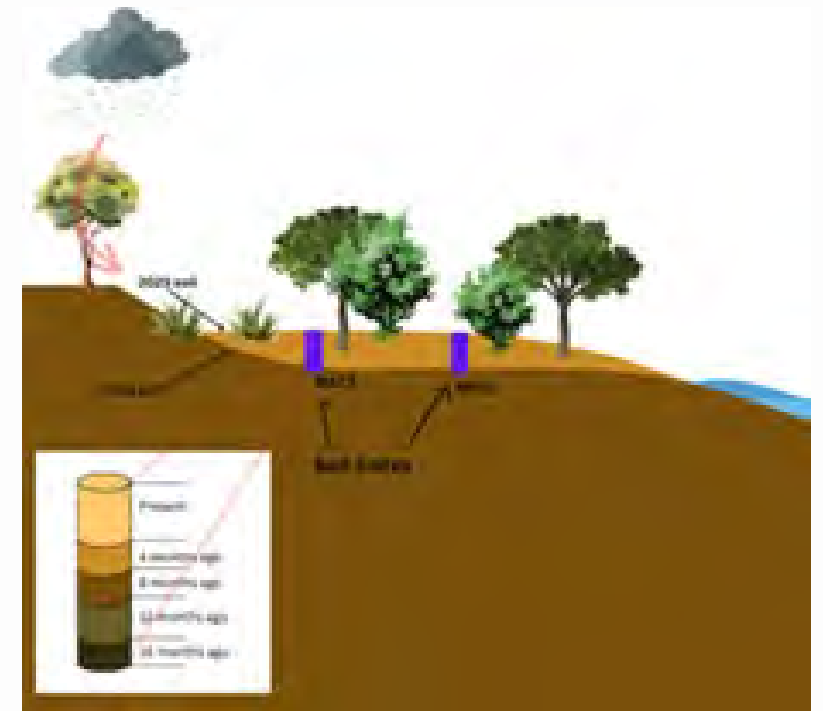


Figure 9: Conceptual diagram of sediment cores in riparian zone

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- Erosion pin measurements indicate a net loss of approximately 0.56 centimeters of soil around macadamia trees between May 2021 and May 2023, highlighting dominant erosion processes and an overall trend of soil loss despite some soil addition in the third year.
  - Mesh horizons in the riparian zone captured an average of 7.39 cm of soil between May 2021 and May 2023. Indicating the riparian area effectively capturing 15 cubic meters of sediment.
  - Soil ecosystem in riparian zone demonstrated resilience as accumulation rates eventually returned to pre-flood levels, indicating the capacity for recovery despite initial nutrient loss
  - Cores from the riparian zone reveal both autochthonous and allochthonous organic and sediment sources, with data from the macadamia orchard indicating similarity in sediment composition, implying effective sediment retention by the riparian zone