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Symposium on
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Conservation and Innovation: Changing the Regional Water Paradigm



Green Solutions for Slope Stability: Regulating Soil Moisture Content in Expansive Clays

Connecting Nature-based Solutions
with Disaster Risk Reduction in
Trinidad

Akil Crichlow, Ronald Roopnarine, and Gaius Eudoxie

Caribbean Science Symposium on Water
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Introduction



- ❑ **Nature-based Solutions (NbS)** have become a popular form of green infrastructure towards improving climate resilience.
- ❑ Popular applications worldwide include Climate Change adaptation/mitigation and **slope stability improvement**.
- ❑ **Vetiver grass** is a global example of using nature/vegetation to improve the stability of slopes which threaten human well-being.



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THE ECONOMIC COST

- Slope instability account for a staggering USD 20 billion, representing 17% of the yearly mean global disaster losses of USD 121 billion (Sim, Lee, and Wong (2022).
- Regionally, it is estimated the cost of repairing landslide damage to roads throughout the Caribbean amounts to USD 15 million (DeGraff 1989).
- T&T's estimated expenditures for landslide inspection, upkeep, and restoration exceeded TTD 1.26 million or USD 0.96 million in 2013 (Roopnarine, Eudoxie, and Opadeyi 2013).

ECOLOGICAL REMEDY.....

Hydrology: water runoff, infiltration & conductivity



CO2 capture and sequestration



Climate resistance and resilience



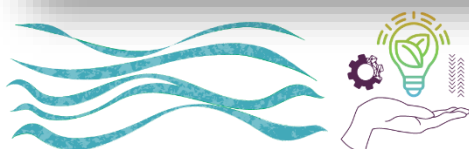
Soil health and quality



Slope stabilisation and erosion control



Soil and water remediation



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Insidious Reality for Southern Trinidad



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Southwestern Main Road
in Chatham village



Image by: T&T Newsday

(12,000) residents, feared
massive landslides
(Moore 2020)

Sahai Trace, St Croix
Road, Princess Town



Image by: Ivan Toolsie

Four homes collapsed; one
plummeted 200 feet
downslope
(Wilson 2021)

Belle Vu Village,
Claxton Bay



Image by: Rishi Ragoonath

Landslip on main road;
destroyed half the roadway
and disrupted businesses
(Wilson 2022)



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Research Question / Issue



- ❑ What is the effect of NbS on soil moisture content at different depths (20 cm, 40 cm, 60 cm, and 100 cm) in the L'Ebranche Clay, and what is the potential influence on the stability of the soil?



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Methodology



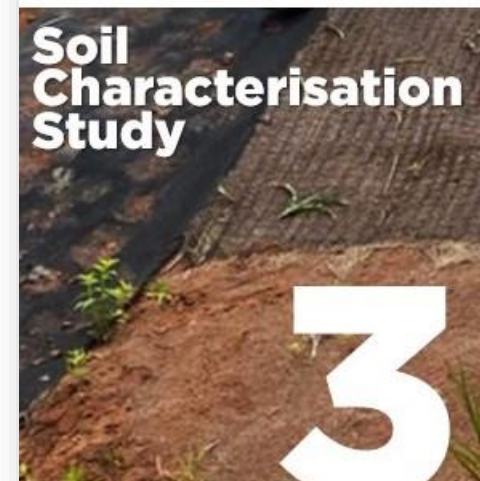
- ❑ Controlled Slope at Tucker Energy Services Campus Facility
- ❑ Climate – Tropical Marine Climate
- ❑ Soil - L'Ebranche Soil Series



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Key Activities:



Nature-based Solutions Installation



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BARE PLOT (Control)



COCONUT MATTING



**COCONUT
MATTING/NATURAL
VEGETATION HYBRID**



NATURAL VEGETATION



VETIVER GRASS

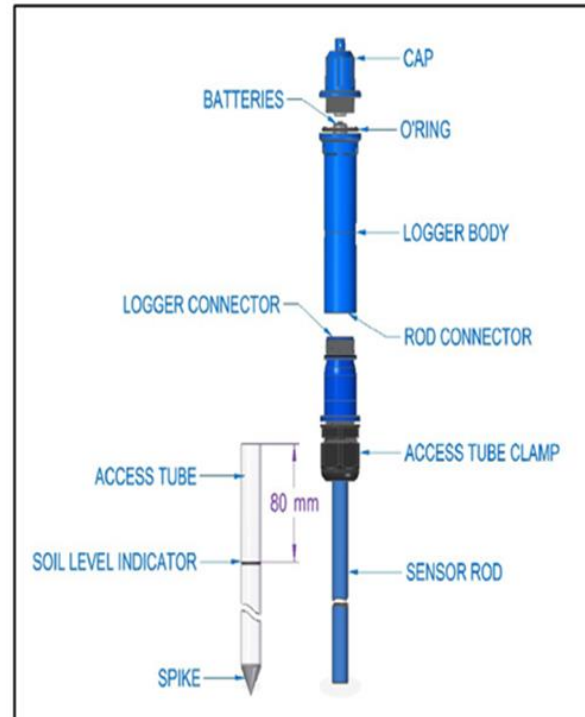


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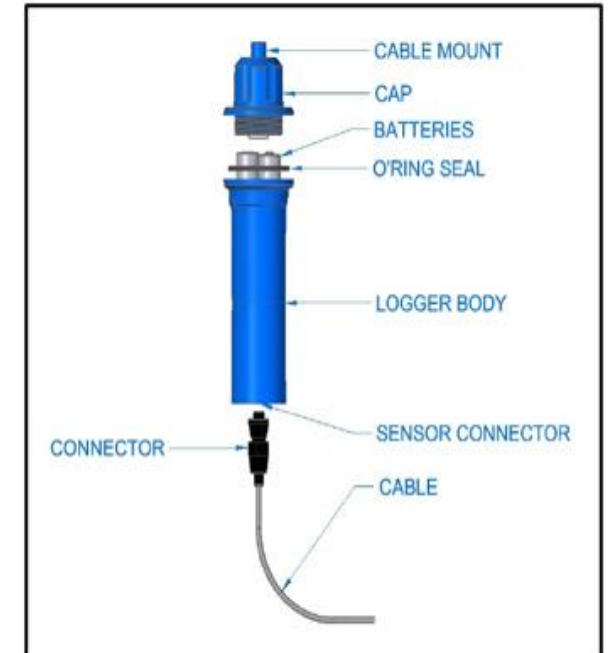
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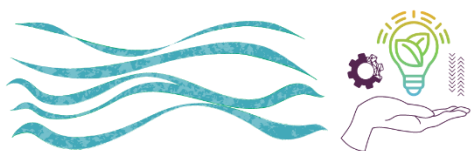
Data Collection Equipment Installation



Soil Moisture Loggers



Rain Gauge



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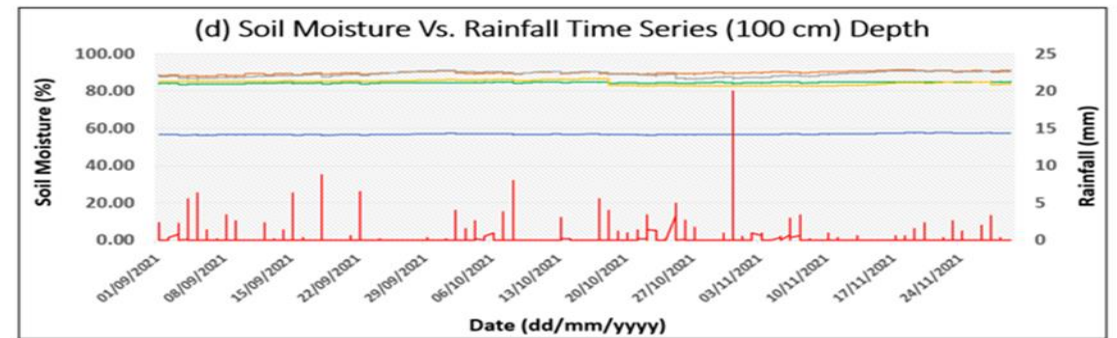
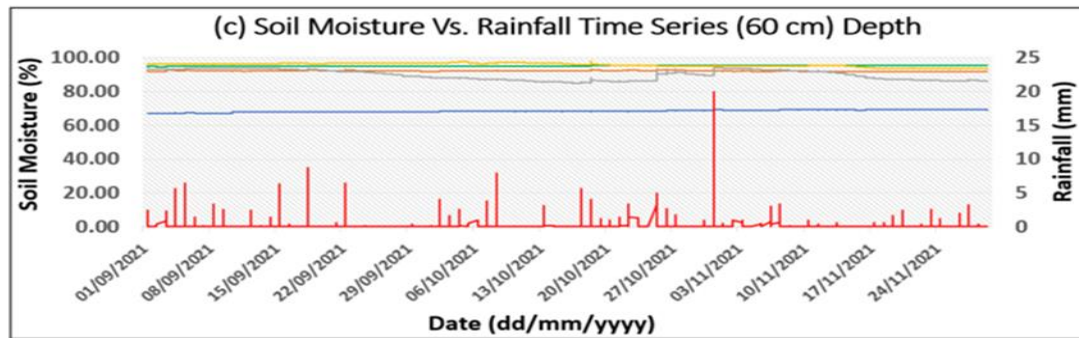
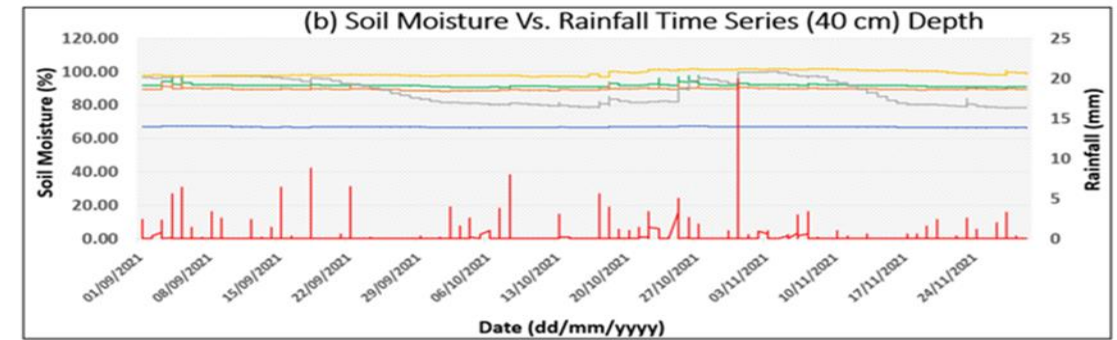
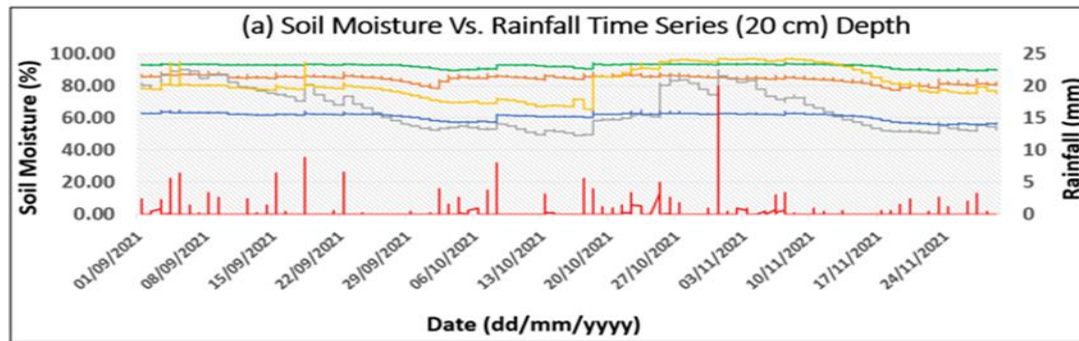
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Results



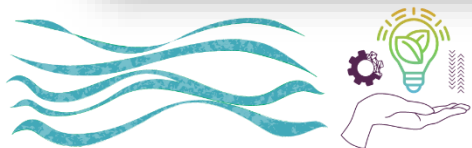
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— Bare Plot — Coconut Matting — Coconut Matting/Natural Vegetation — Natural Vegetation — Vetiver Grass — Rainfall (mm)

...of all treatment plots, **Vetiver** influenced soil moisture the most especially at lower depths, e.g., 60cm



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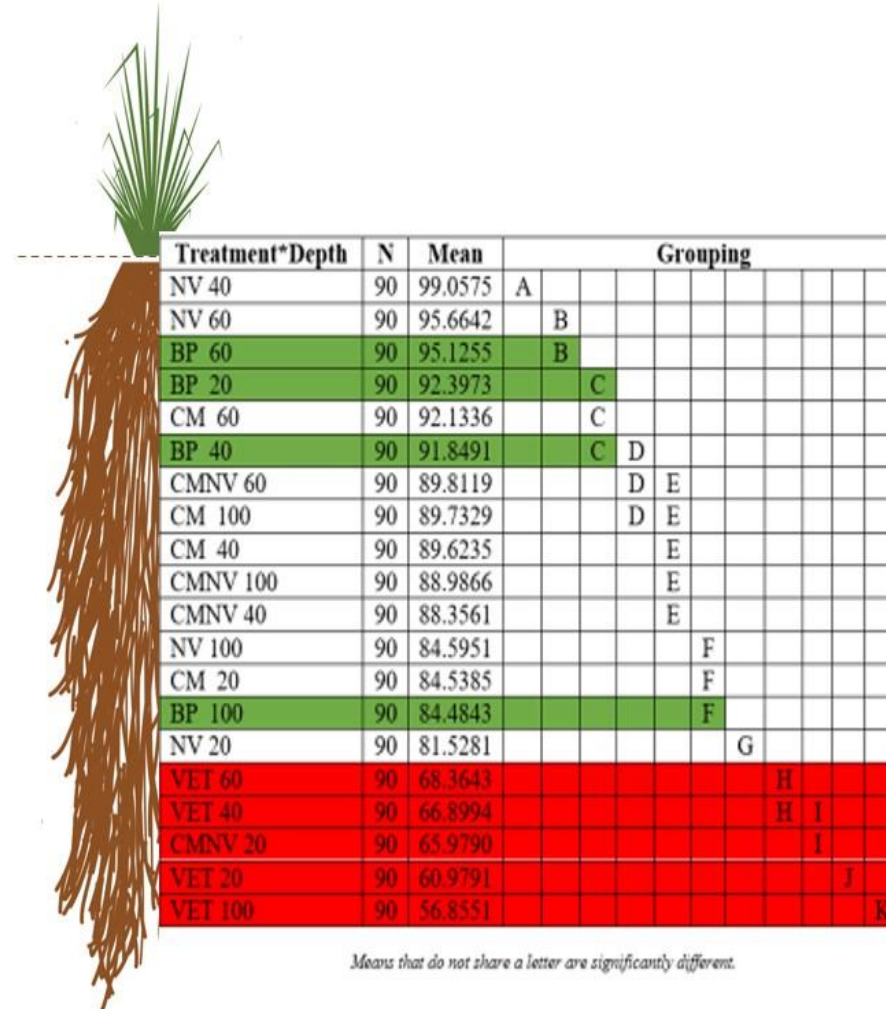
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Discussion



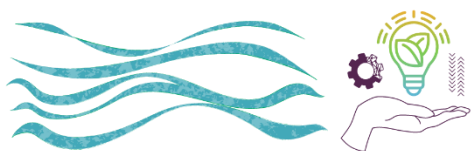
*Tukey pairwise comparisons: treatment*depth interaction for each experimental treatment*



ANOVA GLM Results

Source	0.05
Treatment*Depth	P<0.05
Treatment	
Depth	

**Tukey Pairwise
Comparisons:
Treatment*Depth
Interaction**



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Recommendations Way Forward!!



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1

Soil moisture monitoring can be explored as **potential early warning mechanism** for landslips in hazard prone areas

2

Conduct further **dry-season studies** and compare to wet season

3

Replicate and **upscale study on other soil types** and geographic regions

4

Explore hybrid options with Vetiver; for example, green-grey interventions



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Further Recommendations and Limitations to Consider.....

Combination planting with other grasses

Planting regimes/style

Depth of soil profile

Maturity of plants and zone of influence



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Conclusions



This presentation uncovered a potentially powerful linkage between NbS and enhancing disaster risk reduction in Trinidad and beyond.



Bare Soil Lacks Regulation

High soil moisture means (95.1255% to 84.4843%) in comparison to other treatments.



Vetiver Grass Treatment: Greatest Reduction

range (27.1638% to 34.0034%) across four depths (20, 40, 60, & 100).



Hybrid Systems: Second largest Reduction

range (3.80298% to 28.5921%) across three depths (20, 40, & 60).



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Acknowledgements



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Questions?



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