Date of Submission	30th March 2019

IPL Project (IPL 199) Annual Report 2018

1 January 2018 to 31 December 2018

1. Project Number (approved year) and Title,
   IPL-199 (2015) **The Effect of Root Systems in Natural Slope Erosion Protection in the Hill Country of Sri Lanka**

2. Main Project Fields - Capacity Building; - **Collating and Disseminating Information/ Knowledge**

3. Name of Project leader: Mr. P.V.I.P. Perera; B.Sc. (Env.Mgt.), M.Sc. (F.A.R. Mgt.), MIEPSL

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Core members of the Project

Ms. N. Nimesha Katuwala, B.Sc. (Computational Chemistry) Chemist, CRD, CECB

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Ms. K. Pavani C. Perera, Research Assistant

4. Objectives:

   To Study the existing natural slope protections in over 30 sites in the hill country of Sri Lanka to document the observed details and patterns of vegetation which support slope protection and the roles played by different species in such scenarios. It is understood that not one, but a collection of species contribute to this end through the setting and functions of each type of vegetation and their positioning. Thus results of the study can be directly used for practical application in critical slopes.

5. Study Area:

   The hill country of Sri Lanka where similar slope angles exists with different vegetation cover in comparison with tea grown areas.

6. Project Duration:

   Five (5) years

7. Report

7.1 Progress in the project:

This study reports the observed details and patterns of vegetation which support slope protection and the roles played by different species in such scenarios. Plant functional traits have been well recognized as important predictors for soil erosion. In theory, both plant morphological traits, such as root diameter, and biomechanical traits, such as root tensile strength, have all been shown to significantly affect soil erosion. High endemism plants were recorded in the wet zone including Central Highlands and South Western Wet Zone. The core endemic forest areas such as Sinharaja, Adams Peak, Knuckles, Horton Plains and Kandy are usually subjected to high rainfall conditions and also have relatively less records of upland major soil erosions. Moderate slopes consist of a composite nature of deep-rooted trees, shrubs and grass that can reduce the occurrence of shallow rapidly moving landslides by strengthening and reinforcing soils through their tensile strength and improving drainage. Famers and communities in hill country are used to select some native species and planted on contours along slopes, allow reservation areas and used to grow their agricultural plantation without much issues from the erosional potential of slopes and found to be performing well. Therefore, initial face of the study a number of sites where slope failures were recorded have been visited and documented. The type of vegetation in each location is being studied and being compared to locations with critical slopes where natural protection was evident.

7.2 Planned future activities or Statement of completion of the Project

This on-going project was submitted as a paper titled “Ecosystem Observation of Upland Soil Erosion Reduction in Mountain Slopes in Sri Lanka” and orally presented in the 2018 ICL-IPL Conference held on 01st December – 04th December 2018 in Kyoto, Japan.

Planned future activities: July 2015 - December, 2016: Identification of sampling locations and initial field work – Completed

January 2016 – December 2018: Study of various natural slope protections in forest covered areas of the hill country having critical slope angles. Comparison of the type of vegetation in such scenarios and collecting data of any slope failures that have occurred in the recent past in such forested areas.

January 2018 – April 2019: Visiting over 30 such sites will be conducted to gather data and conducting appropriate field testing, data collection and analysis to identify patterns and type of vegetation present at different elevations and rainfall levels – on going

April 2019- June 2020: Further field studies on identified patterns for in-depth analysis and evaluation to formulate results and conclusions.

7.3 Beneficiaries of Project for Science, Education and/or Society

The beneficiaries of this project would be the tea estate workers and other people residing in landslide prone areas in the hill country of Sri Lanka. Apart from that the visitors to the hill country or tourists will also be indirectly benefited through such a study. The natural protection that can be provided would be environmentally friendly and cost effective while also being a long term solution.

7.4 Results:

The loss of soil from land surfaces by erosion is widespread globally and adversely impacts the productivity of all natural, agricultural, forest, and ecosystems. Understanding the behaviour patterns of roots growth and impact of root architecture on the soil erosion reducing potential is an essential tool in geo-engineering design and applications. For an example, the large single root usually which grows straight down, anchors the plant in the ground and the lateral roots connected to anchor the soil preventing soil erosion and buttress root system which distributes on all sides of a shallowly rooted tree, does not penetrate to deeper surface layers. It prevents the tree from falling over while also gathering more nutrients. This study suggests that functional divergence of restored native forest lands is an important predictor for long term stability and soil erosion of the mountains slope.

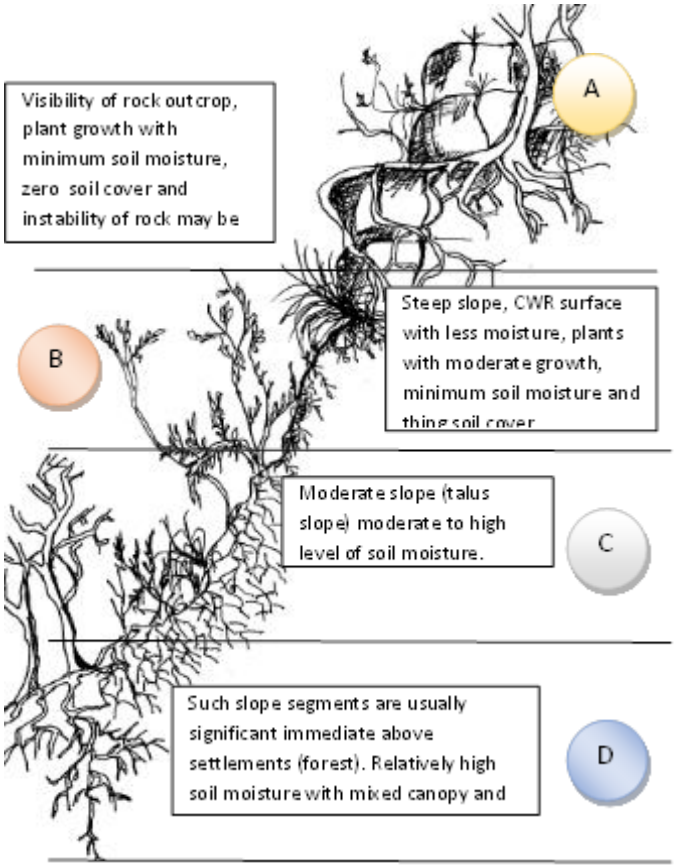

Fig. 1: Understanding the slope segment categorization according to the root grown and type of roots growth

Plant roots act in several ways to increase slope stability:

(1) Bond unstable soil mantles to stable subsoils or substrata,

(2) Provide a cover of a laterally strong fine root systems close to the surface, and

(3) Provide localized centers of reinforcement in the vicinity of individual trees where embedded stems act like a buttress pile or arch-abutment on a slope.

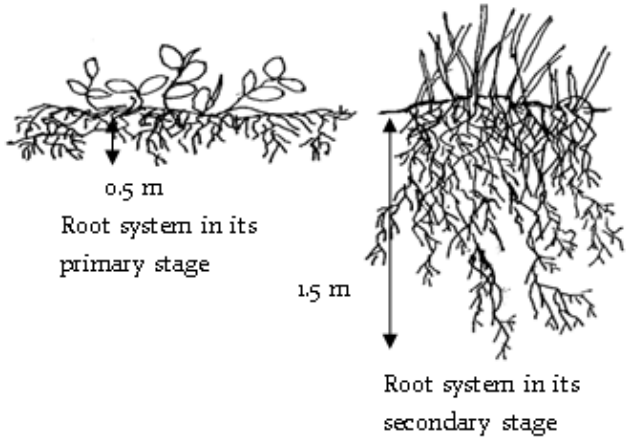

Fig. 2: Plant roots providing a cover of a laterally strong fine root system close to the surface

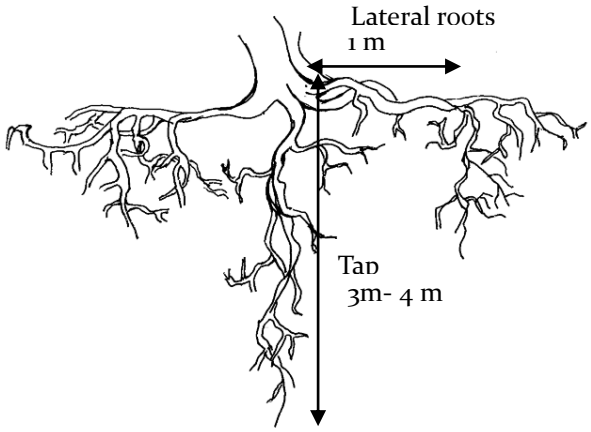

Fig. 3: The large single root (taproot) usually which grows straight down anchors the plant in the ground and the lateral roots connected to anchor the soil

Understanding the original stability and sequence of the development of natural instability potential and regaining stability due to plant root growth structure is somewhat interesting and understandable only after scientifically disintegrated in slope segments as in Figure 1. Most of the upper slopes consist of rock outcrops and native spices are reinforcing with flexible canopies and root systems and thereby reinforcing the protective effect of plants against soil erosion. Immediate below the outcrop structure usually shows steep slope until reaching the upper segment of the talus slope. High moist soil environment always support to the growth of the canopy and thick and deep rooted tree canopy standing as a passive wedge for the stability.

Thus results of the study can be directly used for practical application in critical slopes which lie above small villages or the restored communities. Plant cover always protects soil against erosion by reducing water runoff and roots structure. In the long term, vegetation influences the fluxes of water and sediments by increasing the soil-aggregate stability and cohesion as well as by improving water infiltration.

8. Publications (Journal Papers and conference Papers)

Katuwala, N.N., Perera, P.V.I.P., Herath, H.M.J.M.K., Perera, K.P.C. and Dias, A.A.V., (2018), “Ecosystem Observation of Upland Soil Erosion Reduction in Mountain Slopes in Sri Lanka”, Proceedings of 2018 IPL Symposium, Kyoto, Japan, 1st Dec. – 4th Dec. 2018.