Chapter 7

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Vegetation and Slope Stabilisation – an Epilogue

7.1. Introduction

The use of vegetation for preventing and controlling erosion to stabilise slopes has been practised elsewhere (e.g. Europe, North and South America, Asia) since ancient time. This new discipline has recently regained global recognition and given a new entity 'bioengineering' (Barker, 1996). It is a new phenomenon in Malaysia as development of slopes on extensive scale occurs only recently. Being new, there is woefully tremendous lack of knowledge about the relationship between vegetation and slope stability. In view of this, this project was designed to study some ecophysiological characteristics of plants on slope and how this effects its stability. To my knowledge, this is a pioneering project of this nature in this part of the world.

7.2. Vegetation Role on Slope Stability

The role of vegetation on slope stability operates at two levels : surface erosion control and deeper-seated stabilisation (Barker, 1996). These operations are based on the action of root and above ground parts of vegetation, typically grasses, shrubs and trees (see 1.2.1). The beneficial influence of vegetation, in fact, can reach beyond the actual rooted zones by draw-dawn effects and suction, or low soil water content (see 5.3.2). Apart from being as soil reinforcement (6.3.3a) and solar water pumps (2.3.3), the beneficial ways vegetation cover can act on sloping ground have been summarised as armour, reinforcement, barriers and support (Lawrence, 1992).

7.3. Plant Screening : 3 Ways of Selection

In this project, species of shrubs were selected based on three criteria : extensive root profile (2.3.2), good plant water relation characteristics — high drought resistance (3.3.8) and positive effects of pre-treatment (4.4) and promising physiological aspects including photosynthesis, LAI and biomass (2.3.1, 2.3.4, 3.3.8, 3.3.9, 4.3.1a, 4.3.2a and 4.3.2b) Screening technique using these criteria successfully identify plants which can grow on slopes. Apart from this, more survey to identify indigenous species is suggested in the future including identification of diverse local species which have good pioneering characteristics.

7.4. Bush Ecosystem Model

Bush ecosystem was created from barren slope within one year (6.2.2). Investigation of this system revealed its positive effects on slope stability. Its RLD, LAI and biomass were observed to be the highest (6.3.3a, 6.3.2a and 6.3.2c). Related to these findings, the plant diversity in the bush ecosystem plot increased drastically, about 144.4% as against 25% in monoculture plot (6.3.2b). This species-richness in the bush ecosystem allow the establishment of new species which gradually, accelerate the plant succession. This natural succession enhances the stability of slope in terms of soil penetrability (6.3.3b) and shear strength (6.3.3c). Penetrability was observed to be the highest in the mix-culture plot which is probably due to extensive RLD (see 6.3.3a). The highest shear force was also obtained at 30 cm (12 inches) depth (see 6.3.3c). Its SWC magnitude was similar to that of type A slope (bushy slope) along the NSE. It is suggested that all these bioengineering characteristics be prominent features to establish stable slope.

7.5. Contribution of the Project

This study is vital in providing some data in order to calibrate models of plant function in stabilising the slope. The studies show some clear information of the role of vegetation in enhancing the process of stabilising the slopes. Stable slopes mean more life can be saved and impair numerous environmental problems. The aspects of safety and nature conservation are important enough to illustrate the relevants and needs of this project, and others with similar objectives.

7.6. Challenge and Conflict of Interest

There is no doubt that there are positive effects of vegetation on slope stability. Thus possible re-vegetation and management programmes are needed to provide some surface erosion and deeper-seated stabilisation. However, there are still insufficient studies regarding some techniques or ways to get the best plant performance including planting techniques, how plant system works in harsh slope environment and how they are better established on steep inclination with poor soil quality (Table 1.3). In view of this, it is a challenge especially to bioengineers and ecophysiologists to fulfil this gigantic tasks.

Apart from that, the challenge also arise from the conflict of interest between bioengineers and engineers in considering some aspects of stability. In the simplest example, bioengineering view root hairs as soil reinforcement as it provides suction surface which drives up water, but engineering do not see this contribution of root hairs to soil strength. Understanding of plant functions and contribution to the environment is thus essential to engineers.

7.7. Conclusion

Bioengineering of the slopes at FSKTM provides a natural way to accelerate the establishment and recovery of vegetation cover within a year. Biomass was found to be positively related to soil penetrability and shear strength (Fig. 7.1). Hence, this study has successfully proved effects of vegetation covers on slope stability. The results also show that penetrability is negatively related to SWC, implying that low penetrability can be a sign of saturated soil, a feature of a failing slope. Thus, it is recommended that LAI, biomass increment, RLD, soil penetrability and shear strength be used in a monitoring assessment of cut slope.

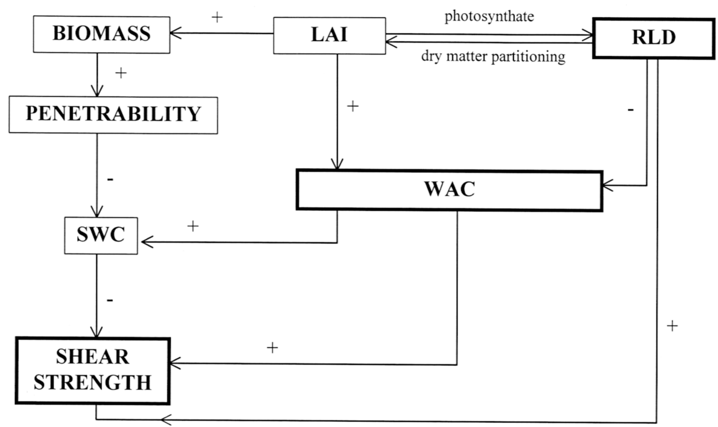

Fig. 7.1 : The negative and positive interaction among some of the parameters studied.