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A new approach for slope stabilization by plant roots on degradation hotspots in Southern China

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Title: A new approach for slope stabilization by plant roots on degradation hotspots in Southern China.

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Abstract: The foothills of Himalayan mountain ranges are areas where plant biodiversity is extremely rich due to the semi-tropical climate and the wide variety of soil substrates. Landslides and erosion are frequent because of natural causes e.g. mountain orogeny and earthquakes, but are largely due to anthropological causes e.g. deforestation by logging and agriculture, road and dam construction. Therefore, to prevent soil loss and sediment pollution of rivers and lakes, it is urgent that management techniques and plans be developed so that further land degradation on steep slopes is limited. The aim of this study is to propose a new approach for slope stabilisation, by focussing on the careful management of degradation hotspots as well as biodiversity hotspots, and understanding better the processes leading to the formation of each type.

We will study how plant roots reinforce soil, with an emphasis on rooting strategies of plants growing under strong ecological and mechanical constraints e.g. landslides and erosion. Our field site is in the Salween River valley, Yunnan province, southern China. We are currently examining root and shoot structure as well as mechanics of local herbaceous species, shrubs and creeping plants to determine which might have a mechanically reinforcing effect on a slope, as well as their ethno botanical advantages. Thus we will identify those which can be considered as "tools for eco-engineering" in this area. Using these data, we will then explore an emerging concept of eco-engineering: the management of erosion and biodiversity hotspots with a view to vegetating the entire degraded zone.

Biodiversity hotspots are traditionally defined as a biogeographic region with a significant reservoir of different plant and animal species (Myers, 1988). However, erosion hotspots are a newer concept and are defined as source areas of sediments (Baigorria et Romero 2006). These areas are also defined as sites with soil erosion rates well above soil loss tolerance levels (Poesen et al 2008). These erosion hotspots often only occupy a small fraction of a catchments' area, but may be held responsible for a very significant contribution to overall sediment production, thus leading to off-site problems. Recent research (Hooke et al 2007, RECONDES European Project) showed that an effective way of managing unstable slopes is to reduce connectivity between erosion hotspots, in order to lower erosion effects such as gullying and debris flows. Therefore, it seems intuitive that connectivity should be improved between biodiversity hotspots, in order to help natural revegetation of the entire slope.

Our research aims at studying in detail revegatation strategies with regard to 'degradation' hotspots (not all hotspots we will examine are due to erosion processes), which are our target zones of management. The use of

a 3D numerical model (Kokutse et al, 2008) will enable us to simulate and calculate the Factor of Safety (FOS) of slopes for different management actions. This model allows individual plants to be positioned on a 3D slope, therefore we can determine the effect of links between hotspots, as well as vegetation type, over the entire slope.

The outcome of this study will be to determine practical recommendations for local stakeholders, who can then use suitable native species on appropriate or fragile zones to stabilize the slopes where they live and grow crops.