Natural Disaster Prevention and Mitigation through Vetiver System

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Prevention of landslides by planting vetiver hedgerows on highways , dykes , and railroads slopes

- **Immediately after construction of roads and other earth excavation are completed , establish terraces, plant vetiver and irrigate, groundcover including *Cynodon dactylon* and *Arachis pinto* are beneficial to save weeding cost and help reducing splash erosion control.**
- **Apply compost and chemical fertilizer when the soil is infertile before and after planting for 1-2 years at critical sites.**
- **Selective weeding vines and tall competitive species and pruning vetiver annually for 1-2 years.**
- **At all critical sites maintain weeding and pruning vetiver hedgerows every year permanently. Apply fertilizer if needed. For most part of the slopes , leave the terraces for local plant species to re-establish themselves among vetiver after 1-2 years .**

Figure 1: Erosion control in highland agriculture system in Nepal : Rice paddy field and terracing

Figure 2: A good example Living quarter always on the high ground in Nepal , a country with long experiences on erosion control.

Figure 3 : Gullies form on the sideslopes of a new road after 1 rainy season exposure without hydroseeding and vetiver planting.

Figure 4 : Planting vetiver hedgerows to stabilize gullies on the road sideslopes.

Figure 5. Well-established vetiver hedgerows network 6 month old to protect the ridges above the gullies and to diffuse run-off water.

Mitigation

Soil Stabilization after natural disaster by vetiver grass technology system

- **Stabilizing gullies on highways and railroads slopes caused by landslides after torrential rainfalls .**
- **Stabilizing gullies to save houses and buildings from landslides.**
- **Stabilizing embankments after soil loss on river banks.**
- **Stabilizing agricultural land after long period of slash-and-burn farming causing serious soil erosion and fertility loss**
- **Stabilizing river banks cover with mud slide and debris after flash flood usually initiated by erosion from slash-and-burn farm land up the river.**

Figure 6: Ineffective stabilization of the road backslope utilizing cement-sprayed metal netting against landslide

Figure 7 : The same gully as in figure 6 four years after planting vetiver hedgerows.

Figure 8. Landslide causing damages to the nursery and daycare center at Hauy Nam Kun village.

Figure 9: The same site as in figure 8 after making the terraces, planting vetiver hedgerows and hydroseeding of bermuda grass on the backslope.

Figure 10: The same site as in figure 8 & 9 four years after planting vetiver hedgerows.

Figure 11: Aerial view of a bare lower slope with new planting of vetiver hedgerows on a new road.

Figure 12: **Sideslope of new road four years after vetiver hedgerows planting with native plant species taking over vetiver grass completely.**

Figure 13: Erosion on gas pipeline construction ground after completion of construction work in Kanchanaburi Thailand (PPT. :Photo)

Figure 14 : Control of soil erosion with vetiver technology on gas pipeline right of way in Kanchanaburi Thailand (PPT. :Photo)

Figure 15: Control of soil erosion with vetiver technology on cut slope above the gas pipeline right of way in Kanchanaburi Thailand(PPT. :Photo)

Figure 16: Vetiver technology and reforestation on the gas pipeline right of way in Kanchanaburi Thailand (PPT. :Photo)

Figure 17: Vetiver technology and reforestation on the gas pipeline right of way in Kanchanaburi Thailand (PPT. :Photo)

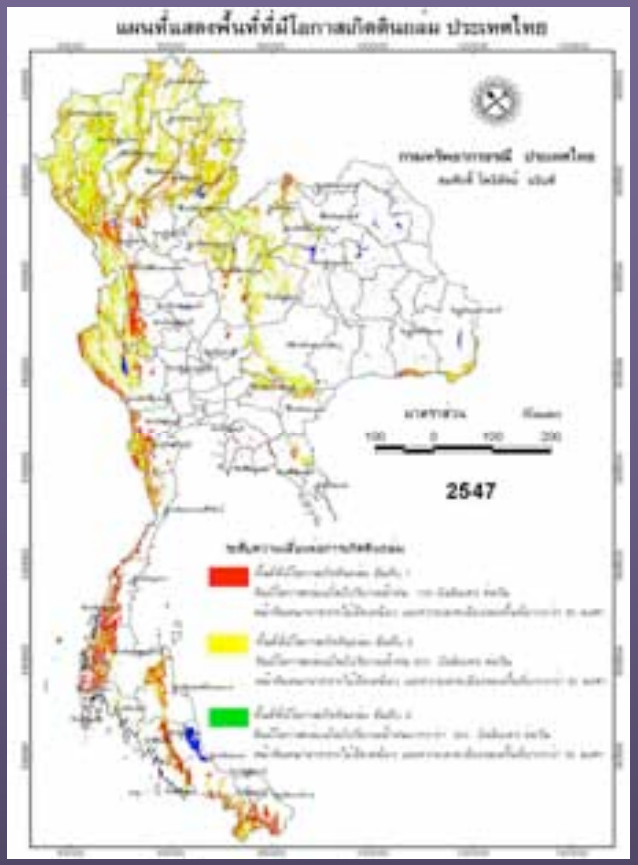
Figure 18: Vetiver hedgerows well established on side slope below the gas pipeline right of way in Kanchanaburi Thailand (PPT. :Photo)

Figure 19: A washed away bridge caused by strong water current after over 300 m.m. rainfall in 24 hours on mountainous area of Uttaradit province : Northern Thailand May 22 , 2006

Figure 20: Mud and debris deposit on riverbanks brought by flash flood and inundation of a river after over
300 m.m. rainfall in 24 hours on mountainous area of Sukhothai Province : Northern Thailand
May 22 , 2006

สภาพบ้านเรือนราษฎรในพื้นที่บ้านห้วยตม ต.บ้านตึก อ.ศรีสัชนาลัย จ.สุโขทัย ที่ถูกน้ำป่าถล่ม

Figure 21: Landslide cause by strong water current after over 300 m.m. rainfall in 24 hours on mountainous area of lower part of Northern Thailand
May 22 , 2006



Map of Thailand

Risky area ranking from red yellow to green respectively from high to low

Figure 22: Restoration of railway in Madagascar after cyclone damage (Hengchaovanich and Freudenberger : Photo)

Figure 23: Repair ground above railway tunnel in Madagascar after cyclone damage

(Hengchaovanich and Freudenberger : Photo)

Figure 24: A restored cement drainage and vetiver hedgerows on the ground above railway Madagascar after cyclone damage
(Hengchaovanich and Freudenberger : Photo)

Figure 25: Vetiver technology in agriculture system on railway right of way (Hengchaovanich and Freudenberger : Photo)