# Establishing Native Vegetation for Soil Stabilization in Semi-Arid Areas in South Africa, Ethiopia and Madagascar



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#### Short Introduction to Hydromulch (Pty) Ltd

- Established in 1969.
- Operates from Johannesburg, South Africa on environmental restoration projects throughout Africa, the Indian Ocean Islands and has even worked as far as the UK & Caribbean (Highway 2000).
- Specializes in erosion control & vegetation restoration projects offering "Turnkey" solutions for the Mining Industry, namely Anglo America, Rio Tinto, Sherritt Mining (Canada) and BHP Billiton.
- Providing erosion control, vegetation establishment consulting, environmental management plans & specifications for Highway and Pipeline consults (BCEOM, SNC Lavalin, Fluor, Hatch) and various construction companies.
- Distributor/Representative for Finn Corporation (hydroseeding Equipment & Erosion Control Consumables), Posi-Shell Environmental Coatings and Gyrotrac.

## Semi-Arid Environments Characteristics and Importance

Semi-arid or sub-humid zones are characterized by low erratic rainfall of up to 700mm (30in) per annum, periodic droughts and different associations of vegetative cover and soils. In the semi-arid zones, inter-annual rainfall varies from 20-50% with averages of up to 700 mm. In the semi-arid areas agricultural harvests are likely to be irregular, although grazing is satisfactory (Goodin & Northington,1985).

In Africa north of the equator, semi-arid zones are bordered by Senegal, Upper Volta and Chad in the south; and Morocco, Algeria, Libya, and Egypt in the north. The zones extend southeast through Somalia, Ethiopia and Northern Kenya, South of the equator the zones cover Lesotho, parts of the Cape, Northern Transvaal and Free State provinces of South Africa; Botswana; Namibia; and parts of Zimbabwe.

The entire African continent (including Islands) comprises of 53 countries.

A short overview of projects in the following countries will be given, illustrating current techniques and activities where erosion control and vegetation establishment has been successfully implemented in the semi-arid areas and often under adverse conditions. Hydromulch pioneered the method of establishing Macchia vegetation in South Africa. The Vetiver system has been applied on many projects to facilitate the recovery of native vegetation through plant succession.

- 1. The Du Toits Kloof and Outeniqua
- Mountain range in the Cape Province of South Africa restoring Macchia vegetation
- 2. Pipeline rehabilitation through a nature reserve, Gauteng, South Africa
- 3. Southern region of Ethiopia
- 4. South east region of Madagascar

The presentation will reflect the major strides that have been achieved in erosion & sediment control, bio-engineering & vegetation restoration

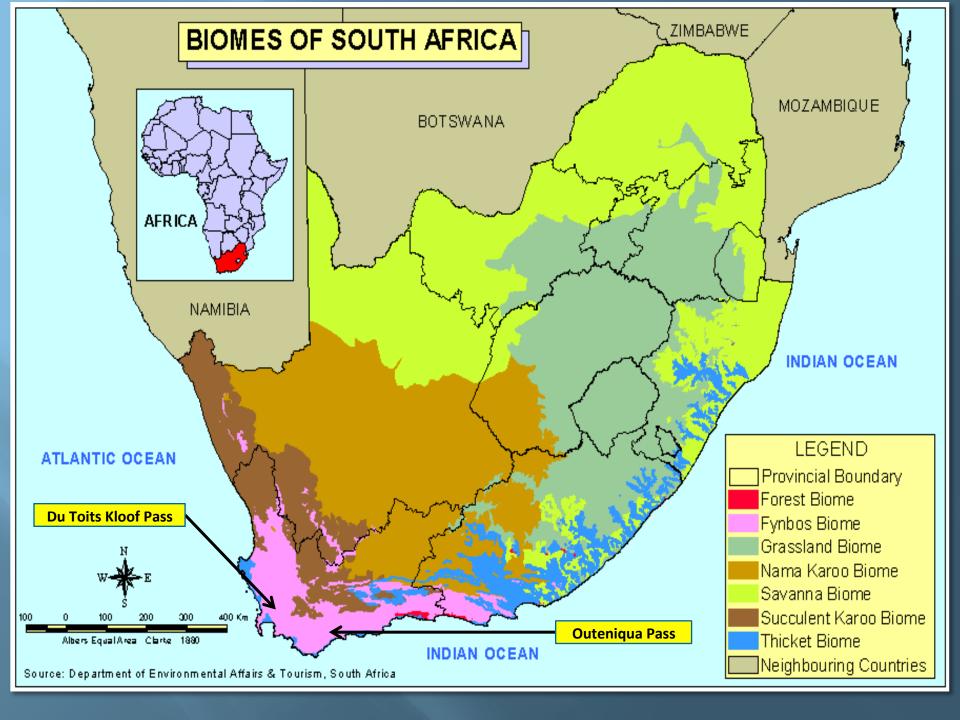


#### **The African Continent**

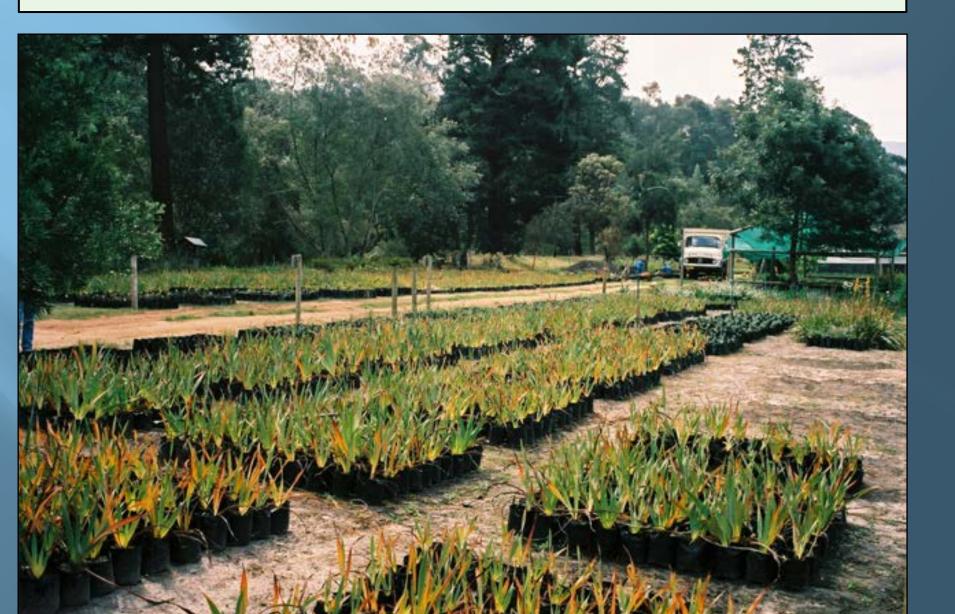


# The Du Toits Kloof and Outeniqua Mountain Range in the Cape Province of South Africa Rehabilitation Process for restoring Macchia vegetation

- Rescued native plant species prior to construction activities and stored in on-site nursery
- Collected seed of native grass and plants
- Harvested and processed Macchia vegetation from surrounding areas
- Contractor stored topsoil from specific areas and replaced when road prism completed
- Replanted rescued plants back to original location
- Mulched processed Macchia vegetation over side slopes
- Over-seeded planted areas with native grass species and light commercial mixture of Lolium and Eragrostis spp to provide initial protection to native species
- Applied organic supplement with seed mixture to rock cuttings.



#### **Rescued Native Plants in Holding Nursery**



# Application of processed "Macchia" Vegetation mulch to side slopes



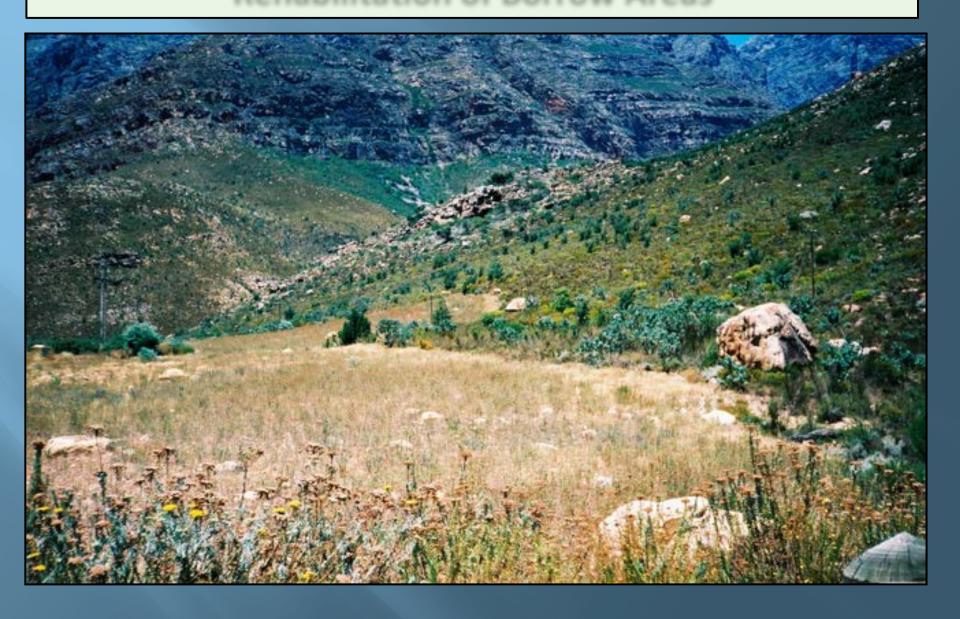
### Application of the native seed mixture with commercial seeds onto Macchia mulched side slopes



# Application of an "Organic slurry" mixture onto the Rock Cuttings

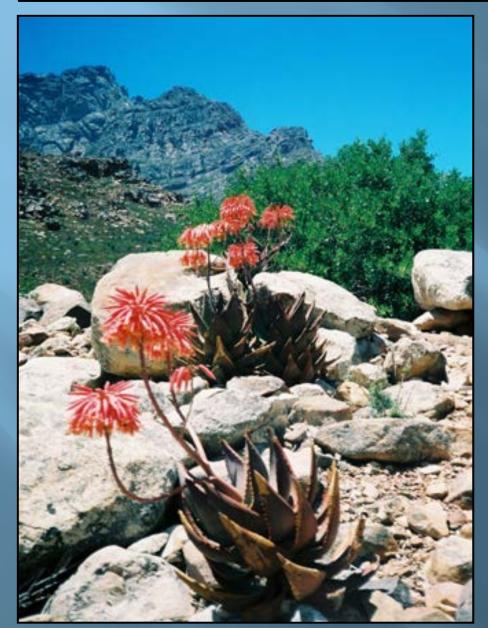


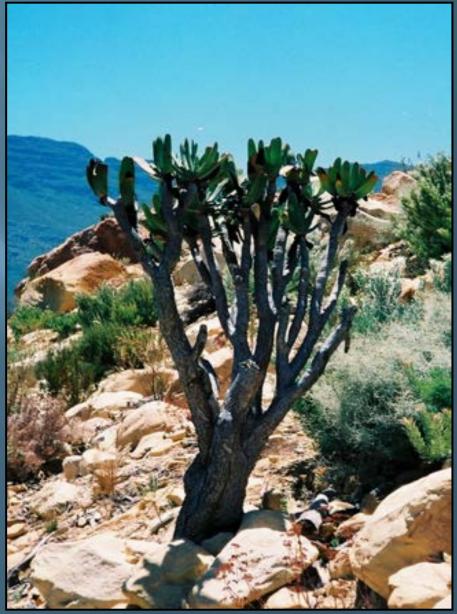
#### **Rehabilitation of Borrow Areas**



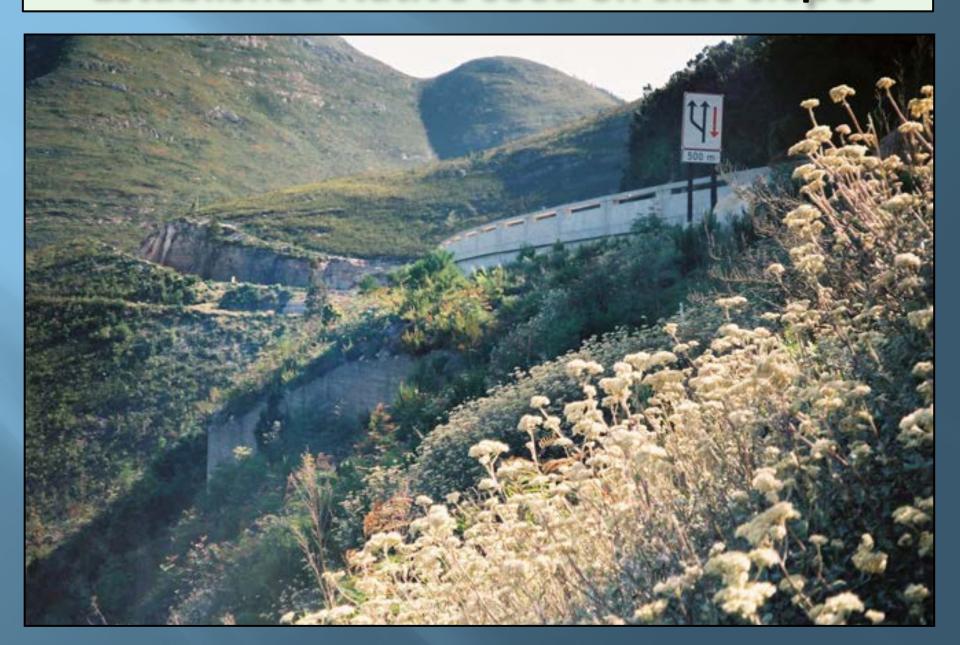


#### **Established rescued plants**

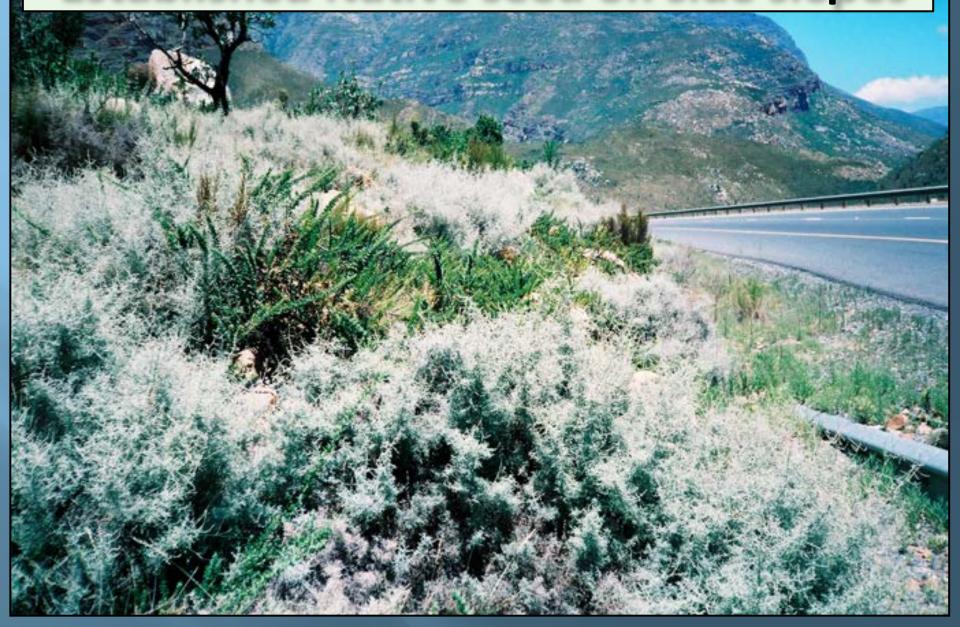


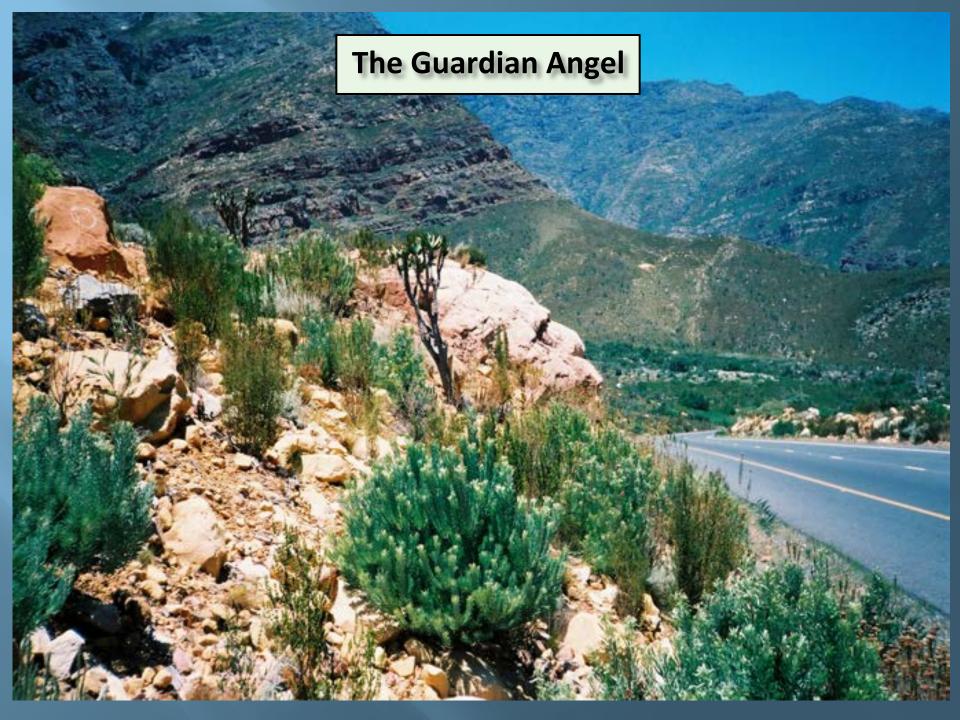


#### **Established Native seed on side slopes**



#### **Established Native seed on side slopes**







Macchia mulched material placed on side slopes and hydroseeding in progress

Established vegetated side slope showing diversity of Macchia vegetation



### Soil stabilisation of disturbed area on pipeline through nature reserve-Gauteng, South Africa

Pipeline rehabilitation through Nature Reserve in Gauteng, South Africa

Length - 900 m<sup>1</sup> (3,000 ft)

Vertical Height – 190 m<sup>1</sup> (650 ft)

Annual rainfall – 1,100 mm (42")

Summer rainfall area

Thunder storms - moderate

**Environmental considerations** 

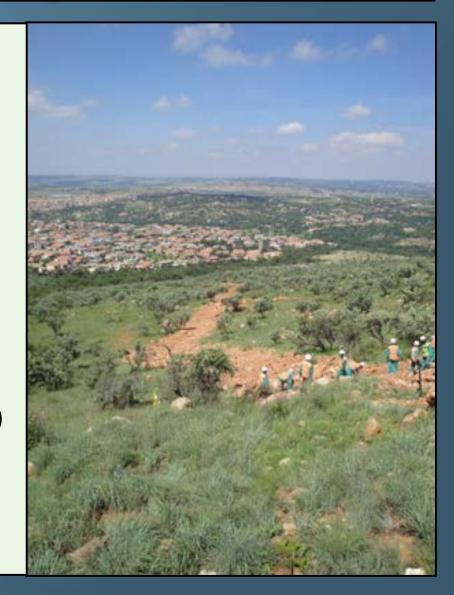
Silt fences - 10 metre spacing's

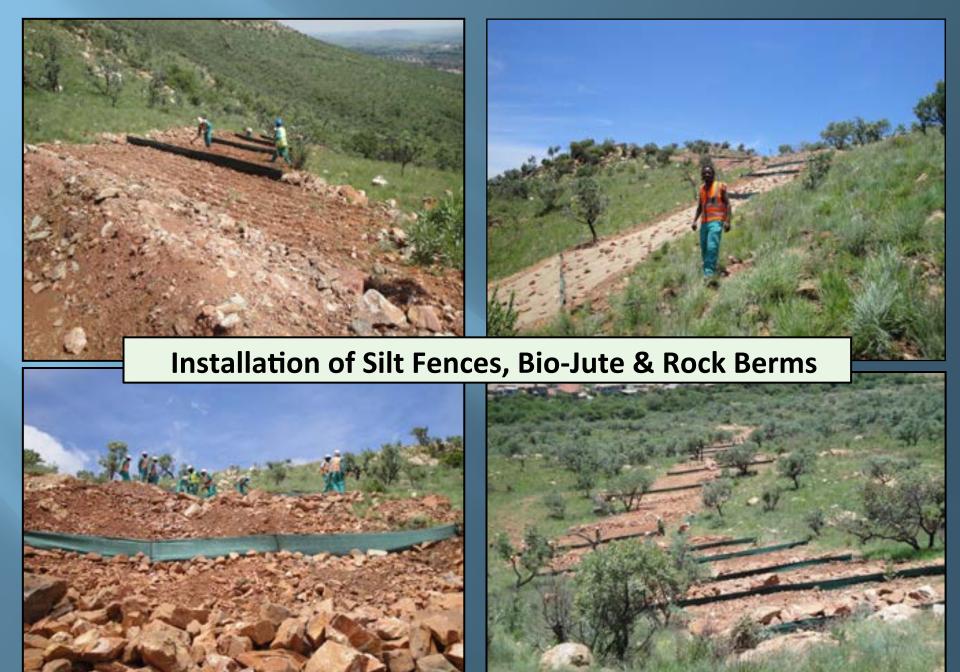
Stone/Rock berms - 10 metre spacing's

Bio-Jute Netting - slopes exceeding 35°

Hydroseeding application after scarifying

- •Mulch application 2,000 kg/ha (2,000 lbs/acre)
- •Grass seed 50 kg/ha (50 lbs/acre)
- •Soil Binder 10 kg/ha (10 lbs/acre)
- •Agricultural lime & NPK application as per soil analysis recommendation.









Hydroseeding application to prepared areas









#### **Understanding the San Antonio River Basin**

The rainfall peak for San Antonio in May-June is mostly associated with late-spring cool fronts that battle it out with moist tropical air masses from the Gulf and the Pacific, producing thunderstorms. The secondary peak in September-October is mostly associated with tropical cyclones and hurricanes.

When the rains in May and June do not come, the lack of new recharge water and the geology of the Aquifer combine to have huge impacts on water availability for the region.

So this made me think of how we address the question of "recharging water" and how we use the Vetiver system for this purpose.

# **Surface Water Movement through the Soil Profile Rows of Vetiver Grass trapping Surface water runoff** Vetiver Roots 1-3m<sup>1</sup> deep



#### INTRODUCTION

The Vetiver System or Vetiver Grass Hedge Row technique (VGHR) as it is often referred to, is based on the use of Vetiver (Chrysopogon zizanioides) for a wide range of applications, namely soil erosion & sediment control, land reclamation and waste water treatment.

The VS/VGHR was first developed by the World Bank for soil and water conservation and is now being widely used in over 100 countries.

The plant is sterile, non invasive, flowers, but sets no seeds hence it has no weed potential.

Organisms are considered non native when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems and even other habitats. Invasive non-native organisms can be serious threats to the natural ecosystems.

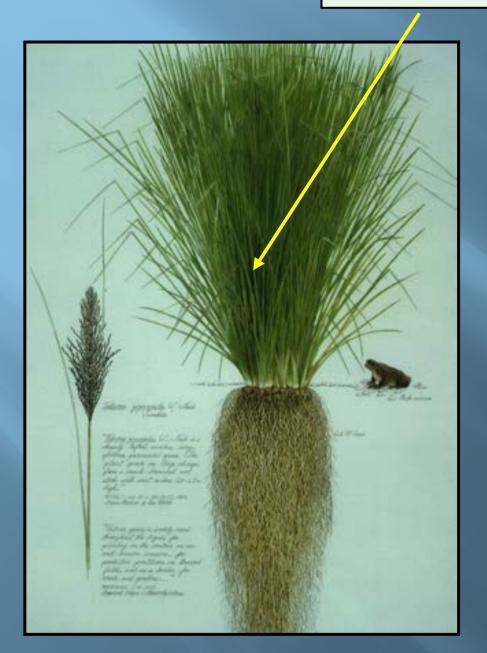
Vetiver grass *Chrysopogon zizanioides*, originated in south India, is non invasive and has been proven so, both technically and from observation. Nowhere has it ever been reported to be invasive. It is also the most robust and effective variety for use under the Vetiver System. Based on DNA fingerprinting data, it appears that almost all the Vetiver used for erosion control outside South Asia has been derived from a single genotype, which we call 'Sunshine'.

Vetiver grass is tolerant to most pests and has <u>not</u> shown to be a problem host plant affecting other plants. Vetiver grass provides, apart from its uses under the Vetiver System, many associated and useful attributes.

As a pioneer species it enables native species to establish on degraded sites where under normal circumstances it is impossible for the latter to develop. Vetiver grass provides habitat, shelter and forage to fauna.

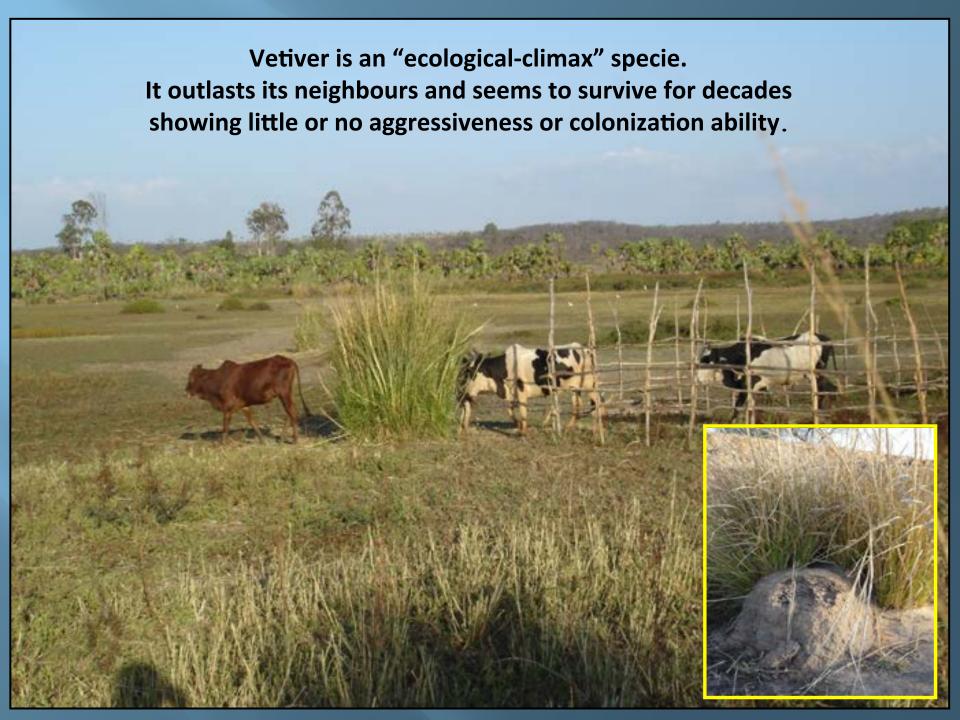
It provides a habitat to beneficial parasitic pests such as the parasitic wasp. In summary Vetiver grass is a very well behaved grass, it is not invasive or a threat to other plants.

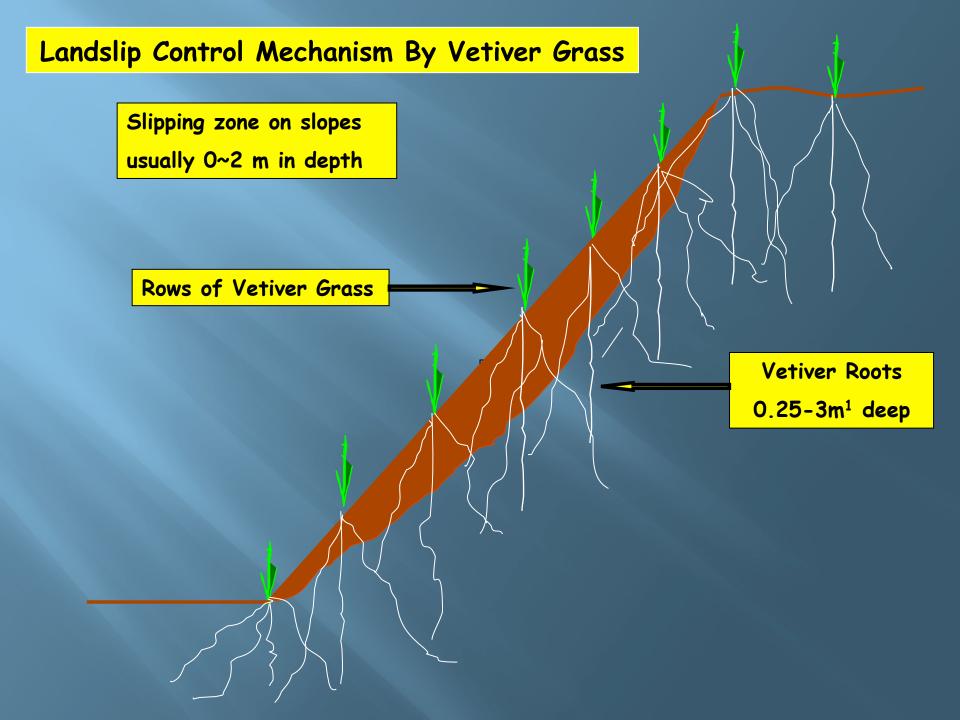
#### The Vetiver Plant









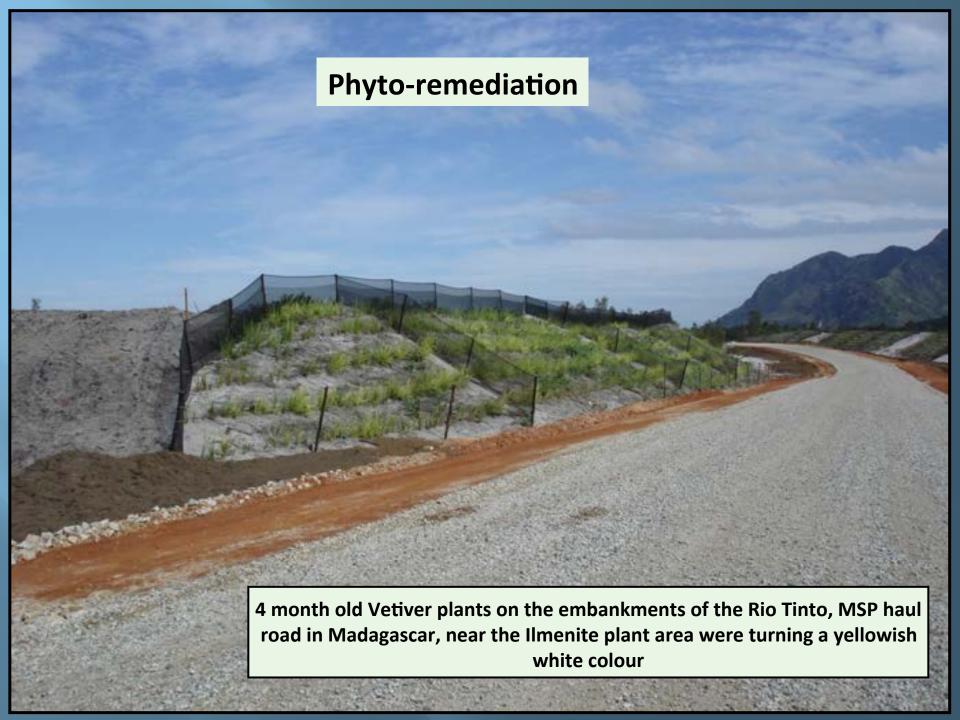


#### VETIVER GRASS HEDGE ROWS SLOPE & SURFACE DISTANCES

The figures for the surface run are based on a Vertical Interval (VI) of 1 Metre

Extracts from
"The Hedge Against
Erosion"
World Bank,
Washington,
DC, USA

Degrees	Percent %	Gradient	Surface Run (m¹)
1	1.7	1 in 57	57.3
5	8.8	1 in 11	11.5
10	17.6	1 in 5.7	5.8
15	27.0	1 in 3.7	4.0
25	46.6	1 in 2.1	2.4
30	57.7	1 in 1.7	2.0
35	70.0	1 in 1.4	1.7
40	84.0	1 in 1.2	1.6
42	90.0	1 in 1.1	1.5
45	100.0	1 in 1.0	1.4
60	200.0	2 in 1.0	1.0





#### **Chemical Analyses of Dune Vetiver plant**

Elements	Leaf Analysis	Root Analysis
Cu	1.10 mg/kg	3.20 mg/kg
Fe	398 mg/kg	381 mg/kg
Mn	174 mg/kg	40 mg/kg
N	1.36 %	1.05%
Р	0.43 %	0.22%





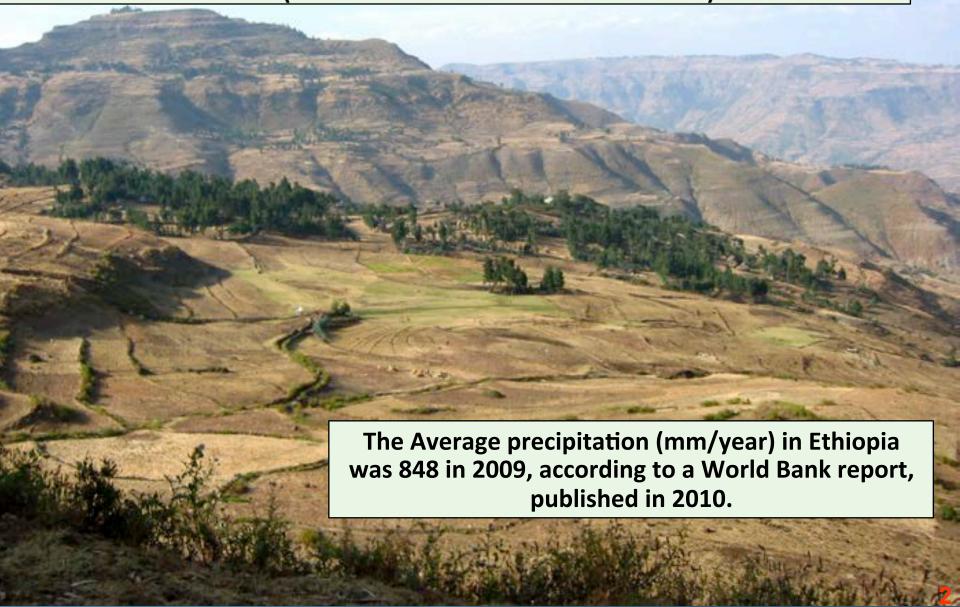




## Reduction of Pollutants from Domestic Effluent under Hydroponics Treatment

DETAIL	TOTAL N mg/lt	TOTAL P mg/lt	Ecoli Org/100 ml
INITIAL	66,0	12,4	>1600
DAY 14	20,3	6,5	50
REDUCTION %	76	59	97

## SOIL CONSERVATION AND EROSION CONTROL PRACTICES IN ETHIOPIA BY SLUF (SUSTAINABLE LAND USE FORUM)



The Temple in Axum, northern Ethiopia, where it is said that the tablets (10 commandments) are kept.



#### **Vetiver Uses by SLUF (Sustainable Land Use Forum)**

#### **Application Considerations**

Highly effective soil erosion control Technique

Low establishment costs

No post establishment maintenance

costs

Very drought resistant once

**Established** 

Increased water infiltration (recharging

effect)

Repellent effect against rodents

**Tolerant to waterlogging** 

No slope restriction

Multi-purpose utilization (forage,

thatching, bio-insecticide, mulch etc.)



# SUN AMHARA PROJECT BACKGROUND The Physical Environment

- Altitude: 1,800 to above 3,500 m.a.s.l
- Total annual rainfall: 700 1,200 mm
- Rainfall pattern: Unimodal (May September)
- Mean annual temperature: 17° C
- Topography: Mountainous rugged terrain
- Dominant soil types: Vertisols, Cambisols, Regosols, Lithosols and Andosols

#### Vetiver System's effectiveness in soil and water conservation

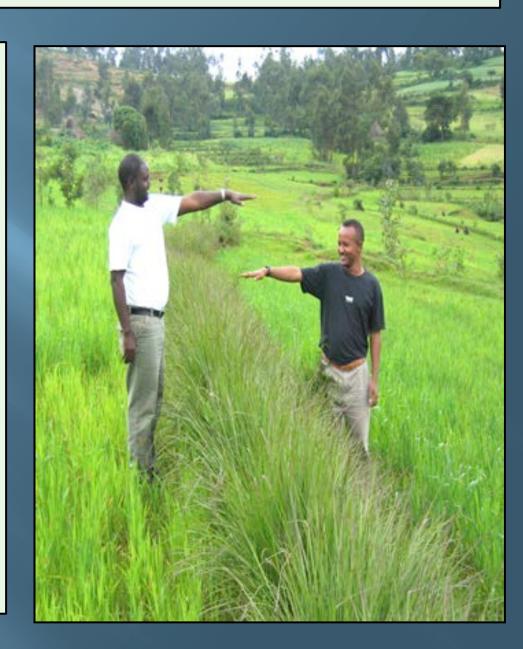
Soil conservation effect using Vetiver depends on the land use types, slope class, land management practices and agro climatic conditions.

Estimated average soil conserved in higher rainfall areas per year:

10 - 20 ton/ha in farm lands

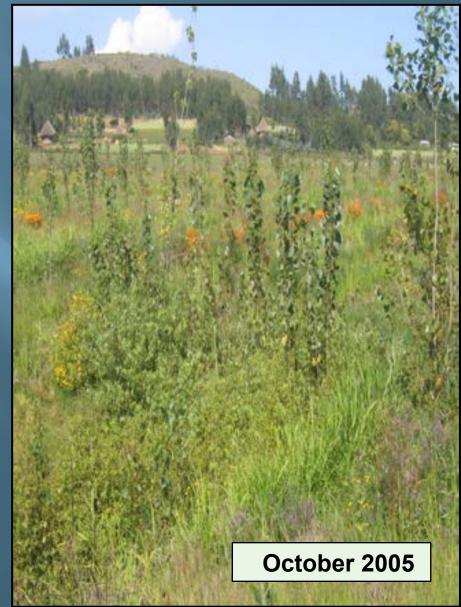
5-7 ton/ha in Gullies

6.5-15 ton/ha in hillside areas.



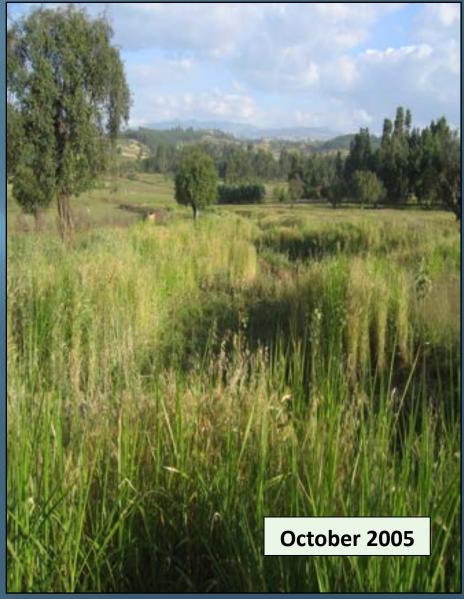
## Rangeland Rehabilitation & Improvement



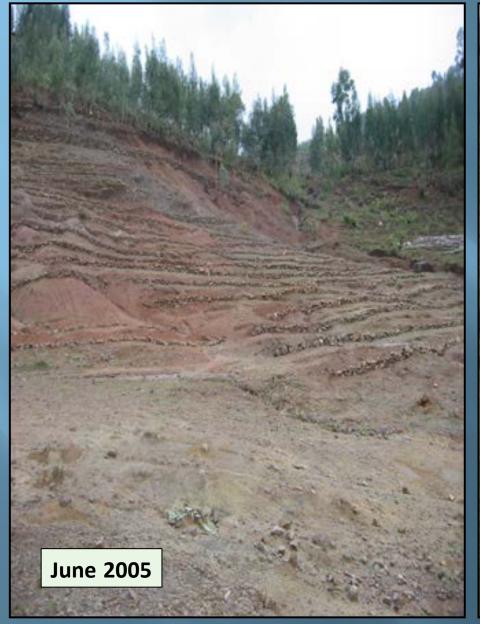


## Rangeland Rehabilitation & Improvement



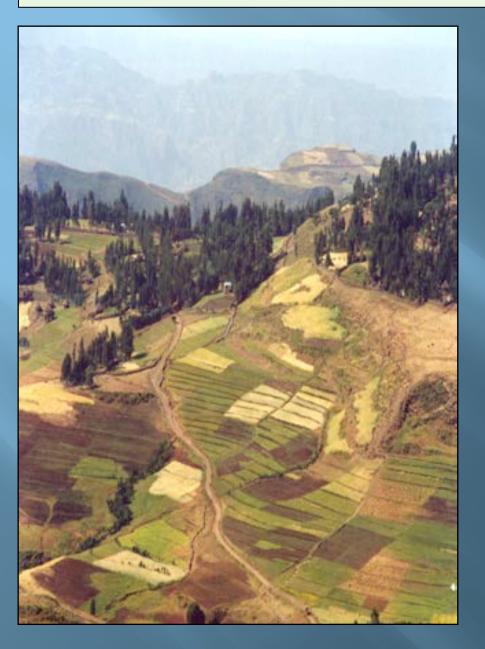


## Rehabilitation of Degraded Land



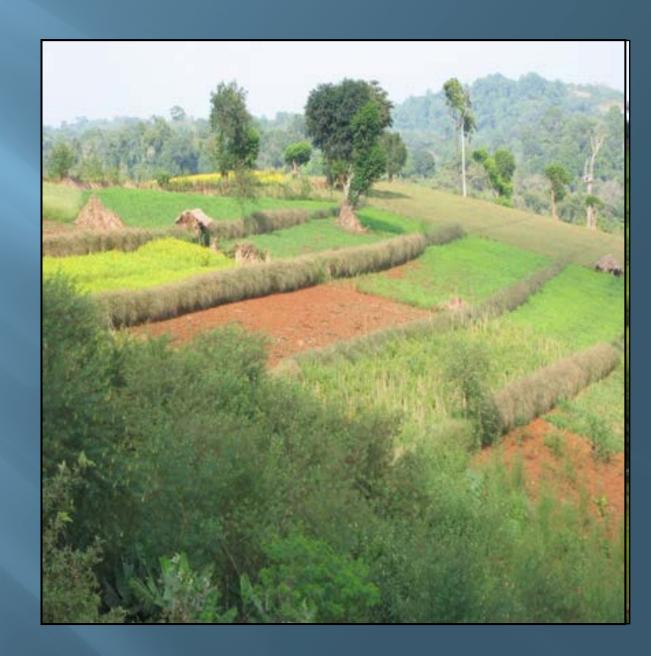


### **Treatment of Micro watersheds using Vetiver Grass**

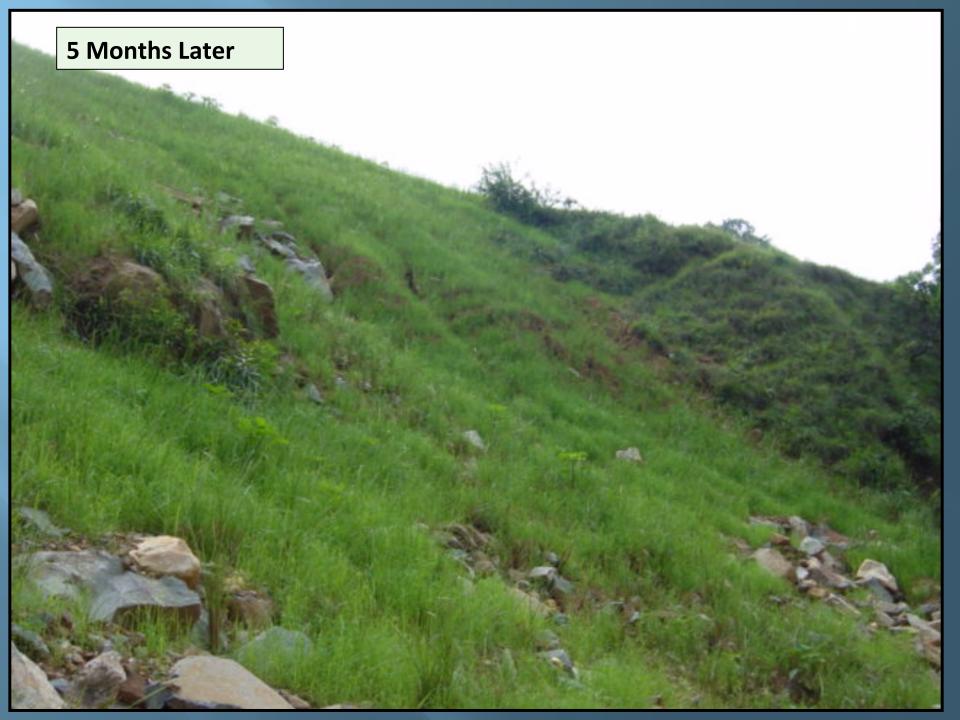




Other effects
of Vetiver
hedge rows
for Soil
Conservation
Practices



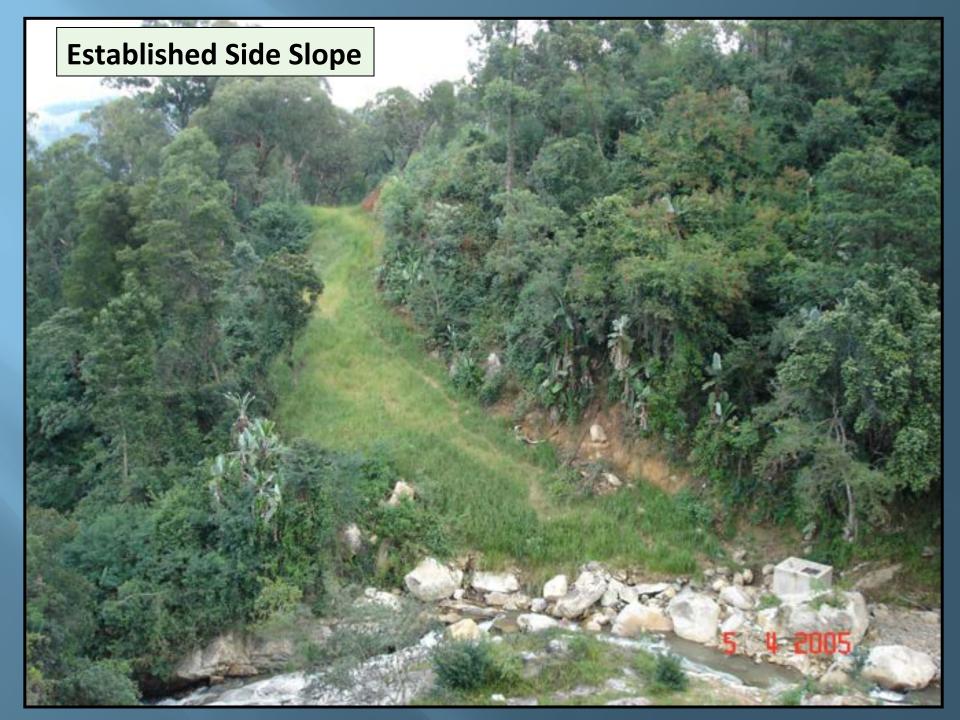














Environmental work Started in 2006 with 15 communities, expanded to 32 communities by 2008.

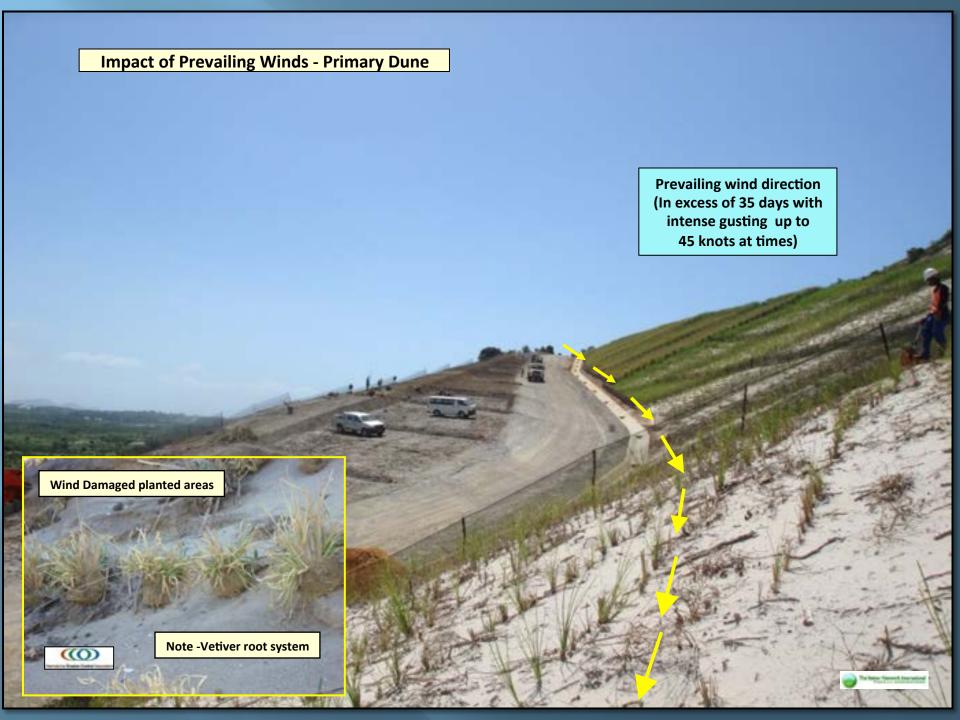
40 hectares were stabilised and re-vegetated.

4,000,000 Vetiver plants were propagated & supplied by local villagers.



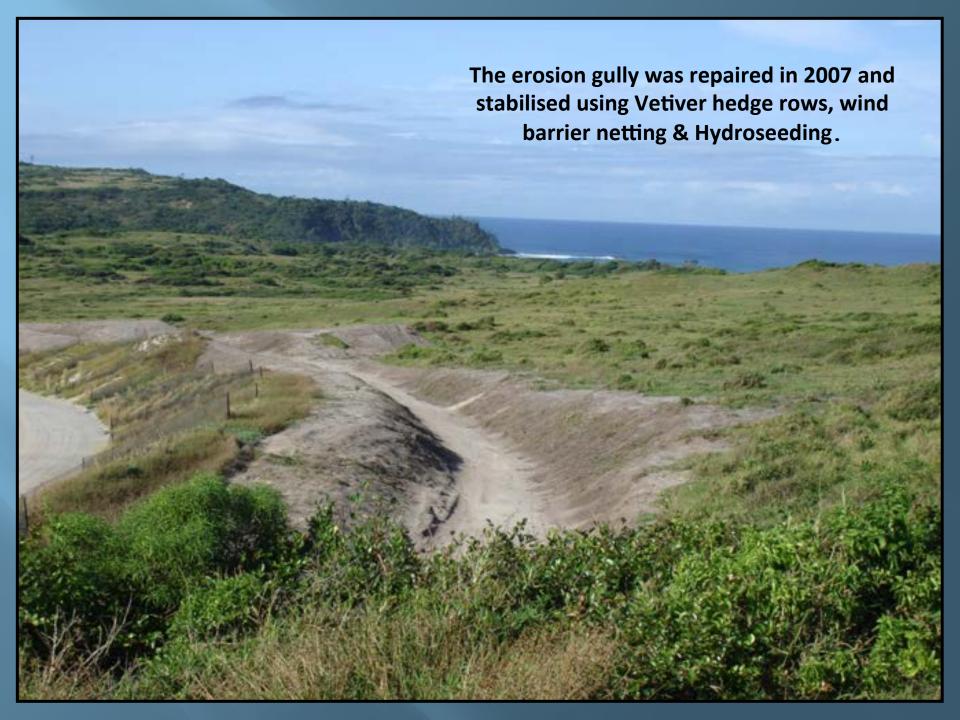


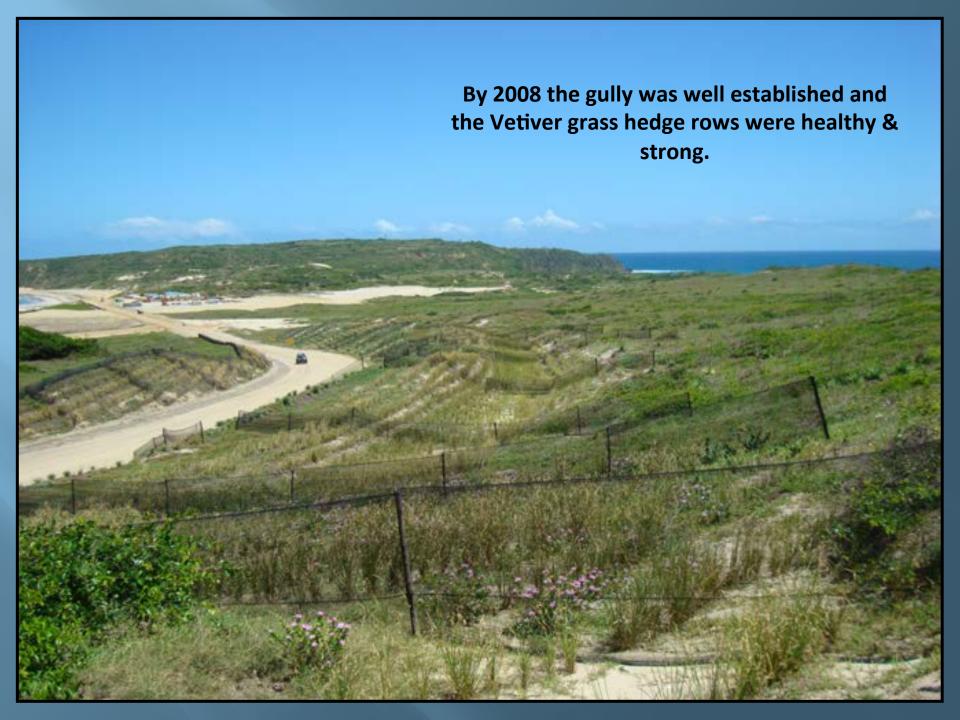










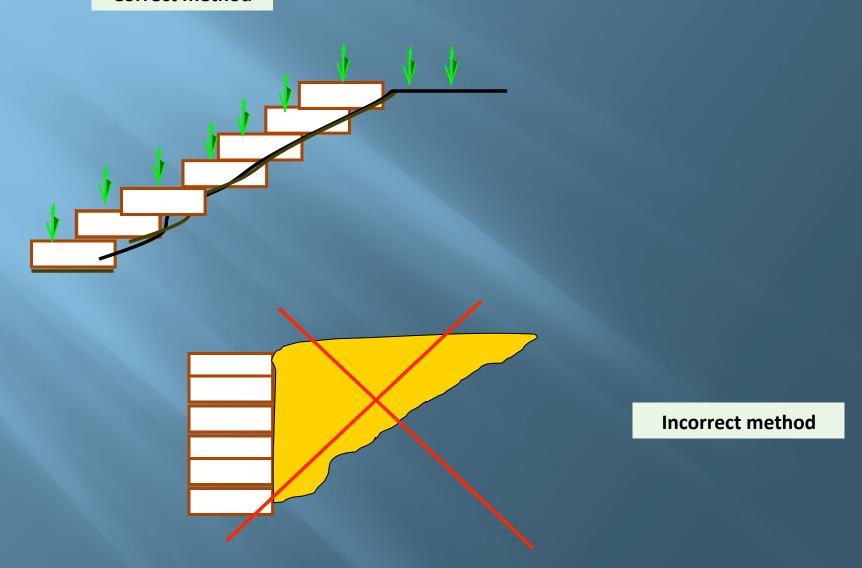


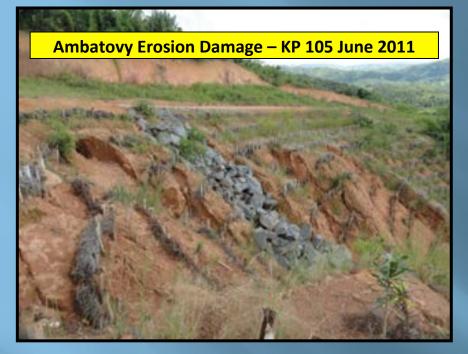




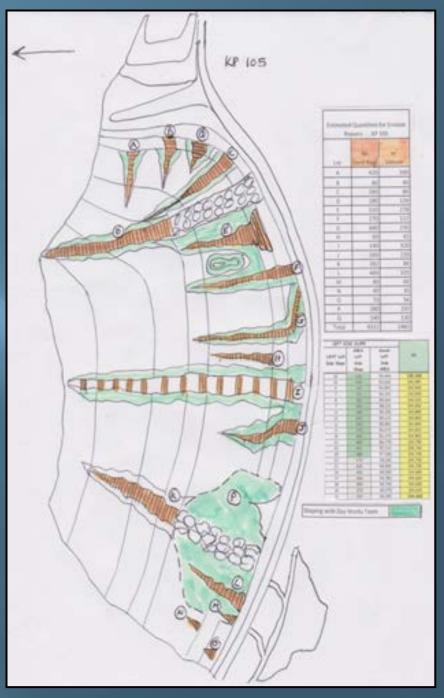
#### **Installation of Sand Bags**

#### **Correct method**









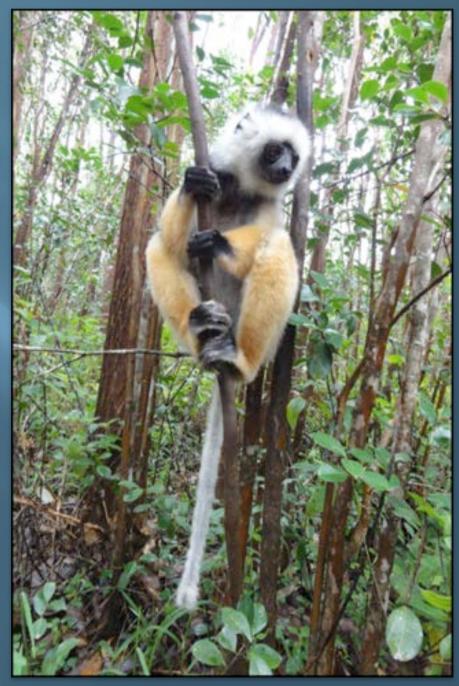












### Is there Vetiver in Texas??? YES

We know that Vetiver has been in Texas since at least the 1920s, as it is mentioned in an early 1930s "Grasses of Texas".

It has been in the Hill Country since the 1970s at least, when the Boucards opened their essential oil distillery in Tarpley.

They contract farmed Vetiver in Dilly, Texas in the 1990s for essential oil production. There is a clump of Vetiver in front of the botanical gardens in San Antonio.

It has been used for erosion control in new housing developments in Austin and Warren Sullivan is using it along the Gulf Coast, near Houston, for coastal zone protection.

THINK ABOUT IT – IT MAY BE THE ANSWER TO MANY PROBLEMS !!!







We always seem to have a

PLAN B

but we forget that there is

"No"

PLANET B

It is our responsibility to preserve and protect the environment we live in.

Thank you



