# The Vetiver System
# for
# Infrastructure Stabilisation in Africa

## With Special References to Road Batter Side Slope Protection
## &
## Sand Dune Stabilisation in Madagascar

**By**

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# INTRODUCTION

**The Vetiver System (VS) has been introduced to many Engineers on Road & Mining projects in several African countries, namely:**
**DR Congo, Ghana, Guinea, Benin, Malawi, Mozambique, Kenya, Ethiopia, South Africa, Uganda, Gabon, Lesotho, Swaziland, Tanzania and the Indian Ocean Islands.**

**The Engineers soon realised that the erosion control potential of Vetiver grass has when used on its own or with other bio-engineering techniques for embankment protection. The VS has overtime been overwhelmingly successful on various projects some of which are described in this presentation.**

**<u>It is to be noted that Vetiver planting material was found in every country where work was carried out and not a single plant was imported.</u>**

**Where severe erosion was once the norm, one can now see the effectiveness of & stabilising effect of the VS.**

# DRCongo-The Selembao Project in Kinshasa

**Shaping of side slopes – 12 hectares**

**Planting of Vetiver grass hedge rows – 90,000 linear metres**

**Hydroseeding of Side Slopes & Flat Areas – 15 hectares**

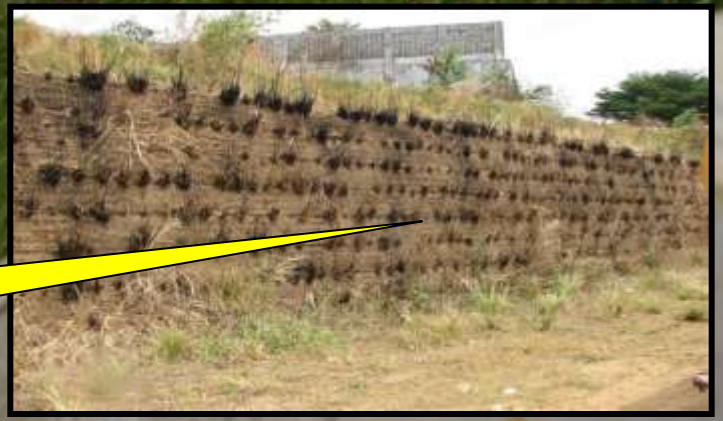
**Vegetating Green Terra mesh walls – 6,000 $m^2$**


Construction of the Green Terra Mesh walls–Selembao, Kinshasa, DRCongo

# Preparation of Planting Holes for Vetiver Slips

The Vetiver slips are planted into holes punched into the sidewall of the green Terramesh wall

# Vetiver stabilised side slope ± 70 °

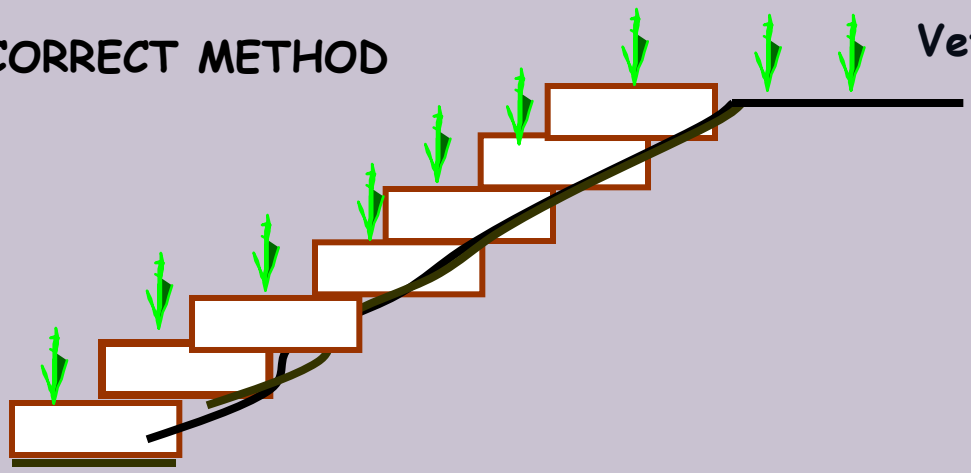


Slope after veld fire-Note distinctive lines of Vetiver

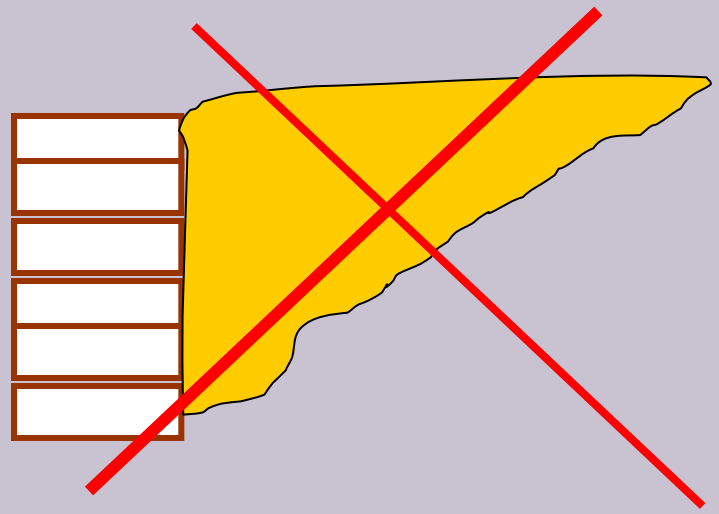

Gully Erosion Stabilisation-Using Vetiver & Sand Bags

# GULLLY EROSION REHABILITATION-Using Vetiver & Sand Bags

CORRECT METHOD



Vetiver grass planted into sand bags



INCORRECT METHOD

# Stabilising Erosion Gullies using Sand Bags & Vetiver System

Empty sand bags are placed into the gully and then backfilled with sand/soil from the surrounding area.

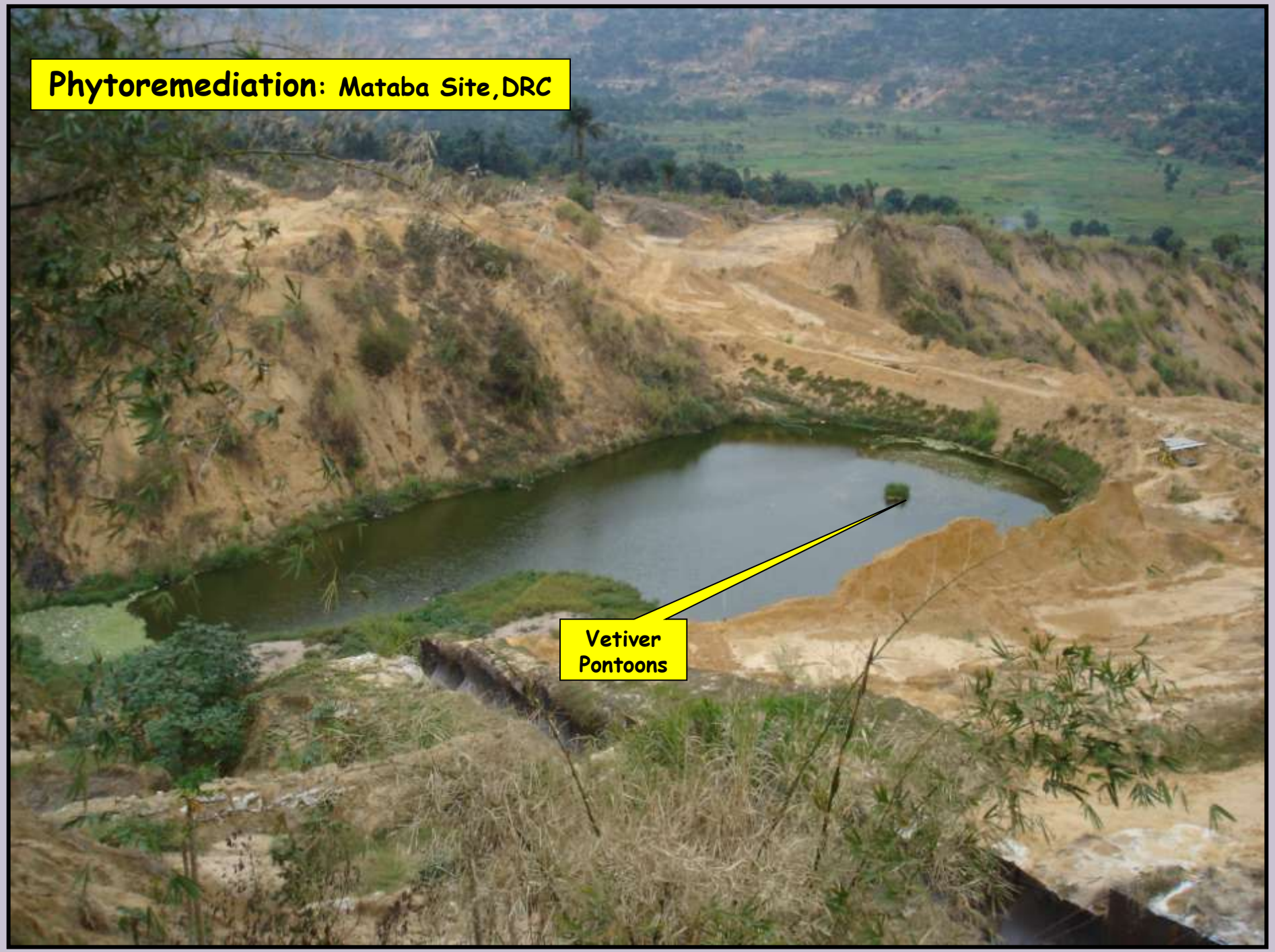
Vetiver slips are planted into the filled sand bag

# Sand Bag stabilisation

Bio-Degradable bags backfilled with sand & placed in cascade formation throughout the eroded drain section.

Filled sandbags planted with Vetiver


Vetiver System with Sand Bag Stabilisation
Established Vetiver grass planted into sand bags on the Banana drain


Phytoremediation: Mataba Site,DRC
Vetiver Pontoons

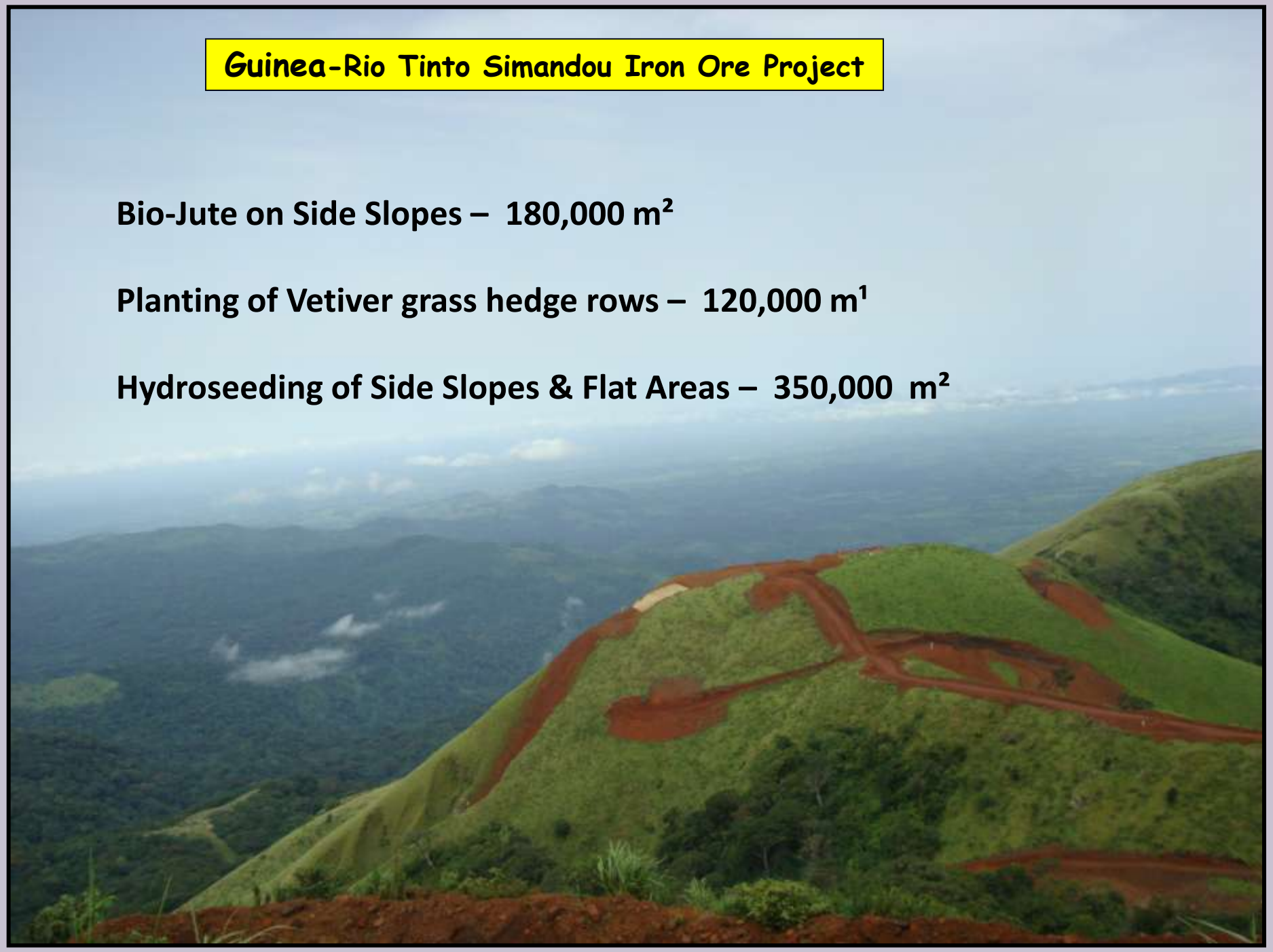

Vetiver growth after 3 months


Root System of Vetiver Plants–Note Ends of roots broken off as a result of Sediment base

# Chemical analyses of "Pontoon" floated Vetiver plant

| Metal | Leaf Analysis | Root Analysis |
|---|---|---|
| Cu | 3 mg/kg | 12 mg/kg |
| Fe | 360 mg/kg | 6764 mg/kg |
| Mn | 170 mg/kg | 621 mg/kg |
| N | 1.31 % | 3.50 % |
| P | 0.07 % | 0.24 % |

# Guinea-Rio Tinto Simandou Iron Ore Project

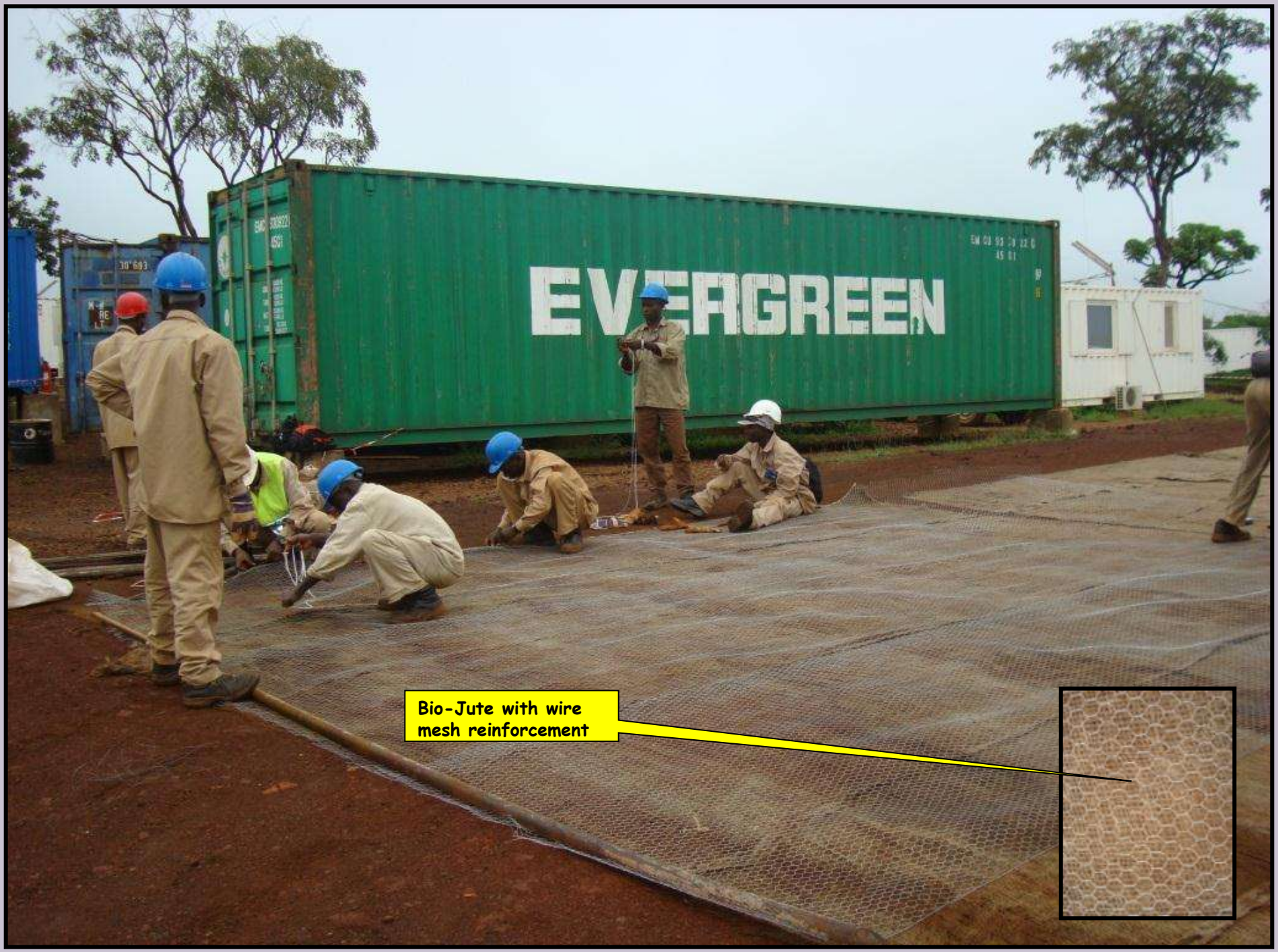


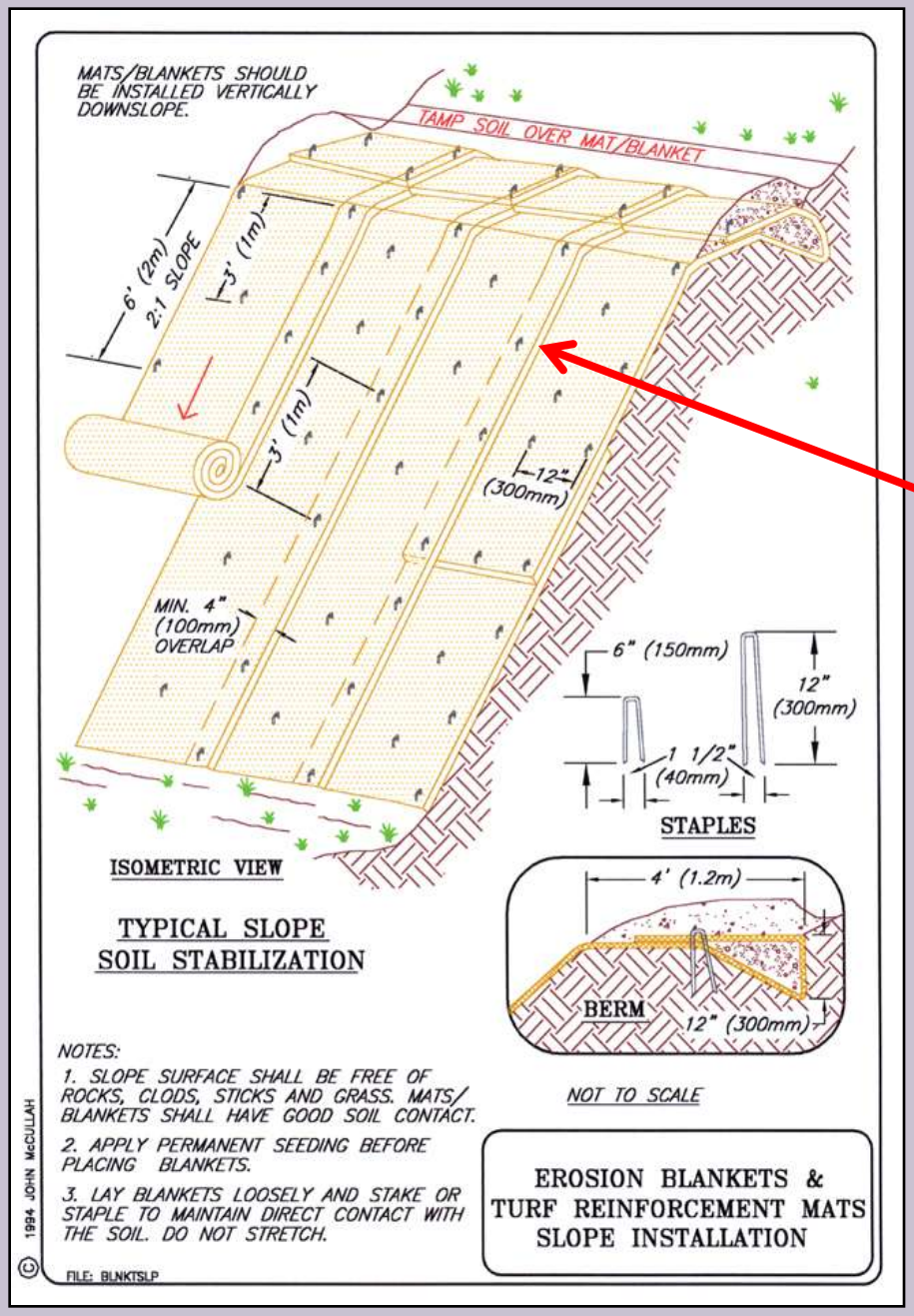
**Bio-Jute on Side Slopes – 180,000 $m^2$**

**Planting of Vetiver grass hedge rows – 120,000 $m^1$**

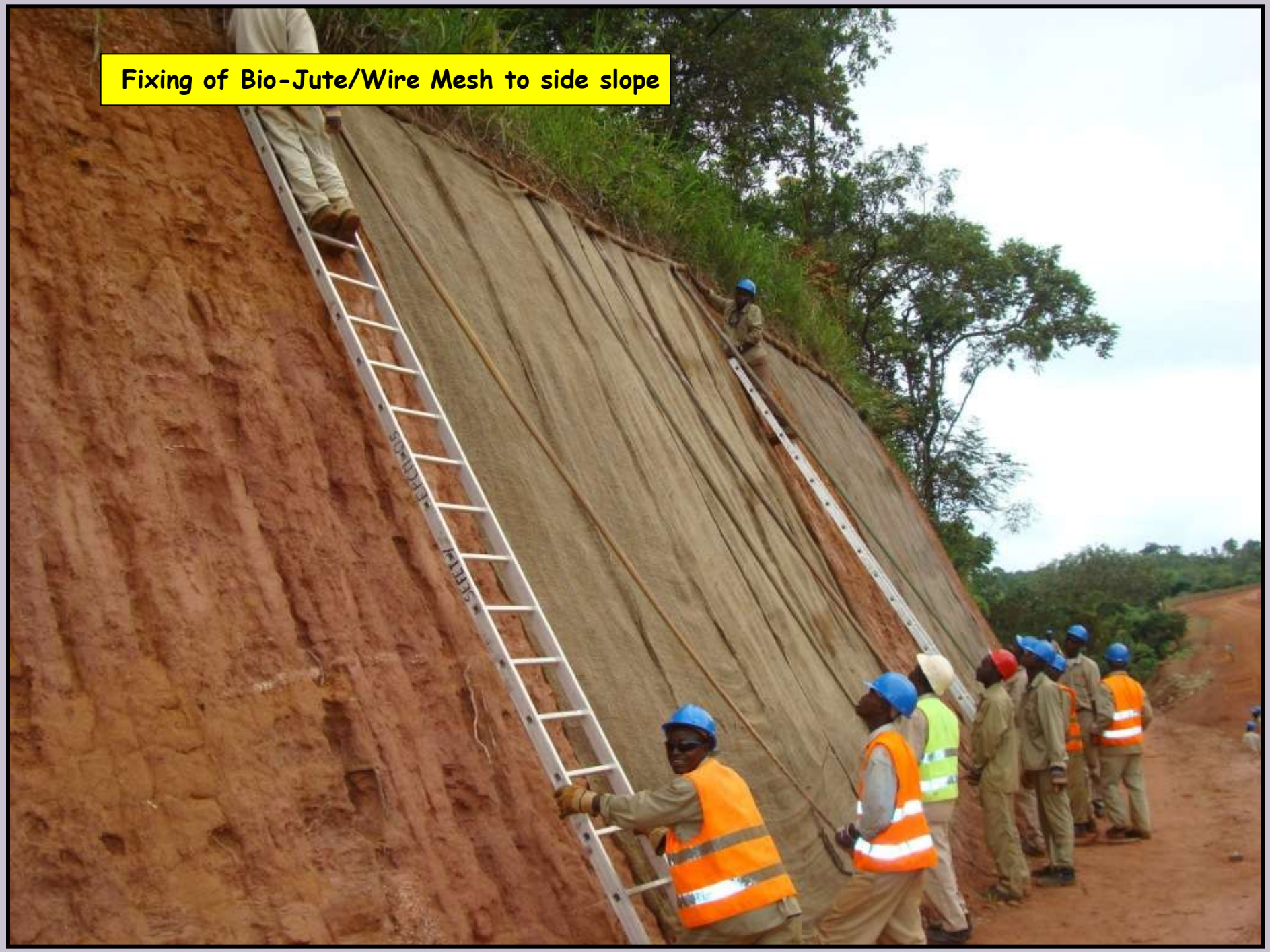
**Hydroseeding of Side Slopes & Flat Areas – 350,000 $m^2$**


Typical Unstable Haul Road Side Slopes


EVERGREEN
Bio-Jute with wire mesh reinforcement

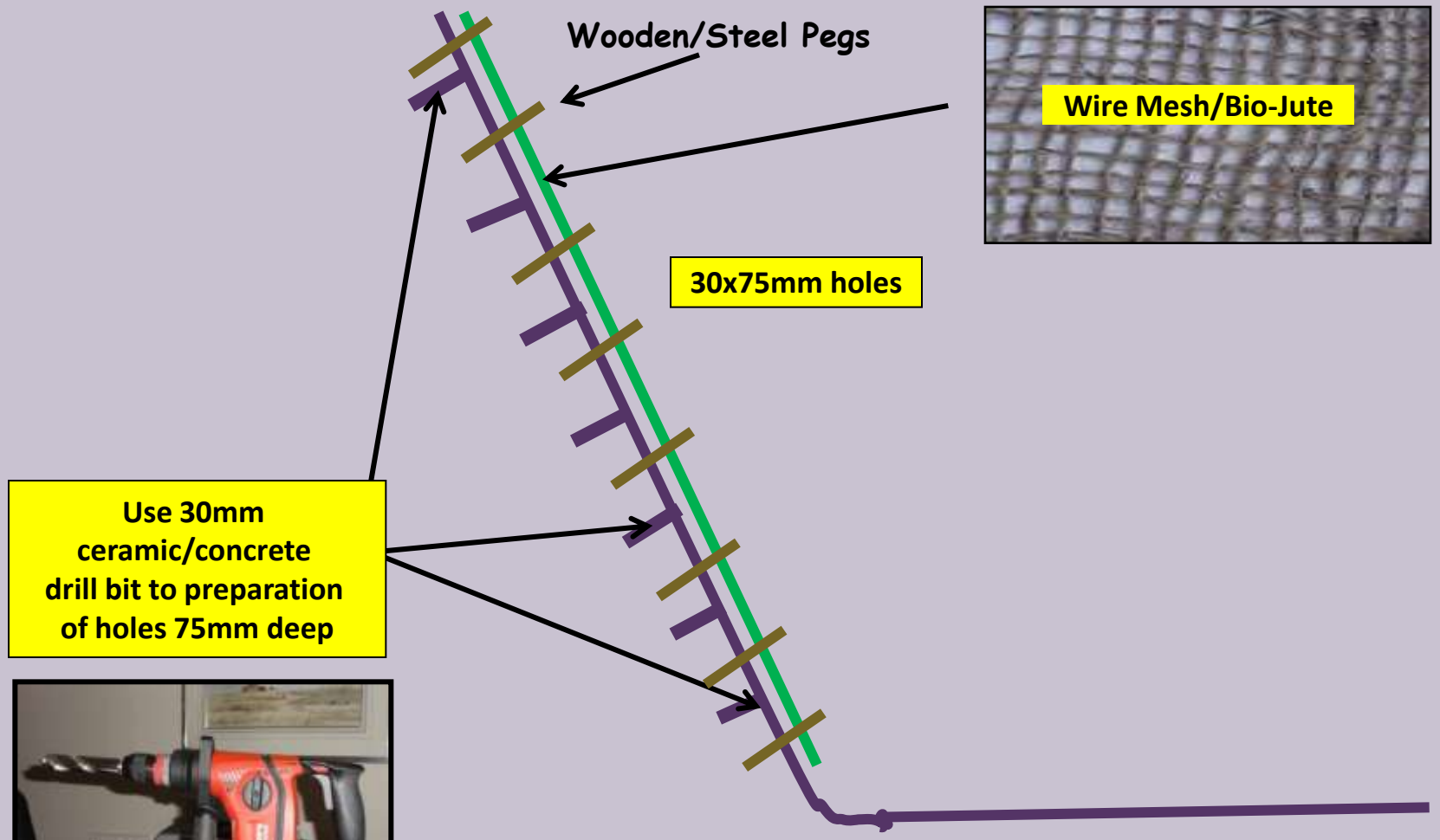



**Stitching of Bio-Jute sections must be carried out prior to installation. Additional pegging with wooden or steel pegs to be done.**


Fixing of Bio-Jute/Wire Mesh to side slope


Slope stabilised with combination of Bio-Jute/Wire Mesh & Vetiver

# Wire Mesh/BioJute/Vetiver Side Slope Stabilisation Diagram




Established Side Slope with Bio-Jute/WireMesh/Vetiver/Hydroseeding


Side Slope showing the Erosion control capabilities of Vetiver grass hedge rows & hydroseeding


Mozambique-Eroded side slopes before VS treatment
Badly eroded shoulder of newly constructed road


Mozambique-Side slopes after VS treatment & HydroSeeding
Same Shoulder protected by Vetiver system and Hydroseeding

# Ethiopia-TVNI Workshop 2010

# South Africa

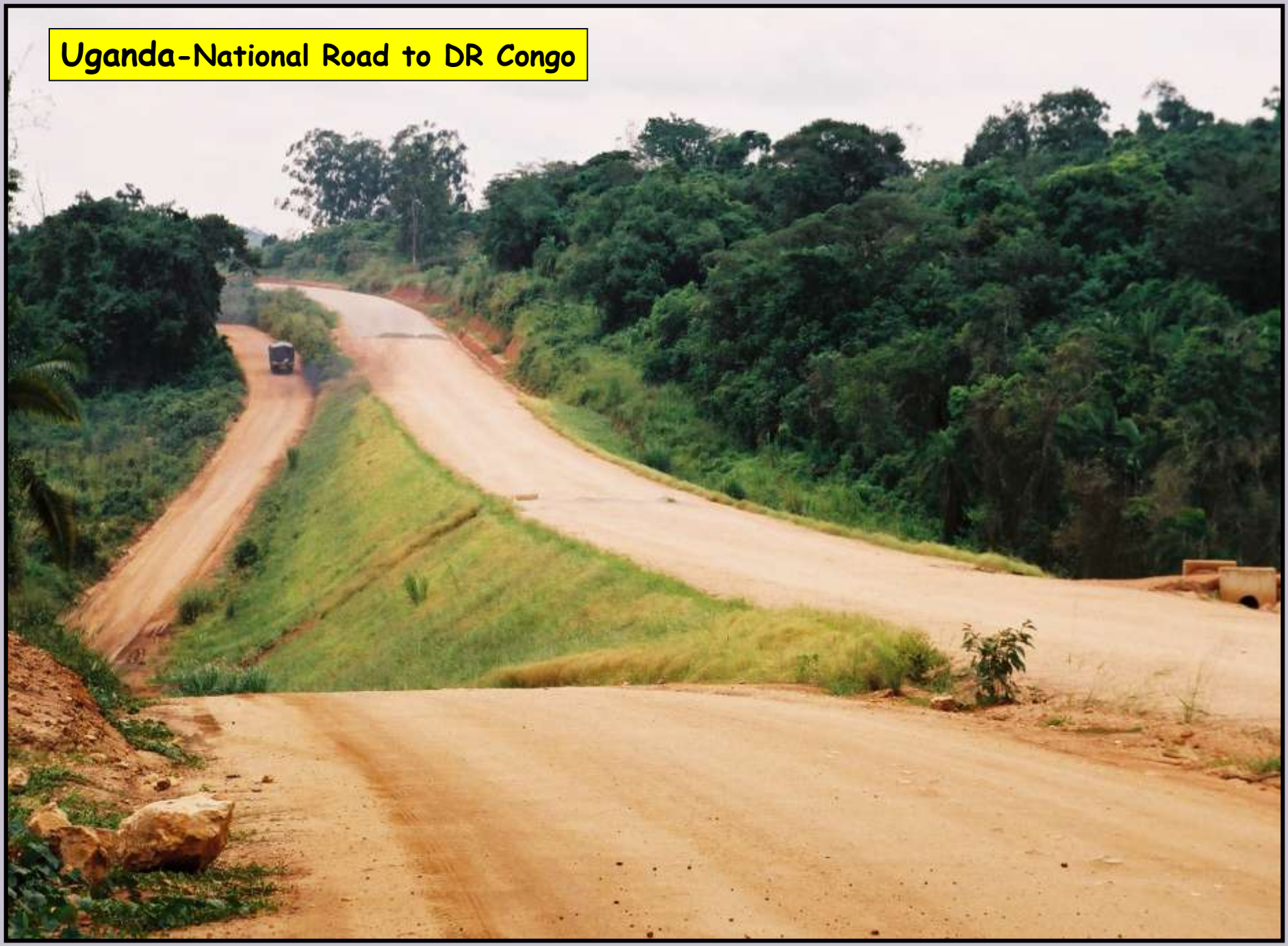
Established Vetiver grass planted behind Coir rolls on mountain pass contract


Established Vetiver grass integrated with HydroSeeding on severe side slope


South Africa-Training of local communities for Dept of Agriculture

# Department of Agriculture-Limpopo Province, South Africa

## Field work


Uganda-National Road to DR Congo

# Swaziland

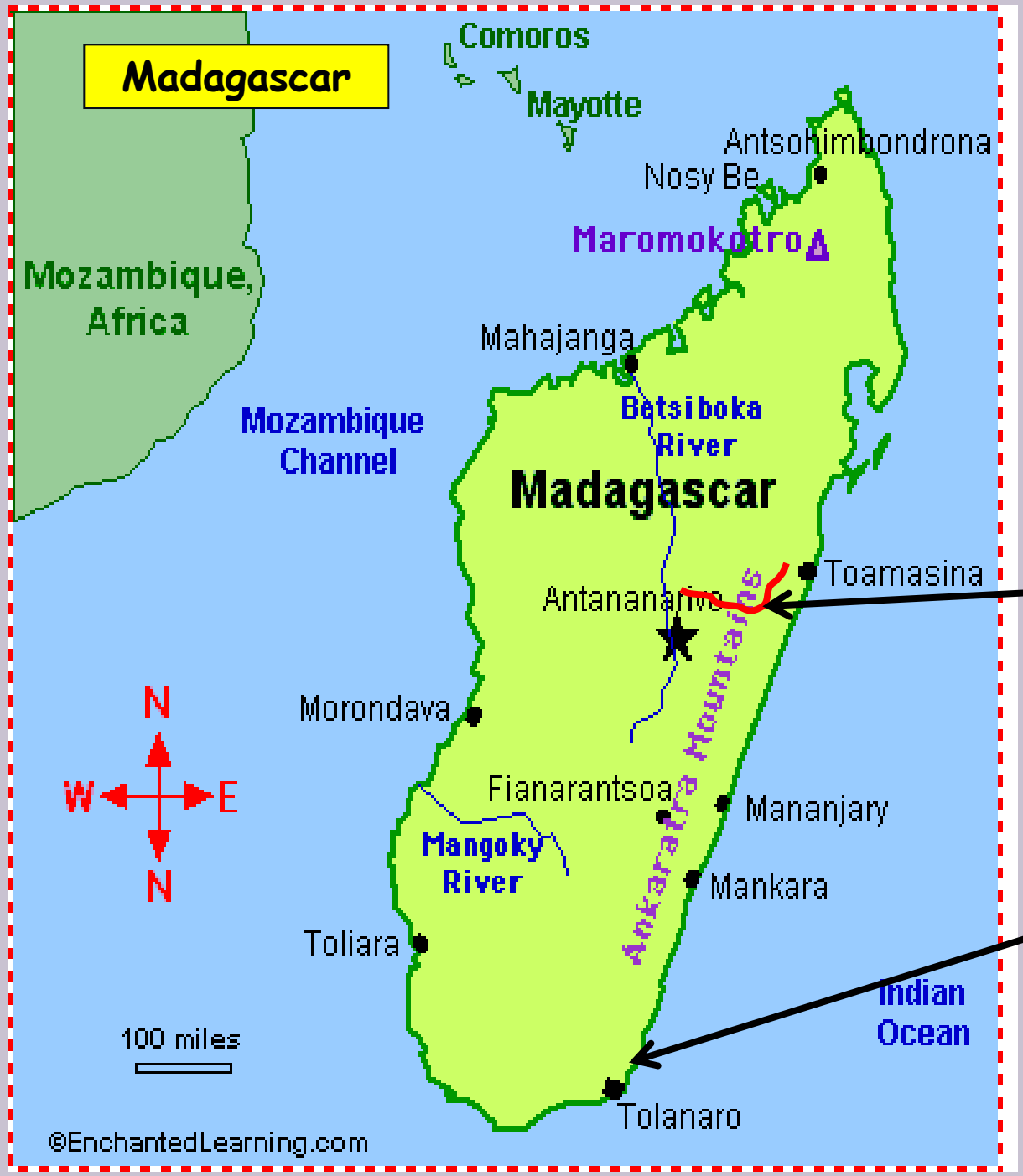
Established Vetiver grass integrated with HydroSeeding on severe side slope


Swaziland
Vetiver System & Hydroseeding
for stabilising sub soil side slopes


Swaziland
Same slope stabilised using Vetiver System & Hydroseeding


Swaziland
Well established shoulder break point using Vetiver & Hydroseeding


Swaziland
Well established embankment showing integrated use of VS (Vetiver System) & Hydroseeding
5 4 2005




Location of Projects in Madagascar where the Vetiver System was introduced

Ambatovy Nickel Slurry Pipeline Project

Rio Tinto/QMM Ilmenite Project

# Madagascar-Ambatovy Project-ROW Embankment Stabilisation


Installed Fascine Structures, Vetiver & Hydroseeding

# Established Side Slopes using the Vetiver System & Hydroseeding

# A Brief review of the Rio Tinto/QMM Ilminite Project at Fort Dauphin, Madagascar

| QUANTITY MATERIALS USED ON THE RIO TINTO/QMM PROJECT | |
|---|---|
| Wind Barrier Netting | 36,000 $m^1$ |
| Brushwood covering | 380,000 $m^2$ |
| No. Vetiver plants propagated by local communities | 4,000,000 |
| Plant Vetiver Grass Hedge Rows | 390,000 $m^1$ |
| Areas Hydroseeded | 48 ha |
| Quantity Commercial seed used | 2,880 kg |
| Quantity Native seed used | 480 kg |
| Lime Used | 24,000 kg |
| NPK fertilisers | 24,000 kg |
| Organic Supplement | 24,000 kg |
| Soil Binder | 480 kg |
| Mulch | 12,000 kg |


Quarry Haul Road under construction


Construction of the Ehoala Dune Access Road


View of Wind barrier (Erosion Control) Structures

# Erection of Wind Barrier Netting on Fill Slopes

# Planting Vetiver Hedge Rows to Stabilise Shoulder of Earth Berm on Fill Slope


Vetiver Hedge Rows for Side Slope Protection

# Wind Erosion Damage


Prevailing Wind Direction


Water Management


Deflecting Water into Concrete side drain

# Hydroseeding process

## The Hydroseeding Mixture

**The Vetiver areas were hydroseeded with a mixture of:**

- **Commercially available grass species: *Eragrostis curvula* and *E. tef*, *Chloris gayana*, *Cynodon dactylon*, *Panicum maximum*, *Paspalum notatum* and the exotic clover for nitrogen fixing, *Trifolium subterranean*.**

- **Locally native grass seeds collected by local communities included and were added to the mixture : *Stenotaphrum dimidiatum* (Buffalo Turf Grass), *Dactyloctenium aegyptium* (Common Crowfoot), *Imperata cylindrica* and *Cynodon dactylon*.**

- **A soil binding agent, HydroPam**
- **An organic supplement consisting of locally sourced rice husks, cotton husks and cattle manure**
- **NPK fertiliser along with agricultural lime and a highly concentrated blend of beneficial organisms for use on soils with low microbial activity**

**FINN equipment coupled to a 4x4 truck was used for the hydroseeding application.**

**Development of the Vetiver hedges simultaneously with HydroSeeding**


Maintenance process
Hose Extension Outlet

A Vetiver Plant
removed from
the Ehoala dune
8 months
after planting.

Interesting to note
the extent of the
root system that
grew on the infertile
sandy dune material


"Scaevola taccada," Inter-planted on the Ehoala Sand Dunes


Stabilised side Slope with Vetiver system

# Stabilising Culvert inlets with Vetiver System


Before

# After

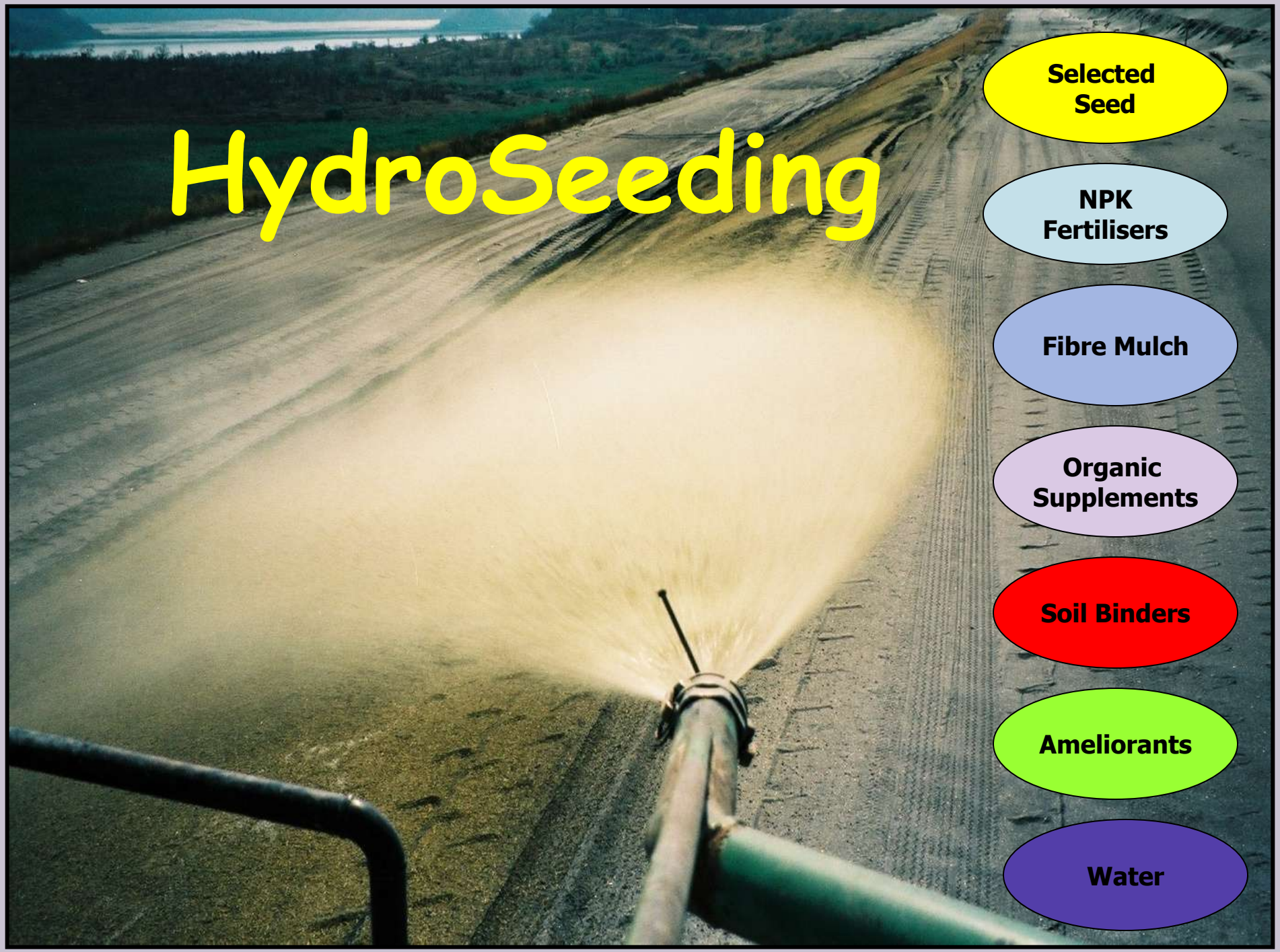
# Mine Village under Construction

26 February 2008

*Permanent Village - Phase 2 & Pioneer Village*


Side Slopes Protected by the Planting of Vetiver grass


Maintenance of established Vetiver side Slopes


HydroSeeding
Selected Seed
NPK Fertilisers
Fibre Mulch
Organic Supplements
Soil Binders
Ameliorants
Water

# WHAT IS HYDROSEEDING?

"Hydroseeding" or "Hydraulic Seeding" is a mechanised dryland seeding application process used in the establishment of vegetation on large, sometimes inaccessible & often hostile environments areas for erosion control & environmental rehabilitation.

A uniform & homogenous mixture of selected grass seeds, fertilisers, soil binders, mulch, soil ameliorants, organic supplements and water is hydraulically sprayed onto prepared surfaces at high pressure and volume.

The soil binders and mulch reinforces the surface, creating a suitable microclimate for seed germination to take place.

A preferred process or technique for vast area applications due to difficulty in conventional watering considerations- mixture remaining in-situ on surface until favourable soil moisture and temperature conditions prevail.

# PRE REQUISITES - HYDROSEEDING OPERATION

A CHEMICAL ANALYSIS of the soils to be vegetated in order to accurately determine the NPK fertiliser, ameliorant & organic matter requirements.

Acceptable ENVIRONMENTAL SPECIFICATION detailing grass seed & hydroseeding formulation/mixture.

AMELIORATION of Areas to be vegetated with soil amendments and organic supplements as indicated by the laboratory analytical report.

SOIL PREPARATION by creating horizontal drills or shallow furrows in which the hydraulic seeding mixture can be contained.

CORRECT APPLICATION by using suitable HydroSeeding equipment that is capable of uniformly applying or dispersing the homogenous mixture to the areas to be rehabilitated.

MAINTENANCE of vegetated areas.

# Chemical Analysis Report

**SOILANALYSIS REPORT**

NviroTek Labs

088 303 2967 FAX: 086 583 7781

| | | | | | |
|---|---|---|---|---|---|
| COMPANY: | Hydromulch | NAME: | NMPP | DATE: | 8/23/11 |
| ADRESS: | P O Box 227 | FARM: | | | |
| ADRESS: | Halfway House | EMAIL: | | | |
| CODE: | 1685 | FAX: | 011 964 2581 | | |
| TEL: | 011 964 2582 | ORDER NO: | 6243 | | |

| Lab No | Ref No | pH (KCl) | PBray1 | K | Na | Ca | Mg | EA,KCl | %Ca | %Mg | %K | %Na | ACID SAT | Ca:Mg | (Ca+Mg)/K | Mg:K | S-Waarde | Na:K | T | Density | S-AMAC | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | cmol(c)/kg | % | % | % | % | % | 1,5-4,5 | 10,0-20,0 | 3,0-4,0 | cmol(+)/kg | | cmol(c)/kg | g/cm3 | mg/kg | % |
| 52856 | BA | 4,28 | 4 | 195 | 17 | 1335 | 301 | 0,21 | 67,24 | 24,88 | 5,02 | 0,76 | 2,10 | 2,70 | 18,36 | 4,96 | 9,72 | 0,15 | 9,93 | 0,87 | 34,75 | 0,9 |
| 52857 | BB | 4,14 | 1 | 69 | 41 | 782 | 460 | 0,35 | 46,59 | 44,97 | 2,11 | 2,13 | 4,20 | 1,04 | 43,33 | 21,28 | 8,04 | 1,01 | 8,39 | 1,01 | 19,46 | 5,2 |
| 52858 | BC | 4,41 | 1 | 322 | 13 | 689 | 353 | 0,18 | 46,53 | 39,10 | 11,11 | 0,79 | 2,46 | 1,19 | 7,70 | 3,52 | 7,22 | 0,07 | 7,40 | 0,81 | 34,78 | 4,4 |
| 52859 | BD | 4,23 | 1 | 157 | 17 | 520 | 276 | 0,53 | 44,35 | 38,52 | 5,85 | 1,29 | 8,99 | 1,15 | 12,09 | 5,62 | 5,34 | 0,19 | 5,87 | 0,87 | 61,31 | 0,6 |
| 52860 | BE | 4,60 | 1 | 76 | 26 | 665 | 312 | 0,00 | 53,72 | 41,32 | 3,14 | 1,82 | 0,00 | 1,30 | 30,29 | 13,17 | 6,18 | 0,58 | 6,18 | 1,06 | 11,79 | 0,4 |
| 52861 | BF | 5,54 | 1 | 124 | 235 | 3206 | 1463 | 0,00 | 54,60 | 40,84 | 1,08 | 3,48 | 0,00 | 1,34 | 88,28 | 37,78 | 29,36 | 3,22 | 29,36 | 0,98 | 2,36 | 0,2 |
| 52862 | BG | 5,10 | 2 | 49 | 51 | 1499 | 508 | 0,00 | 62,41 | 34,68 | 1,05 | 1,86 | 0,00 | 1,80 | 92,46 | 33,03 | 12,01 | 1,77 | 12,01 | 1,14 | 4,38 | 0,2 |

NF REEDERS

# FEATURES OF THE HYDROSEEDED GRASS SPECIES
## Suggested for the Area @ 40 kg/ha

| Botanical Name | Common Name | Plant Succession | Features | Flowering Cycle |
|---|---|---|---|---|
| Eragrostis tef -5% | Tef | Pioneer-annual | A loose annual sometimes dense tufted grass growing for 1 season. | Nov to May |
| Panicum maximum - 20% | Guinea grass | Sub climax, Climax or Pioneer-perennial (Decreaser) | A leafy weak perennial tufted grass or perennial grass growing more than 5 seasons | Sept to March |
| Digataria Eriantha - 20% | Smuts finger grass | Sub climax or Climax-perennial (Increaser) | A perennial tufted grass with a shrub like growth form growing for more than 5 seasons. | Jan to April |
| Cynodon dactylon - 30% | Bermuda grass | Pioneer or Climax-perennial (Increaser) | Short mat forming creeping grass spreading by means of stolon's & rhizomes | Sept to May |
| Chloris gayana - 10% | Rhodes grass | Climax perennial (Decreaser) | A tufted stoloniferous perennial. The long surface runners rooting at the nodes. | Nov to May |
| Eragrostis curvula - 15% | Love Grass | Sub climax or Climax-perennial (Increaser) | A robust densely tufted perennial grass growing more than 5 seasons | Aug to June |


Soil Preparation-Manual scarifying

# Mechanic Side Slope Preparation

# HydroSeeding Unit

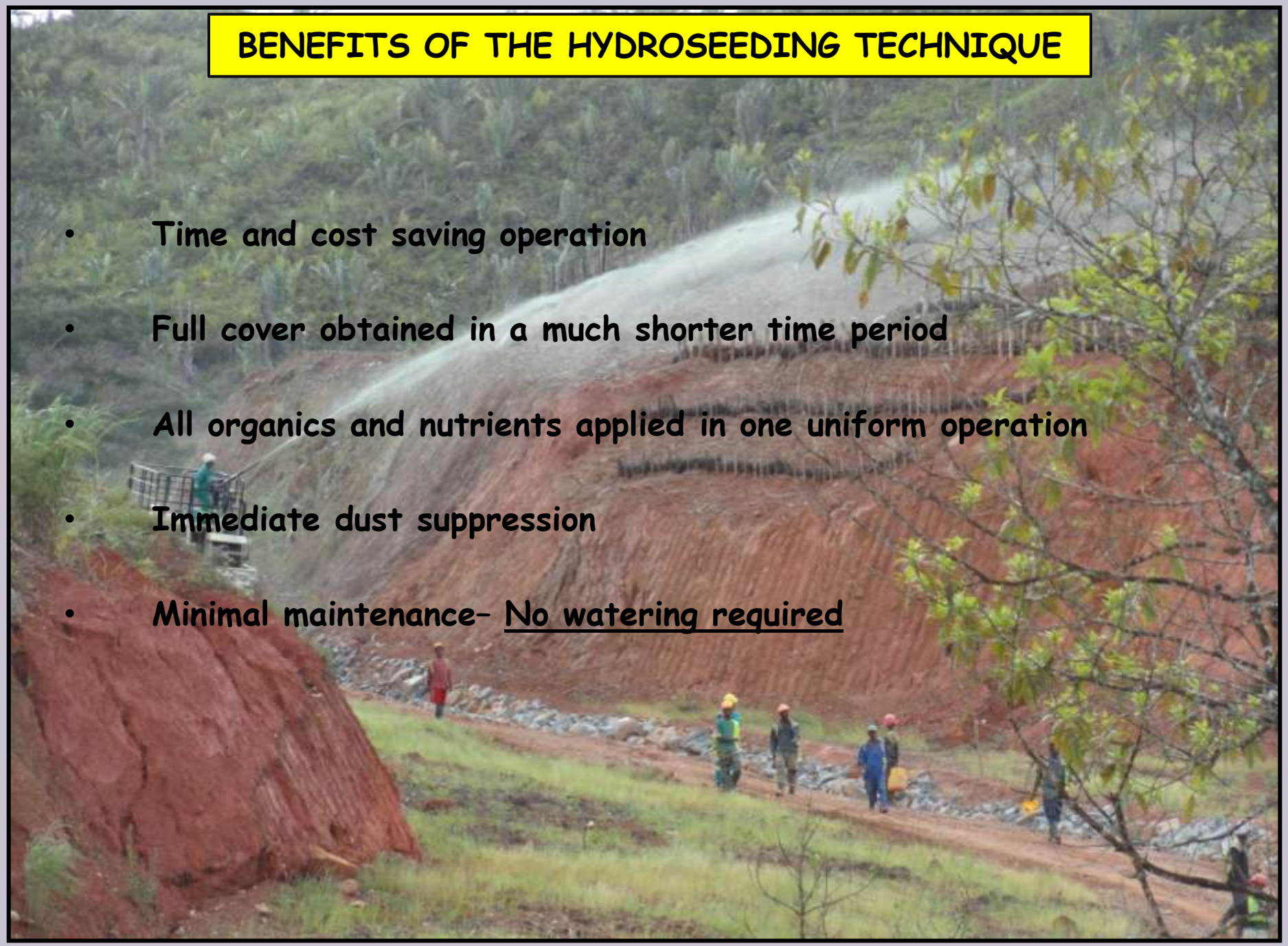
6X6 Magirus Deutz truck with T170 FINN hydroseeder

# HydroSeeding Application

Wheel Chains


HydroSeeding Application on Difficult Terrain

# BENEFITS OF THE HYDROSEEDING TECHNIQUE



- Time and cost saving operation
- Full cover obtained in a much shorter time period
- All organics and nutrients applied in one uniform operation
- Immediate dust suppression
- Minimal maintenance– No watering required

# Problems-Domestic Animals

Villagers are asked to keep their animals off the grassed areas for a minimum period of 3 months


In Conclusion
There is always
PLAN B
but
there is no
PLANET B
It is our responsibility to
preserve and protect the
environment we live in