Watershed Restoration by Using Vetiver Grass Systems (VGS) for Downstream Water Quality Improvement in Southern Guam

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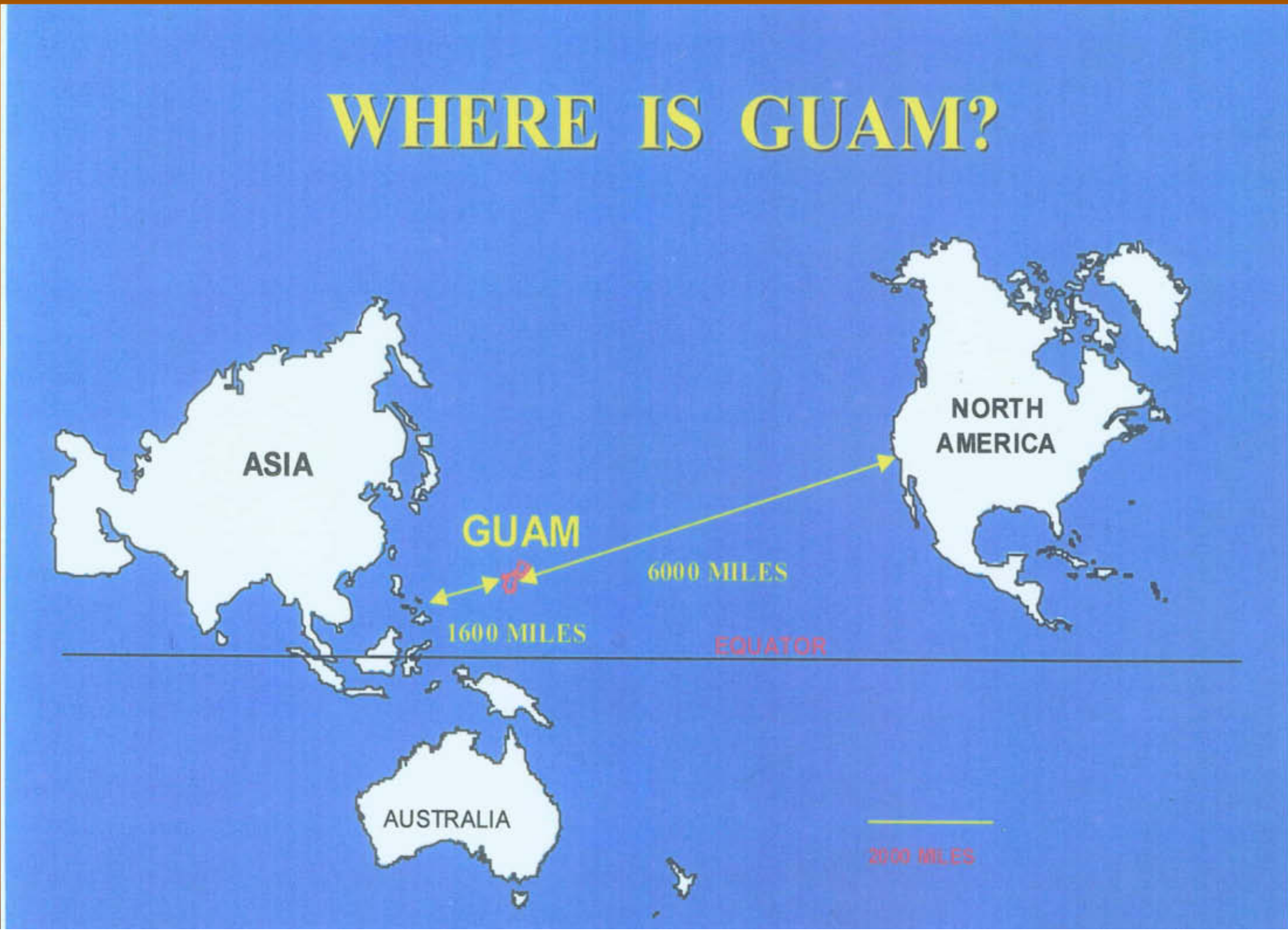
WHERE IS GUAM?



0 6 12 km
0 6 12 mi
reef
reef
Yigo
Tamuning
Cabras Island
Apra Harbor
HAGÅTÑA (Agana)
Agat
North Pacific Ocean
reef
Merizo
Cocos Island

Typical badland in southern Guam
M.H. Golabi

Grass burning is among the causes of soil degradation in southern Guam
M.H. Golabi

Human Activities
&
Their effect on soil degradation in Southern Guam


Construction site


Burning


Mismanaged farming


Off reading

The Problem

Soil erosion as the result of the burning and other human activities is the principle anthropogenic threat to the coral reefs in the Pacific Islands.

Sediment loss due to erosion clogs rivers, lakes, waterways and more importantly damages the coral reef that is the major attraction for the tourist.

- Sediment loss also reduces the water storage capacity of reservoirs and canals and increases flooding.

Challenges Facing Guam's Soil and Environmental Scientists

- Soil and environmental scientists and managers must develop strategies to control erosion on the farms, rangelands as well as the watershed areas

- New techniques must be introduced and examined for soil conservation and natural resources protection

Research Objectives

- Evaluate the effect of Vetiver grass to prevent sediment loss and control soil erosion at the watershed level

- Hence better the health of reef ecosystem of the Island.

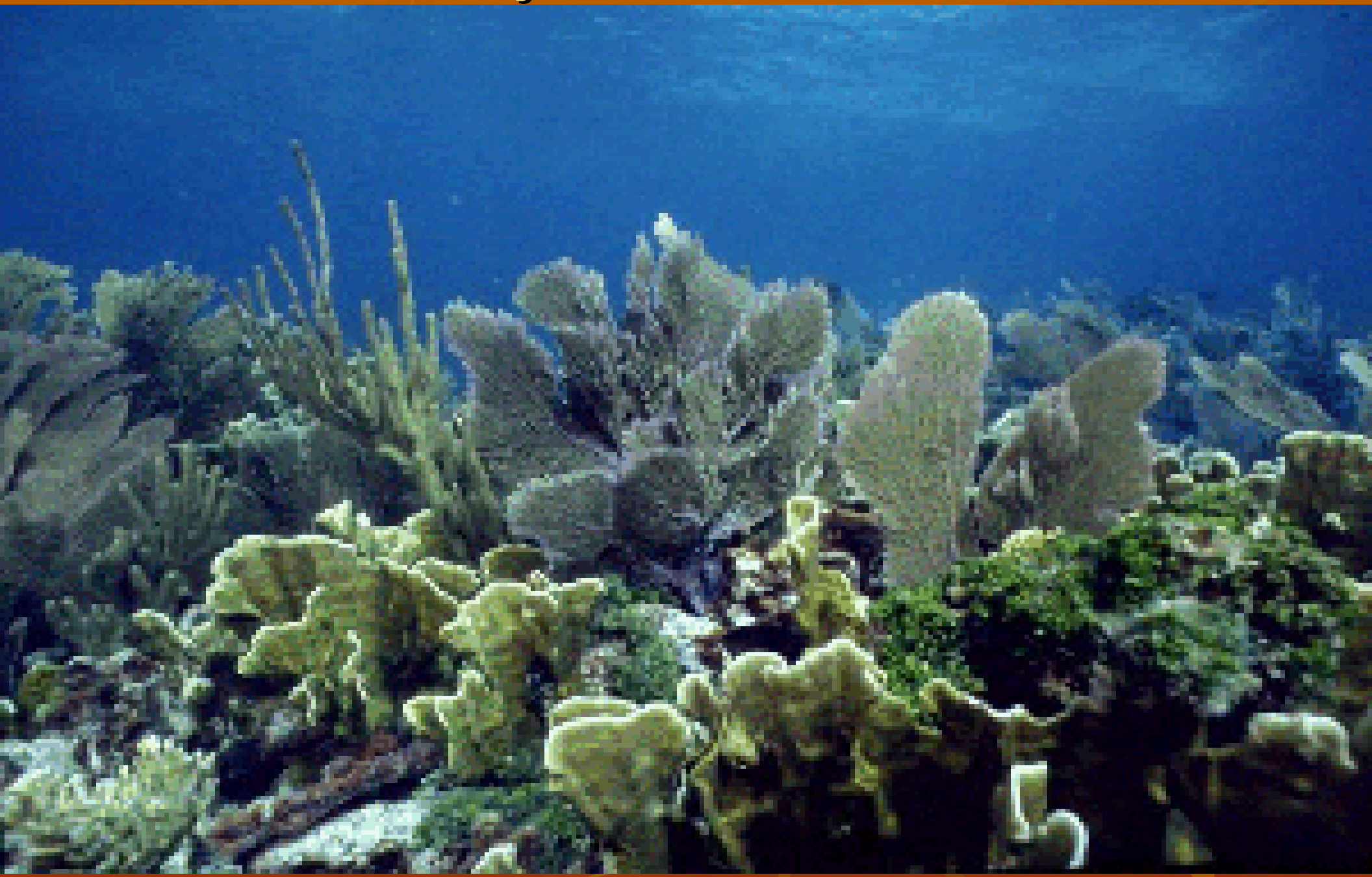
Project Importance

- Watershed Degradation
- Water Quality Problems
- Limited Water Sources
- Coral Reef Degradation
- Economic Impacts

Mud in Pauliluc Bay

Courtesy of Dr. Minton, NPS

Healthy Coral Reef



Courtesy of Dr. Minton, NPS

Coral Reef Degradation As the Result of Severe Soil Erosion

Courtesy of Dr. Minton, NPS

Using Vetiver Grass Systems For :

- Trapping sediment at the watershed level
- Protecting downstream water bodies from sedimentation
- Improving water quality entering the ocean
- Protecting the Coral from smothering and dying

What Is Vetiver Grass

- **Scientific Name:** *Vetiveria Zizanioides*

Vetiver in Nature

Seedlings

Vetiver Origin

Mainly mass produced in Thailand

Also found and Used In:

- **China**
- **Australia**
- **Madagascar**
- **Persia**
- **Indonesia**
- **South Africa**
- **Guam**

Special Characteristics

- Adoptable to Various Soil Conditions:

  * Low pH: < 4 * High pH: > 12

- Able to take up heavy metals
  * Zn, As, Mn, Cu, Al, & Pb

- Water Purifier (Sediment & Nutrients)
  * Nitrates & Phosphates

Vetiver Root System

Comparison between the common savanna Sword grass and Vetiver grass - Root systems

Local Sword Grass

Vetiver Grass

Main Uses

Badland

Six Months after Planting

China:
Golabi

End Goal

Stop Erosion From Source

Stop Major Sediment Outfalls

Case Study

Use of Vetiver Technology to control erosion as a watershed management strategy for water quality improvement and natural resource preservation

Methodology

Four flumes (72ft X 5.5ft) are installed on a uniformly sloped selected watershed area for measuring the runoff and to estimate the sedimentation rate under four different treatments.

Treatments are:

1)‘**as it is condition**’,
2)‘**competently exposed condition**’,
3)‘**burned**’ and
4) ‘**Vetiver grass establishment’** as the sediment a trapping technique.

Methodology Cont'd

Sets of suspended runoff/sediment samplers are constructed in a runoff-collecting tank placed at the bottom of each treatment plots for the measurement of sediment discharge as well as runoff assessment.

Samples are used to measure the turbidity and the amount of sediment collected under each treatment.

Newly established Vetiver grass – Cross island road, S. Guam
Golabi

Cross Island Road Project (4 treatments)

Burned

Vetiver & Sunnhemp

Tilled

Natural Cover

Flumes & Sampling Setup

Flume Drain

Sampling Design

Sampling Protocol

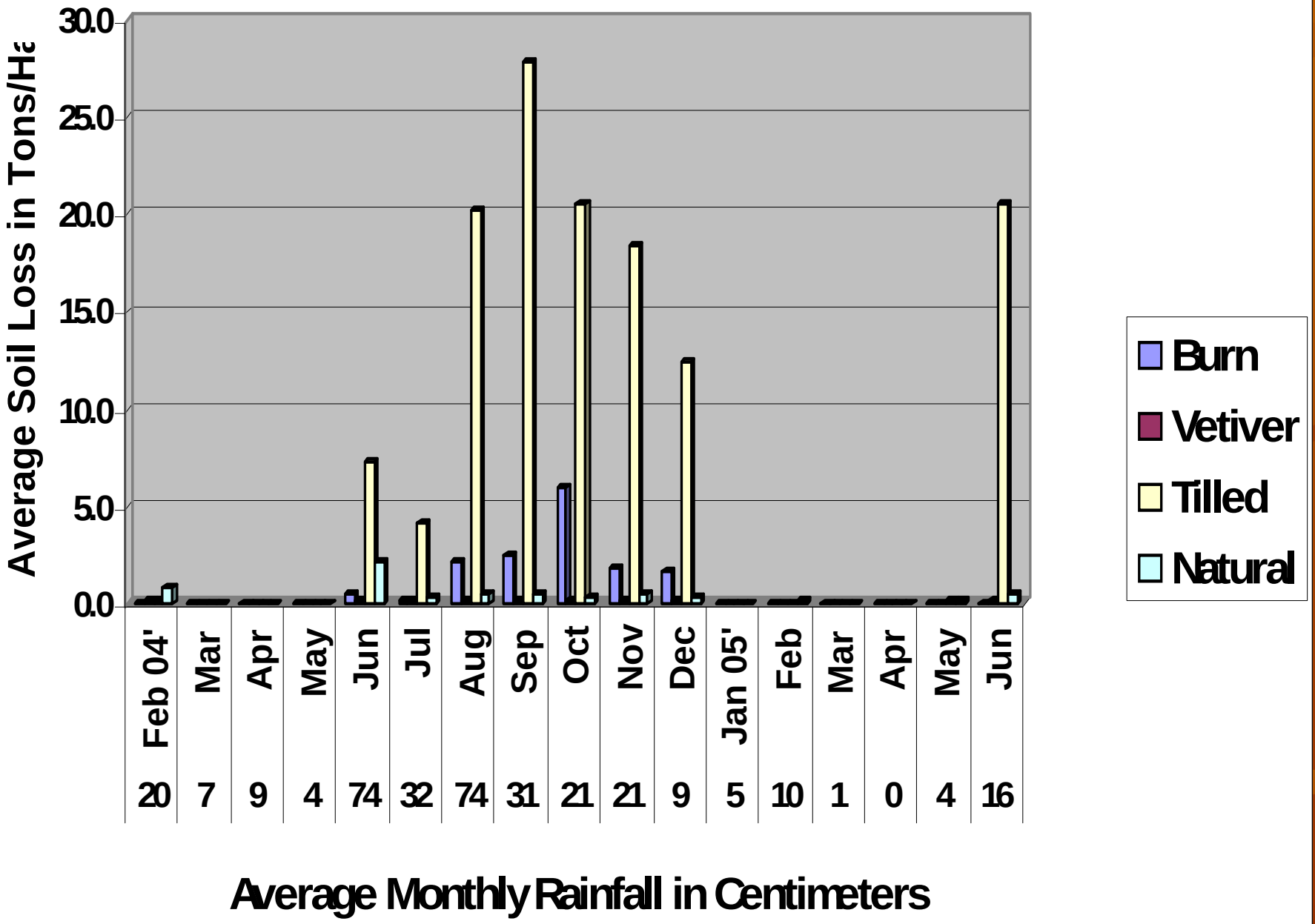
Tank Drainage

RESULTS

Initial soil characteristics				Management Practices	Soil characteristics as affected by study treatments			
	Soil Texture (%)				Soil Texture (%)			
O.M. (%)	Clay	Sand	Silt		Clay	Sand	Silt	Avg. % O.M.
3.9	54.4	24.9	20.7	Burn	57.2	20.5	22.3	5.1
3.9	54.4	24.9	20.7	Vetiver	51.8	28.2	20.0	5.4
3.9	54.4	24.9	20.7	Till	54.8	26.1	19.1	3.0
3.9	54.4	24.9	20.7	Natural	56.8	25.7	17.5	3.8

Table 1: Soil characterization prior and following the treatments.

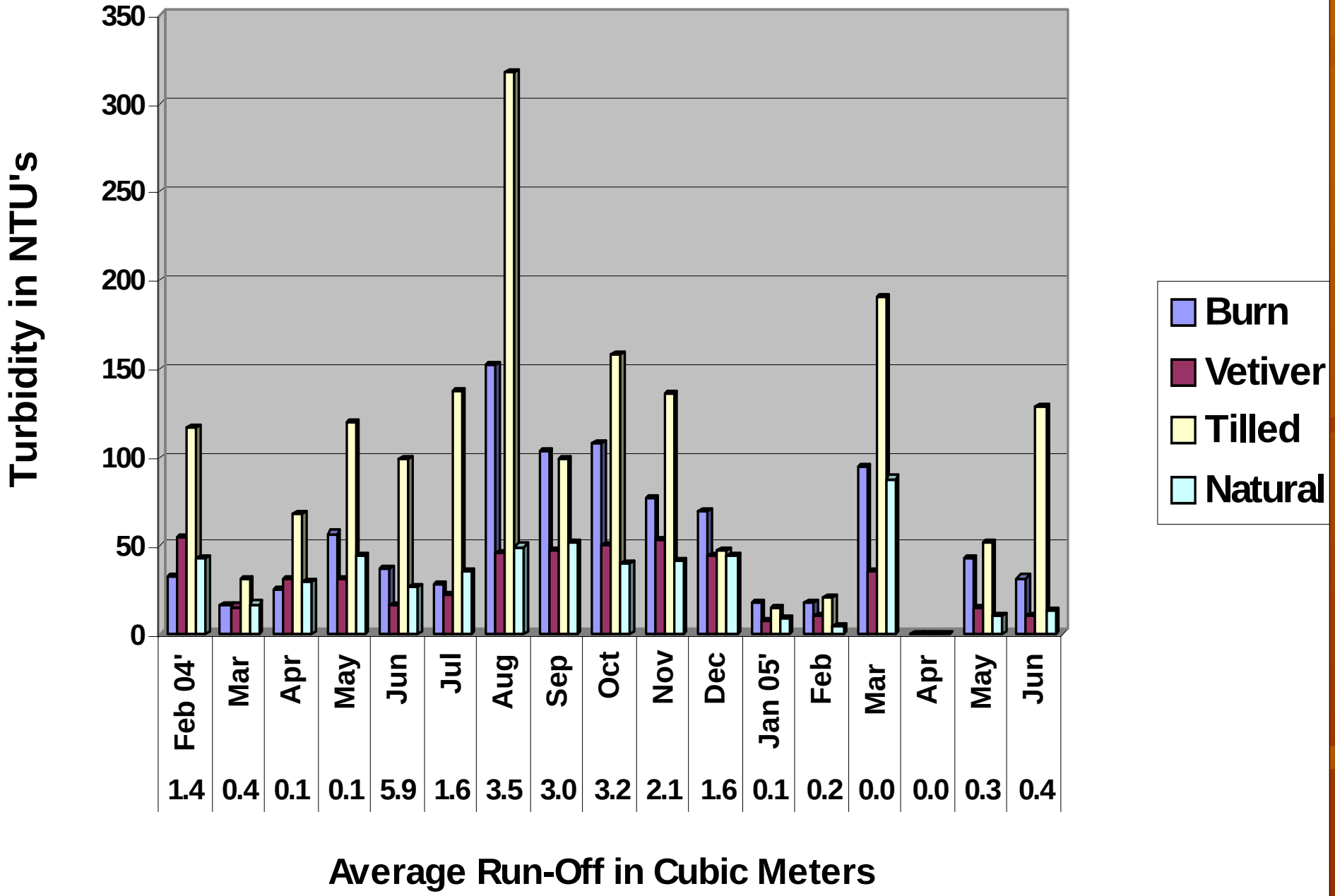
Soil Loss vs. Rainfall



Size and slope of the study plots			Management practices (Soil surface conditions)	Soil loss (tons/ha/yr)
Area ha	Length m	Slope %		
0.0037	21.95	12	Burn	14.13
0.0037	21.95	12	Vetiver	1.47
0.0037	21.95	12	Till	104.75
0.0037	21.95	12	Natural	5.22

Table 2 : Annual Soil loss from each plot with different treatments.

Run-Off vs. Turbidity




Vetiver
Natural
Burn
Bare Soil

Concluding Remarks

- Vetiver Technology is viable system for mitigating sedimentation at the watershed level for the water quality improvement and environmental preservation

Concluding remarks (cont'd)

Preserving natural resources and

Maintaining cleaner environment requires:

- Highly coordinated holistic approach towards natural resource management that include:
  - Soil
  - Water
  - Rangelands
  - Forests
  - And watershed protection


Thank You
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