Using Vetiver Technology for Watershed Management for Water Quality Improvement

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Human Activities
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
Use of Vetiver Technology
For
Trapping sediment
At the
Watershed level.
What Is Vetiver Grass

- Scientific Name: *Vetiveria Zizanioides*
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

- Scientific Name: *Vetiveria Zizanioides*
Comparison between Common Savanna Sword Grass and Vetiver grass Root systems

Local Sword Grass  Vetiver Grass
Main Uses

Badland

Six Months after Planting
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.
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.
Cross Island Road Project (4 treatments)

- Burned
- Vetiver & Sunn Hemp
- Tilled
- Natural Cover
Flume & Sampling Setup

Flume Drain

Sampling Design

Sampling Protocol

Tank Drainage
RESULTS
<table>
<thead>
<tr>
<th>Initial soil characteristics</th>
<th>Management Practices</th>
<th>Soil characteristics as affected by study treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Texture (%)</td>
<td></td>
<td>Soil Texture (%)</td>
</tr>
<tr>
<td>O.M. (%)</td>
<td>Clay</td>
<td>Sand</td>
</tr>
<tr>
<td>3.9</td>
<td>54.4</td>
<td>24.9</td>
</tr>
<tr>
<td>3.9</td>
<td>54.4</td>
<td>24.9</td>
</tr>
<tr>
<td>3.9</td>
<td>54.4</td>
<td>24.9</td>
</tr>
<tr>
<td>3.9</td>
<td>54.4</td>
<td>24.9</td>
</tr>
</tbody>
</table>

Table 1.: Soil characterization prior and following the treatments.
### Size and slope of the study plots

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>Length (m)</th>
<th>Slope (%)</th>
<th>Management practices (Soil surface conditions)</th>
<th>Soil loss (tons/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0037</td>
<td>21.95</td>
<td>12</td>
<td>Burn</td>
<td>14.13</td>
</tr>
<tr>
<td>0.0037</td>
<td>21.95</td>
<td>12</td>
<td>Vetiver</td>
<td>1.47</td>
</tr>
<tr>
<td>0.0037</td>
<td>21.95</td>
<td>12</td>
<td>Till</td>
<td>104.75</td>
</tr>
<tr>
<td>0.0037</td>
<td>21.95</td>
<td>12</td>
<td>Natural</td>
<td>5.22</td>
</tr>
</tbody>
</table>

Table 2: Annual Soil loss from each plot with different treatments.
Run-Off vs. Turbidity

Turbidity in NTU's

Run-Off in Cubic Meters

0 50 100 150 200 250 300 350

Jan 05' Jan 04' Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan

Burn
Vetiver
Tilled
Natural
Concluding Remarks

- Vetiver Technology is viable system for mitigating sedimentation at the watershed level for the water quality improvement and environmental preservation
Preserving natural resources and maintaining a cleaner environment requires:

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

- Use of Vetiver System for shoreline erosion control.
- Use of Vetiver System as a bioremediation technique for reducing and/or eliminating the contaminants (i.e. N, P) from wastewater before entering the ocean.
- Vetiver growth performance in different media: distilled water, wastewater effluent, and ocean water – all with and without fertilizers.
Thank You