Sustainable Erosion Control on North Florida Riverbanks: A Comparative Study of Vegetative Treatments versus Rock Armoring

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Background Information

Previous research:

- Frequent intense rainfall in regions such as Florida can trigger erosion and slope failures along roadsides and streambanks (USDA Forest Service 2006; Minnesota Stormwater Manual 2021).
- Conventional erosion control often involves vegetation seeding or rock armoring. Vegetation can enhance habitat, improve water quality, and be cost-effective. Rock armoring (e.g., riprap) offers strong, immediate protection against high-energy flow.
- Research suggests that well-managed vegetation can bind soil effectively on moderate slopes, while more severe conditions may require sturdier approaches (Asima et al. 2022).

A model of vegetation seeding on the left and rock armoring on the right

Current Technique Issues:

- For erosion protection, vegetation alone may struggle on very steep or heavily scoured slopes due to shallow roots and growth stages.
- In contrast, rock armoring can be expensive and lacks ecological benefits since it typically prevents plant growth.
- Neither method fully addresses all needs in high-rainfall environments, highlighting a gap in cost-effective, eco-friendly solutions for steep embankments.

Goal and Expectation:

Evaluate how vegetation-based techniques compare with rock armoring under Florida's rainfall patterns, focusing on sediment reduction, slope stability, and environmental benefits.

Although rock armoring may achieve higher erosion reduction, **strategically chosen vegetation** can provide a balanced approach that offers moderate protection plus habitat value at lower overall cost.

Discussion

Vegetation Treatment:

- Long-Term Monitoring:
  - Extend studies beyond one year to see how vegetation maintains effectiveness over multiple growing seasons.
  - Examine root depth and density over time to quantify stabilization potential.
- Mixed-Method Approaches:
  - Test hybrid techniques combining vegetation with strategically placed rock armoring.
  - Compare effectiveness in different soil types and rainfall conditions.
- Erosion Measurement Enhancements:
  - Potentially utilize LiDAR scanning and drone imaging to detect subtle erosion changes.
  - Conduct water turbidity analysis to measure sediment runoff from each method.

Vegetation Treatment:

- Cost-Benefit Analysis:
  - Assess long-term maintenance costs and effectiveness to determine the best value per dollar spent.
- Environmental Impact Studies:
  - Evaluate effects on local biodiversity, water quality, and habitat restoration.
- Site-Specific Effectiveness:
  - Study results in different river conditions, such as meandering streams vs. straight riverbanks.
  - Identify thresholds where vegetation alone is insufficient, and reinforcement is necessary.

Methods and Anticipated Results

Vegetation Treatment:

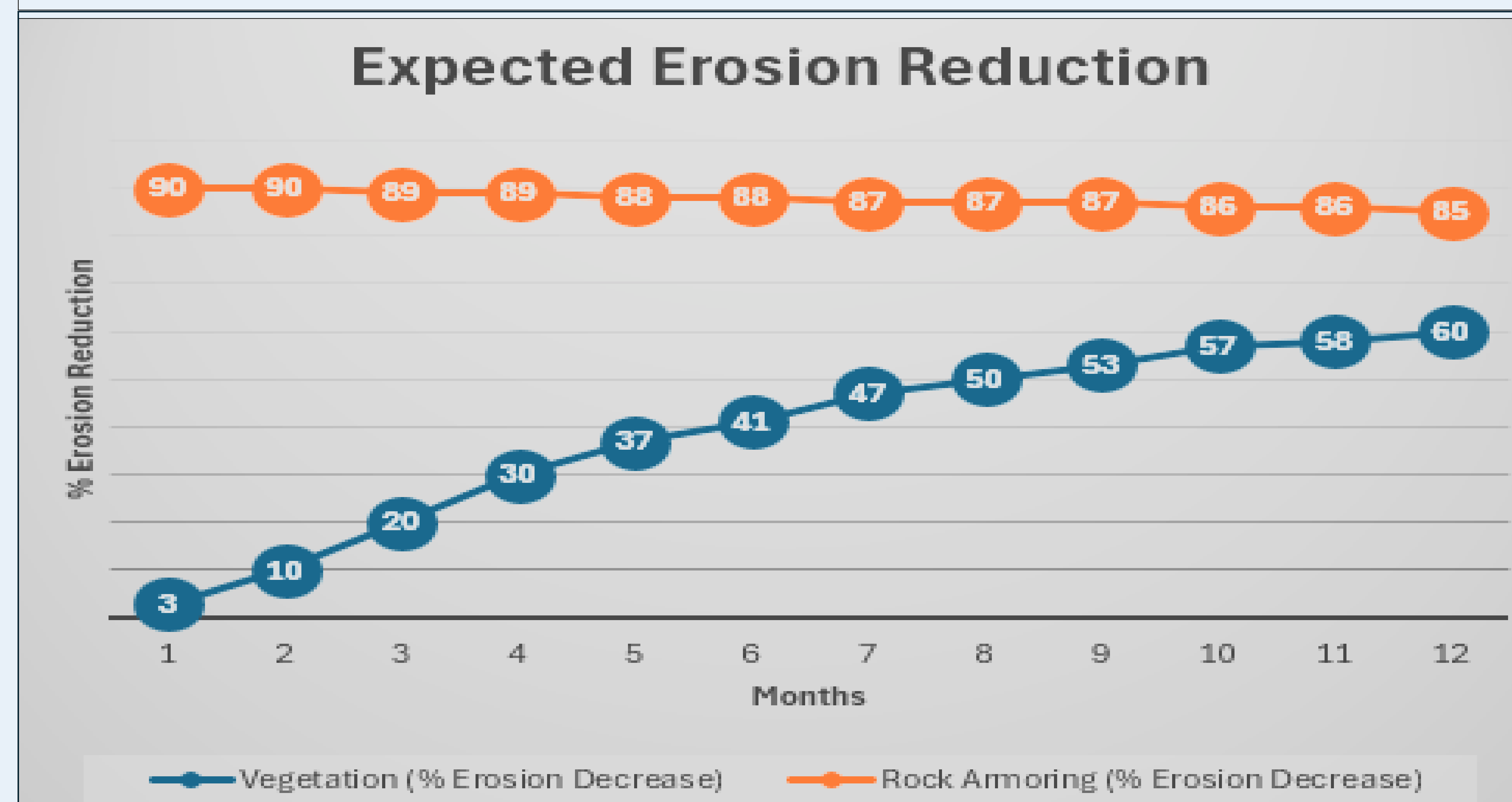
- Starts at 3% erosion reduction in Month 1.
- Gradually increases to around 60% by Month 12.
- Indicates slow but steady improvement as vegetation establishes.

Rock Armoring:

- Begins with approximately 90% erosion reduction from the start.
- Remains high throughout the year, decreasing slightly to about 85% by Month 12.
- Provides immediate and consistent high-level protection.

Overall Comparison:

- Vegetation improves over time but starts with minimal effect.
- Rock armoring offers strong initial performance with a modest downward trend.



Resources

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