Kihei Wastewater Reuse Pilot

Ridge to Reefs & Sunshine Vetiver Solutions

Team

Ridge to Reefs team for this project

John Astilla
Sunshine Vetiver Solutions

Collaborators include:

John Astilla with Sunshine Vetiver Solutions

Maui Nui Resource Council

Maui College

MAUI NUI
MARINE RESOURCE COUNCIL

Other examples of our team's nature-based wastewater solutions
Bioreactor Garden for addressing cesspools

Context

- **The Problem:** Maui County Wastewater Reclamation (particularly as tourism has returned) has an excess of R-1 wastewater that must either be disposed of or reused – (R-1 is the highest standard of quality for reusing wastewater)
- **The Opportunity:** Ridge to Reefs Team has funding from NFWF to pilot test several scalable solutions using biological processes for wastewater reuse or treatment
- **Benefit:** These nature based practices are:
  - low cost
  - low maintenance
  - sequester large amounts of CO2
  - use very little energy
  - Can be implemented quickly

In this talk…

Project goal:

Provide and test low cost viable options for wastewater reuse that minimize impacts on the Maui environment and coral reefs and compliance with all regulations

Three Different Strategies Proposed for Testing

1. **Reuse via land application using restoration (vetiver) and native plants efficient at evapotranspiration and nutrient/pollutant removal**
2. Treatment using a bioreactor and natural filtration technology to clean the water so that it approaches as low a nitrogen level as possible increases the disposal possibilities to include food production agriculture and re-injection
3. Test a "Water Quality" SAT Basin that uses evaporation, evapotranspiration and water quality improvements to dispose of wastewater and minimize risk to groundwater and surface water

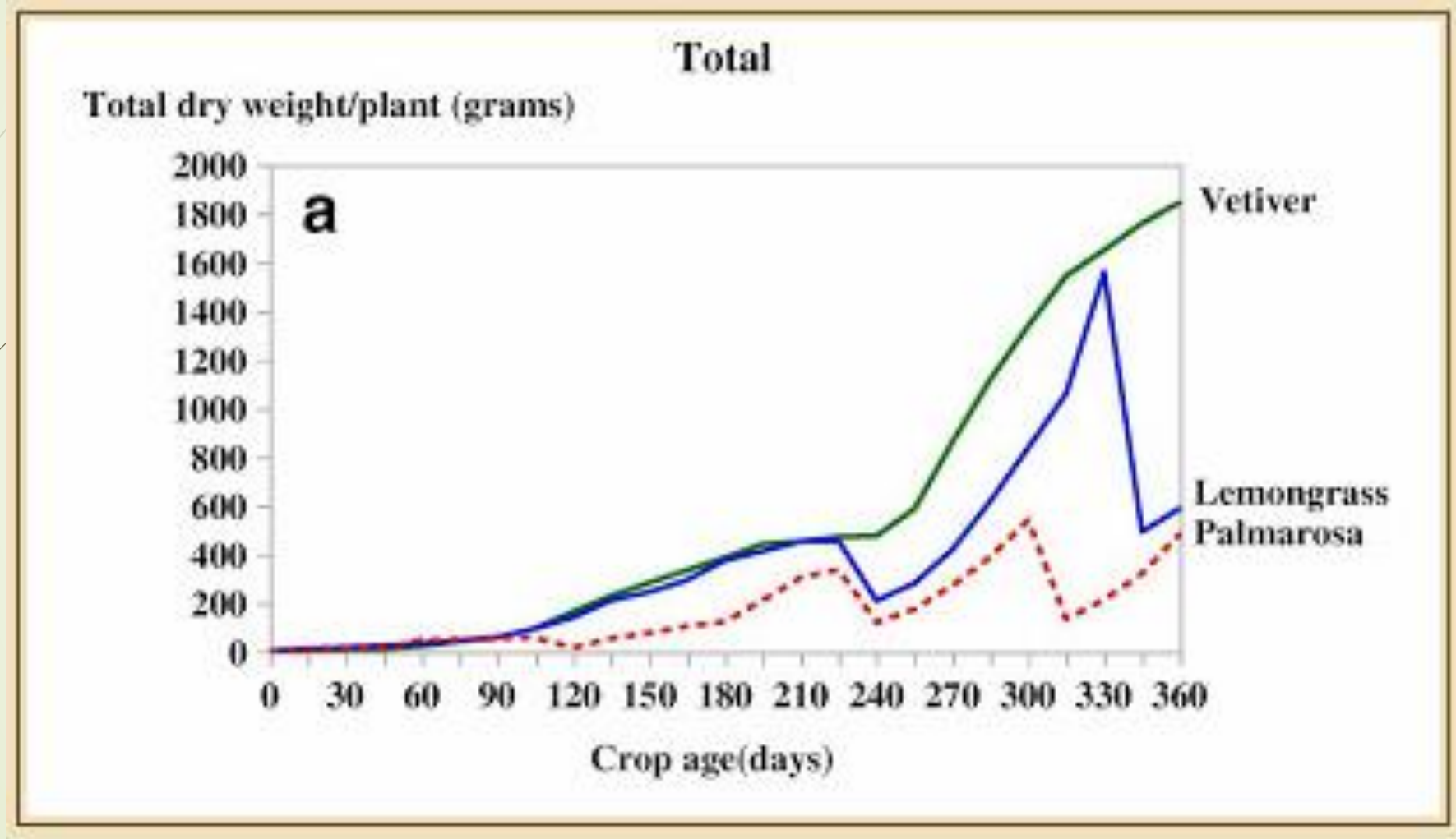
1. Reuse via land application -- surface and subsurface irrigation

Vetiver grass and history

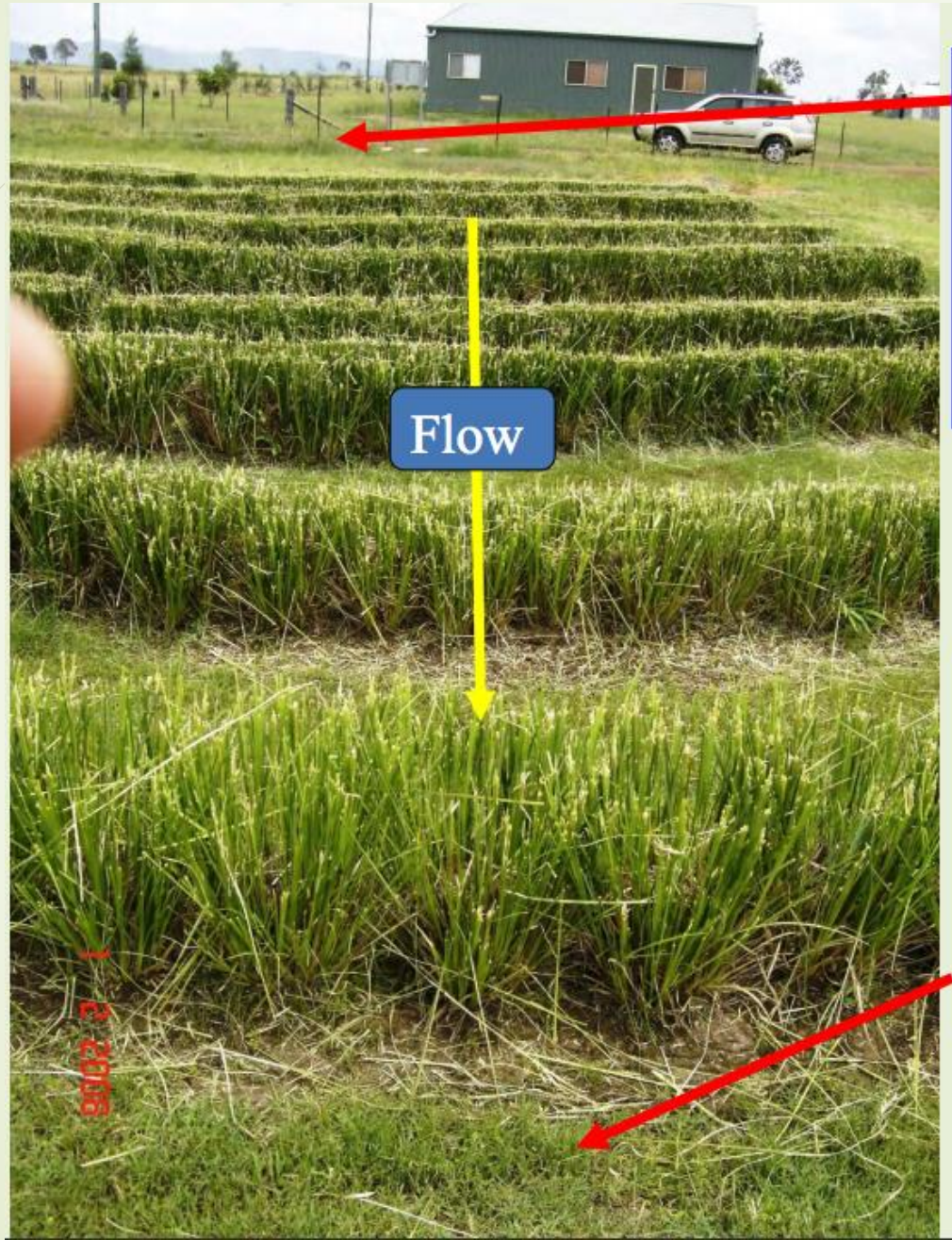
- Vetiver grass characteristics and usage
- History / usage in Hawai'i
- This project history
- County's Brown and Caldwell Study (2018)

Figure 10. After two large rain events and less than two months in the ground

Vetiver grass does not have an annual cessation period like other grasses and crops



Performance



IN FLOW

Average daily flow: 1 670L

Average total N: 68mg/L

Average total P: 10.6mg/L

Average Faecal Coliform:>8 000

SUMMARY

OUT FLOW

Average daily flow: Almost Nil*

Average total N: 0.13mg/L

Average total P: 0.152mg/L

Average Faecal Coliform:<10

* Only flow after heavy rain

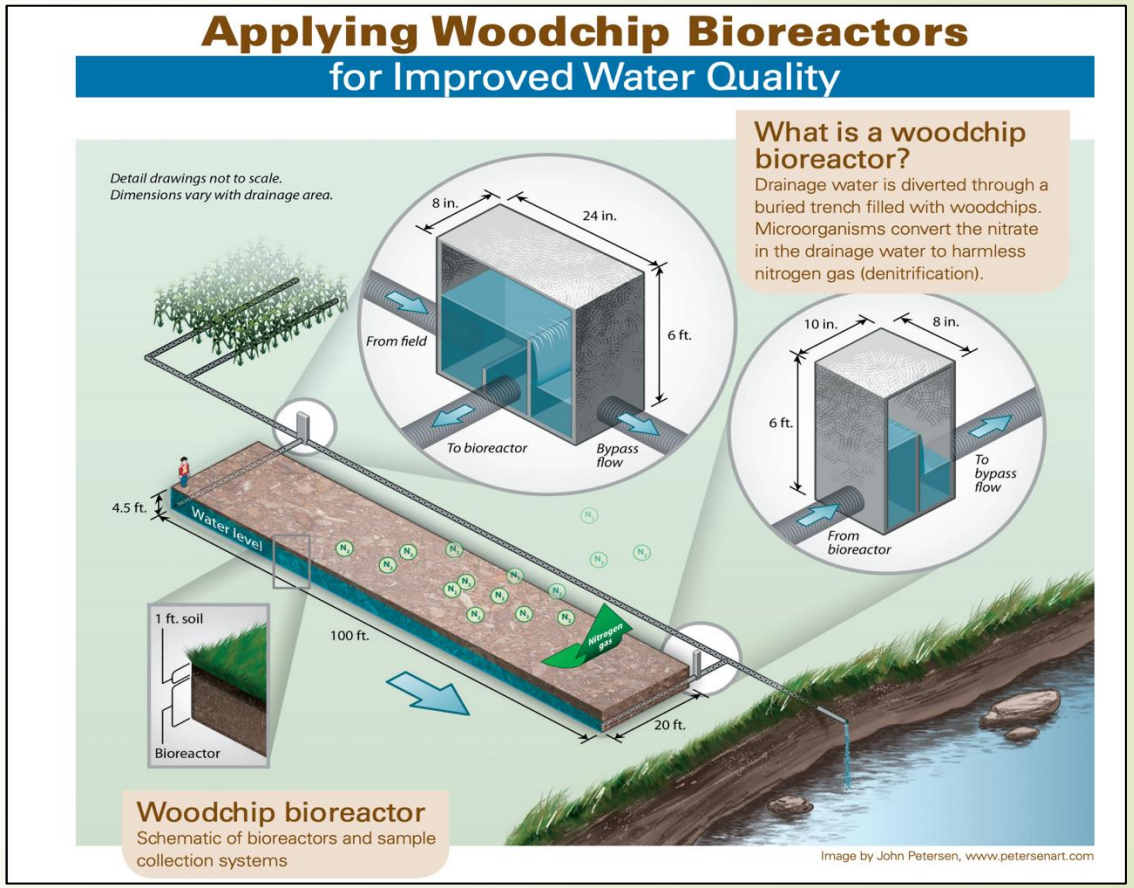
(Truong and Hart, 1991)

Kihei Project

- Sprinklers and drip irrigation
- Relative low cost to implement
- Rapid growth and expansion

2. Denitrifying bioreactor

- Highly effective at removing nitrate, pharmaceutical compounds, etc
- Use sand pre-filter and woodchips as fuel for bacteria which breakdown contaminants
- Combined with a second stage biochar and sand filter to further improve Water Quality -- increase dissolved oxygen and further reduce pharmaceuticals



Denitrifying Bioreactor Construction

Denitrification Curtain at Ka'anapali Golf Course

3. Modified SAT Basin

- Perform evapotranspiration, water quality treatment and protection of underlying aquifers
- Use sand, biochar and vetiver grass

“Modified” SAT Basin Benefits

- Protects underlying groundwater
- Perform evapotranspiration, water quality treatment and protection of underlying aquifers
- Use basalt sand, biochar and vetiver grass

4. Monitoring

1. Determine the ability of vetiver grass (square ft basis) to uptake processed wastewater using both surface and subsurface irrigation without impacting groundwater or surface water quality
2. Determine the ability of denitrifying bioreactors and biofilters in combination in order to determine how close we can come to low nitrogen and water quality objectives ie. Nitrate < 2mg/l, reduced pharmaceutical compounds
3. Determine the ability of a modified SAT basin to reduce the volume and improve quality of treated discharge in a shallow constructed basin


100'
160'
PERIMETER ROW OF
VETIVER (NON-IRRIGATED)
INFILTRATION/SAT BASIN W/ VETIVER
BIOCHAR SAND FILTER
WOODCHIP BIOREACTOR
5'
VETIVER SURFACE IRRIGATION AREA
VETIVER ROWS (20 TOTAL)

Next Steps

- Monitoring
- Determination of land area needed for various practices
- Costs of practices for establishment
- Reporting back to County and Stakeholders

Relevant Literature

- Olga Mutera,*, Ingus Peŗkonsb, Vadims Bartkevičs, 2019. Removal of pharmaceutical residues from wastewater by woodchip-derived biochar https://pdfs.semanticscholar.org/8362/07f3e75387afa55c70fd3e913f3ebf2c3fca.pdf
- Schipper,L.A.,W.D. Robertson, A.J. Gold, D.B. Jaynes, S.C. Cameron, 2010. Denitrifying bioreactors–an approach for reducing nitrate loads to receiving waters. Ecol. Eng., 36 (2010), pp. 1532-1543 ArticleDownload PDF
- Moorman et al., 2010 T.B. Moorman, T.B. Parkin, T.C. Kaspar, D.B. Jaynes. Denitrification activity, wood loss, and N2O emissions over 9 years from a wood chip bioreactor. Ecol. Eng., 36 (2010), pp. 1567-1574
- Rambags*, F.; Tanner, C.C.; Schipper, L.A. (2019) Denitrification and anammox remove nitrogen in denitrifying bioreactors. *Ecological Engineering. 138: 38-45.*
- Rambags*, F.; Tanner, C.C.; Schipper, L.A. Stott, R. (2019) Bacteria and virus removal in denitrifying bioreactors: effects of media type and age. *Ecological Engineering. 138: 46-53.*