Development of a sustainable waste treatment system for a coastal Fijian village

Wai Votua
Wai ni Cola i Qwata
Management issues addressed:

- Sewage pollution
- Declining coastal resources

Overall project objective:

Improve wastewater disposal systems to safeguard the health of the village, the river and the coral reef.
How this will be done:

- Health risk and environmental assessment
- Developing, testing and demonstrating sustainable water treatment solutions
- Building local knowledge and capacity
Who’s involved and what’s their role:

• NIWA (Chris, Tom, Rebecca) – Oversee project implementation; assist with design of wastewater systems and maintenance schedule; assist with health assessment and components on the project.

• ESR (Ann & Miria) – Assist with health assessment and components on the project.

• EcoEng (Andrew) – Assist with design of wastewater systems and maintenance schedule.

• University of the South Pacific (Prof. Bill & group) – Oversee project implementation; conduct water quality sampling; assist with workshops and training; incorporate transferable information into other FLMMA activities.

• Vili Jeke – Oversee, coordinate, and assist with construction and installation of wastewater systems; conduct training for system maintenance and repair; assist with communication with village.

• Reef Explorer (Victor) – Assist with project implementation, integration, coordination of activities, and communication with the village.

• Votua village – Main project beneficiary. Assist with design of systems; provide manpower for installation of systems; maintain systems.
Health risk and environmental assessment

Septic discharges

Drain

Beach

River
Water quality monitoring

- Nutrients (Nitrogen, Phosphates)
- Faecal indicator bacteria
- Organic enrichment (BOD)
- Suspended sediments / turbidity
Votua River Water Quality (2006-2008)

**Danger** = >550 EC/100mL

**Alert** = 260 - 550 EC/100mL

**Acceptable** = <260 EC/100mL
River profile
Nov 2007

Upper housing

200m d/stream housing

grey & blackwater discharge #1

Grey & Blackwater discharge #2

River mouth by piggery

~4000/100mL

~3000/100mL

1700/100mL

~3000/100mL

1600/100mL

400/100mL

500/100mL

600/100mL

bathing area

Before Votua bridge

d/stream housing

River sediment by piggery

400/100mL 500/100mL 600/100mL
Rainy weather – sitting water

Surface water around village
Surface water

Clean water

puddles

rainwater

Old wash out

Leaking tap
Health diaries and household visits

Identified common health issues that may be water related:

• Diarrhea
• Vomiting
• Boils
• Skin rash & infections
Developing, testing and demonstrating sustainable water treatment solutions

Waste water systems need to remove:

- Nutrients to protect reef (Nitrogen + Phosphate)
- Pathogens to protect human health
Wastewater treatment systems also needs to be:

- Affordable to build and maintain
- Robust under local conditions
- Simple to understand, design, construct and replicate in other areas
  - build upon existing infrastructure and approaches
- Easy to operate and maintain
  - minimal technical knowledge and ongoing costs
- Minimal reliance on pumps and electricity
  - use gravity wherever possible.
Wastewater treatment systems
- capable of nutrient removal
- sustainable and appropriate

- Conventional western centralised sewerage and treatment systems
  - too expensive
  - inappropriate
- On-site treatment and disposal
  - Mechanised package treatment plants
    - too expensive
    - unreliable and unsustainable under Fiji conditions
  - Passive systems (e.g. septic tanks followed by wetlands)
    - Insufficient space in village
Wastewater treatment system: sustainable and appropriate for Votua

- Manage blackwater and greywater separately
- Focus on nutrient removal from blackwater (watch phosphates in GW)
  - Main source of nutrients & pathogens
  - Option 1 - Composting toilets
  - Option 2 - Hybrid cluster treatment system
(Village wanted to retain flushing toilets)
Design data-wastewater

- Water metering to find out how much water the village uses
  - For design of water supply and wastewater management systems
- Installed water meters in 3 houses (total inflow and toilet cistern)

Pre-water supply upgrade
- Greywater ~110 L/person/day
- Blackwater ~15 L/person/day

Pathogen count in wastewater discharge
Blackwater

- Hybrid cluster treatment system
- Utilise existing septic tanks
- Add extra septic systems
  - clusters 3-5 houses
- Provide additional wetland treatment inland of village
Blackwater System

Collect and treat septic tank water in wetland system
Greywater

- More dilute
- Fewer nutrients (watch out for phosphates!) & potential pathogens
- Aim to keep greywater below-ground
  - Utilise soil / sand filtration
  - Dispose to groundwater where possible
- Avoid surface ponding and clogged, muddy areas around houses
In sandy soils: adapt black-water drum system and use subsurface disposal for grey-water management
Greywater disposal systems

- Twin – drum system
- Into modified drain
- Into large soaker trench
- Into sandy soil option 2
- Into banana trench
Greywater System – Option 1 – Sandy Soils

Plastic drum with holes in lower half.

- Coconut husk
- Coconut shell
- Rock/gravel

Concrete lid

Porous geofabric / weedmat

Sandy soil

2 m (6 ft)

40-50 mm waste pipe
Modified Drain System for greywater disposal

Additional drain for carpark runoff
Option 2a: Pre-filter and pipe to seepage beds in village green (sandy soils)

Or 2b: to vegetated drain

Areas of village with clay soils

Village green with sandy soils

Piping pre-filtered greywater to seepage beds in the village green (or vegetated drain)
Building local knowledge and capacity

- Village workshops + training
  - liquid waste management
  - maintenance & repair of water & wastewater systems
  - health / environment issues

- Involving community members in planning & construction process
Anticipated benefits for Votua:

- Improved wastewater disposal in the village
  - Reduced nutrient and pathogen pollution
  - Improved water quality – creek and reef
  - Healthier village environment
  - Better health & quality of life of villagers

- Improved capacity to deal with wastewater disposal issues:
  - Better construction skills & knowledge of waste disposal systems;
  - Rigorous maintenance program for wastewater systems;
  - Backup plans in case of power or partial system failures.

- Improved understanding of water-related health issues

- Economic benefits from contributions to labor

- International exposure of village resource management activities
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+ Exsley, Patrina & Bale