Integrated Ecosystem Management

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What is “Integrated Ecosystem Management”? 

- Natural resources are used for multiple purposes by a variety of stakeholders
- The key to sustainable environmental management is to integrate the various uses and the needs of the stakeholders into an overall plan
- One useful tool is to integrate environmental protection with economic benefits;
  + Will discuss two examples of treatment of domestic wastewater in:
    - Central Mexico
    - The highlands of Ecuador
CASE HISTORY 1

Mezquital Valley, Hidalgo State

- Recipient of untreated wastewater from Mexico City (>20 million people)
- Flow of >100 m$^3$ per second
- Used to irrigate crops that are non-edible by humans (e.g. alfalfa, fodder corn)
Project “la Coralilla”, Hidalgo State

- Floriculture project using Mexico City wastewater
- Indigenous farmer cooperative
- Subsurface flow wetland
  - Phase I: 2005-2007
  - Phase II: 2007- present
- Design based on pilot scale wetland in Texcoco, MX:
  - Subsurface flow wetlands
  - Grow ornamental flowers
    - Calla lilies
    - Canna lilies
Project “la Coralilla”, Hidalgo State

Phase II:

- Covered green houses
- Aquaculture ponds
- Carp production
  ~5 tonnes/y
- Fish sold on site at a small restaurant
Lessons learned

- Treatment wetlands are practical, low cost systems for treating domestic wastewater produced by:
  - Small communities
  - Farms
  - Small hotels and businesses

- Cooperatives or family units can derive economic benefits from the sewage treatment:
  - Floriculture
  - Aquaculture
  - Irrigation

- Considerable effort required for system maintenance

- Therefore, must be economic or social benefits to the project in order to ensure sustainability
CASE HISTORY 2

Bario Brasilia:

- Small village in the watershed of Lago San Pablo (Imbakucha) in the highlands of Ecuador (>3,000 m)
- Almost entirely indigenous population
- Discharged untreated sewage into the lake
- Destroys wetlands surrounding the lake
- Contributes to “dead zone” in lake below 10 m depth
- Work supported by Canadian International Development Agency

Two components:

- Community outreach and capacity building
- Institutional capacity building (universities, NGOs)
Bario Brasilia
Population = 165
Central sewage collection
No sewage treatment
Mitigation – Treatment Wetland

- Surface flow wetland – 6 cells (each 12 m x 1.5 m)
- Treatment of entire wastewater flow of the village; approximately 3,200 L/d
- HRT = 3.5 days
- Community approval and participation in wetland construction and maintenance
- Promotion of economic incentives for sewage treatment
- Participation of a doctoral student and an honours science student (Licenciatura) from the Catholic University in Ibarra
Surface flow wetland with *Lemna* (duckweed)
Nitrate removal

Nitrate (n=12)

Inflow | Tank | Cell 1 | Cell 2 | Cell 3 | Cell 4 | Cell 5 | Cell 6 | Outflow

Nitrate (mg/L)
Dry *Lemna* and mix with cereal grain
Feed to guinea pigs ("Cuyi")

45% better weight gain with addition of 10% *Lemna* to food
Skin, cook and serve!
Lessons learned

- Treatment wetlands are appropriate systems in rural Ecuador for management of water quality.
- Cost is relatively low (e.g. $4,500 Cdn for surface flow wetland)
- Promote economic benefits: Use of *Lemna* for guinea pig food supplement
- Choice of an indigenous community for the project was an advantage:
  - Cohesive
  - Self-sufficient
  - Resourceful
- Wetland is still operating in Bario Brasilia, but no other communities in the watershed have adopted the technology