Acknowledgements

- MIT: Susan Murcott and Simon Johnson
- Hari Govinda Prajapati
- ENPHO
- IDE Nepal
- Reid Harvey
- Red Cross Society of Nepal
- Integrated Development Society (IDS)
- British Gurkha Welfare Scheme (GWS)
- Mr. Nepal
- DWSS
- Mangala Karanjit
- Professor Subodh Sharma
- Lumanti

Agenda

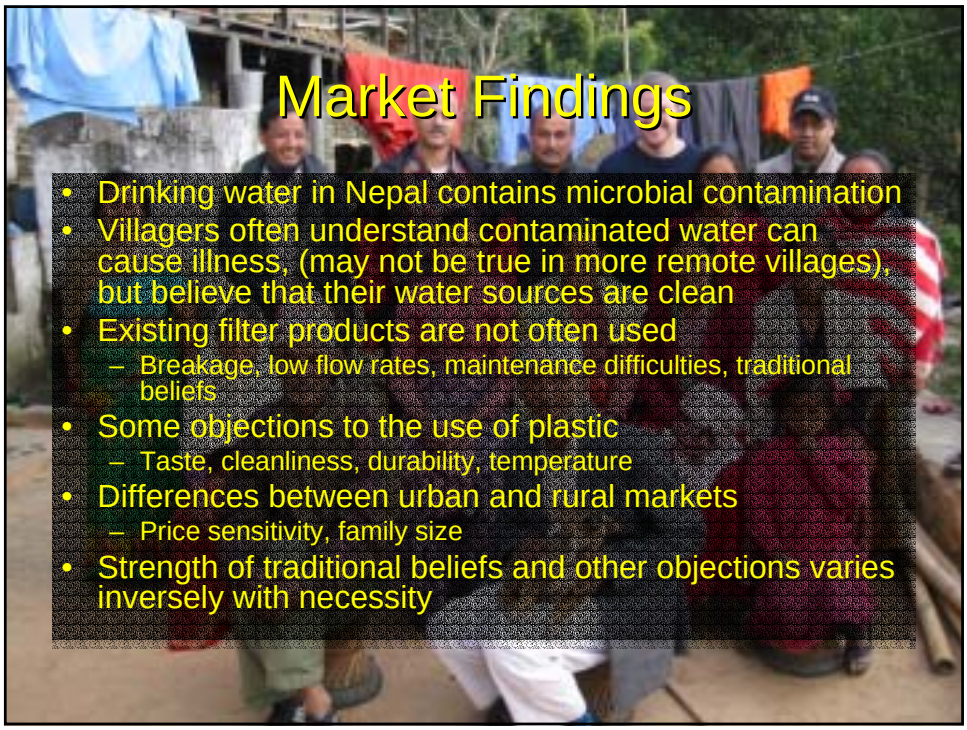
- Introduction
- Market Studies
- Laboratory Studies
- Recommendations:
  - Product Design
  - Business Organization
  - Marketing
  - Future Work
- Questions and Comments

Introduction

- MIT Nepal Water Project
  - CeraMIT is the latest in a line of MIT studies of ceramic filters for removal of microbial contamination in Nepal
  - First time business students have been involved; looking to take advantage of prior studies to promote filter use on a wider scale
- IDE Low Cost Water Filter Project
  - Catalyze the development of Nepali entrepreneurs that will sell a low cost ceramic water filter that removes microbial contamination and is appropriate throughout the hills of Nepal

Market Studies

- Ideal: A thorough, systematic study of the market for a ceramic filter throughout Nepal
- Reality:
  - Discussions with numerous experts
  - Limited field research:
    - 2 villages in hills near Pokhara
    - Retailers in Pokhara
    - 1 village at the edge of Kathmandu Valley
    - 1 Urban community



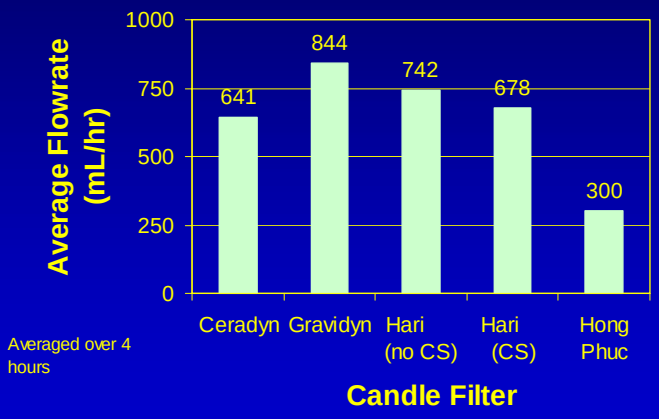
Market Findings

- Drinking water in Nepal contains microbial contamination
- Villagers often understand contaminated water can cause illness, (may not be true in more remote villages), but believe that their water sources are clean
- Existing filter products are not often used
  - Breakage, low flow rates, maintenance difficulties, traditional beliefs
- Some objections to the use of plastic
  - Taste, cleanliness, durability, temperature
- Differences between urban and rural markets
  - Price sensitivity, family size
- Strength of traditional beliefs and other objections varies inversely with necessity

Laboratory Studies

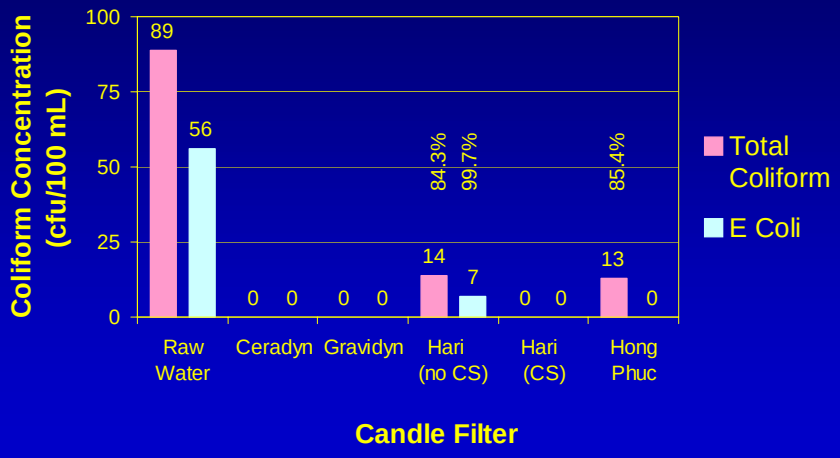
- Tested 5 candle filters
  - Ceradyn (Katadyn), Gravidyn (Katadyn), Hari White Clay with colloidal silver, Hari White Clay without colloidal silver, Hong Phuc
- Tested 3 Disks
  - Hari White Clay disk (2 w/ colloidal silver; 2 w/out)
  - Reid Harvey Red Clay disk (2 w/ CS; 2 w/out)
  - Reid Harvey Black Clay disk (2 w/ CS; 2 w/out)
- Tested for:
  - Flowrate
  - Removal of Total Coliform and E Coli

Candle Filters
Average Hourly Flowrate

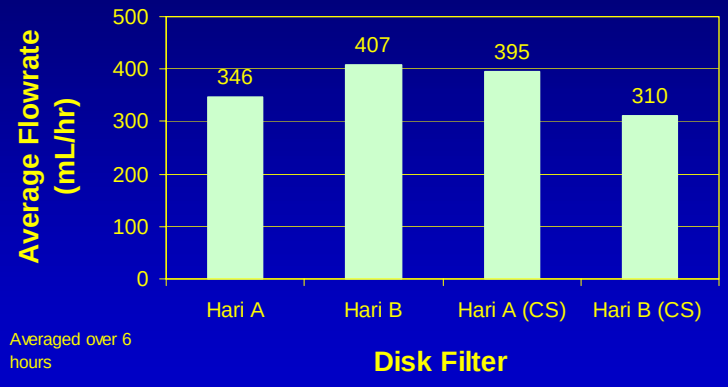


Averaged over 4 hours

Candle Filters
Microbial Removal

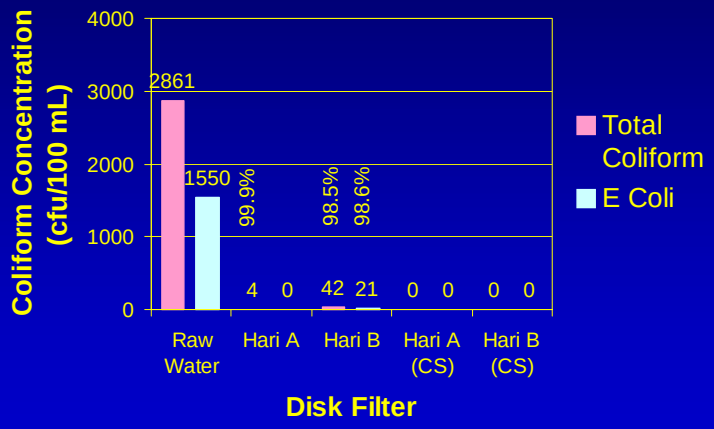


Hari White Clay Disk Filters
Average Hourly Flowrate

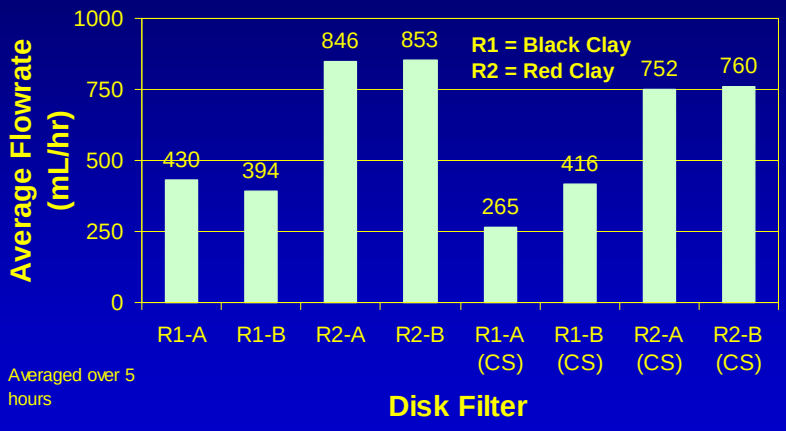


Averaged over 6 hours

Hari White Clay Disk Filters
Microbial Removal

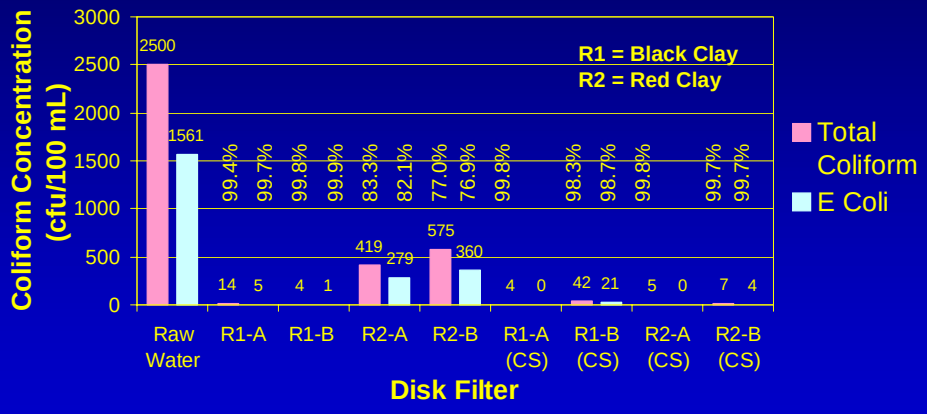


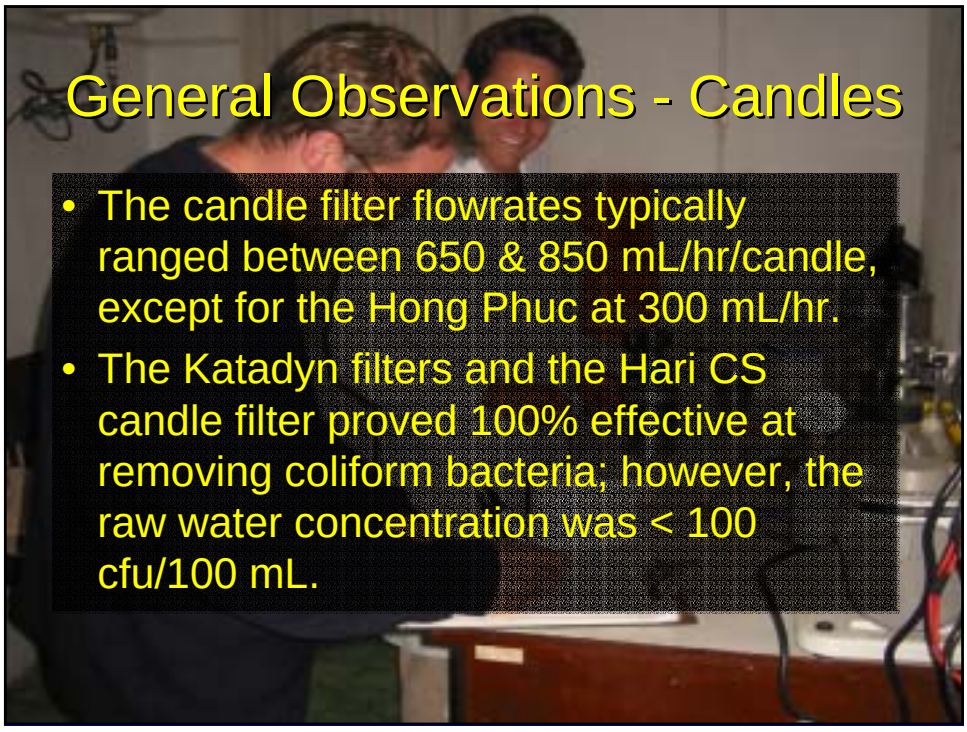
Reid Disk Filters
Average Hourly Flowrate



Averaged over 5 hours

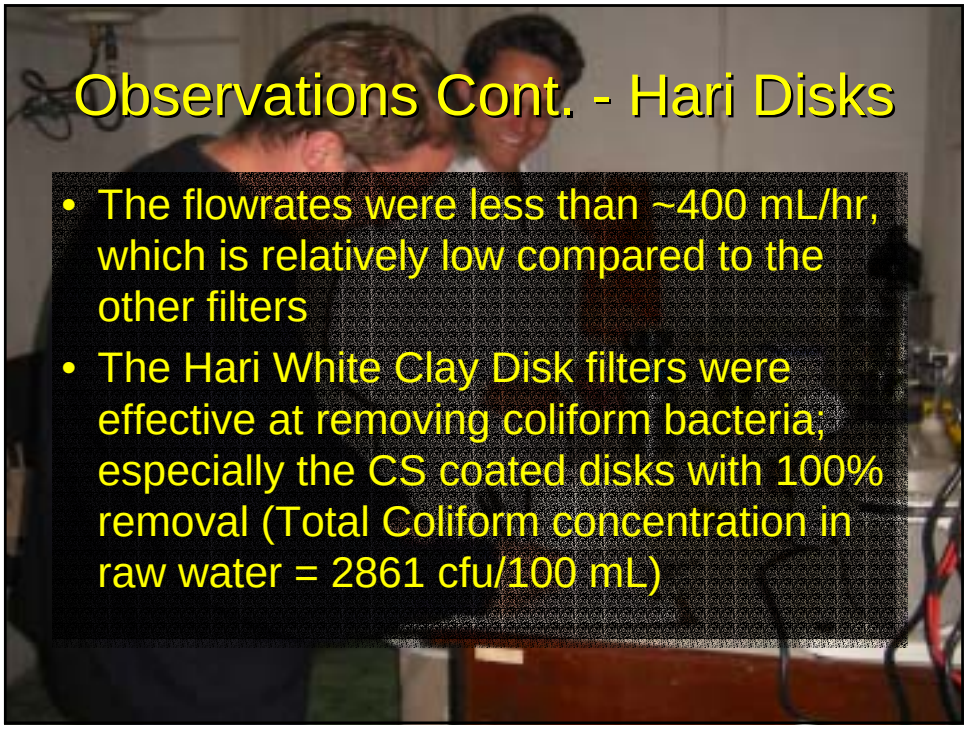
Reid Disk Filters
Microbial Removal





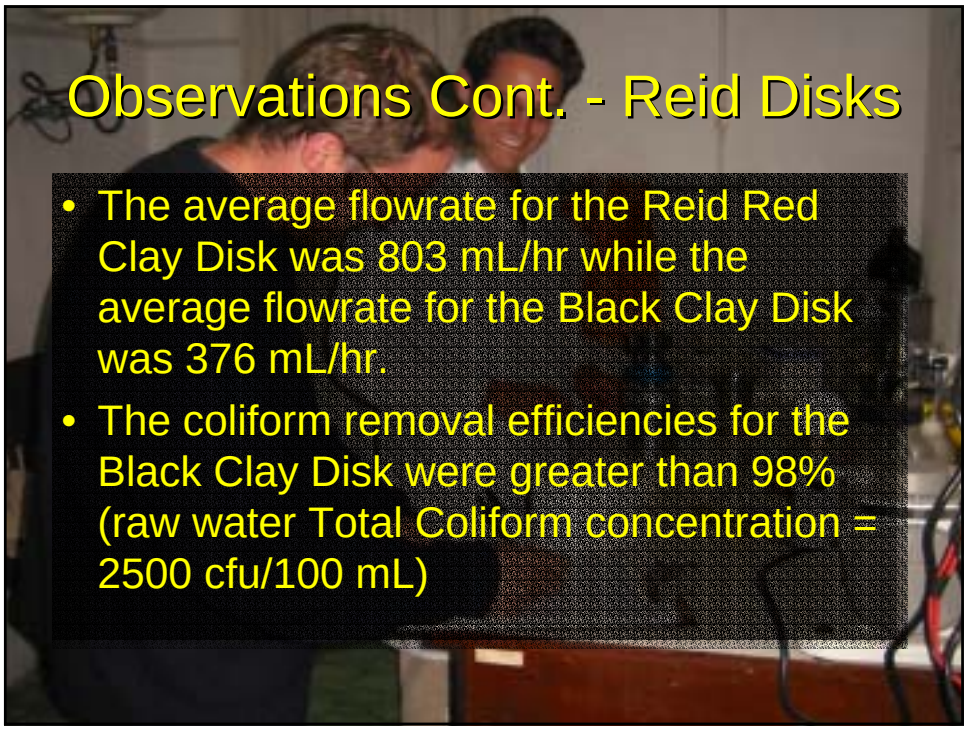
General Observations - Candles

- The candle filter flowrates typically ranged between 650 & 850 mL/hr/candle, except for the Hong Phuc at 300 mL/hr.
- The Katadyn filters and the Hari CS candle filter proved 100% effective at removing coliform bacteria; however, the raw water concentration was < 100 cfu/100 mL.



Observations Cont. - Hari Disks

- The flowrates were less than ~400 mL/hr, which is relatively low compared to the other filters
- The Hari White Clay Disk filters were effective at removing coliform bacteria; especially the CS coated disks with 100% removal (Total Coliform concentration in raw water = 2861 cfu/100 mL)



Observations Cont. - Reid Disks

- The average flowrate for the Reid Red Clay Disk was 803 mL/hr while the average flowrate for the Black Clay Disk was 376 mL/hr.
- The coliform removal efficiencies for the Black Clay Disk were greater than 98% (raw water Total Coliform concentration = 2500 cfu/100 mL)

Observations Cont. - Reid Disks

- The coliform removal efficiencies for the Red Clay Disks ranged from 77% to 83% for the non-coated CS filters while the filters coated with CS had removal efficiencies greater than 99.7%.
- Reid's disks were slightly less durable than Hari's disks, with sand-size particles falling off during cleaning.

Lab Test Conclusions

- The results from these tests support the hypothesis that colloidal silver helps to inactivate coliform bacteria.
- The validity of the test results is limited to the one day of testing - they do not prove anything beyond 1 day of use.

Recommendations: Testing

- Lab Testing
  - Long-term performance testing (weeks to months)
  - Challenge testing (varying microbial concentrations)
  - Colloidal silver testing (colloidal silver concentration & effectiveness over time)
- Field Testing
  - Long-term performance testing (months)
  - Rainy/dry season conditions
- Durability Testing

Recommendations: Testing Cont.

- Media & shape variations
  - Vary material (porosity, durability), surface area/shape, & thickness.
- Best bets for future studies:
  - Hari's White Clay Candle Filter with capped ends.
  - Reid's Red Clay Disk Media coated with CS, provided it can be made more durable.
  - Hari's Mixed Grog Clay Disks.

Recommendations: Product Design

- low cost
- high flow rate (2L/hr minimum)
- 20L capacity or more
- light and durable
- easy to carry
- bucket material should not affect taste or smell
- good quality tap (no leaks)
- disk filter element, 9” in diameter
- need a candle for legacy systems
- compact for transport and storage (one bucket should fit inside the other)
- a lid for the top bucket
- an available stand is a plus

Recommendations: Business Organization

- Phase I
  - Local part suppliers
    - Process QC by MIT
    - Onsite QC by IDE
  - Hari Govinda manufactures filters
  - Mass production issues
  - Hari also assembles & distributes kits
    - Available network
    - Expansion capabilities through co-operative
- Phase II?

Recommendations: Future Work

- Formal collaboration between IDE, ENPHO, and MIT
- Thorough scientific testing of prototypes
- Field testing: scientific as well as marketability
- Colloidal silver production
- Continued redesign of prototypes to reduce cost and improve performance
- Investigation of product line expansion
- Consistent women's input
- Study of Colloidal Silver (MIT - Chem E)
- Study of Ceramic Media (MIT - Mat Sci)
- Collaboration with local universities like Kathmandu University


Questions?
Comments?