InStove Water Purifier

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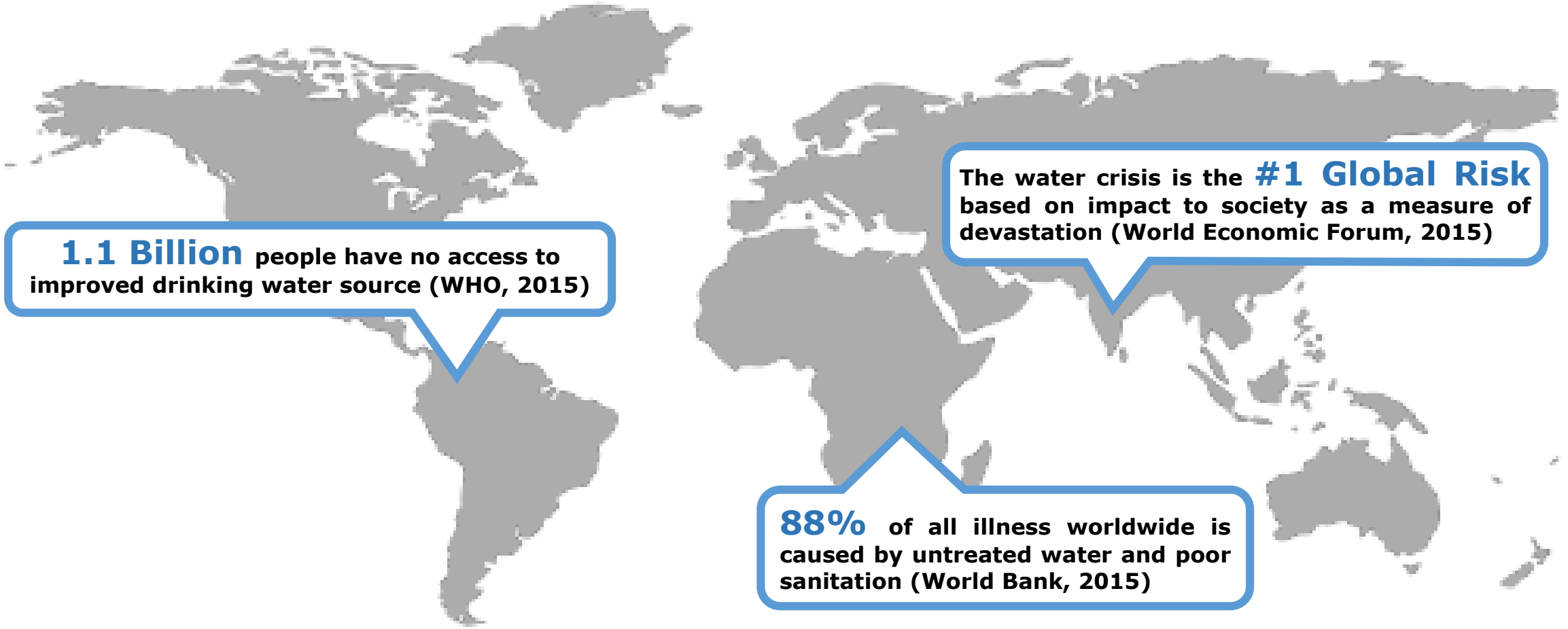
COLLEGE OF ENGINEERING | Humanitarian Engineering Program

Oregon State University


1.1 Billion people have no access to improved drinking water source (WHO, 2015)
The water crisis is the #1 Global Risk based on impact to society as a measure of devastation (World Economic Forum, 2015)
88% of all illness worldwide is caused by untreated water and poor sanitation (World Bank, 2015)


20 L
CHLORINE DISPENSER
Tilu Maji ya Kunywa

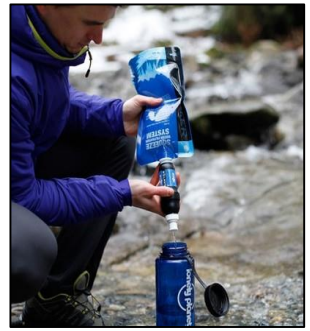

Aquatabs


Water Guard
Your sure way to safe water
The PSI Chlorination Product in Nigeria


eraMaji


HydrAid
BioSand Water Filter


CT
Filtron




CORNFLOUR

Pasteurization Background

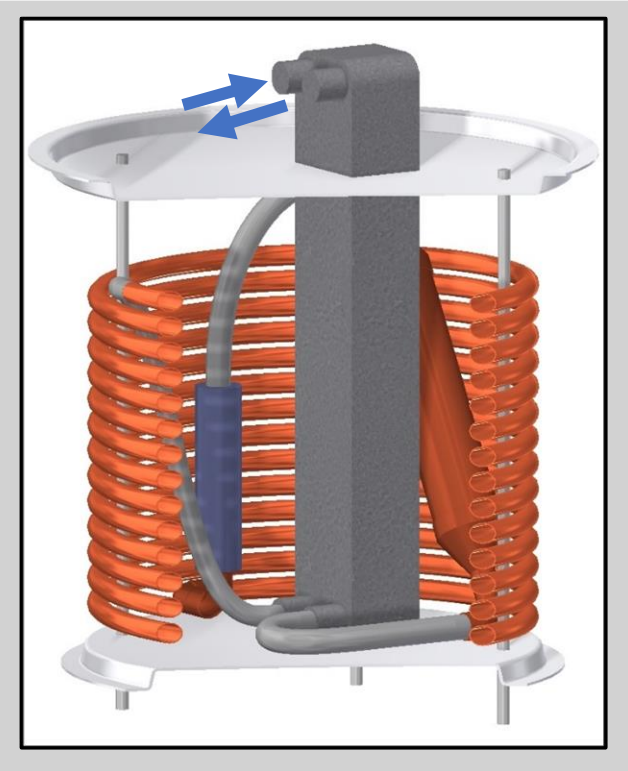
- #1 water disinfection method recommended by WHO (using boiling as a visual indicator)
- Only need to bring temperature to 71° C for most bacteria and viruses
- Costly and inefficient over open-fires
- Bacteria is destroyed based on kill-ratios (specific time and temperature)

Boiling water over open-fire (photo by HuffPost)

InStove Purifier Design

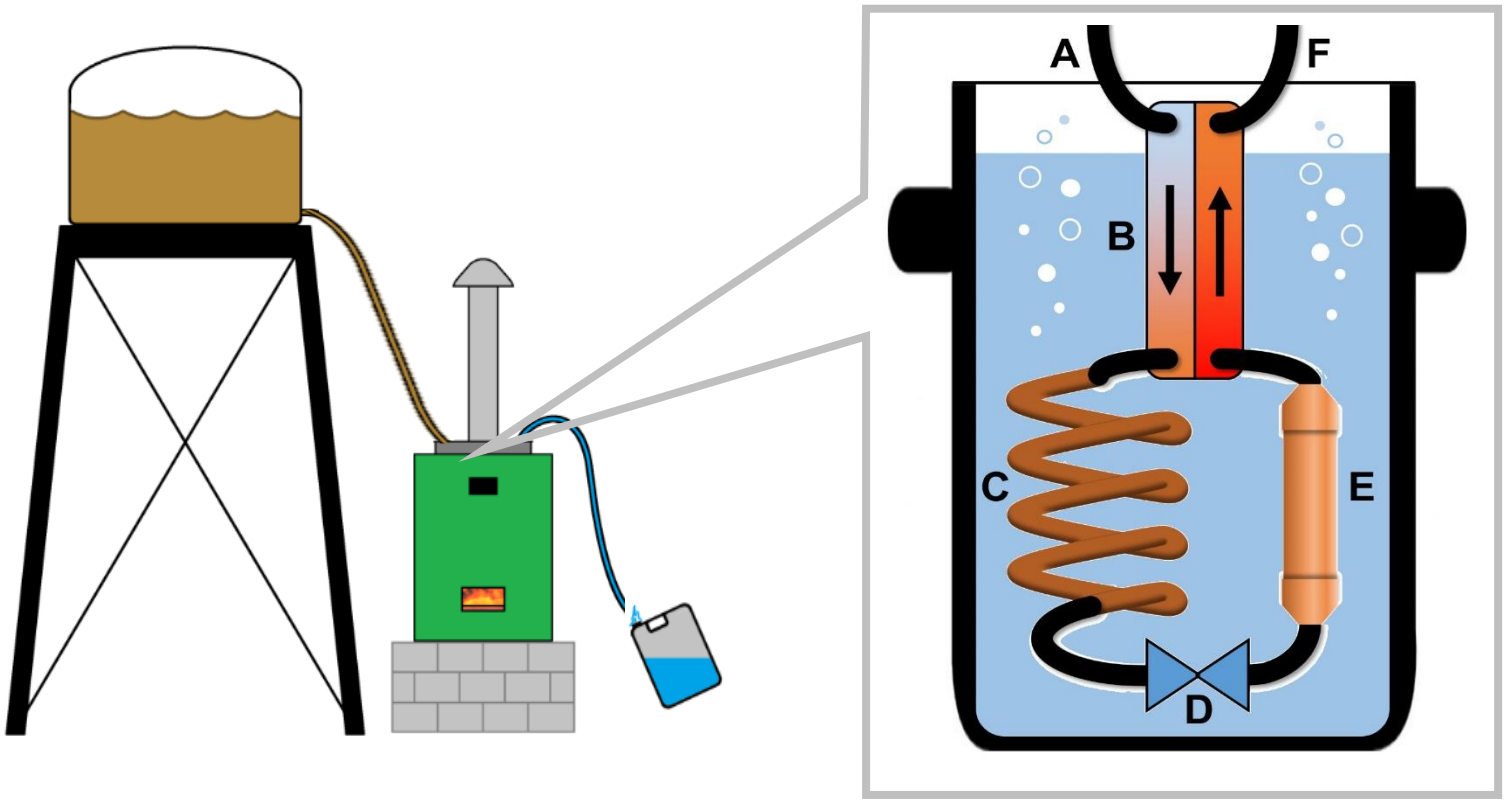
MAPLE employees with the InStove 60 L Stove, MBALE, UGANDA

Water pasteurizer insert in 60 L pot



Water pasteurizer insert

InStove Purifier



Components:

A. Inlet pipe
B. Heat exchanger
C. Heating coil
D. Thermostatic valve
E. Kill chamber
F. Outlet pipe

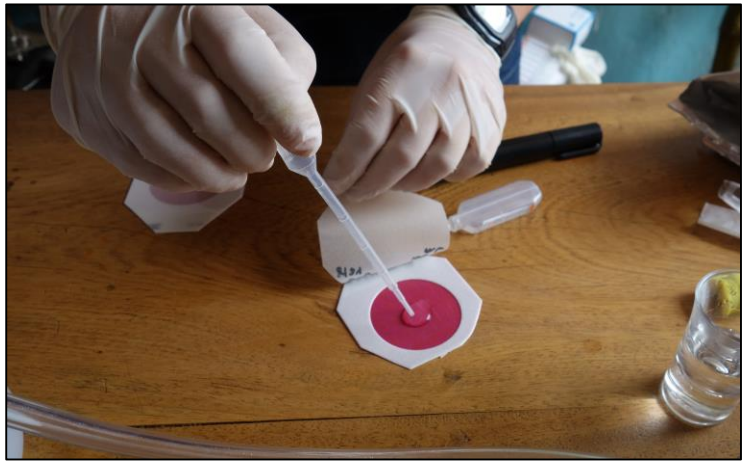
Testing Methods

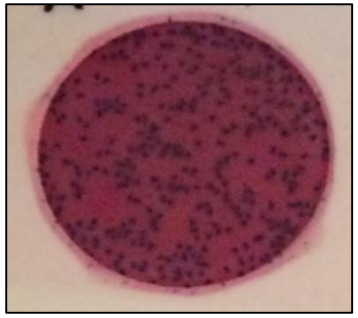
- Lab testing
  - Bacteria removal
  - Throughput and efficiency tests
- Field testing
  - Usability and feasibility in context

Photo from Mbale, Uganda

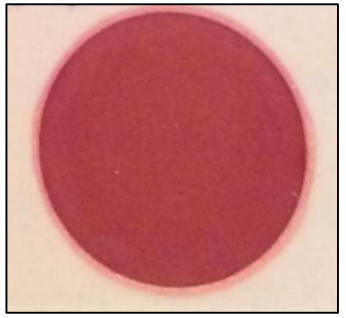
Bacteria Removal

- Inoculated influent water with >100,000 bacteria/mL of *E. coli*
- Used 3M™ Petrifilm™ count plate
- **Results:**
  - Zero presence of coliforms/E. coli in outlet water
  - 99.9999% (6 log) reduction





Inlet water



Outlet water

Throughput & Efficiency

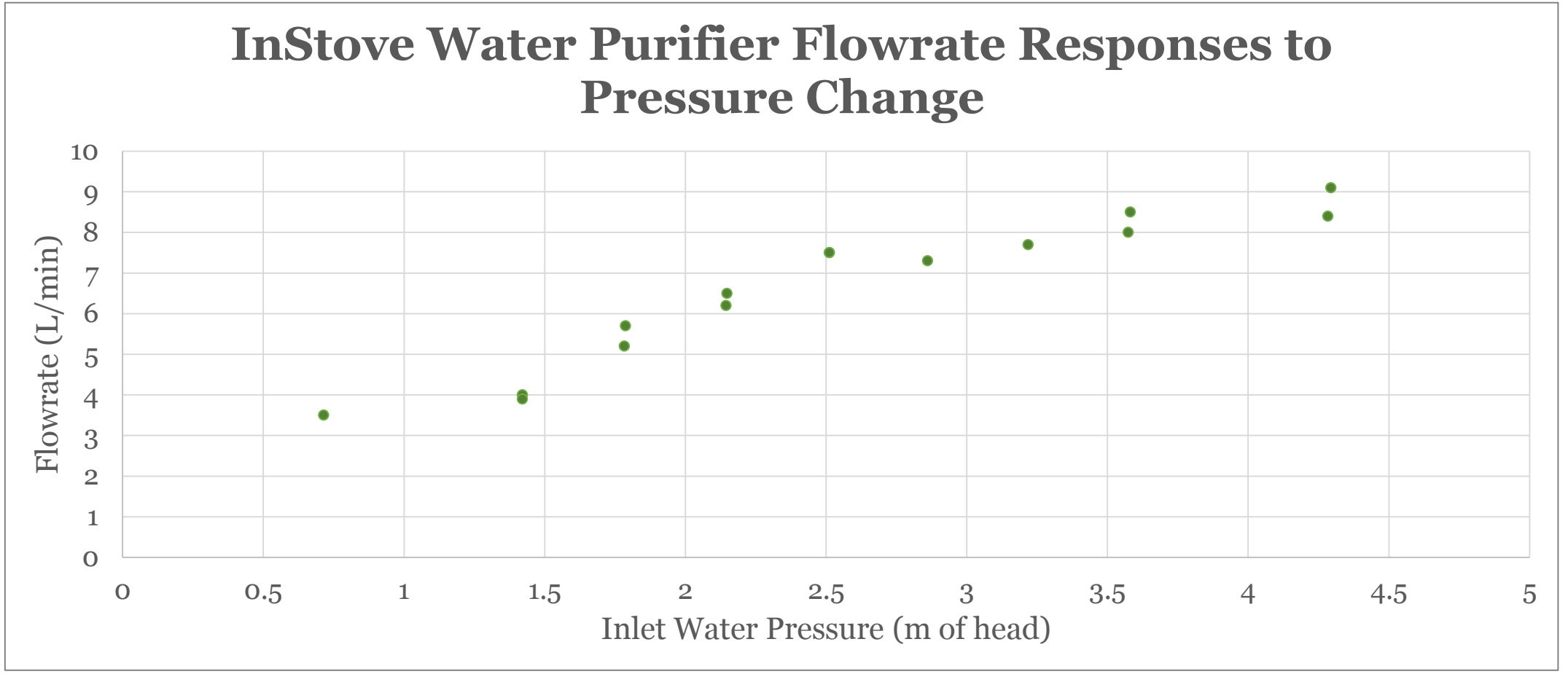
Lab testing

Field testing

InStove vs Boiling

	Boiling on traditional fire	InStove Water Purifier	
Capacity per hr	~ 50 L [i]	~ 250 L [ii]	↑ 400%
Fuel usage	200 g/L [iii]	5.5 g/L [iv]	↓ 97.25%
Temperature of clean water	90 – 100 °C (194 – 212 °F)	25 – 35 °C (77 – 94 °F)	

i. Data from field testing
ii. Data based on average flow rate
iii. MacCarty N, Still D, and Ogle D, 2010, "Fuel use and emission performance of fifty cooking stoves in the laboratory and related benchmarks of performance." Energy for Sustainable Development, 14(3), pp. 161-17.
iv. MacCarty, et.al, 2017, "Design and testing of a high-efficiency rapid throughput community-scale water pasteurization system." IDETC Procedings.


InStove Water Purifier Flowrate Responses to Pressure Change
Flowrate (L/min)
10
9
8
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Inlet Water Pressure (m of head)

Usability in Context

Ethnographic field study in Mbale, Uganda with MAPLE Microdevelopment

Girl's dormitory


Water supply


Implementation

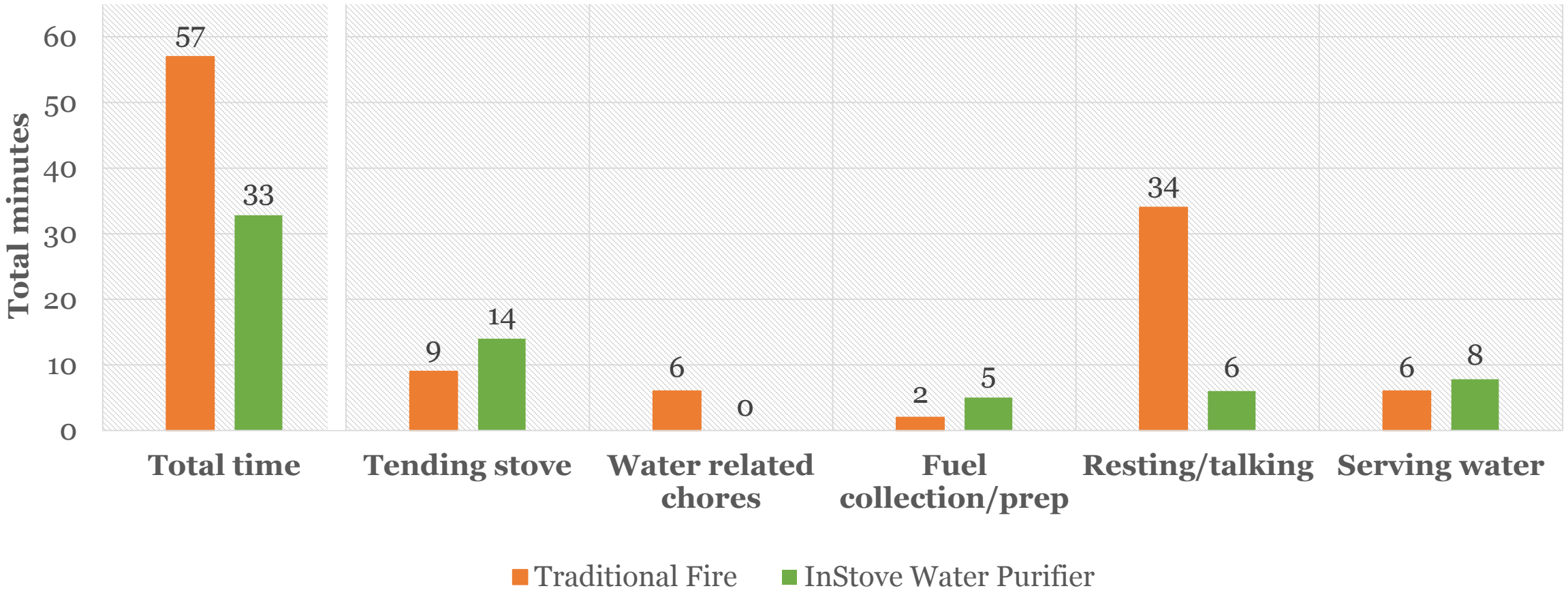
Ethnographic Study

Methods: Participatory observation, focal follow, and time allocation

Traditional fire for water disinfection

Cook serving hot, clean water

Time Allocation Study for 50 L of Drinking Water



Conclusion

- Ethnographic study suggests that users are willing to adopt this technology because…
  - High throughput (they want to start a business)
  - Low temperature of the water
  - Fuel savings

- Potential barriers:
  - Cannot see the fire while cooking
  - Trusting the product
  - Smaller pieces of wood

Acknowledgements

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Thank you for your time.

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