

Development of xylem-based water filters

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Motivation

- As per UNDP standards : Affordable water < 3% of household income
- In India, cost of affordable water for poorest of poor < 12 cents a day

Classification of Water Filters

Reverse Osmosis Filters



Price : \$98-233

Gravity Non-Electric Filters



Price : \$17-50

Conventional Particle Filters



Cloth

Jali

Price : \$0.5-1

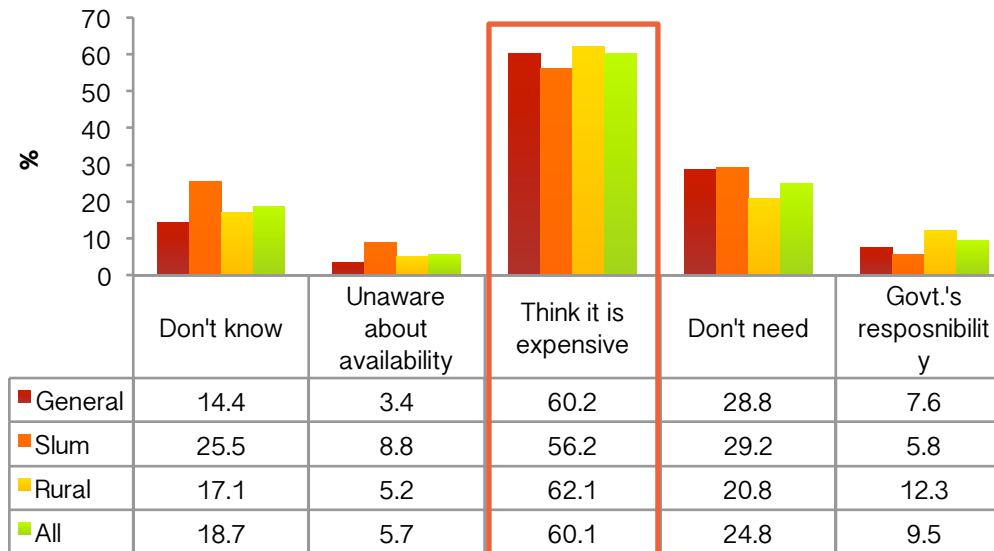
Motivation

Options available for the poorest of the poor

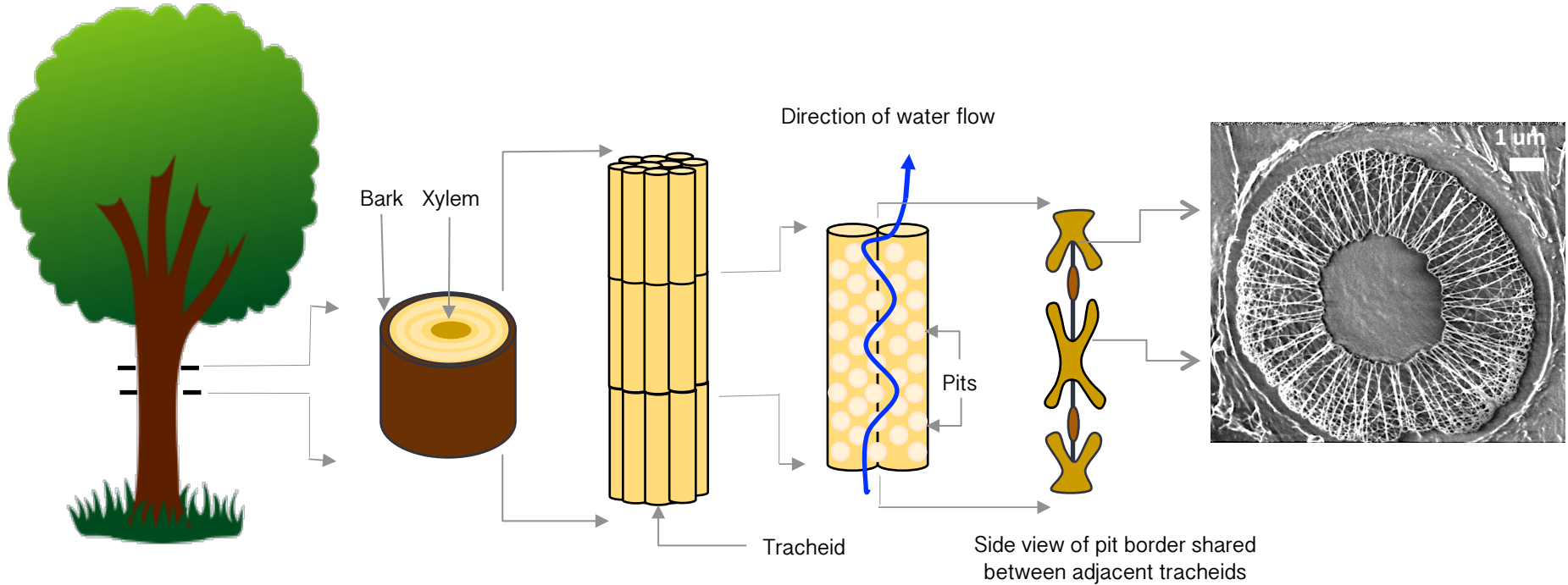
Parameter		Conventional particle filters	Gravity non-electric filters
Filtration	Turbidity	5-60%	80-100%
	E.Coli	No-effect-20%	90-99.99%
Access	Availability	Easy	Difficult
	Affordability	Very affordable	High upfront costs



Barriers for buying a water purifier



Water Transport in Plants



Contaminants in Water

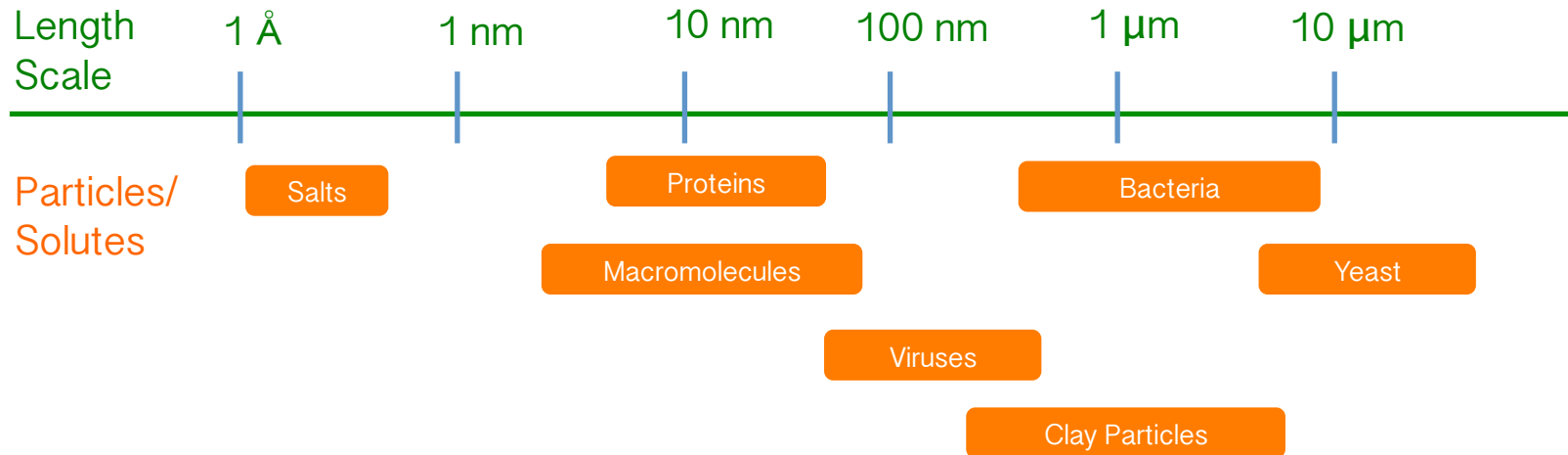
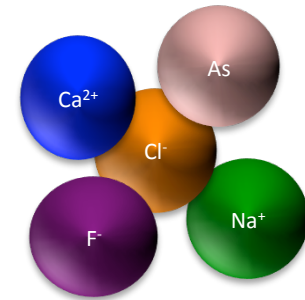
Physical



Biological



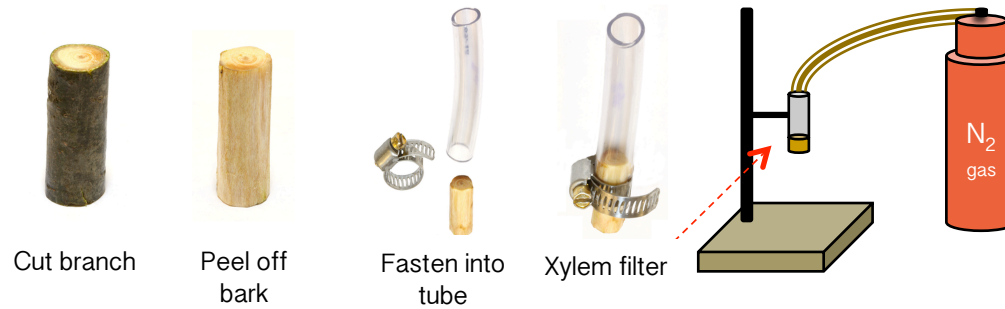
Chemical



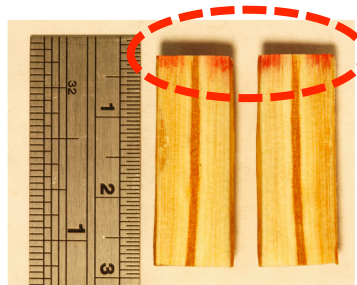
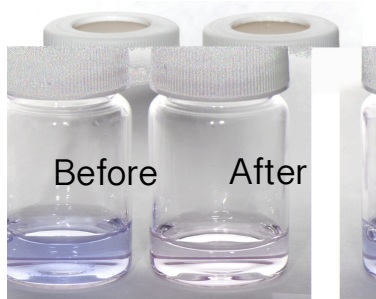
Can plant xylem be used to remove contaminants in water?



Proof-of-Concept



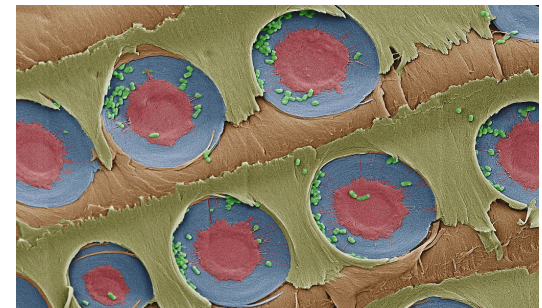
Dye Filtration



Dye filtered
by top 2-3
mm

Filtration of E.Coli

99.99% rejection of 1 μ m E. Coli



Use of Xylem as a Filter

Advantages



Simple to make



Eco-friendly if sustainable manufacturing practices are adopted



Cost effective

Challenges

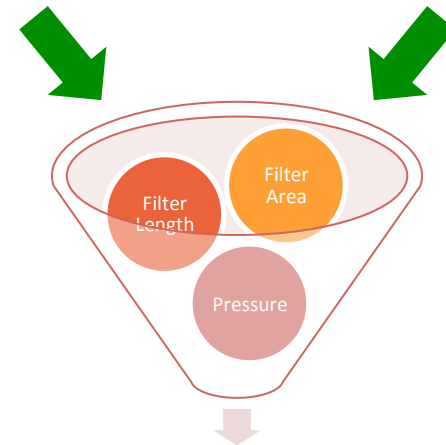
Permeability



Permeability loss/
blockage upon drying¹



Operational attributes



Filter design

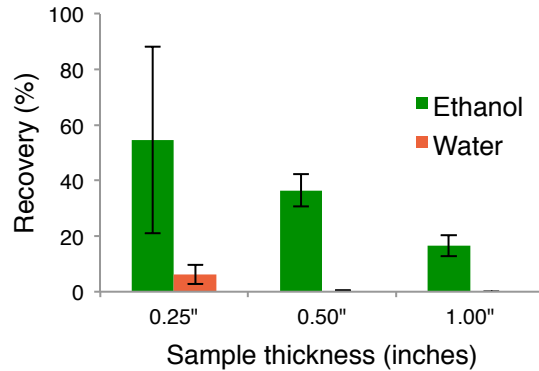
1. Boutilier, Lee et al PLoS One (2014)
2. [circularenergy.com/achieve-that-new-years-resolution-and-save-with-solar/](https://www.circularenergy.com/achieve-that-new-years-resolution-and-save-with-solar/)
3. getmainelobster.com/about/eco-friendly-lobster



State-of-the-Art

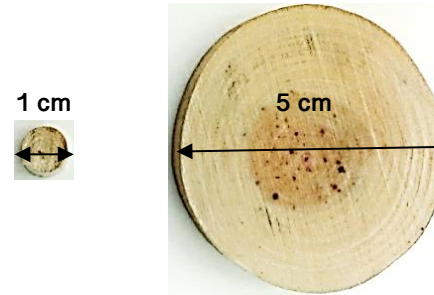
Technical Aspects

Can the permeability of xylem filters be preserved in dry state?



Yes, can be done by using ethanol

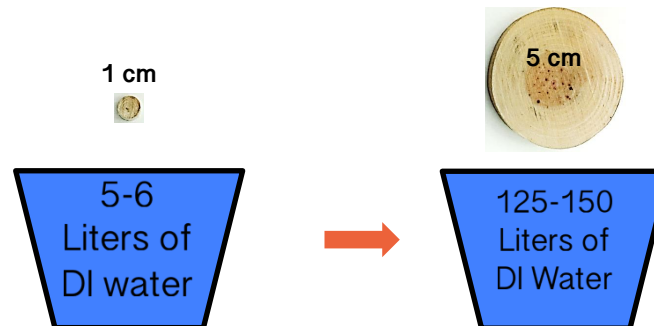
Can we achieve fluxes comparable to commercial filters?



Pressure Head: 1 m
Diameter : 5 cm
Flux : 80-100 mL/min

Yes, can be done by optimizing filter area and operating pressure head (linear scaling)

What is the lifetime of these filters?



Avg Daily Consumption: 3-4 liters
Avg Household Size : 4
Expected Lifetime : ~ 1 week



State-of-the-Art

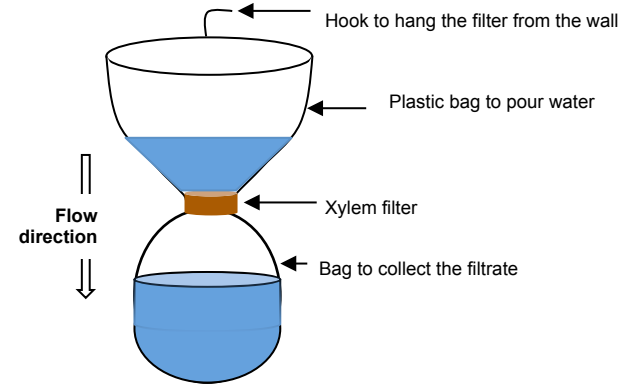
Implementation Aspects

Can these filters be made locally in India?

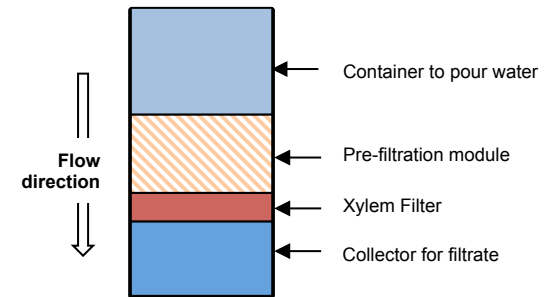


Yes, using Chir Pine (*Pinus Roxburghii*)

How much would these filters cost?

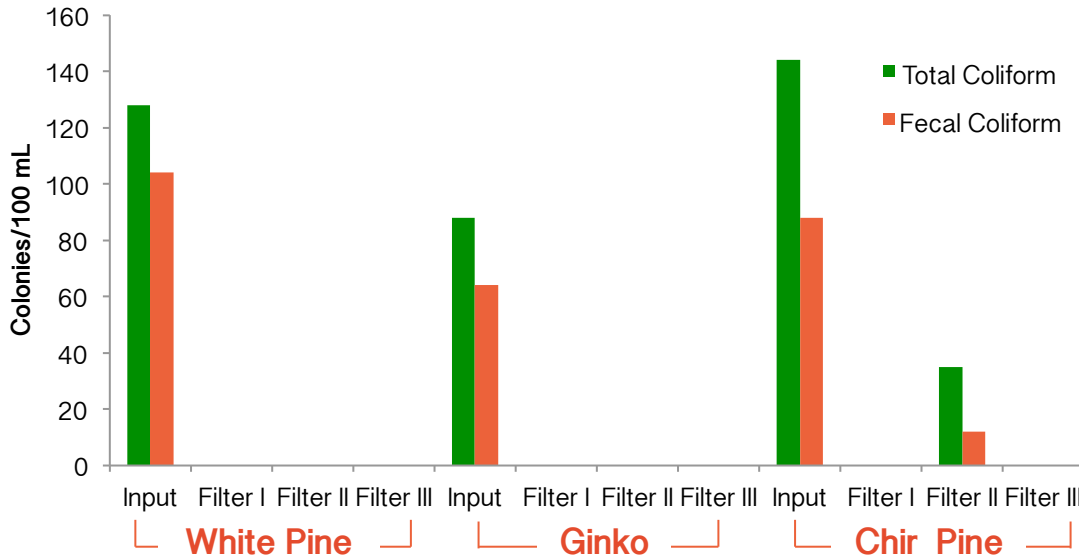


Cost : 5-10 ₹



Cost : Depends on pre-filter

How effective are these filters with local water?





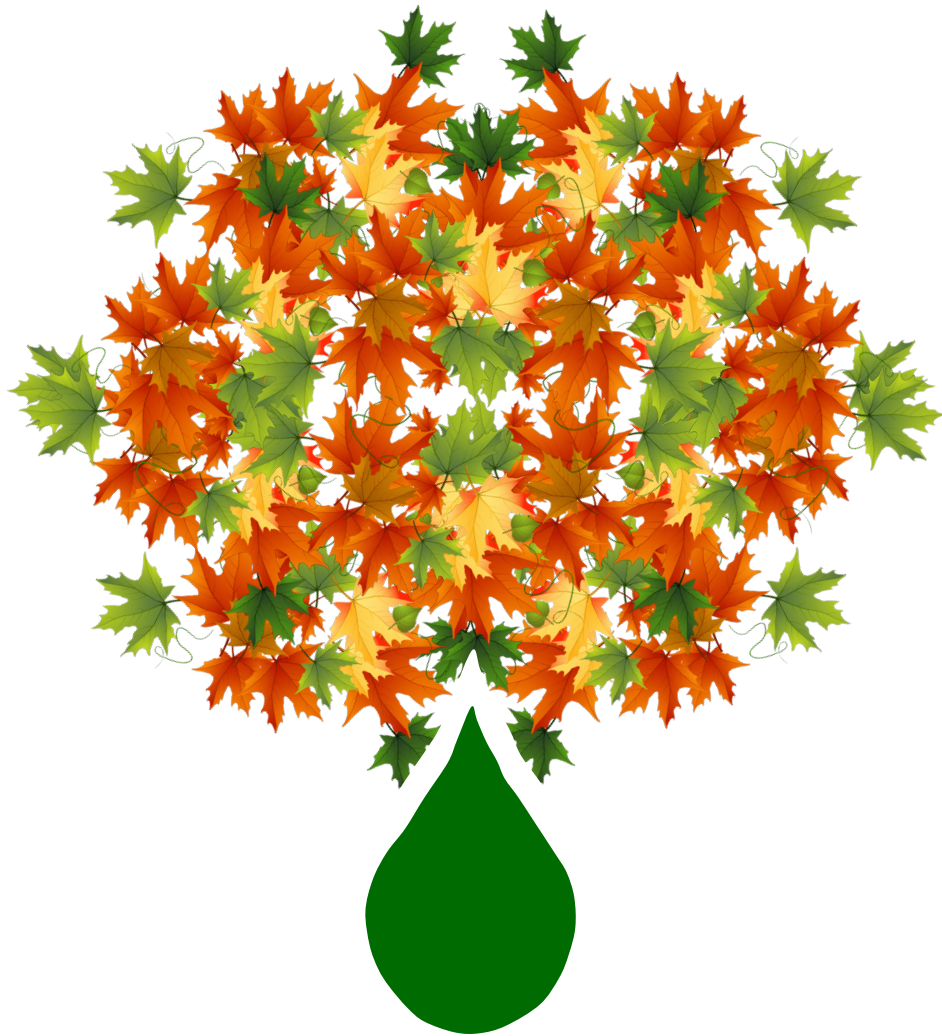
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TATA CENTER
TECHNOLOGY + DESIGN

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THANK YOU!!!