

Developing World Laundry System





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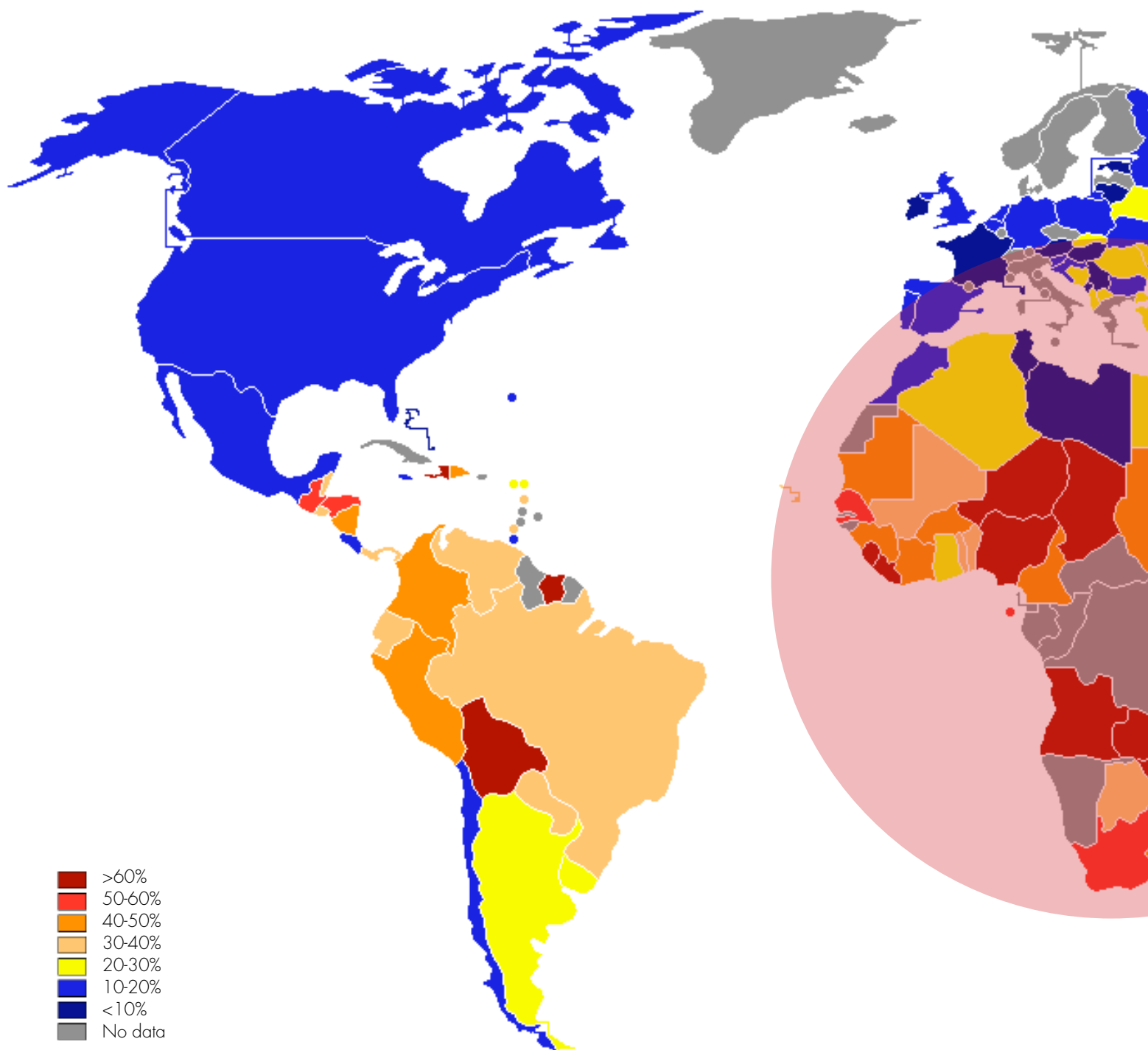
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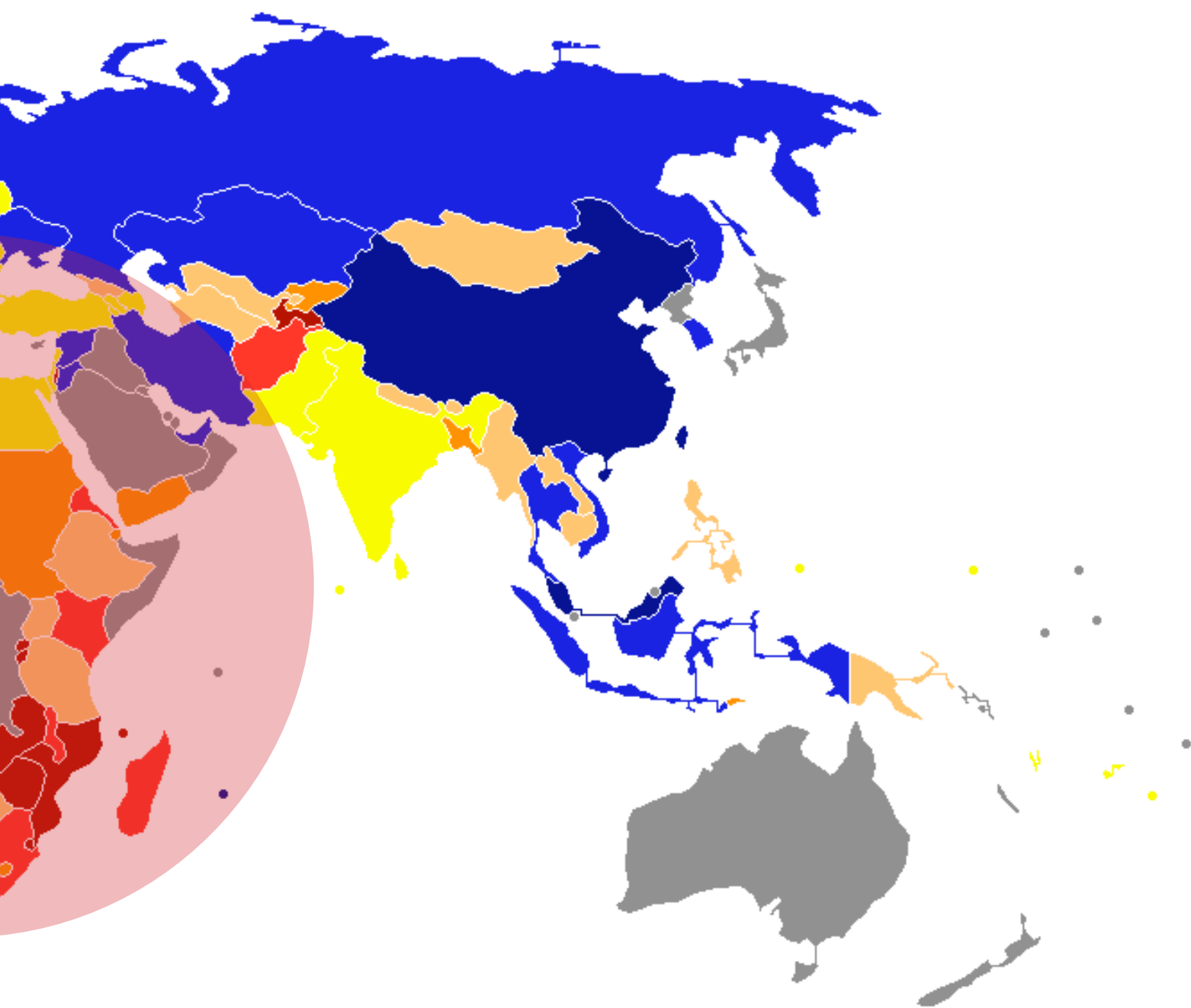
Background

Impoverished nations need more than just aid. They need devices and systems to allow them to help themselves. They need high quality, high functioning products made of locally sourced materials and available at a low cost.

Doing laundry in the developing world is a time consuming and tiring task. The washer must go to the river, soak clothes, scrub them by hand, wring the clothes out, carry the clothing back, and hang it out to dry. Often the clothes lose structural integrity due to these harsh washing habits. We strived to design a laundry device that was not only functional, but also kept the user in mind.



* Population living below the poverty line



Daily Water Usage Per Person in Liters



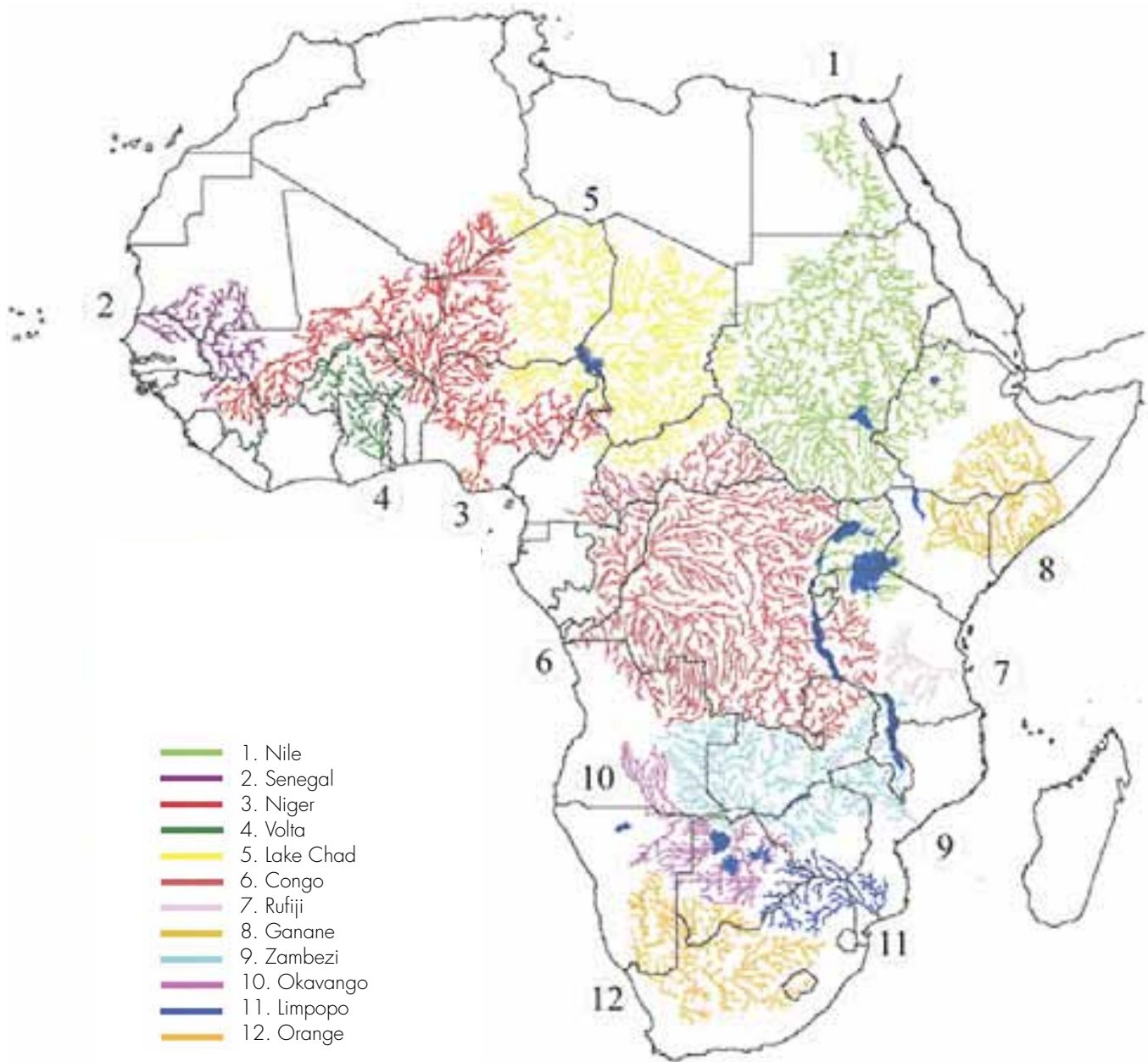
X 10

Developing World



X 400

Western World



Waterways become contaminated from washing and can dry up during warm months



About the Laundry Process

There is an unfair divide between laundry devices and services in the western world and in developing countries. Despite Africa's social and economic problems, African's still desire and need clean clothes. We hope to reduce the time, effort and resources needed to perform these tasks. By understanding local customs, practices, and geography, we hope to fill the void and modernize an age old process for people who need it the most.

Why is laundry an issue?



Time Consuming:
One hour walk, up to 4 miles away,
hang drying



Resource Reliant:
Water, buckets, detergent



Labor Intensive:
Walking, heavy loads,
bending, scrubbing, folding



Damaging:
Constant scrubbing and wringing
ruins the fabric

Ideal Laundry Conditions



Water:
Dilutes the stain
Best to pretreat the stain



Surfactant:
Breaks the bonds between
stain and the clothing



Agitation:
Rubs the stain out
Moves the clothes



Drying:
Extract excess moisture
with minimal clothing warpage

History of Laundry Devices

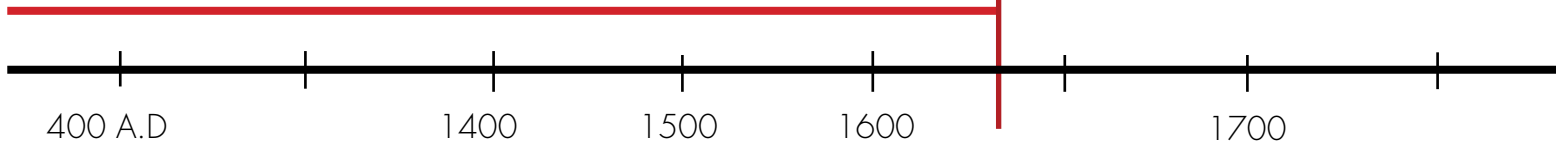
■ Developing World Innovation

■ Western World Innovation

Beating clothes on rocks



1779 Scrub Boards



Soap Invented

1861 First clothes wringer added



1922 Agitator system



Modern Washing Machine



1800

1900

2000



1851 Hand Powered



1907 Flywheel Added



1908 First Electric Washer



Existing Laundry Products

Currently there are many western laundry products, but few consider the specific needs and conditions of doing laundry in African nations. Of those few, most are ineffective, unused or overpriced. As of now, people still use large buckets, water and soap to scrub clothing by hand. We have the power to change that.

Analyzing Existing Products



Swirl: Designaffairs Studio
Adds the element of play to a boring task >Not realistic, function does not meet the need.



Spin Cycle: MIT
Upcycled materials, low energy high yield > Bike parts are not local and tough to repair



The Laundry Pod:
Salad spinner style drying, spin cleaning
> Too costly, multiple loads required



Home made kit:
DIY makability, very cheap
> Unstylized, crude solution



Solarball: Jonathan Liow
Creates potable water through
condensation
> Not a laundry device



Wonderwash:
90% less water
> Small loads, plastic not a totally viable
option



Solar Washer: French Design Students
Re-uses bike hubs and bamboo
> Solar panels aren't affordable for the average
rural African



Laundry Rapid Washer:
Simple to understand, affordable
> Lots of work



Systems Developments and Successful Design Strategies

"When companies design products and services for the poor, they often think about making them as low-cost as possible. But whether you're tapping a market opportunity or addressing a social need, it's important to realize that people living in poverty value quality design. Quality design doesn't mean that goods and services need to cost more."- IDEO. If we can produce a durable, simple, product as well as create jobs with an understanding of local materials and customs, we not only help the laundry process, but we also affect the people.

System Design Strategies



Local Jobs: In South Africa, TOUCH is training unemployed seamstresses to make rugby balls from recycled materials, addressing the problems of waste and unemployment simultaneously.



Readymade: Finding a way to repurpose and revalue accessible products. A Liter of Light Project found a way to light up dark homes during the daytime using only found objects.



Local Materials: Designo Patagonia create objects that recover the stories, materials and craftsmanship of the countries they design for. "When you use natural materials that are from your own region, you start to have a deeper concern about them."

Corporate Responsibility to Developing Worlds



Accessibility: "The most effective ways to make a difference is by ensuring our products are more affordable and more accessible for consumers. We are doing more to enhance our impact on poverty, employee skills development and small-scale suppliers, to mention just a few.



Sustainability: "We must protect the environments in which we work and live. A healthy planet and a healthy community go hand in hand."



Education: "Through P&G's Live, Learn and Thrive cause, we are helping children in need around the world get off to a healthy start, receive access to education and build skills for life."

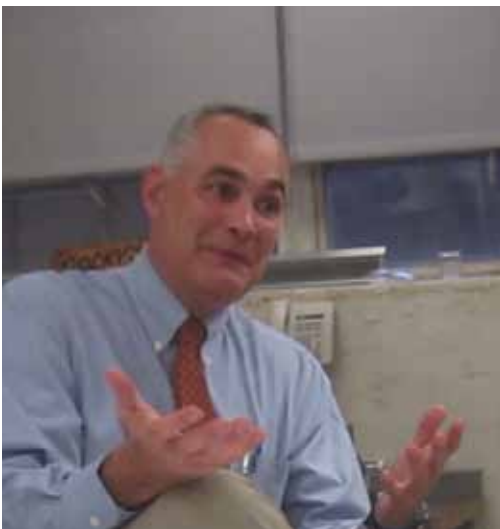


Collaborations

Our experience in design has never been challenged as much as trying to design for people from a different continent. In order to avoid misunderstandings or uneducated design decisions we were fully committed to working directly with anyone who was willing to share insight. We saw the value of collaborations as a productive and efficient process. We partnered with as many people, spanning cultural, professional, and interdepartmental boundaries as possible. Our collaborations spanned multiple areas including Africa studies experts, textile engineers, and African refugees.

Textile and Laundry Advice

- Wringing out clothing warps and stretches fibers.
- There are several textiles available that are moisture absorbing, as well as moisture wicking.
- Multiple rinse cycles are essential to getting maximum cleanliness.
- The drying process is one of the most overlooked, but important part of cleaning clothes: air, humidity, and temperature could make the drying process several days long.
- Spinning and rubbing textiles is not nearly as effective as agitating clothing.



Mark Sunderland
Assistant Dean of the
School of Engineer-
ing and Textiles

Working with African Natives

- Their main water sources were rivers, until they dried up half way through the year, then well water was utilized.
- In Kenya, if a man had a product that was needed by others in the community, the man would rent out the product, creating a small business for himself, making sure the product wasn't stolen or damaged.
- Clothing was purchased at a large flea markets that multiple villages would shop at. This told us that opportunities to buy clothing were few, making the longevity of clothing important
- Genarally they would wear cotton clothing with a style that looks similar to everyday western wear, with the exception of Muslims who would wear a white gown once a week to attend Mosque
- Even though they see inherent risks with unpure river water, the African Natives still choose to wash and drink with little to no regards. This revealed to us that a microbial clean was less important than spot cleaning.



Philip, Musa, Arbab,
Gamar
Mohammed:
Former Sudanese
Refugees
relocated to New
Jersey

Africa Area Studies Expert

- Crisp, clean looking clothes are a display of power in rural Africa.
- The role of men and women is very important. Women tend to cook and clean, and men tend to work labor positions. We must consider our market as mainly women.
- Government organizations would be more likely to fund and support projects like ours if the solution was beneficial to the environment and good for the people, such as stopping river contamination.
- People will often adapt products to their needs, altering them as they see fit
- Detergents often have masculine symbols on them to represent strength and heavy duty cleaning power



Richard Shain Ph. D
Associate Professor
of History and
Africa Area
Studies

Project Criteria

Performance Criteria:

- Odorless, spot stainless washing
- Agitate vs. over work clothing
- Uses motorless motion/ energy
- Cuts down on the time involved in the cleaning process
- Avoids river contamination

Cost Criteria:

- Affordable to the user
- Not reliant on outside grants or NGO aid
- Makeable locally, using repairable materials and parts

Market Criteria:

- People who desire washed clothing
- People who currently expend too much effort washing clothes
- Whole communities
- People without laundry devices

Geographic Criteria:

- Accessible to by an open water source- river, stream, lake, well etc.
- Impoverished (ie. Rural Africa, Sudan)
- Accessible to the outside world
- Dry climate for clothing drying

Review Criteria:

- Textile/ Washing Experts
- African Studies Professional
- Our target market users
- Design professional



Human Powered



Addresses Spot Stains



Avoids River Contamination

Food Preservation

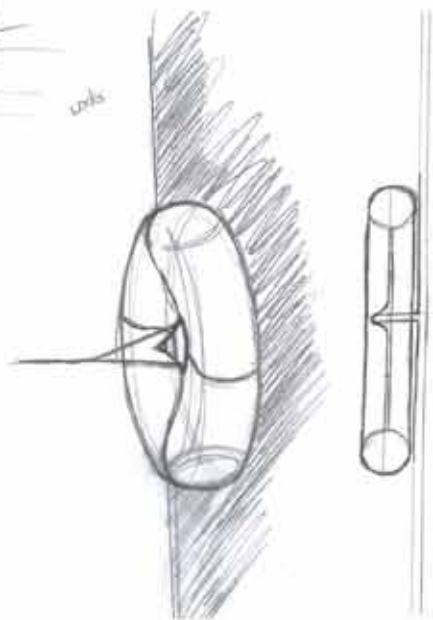
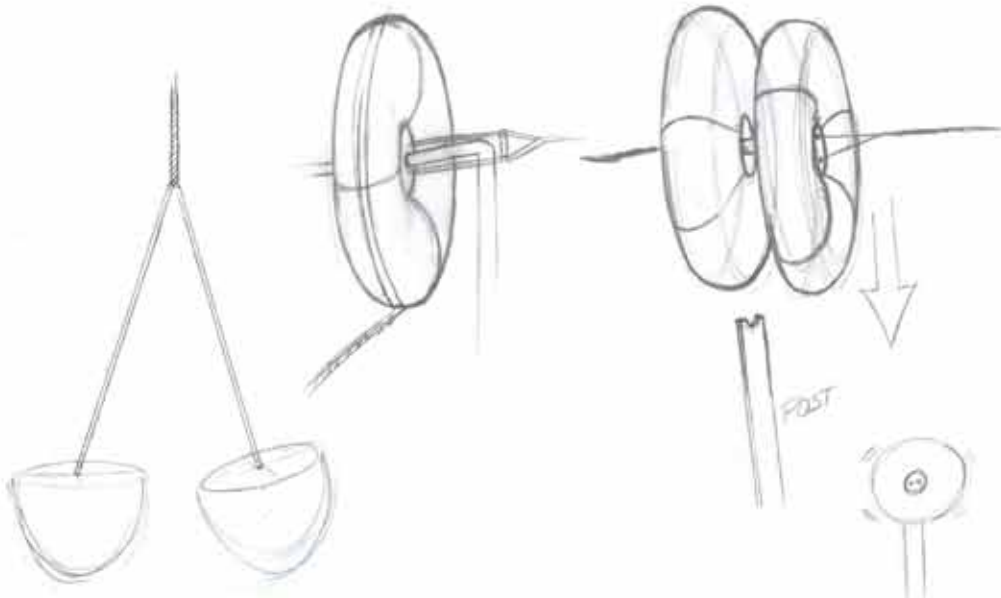
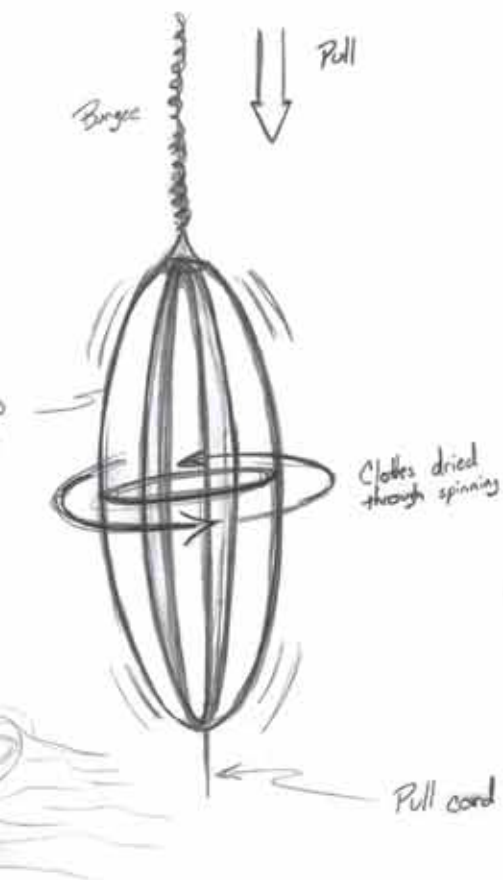
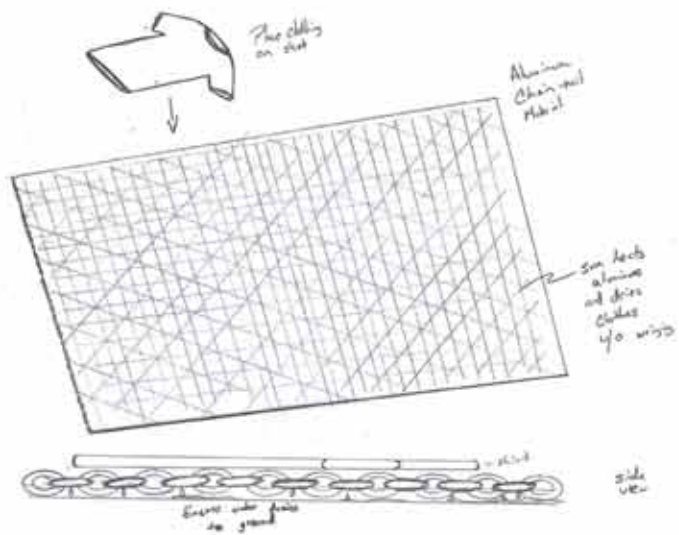
- Rotten Food →
- Bacteria
- Aerosols / Hubs
- Moisture
- Cold temperatures
- Length of time
- Red Heat, Yeast
- Education
- Currency Issues
- Community / Household
- Retaining Pattern
- Invest Fair
- Storage
- Satisfaction
- Air Tight
- Sealing
- ~~to raising~~
- Mining
- Royal Road
- ~~Expenditure~~
- ~~national~~
- and Transport
- ~~Process~~
- and Distribution

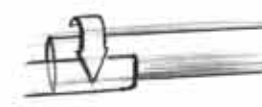
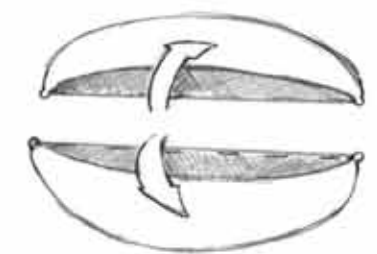
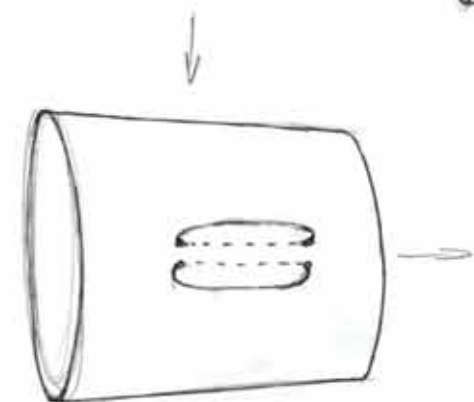
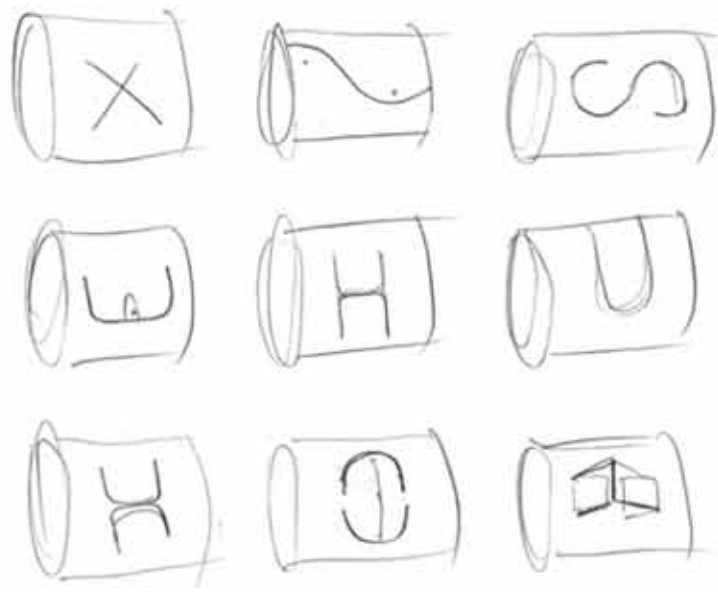
- Clean Bodies
- Clean Clothes
- Water
- ~~Clean water~~
- Clean food
- Health
- Soap
- Boiling
- clothing/ protection
- Shelter (rain)
- Sustainable detergent
- Clean teeth
- Shoes
- Disease
- Kits
- Education
- Sex prevention
- Cleaning each other
- River bathing
- Bucket shower
- Subergarbs
- ~~Shower to glory~~
- ~~boiling/ wiping~~
- ~~Medicines~~

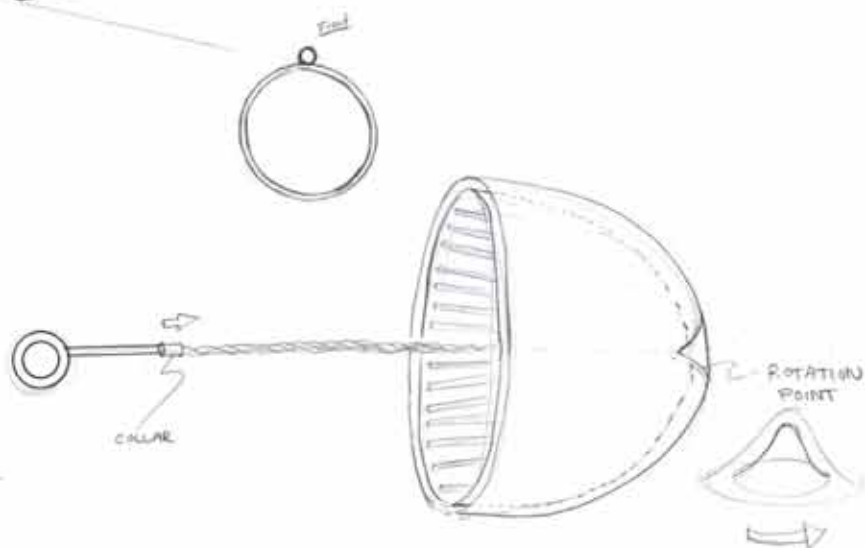
- Land**
- Burial
 - Cremation
 - Customs / traditions
 - Taboos
 - Community gathering
 - Coping
 - Loss of husband
 - Loss of child
 - Loss of social
 - Regeneration (eco-cycle) ✓
 - Quantity (space intake) ✓
 - Transport of Bodies
 - Where?
 - How?
 - Cremate
 - How? Is it a safe way to dispose?
 - Bury (encasement?)
 - Education Question
 - Flot (Shr.) water
 - Widows (social)
 - Getting married into society
 - Celebrations
 - Funerals - happy or sad?
 - Placement of body - Location
 - Appearance
 - Displacement
 - Documentation
 - Disease transfer
 - Decomposition
- The three**

Brainstorming

As industrial designers, we have an obligation to design towards bettering the inconveniences of daily life. We knew the developing world had many important issues that needed to be addressed, including the water crisis, shortage of food, and shelter. Instead we focused on solving life's daily problems.





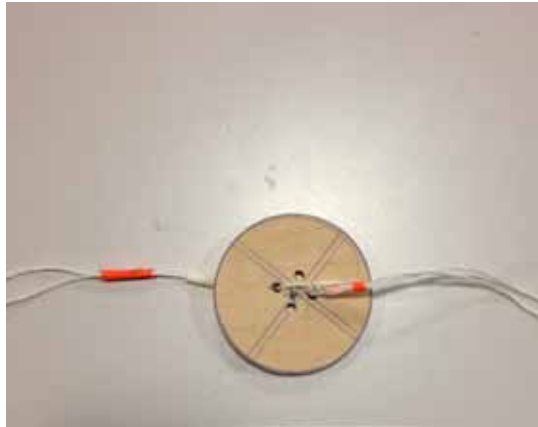




Prototyping

This phase in our design process was the most important because we learned through experimentation what is actually effective for creating a washing device. We weren't satisfied with the device unless it worked in the "real world". Ideas such as "not everything scales up" and "always use nylon rope" were foundations that we could only learn during this phase. If the end result wasn't clean laundry, we knew we had not found the answer.

Test Models



Initial Inspiration

This classic button spinner allowed us to realize that we could harvest string energy



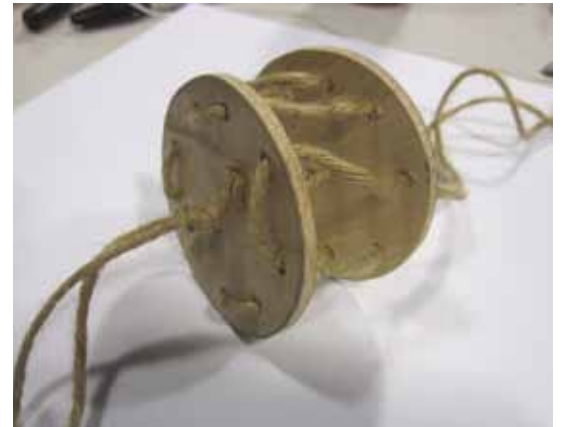
Capsule Spinner

We needed to understand if the "button spinner" theory would work as 3D object that housed material



Weighted Basket Spinner

To reduce wobble we placed pennies on each strand of this wire frame model



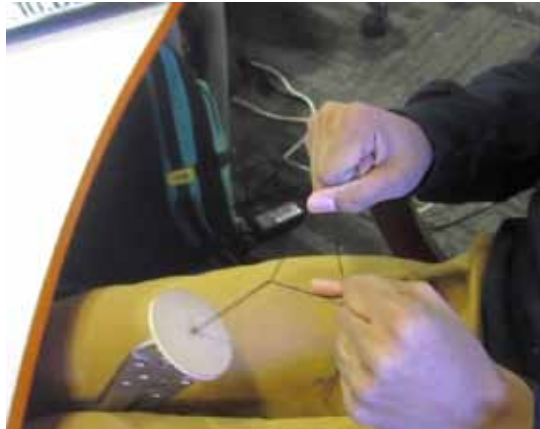
Double Button Spinner

A model failure, this designs lack of interior support stopped the spinning motion



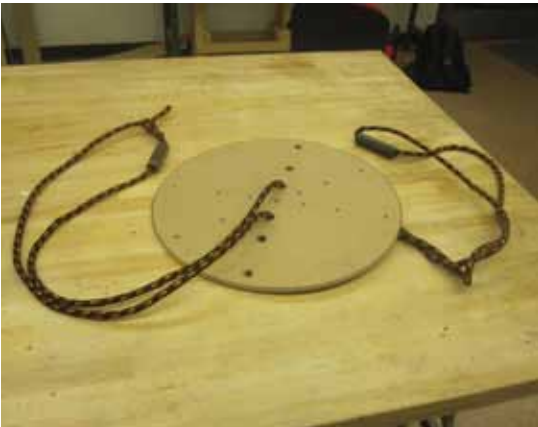
Spinner Understanding Test

We needed to confirm that this motion study would translate well to our end user



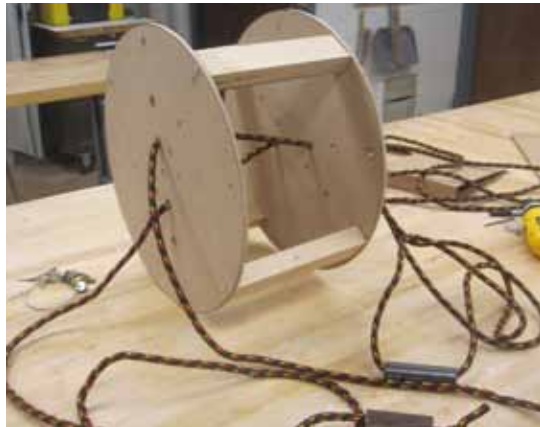
One Sided Needle Spinner

A needle was held between vice grips, creating an axel for this model to spin more efficiently



Large Scale Button Spinner

Eventually we had to prove this concept worked in full scale to know if we could move forward



Full Scale Capsule Style Spinner

Clothing would be housed inside this model. However it was very heavy and wobbly





Inspiration



The 5 gallon bucket is synonymous with cleaning throughout the world. In Africa it is also a means of transportation as well. Because it is so readily available, users can source their own buckets to lower costs



Prototypes



Leak Protection

By using plumbers putty we stopped water leakage in unwanted areas



Water Removal

By attaching the rope at a longer length the user can extract water



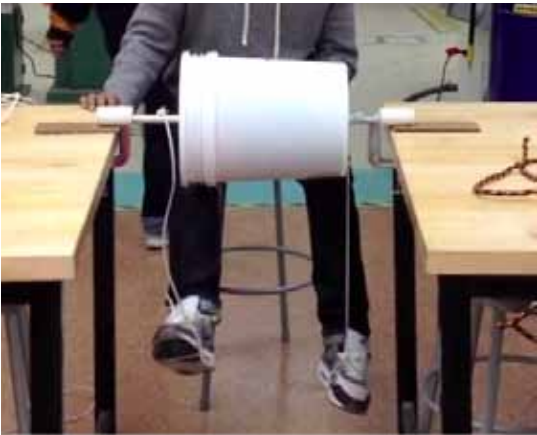
Reels

Our first attempt at reels were lathed, the gear ratio was too low. We needed a larger inner diameter



Reel Test

This test used two separate reels on either side of the bucket. The gear ratio was corrected but the motion was awkward



Pedaling Prototype

The turning point in our project. We realized that the productivity of leg energy was much more efficient than arm power



Cleaning Sleeve

To address spot stains we thought that as the bucket spun we could rub clothes against an outside surface



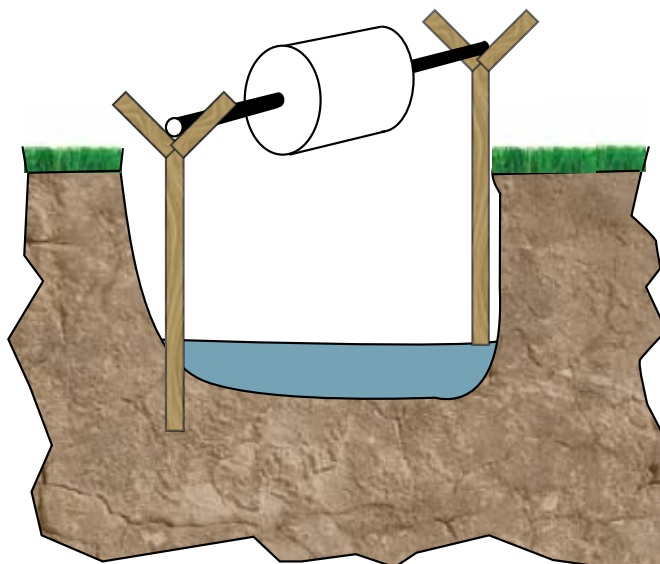
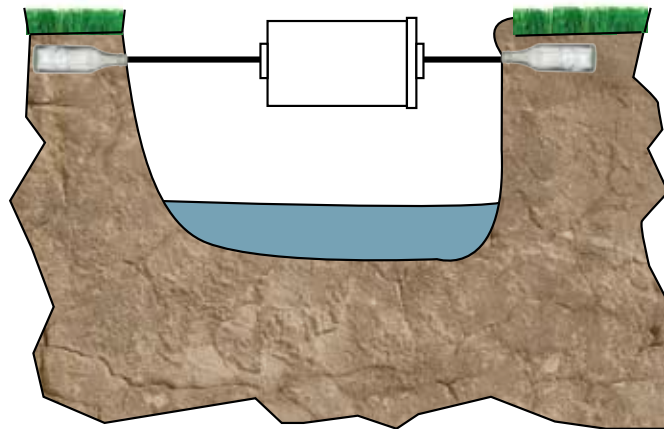
Water Release Concept

We needed to achieve a system that allowed us to hold water when washing clothes, then release the water



Simple Water Release Holes

Openings allowed for a water dump but also permeantation



Trench style mounting systems were eventually passed up for a more structurally sound frame



Prototypes



Agitation

By adding two tire treads on the interior, clothes rotate back and forth as the user pedals



Bucket Bag Prototype

We thought that an interior bag could agitate and make transportation easier. It tangled and didnt allow clothes to spin



Washer Attachment

In prior test models the spinning motion was wearing out/ cracking the bucket. It also allowed for a smoother spin



Reel

Our device went from two large pulleys to one reel. Cutting down on parts and changing the orientation of the device



Metal Self Standing Frame

Instead of ground mounting the device we explored a cheap, simple to put together frame



PVC Connection Test

The stresses put on PVC told us we needed to use connections made of metal such as iron or steel



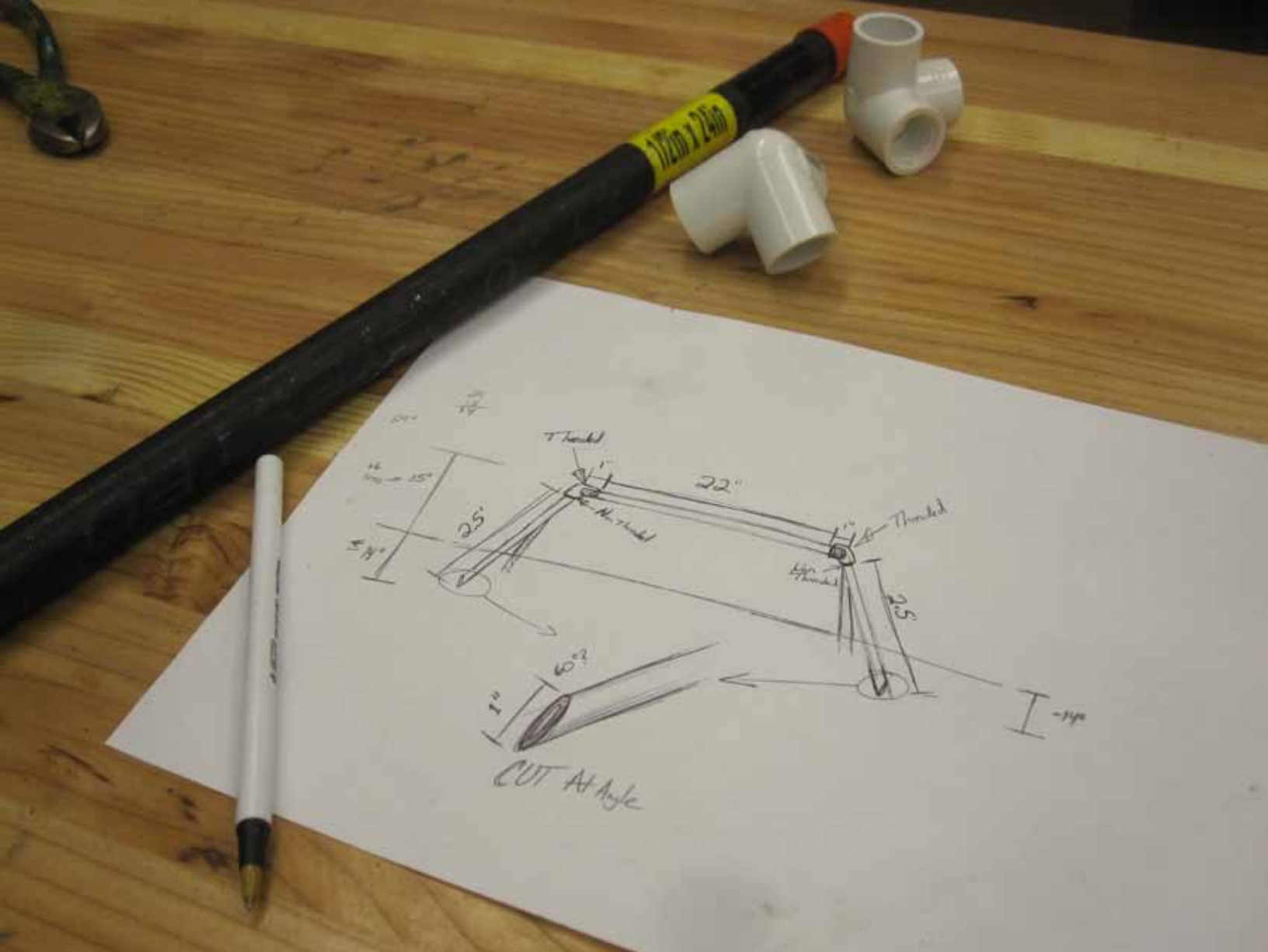
Bucket Permeation Test

After finding a good balance between hole size and sleeve material, the bucket trapped water in, but let a small amount soak into outside cleaning surface



Final Pipe Setup

Using threaded plumbing iron we achieved a sturdy but dis-assembleable base for our washer



INVENTION AGREEMENT

Aaron Statham and Eliot Coven (“Inventors”) have conceived and developed an inventive manually powered laundering device. The invention (“Invention”) has particular applicability to third world, underdeveloped societies lacking access to electricity and running water.

All parties intending to be legally bound, Inventors hereby assign their invention to Philadelphia University and Philadelphia University agrees to pay royalties to Inventors of 5% out of net proceeds received by the University from commercialization of the Invention.

By signing this agreement, Inventors assert that to the best of their knowledge they are the sole inventors of the Invention.

AARON STATHUM

Date

ELIOT COVEN

Date

PHILADELPHIA UNIVERSITY

By:

Date

Printed Name

Title

Final Model





Steps to Wash



1. Assemble base



2. Hammer device into the ground



5. Add detergent



6. Add water



3. Load clothing



4. Open cap



7. Secure foot straps



8. Pedal to wash, use surface for spot stains



9. Make sure stains are removed



10. Remove outer sleeve



13. Remove cap



14. Take out clothes



11. Reconfigure rope



12. Spin dry



15. Hang dry



16. Disassemble washing device

This product, purchased in multiples, can be used to create small businesses, to drive the economy. The owner can charge a small fee per use to earn income





Kit of Parts/ Packaging



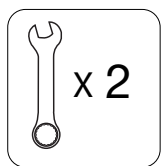
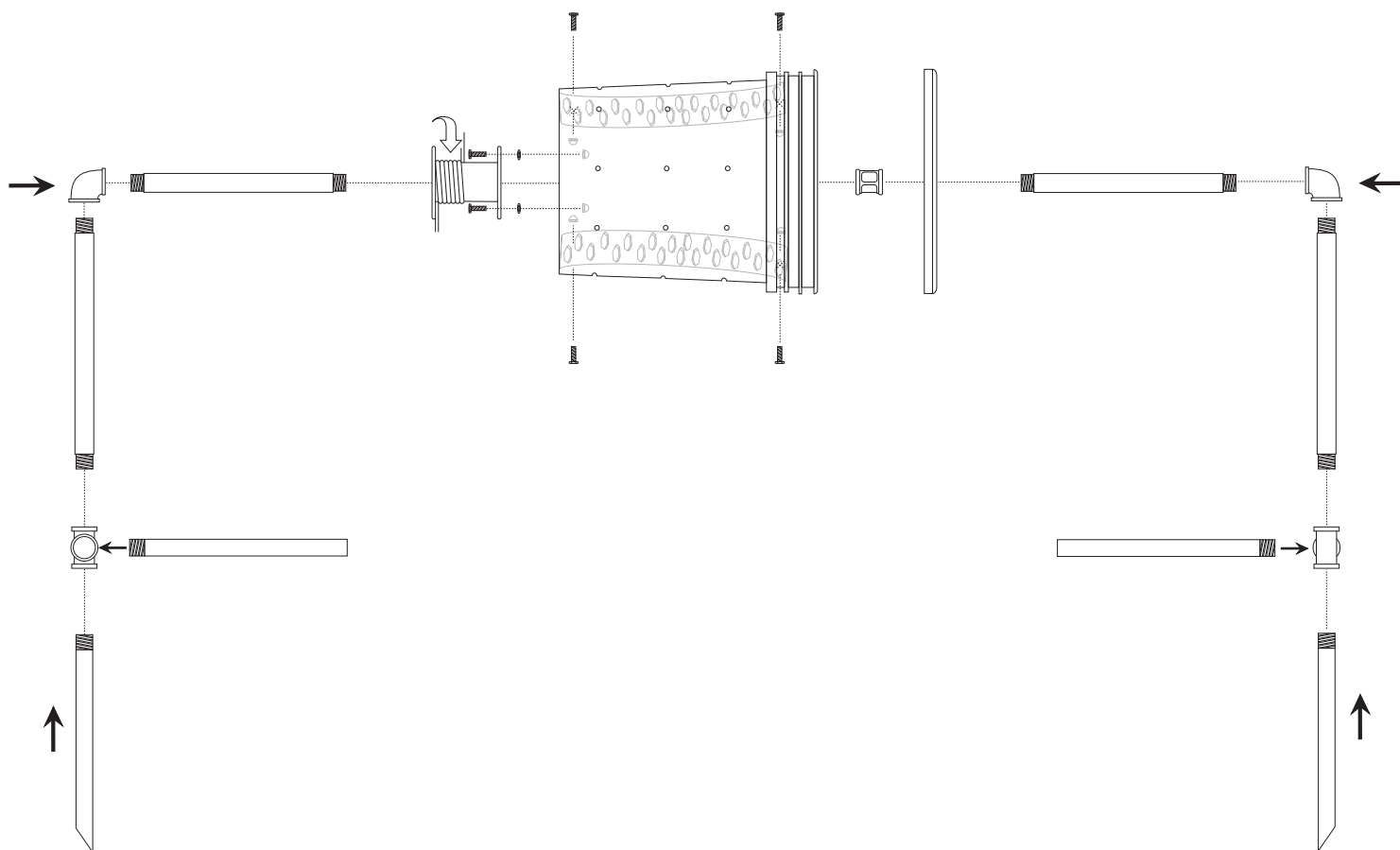
All parts can be found at your local hardware store for under \$20. They can be upcycled or donated. All of the components fit inside the bucket making it great for shipping and transportation.

Sleeve Scrubber









Directions follow the
IKEA model, legible
beyond all language
barriers



Low cost stamped
wrenches come
inside the kit for
quick assembly

Special Thanks To...

Joyce Reilly
Ros Stafford
Mike Leonard
D.R. Widder
Jay Tapper
Jewish Vocational Services
Matt Price
Neal Matheson
Hy Zelkowitz
Charles Rozier
Orly Zeewy
Christina Dos Santos
Gotz Unger
Mark Sunderland
Dr. Richard Shain
Musa Aluga
Philip Abdulkakim
Mohammed Hakon
Gamar Hussein
Arbab Yahya



Provisional
patent filed with
Philadelphia
University

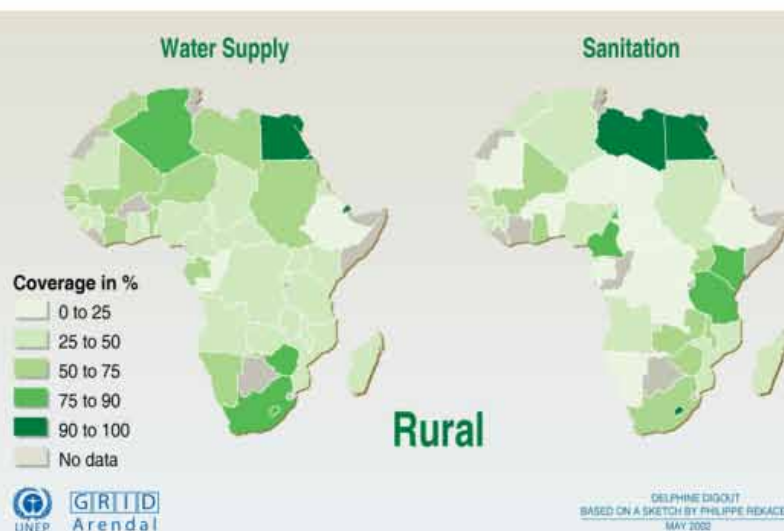
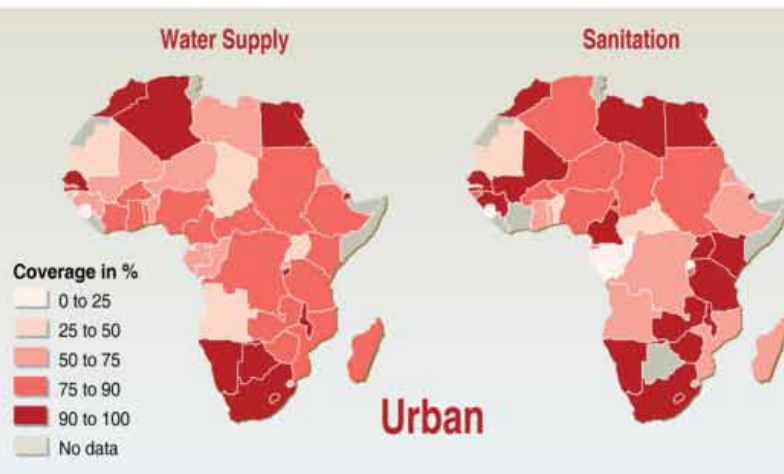
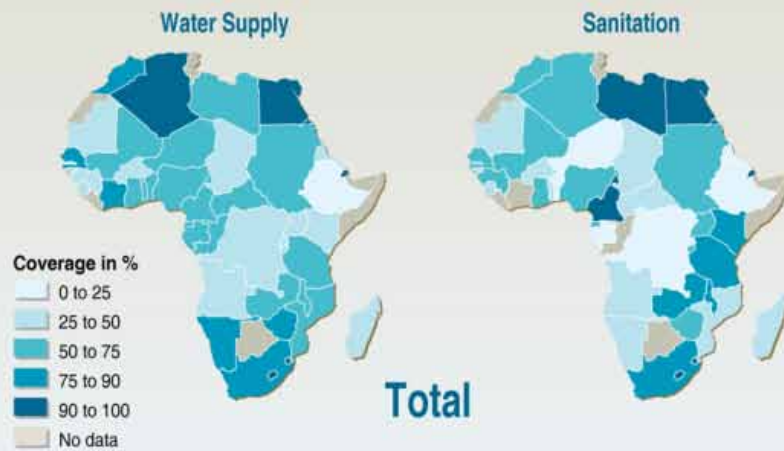
Appendix

Milestones in the History of Washing Machines and Dryers

1797	Scrub boards.
1800	First clothes dryers; hand-powered.
1851	Hand-powered, washing machine with a drum, invented by James King.
1861	First clothes wringer added to the washing machine.
1874	William Blackstone built his first hand-driven wooden washing machine.
1858	First rotary washing machine, invented by Hamilton Smith.
1900	Wooden wash tubs are replaced by metal tubs.
1907	Maytag Corporation began manufacturing a wooden tub washing machine with a flywheel, still manually operated with a rotary handle.
1922	Maytag Corporation introduces the agitator system for moving the water around in the drum, rather than dragging the fabrics around in the water.
1908	First electric-powered washing machine is invented by Alva J. Fisher.

- 1911 Whirlpool Corporation, then called the Upton Machine Co. is founded in St. Joseph, Michigan and starts producing electric motor-driven wringer washers.
- 1915 The first electrical clothes dryers appear.
- 1930s John W. Chamberlain of Bendix Aviation Corporation invents a machine that can wash, rinse, and extract water from clothes in a single operation.
- 1947 The first top-loading automatic washing machines are introduced by the forerunner of the Whirlpool Corporation.
- 1950 The agitator system and the tumbling system. Wash cycles and products are developed for new fabrics and a greater range of wash conditions.
- 1951 The first automatic washing machines are made in Europe. The first computer-controlled automatic washing machines appear.
- 1978 The first microchip-controlled automatic washing machines were produced.
- Beyond Many technological advances follow. Among hundreds of systems tested, only two washing systems survive until this day.

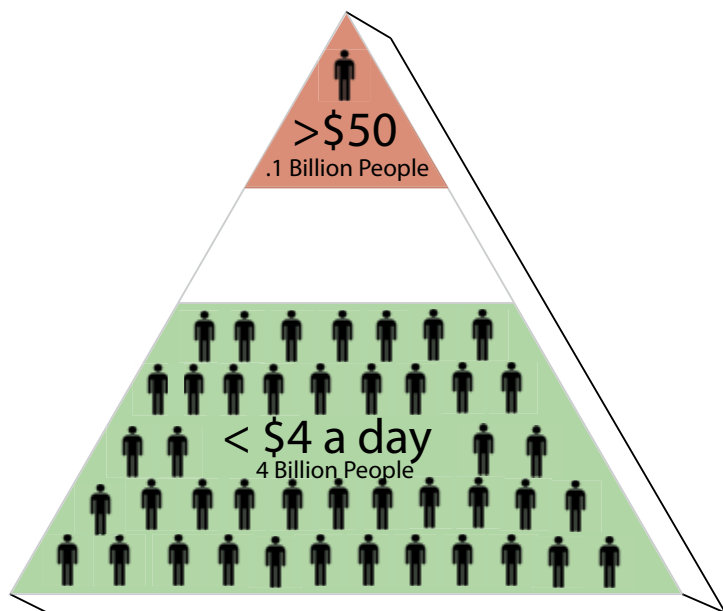
Water Supply and Sanitation Coverage in Africa



Source: Global Water Supply and Sanitation Assessment 2000 Report.



Simple tools can create big change: The biggest issue is often time. With time saving tools, up to 8 hours a week doing laundry could be devoted to getting ahead in life and escaping poverty.



There are over 7 billion people in the world. Of that number, over 4 billion live on less than \$4 a day. If we can design a viable solution, we have the ability to make a huge profit, while still creating social change.

↑ = net\$↑

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