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ECHO Development Notes

FIRELESS COOKERS AND CLEAN COOKING INITIATIVES

Since January 2024, the ECHO East Africa Appropriate Technology Department has been actively integrating fireless cookers, commonly known as Wonderbag Cookers, into our range of clean cooking technologies.

BIOSAND WATER FILTER EFFECTIVENESS

ECHO Asia currently trains on the 'blue barrel' biosand water filtration system. The team conducted a series of interviews, water tests, and design modifications to validate the design we train on.

SEED VILLAGE

This study reflects experiences of living in the community and conducting a participatory needs assessment with tribal farmers in the Mysuru district of Karnataka, India.

From ECHO's Seed Bank | Upcoming Events

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ECHO Inc.

Integrating Fireless Cookers (Wonderbag Cookers) Into Clean Cooking Initiatives in East Africa

by Harold Msanya, Joyce Nambaso, and Charei Munene

Figure 1. An example of a fireless cooker. *Source:* ECHO East Africa Staff

Introduction

Since January 2024, the ECHO East Africa Appropriate Technology Department has been actively integrating fireless cookers (Figure 1), commonly known as Wonderbag Cookers, into our range of clean cooking technologies. This initiative was launched in response to the rising demand for affordable, energy-efficient cooking solutions among small-scale farmers in East Africa. This work complements ECHO's ongoing promotion of clean cooking technologies such as rocket stoves, biogas stoves, improved biomass burners, and other energy-efficient devices while also encouraging local entrepreneurship for income generation and sustainability.

Fireless cookers offer a simple but effective method for cooking food. Food is heated briefly on a stove, in a regular pot, before placing the cooking pot--with the food inside--into an insulated container (fireless cooker) that retains the heat for continued cooking. You can cook rice, for example, by

1. adding rice and water to a regular pot,
2. bringing the water to a boil on a stove, and
3. transferring the pot and its contents to the fireless cooker and
4. leaving it for several hours.

This reduces the amount of fuel required, shortens active cooking time, and decreases exposure to harmful smoke (Figure 2).

Rationale

Many rural households across East Africa face persistent challenges related to cooking and household energy. These include:

- Heavy dependence on firewood or charcoal, which is costly, time-consuming to collect, and contributes to deforestation in some areas.
- High exposure to smoke, leading to respiratory problems, especially for women and children.
- Long hours spent cooking, limiting time available for farming or income-generation.

Figure 2. Integration of cooking and insulated containers (fireless cookers) for increased time, fuel, and labor efficiency. *Source:* ECHO East Africa Staff

Fireless cookers help address these challenges by:

- Reducing the amount and consumption of firewood, briquettes, biogas, or LPG (liquified petroleum gas) required.
- Allowing food to cook unattended, freeing time for other tasks.
- Reducing smoke exposure by minimizing time spent near cooking fire.
- Creating opportunities for local, small-scale production and business.

Implementation approach

ECHO's work to integrate fireless cookers into communities involves raising awareness, identifying interested groups, and providing technical training. ECHO holds awareness creation meetings, during which facilitators demonstrate how fireless cookers work and explain the kinds of meals that can be prepared using retained heat. Interested groups are identified by mapping individuals, women's groups, and churches willing to adopt or produce the technology. Technical training provides hands-on, how-to instruction on how to construct durable and effective fireless cookers using local materials. Participants learn to make cloth-covered and basket-covered cookers. Below are the steps for constructing these two designs.

Figure 3. An entrepreneur sewing a fireless cooker. *Source:* ECHO East Africa Staff

Design and steps to make a cloth-covered fireless cooker (Figures 3 and 4)

Materials

- Outer fabric: heavy cotton / *Maasai shuka*
- Inner liner: light cotton
- Insulation (5-8 cm thick): wool, rice husks, old blankets, or wood shavings
- Thread, needle/sewing machine, scissors, measuring tape

Key Measurements

- Rough estimate of overall dimensions:
  - Pot diameter (D) plus 6–8 cm extra❶
  - Pot height (H) plus 8–12 cm extra❶
- Insulation-related dimensions:
  - Insulation thickness (IT): 5-8 cm
  - Insulation seam thickness (ST): 1 cm (allowance for stitching)❷
- Fabric dimensions for outer cylinder:
  - Outer cylinder width = D + ([IT + ST] x 2)
  - Outer cylinder circumference = outer cylinder width x 3.14
  - Outer cylinder height = H + ([IT + ST] x 2)
  - Rectangle of fabric needed
    - ◊ Length = outer cylinder circumference
    - ◊ Width = outer cylinder height
- Fabric dimensions for inner cylinder:
  - Inner cylinder width = D + ST
  - Inner cylinder circumference = inner cylinder width x 3.14
  - Inner cylinder height = H + ST
  - Rectangle of fabric needed
    - ◊ Length = inner cylinder circumference
    - ◊ Width = inner cylinder height

Figure 4. A cloth-covered fireless cooker with a pot and lid. *Source:* ECHO East Africa staff

❶ Base the diameter and height of the fireless cooker on the dimensions of the pot used for initial heating on a stove. This will ensure that the pot fits in the fireless cooker. The extra centimeters for diameter and height account for the thickness of the insulation material around the sides and on the top and bottom of the fireless cooker.

❷ When you cut your fabric pieces, add about 1 cm of extra fabric along all edges so there is space to sew the pieces together without reducing the final size of the cooker. The sewing needle will go close to but not exactly on the edge of the fabric. The stitching becomes hidden inside the seam. If you don't add this extra space, your finished cylinder will be smaller than planned, and the pot may not fit properly.

❸ Prepare two separate pieces of insulation padding, each being 5 to 8 cm thick, before assembling the cooker. The two pieces include a:

- Side strip (wall insulation) comprised of insulation material arranged into long rectangular strip that will wrap around the pot area, between the inner and outer fabric layers. It needs to be long enough to go around the inner cylinder and as tall as the height of the insulated wall.
- Base (bottom insulation) consisting of a round pad of insulation to provide insulation and padding at the bottom.

- Diameter of fabric for two base circles:
  - Base circle for outer cylinder = outer cylinder width
  - Base circle for inner cylinder = inner cylinder width

Steps

1. Cut the fabric for the outer cylinder, inner cylinder, and two base circles (with the inner circle slightly smaller).
2. Prepare insulation (5 to 8 cm thick) by creating a side strip plus a circular base.❸
3. Sew the inner liner, making a cylinder with the base attached and the top left open.
4. Insert the insulation by placing a bottom layer (on top of the outer cylinder base circle) of insulation and then wrapping the previously prepared rectangle of insulation around the sides and tacking the insulation in place.
5. Sew outer shell, sewing together the ends of the outer cylinder fabric to create a cylinder and stitching the bottom of the cylinder to the base.
6. Combine the inner liner and outer shell by inserting the insulated inner liner into the outer shell; topstitch if needed.
7. Make a circular, insulated lid with short walls and a drawstring casing.
8. Finish by reinforcing the edges.

Approaches to making fireless cookers vary. See this video [http://edn.link/kjg747] for an example of a method used by a local, Tanzanian entrepreneur.

Figure 5. A basket-covered fireless cooker.
Source: ECHO East Africa staff

❹ The length of fabric needed to line the inside of the basket is equal to the circumference of the pot used for initial heating (outer diameter x 3.14). The width of this fabric is equal to the height of the pot used for initial heating plus twice (2x) the thickness of insulation (to account for an insulated base and lid).

❺ The lid is a separate piece of fabric, stuffed with insulation material, and is large enough to cover the pot at the top (by pushing it into place). Baskets are obtained ready made and are of different sizes. The lid measurements will therefore need to be based on the size of the basket, resulting in a lid that covers the space between the inner walls of the basket.

Design and steps to make a basket-covered fireless cooker (Figure 5)

Materials

- Sturdy basket or crate: choose one with a diameter equal to that of the pot used for initial heating plus twice (2x) the thickness of the insulation (5 to 10 cm)
- Fabric for inner liner
- Insulation (5 to 10 cm thickness): wool, rice husks, old blankets, or wood shavings (5 to 10 cm thick)
- Heavy-duty thread and sewing tools

Steps

1. Make the insulated liner:
   a. Cut fabric into a cylinder matching the basket size.❹
   b. Add side pockets and base pockets for insulation.
2. Insert insulation, filling the side and base pockets with insulation material.
3. Fit the liner inside the basket: secure the top edge by folding or stitching.
4. Make a soft, insulated lid with fabric plus stuffing.❺

Foods that can be prepared with fireless cookers

Fireless cookers work well for all steamed and boiled foods. Examples of East African foods include rice, pilau (rice with broth and/or meat, vegetables, and spices), plantains with beef, and githeri/makande (boiled maize and beans). Foods that are not suitable for use of fireless cookers include fried foods (e.g., fried rice, green bananas, and chips) and roasted foods.

Additional training elements

In addition to learning how to make fireless cookers, participants receive entrepreneurship training. They learn skills in pricing, marketing, record-keeping, and customer education. ECHO facilitators also engage in monitoring and follow-up, gathering user feedback and assessing cost and fuel savings.

Key Findings from ECHO Research

Field research was conducted by S.A. Rivera Plua and Z.M. Longacre in November 2025 in the Monduli, Longido, Meru, and Arusha districts of Arusha Tanzania. Household survey data were collected from those using both the cloth and basket types of fireless cookers. Scientific data collection focused on the cloth-covered cookers. Their findings, summarized below, provide strong evidence that fireless cookers offer significant household-level benefits.

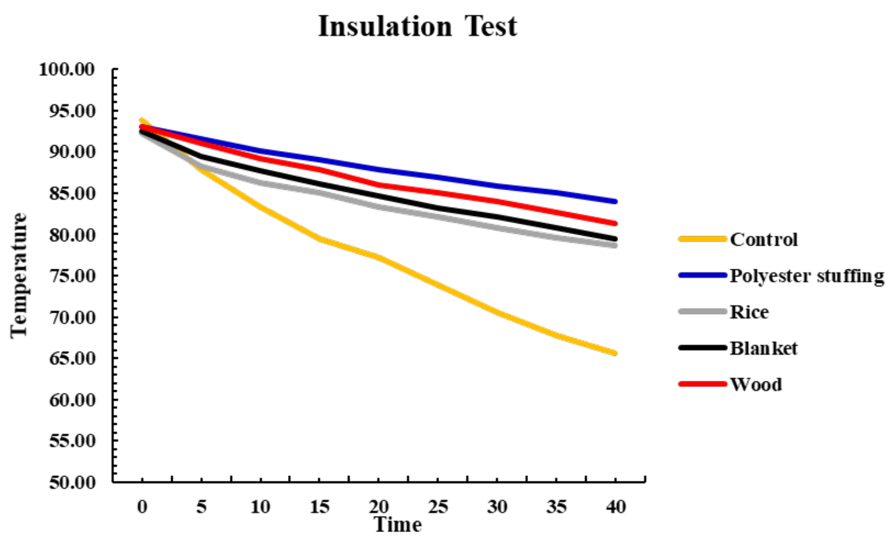

Figure 6. Heat retention insulation test for four commonly found insulation materials.

Thermal Efficiency

Comparative tests of rice husks, blankets, polyester stuffing (synthetic fiber), and wood shavings showed that all insulation materials slowed heat loss, with polyester performing best (Figure 6). A cooker insulated with polyester stuffing maintained 88.2°C after 40 minutes, compared to <70°C for a pot left in open air (control). These findings confirm that properly made fireless cookers can buffer heat loss from cooking pots. This, therefore, helps food finish cooking using retained heat, though times needed for cooking and finishing in fireless cookstoves must be determined for each food type and consumer preference.

Fuel savings (measured for cloth fireless cookers)

During rice-cooking trials, the fireless cookers reduced LPG consumption by 50 to 70%. Meals requiring long simmering on an open fire or stove only needed six minutes of initial heating before being transferred to the fireless cooker to finish cooking (Figure 7). Such reductions directly address deforestation pressures and high household energy costs.

Figure 7. Foods finished cooking from fireless cookers.
Source: ECHO East Africa staff

Time savings for women

Women across the four districts consistently reported that while fireless cookers do not shorten total cooking time, they eliminate the need for constant attention. This freed up time for farming, childcare, income-generation, and/or attending community meetings. In some pastoralist communities, firewood collection trips decreased from three times a week to once a week.

Cost savings

Savings varied by household, depending on the type of fuel used:

- LPG users extended the lifespan of a 6 kg cylinder from one month to two months.
- Wood fire users reported savings of 20,000 to 135,000 TSH (8 to 52 USD) per month, particularly when combining fireless cookers with efficient stoves.

These savings represent meaningful improvements in household budgeting and resilience

Health improvements

Women described the fireless cookers as “friendly to the body” because of reduced contact with smoke. Less time spent leaning over fires is especially important in homes using three-stone fires or inefficient stoves. This aligns with global research linking reduced smoke exposure to improved respiratory health.

Income generation and women’s empowerment

Several women’s groups are producing fireless cookers for sale. Income from the sales is used to purchase chickens, pay school fees, or reinvest in small enterprises. Cooperative production models also strengthen group cohesion and leadership among women.

Community acceptance

All interviewed users actively use their fireless cookers. Acceptance is strengthened by:

- Safety—reduced risks of burning or over-cooking
- Compatibility with traditional dishes (rice, beans, milk tea, meat stews)
- Reduced workload and stress for women and increased engagement in other activities

Challenges identified

- Fireless cookers require adequate initial boiling; insufficient pre-heating can lead to undercooked food.
- Poor-quality materials reduce insulation performance over time.
- Some communities struggle to source suitable insulation materials.

These challenges highlight the need for ongoing research, training, and improved supply chains for quality materials.

Conclusion

Integrating fireless cookers into ECHO East Africa's clean cooking efforts has proven to be effective in improving household wellbeing, reducing fuel use, and supporting environmental sustainability. Field research conducted from 2024 to 2025 shows that these low-cost cookers retain heat well and significantly reduce energy consumption, lowering expenses for LPG users and reducing pressure on firewood resources. Communities reported social and health benefits, including reduced smoke exposure and time savings that allow women to focus on farming, childcare, and income-generating work. The initiative also encourages local entrepreneurship, especially among women's groups that produce and sell the cookers. Overall, fireless cookers are a valuable addition to clean cooking solutions, with strong potential to expand household impact and local economic opportunities across East Africa.

Biosand Water Filter Effectiveness

by Shaun Snoxell, Dr Krit Suriyachaipun, Anochao Potjanathamrongpong, and Sombat Chalermliamthong

Introduction

Many communities around the world struggle to access clean, safe drinking water. Biosand water filters are one option to address this problem. Biosand filters are easy and inexpensive to set up, assembled using locally available materials, are low maintenance, do not require electricity, and are reasonably effective. The major downside is that they are not as effective as some more expensive water filtration systems. This article shares real-world evidence of the effectiveness of biosand filters.

ECHO Asia trains on the 'blue barrel' biosand water filtration system. ❻ Our preferred design was developed by Aqueous Solutions (2016), and is available on ECHO Community here: Water Treatment System Booklet - 300 Liter Per Day [http://edn.link/fmrxft] ; link to video. This design includes a biochar filtration layer, which effectively absorbs some chemical pollutants such as 2-4-D pesticide residues (Kearns *et al.*, 2010). Our network members promote the adoption of these filters in communities across Thailand and Southeast Asia.

❻ The sand in a biosand filter provides surface area for the formation of the biolayer, a layer of microbes that eventually develops near the top of the sand column–where oxygen and food particles are available. This layer is called a 'schmutzdecke'. This is the main reason that biosand filters are effective at pathogen removal. It usually takes a month for this bio-layer to develop. If it dries out, the microorganisms will die. It is important for the water level to always cover the top of the sand.

The blue barrel filter costs around 5,000 THB (160 USD) to build and can filter around 300 liters of water per day. Materials are typically available locally in Southeast Asia. The 200-liter plastic barrel used in construction can be substituted for other containers such as cement rings or smaller buckets depending on resource availability and cost. It operates without electricity, so long as water can be piped to the first barrel under gravity flow. Maintenance is low and straightforward.

But do these filtration systems work? How safe is the water coming out of these biosand filters (Figure 8)? The ECHO Asia team conducted a series of interviews, water tests, and design modifications to validate the design we train on. A complete report on this research is available as an ECHO Research Note: Analysis of Water Quality Results from Biosand Water Filtration Systems [http://edn.link/mfqphk]. In this article, we summarize our key findings. For designs and explanations on how these filters work, check out ECHO's resources here Biosand Water Filters [http://edn.link/z2a394] or see the references at the end of this article.

Figure 8. Before (left) and after (right) filtration at demo on ECHO Asia site. *Source:* ECHO Asia Staff

Background information

First, what does previous research say about the effectiveness of biosand filters? Biosand filters clean water through four key mechanisms (CAWST, 2012):

1. Filtration- trapping dirt and pathogens in the sand
2. Predation- microbes eat each other inside the filter, especially in the biolayer
3. Adsorption- some pathogens get stuck to the sand and biochar, and can't wash out
4. Death of pathogens- some pathogens die inside the filter due to an unsuitable environment that lacks food or air for them

Biosand filters typically remove most of the suspended sediment from water and improve water taste and visual color of the water. Lab trials have shown that properly working biosand water filters can remove 90 to 99% of bacteria (Eniola and Sizirici, 2023; Maiyo *et al.*, 2023). Field trials have shown more mixed results but also show removal of most microbial contamination (Aiken *et al.*, 2011; O'Connell *et al.*, 2023).

Biosand filters often remove iron and manganese compounds effectively (Demir, 2016). However, without special modifications, they are not usually effective at removing toxic heavy metals like lead, highly soluble nutrients like nitrate, or dissolved salts like sodium (Maiyo *et al.*, 2023).

Biosand filters, with the addition of a biochar layer (or activated charcoal), benefit from additional filtration capacity for chemical contaminants. Biochar has very high porosity and can help absorb and/or filter contaminants. There is evidence that biochar can help remove some pesticide residues (Kearns *et al.*, 2014).

Community feedback

We interviewed six Northern Thailand communities about adoption of the biosand filters (Figure 9). Participants provided generally positive feedback. At least one community reported a reduction in diseases associated with drinking unsafe water since the installation of the filter. People reported saving time on water collection. For example, some people were able to collect water from a communal biosand filter in the village rather than travelling to collect water from the stream. Other people had previously relied on buying bottled drinking water. When the communal biosand filter was installed, they were able to save money by reducing water purchases. Five of the six surveyed communities regularly used the biosand filters and maintained them. The remaining community never used the filter as it was installed by an external project, and they were not convinced at the start that it was effective.

Figure 9. ECHO Asia team interviewing a biosand water custodian in Houypa village, Northern Thailand. *Source:* ECHO Asia Staff

Results of water quality testing

ECHO gathered data from twelve biosand water filtration systems across northern Thailand. Of these, there were eight systems with water tests prior to

Figure 10. Checking a biosand water filter and taking water samples in Pangfan village. *Source:* ECHO Asia Staff

Figure 11. Water samples being prepared for submission to the laboratory. *Source:* ECHO Asia Staff

filtration as well as after filtration (pre and post filtration data). Water samples were analyzed by the Department of Health laboratory in Chiang Mai, Thailand for 21 water quality parameters (Figures 10 and 11). An ECHO partner, Global Hope Network International, also contributed water quality test results from biosand filters of the same design that they had installed.

The tests cover water physical, chemical, and biological quality as follows:

- **Physical:** color and turbidity
- **Chemical:** pH, total dissolved solids (TDS), hardness, nitrates and nitrites, iron, sulfate, chloride, fluoride, manganese, copper, zinc, lead, total chromium, cadmium, arsenic, mercury
- **Biological:** total coliforms bacteria,[7] *Escherichia coli* (E. coli)

[7] Total coliform bacteria are a group of microorganisms found in soil, surface water, and the intestines of mammals. While most coliforms are harmless, their presence in drinking water can signal that the water supply may be contaminated with harmful pathogens from animal or human waste.

E. coli in water indicates fecal contamination, meaning human or animal waste has entered the water supply. Some strains of E. coli can cause illness in humans. E. coli presence is a more reliable indicator of unhealth microbes in water than total coliforms.

In general, there was high variability across different systems. The quality of filtered water from a biosand water filter depends on the original installed specifications of the system, maintenance, and most importantly on the quality of the source water. Some insights from our test results are distilled below.

Biosand filters were very effective at improving water color and reducing turbidity (visible dirt/particles) in the water. They struggled to clean the water enough to meet drinking water quality standards when source water was extremely contaminated (high turbidity).

The filters typically result in a small increase in the pH of filtered water. This is likely because biochar is alkaline. We observed small changes in water pH. With pH of up to 8.5 being within drinking water standards; there is no concern from this study about drinking water quality impacted by pH in filtration.

The biosand filter was effective at reducing iron levels in the water. The filters had little impact or no clear trend on TDS, hardness, nitrates and nitrites, sulfate, chloride, fluoride, manganese, copper, zinc, lead, total chromium, cadmium, arsenic, and mercury.

Biosand filters were generally effective at removing E. coli, however there is evidence that not all systems perform effectively. Biosand filters did not produce sterile water, but seemed to reduce the amount of

Table 1. Selection of pre and post – filtered water samples

Village	Parameter	Before	After	Minimum Water Quality Standard
Village A	Color	10	0	not more than 15 Platinum Cobalt Units
	Coliform	detected	detected	not detected
	E. coli	not detected	not detected	not detected
Village B	Color	20	10	not more than 15 Platinum Cobalt Units
	Coliform	detected	detected	not detected
	E. coli	not detected	not detected	not detected
Village C	Color	10	0	not more than 15 Platinum Cobalt Units
	Coliform	detected	detected	not detected
	E. coli	not detected	not detected	not detected
Village D	Color	120	90	not more than 15 Platinum Cobalt Units
	Coliform	detected	detected	not detected
	E. coli	detected	not detected	not detected

coliforms in the water. Combining our results with a literature review, we believe that biosand filters with biochar typically remove most of the harmful bacteria; however they are not 100% effective (Eniola and Banu, 2023).

Table 1 presents before and after filtration test results for three of the measured parameters, across filters in four villages. The full dataset is available on GitHub [http://edn.link/githubresearch].

Design insights from ECHO Asia

The Appropriate Technology team at ECHO Asia did a series of design experiments to see if we could make highly polluted water from our fishpond drinkable. We found that while the filter dramatically improved the quality of fishpond water, it still could not meet the Thai Ministry of Health drinking water standards.

In the process, we learned the following:

- Reducing the flow rate through the barrels helps improve water quality as water has more time in the sand layers.
- Letting water settle in a holding tank prior to filtration reduces sedimentation.
- Reducing the particle size of sand and gravel and increasing the depth of the layers with smaller particles improves filtration.
- We previously placed biochar in a mesh bag before placing it in the third barrel. We learned that it is best to add the biochar directly to the barrel and allow it to form a thick mat.
- Crushing biochar to small particle sizes improved filtration effectiveness, but too small slows the water flow. We prefer a particle size range from around the size of a corn grain to the size of a thumb-nail (around 0.5 to 2 cm diameter).
- We learned to soak biochar prior to installing. Floating biochar particles are not properly pyrolyzed and are less water-permeable. Removing floating biochar particles removes the lower quality biochar. The remaining biochar is therefore better quality.

Figure 12. Building a biosand filter.
Source: ECHO Asia Staff

Our conclusion is that the biosand water filter needs to be constructed (Figure 12) according to the design specifications to perform well. The biosand filter can dramatically improve water quality but will not always improve water quality to meet drinking water standards.

Figure 13. Taking water samples for laboratory testing *Source:* ECHO Asia Staff

Recommendations for development practitioners

- Biosand filters are not 100% effective at improving water quality across all parameters, but they reliably produce better quality water than with no filtration. It is very likely that a community drinking water from a biosand filter will have less incidence of water-borne diseases. Water taste is also usually improved. Biosand filters can often save people money or time collecting water from other sources. We are confident in promoting biosand water filtration, despite limitations.
- Boiling water may still be an appropriate option for post-filtration treatment to kill microbes in the water. If symptoms of water-borne illness persist, then we strongly recommend water boiling, or looking to other water purification alternatives.
- Not all biosand filters are equal. Building filters using well-validated designs is more likely to produce effective systems.
- There are many other water treatment options available. We recommend the work of CAWST (Centre for Affordable Water and Sanitation Technology) for other low cost, decentralized water treatment options. See their website: CAWST – WASH Education and Training Resources [http://edn.link/cawst].

As always, community engagement and local ownership are key for adoption and long-term success of biosand water filters. In many contexts the source water may be too dirty for biosand filters to be the right solution. Communities may prefer other alternatives. The community must understand the filter and its benefits for sustained use. Community members must be responsible for ongoing maintenance.

Acknowledgement

ECHO would like to acknowledge the team at Global Hope Network International Thailand for their cooperation. Thanks for sharing your experiences and water test data (Figure 13).

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Echoes from Our Network: Seed Village

by Shashidhar M.

A Pathway to Entrepreneurial Development and Self-Reliance among Forest-Based Tribal Farmers in H.D. Kote, Karnataka

This study reflects experiences of living in the community and conducting a participatory needs assessment with tribal farmers in the Mysuru district of Karnataka, India. Access to quality seeds can increase crop yields through our research experience ; however, tribal communities often face persistent challenges in accessing affordable, timely, and high-quality seeds. To respond to this constraint, we designed a local action to start a decentralized, community-led program to improve access to quality seeds, building local capacity for seed production, preservation, and exchange, called a "Seed Village." The Seed Village model seeks to promote the use of quality seeds while developing entrepreneurship for self-reliance and sustainable income.

This study presents insights learned from the implementation process of the Seed Village model, which reduced dependence on commercial seeds and empowered tribal farmers at the village level. It shows that localized seed production systems can enhance self-reliance and improve incomes while upholding constitutional values within the tribal context.

The 14,000 inhabitants of the tribal communities in H.D. Kote in Mysuru district face multiple agricultural challenges: limited livelihood options, marginal landholdings,[8] wild animal pressure, and lack of access to quality seeds and opportunities for irrigation or mechanization, leading to a cycle of low productivity and income.

[8] In this case, landholdings were either small in size or fragmented.

Objectives of this study

- To promote sustainable agriculture by producing quality seeds
- Develop the capacity for seed saving and self-sufficiency
- Develop entrepreneurship among tribal farmers
- To enhance economic viability while conserving traditional practices
- To uphold constitutional values through participatory implementation

Materials and methods

The participatory action-research approach was adopted, and a baseline survey was conducted in five tribal hamlets (one was excluded due to wildlife threats). Collaboration and Institutional Support was provided by the Swami Vivekananda Youth Movement (SVYM), the Indian Council of Agriculture Research (ICAR), the Zonal Agriculture Research Station (ZARS) Mandya, and the Tribal Women's Federation "Prakruthi Girijana mahila Okkuta" (SHG).

Figure 14. Mature white ragi. *Source:* Mandya the Zonal Agriculture Research Station

The program selected 15 farmers with access to irrigation and an interest in seed cultivation to participate. These farmers were provided with improved and high-quality seeds to serve as foundation seeds for seed production and multiplication. Cultivars of *Eleusine coracana*, or finger millet known locally as White Ragi (KMR-340; Figure 14; Raveendra, 2019) and *Vigna unguiculata* Cowpea (KGB-9; Figure 15) were provided to farmers.

Figure 15. Mr. Bharya harvesting and storing cowpea. *Source:* Shashidhar M.

To build farmer capacity, the project conducted training on seed cultivation, agronomic plot maintenance, and post-harvest processing. During the 8-month project (July 2019 to Feb. 2020), monitoring consisted of regular field visits and technical support to ensure the quality of improved farming practices, along with expert consultation (Figure 16).

A critical feature of this model was the involvement of a local farmer collective "*Prakruthi Girijana mahila Okkuta*" (SHG). The SHG played a central role in post-harvest procurement, seed grading, drying, and storage. This not only enhanced local ownership, but also created an ecosystem system for seed reuse and distribution within the community.

By decentralizing seed production and strengthening community institutions, the "Seed Village" initiative empowered farmers, reducing dependency on commercial seed markets, and promoting agricultural resilience and biodiversity conservation at the local level.

Figure 16. ICAR scientist filed visit scientist. *Source:* Dr. Ramamurthy – Principal Scientist

Results and outcomes

Tribal farmers successfully grew improved varieties of millet (White Rag KMR-340) and cowpea (KGB-9). The farmers were also able to market the grain they harvested through seed resale. In this research project, the introduction of improved crop varieties and agronomic crop management support improved crop performance compared to farmers' earlier experiences.

The market data was not collected, but after seeing the yield of the white ragi another 10 farmers have taken and sown the foundation seeds. These farmers reported improved market participation and easier access to local buyers. Crop residues also provided fodder for livestock. This seed initiative laid a foundation for community-level agricultural enterprises and provided a foundation for entrepreneurship, and the increased cooperation among tribal groups enhanced solidarity.

Figure 17. SVYM Founder Dr R. Balasubramaniam Visited to Ms. Boomi's land.
Source: Shashidhar M.

Ms. Boomi, a successful farmer

Ms. Boomi (Figure 17), a tribal woman from Kempanahadi, adopted improved White Ragi millet seed production with project guidance. Her success inspired nearby farmers and positioned her as a local role model. She demonstrated the transformative potential of agricultural project interventions. Her yield of 12.8 quintals per acre (1,280 kg/ha) was above normal yields for the region.[9]

[9] This represents a 30–40% productivity gain without significant increases in input costs compared to 7 to 8 quintals per hectare for local varieties grown in rainfed conditions.

Discussion

Despite the limitations mentioned, community participation and consistent mentorship helped overcome some major barriers. "Seed Village" is one model that fosters economic justice, reduces dependency on external seed markets, and builds local agricultural enterprise capacity. Institutional facilitation and farmer-centered planning are key to scalability. The project showed the constitutional values of equality, justice, and fraternity with different tribal group collaboration during training and marketing.

Conclusion and recommendations

The Seed Village initiative has created a replicable model for sustainable, localized, and participatory agricultural entrepreneurship in tribal areas. Future work should focus on:

- Institutionalizing the local farmer collective role in seed commerce.
- Accessing microcredit for scale-up.
- Training on branding and marketing.
- Exploring more crops and varieties with high local and commercial value.

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From ECHO's Seed Bank: *Afzelia quanzensis*

by Robert Walle

Introduction

Afzelia quanzensis is commonly known as pod mahogany, lucky bean tree, chamfuti, or afzelia. *A. quanzensis* is a deciduous, deep-rooted tree up to 35 m tall with a spreading crown, good for providing shade and high-quality timber (Gérard and Louppe, 2011; Orwa *et al.*, 2009). *A. quanzensis* grows rapidly (50 to 60 cm per yr) when young, producing a straight trunk. Under good conditions, it reaches initial maturity in 7 years and trunks can grow up to 1 m in width. *A. quanzensis* is worthy of conservation in its native range, which includes dry, low-lying areas of southern Africa as well as parts of west, east, and central Africa (Mtambalika *et al.*, 2014).

The foliage consists of compound leaves, each with 4 to 7 pairs of leaflets (Orwa *et al.*, 2009). The leaves are smooth, elliptic to oblong shaped, rounded or slightly tapered to a long narrow point, with a petiole present. It has yellow to orange-red flowers with axillary inflorescences. The glossy black, large seeds are oblong and thick (Figure 18), formed in a woody pod that splits when mature. It has a bright orange-red aril that aids seed dispersal by making them attractive to birds and mammals.

Figure 18. *Afzelia quanzensis* seeds at ECHO's seed bank in Florida. *Source:* Tim Motis

Climate

A tree of the southern hemisphere, it grows under bright to cloudy skies. It grows at temperatures of 18 to 36°C and with a rainfall of 400 to 1700 mm at a maximum altitude of 1300 m. It develops a deep root system that thrives on well-drained, light- to medium-textured soil with moderate fertility and pH ranges of 4.5 to 7.5 (FAO, 2024).

Cultivation

Cut pods using lopping shears and collect immediately as they turn from green to brown-black (Orwa *et al.*, 2009). It is also possible to collect fallen pods (BeyondForest, 2025). Each pod will contain 6 to 10 seeds (Orwa *et al.*, 2009). Extract the seeds from the pod, let them dry in the sun, and store them under low temperature in airtight containers (to exclude humidity). According to Orwa *et al.* (2009), seeds dried in the sun to a moisture content of 6 to 10% and kept at 3°C can retain a germination rate of 30% after 10 years of storage. (10)

(10) Germination percentage of A. quanzensis at ECHO's seed bank in Florida remained virtually unchanged, at 75-80%, after 7.85 years of storage in a sealed bag in an air-conditioned room (exact temperature unknown but significantly warmer than 3 °C).

Prior to planting seeds, remove the aril and nick the side of the seed or soak the seeds in water for 12 to 24 hours to hasten germination (BeyondForest, 2025; Gérard and Louppe, 2011; Orwa *et al.*, 2009). Sow seeds 2 to 3 cm deep in a 5:1 mixture of river sand and compost, keeping the mixture moist. Healthy seeds germinate in 11 to 28 days (Orwa *et al.*, 2009; BeyondForest, 2025).

Mtambalika *et al.* (2014) found that seed size did not significantly affect germination (up to 95%) but significantly affected survival of seedlings against shoot dieback. At 86 days after sowing, 92% of seedlings from large seeds had survived, compared to 68% survival with small seeds. Larger seeds conferred advantages in early growth, vigor, and resilience, showing the preferable use of large seeds for quality nursery production.

In a nursery setting with seedlings grown in polyethylene bags, Hounsouvo *et al.* (2022) compared combinations of mycorrhizal inoculation, manure, and mineral fertilizer. They found that growth was best with *Scleroderma verrucosum* (a beneficial mycorrhizal fungus), 166 g of chicken manure/L of soil, and 20 g of mineral fertilizer/L of soil. The mineral fertilizer they used consisted of 13% nitrogen, 10% phosphorus, and 10% potassium.

Outplant seedlings at the 2-leaf stage and protect from cold wind for 2 seasons (Orwa *et al.*, 2009). Transplant seedlings after 4 to 6 months of growth in a nursery (Gérard and Louppe, 2011), while still small since *A. quanzensis* produces a deep taproot (Fern, 2026). Space the trees 4 to 6 m apart, which will account for canopy width (BeyondForest, 2025). Protect young trees from animal grazing and drought.

Pests

A small Ambrosia beetle, *Euwallacea fornicatus* (Curculionidae) completes its life cycle in *A. quanzensis* (Van Rooyen *et al.*, 2021. Adults bore into stems and branches, causing vascular blockages, branch death, or tree mortality. It carries the fungal disease *Fusarium euwallaceae*, identified by small holes with powdery sawdust (frass) and dark staining around the fungal infections.

Another beetle, *Pachydissus hector*, has been reported to attack the trunks (Gérard and Louppe, 2011). Baboons, monkeys, squirrels, and hornbills, all eat and distribute seeds (Orwa *et al.*, 2009).

Benefits and uses

As a valuable timber species, its precious wood is resistant to borers and termites and polishes well for use in cabinetry and musical instruments (Orwa *et al.*, 2009). Bark and leaves are eaten by elephants, and the leaves are browsed by eland antelope and grey duiker. Cooked leaves are consumed as a vegetable (Fern, 2024). Jewelry is made with the seeds (Gérard and Louppe, 2011). Traditional medicine is made from various parts of the plant. *A. quanzensis* has merit for use in reforestation, fuel, agroforestry and other food systems in its native range.

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Books, Websites, and Other Resources

by Gabriel Buttram,Technical Director, Trees for the Future

Forest Garden Technical Manual

Available in English and French: http://edn.link/x3xe7e

Trees for the Future is recognized by the UN Decade on Ecosystem Restoration as a World Restoration Flagship. Through this designation, they received support from the Food and Agriculture Organization of the United Nations (FAO) and the UN Environment Programme (UNEP) to produce the Forest Garden Technical Manual.

This manual is designed as a practical, field-ready resource. It lays out a proven process for transforming marginalized or degraded agricultural land into highly productive, sustainable forest gardens, with detailed guidance practitioners need to support planning, design, establishment, and ongoing management. By supporting a shift from subsistence agriculture toward more regenerative, diversified systems, the resource is explicitly oriented toward improving the livelihoods of smallholder farming families—including stronger yields, food security, and income potential—while contributing to restoration outcomes such as carbon storage and biodiversity.

The technical manual is written primarily for trainers, extension workers, specialists, and other practitioners who want to empower farmers to enhance production while restoring degraded ecosystems. While the approach draws on decades of learning from agricultural communities worldwide, the manual is grounded in TREES' implementation experience in sub-Saharan Africa, including lessons generated over more than eight years of programming and farmer/staff feedback. It also reflects farmer experience from project contexts spanning East Africa and West Africa (specifically Uganda, Kenya, Tanzania, and Senegal). At the same time, the relevance of concepts and practices is not Africa-

exclusive. Forest gardening has been practiced across cultures and climates for centuries, and the Forest Garden Approach adapts those principles into a structured, step-by-step program that can be relevant to smallholder producers globally with appropriate contextualization.

Adoption, however, can be constrained by realities common to smallholder settings. Farmers often operate with limited land and water access, which can make it difficult to balance crop production with trees and livestock integration. These constraints can limit how fully the forest-garden model can be implemented at once. Additional barriers can also slow uptake or reduce impact, including limited access to seeds, tools, finance, livestock, and reliable markets.

Ultimately, the Forest Garden Approach offers smallholder farmers a practical path to improved food security and income while strengthening community resilience and restoring soils, biodiversity, and ecosystem function. For anyone committed to land restoration and sustainable agricultural extension, this manual provides a proven, field-tested framework for partnering effectively with smallholder communities and supporting durable, locally owned change.

Upcoming Events

ECHO Asia Training Calendar 2026 ปฏิทินการอบรมเอคโค่ ปี 2569

January มกราคม	16	Solar Dryer Workshop	การทำเครื่องตากเมล็ดพันธุ์พลังงานแสงอาทิตย์
February กุมภาพันธ์	2	Asian National Apprenticeship Program Start Date Cohort 1	เริ่มต้นโครงการฝึกประสบการณ์สำหรับผู้มีสัญชาติเอเชีย รุ่นที่ 1
	2-7	Intro to Tropical Agriculture & Development (TAD) Course	หลักสูตรการพัฒนาและการทำเกษตรในพื้นที่เขตร้อนชื้น
	19-20	Kitchen Gardening Workshop	การปลูกผักสวนครัว
March มีนาคม	2-6	Faith & Farming Training	การอบรมหัวข้อความเชื่อและการเกษตร
	19-20	Biochar & Biosand Water Filtration Workshop	การผลิตถ่านชีวภาพไบโอชาร์และการผลิตเครื่องกรองน้ำระบบชีวภาพ
	24-26	Sri Lanka Agriculture Networking & Training Event	การอบรมและสัมนาเครือข่ายด้านการเกษตรในประเทศศรีลังกา
April เมษายน	6-7	NE India Agriculture Networking & Training Event	การอบรมและสัมนาเครือข่ายด้านการเกษตรในอินเดียตะวันออกเฉียงเหนือ
	7-9	Biochar Forum: Farm Waste, Sustainability & Carbon Credits - Thai ONLY	การสัมนาเชิงปฏิบัติการไบโอชาร์: จากวัสดุเหลือใช้ทางการเกษตรและทรัพยากรที่ยั่งยืน สู่คาร์บอนเครดิต - ภาษาไทยเท่านั้น
May พฤษภาคม	15	NUS Cooking Workshop	การทำอาหารจากพืชที่ถูกละเลยและใช้ประโยชน์น้อย
June มิถุนายน	1	Asian National Apprenticeship Program Start Date Cohort 2	เริ่มต้นโครงการฝึกประสบการณ์สำหรับผู้มีสัญชาติเอเชีย รุ่นที่ 2
	1-6	Intro to Tropical Agriculture & Development (TAD) Course	หลักสูตรการพัฒนาและการทำเกษตรในพื้นที่เขตร้อนชื้น
	25-26	Kitchen Gardening Workshop	การปลูกผักสวนครัว
July กรกฎาคม	16-17	Biochar & Biosand Water Filtration Workshop	การผลิตถ่านชีวภาพไบโอชาร์และการผลิตเครื่องกรองน้ำระบบชีวภาพ
	24	System of Rice Intensification (SRI) Planting Day	กิจกรรมการปลูกข้าวต้นเดียว (ครึ่งวัน)
August สิงหาคม	3-8	Intro to Agroecology Course - Thai ONLY	หลักสูตรการอบรมเกษตรเชิงนิเวศน์ - ภาษาไทยเท่านั้น
	18-20	Agribusiness Community of Practice Event	การอบรมและสัมนาธุรกิจการเกษตรสำหรับชุมชน
September กันยายน	4	NUS Cooking Workshop	การทำอาหารจากพืชที่ถูกละเลยและใช้ประโยชน์น้อย
October ตุลาคม	5-9	Seed Bank Managers Forum	การสัมนาเชิงปฏิบัติการสำหรับผู้จัดการธนาคารเมล็ดพันธุ์
	16	Solar Dryer Workshop	การทำเครื่องตากเมล็ดพันธุ์พลังงานแสงอาทิตย์
November พฤศจิกายน	2	Asian National Apprenticeship Program Start Date Cohort 3	เริ่มต้นโครงการฝึกประสบการณ์สำหรับผู้มีสัญชาติเอเชีย รุ่นที่ 3
	2-7	Intro to Tropical Agriculture & Development (TAD) Course	หลักสูตรการพัฒนาและการทำเกษตรในพื้นที่เขตร้อนชื้น
	27	System of Rice Intensification (SRI) Harvesting Day	กิจกรรมการเก็บเกี่ยวข้าวต้นเดียว (ครึ่งวัน)

For more information or to register echoasia@echocommunity.org 053-304-028 ECHO Asia Impact Center


ECHO North America
Training Calendar 2026
February 23-27 TOT with Global CHE Network
March 14 Global Food & Farm Festival
April 13-17 Intro to Tropical Ag Development
21-24 Syntropic Agroforestry
May 20-22 Seed Banking
July 13-17 Intro to Tropical Ag Development
November 10-12 ECHO International Agriculture Conference
Scan for more details about each training
email: study@echonet.org
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