ECHO® Development Notes

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Learning about and from Local Seed Systems

Summarized by Dawn Berkelaar

At ECHO's 2014 International Agriculture Conference, Dr. Laura Meitzner Yoder gave a plenary talk titled "Planting Connections: Learning from Local Seed Systems and Fostering Community Seed Exchange." The talk was based on collaborative work that was done by the following:

Rick Burnette, ECHO Asia founding director
Dr. Abram Bicksler, former ECHO Asia director
Dr. Ricky Bates, Penn State University
Dr. Tom Gill, Penn State University
Vincent Ricciardi, ECHO Asia research technician
Dr. Laura Meitzner Yoder, Wheaton College
Yongyooth Srigiofun, Maejo University.

Highlights from Dr. Meitzner Yoder's talk are summarized in this article.

Access to viable seed (Figure 1) is critical for successful farming. This is one reason our seed banks in Florida (USA), Thailand, and East Africa offer trial packets of seed to our network members. We have written about how to hold a seed fair, to enable people within a community to share and acquire seeds directly from each other. But what do we know about how seed normally flows throughout a small farming community?

Figure 1. Small lots of indigenous seeds in Southeast Asia. *Source:* ECHO Asia research team

Importance of smallholder agriculture for seed flow of diverse crops

Smallholder farmers make an enormous contribution to agriculture, producing and conserving biodiversity. In a recent study, Vincent Ricciardi and colleagues examined farmer surveys and census data from 55 countries. They found that farms under 2 ha produce 30-35% of the world's food, and have the greatest share of crop species diversity compared to other farm size classes (Ricciardi *et al.* 2018). On more than 500 million small farms worldwide, farmers grow food in small plots in variable ecosystems and microclimates, often close to forests and edges. Where farmers are able to periodically leave land fallow, local plant species regrow. Where the local diet includes wild foods, farmers continue the process of crop domestication when they collect and plant seeds of wild species.

Planting processes also contribute to biodiversity. Many smallholder farmers use little mechanization. Instead, they hand-sow small volumes of very diverse landraces or genetically diverse local varieties. They can be attentive to new characteristics or traits. Often, smallholder farmers save their own seed, in a labor-intensive process of selecting and harvesting seed by hand.

Importance of understanding seed flow

Understanding how seeds move through a community is incredibly important, for many reasons:

Helps with local resource assessment. You can find out, for example, what crops people are growing. This helps you learn how much genetic diversity is present, and where. Knowledge about what seeds are available can give information about the nutrition content of crops that are regularly grown and eaten.

Helps with new crop evaluation and promotion. If you want to test or introduce a new crop, you will first want to know how seeds and varieties move throughout a community, so that you can work within the already-existing system.

Enhances awareness of factors affecting change. Understanding the informal seed system can give insights into local social networks or hierarchies, internal/external changes in resources, access, marketing, etc.

Featured in this EDN

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Provides awareness of threats to:

Seed availability. Sometimes only one or two main people in a community save seed of a specific crop. Twenty years ago, Dr. Meitzner Yoder studied seed systems in the highlands of Honduras. She learned that in one region, while most farmers tended to save their own maize seed, they ate all their beans and then bought bean seeds at planting time. The bean seeds for a wide region were coming mostly from one man who grew a lot of beans in a distant village. In a situation like this, where few people save or distribute seed of a specific crop, the whole system would be in jeopardy if such "seed keepers" were to stop producing seed, or if they saved seeds of unreliable quality. But that same individual might be well placed to improve regional production through improved on-farm seed selection or by trying new species or varieties.

Genetic diversity. If the genetic diversity of a crop or variety is small, a disease could conceivably come through and wipe it out completely.

Seed performance. Seed that is being planted might be hybrid seed, introduced by development programs or through markets. If so, it will most likely give more and more variable results the more often seed is saved and replanted.

Helps in understanding factors affecting seed access. Finding out how seed flows through a community can give insight into the social components of access. Do all people have equal access to seed? What types of people share seed, and what social boundaries exist in seed exchange?

Provides insights into local seed saving dynamics. You can learn what criteria farmers use when they select plants from which to save seeds. These likely include "quality" factors—such as storage life, taste or palatability, and ease of cooking—in addition to yields.

Insights gleaned from research in Asia

Dr. Meitzner Yoder described a study coordinated by ECHO Asia in collaboration with Penn State University and Maejo University, done to learn about local seed systems in three indigenous village clusters in Thailand and Cambodia (12 villages in total). The team decided to investigate five aspects of seed flow within the communities, described below. Team members lived in each village for a month, interviewing households about what seeds they had and where they had gotten them.

Figure 2. Vegetable identification cards (such as the card shown on the left) were used in farmer discussions (photo on right) about seed systems in Asia. *Source:* ECHO Asia research team

1. **For which species did farmers save seed?** The team decided to ask about vegetable seeds in particular, but first had to figure out how to define a "vegetable" in their context. Dr. Meitzner Yoder commented that the term "vegetable" is a cultural and culinary concept; there are no universal criteria for describing whether or not a plant is a vegetable. For the purposes of the study, a vegetable was considered to be any plant used as a main ingredient in dishes served on the small round table during a typical northern Thai meal. ECHO Asia director Rick Burnette nominated a list of 210 indigenous vegetables, which the team narrowed down to 80 (50 perennials and 30 annuals; together, 30 plant families were represented). Some of the species were only semi-domesticated, and they were usually stored and planted in a mix that included up to a dozen different species.

2. **Sources and supply—from where did people get their seed?** To facilitate conversations with households, interviewers used an identifying card for each vegetable, showing photos of different plant parts. These cards (Figure 2) were used over and over, adapted as necessary in different locations to include photos of local varieties. The photo cards gave a common reference point in a low literacy area with seven language groups represented. They were participatory and fun to use; they also made it easy to collect data, since each card was numbered and thus could be recorded very easily. Participants made piles of the cards to answer questions: Have you seen this species before? Is this species present in your community? Did it used to be present? Do you save seed of this species? Do you buy seed of this species? Would you like more of this species?

   In northern Thailand and Cambodia, trading small amounts of seed was common. Unlike in Honduras, this research did not indicate that there were designated "seed keepers." People did not pay for seeds, and did not expect any kind of repayment for sharing seeds. Seed sharing built relationships, and overcame ethnic conflicts; it was easier for farmers to ask farmers from other ethnicities for seed than to ask farmers from other socioeconomic classes. Buying commercial seed (most of it hybrid) was new, and many people viewed it as a marker of economic success.

   Seed diversity in Cambodia was lower than in the varied microclimates and ethnicities of upland regions in Thailand, with mainly beans and pumpkins available. Farmers noted that the previous seed system in Cambodia was destroyed during the genocide, then replaced by hybrid commercial seed that development agencies introduced in the recovery period, resulting in a drastic loss of biodiversity.

3. **What was the quality of the seed?** Little data existed about the seed quality. ECHO Asia has tested many seeds' germination levels (Bicksler 2011; Gill *et al.* 2013; Lawrence *et al.* 2017). Legumes had the highest germination rates of the seeds that were tested.

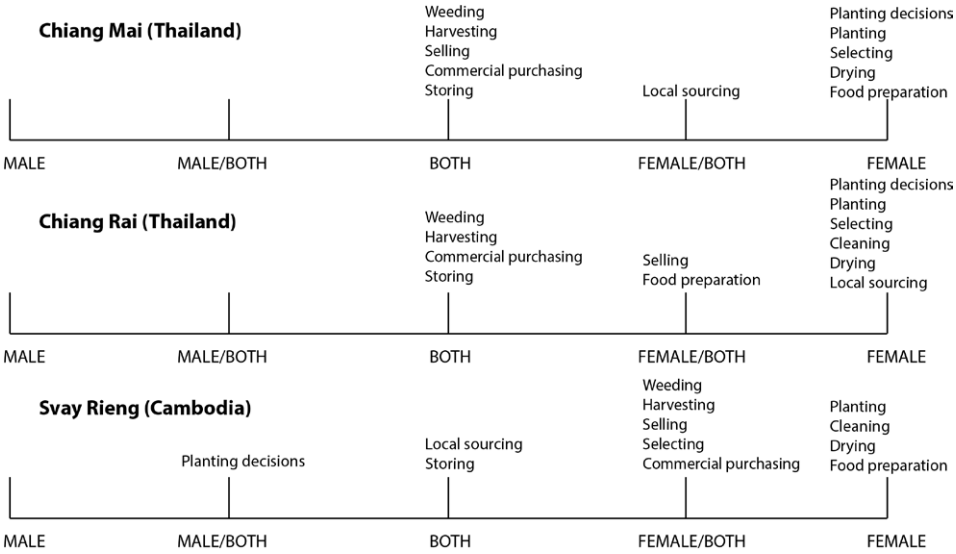

Figure 3. Gender roles in the informal seed system as identified by focus group participants in communities in Chiang Mai (Thailand) [top], Chiang Rai (Thailand) [middle], and Svay Rieng (Cambodia) [bottom]. From Gill *et al.* 2013 (content licenced as Creative Commons By 4.0).

4. **How were seeds processed and stored?** Participants were asked how seeds were dried (on the plant? in the sun?), how they were stored, and what kind of containers were used. Seed processing methods varied between countries. Mostly, seeds were dried on the plant or in the sun, and were stored in the kitchen.

   Participants were also asked about the phases of the seed cycle, and about who (men, women, or both) was responsible for weeding, making planting decisions, harvesting and drying seeds, selling, purchasing, storing and sourcing seeds (Figure 3). The results, showing women's high level of involvement with nearly all stages of the seed cycle, were extremely surprising for some local extension workers, who asked that the exercise be repeated (the same results were found the second time). They learned to be sure to invite women when holding a training related to seeds!

5. **What were the local varieties, and what potential existed for improvement?** Interviewers asked people if they were doing any plant breeding or selection. Were farmers saving "better" fruits deliberately? Were seeds sorted before being stored (e.g. to remove small seeds, or those with holes in them)?

Example of a seed fair to enhance seed flow

Dr. Meitzner Yoder concluded her talk by describing a seed fair that was held after the month of interviews, to foster community seed exchange. Families involved in the study were each given an invitation, along with ten small plastic zip top bags. Each family was invited to package and bring seeds of a vegetable that had a special characteristic. At the seed fair, each farmer was given an opportunity to discuss the seed varieties they brought, and why they liked them. The fair also included education about seed saving, and a time to answer questions about seed storage. At the end of the seed fair, participants were given time to discuss their plant varieties with each other, and to choose seed packets to take home.

Conclusion

When you understand the seed systems in a community, you can plan agriculture interventions that are sensible, purposeful, and effective. As you learn about existing seed systems, you can also help farmers understand how they can share and acquire seeds that they produce themselves or obtain from others. We hope this article helps you to do both!

Further Resources

Tshin, Ruth. 2013. How to facilitate seed exchanges during country meetings or as a single-day event. ECHO Asia Notes 16.

Read more about the study described in this article here.

To learn more about the importance of small farms globally, check out this interactive "story map" website. Scroll down to view the interactive information.

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Germination to Detoxify Jack Bean

by Dawn Berkelaar

In *EDN* 142, we linked to several documents from Feed the Future, produced with support from USAID for the RAMA-BC (Resilient Agricultural Markets Activity — Beira Corridor) project. Another, slightly longer document by Zachary Hall describes how to germinate, soak and boil jack beans, to detoxify them and make them suitable for human consumption. This article summarizes that information. We encourage you to read the full document for more details.

	Beginning of the soaking process, before the seeds have absorbed water and expanded.
	After 24 hours of soaking. Note the increased size of the seeds. Shortly after this photo was taken, the seeds were drained and washed, then kept moist---but not submerged--- in the pot (with the lid on) for an additional 48 hours. During those 48 hours, the seeds were washed and rinsed at least twice daily, to keep them moist.
	Fully sprouted seeds 48 hours after they were first drained and washed. The sprouts at this stage were approximately 2.5 cm (1 in) long.
	Fully sprouted seeds with seed coats removed.
	Seed coats (left) and non-sprouted seeds (right) that were removed before boiling.
	Sprouted seeds that were boiled for 90 minutes, with the cooking water discarded. Several ECHO staff tried them, saying that the beans were filling and tasted good.

Figure 4. Steps of the RAMA-BC jack bean detoxification method tried at ECHO in Florida. *Source:* Tim Motis

Benefits of jack bean

Jack bean (*Canavalia ensiformis*) is an important green manure/cover crop plant. It improves soil, both through its high biomass production and through its relationship with nitrogen-fixing microorganisms in the soil. Jack bean seeds contain a number of antinutrients that repel pest insects and animals, which is helpful both in the field and when storing the beans. These traits, along with its drought tolerance, enable jack bean to grow in very poor soil. In the Beira Corridor in Mozambique, a single planting of jack bean can often produce two harvests.

Antinutrient removal process

Antinutrients (described below) in the seeds of jack bean make them unsuitable for human food without treatment. Most legumes are made more digestible by soaking them for one day, then cooking them for one to three hours. Long treatment practices like these are common in Mozambique. However, jack bean contains some antinutrients that are only removed when the seeds germinate. Other antinutrients, which are somewhat reduced by cooking, are reduced even more by germination.

The germination process is not difficult, but it requires some planning. Jack beans can be germinated as follows: Soak beans for one day, then drain and wash them. Continue to wash them morning and night until they have germinated and the sprouts are one inch long (this usually takes two to four days). Finally, remove the seed coats—germination makes beans much easier to dehull—and cook the seeds for 90 minutes. See Figure 4 for pictures of the RAMA-BC process undertaken at ECHO.

The paper lists a number of antinutrients in jack bean that are only removed by germination, or (in the case of concanavalin A) by germination along with soaking and boiling:

- **Polyphenols** and **polyamines** can bind with iron, making it unavailable.
- **Phytates** can prevent iron, zinc and calcium from being used by the body.
- **Cyanide** consumption can result in iodine deficiency and related disorders such as cretinism and goiter.
- **Concanavalin A** is the most concerning antinutrient in jack bean, and blocks nutrients from being absorbed by the body in a number of ways. It is more heat resistant than other antinutrients, and is only partially removed by germination. Udedibie and Carlini (1998) showed that it could be removed by a combination of soaking (for 72 hours), breaking the beans into pieces, and cooking. The RAMA-BC approach achieves similar results by combining germination with soaking and boiling; in the boiling step, the beans naturally break into smaller pieces.

In Mozambique, the RAMA-BC project is undertaking “a behavior change campaign that includes trainings aimed at the adoption of germinating all beans and jack bean as a food crop.” This campaign includes spots on radio and TV, live demonstrations, trainings, and publication of various documents. So far, jack beans have been well-received as a high protein, good-tasting bean.

This multi-step approach to detoxifying jack bean is most relevant for areas where access to alternative legumes is limited, and where people are already familiar with processing to remove antinutrients. If you experiment with this, be sure to follow all the steps as well as advice from physicians. To our knowledge, no adverse effects

have been reported after eating jack bean seeds treated with this method. We are unaware of scientific reports of antinutrient levels in jack bean seeds that have been processed by the RAMA-BC method; however, the paper authored by Zachary Hall refers to numerous publications that support the effectiveness of the various parts of the process.

References and further reading

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For more about the effect of germination on the nutritional value of seeds, see the article "Effect of Sprouting on the Nutrition of Grain and Legume Seeds" in *EDN* 106.

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Techniques to Boost Plants' Stress Tolerance and Extend Fruit Marketability

by Tim Motis

In August of 2018, I attended the 30th International Horticultural Congress in Istanbul, Turkey. It was an excellent opportunity to meet other scientists and to hear talks on horticultural topics, many of which were relevant to ECHO's network. Here is a synopsis of a few of those talks.

Salicylic Acid for Improved Stress Tolerance

Several presentations were given on salicylic acid (SA), a plant hormone that enhances disease resistance and tolerance to environmental stress factors such as heat, cold, and drought. A form of SA called acetylsalicylic acid (ASA) is the active ingredient of aspirin, a commonly available drug with which most people are familiar. I attended a talk by M.R. Shaheen, who observed that spraying tomato plant leaves with a 1.5 mM (millimolar) concentration of SA improved the crop's ability to withstand high temperatures (40°C). Most formal research is done with laboratory-grade SA instead of aspirin tablets, but Shaheen shared that aspirin can be used. While aspirin should not be viewed as a substitute for good farm management, it might help boost crop performance under less-than-ideal growing conditions.

As with any new practice, minimize risk by experimenting on a small number of plants. Try varying the concentration, application interval, or application method. Do not make the concentration too high; avoid using more than two aspirin tablets per gallon of water. Depending on the purity of the pills, two 325-gram aspirin tablets dissolved in 3.8 liters (1 gallon) of water is the equivalent of about 1 mM ASA. Senaratna *et al.* (2000) reported negative effects with over 1 mM ASA on bean and tomato plants.

When spraying plants with ASA solution, timing matters. Shaheen recommended spraying tomato leaves when air temperatures reach 32°C and/or at flowering. I do not recall whether he sprayed SA more than one time after each of these events. Browsing online, I found examples of success with SA or ASA applied at specific times (e.g., growth stages or when yield-limiting temperatures, soil moisture levels, or pest populations are reached) or intervals (e.g., every two to three weeks). An approach like Shaheen's would boost plant defenses at critical growth stages and when plants are exposed to adverse conditions.

Besides foliar sprays, ASA can be applied by drenching soil with the solution or by soaking seeds in it. Senaratna *et al.* (2000) found that water containing 0.1 to 0.5 mM ASA increased the tolerance of bean and tomato seedlings to multiple stresses (heat, cold, and drought); this occurred when seeds were soaked in the ASA-water for 24 hours prior to planting, and also when the solution was used to saturate the soil of two-week-old potted seedlings.

Postharvest Practices for Longer Shelf Life of Fruits and Vegetables

A number of talks were devoted to reducing postharvest loss of perishable produce. Below are a few practical techniques that were discussed for mango and tomato.

Mango processing options

Md. Atiqur Rahman talked about several practices used in Bangladesh to extend the shelf life of mangoes: pre-harvest fruit bagging, a harvesting tool that minimizes fruit damage, use of stackable plastic crates, and hot water treatment. These practices are most applicable to farmers who sell their mangoes in distant markets. Below are summaries of the practices, based on parts of Rahman's talk, an FAO (2018) publication (in which Rahman is listed as a contributor), and an extension document by Brecht *et al.* (2017). These latter two documents are well-illustrated with photos and contain additional information on these and other postharvest practices.

Ensuring fruit quality: To fetch the best market prices, harvest mature mangoes that are still green or are starting to color. Such mangoes ripen properly off the tree and are not as susceptible as fully-ripe fruit to injury and spoilage during transport. Harvest mature green mangoes if subjecting the fruits to hot water treatment (discussed later). A commonly used indicator of the mature green stage is a widening of the fruit at the stem end, resulting in "shoulders" (see page 35 of Brecht *et al.* 2017). Be careful not to harvest too early, as this leads to poor flavor. Keep fruits free of blemishes, such as scars caused by insect feeding and wind damage; latex (sap) stains; disease-related defects; and mechanical damage due to improper handling.

Pre-harvest fruit bagging: This is done to reduce insect damage and to improve overall fruit quality. Six or seven weeks after fruit set, place a paper bag over each mango and wrap the bag at the stem end

Figure 5. Mango fruit bagging in Myanmar. *Source:* Brian Flanagan

of the fruit (to keep the bag from dropping off the fruit; Figure 5). Leave the bags on the fruits in the tree until harvest. See research reports by Rathore and Pal (2016) and Islam *et al.* (2017) for information on improved fruit retention and quality.

Use of an appropriate harvesting tool: This tool consists of a pole with a blade to remove the fruit and a collection net to prevent fruit from dropping to the ground (Figure 6). Leaving a few centimeters of stem attached to the fruit reduces leakage of sap/latex onto the fruit.

Delatexing (removing latex from the fruit): This step and hot water treatment are done at a packing area. Delatexing improves fruit appearance and marketability by preventing sap stains. Use a pruning shears to trim off stems that were left on the fruits at harvest. Then place the fruits on metal or plastic mesh with the stem end down. Allow the latex to drip onto the ground below the rack for about 30 minutes.

Hot water treatment: This is a non-chemical way to minimize defects caused by postharvest diseases—stem end rot and anthracnose. For some markets, it is a requirement for control of fruit fly larvae. This practice is perhaps the most difficult to implement. Farmers using hot water treatment should harvest fruits at mature green stage, as green fruits are less susceptible to heat injury than those with color. Place fruits in a tub of water heated to 55°C for 5 to 10 minutes; Stir the water, either manually or with a pump, to ensure uniform temperature throughout the tub. Hot water treatment hastens ripening, so if the fruits are to be shipped a long distance, cool them after the hot water treatment for 10 minutes in tap water at ambient temperature. Steve Sargent (2019), postharvest specialist at the University of Florida, commented:

> "Hot water treatments can be effective for decay control, but care must be taken to avoid thermal injury, so cooling with ambient water is a good practice. One key issue with any water treatment is sanitation. We recommend 150 ppm free chlorine in any type of water to kill fungi in particular; of course that will also kill decay bacteria and human pathogen bacteria as well. [Without the addition of chlorine], the water becomes an inoculation soup. For best results, the solution pH should be from 6.8 to 7.2."

Using an online chlorine dilution calculator, 150 ppm chlorine in 1 liter of water is achieved with 3 ml of bleach containing 5.25% sodium hypochlorite. Sargent also cautioned that hot water treatment protocols (for water temperature, equipment and other aspects of the process) are very strict for exporting mangoes to the United States (USDA-PPQ 2016).

Stackable crates: Processed fruits are placed in crates with holes on the sides for ventilation. The crates are lined with clean paper, jute sacks, or plastic, to cushion the fruits against injury during transport to market. Where plastic crates are unavailable and baskets are used instead, it helps to line them with cushioning material for the same reason.

Tomato marketing issues and drying options

Presentations by J.W.H. van der Waal and O. Oyedele dealt with the tomato supply chain in Nigeria. Oyedele collected data from 146 tomato producers in Oyo state. Nearly two thirds (65%) of those farmers sold all of their tomatoes in rural markets, compared to only 21% who sold theirs in urban markets. Urban markets offered higher prices and access to a larger population, but rural markets are closer to farmers' fields. Farmers cited perishability and price fluctuation as two major marketing constraints.

Van der Waal evaluated methods of transporting tomatoes and found that the use of plastic crates helped preserve fruit quality during transport to markets. The crates reduce fruit injury due to their smooth sides, holes for ventilation, and the fact that they can be stacked without crushing tomatoes at the bottom of a truck bed. Fruit losses were reduced from 30% with woven baskets—which can only be used once—to 12% with crates. Van der Waal pointed out that crates are available in Nigeria, but adoption of crates is often limited because farmers do not want to risk losing them in the supply chain.

Prices of tomatoes vary depending on the time of year, fruit quality, and distance to markets. Staggered plantings and fruit drying were discussed as two options for coping with price fluctuations. Plantings can successfully be staggered in areas where there is a long enough period during which tomatoes can be grown (*i.e.*, not too hot/dry or humid; irrigation is helpful). Drying extends the time over which fruits can be sold, and allows farmers to market their culls, fruits that are okay to eat but are small or misshapen. Drying tomatoes on an elevated platform or table (Figure 7) results in higher fruit quality than drying produce on the ground, where fruits are easily contaminated by dust, sand, and animals. An article entitled "Modernizing tomato production in Nigeria" (Umar 2019) highlights some of the issues with sun drying tomatoes on the ground.

Figure 6. Examples in Myanmar of a mango harvesting tool equipped with a collection net and bladed edges to sever fruit stems. Note the hack saw blades used in the tool on the right.
Source: Brian Flanagan

Figure 7. Elevated drying box in Tanzania.
Source: Stacy Swartz

Zero Energy Cooling Chambers

To prolong the shelf life of fresh produce, fruits and vegetables must be stored under cool, humid conditions. Cool temperatures extend the life of harvested produce by slowing ripening. Humidity reduces water loss, keeping fruits and vegetables from drying out and shriveling. While refrigerators can provide cool, humid conditions, they are expensive to purchase and maintain. Zero energy cooling chambers (ZECCs) are a low cost alternative. W.B. Legesse presented work on ZECCs that were tested by AVRDC (World Vegetable Center) in Mali. The approach makes use of porous materials and the cooling effect of evaporation. An example of evaporative cooling is the pot-in-pot method described in EDN 89. A clay pot containing fruits/vegetables is placed inside a slightly larger clay pot. The gap between the two pots is filled with sand, which is kept moist. Produce in the inner pot is cooled as water evaporates through the sides of the outer pot. Evaporation, with associated cooling, happens as long as the surrounding air is not already saturated with moisture. For that reason, ZECCs work best in hot, dry conditions. The center in Mali experimented with ZECCs made with clay pots, burlap sacks, straw, and bricks (see Figure 8 for an example of a ZECC made with bricks). All of these materials reduced temperature, but sacks and straw dried out more quickly—and had to be rewetted more frequently—than clay pots and bricks.

Figure 8. An evaporative cooling chamber at AVRDC in Tanzania, made with bricks. *Source:* Stacy Swartz

For links to more information, see the following websites:

- MITD-Lab web page entitled Evaluation of Evaporative Cooling Technologies for Improved Vegetable Storage in Mali
- A Practical Action Technical Brief on Evaporative Cooling

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FROM ECHO'S SEED BANK

Fever Tree:

A thorny lowland tree

by Stacy Swartz

Fever tree (*Acacia xanthophloea*) is a fast-growing, medium-size tree (reaching 15 to 25 m in height) with smooth, yellow-green bark. Thorns up to 7 cm long grow on the trunk and become more dense in the spreading branches (Figure 9). Fever tree can be found throughout Africa, most commonly in swampy, low-lying areas. The tree's common name indicates its association with malarial fever; this is because mosquitoes that transmit malaria prefer such swampy areas for breeding. Fever tree can grow up to 2100 m above sea level and can tolerate moderate frost (Lemmens 2006).

Wood from the fever tree is used for construction and carpentry, being durable with attractive brown to reddish coloring. The wood cracks easily, unless seasoned by drying. The wood is also susceptible to termites and wood borers (*Triozastus baghaasi*), an important consideration when using the wood for construction and/or carpentry. Fever trees are also used for fuel, with the wood either burned directly as firewood or used to produce high quality charcoal (Lemmens 2006). Charcoal is a key energy resource, and charcoal production helps many people generate income in parts of the tropics. If charcoal production is to be environmentally and economically sustainable, communities require good post-harvest management strategies and environmental policies that include all stakeholders (Chidumayo and Gumbo 2013). An example of collaborative and sustainable efforts is that of Tanzania's Kilosa district forest management and charcoal production methods. Politicians, community members, and the Tanzania Forest Conservation Group (a Tanzanian

Figure 9. Fever tree trunk with thorns. *Source:* Stacy Swartz

NGO) worked together to determine harvest and production practices that would conserve forest ecology as well as provide income in the long term. These practices include not returning to a harvested section for 24 years; leaving at least 60 cm of the trunks to remain as stumps after harvest; and using basic earth kilns to produce charcoal. Detailed crop management for charcoal production, and multiple processing technologies, can be found in the Sustainable Tree Management for Charcoal Production Acacia Pocketbook prepared for PISCES by Practical Action Consulting East Africa (Oduor *et al.* 2012).

The fever tree is useful for reasons beyond its wood. The tree's yellow, fragrant flowers provide forage for bees, while the feathery leaves can be fed to livestock. Fever tree bark is harvested for medicinal applications in East Africa. Livestock may also remove the outer bark of the tree (Figure 10). Fortunately the tree has high tolerance for bark damage, and often recovers from human or animal destruction (Lemmens 2006). The roots of fever tree form symbiotic relationships with microorganisms, which fix nitrogen and enrich the soil.

Soaking seeds for 24 hours before seeding in the nursery may help speed up germination. Once seedlings have at least two leaves, you can transplant them to larger vessels that contain local potting mixture (this may need to be supplemented with compost or aged manure if it lacks nutrients). Transplant trees into the field at the onset of the rainy season for good establishment. If growing the trees for charcoal production, space them a minimum of 2 m apart (both in row and between rows).

Figure 10. Fever tree trunk with outer bark damage. This tree was damaged by cattle. *Source:* Stacy Swartz

Because of the thorns, protective clothing is recommended when harvesting any plant material from a fever tree (timber, seeds, etc.). Stumps will resprout multiple branches; leave up to four new dominant branches for maximum production. The thorns are a definite disadvantage. Many non-thorny tree species can be used instead for fuel production, including leucaena (*Leucaena leucocephala*), gumbo limbo (*Bursera simaruba*), calliandra (*Calliandra calothyrus*), Madre de Cacao (*Gliricidia sepium*), *Erythrina* spp., *Inga* spp., *Grevillea* spp., Albizia spp. and Siamese senna (*Senna siamea*).

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BOOKS, WEB SITES, AND OTHER RESOURCES

Planetary Health Diet Proposal: Introducing the EAT-Lancet Commission Report

by Dawn Berkelaar

Have you ever wondered how our planet could support a nutritious diet for all people? A new report, released in January by 37 scientists making up the global "EAT-Lancet Commission on Food, Planet, Health," proposes a way of eating that could "feed a future population of 10 billion people a healthy diet within planetary boundaries." As agricultural development workers, you no doubt have a concern to see people well fed and well nourished, and also a desire to see the land sustainably stewarded and improved. This report uniquely tries to address both concerns at once.

When it comes to nutrition, recommending a particular kind of diet can be difficult, because approaches to nutrition can vary widely. If you are in a position to give guidance when it comes to local nutrition, you may benefit from knowing about this report and its recommendations. The suggested guidelines include proportions for different kinds of food, leaving room for diverse cultural interpretations. For example, the diet recommends that half of each meal be made up of vegetables and fruits. Meat is part of the diet, but legumes and nuts form a larger proportion when it comes to protein sources.

The full EAT-Lancet Commission report is available from *The Lancet* (register for free to view and download the report). A short and accessible Summary Report is also available, in seven languages. The Summary Report lists five strategies to improve people's access to nutritious food in a way that is sustainable for the earth. The strategies highlight the importance of biodiversity, encourage sustainable intensification of food production in order to "increase high-quality output," and call for reducing food losses and waste by at least half.

EAT-Lancet has a brief written specifically for farmers. Many of the recommendations in it are things ECHO already promotes, including sustainable intensification; carbon sequestration; crop diversity; precision application of nutrients [*e.g.* bottle cap fertilization]; cover crops; and integration of animals.

Like me, you may read the Summary Report and come away with questions about the suggested diet. For example, I wonder why the proposed proportion of root crops is so low. Also, would this diet provide enough calories for a small-scale farmer who does a lot of manual labor? However, I hope you will be encouraged by this attempt to advocate for a healthy diet for all within our planet's physical limits. Perhaps this report will be a useful tool for addressing long-term nutritional needs in your project area.

UPCOMING EVENTS

ECHO Florida Events:

Location: ECHO Global Farm, USA

Agroforestry
July 15 - 19, 2019

Seed Saving & Banking
September 16 - 20, 2019

TAD I: The basics
October 28 - November 1, 2019

26th Annual International Agriculture Conference
November 19 - 21, 2019

ECHO East Africa Events:

Best Practices Improving Nutrition and Sustainable Agriculture in Highland Areas
November 26 - 28, 2019
Hilltop hotel in Kigali-Remera (TENTATIVE), Rwanda

Best Practices to Improve Nutrition and Livelihoods in Pastoralist Areas
March 2 - 4, 2020
Uganda

ECHO Asia Event:

Agriculture & Community Development Conference
October 1 - 4, 2019
Chiang Mai, Thailand

ECHO West Africa Workshops:

Bouake, Cote D'Ivoire
May 7 - 9, 2019

Jos, Nigeria
May 21 - 24, 2019
Please contact Noemi Kara (knoemi@echonet.org) for information on trainings.

PLEASE NOTE: At ECHO we are always striving to be more effective. Do you have ideas that could help others, or have you experimented with an idea you read about in *EDN*? What did or did not work for you? Please let us know the results!