ECHO® Development Notes

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Responding in the Case of an Epidemic or Pandemic

by Dawn Berkelaar

SARS-CoV-2, the virus that causes COVID-19, has been making its way around the world in past weeks and months. The effects of this disease will almost certainly be felt by every community. Countries where the infection is already well-established have found it difficult to manage. Coping with a pandemic like this is particularly challenging in places with high population densities, lack of infrastructure, malnutrition, and incidence of other infections that leave people's immune systems more vulnerable. Here are a few suggestions for ways to respond well in your community to the presence of a highly contagious disease.

Be informed

Find reputable sources of information. What are the symptoms of the disease, how does it spread, what are the best ways to slow its spread, and what effective treatment options are there? In the midst of an epidemic or pandemic, myths quickly circulate around these questions. It can be difficult to wade through the information and misinformation that spreads during a pandemic, particularly when little is known about the disease. Focusing your attention on reliable information can help protect your mental health while enabling you to take responsible action. The "Further Reading" section of this article contains sources of information that you may find helpful.

Avoid exposure

Avoiding exposure—and helping others to do so as well—is the best way to respond in a situation where a contagious disease is spreading. Practices to avoid exposure and subsequent infection are discussed below.

Implement basic health precautions

Common public health precautions to avoid exposure to infectious diseases include the following:

- wash hands often and well with soap and water
- avoid touching your face
- sneeze or cough into the bend of your elbow
- stay home when you are sick
- keep a safe distance from people, especially in public areas
- depending on the situation, health authorities may encourage people to wear masks in public and when taking care of sick individuals

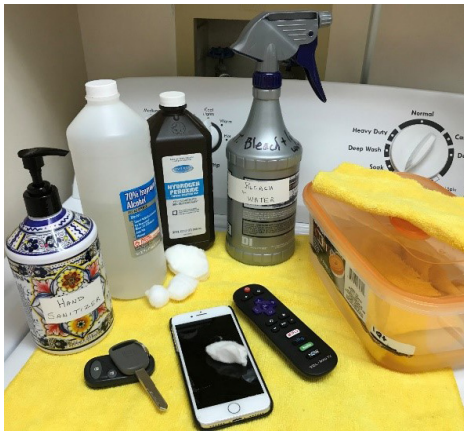

Figure 1. Cleaning agents for a household disinfection station. *Source:* Penny Rambacher.

Disinfect surfaces

Disease-causing agents (e.g., certain bacteria, viruses, and fungi) often live for a time in the environment, outside the body. Household bleach, rubbing alcohol (containing at least 70% alcohol), and hydrogen peroxide are all useful against any pathogens living on surfaces within the home (Figure 1). Penny Rambacher of Miracles in Action suggests setting up a low-cost disinfection station in your home, near the entrance. She shared some details for making and using the station, summarized here:

- Fill an adequately-sized container with 30 ml (2 Tbsp) of bleach and 1 L (1 qt) of water. [Ed: According to the Centers for Disease Control and Prevention (2019), 20 ml (4 tsp) of bleach is sufficient for 1 L (1 qt) of water.]
- Disinfect your home by dipping a cloth rag into the solution, wringing it out, and using it to wipe down surfaces (e.g., doorknobs and handles). Return the rag to the container after each use.
- Prevent the solution from breaking down and losing effectiveness by keeping a lid on the container. [Ed: Bleach breaks down in sunlight, so keep the container covered or in a dark room (WHO, 2014).]
- Replace the solution periodically to maintain its potency. [Ed: It is recommended that dilute bleach solutions be replaced daily (WHO, 2014).]

Note that for a bleach solution to be effective, surfaces must first be cleaned to remove dirt/organic matter. Contact with organic matter quickly reduces bleach's effectiveness. Also be sure to observe the following safety precautions. Use bleach in

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a ventilated area. Do not ingest bleach or get it in your eyes or on your clothes. Wear gloves, since bleach is a skin irritant. Also, do not mix bleach with other chemicals.

Wash your hands often with soap and water!

This is one of the most important things you can do to minimize the spread of an infectious disease. Health authorities recommend washing hands for 20 seconds using soap and water. Handwashing is a challenge in areas where water is scarce. The very simple tippy tap technology can help; see the article later in this issue by Elliott Toevs.

Sometimes a lack of water is not the only impediment to handwashing. After reading about the tippy tap, Dr. Tom Post shared, "I think that the tippy tap looks very useful for places like the mountain environments of Laos. [But] our long-standing challenge there has been that people don't have access to soap…. And it has been difficult to convince people to make their own soap."

I asked Dr. Post what he would do if he found himself with no access to soap, and with a rapidly spreading virus in the community. He responded:

> I would try participatory learning activities—which we have done in Laos…I would try modeling and discussion after. However, here is where [we have] had a struggle. [Some staff] are reluctant to model handwashing with soap and also to try to change the common pot style of eating. It would need some very good facilitation—and we have worked to train our Lao staff in dialogue education, too.

Communicate with your community

Communicate information about the disease with all members of a community, especially marginalized and vulnerable people. Photos and text-free diagrams/ videos are good ways to communicate with those unable to read. Use appropriate media options for your area. These can include radio and messaging via mobile phone applications.

Consider communication to address cultural customs or traditions that may need to change to slow the spread of a disease. Mike Fennema, who works with World Renew in Laos, encourages people to think carefully about helpful and harmful aspects of culture in this regard, adding that this should happen "ideally within a group of people from a wide variety of different cultures to enable better reflection." He related a few examples as follows:

> In Laos, a big danger is connected with the tradition of eating from a communal soup bowl. One big bowl [is] placed in the center of the table, [and] everyone uses their own spoon to take out one spoon full at a time. I suspect (I did not do any research on this) that it is a situation perfect for passing on the virus to the entire family….[It can be difficult to recognize] these aspects. My Lao staff were doing a pretty good job of following the advice to clean hands more often, use a mask, etc. However, when I raised this issue a while back, they sheepishly admitted that they had not thought about changing this habit (they are now).
>
> One of the other challenges we face is the use of the communal hand towel. Even at the office, with an attempt to keep them clean, since so many people use [the towels], they quickly get dirty… We tested several water sources at the office (e.g. filtered, from a tap) as well as swabs of the toilet and a swab from the communal towel. The towel had higher numbers of bacterial colonies than the swab from the squatting toilet bowl. The towels were washed much more frequently after that. I assume that in [each culture] there are various traditions that are helpful (e.g., handshaking is not so common in Laos) and some that are hurtful in regards to spreading [disease].

Strengthen immunity

Attempting to avoid exposure is one way to fight against this virus. Another is to do what you can to strengthen your immune system. Ideally, people would follow the steps below before facing exposure to a virus like the one that causes COVID-19. However, these suggestions remain important.

Eat nutritious plants

Green leafy vegetables are an excellent source of many vitamins and minerals that strengthen the immune system. Some vitamins and minerals that are especially important for the immune system include Vitamins A, D, and C; zinc; and selenium (see *EDN* 126 for more information about selenium).

Vegetables and fruits contain high amounts of antioxidants, which are molecules that protect your body from free radicals (that are produced when your body breaks down food, or when you are exposed to toxins). Many vitamins are antioxidants (including vitamins A, C, and E), and so is selenium and various other molecules.

World Renew has worked with many organizations in East Africa to introduce grain amaranth (*EDN* 91). It seems to have a unique effect on the immune system. For example, people living with HIV (the virus that causes AIDS) who ate grain amaranth have experienced a remarkable increase in their CD4 count, which is one indication of how well their immune system is functioning. Grain amaranth contains a high amount of protein, especially the amino acid lysine, which is not present in most grains. It also contains important vitamins and minerals, including zinc. For best digestion and assimilation of nutrients, pop grain amaranth or grind it into flour before eating it.

Much of our immune function depends on the health of the microorganisms in our intestines, collectively known as the gut microbiome (Belkaid and Hand, 2014). To support your gut microbiome, eat foods that feed and add beneficial bacteria. Plants that feed beneficial microbes contain non-digestible fiber; these include leafy greens, onions (*Allium cepa*), garlic (*Allium sativum*), and bananas (*Musa* spp.). Foods that add beneficial bacteria include sauerkraut, kimchi, dairy products with live cultures, and many others.

Grow nutritious plants

If a large percentage of a population becomes ill, or if a government mandates that people stay home to reduce the spread of a disease, food supply systems can be disrupted.

The "From Our Seed Bank" section of this issue contains suggestions for crops that grow quickly and produce food soon after planting. Also plant longer-term crops that continue to provide food after the fast-growing plants decline. Perennial greens are especially beneficial, because they require little work to maintain and can yield fresh greens for a long time. Even if a perennial plant goes dormant for a season, the established root system allows rapid growth to resume once

conditions are favorable. Like other leafy green vegetables, they provide vitamins and minerals that are important for strengthening a person's immune system. For perennial green leafy vegetables, we recommend moringa (*Moringa oleifera*), chaya (*Cnidoscolus aconitifolius*), and katuk (*Sauropus androgynus*). (*TN* 91)

If you grow most of your own food but become sick, you may lack energy to tend crops. Root crops produce an abundance of food and calories. Some of these include cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), and yam (*Dioscorea* spp.) (*TN* 81).

Gardening around the home is an excellent way to alleviate anxiety while producing a portion of your own food, or food to share with those in need. ECHO has information about various types of gardens, including keyhole gardens (*EDN* 131), rooftop gardens (*TN* 31), and wicking bed gardens (*TN* 95, with more information in the "ECHOs From Our Network" section of this *EDN* issue). Where space is limited, plants can be grown in containers, sacks, and tires. Gardening initiatives are most impactful when supported with seed sources and teaching on nutrition and hygiene (World Vegetable Center, 2016).

Plan for the future

Like most disasters, a pandemic is unexpected. But steps can be taken ahead of time to increase a community's resilience in case of a disaster. *EDN* 122 contains an article about preparing for and responding to a disaster; though geared toward natural disasters, some of the content applies to pandemics. For example, promote root and tuber crops, which can often remain in the ground for a long time and can be used as emergency foods. Plants trees like coconut palms (*Cocos nucifera*), which are also important sources of food. Get to know local authorities, and work to build trust and local capacity in your community.

Conclusion

Disease outbreaks are extremely challenging to cope with. Yet, we can take practical actions to lessen their impacts. While certainly not exhaustive, we hope that this article inspires creative, agricultural solutions to problems associated with pandemics such as COVID-19.

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Further reading (information on COVID-19)

General information from health authorities

Centers for Disease Control and Prevention (CDC): a wealth of public safety information on how to protect yourself from COVID-19 and what to do when sick.

World Health Organization (WHO): includes a coronavirus disease dashboard where you can view an updated map and table listing reported cases of COVID-19 by country. WHO also has a dashboard specifically for Africa.

Johns Hopkins Medicine: provides answers to frequently asked questions and informational tools similar to those from the CDC and WHO.

Disinfecting surfaces

US Environmental Protection Agency: list of products suitable for use against SARS-CoV-2.

Paper showing that SARS-CoV-2 lives on surfaces for four hours to four days depending on the type of surface: N van Doremalen, *et al.* 2020. Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1. *The New England Journal of Medicine*.

Disinfecting fresh fruits and vegetables (in case you are concerned about produce touched by human hands):

A WHO doc entitled Surface decontamination of fruits and vegetables eaten raw.

Recommended concentrations of chlorine for disinfecting various types of produce: Wash water chlorine disinfection: best practices to ensure on-farm food safety, a fact sheet by the Louisiana State University AgCenter.

A tool for calculating the amount of water and bleach you need to achieve a desired concentration of chlorine: Chlorine Dilution Calculator by Public Health Ontario.

Gardening options

The World Vegetable Center (AVRDC) offers ideas/production guides and videos.

Communicating with your community

An example of a video without words: Stanford Medicine.

A video on handwashing in multiple languages: How to wash your hands, by SAWBO (Scientific Animation without Borders).

A collection of resources on the ECHOcommunity website contains links to information on digital communication platforms.

A Tip of the Hat to the Tippy Tap

by Elliott Toevs

The current COVID-19 global pandemic has reignited conversation around the importance of handwashing to prevent the spread of disease. While a seemingly easy task for most of us, this is no small feat for the 785 million people who live without basic water services in their homes (WHO, 2017). Thanks to the work of Dr. Jim Watt and Jackson Masawi at the University of Zimbabwe, there is a simple solution to handwashing in areas with limited water access: the tippy tap. Although many of us are accustomed to washing our hands with copious amounts of water from our sink faucet (help save water by turning off your faucet while you scrub!), you can effectively wash your hands with as little as 40 ml of water by using a tippy tap (DDOnline, 1993).

You can make a tippy tap from readily available materials:

- an empty jug
- a water bottle (to cover and protect the soap)
- string
- a bar of soap
- a stick (optional)
- gravel or other porous material (optional)

Instructions on how to assemble a tippy tap can be found online; see the bottom of this article for links to illustrated guides. In a matter of minutes, you can have a fully functional handwashing station (Figure 2). Best of all, you can upgrade your tippy tap to run hands-free by making a foot pedal out of a stick. The foot pedal makes handwashing easier and more effective. In areas with poor drainage, adding a gravel/porous material in a shallow pit under the tippy tap will allow the water to slowly drain into the surrounding soil, preventing the formation of a puddle where mosquitos could breed.

Once your tippy tap is complete, use it while following the Centers for Disease Control's five steps for washing hands (CDC, 2020):

1. Wet your hands with clean water.
2. Lather your hands by rubbing them together with the soap. Do not forget to lather the backs of your hands, between your fingers, and under your nails.
3. Scrub your hands for at least 20 seconds.
4. Rinse your hands.
5. Dry your hands with a clean towel or allow to air dry.

Making and using a tippy tap can be simple, though being aware of potential issues in cultural adoption is important (SPRING/Bangladesh, 2015). Handwashing is a proven front-line method to mitigate disease transmission.

Guides for tippy tap construction

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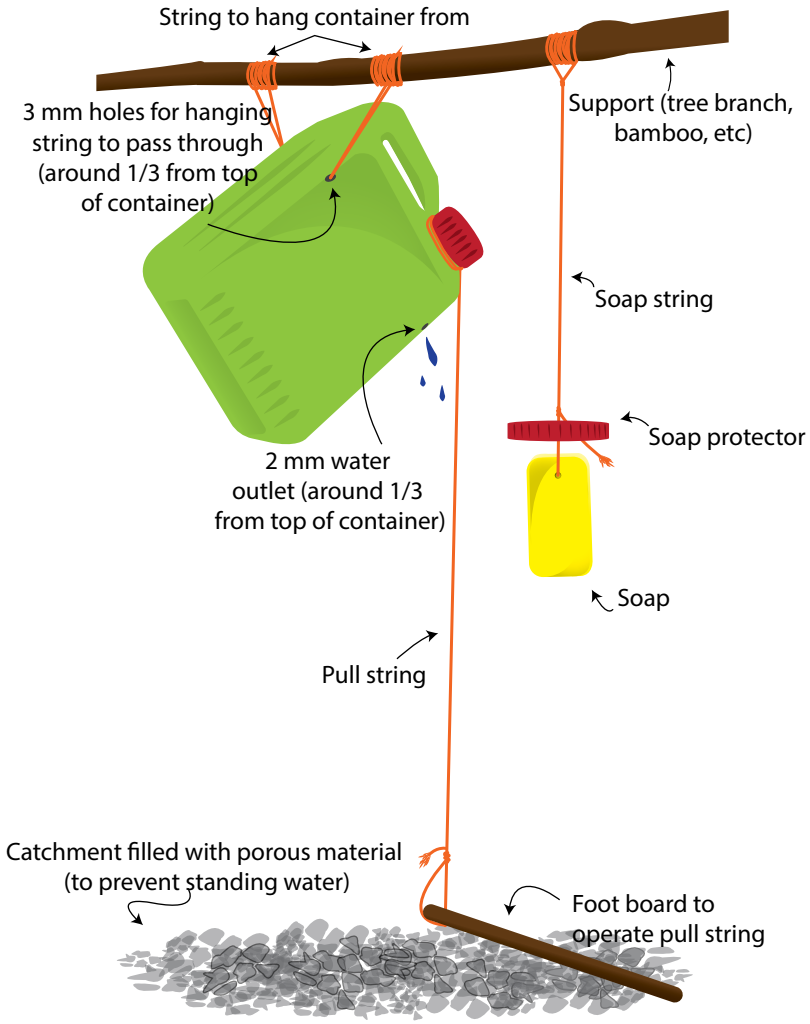

Figure 2. Tippy tap parts diagram with optional foot pedal and catchment included. S*ource:* Cody Kiefer, inspired by Lifewater International, 2005.

Promoting Biodiversity on Maize Smallholdings: Importance of Birds

by Sean Lyon, Erwin Kinsey, and Dr. Kristen Page

The following article contains results and insights from Sean Lyon's Human Needs and Global Resources (HNGR) internship at the ECHO East Africa Regional Impact Center in Ngaramtoni, Tanzania. The HNGR Program is run by Wheaton College in Wheaton, Illinois, USA. Sean was an intern from May 10th to December 8th, 2017, during which time he conducted on-farm surveys for bird diversity.

Biodiversity benefits smallholders

Farmers in tropical regions are often economically disadvantaged and farm on marginal soils. Their vulnerability is exacerbated by realities such as climate change, regional conflicts, and disease outbreaks (Stocking, 2001). In our efforts to address the agricultural needs of vulnerable communities, we often focus on the crops being grown. In this article, I want to draw attention to the ecological context in which that food production occurs.

A healthy ecosystem provides key services that benefit humans (Şekercioğlu, 2010). Many of these services include a positive financial impact (Kellermann *et al.*, 2008). Ecosystem services can be categorized as one of four distinct types: supporting, provisioning, regulating, and cultural services. Supporting services contribute to the other three services, and include soil formation, nutrient cycling, and primary production. Provisioning services provide products such as food, fresh water, and fuelwood directly from the ecosystem. Regulating services include disease regulation, water purification, and pest moderation. Cultural services offer nonmaterial benefits such as spiritual and religious value, cultural heritage, and a sense of place (Millennium Ecosystem Assessment, 2003).

Birds contribute to farm production

Birds provide an important regulating ecosystem service to farmers by controlling pests and thus reducing the need for pesticides. Studies of insectivorous birds on coffee farms have shown economic benefits of USD $44 to $310 per hectare per year (Kellermann *et al.*, 2008; Johnson *et al.*, 2009). Recent research of birds' diets in maize fields that border prairie ecosystems revealed that an economically-important crop pest, the northern corn rootworm, was consumed by 34.5% of the birds studied; the benefit was calculated to be worth USD $275 per hectare (Garfinkel *et al.*, 2020). Another study found that birds of prey can decrease the population of rodents in farm fields by nearly 50% (Kay *et al.*, 1994). Furthermore, studies of Kenyan sun coffee farms showed that both birds and ants provided pest control services, and that fragments of forest nearby the field promoted pest removal (Milligan *et al.*, 2016).

The high economic value and the increased production potential for farmers are powerful incentives for attracting birds to farm plots. However, there are some instances where birds are implicated in the destruction of crops. For example, birds sometimes dig up seeds that have been planted, eat young seedlings, damage mature fruits, or consume the seeds of cereal crops. These are considered to be ecosystem disservices provided by birds. Despite this reality, Şekercioğlu *et al.* (2016) thoroughly analyzed worldwide research and found that though localized losses of crops may be high, overall, birds consume only about 1% of crops. These crop losses due to birds' activities are much lower than losses due to insect and rodent pests. Additionally, a bird often thought to be a major crop pest in Venezuela (dickcissel, *Spiza americana*), was found to be more beneficial than detrimental once all costs were considered, including the costs of lethal control measures--both in terms of finances and of impact on human health (Basili and Temple, 1999). The services provided by birds (among others, eating insects and rodents, fertilizing fields, consuming the seeds of pest plants, and dispersing indigenous plants) far outweigh their cost.

Purpose of our study

Through this observational study, Erwin Kinsey, Dr. Kristen Page, and Sean Lyon (hereafter "we") sought to clarify the interrelationships of birds, trees and pests on maize/bean intercropping smallholdings in northern Tanzania, and to hear directly from farmers about their own participation in agroecosytem functioning. In this article, I (SL) focus specifically on lessons learned from observing birds in these farmers' fields.

Stakeholders

Stakeholder inclusion

Prior to implementing this study in the community of Ngaramtoni (subvillage of Seuri), we first sought permission to survey from the village chairman, or *mwenyekiti*. Receiving the consent and welcome of everyone involved in biological or agricultural studies is extremely important. In addition to obtaining written permission from the *mwenyekiti*, we asked every farmer whose property was surveyed for permission to study their farm and crops. Some farmers questioned the impact and purpose of the research, giving us an

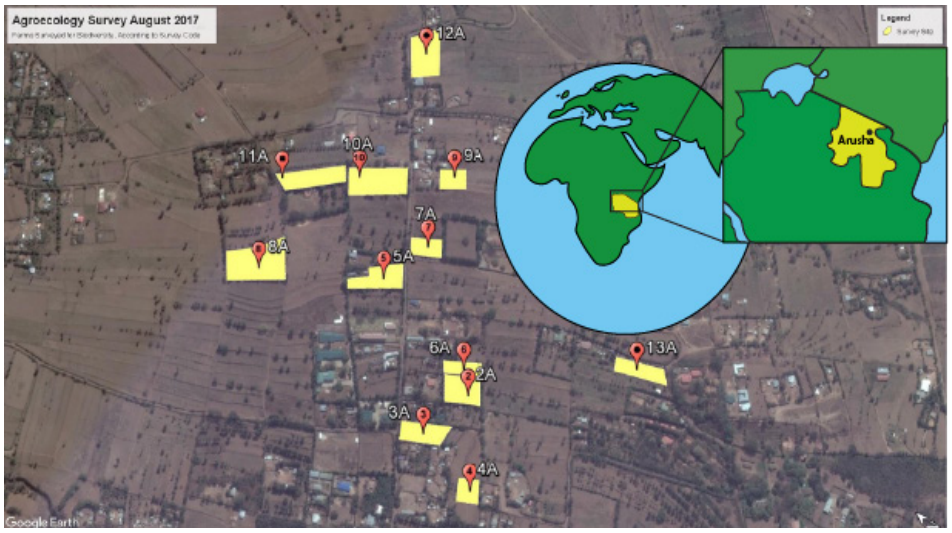

Figure 3. Survey sites in Seuri subvillage, Ngaramtoni, Tanzania. Each surveyed farm is highlighted in yellow. *Source:* Google maps, modifications by Sean Lyon.

opportunity to clarify the project and to put the main actors—the farmers themselves—at ease. Some farmers, though initially skeptical, soon opened their fields to our survey. Agroecology is a foreign concept to some people, so the approaches and techniques used when surveying fields can appear strange. Standing in the corner of a field and watching birds for minutes on end is hardly typical behavior in many farming communities!

Study site

This study was conducted in the Arusha Region of north-central Tanzania, a plains-dominated landscape which borders Kenya to the north. Mount Meru rises from these dry plains, and its unique topography makes the region a center for small-scale agriculture; fertile volcanic soils and elevation-determined rainfall predispose the land to productive farming. West of the city of Arusha is Ngaramtoni, a trade town with subvillages where subsistence agriculture is practiced, resulting in a range of landscape modification across the region.

Surveys occurred within the Afromontane Dry Transitional Forest zone (Kindt *et al.,* 2015). This vegetation zone is found on dry lower slopes of East African mountains. Characteristic tree species found here include the Nile tulip tree (*Markhamia lutea*) and the silvery-leaved croton (*Croton megalocarpus*). Agricultural activity and deforestation have changed the vegetation composition of the region; therefore, only small fragments of Afromontane Dry Transitional Forest remain (Kindt *et al.*, 2015). Maize and bean intercropping is dominant due to the rich soils. The farms (Figure 3) were surveyed in August 2017, during the dry season. Average temperatures in August range from 12 to 22°C , and the air is very dry, with the last rains having fallen two months prior. August marks the very end of the growing season and the beginning of the harvest season.

Bird survey methods

We conducted avian (bird) surveys at 9:20 am ± 20 minutes via unlimited point-counts, during which I (SL) recorded all birds visible within 360°. Point-count surveys (described by Verner, 1985) are common in avian research. They involve identifying birds at a single location for a defined period of time, noting both the species and number of individuals of each species. Some point-counts are limited, with birds counted up to a certain distance away from the observer. Others, known as unlimited point-counts, or "point counts without distance estimation" (Verner, 1985), take into account all birds present in the surveyor's view. I used *Birds of East Africa* by Terry Stevenson and John Fanshawe (2004) to identify bird species. I stood for ten minutes per corner at each farm field (see Figure 3), recording on a data sheet each species that I saw, and the number of individual birds of that species. That gave me four observation points, totaling forty minutes of bird count-time, for each farm surveyed.

Table 1. Summary results of avian survey. Note the sites with the highest diversity in bold.

Site #	Site area (hectares)	Bird species total	Bird records total on site	Bird population density (birds/hectare)	Shannon Index
2A	0.134	10	54	403.0	1.634
3A	0.138	10	45	326.1	1.679
4A	0.097	12	59	608.2	1.967
5A	0.077	10	28	363.6	**2.175**
6A	0.113	14	92	814.2	1.781
7A	0.105	12	50	476.2	2.105
8A	0.336	4	50	148.8	0.662
9A	0.101	9	23	227.7	1.978
10A	0.360	12	42	116.6	2.017
11A	0.223	11	49	219.7	1.845
12A	0.267	13	144	539.3	1.832
13A	0.121	12	82	677.7	**2.23**

We offer these recommendations when gathering agroecology data:

- **Use local languages** for all data sheets, questionnaires, and other survey tools. This makes it easier to show farmers and other respondents what you are doing.
- **Include photos of plants and trees on the survey,** to provide clarity to participants who may not be able to read, or in contexts where multiple languages are spoken.
- **Survey in pairs** (ideally with one person being a native speaker of a local language), for increased safety, improved communication, and the opportunity to share time-consuming responsibilities, such as quantifying trees.

Bird survey results (*Tables 1 & 2*)

718 individual birds were recorded in the avian point-count surveys, with 38 total species seen during the survey period. Most of the individual birds were the pied crow (*Corvus albus*, 30.4%; see Figure 4), followed by baglafecht weavers (*Ploceus baglafecht reichenowi*, 17.6%; see Figure 5). The number of species per farm (bird species richness) ranged from 4 to 14 species, averaging 10.8 species per farm. A point-count survey is not the best survey method for representing avian population density (number of individual birds per unit of land area). However, population density can give a basic understanding of how landscape affects birds, so I have included that calculation here. The Shannon Index (Table 1) is one way of representing species diversity, and is calculated by dividing the number of individuals of a given species by the total number of individuals of all species in an area. In this calculation, the higher the number, the more diverse the study site.

Insights gained from bird surveys

There is a large gap between the most-abundant and second-most-abundant species (Table 2). This indicates the presence of a few dominant generalist species in this modified agricultural landscape rather than a greater diversity of specialist species that would be found in

Figure 4. Pied crow (*Corvus albus). Source:* Dr. Kristen Page.

Table 2. Most-abundant bird species in avian survey.

#	Species seen	Common name	Total sightings	Average per farm	Average per watch-hour	Feeding groups
1	*Corvus alba*	pied crow	236	18.2	29.5	Wide diet
2	*Ploceus baglafecht*	baglafecht weaver	126	10.5	15.75	Seed eater
3	*Colius striatus*	speckled mousebird	39	3.25	4.88	Leaf eater
4	*Streptopelia semitorquata*	red-eyed dove	35	2.92	4.38	Seed eater
5	*Merops bullockoides*	white-fronted bee-eater	29	2.41	3.625	Insect eater

the native landscape. Even so, the top five bird species represent four different feeding groups (i.e. species groupings based on dietary preference), with only baglafecht weavers and red-eyed doves sharing a diet. This may indicate that one species exploits each of the main food sources in the ecosystem.

A relevant example of the importance of farmer involvement in bird diversity is found in Site 8A, a large maize/bean intercropped smallholding that was planted entirely with a single, non-native tree species (Australian silky oak, *Grevillea robusta*). This farm showed conspicuously low avian diversity, with just four bird species seen in 40 minutes of watching. With the loss of habitat for insect-eating species, this farm lost any benefit that those birds would provide. Meanwhile, Site 13A, which had a maize/bean intercrop planted amidst an indigenous permaculture, had the highest tree diversity, and bird diversity was above average (12 species, with a study-wide average of 10.8 species) at that site as well. This site could take full advantage of the ecosystem services provided by a variety of birds.

Strategies for Farmers

As smallholders seek to maximize the production of crops, they would do well to consider bird biodiversity. Several modifications can be made to cropping systems to incentivize bird activity.

1. **Plant native species of trees, and avoid the use of nonnative trees.** Fruitbearing or seedbearing trees attract birds throughout the year and provide habitat for them, including during the non-breeding season.

2. **Incorporate buffer zones between fields.** Bushes and trees in hedgerows or windbreaks promote soil fertility and help retain moisture; they also provide nesting sites and perches for insectivorous birds. Garfinkel and Johnson (2015) demonstrated that the probability of pest removal is higher near hedgerows.

3. **Construct perches near the fields for birds of prey.** Raptors (birds that eat small animals) can reduce the mouse population by half if they are provided with perches spaced 100 m apart (Kay *et al.*, 1994). Raptors are more likely to spend time in a field with stable perches (natural or artificial). This incentivizing can also be accomplished by leaving dead trees standing adjacent to fields.

Smallholder farmers should also consider the importance of birds breeding adjacent to their fields. Many species that eat seeds during most of the year will seek protein-rich insects to feed to their young during the breeding season. Sunbirds, which as adults consume only nectar, feed their young exclusively insects (Markman *et al.*, 1999). Some species of lark (in the widespread family Alaudidae) feed their young at least once every five minutes on average, mostly providing insects and other arthropods. They make dozens or hundreds of forays per day, including in agricultural landscapes where they consume crop pests (Engelbrecht and Mathonsi, 2012). By providing sites for birds to nest (mature trees with cavities, thick brush, or tall grasses are all suitable nest spots), farmers gain resident insect-seeking pairs that feed their young very frequently while their young are in the nest. These parents work constantly to a farmer's advantage if he or she provides habitat for birds during the breeding season.

Conclusion

In our study, the large gap between the most-abundant species and those that were next-highest in prevalence indicated a loss of biodiversity, with the landscape dominated by fewer generalist species rather than a wider distribution of specialist species. However, farmers also can be agents of beneficial ecological change. The results of this study are important to both farmers and development workers, as the insights help clarify that biodiversity is a foundation for the future of crop productivity. This is especially true in a changing global landscape where smallholder farmers are making decisions of ecological importance.

Figure 5. Baglafecht weaver (*Ploceus baglafecht reichenowi*). *Source:* Dr. Kristen Page.

When the livelihoods of smallholder farmers are often fraught with challenges--both economic and environmental--taking an agroecological approach to the farm can help ease the burdens. Birds can benefit farmers in crucially important ways, providing ecosystem services worth several hundred dollars per hectare in pest reduction alone (Garfinkel *et al.*, 2020). Many farmers can easily incorporate tools to incentivize birds to spend time near their fields, by using hedgerows and planting native trees. They can also implement appropriate technologies like constructing simple perches for birds of prey to use while hunting for rodents in their fields. These interventions allow smallholder farmers to participate more fully in supporting local ecological health, and to reap the benefits (high-value native trees also provide longer-term financial security). By applying these principles and techniques, smallholder farmers can provide supporting, provisioning, regulating, and cultural ecosystem services that will benefit themselves, the rest of the community, and the planet as a whole.

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FROM ECHO'S SEED BANK

Fast-Growing Plants for Household Food Supply

by Tim Motis

Quarantines, preventative measures associated with disease outbreaks like COVID-19, limit people's ability to go to markets and stores to get food. People may also find that they have extra time around the house to invest in gardening. During such times, household gardening gains importance for sustaining families. Perennials can be grown around the home and offer long-term sources of food; where space is available, plant them as soon as possible. Here, however, we cover plants that are propagated from seed and that provide edible leaves, fruits, or roots in as little time as possible.

Plants for edible, young leaves

You can harvest plants with edible leaves before they flower and set seed. Amaranth plants, for example, produce edible leaves and tender stems that can be harvested as soon as a month after seeding. Sow seeds directly into the garden, or into containers for subsequent transplanting into garden beds. Table 3 provides suggested spacing for this and other plants mentioned in this article. ECHO's Global Seed Bank carries several varieties of vegetable amaranth (*Amaranthus tricolor*), which tend to produce more leaves than their grain-type cousins (*A. cruentus* and *A. hypochondriacus*)--although the leaves of grain types are also edible. If you aren't sure which variety you have, seeds of the vegetable type tend to be black in color, while seeds of the grain types tend to be white, tan, or red in color.

Lagos spinach (*Celosia argentea*; Figure 6) can be planted and harvested in the same manner as vegetable amaranth. Both amaranth and Lagos spinach are high in protein, vitamins A and C, calcium, and iron. Lagos spinach is also high in antioxidants, important in maintaining the body's immune system. Amaranth and Lagos spinach contain anti-nutrients such as oxalate and nitrate, which are most effectively removed by boiling for 5-10 minutes and discarding the cooking water. ECHO's Global Seed Bank carries a green-leaved variety and a green- and red-leaved mix.

Figure 6. Lagos spinach plants at ECHO's Global Demonstration Farm in Florida. S*ource:* Tim Motis.

Other underutilized, leafy greens featured in our seed bank include cowpea (*Vigna unguiculata*) and jute mallow (*Corchorus olitorius*). Cowpea is most commonly grown for its edible seeds, but you can also eat the leaves. Owade *et al.* (2020) discuss boiling, sun drying and other ways to process cowpea leaves. By providing cowpea plants with something to climb (e.g., stakes or a trellis), you can concentrate leaf production in a small area while also minimizing plant diseases by keeping the leaves off the ground. Jute mallow leaves and shoot tips can be eaten raw or cooked.

Leaf-harvesting tips:

- Leave developing leaves on the plant for later harvest(s).
- When plants are 20-30 cm tall, cut off the top 2-3 cm of stem growth to encourage branching and more leaf production.
- Let a few of the healthiest-looking plants grow for seed.

More conventional leaf vegetables include bok choy (*Brassica rapa* subsp. *chinensis*), lettuce (*Lactuca* spp.), collards (*Brassica oleracea* var. *viridis*), and kale (*Brassica viridis*). Collards and kale are the most heat tolerant of these. Of the lettuce varieties offered in our seed bank, 'Queensland' and 'Tropical Lettuce' withstand warm temperatures the best.

Plants with edible structures other than leaves

If you are looking for something besides leaves, three fruit-bearing options are okra (*Abelmoschus esculentus*), tomato (*Solanum lycopersicum*), and zucchini (*Cucurbita pepo*). Okra grows well in hot climates, and early-yielding okra varieties such as 'Prelude' and 'Burmese' start to produce pods in a little less than two months. Okra pods are good for eating while still young and tender. Harvest the pods regularly—every few days—to prolong the harvest season and to prevent pods from getting fibrous. Grape, cherry, and roma tomatoes are more forgiving of heat and humidity than the large, round types. In tropical climates, zucchini should be planted during the coolest months, which usually coincides with the beginning of the dry season.

Fast-growing root vegetables include beets (*Beta vulgaris*), carrots (*Daucus carota*), and radishes (*Raphanus sativus*). These cool-season crops grow best in high-elevation (600-1200 m) parts of the tropics. In lower-lying areas, try growing them during the coolest time of year, and mulch the soil to reduce heat. Though most carrots require a cold period to set seed, the 'Uberlandia' carrot variety (available from ECHO's Global Seed Bank) was selected for its ability to produce carrots and even set seed in the low-lying tropics. Though it is more heat tolerant than other carrot varieties, plant 'Uberlandia' during the coolest time of year for best-tasting carrots.

Table 3. Time from planting to harvest and spacing recommendations for fast-growing vegetables with edible leaves, fruits, and roots. Days to harvest and spacing designations are approximations.

Leafy greens	**Common name**	**Days to harvest (from seeding to earliest harvest)**	**Spacing (cm within x between row)**	**Source**
Amaranthus spp.	amaranth	28-42	15 x 30	ECHO *TN* 2
Brassica rapa subsp. *chinensis*	bok choy	40	10 x 20	PROTA4U
Celosia argentia	Lagos spinach	28-35	15 x 30	ECHO *TN* 56
Corchorus olitorius	jute mallow	21-28	10-20 x 30-50	PROTA4U
Lactuca spp.	lettuce	60	35-60 x 35	PROTA4U
Vigna unguiculata	cowpea	28	15 x 50	PROTA4U
Fruits				
Abelmoschus esculentus	okra	50	30 x 60	PROTA4U
Cucurbita pepo	zucchini	55	50-100 x 50-100	PROTA4U
Solanum lycopersicum	tomato	60-80	40 x 60-75	Ebesu (2004)
Roots				
Beta vulgaris	beet	56	25 x 10	PROTA4U
Daucus carota	carrot	60	5-10 x 8-10	PROTA4U
Raphanus sativus	radish	21	2-4 x 10-25	PROTA4U

Where to get seeds

ECHO supplies trial packets of seeds, which we will continue to do as best we are able under the uncertain circumstances of the current COVID-19 pandemic. Crops mentioned in this article are available through the ECHO Global Seed Bank at this writing. You can select your own combination of crops, or select a Quick Garden Bundle (one for tropical and another for temperate conditions). See our online catalog for ordering/pricing information. Additionally, Seed Programs International (SPI) and Hope Seeds can help you with bulk quantities of vegetable seeds. SPI has a Global Gardeners web page, through which those in the United States can purchase seeds and, in so doing, support SPI's international efforts.

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Plant Resources of Tropical Africa. PROTA4U Database. https://www.prota4u.org/database/. Accessed 8 April 2020 [NOTE: You can search by common or scientific name for information on crops you are interested in.]

Yarger, L. 2007. Lagos Spinach. *ECHO Technical Note* no. 56.

Further Reading

Food and Agriculture Organization. Crop calendar- An information tool for seed security. [This is an interactive tool with information on planting and harvest times of crops within countries.]

Shackleton, C.M., M.W. Pasquini, and A.W. Drescher (Eds). 2009. *African Indigenous Vegetables in Urban Agriculture*. Earthscan. [Chapter 5 contains production and harvesting information for a number of vegetables grown in Africa.]

ECHOES FROM OUR NETWORK

Dan Sikkink sent us a few photos of a 100-fold garden he helped build in Honduras. He commented, "We changed the size because of lack of room. Water is so very hard to come by in this area so [the 100-fold garden] was an excellent solution for this area."

Figure 7. Digging the foundation for a 100-fold garden, and sifting the soil to be used as filler for the reservoir (material left on top of the screen) or to be mixed and used as topsoil (material that passes through the screen). *Source:* Dan Sikkink.

When asked what they had used for "filler" material in the reservoir area, Dan shared, "The people live in an area where the land is mostly rock. When we dug the hole in or a trench out, we screened the material (Figure 7). About 50% was rock. We used [what was left on the screens] to fill the bags [that are laid in the reservoir (Figure 8)]. We mixed the [finer material that fell through] with topsoil, and we got compost from the greenhouse. There was a lot of pony dung around in the streets of the community, so I had the kids gather up a sack full and we made a manure tea that they will use for a topdressing fertilizer."

Figure 8. Placing the bags of reservoir filler on top of the plastic. *Source:* Dan Sikkink.

"We planted tomatoes, celery, peppers, and cabbages [in our 100-fold garden], using the square gardening method that was suggested in *EDN*" (Figure 9).

Figure 9. The finished and planted 100-Fold Garden! *Source:* Dan Sikkink.

BOOKS, WEB SITES AND OTHER RESOURCES

Learning from a Post-Program Review
Grain Amaranth Program in Eastern Africa
by Dawn Berkelaar

Have you ever wondered about the long-term impact of a project with which you were involved? Wouldn't it be nice to know whether changes in a community lasted after an official program ended? Do you wish you knew what worked and what did not, so you could adjust for a more effective program next time?

In 1998, World Renew and partner institutions introduced grain amaranth to two villages in a semi-arid region of Kenya. Over time, the program expanded into more parts of Kenya and into Uganda. The program included both agricultural and nutritional training.

The grain amaranth program ended in 2008. Five years later, World Renew conducted a post-program evaluation, led by Dr. Tom Post and Dr. Dorothy Nakimbugwe. We summarize the evaluation here because the lessons learned might be helpful for people planning to start an agriculture or nutrition project, whether or not grain amaranth is the focus.

The purpose of the 2014 evaluation was to determine the level of adoption of grain amaranth, and to understand challenges to adoption. What worked? What did not? The evaluation also was intended to "document the process of change in rural communities."

World Renew used several evaluation methods:

- They interviewed the staff of partner institutions.
- 480 farmers from seven sites filled out a questionnaire.
- World Renew staff also led focus group discussions in six communities.

Key findings

The evaluation led to several key findings. The biggest takeaway: amaranth use is well established and has continued to spread from farmer to farmer. Grain amaranth is a culturally appropriate food in the East African context. According to the report, "…Amaranth flour mixes easily with maize, millet, wheat, and cassava flours to [make] improved traditional foods, such as porridge, mandaazi, chapati, etc.—and meets taste preferences of East African cultures." Amaranth grain provides a range of essential nutrients, including well-balanced protein that is high in the amino acid lysine. (The leaves of grain amaranth are also edible; they become available early in the growing season—i.e., in the hungriest season—and are high in Vitamin A.) Special training around nutrition really paid off; farmers ranked amaranth as "a highly important crop for their wellbeing," in terms of both health and income (though the latter depended on location, as marketing could be difficult). Amaranth

grain is especially beneficial for children, mothers, and people living with HIV/AIDS. Many farmers eat grain amaranth as part of a breakfast porridge that consists of one part amaranth flour to three parts maize or millet flour.

The evaluation also revealed information about growing conditions. Amaranth plants flower well and produce grain within 75 days (about 15 days earlier than the fastest-maturing available maize varieties), within the constant day lengths found near the equator. Amaranth is suited to a range of climatic conditions, from semi-arid to sub-humid. It is particularly useful for semi-arid regions of East Africa (especially with rains becoming more unpredictable), because of the plant's drought resistance and rapid maturation. However, amaranth requires reasonable soil fertility with adequate amounts of nitrogen and phosphorus. In many parts of East Africa, where soil fertility is "fragile," growing grain amaranth could further harm the soil unless techniques such as crop rotations and cover-cropping are used to restore fertility. The original amaranth program did not include training in these techniques, but the post-program review recommended that they be included in such programs in the future.

Few Kenyan farmers grow amaranth on a large scale. According to one survey, more than half of farmers grow 0.1 hectare (¼ acre) or less of amaranth, and harvest up to 30 kg of grain per growing season. They use amaranth as an important source of nutrition, but not as a main source of carbohydrates. Still, the amount grown is usually enough to provide 40 g of flour per adult per day (or, for a child, 20 g of flour per day). [Dr. Benito Manrique Lara, former director of Nutrisol in Mexico, recommended these amounts. Dr. Post shared that he has recently seen recommendations for higher daily amounts, but that "the 40 g and 20 g minimal amounts have proven a useful starting point guideline [to improve nutrition] in World Renew's East Africa experience."]

The evaluation revealed some challenges. For example, seed degeneration (from grain amaranth plants crossing with other types) can be a problem. Farmers are encouraged to buy good seed where possible. Where seed is not available for purchase, farmers should exercise seed selection themselves, by removing black-seeded plants from seed-production areas or removing the heads of black-seeded plants before flowering to reduce cross-pollination. [Stacy Swartz commented that these black-seeded plants "are vegetable amaranth, which is a regularly consumed leafy green (locally called mchicha) that is cooked before eating and is an important part of household nutrition."] At the end of the season, farmers should identify the best plants and keep those heads, once fully matured, for seed.

Another challenge was that many farmers would like to sell grain amaranth as a cash crop, but marketing has been difficult. When I asked Dr. Post about this, he commented that, in two areas of East Africa, World Renew's partner organizations "have taken on the role of gathering the product from farmers, processing and marketing." He added, "While this is not a usual role for non-profits, it seems that, at this point, it is a needed intermediate step towards integrating [grain] amaranth in the market."

Key recommendations

This evaluation led to several key recommendations for World Renew going forward, namely that they:

- Experiment with promoting amaranth as a nutrition supplement for "mothers and children in the first 1000 days of life."
- Teach methods to promote soil fertility, either along with promoting amaranth or before introducing it.
- Train on seed selection and provide quality seed from Kenya.
- Introduce grain amaranth first as a "nutrition supplement for home consumption," and avoid promising a market for cash crops.
- The evaluators also suggested the need for research on the effects of amaranth consumption on immune systems. Just a small amount of grain amaranth consumed daily in breakfast porridge has a disproportionate impact in cases of malnutrition. People with AIDS who eat amaranth experience significant increases in the number of CD-4 T cells in their blood. (The number of CD-4 cells gives an indication of the strength of a person's immune system; a higher number is better.) It would be interesting to understand how amaranth consumption results in such benefits to health.

Whether or not amaranth is a crop that would grow well in your area, we hope you will find the results of World Renew's evaluation informative as you and your community work to address local needs. Perhaps reading the results of someone else's program will help you ask better questions and consider new angles as you plan.

Reference

Post, T. and D. Nakimbugwe. 2014. Ex-Post Evaluation of the Introduction and Promotion of Grain Amaranth Program in Eastern Africa (1998-2008). World Renew. 69p.

UPCOMING EVENTS

Information for rescheduled training events, in Florida and at our Regional Impact Centers, will be announced on ECHOcommunity by June 30.

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!