



Women and Agriculture

by Dawn Berkelaar

Gender dynamics in relation to agriculture is a big topic, and one we have not previously written about in EDN. Yet in recent years, widespread attention has been paid to the disparity that often exists between men and women when it comes to agriculture and access to related resources. I talked to several members of ECHO's network (who are also former interns and staff members) to get their input, based on their experiences in a wide range of cultures and communities. I hope you enjoy the unique article that resulted!

Introduction

Success on a small farm depends on the family members who run it and live on what it produces. In serving smallholders, it helps to know who does what on the farm. Who makes decisions about what and where to plant? At harvest time, how is the income used, and who decides this? When you plan, implement and evaluate your agricultural programs, do both men and women participate equally in the meetings, trainings and projects that are undertaken?

Globally, women are very involved in agriculture; according to some estimates, they do more than half the work involved in farming. However, they do not receive a proportional amount of extension and other help; nor do they receive benefits proportional to their labor. According to FAO's 2011 [State of Food and Agriculture](#), "If women had the same access to productive resources as men, they could increase yields on their farms by 20 to 30%. This could raise total agricultural output in developing countries by 2.5 to 4%, which could in turn reduce the number of hungry people in the world by [raising] up to 150 million people out of hunger."

Agricultural involvement encompasses activities all the way from seed saving to the marketing of agricultural products. This article gives ideas for methods to learn about gender dynamics in a community, examines some of the reasons women



Figure 1. Thai hill tribe woman weeding her field. Source: Tim Motis

may face constraints related to agriculture, and shares some potentially helpful ways to address the challenges. This article only scratches the surface, so at the end we share other resources that can be used to dig deeper into the subject. We would welcome feedback and insights on this topic from you, our network members!

Learning about Gender Dynamics

Before trying to implement change in a community, observe the gender dynamics. When I talked to Laura Meitzner Yoder, she shared some excellent ideas for doing so. First, carefully observe people's interactions in the community. Laura said, "Every day try to learn something about how women and men relate. Write it down at the end of the day. At every single meeting, count men and women. In meetings, draw a picture of where they are. Are the women outside the tent and men inside the tent? Who gets chairs or sits in the front? Keep track of who speaks. When women speak, how do people respond?"

Second, actively seek to learn about men's and women's roles in the agricultural cycle. For example, ask a local artist to make simple cards, one with a picture

of a woman and the other with a picture of a man. Ensure that their features and clothing look like those of men and women farmers in the area where you work. Give a set of cards to each person in the group. Ask people about who does various farming tasks, and ask them to hold up the card for the person or people who do that task. (It might work best to ask men and women separately). The results may surprise you! As an example of what you might learn, Figure 2 shows gender roles for activities related to seed saving, as identified by participants using this technique in three different communities in Thailand and Cambodia. The local extension officers who worked with these communities found the exercise helpful, both because they didn't know who was responsible for certain parts of the agricultural cycle, and because it taught them that they had over-predicted male participation.

Laura cautioned, "There are few absolutes from place to place. It would be tempting to say that men do the heavy work of cutting things down, but in many communities it

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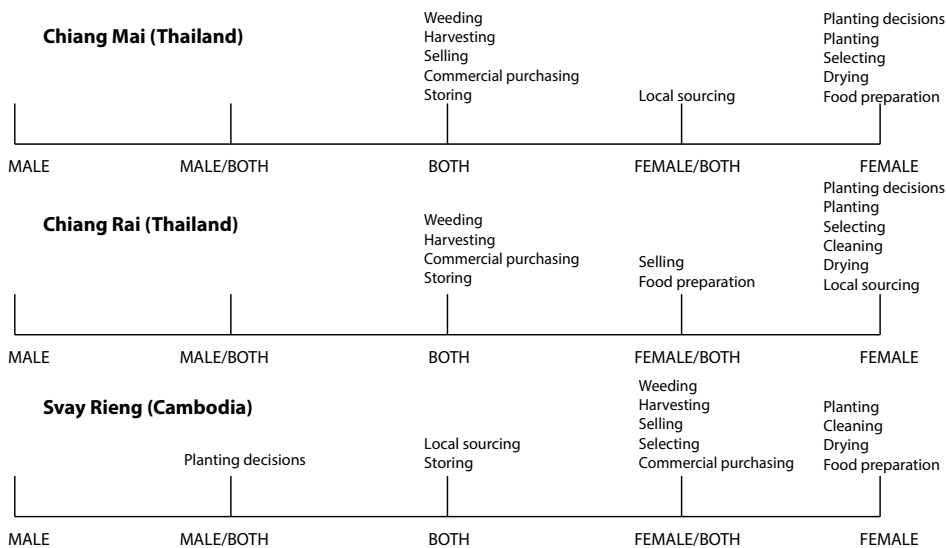


Figure 2. Gender roles in the informal seed system as identified by focus group participants in communities in Chiang Mai (Thailand) [top], Chiang Rai (Thailand) [middle], and Svay Rieng (Cambodia) [bottom]. From Gill *et al.* 2013.

is as likely to be a woman, or a man and a woman working together. In southeast Asia, men and women would often work together, but the tasks would be separate. "Be sure to ask about not just fieldwork, but decisions. Who decides what crops will be planted? Who purchases/acquires the seeds? In terms of seed saving, a lot of that work centers around the kitchen, and from our research a lot of that work was often done by women. But in some homes, women did none of the cooking! Be aware and skeptical of your own assumptions. Do not generalize too quickly."

Laura added, "In Thailand and Papua, men and women often worked in the fields together and there didn't seem to be strict gender separation. In other places that is different. Roles vary widely from place to place, but also within a society. Just as there is variation in your home culture, you are likely to find exceptions in other places. For people who are working cross-culturally, do not take your own categories with you. It can take quite a bit of 'unlearning' to see what is actually there, rather than assuming that it is a certain way."

Third, have people tell a story of an incident; it could be something they do in the community, or a story of a conflict. Laura suggested, "Listen for the gender comments and the assumptions. Is the elder male or female? Do women work out conflict, then share it with the men, who formalize the peacemaking?"

This process of learning about gender dynamics is called *gender analysis*. Susan

Stewart described the process in chapter 9 of her book *Learning Together: The Agricultural Worker's Participatory Sourcebook*. A person's sex (whether they are physically male or female) is biologically defined. By contrast, "gender refers to the roles or characteristics society has given people, such as who washes the clothes and who drives the car in a family, or who is supposed to be meek and who is supposed to be strong. This is changeable and not universal. It is socially or culturally defined." Gender analysis is a process of working together to reflect on the gender roles that exist in a culture or society.

Become aware of assumptions (your own and others), spoken or unspoken, that keep men or women from participating, or that cause us to design non-inclusive programs, such as:

"Farming is a man's job."

"Only women should handle purchases of farm inputs."

"It's a husband's job to make decisions for the family."

"Women's work doesn't matter."

"It is best if men market the produce in public places."

"Only women cook and clean."

Stewart pointed out that gender analysis is important for many reasons: so that

husbands and wives learn to appreciate each other's work; women begin to value their own work; community members are more effective; training is given to appropriate people; and the work burden can be appropriately shared between men and women in households.

When it comes to specific projects, long-term success becomes more likely when gender analysis is undertaken early on. Before launching a project, planners should ask questions about women's and men's roles and responsibilities, and about ownership and control of resources.

In the process of gender analysis, questions are asked about women's and men's roles (in the family, on the farm and in society); about their access to resources; and about their control over resources (e.g. money, land and animals).

One way to approach gender analysis is to place men and women in separate groups, and ask them to describe the work they do. Also in groups of all-men and all-women, have people describe what a woman's life is like at different stages. Finally, have women map the village, then have men map the same area. Share the responses in a big group, with the help of a facilitator. If men's and women's perceptions are different, it will become clear. The mapping exercise will help illustrate what women and men each find important in their community.

Using drawings or pictures of a person doing agricultural activities, have workshop participants indicate who usually does them on a farm: men or women? (To avoid introducing bias, for each activity, either make two sets of drawings--one a woman and the other a man--or use all pictures of a woman). Do the same with drawings of resources. Who uses them, and who owns them? The "Further Resources" section at the end of this article includes helpful tools that can help with gender analysis.

Note that in some cultures, you may need to take very small, culturally-appropriate steps. When working in Tanzania with a male-dominated community, Stacy Reader learned that extreme caution was necessary when having conversations about gender dynamics. Stacy commented, "Multi-gendered groups were not allowed, or the men would potentially punish outspoken women. Sometimes even if it was heard that women met together to talk about gender relations, men would punish the women who attended. So [my mentor] would often call women together for school meetings

and talk about the kids' education, and then add on bits of gender dynamics and give the women space to talk." Much harm can be done if societal standards are not respected at the outset. In some cultures, woman-to-woman mentorships may be the best way for women to build each other up and encourage one another.

Constraints Women May Face

What if your observations, along with community responses to your questions, show that women are underrepresented and that their skills are underutilized? To understand why this might be the case, it helps to understand some of the factors that can be especially challenging for women when it comes to farming. These may include:

Misperceptions. In many places, people associate the term "farmer" with men. This misperception is perpetuated by brochures and advertisements if they use only pictures of men to depict farmers. The notion can become further embedded in people's minds when all the extension agents in an area are men.

Also, people may not think of home gardens or food production for the household (which is often done by women) as "farming," because of the lack of a cash or commercial component.

Sometimes a woman's own self-perceptions need to change before she can take a more active role. If a woman has spent her whole life being told that she is not capable, or if she has not been given opportunities to make decisions, she may be hesitant to begin doing so. The traditional roles of a husband and wife may be such that a woman is unused to making certain types of decisions.

Little access to land. Women often have fewer land rights, and less security of tenure. Sometimes women farm on open, unused land, but may not be recognized as farmers because they don't own land.

Inaccessible training. Meetings and training related to farming may be at scheduled times and places that make it difficult for women to attend. Any time spent in a meeting may mean something else does not get done, such as food processing or meal preparation. Lack of provision for child care can also make trainings inaccessible.

Discrimination. Explicit gender discrimination occurs within some communities.

Lack of literacy and numeracy. Women may have had fewer opportunities to learn to read or to work with numbers, making it difficult for them to access information about farming. Brochures and advertisements that rely on the written word may be inaccessible for many women.

Invisibility of women's work. In *Learning Together*, Susan Stewart described the invisibility of women's work: "...village men and women tend not to value the work of women. As a reflection of this problem, sometimes development programs do not consider the roles of both men and women in agriculture in their planning." Though perhaps not directly involved in economic agricultural activity, women's extensive activities in and around the home mean that they "...[play] a vital role in the production of crops, even though they [are] not always in the fields." Overlooking and/or disregarding "women's roles only hurts the community as they lose half of the available resources the community has for the wise solution of its problems. It is like a bicycle with two tires. No one notices that both are important until one of the tires has a flat."

Addressing the Challenges

Once you have an idea of how gender dynamics work in your community, and you have some understanding of why men and women interact as they do, you can begin to deliberately encourage involvement by both women and men. Following are suggestions to encourage greater participation by women.

Be attentive to your own modelling. How does your own household demonstrate equal value of women and men? Do you share burdensome tasks? Do not underestimate the influence of this! Others may be closely observing your home life, to see possible ways for both women and men to take on unconventional roles.

Look for entry points. Look for examples in the local culture where women already play a strong role, or where change is happening and women are being included. For example, Rick Burnette shared that in



Figure 3. Husband and wife Tanzanian farmers grading vanilla and showing their harvest. *Source: Stacy Reader*

parts of Asia, women often manage the family finances. This could be significant when promoting micro-enterprise, micro-finance and marketing. Start with what is working.

Change women's self-perceptions by working with them strategically.

Stacy Reader worked in Tanzania with a group of mostly pastoralist women who lacked confidence in themselves but were concerned about their children's nutrition. She said, "I talked with them about how better health for them and their kids would help them not be so tired (many women have brucellosis where I was), and so they would start on small medicinal/nutritional gardens around their houses. From there they wanted protein from chicken eggs for their children, so they started raising chickens. It just kept expanding (from the house out) from there, organically and naturally. In that situation, using what women were already passionate about to encourage or show them their worth was the key for success in getting their voices heard for their and their children's health."

Enable women to participate in meetings.

To increase participation by women, Laura Meitzner Yoder suggested that you first invite women, then ask them specifically when and where they would like to meet. She commented, "One of the classic errors is to hold meetings when it is impossible for women to attend. In some regions, if you were to hold a meeting for women in the mornings, they would not come, because they have to attend to the day's household duties early.

"If you are interested in women's participation, do not assume that they can come on your Monday to Friday, 9 to 5

schedule, or that they are going to travel to get there. Ask very openly, 'Where and when would you like the meeting to take place?' Women may not be able to travel to an office or training center, but may be eager to attend events held in their own village. In small villages, they may say, 'At night [when the children are fed and they are not busy preparing food for the day], in someone's kitchen.' Changing the timing, location, and format of meetings requires flexibility from extension workers, but could make all the difference in making it possible for women to participate."

Then again, depending where you live, evening meetings might not be ideal. Angela Boss commented, "In some cultures, women cannot leave their homes after dark or are not able to leave their home without a male escort. Participatory planning of training activities is ideal for ensuring equal involvement of men and women."

Sometimes men come to agriculture extension meetings, while women do more of the farming tasks. The reasons for this might vary. Laura Meitzner Yoder commented, "If your extension workers are mostly male, they may have an easier time talking to other men. Also, being invited to a government meeting is something that is a high-status event; you are likely going to be fed, and maybe paid. If you are in a society where men get the higher-status things handed to them, they may be the ones invited."

Be careful to consider women's daily commitments when planning a training session. It may be impossible for a woman to come for an extended period of time. Rhoda Beutler pointed out that in communities where women depend on

daily income from selling in a local market, they will not be able to spend consecutive whole days in training. "Consider people's economic activity when planning," she cautioned. Brian Flanagan agrees. He commented, "My experience in rural Haiti was that market days never worked well for meetings. Both men and women were often busy, but especially the women."

"I've tried to include women, but they won't come to meetings!"

- Ask women why they do not come to meetings.
- Ask women when and where they would prefer to meet.

Even when both women and men are present at a meeting, participation by both is not assured. Laura suggested, "Build into your meetings ways for women's voices to be included and heard. In some places, all that requires is a 'talking stick'; you can only talk when holding the talking stick, and if you are male you have to hand it to a female, who then hands it to a male. Each person needs to speak before it is returned."

When leading a meeting, be aware that subtle behaviors can unknowingly work against gender equality. Jan Disselkoen, now retired from World Renew, shared about a memorable experience she had in Niger: "Men and women always sat separately--that was almost impossible to change. But I noticed that when the male facilitators spoke to the group, they never even looked towards the women's section. Eye contact was made entirely with the men--and they wondered why the women never responded to their questions! They were a bit defensive when I pointed out my observation, but they altered their behavior with the result that the women did begin to participate more."

Encourage literacy, using locally available resources. Jan Disselkoen shared some thoughts with me about literacy, based on her thirty years of experience. "If there's a common thread in how World Renew approaches literacy these days, it's using and linking people to the materials and programs that the government and other groups have developed in

their country. In the early days, especially in countries where no such materials or programs existed, we created our own materials.

"Creating your literacy materials from scratch is time consuming and expensive. Literacy training is also intensive and time consuming for participants. They have to come to a class at least four times a week for at least six to eight months before they actually learn to read fairly proficiently—and it takes another six to eight months before the reading level is high enough for folks to maintain without classes. This takes a lot of commitment, both by the volunteers and by the participants. However, this intensity has a wonderful spin off. In every literacy program for women that I've observed, the social impacts of getting together and talking with other women in the community about something other than the everyday stuff are huge. And even if the women don't have that many places to actually use their literacy, the growth of self-esteem from learning to read is significant.

"Another thing we commonly do to promote literacy is to create box libraries so that reading materials are available in communities and people can maintain their literacy levels. Literacy classes and materials are, of course, ways to promote other things like agriculture and health. But I found that what really motivated people to learn to read and write in their own language was either religious (e.g. wanting to be able to read the Bible) or cultural (marginalized ethnic groups such as the Tuareg in Niger had a very strong desire to maintain their language and had even created their own alphabet). In Sierra Leone, our most popular books were chiefdom histories, stories and songs, and books of local proverbs."

When several women in a community are able to read, they can learn and share information with other women. Stacy Reader commented, "I found an ANAMED medicinal book in Swahili for the women I worked with; the few that could read would read it to the others and they all got to learn together, so I wasn't always the one sharing the information."

Non-text resources for extension. Literacy is important, but when incorporating text in extension materials, use simple terms that are easy to read. Agricultural extension can also make use of photos, drawings, and other media to communicate technical material in ways that non-literate people can understand.



Figure 4. Tanzanian farmers harvesting beans together. Source: Stacy Reader

Radio broadcasts are a good non-text option for extension. [Farm Radio International](#) has Resource Packs (104 of them!) on a wide range of topics, all geared toward smallholder farmers. Radio scripts can be adapted to local conditions.

Digital instruction can be helpful where available (but be aware that women also often lack access to technology, compared to men). Several organizations that share video information online are listed at the end of this article in the "Further Resources" section.

Involve women as extensionists and lead farmers. Despite women's integral involvement in farming activities, you may find that most extension agents in your area are men. While working in Haiti, Rhoda Beutler told me, "We organized a conference in Haiti, and at least twice we requested in the invitation letter that each organization send a man and a woman. Each time, the actual percentage of women who came was between 10% and 25%. One organization called and said, 'We actually don't have any women on our agriculture team,' so they sent two men. Others just sent two men without contacting us about it."

"I've tried to hire women agricultural agents, but they never apply for the jobs."

- Ask women you know what hinders them from applying, and what would make such a job feasible.
- Ask members of agencies who have women agricultural workers on staff what they do to recruit, develop and encourage their women staff members.
- Consider helping to set up child care, so that women are able to accept and do the job.

Angela Boss's organization, World Renew, looks for and works with "lead farmers." She pointed out that if you want female lead farmers, you must also prioritize women as extension agents. But be sensitive when hiring female staff and volunteers! Be willing to invest in new ways to make the position feasible. Angela described an organization in Niger that budgeted extra money to enable women to have chaperones, especially when required to travel overnight. In southern Africa, MCC provided a nanny for a woman hired to promote Conservation Agriculture, so that she could bring her baby along on extension trips.

Angela suggested, in the case of a lead farmer agreement (whether for a man

or woman), that the hiring organization require the paperwork to be signed by the spouse and returned after one week. This would help promote family communication and consideration.

When considering women for leadership positions, be careful not to overschedule. One unintended consequence of trying to engage women in committees can be a labor overload. How many meetings are truly necessary?

It is not always the case that women are underrepresented in positions of leadership. Rhoda Beutler received comments from someone working in the area of agricultural development that some of his best community leaders/animators were women, and that where he worked in Haiti, women were accepted as leaders and their voices were heard. ECHO staff member Brian Flanagan, who worked in Haiti for many years, has seen the same dynamic at work.

Help women get access to land. Advocate with community leaders regarding land access for women. Laura Meitzner Yoder's article "[Resource Rights](#)" from *EDN 106* underscores the importance of land rights when it comes to agriculture.

Provide options for child care. Child care can be critically important for encouraging and enabling women's involvement in agriculture. Laura Meitzner Yoder shared a case study from a group of women near Hyderabad, India. The women went through a very long process to become food self-sufficient. They had owned no land, and were desperately poor. Finally they requested and received land from landowners who did not want to pay tax on it—but the land had no topsoil and nothing would grow on it. The women spent twelve years improving the land; they carried silt from the river and built rock bunds. Then, when they finally could plant, they had to locate seeds from older women in the community.

The women planted crops appropriate for their dryland climate—ones that could grow in poor soil and without irrigation. The community is now food sufficient, and most of the women now own some land.

Laura shared, "I told them, 'This is an amazing story. You had to make the soil.

You had to get the seeds. What one thing made this agricultural transformation, this food sovereignty, possible?' Their answer was, 'Preschool.' They decided to do a childcare co-op, taking turns looking after young children. Little babies would be with them, on their back. But the children who were preschool-age needed their attention at home and couldn't be in the fields because they would roam too far. So they came together and decided to make their own kindergarten. Childcare is demanding! They said, 'When we knew that our children were well-cared for and happy, then we could do this work.'"

Concerns about child care also exist for women who work as extension agents. An organization may understandably be hesitant to assign a woman to travel if she has young children at home (though Rhoda Beutler pointed out that this can also go the other way, if a man is the primary caregiver in a family).

Request feedback from women. Look for ways to involve women in all parts of the agriculture continuum. For example, women's input is important when it comes to research questions. People tend to have strong preferences when it comes to food. When developing a new crop, higher yield is not necessarily enough, if the taste or even color are perceived to be inferior. Often women are the family members who shop for and cook food, so their input on desired characteristics is extremely important. For example, Angela Boss shared, "When we introduced new bean varieties into the Central African Republic, one of the key considerations beyond yield and marketability was cooking time. Women do much of the foraging for firewood, so bean varieties that cook relatively quickly was an important factor for women. Faster cooking meant less firewood was consumed."

Jan Disselkoen agrees on the importance of women's input when deciding on crop varieties. In Niger, she encountered an assumption that if men traditionally grew the crop, they should decide what varieties to grow. She said, "Villages were testing 3-month maize varieties in order to make a choice about which ones to multiply for seed to plant on their farms. The field worker did an exercise with the men's group to decide which variety to multiply. When he got back to the office, my colleague asked him what variety the women preferred. He went back to the villages and did the same exercise with the women. It turned out that the variety the men had chosen required significant extra time to pound. The men's

first and second choice were quite close together, and their second choice matched the women's first choice, so it was obvious to them that they should make the change."

The Global Rice Science Partnership (GRiSP) has a gender strategy to empower women. According to an article in *Spore* magazine, "The term 'empowerment' includes the enhanced role of women in the design, experimentation and evaluation of agricultural research for development, as well as improved access to resources (inputs, knowledge, and improved technologies) and control over output (harvested rice and processed products)." The article included this statement: "All scientists are aware that technologies are not neutral and men and women may adopt or reject the technology developed." For this reason, scientists are working with women to identify specific needs.

Farming as a Family. Angela Boss suggested being intentional in how you talk about farming. For example, the catchphrase "Farming as a family" has a very different connotation than "Farming is a business." Within a family, some members may do more of the labor while others make more of the decisions. To whom then do you direct your training? One approach is to train the whole family.

Angela added, "Remember that 'equal' does not mean 'same.' There is room for different roles—but communication and joint decision-making are key!"

Conclusion

Women often face challenges that limit their participation in agriculture extension activities and their access to resources. The process of gender analysis can help to reveal gender dynamics in a community. When we understand some of the constraints women face, we can take steps toward greater inclusion.

However, inclusion of women does not mean exclusion of men. Rather, our goal is a society in which men and women work together, for the good of their families and of the community. In this way, we will all benefit.

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Further Resources

INGENAES (Integrating Gender and Nutrition within Agricultural Extension Services). <http://ingenaes.illinois.edu/>. ECHO has benefitted from their resources; they are also recommended by Angela Boss. See especially the gender training activity sheets under the "Apply Tools" page.

80 Tools for Participatory Development, by Frans Geilfus. <http://repiica.iica>

int/docs/B10131/B10131.pdf Angela Boss lists this as a favorite tool for participatory development. It is available in English and Spanish. Chapter 7 (p. 131) has gender tools, each with a one-page description of how to use the tool and a one-page diagram showing a completed tool.

Gender Equality in Agriculture

Extension. 2015. ECHO Summary of MEAS Brief #2. [Technical Note on Applying Gender-Responsive Value-Chain Analysis in Extension and Advisory Services](#). MEAS

Advancing Women in Agriculture through Research and Education (AWARE) online resources and reports gathered by Cornell University's AWARE program which is focusing on empowering women in agriculture.

Digital Green shares short, helpful videos.

SAWBO (Scientific Animation without Borders) shares short, animated videos.

Access Agriculture (www.accessagriculture.org/home) is an "international NGO that encourages the use of training videos to help farmers improve their profits....Videos are all designed to support sustainable agriculture in developing countries." Videos can be watched online or downloaded; audio tracks are also available, for use by radio stations. DVD copies of videos can be requested. Downloads are free, but registration is required in order to access them. Videos are high quality, and video scripts are available—so organizations can coordinate translation into local languages. Many local language versions of videos are already listed on the website and available to download. Video files for downloading are in mp4 format, and audio files are in mp3 format. The Access Agriculture site recommends a media player that can be downloaded for free if you have trouble playing files in these formats. Videos are available in 14 categories: cereals; roots, tubers and bananas; vegetables; pulses; fruits and nuts; other crops; livestock; fish; integrated pest management; sustainable land management; mechanization; business skills; methods; and other. A search function can be used to search by topic, language or keywords.

2016 ECHO International Agriculture Conference: Topic Summaries

by ECHO Staff

This article summarizes several of the plenary sessions presented at the 2016 ECHO conference in Florida. If you were unable to attend the conference, or would like to review some of the talks, many of them can be viewed on [ECHOcommunity](#). Other 2016 presentations that appear there include "Tropical legumes for sustained cropping on marginal soils," "Silvopastoral systems in Brazil," and "Culturing beneficial microbiology for farming." Talks given in previous years are also available on the website.

Biodigestion: Dr. Ann Wilkie

Dr. Ann Wilkie from the University of Florida spoke about biodigestion. This process produces biogas and also results in a high-nutrient organic fertilizer.

Biogas is a mixture of different gases, primarily methane (CH₄), produced through anaerobic fermentation of organic material. The methane can be used in a manner very similar to natural gas. It is most efficiently and easily used for cooking.

During biodigestion, much of the carbon in the organic feeder material is pulled off and

converted to methane. Nutrients, including N, P and K, are left in the remaining bioslurry. These nutrients are in plant-available form and are excellent for use as a fertilizer. Bioslurry can be added to compost or directly applied to agricultural land.

A successful biogas system requires the presence of anaerobes, microorganisms that can break down organic matter in the absence of oxygen. Manure is a good option for starter material, but if that is not accessible, other options could include muck from the bottom of a pond, or even garden soil. After the system is established, any organic material can be used (for example, food waste); a permanent source of manure is not necessary.

Dr. Wilkie shared diagrams that contrast current agricultural practices with a more food-centric system (see Figure 5, A and B). Biodigestion takes "waste" products and turns them into a resource, integrating sustainable energy production, food security, and eco-sanitation. As Dr. Wilkie reminded us, "Waste is not waste until you waste it!"

change. He stated that global warming has been convincingly documented. The causes are debated, but most scientists agree that human activity has contributed to it.

Resilience is necessary for ecological systems, including small-scale farms. Dr. Nair defined resilience as "the capacity for ecological systems to persist and absorb change," or the ability of a system to tolerate disturbance (natural and/or due to human activities) and to restore itself. Dr. Nair pointed out that 70% of the world's food is grown on farms that average 2.2 hectares (5.44 acres), and argued that sustainable farming methods are required to protect the ecological resources necessary to feed a growing global population.

Dr. Nair presented a very helpful summary of the differences in how economists and ecologists view our world (Table 1). In general, economists view the environment as part of the economy, but do not take into account the economy-driven destruction of earth's natural systems; by contrast, ecologists view the economy as a subset of the environment and emphasize that economic activities depend on the earth's ecosystem. Agroforestry, which provides many ecosystem services, can bridge the Economy – Ecology divide in fragile ecosystems and help improve the stability, sustainability and resilience of those systems. Dr. Nair gave many examples of such systems. He concluded with a description of "Cinderella systems," which are agroforestry systems that have been practiced for a long time but rarely evaluated scientifically or mentioned in the literature.

Table 1. The Ecology - Economy Conflict

Ecologist's view	Economist's view
Economy is a subset of the environment	Environment as a part of the economy
All economic activities, indeed life, depends on earth's ecosystem	Economic theory does not explain the economy-driven destruction of earth's natural systems
Recognizes limits, constraints, and cycles - nutrients, water, ...	Works linearly or curvilinearly
Ecological deficits mean we take (not borrow) from future generations	Economic deficits mean we borrow from each other

Source: Dr. PK Nair, Conference Plenary Presentation

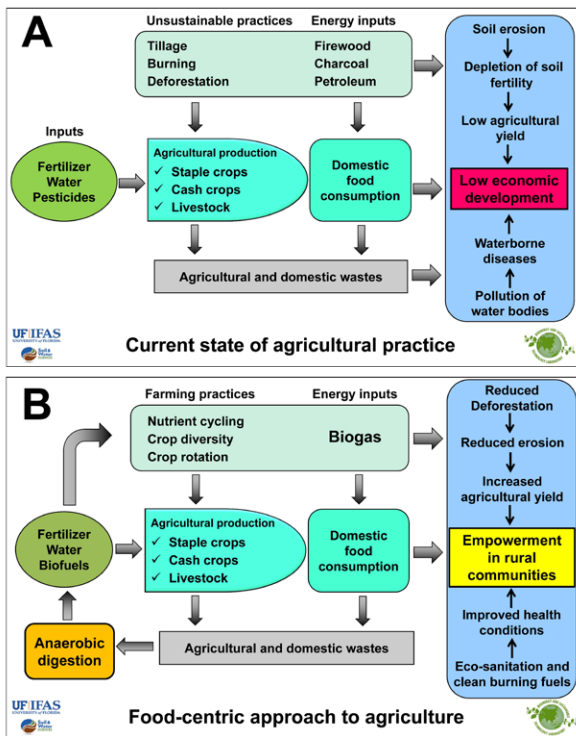


Figure 5. Representation of current agricultural practice (A), compared to a food-centric approach to agriculture (B). Source: Dr. Ann C. Wilkie, University of Florida-IFAS, Conference Plenary Presentation

Biodigestion can be done at a household level or on a large-scale level. At a post-conference workshop at ECHO's Global Farm in Florida, Dr. Wilkie showed participants how to set up a trial-sized biogas system, to get us familiar with the system and to take away some of our confusion about the process. Step-by-step instructions for setting up two different kinds of biodigesters can be found at http://biogas.ifas.ufl.edu/ad_development/howto.asp

Increasing Smallholder Resilience Through Agroforestry: Dr. PK Nair

Dr. P.K. Nair helped found the discipline of agroforestry. In his plenary talk, he first defined and described the issue of climate

Planting the Rain: Brad Lancaster

Brad Lancaster is the author of *Rainwater Harvesting for Drylands and Beyond*, a two-volume guide on sustainable water-harvesting systems, with a third volume in progress. While telling the story of a mentor from Zimbabwe (Mr. Phiri), Lancaster shared eight principles for stewarding water resources.

Despite frequent droughts, and without the benefit of incoming streams, Mr. Phiri transformed his dry, eroded 3-hectare farm into a place of abundance. Lancaster quoted Phiri as saying “Everyone plants trees, but almost nobody plants the water.”

The principles Lancaster presented do not require modern technology; they can be implemented by simply making wise use of resources freely available in nature. The eight water harvesting principles Lancaster presented are:

- Begin with long and thoughtful observation.
- Start at the top—or highpoint—of your watershed and work your way down.
- Start small and simple.
- Spread the flow of water so that it will infiltrate the ground.
- Always plan for an overflow route, and manage that overflow water as a resource.
- Maximize living, organic groundcover.
- Maximize beneficial relationships and efficiency by “stacking functions.”
- Continuously reassess your system.

Lancaster described specific techniques for putting these principles into practice. During a post-conference workshop, he

also explained how to understand the path of the sun across a site, and how to then place plants and orient buildings to make the best use of sun and shade.

More can be learned by accessing Lancaster’s conference presentation, visiting his website (www.HarvestingRainwater.com), or purchasing his books (from Lancaster’s website or through ECHO’s bookstore [www.ECHObooks.org]).

Applied Linguistics in Agriculture: Dr. David Ross

Each person has a worldview—a unique perspective through which he or she interprets the world. As vastly different worldviews intersect (for example, during cross-cultural development work), misunderstandings may result if one party is not sensitive to the other’s worldview. In his plenary talk, David Ross, president of the Graduate Institute of Applied Linguistics in Dallas, Texas, explained through case studies and publicity materials, how linguistics can affect agricultural development.

Applied linguistics is an “interdisciplinary field of linguistics that identifies, investigates and offers solutions to language-related real-life problems.” Spanning several realms of study including philosophy, anthropology, language and education, applied linguistics seeks to enhance understanding and promote sensitivity to differences in worldview. Table 2 describes some fundamental questions answered by every community’s worldview, and to what societal factors they relate:

Sometimes well-intentioned agriculture projects fail due to insensitivity or intolerance towards differences in worldviews. Dr. Ross

Table 2. Worldview Fundamentals.

Question	Societal Factor
How do we survive?	Economics
Who are we and where did we come from?	Kinship
How do we interact with others?	Social Structure
How do we control behavior?	Politics
How do we interact with the supernatural?	Religion

Source: Dr. David Ross, Conference Plenary Presentation

gave concrete examples of some such projects. He also explained how differences in cultural values can undermine a project, such as:

- promoting individual farmers’ personal benefit when community benefit is of highest value (political factor)
- promoting individual farmers’ personal benefit when conformity is a higher value (community decision-making factor)
- ignoring historical or religious associations with proposed solutions (religious factor)

Dr. Ross shared that a main principle in applying linguistics to development is taking the time to learn language and culture (including worldview), to better understand and help communities meet their own felt needs. Ross also cautioned that careful thought must go into any publicity materials that are distributed, and explained the difference between illiteracy (inability to read or write) and functional illiteracy (the ability to read and write simple sentences with limited vocabulary, but inability to do so well enough to manage daily living and employment tasks).

FROM ECHO'S SEED BANK



Figure 6. Flower and foliage of *Tithonia diversifolia*. Source: Tim Motis

Tithonia for green manure

By Tim Motis

Tithonia (*Tithonia diversifolia*), also known as Mexican sunflower or tree marigold, is a perennial shrub that is native to Mexico and Central America. Often introduced for its attractive flowers, it is now found in humid and sub-humid parts of Africa, Asia, and South America. It grows on most soils, can reach 3 meters (m) in height, and is moderately resistant to drought (Heuzé *et al.* 2016; Orwa *et al.* 2009).

Tithonia is often considered a weed. However, it can be used for animal fodder, compost, fuelwood, and insect control. Here we focus on its potential as a soil fertility amendment. According to an extensive review of *tithonia*’s use as a green manure in Kenya (Jama *et al.* 2000), nutrients are most concentrated in the tender green leaves and stems. Green leaves, collected before they fall to the ground as leaf litter, contain about 3.5% nitrogen, 0.37% phosphorus, and 4.1% potassium. Leaves of a *tithonia* plant on ECHO’s Global Demonstration Farm

Table 3. Nitrogen (N), phosphorus (P) and potassium (K) in plant tissue of *Tithonia diversifolia*, *Moringa oleifera*, and *Lablab purpureus* that had not received any soil fertility inputs.

Tithonia diversifolia on sandy, ECHO Florida soil	% N	% P	% K
Leaves (new growth)	5.70	0.52	2.83
Stems (new growth)	1.96	0.46	3.08
Mix of leaves and stems (new growth)	5.66	0.52	2.58
Old, decaying leaves (leaf litter)	2.67	0.38	0.58
<i>Moringa oleifera</i> (green leaves, 4-month regrowth)*	5.11	0.53	1.82
<i>Lablab purpureus</i> (mix of green leaves and stems)**	3.85	0.21	2.23

* Leaves harvested Dec 1-2, 2016, from trees grown at ECHO Florida. This harvest followed a pruning and harvest event conducted four months earlier.

**Above-ground biomass sampled six months after seeding into dry, sandy soil in South Africa. Data are the highest values measured over 4 seasons.

Data for *T. diversifolia* are from 1 sample; data for *M. oleifera* and *L. purpureus* are the average of 3 and 4 samples, respectively.

in Florida contained even higher levels of nitrogen (5.7%) and phosphorus (0.52%), with nutrient concentrations comparable to those of moringa and lablab (Table 3). After green leaf/stem tissue is worked into the soil, these nutrients quickly become available for uptake by plant roots.

To supply enough potassium and phosphorus for most crops, a farmer would need to apply 13 to 26 metric tonnes per hectare (t/ha) of fresh tithonia biomass. Since tithonia has a moisture content of 85%, this is the equivalent of 2 to 4 t/ha of dry matter. It takes closer to 33 t/ha fresh biomass (the equivalent of 5 t/ha of dry matter) to alleviate phosphorus deficiencies. Collecting this much biomass is laborious. Also, even though it has no thorns, tithonia is unpleasant to handle, due to its stickiness and strong smell. Consequently, it is mostly used to improve the soil on smaller plots of land devoted to high-value crops such as vegetables. Two ways to reduce the amounts of biomass needed are to 1) combine it with other fertility inputs and 2) apply it in close proximity to crop roots. If you have applied it in planting basins/stations, we would like to know of your experience.

If you are interested in exploring tithonia as a green manure, you may not need to look far for plants. Tithonia reproduces from stem and root cuttings, as well as through numerous, small seeds that are light enough to be dispersed by wind (Muoghalu and Chuba 2005). It quickly colonizes disturbed areas and is frequently found around farmers' fields and homesteads, along roadsides, and in ditches. Our seed bank has trial packets of seed available for

special requests, but we caution against planting tithonia where it does not already exist. If it is already present locally, and you simply want to establish some plants for better accessibility, the best option is to plant soft/green stem cuttings, 20 to 40 cm-long (Jama et al. 2000; findings of an ECHO observation trial shown in Figure 7), spaced 0.5 to 0.75 X 0.75 m (Heuzé et al. 2016). To keep them from drying

out, place stem cuttings—at any angle—into moist soil soon after collecting them (Jama et al. 2000).

Planted cuttings will likely grow well without fertilizer. Once established, plants tolerate heavy pruning. Tithonia biomass can be harvested as often as every four months (Sosef and van der Maesen 1997). We at ECHO welcome information about ways that you have used this multi-purpose plant.



Figure 7. *Tithonia diversifolia* stem cuttings in a non-replicated tithonia propagation and germination experiment at ECHO in Florida. Twenty days after planting into commercial potting soil (with no rooting hormones used), the percentage of cuttings that produced shoots was 100% for green stems, 80% for woody stems, and 10% for roots. Twenty days after sowing, on the same day cuttings were planted, shoot emergence had occurred with 40% of the planted seeds. Source: Stacy Reader

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Seed Saving: A Practical Overview for Small-Scale Seed Banking

This is a course to be held at ECHO Florida from May 9 to 11, 2017. ECHO offers over 350 varieties from its Florida seed bank, requiring diverse approaches to growing, processing, and storing seeds. This three-day course will begin in ECHO's seed production plots to help participants better understand how crops are managed and harvested. Techniques related to both wet and dry processing of seeds will be practiced, as well as essential tasks such as germination testing. We will explore long-term seed storage approaches, including vacuum sealing and cold storage; emphasis will be placed on seed saving technologies and approaches for challenging tropical locations. See [ECHOcommunity](#) for registration information.

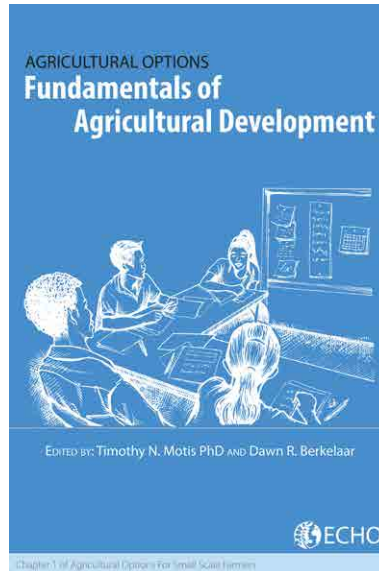
BOOKS, WEB SITES AND OTHER RESOURCES

Fundamentals of Agricultural Development publication Release

ECHO is pleased to announce availability of the ebook **Fundamentals of Agricultural Development**. This electronic publication includes the content from the first chapter of *Agricultural Options for Small-Scale Farmers: A Handbook for Those Who Serve Them* (originally published in 2012 as a sequel to *Amaranth to Zai Holes*). **Fundamentals of Agricultural Development** shares foundational concepts to equip those working with smallholder farmers and urban gardeners in the tropics and subtropics. It features technical notes written by experienced practitioners, on development principles and how to think "outside the box." It also contains insights on research and experimentation, and shares information helpful for selecting suitable crops in the tropics and subtropics.

Upcoming ebooks include Chapters 2 and 3, which cover practical, project-oriented options for the restoration of unproductive

soils (Chapter 2) and for coping with scarce rainfall (Chapter 3).



The ebook is available for purchase from Amazon for \$4.99 in [English](#), [Spanish](#), and [French](#).

We hope that this ebook will provide helpful perspective that, ultimately, will lead to improved livelihoods of smallholder farmers around the world. Please let us know how its content contributes to your efforts to serve the poor.

Also available in electronic form, Dan Fountain's [Let's Restore Our Land](#) describes how church and community leaders can come together to understand problems of the land and forests, consider how God would want them to respond, determine solutions for these problems, and put them into practice.

Access Agriculture Website *Reviewed by Bob Hargrave*

Our East Africa director recently sent us links to some excellent videos explaining onion production. These were produced for West Africa but are widely applicable. <http://www.accessagriculture.org/category/72/Onions>. The videos are from Access Agriculture; for more information about this international NGO, see the "Further Resources" section on page 6 of this issue

UPCOMING EVENTS

ECHO Florida Events:

Location: ECHO Global Farm, USA
Presented by: ECHO

Tropical Agriculture Development Workshops

- **Bamboo Basics: Production, preservation and construction**
February 7-10, 2017
- **Seed Saving: A practical overview for small-scale seed banking**
May 9-11, 2017
- **Tropical Agriculture Development 1: The Basics**
July 24-28, 2017
- **An Introduction to Community Development**
August 14-18, 2017

ECHO International Agriculture Conference
November 14-16, 2017

ECHO's remaining 2017 training schedule will be posted at ECHOcommunity.org/events.

ECHO East Africa Events:

East Africa Symposium
February 7-9, 2017
Location: Arusha, Tanzania

ECHO West Africa Events:

ECHO Sierra Leone Forum
February 28-March 2, 2017
Location: Freetown, Sierra Leone

Forum à Kindia en Guinée Conakry
March 7-9, 2017
Location: Friguigbé, Guinée

2nd ECHO Nigeria Forum
March 21-23, 2017
Location: Jos, Nigeria

ECHO Asia Events:

ECHO Asia/MBC NW Myanmar Agriculture and Community Development Workshop
February 7-10, 2017
Location: Kalay Myo, Myanmar

ECHO Nepal Ag and Community Development Workshop
May 22-24, 2017
Location: Kathmandu, Nepal

ECHO Asia Agriculture and Community Development Conference
October 3-6, 2017
Location: Chiang Mai, Thailand

Please watch ECHOcommunity for further information. Subscribing to "calendar notifications" will help ensure that you don't miss out. More information and registration details can be found on www.ECHOcommunity.org.

This issue is copyrighted 2017. Selected material from *EDN* 1-100 is featured in the book *Agricultural Options for Small-Scale Farmers*, available from our bookstore (www.echobooks.org) at a cost of \$19.95 plus postage. Individual issues of *EDN* may be downloaded from our website (www.ECHOcommunity.org) as pdf documents in English (51-134), French (91-133) and Spanish (47-133). Recent issues (101-134) can be purchased as a group from our bookstore (www.echobooks.org). Earlier issues (1-51 in English) are compiled in the book *Amaranth to Zai Holes*, also available on our website. ECHO is a non-profit, Christian organization that helps you help the poor to grow food.

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!