Fertilizing with Organic Materials for Smallholder Farmers in Emergency and Non-Emergency Contexts

This presentation is made possible by the generous support of the American people through the United States Agency for International Development (USAID).
The contents are the responsibility of the SCALE Award and do not necessarily reflect the views of USAID or the United States Government.

About this guidance

This guidance document was developed in response to the multiple threats of rising global fertilizer prices, declining soil fertility, and increased prevalence of climate shocks faced by smallholder farmers. Farmers in both emergency and non-emergency contexts need low-technology soil management solutions that provide nutrients to their crops, improve soil conditions, and increase their fertilizer use efficiency. Organic resources can be a valuable tool for farmers facing a rise in fertilizer prices and a decline in their environmental conditions.

The techniques in this guidance rely on basic plant nutrition concepts and are sufficiently flexible so that program staff can tailor their messages to the context at hand. Many of these recommendations are considered good agricultural practices and only require creative thinking about how to apply these recommendations given the context and resources available.

This guidance document has been written to be used by non-agricultural program staff. The language is therefore kept straightforward and concise. Each technique is first defined and a list of best practices given. The technique is then broken down into a step-by-step process. The exact organic materials and equipment used will depend on what is available at the site in question, however a list of suggestions has been provided. The document ends with a case example of how these techniques have been successfully used in Palabek refugee settlement and some brief guidance on how to improve adoption of new techniques among smallholders.

What are organic materials?

Organic materials include a wide variety of carbon-based resources

Tithonia diversifolia

Kitchen waste

Cooking ash

Animal bedding and manures

Desmodium Sp.

Crop residues

Charcoal dust

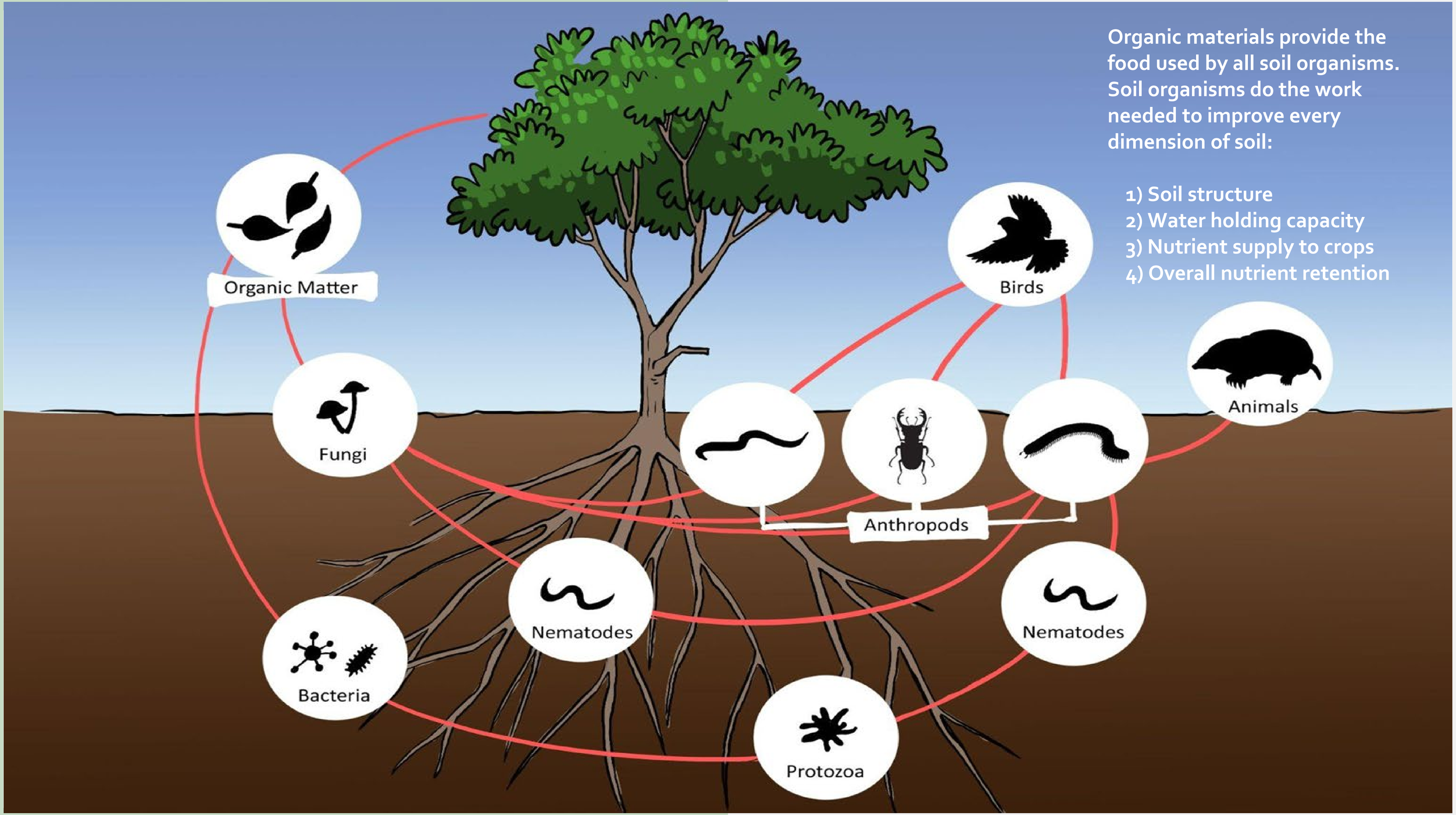
Household sweepings

Why should smallholder farmers use organic materials?

- **They are available everywhere, even in emergency contexts.** Anywhere humans reside, they are likely to create organic waste streams that can boost crop production.

- **They are often considered waste.** Using organic waste for agricultural production is a low-cost solution that cuts across Agriculture and WASH sectors to boost yields and improve sanitation. Ata minimum, refugee camps contain unused kitchen and cooking waste that can be used for gardening.

- **They can be used to improve soil conditions in the short- and long-term.** Organic materials can be added to any soil to improve soil structure, water holding capacity, macro and micronutrient stores, and overall nutrient retention. **In poor soils, these improvements need to happen before mineral fertilizer can be used efficiently by crops.** Adding organic materials to soil can lead to better growing conditions - and thus, increased yields - even during the course of a short-term funding cycle. Over time, adding organic material to soil will improve soil health by increasing soil organic matter.



Organic materials provide the food used by all soil organisms. Soil organisms do the work needed to improve every dimension of soil:

1) Soil structure
2) Water holding capacity
3) Nutrient supply to crops
4) Overall nutrient retention

Organic materials are best applied in combination with other soil and water conservation practices

- **Reduce erosion.** When rainfall falls on bare, sloped soils, it carries away topsoil and fertilizers.

- **Keep soils covered with mulches or crop residues.** Layering mulches and crop residues on the soil surface can reduce erosion, keep soils cooler, and preserve soil moisture.

- **Keep soils covered with living plants whenever possible.** The root systems and canopy provided by living plants on soils prevents topsoil and fertilizers from washing away and protects soil from the hot sun. Add perennials to the edges of fields, use cover crops (see below), and allow natural vegetation to grow in between seasons. Cut natural vegetation before flowers go to seed.

Composting organic materials

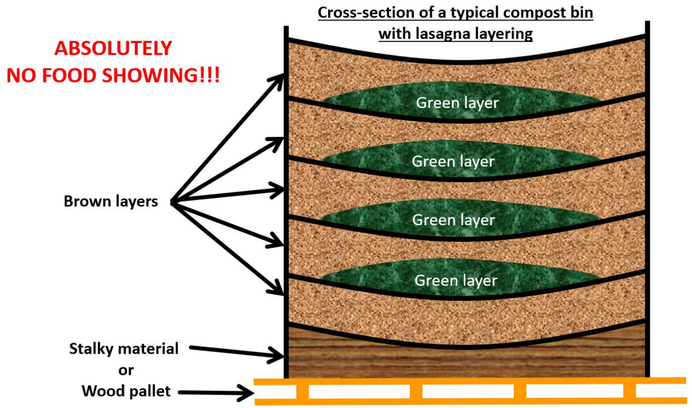
TIMEFRAME FOR RESULTS:
ONE TO TWO SEASONS

WHY COMPOST?

- Composting breaks down and mixes organic materials for easier and more consistent application.

BEST PRACTICES

- Apply compost when materials have fully broken down and it is no longer possible to distinguish original materials. Compost can take 1-3 months to "cure."
- Turn and water compost weekly to heat compost. Aim for sufficient water content (50-60% moisture) and heat (55-70°C) to kill weed seeds and pathogens and speed up decomposition.
- Make compost with a diversity of organic materials so that it contains an array of macro- and micro-nutrients.
- Use compost piles in wet environments and compost pits in dry environments. Shade or cover compost to protect from strong sun and rain.
- Place piles or pits near fields or gardens for easy access.
- Do not add diseased crop residues to compost to avoid spreading diseases across fields.



Carbon to nitrogen ratio should be approx. 30:1

Source: Rodale Institute

How to apply composted organic materials

Applying compost to field crops:

1. Remove a spadeful of soil per planting hole or dig trenches.
2. Add a handful of compost to each hole and thoroughly mix with soil or spread compost along trench.
3. Seed crop as usual.

Applying compost to fields

Applying compost to garden beds:

1. Loosen soil in garden beds to a depth of 60 cm, or the depth of two hoe-heads.
2. Add 3-4 20L buckets of compost to each 1m x 5 m bed.
3. Thoroughly mix compost with soil.
4. Seed or transplant crops into bed.
5. Water in seeds or transplants and mulch beds to preserve soil moisture.

Applying compost to garden beds

*** If it is not possible to create a compost pit or pile, bury organic materials in a garden bed and allow to naturally decompose for one season before planting.*

Intercropping cereal crops with legumes

TIMEFRAME FOR RESULTS:
ONE SEASON

WHAT IS IT?

- Intercropping is the cultivation of two or more crops simultaneously in a field.
- When legumes are intercropped with cereal crops, the legume can reduce the need for a nitrogen fertilizer.
- Intercropping cereal crops with legumes can also reduce pest infestations, like Fall armyworm, by separating host and non-host plants.

BEST PRACTICES

- Any cereal crop (sorghum, millet, maize, etc.) except paddy rice can be intercropped with a legume (soya bean, cowpea, bush bean, alfalfa, etc).
- Alternate rows of cereal and legume crops when planting.
- Plant crops denser than normal to create a full canopy, reducing the need to weed and encouraging nitrogen uptake by cereal crop.

Maize and bean intercrop

Green manures

TIMEFRAME FOR RESULTS: ONE SEASON

WHAT ARE THEY?

- Green manures are plant materials that are incorporated into the soil while still green.
- Green manure plants have soft tissues that decompose quickly and contain a large amount of nutrients.

BEST PRACTICES

- Grow a cover crop to intentionally plow back into the soil before plant flowers to add maximum nitrogen to soil.
- Harvest leaves and stems from nearby shrubs (*Tithonia diversifolia*), ground covers (*Desmodium sp.*), and leguminous trees to add to soil.

Examples of green manure plants

Tithonia diversifolia

Leucaena leucocephala

Canavalia ensiformis

Desmodium Sp.

***Cowpea** (Vigna unguiculata)*

Mucuna pruriens

How to apply green manures

Applying green manures to field crops:

1. Roughly chop materials to speed up decomposition.
2. Remove a spadeful of soil per planting hole.
3. Add a handful of green manure to hole and thoroughly mix with soil.
4. Seed crop as usual.

Applying green manure to fields

Applying green manures to garden beds:

1. Loosen soil in garden beds to a depth of 60 cm, or the depth of two hoe heads.
2. Add 3-4 20L buckets of green manure to each 1m x 5 m bed.
3. Thoroughly mix green manure with soil.
4. Seed or transplant crops.
5. Water in seeds or transplants and mulch beds to preserve soil moisture.

Applying green manure to garden beds

Liquid fertilizers

TIMEFRAME FOR RESULTS:
ONE SEASON

WHAT ARE THEY?

- Liquid fertilizers are nutrient-rich solutions made by steeping organic materials in water. They can be applied to crop leaves and stems or to the soil around the plant.
- Liquid fertilizers can be used to address mid-season nutrient deficiencies that emerge. Plants can quickly absorb nutrients through their stems and leaves, particularly for nutrients that are immobile in soil (P, Zn, Fe).
- Liquid fertilizers can also be applied to prior plant growth stages with high nutrient demands, such as during flowering or silking.

BEST PRACTICES

- Apply in early morning or evening when there is indirect light for best absorption.

Liquid fertilizers should be applied using the proper safety equipment, including hand gloves

Tithonia diversifolia

Desmodium Sp.

Animal manure (use composted, not fresh)

How to make and apply liquid fertilizers

How to make liquid fertilizers:

1. Collect organic materials, such as dried or composted manure (never fresh) or leaves and other soft tissue materials.
2. Finely chop any leaves or stems.
3. Fill a bucket one third full of organic material and then top up the bucket with water. Organic material can be placed in a sack within the bucket or strained out later.
4. Cover bucket loosely and let steep for three weeks.
5. Remove sack or strain solution through cloth.
6. Add solids to compost or bury in growing area.

Steeping organic materials in bucket

Applying liquid fertilizers to field or garden crops:

1. Dip a branch with leaves into solution and dab plants until solution starts to drip off leaves.
2. Apply liquid fertilizers every two weeks or strategically when plants show signs of nutrient deficiencies or are approaching a high nutrient demand stage.

“Micro-dosing” mineral fertilizers in combination with organic materials

TIMEFRAME FOR RESULTS: ONE SEASON

Mineral fertilizers supply plant-available macronutrients (NPK) that are often insufficient in organic materials.

Organic materials are a source of carbon, an essential ingredient in improving soil structure and water retention, in addition to NPK.

- Efficacy of both fertilizers is increased when used in combination. To further increase fertilizer use efficiency, strategically apply mineral fertilizers in small doses close to plant root zones (micro-dosing) rather than broadcasting across a large area.
- Increased yields from combining fertilizers leads to steadily improving soil conditions as crop residue and root biomass are added to soil.

How to combine mineral fertilizers with organic materials in garden beds

1. Amend soil with organic materials up to a depth of 60 cm.
2. Apply a thin band of mineral fertilizers to each row two weeks after planting. Dig a 7 cm deep trench that is 5 cm away from seeds. Use fingers to sprinkle fertilizer in the same proportion as the seeds were applied.
3. Apply mineral fertilizer mid-season according to crop requirements.

Applying mineral fertilizers in garden beds

How to combine mineral fertilizers with organic materials on field crops

1. Remove a spadeful of soil per planting hole.
2. Add a handful of organic material to hole and thoroughly mix into hole.
3. Apply a "three-finger pinch," about the equivalent of a bottle cap, of mineral fertilizer to each planting hole at sowing.
4. Lightly cover fertilizer with soil before planting seeds to ensure seeds do not come in contact with fertilizer.
5. Apply mineral fertilizer mid-season according to crop requirements.

Applying mineral fertilizer to field crops

Mid-season mineral fertilizer application. Cover fertilizer after placing next to crop

Putting the techniques into practice: Palabek refugee settlement

- Settlement hosts ~71,000 South Sudanese refugees in Northern Uganda.
- Arriving refugees allocated a 30 x 30m plot for a homestead.
- WFP food aid provided, but deliveries can be late, rations are lacking in dietary diversity, and ration sizes continue to be cut.

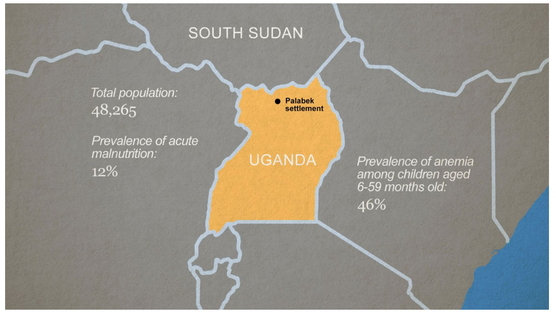


Photo credit: Thomas Cole, African Women Rising

Putting the techniques into practice: Techniques applied in Palabek

African Women Rising, an NGO operating in Palabek, trained women and girls to:

- Use readily available organic waste streams to make **compost** for garden beds;
- Collect leaves and stems from nearby bushes and trees to make **green manure**; and
- Identify local species to create **liquid fertilizers** for application on growing crops.

In addition to increasing their use of organic materials, Palabek community members:

- Used deep soil preparation to reduce compaction;
- Captured rainwater with swales and used grey water for garden production;
- Implemented strategies to improve agro-biodiversity; and
- Erected fencing and shade structures to protect crops.

Planting day

After 2.5 months of growth

Photo credit: Thomas Cole, African Women Rising

Putting the techniques into practice: Outcomes

Findings from a Participatory Impact Assessment conducted in 2019 included the following:

- Food consumption increased for refugee households.
- Refugee reliance on WFP rations decreased.
- Dietary diversity within refugee households increased.
- Gardens became the primary source of dry season income for camp residents.

Photo credit: Thomas Cole, African Women Rising

Improving adoption by smallholders

Farmers learn best in a participatory, respectful teaching environment

- Use adult learning principles to develop more effective trainings. This includes creating space for discussion and peer-to-peer learning; ensuring that training topics are practical, relevant, and goal-oriented; and allowing participants to contribute to decision making processes around the training, how it is conducted, and its objectives.

Farmers gain confidence through practicing new techniques in a supportive environment

- Plan training sessions with a hands-on component so farmers can practice the techniques in a supportive environment. Practicing each technique as a group will give farmers confidence they can replicate the techniques on their own.

Farmer adoption improves after observing positive results

- Pair a training program with a demonstration site (see following slide) so farmers can observe how to use new techniques and witness any positive results from using new techniques.

Demonstration site best practices

Use only locally available materials, especially organic materials

- Ensure community members can access any equipment, lumber, organic materials, seeds, etc. used in the demonstration site to facilitate sustainable adoption of the new practices.

Engage community members early and often

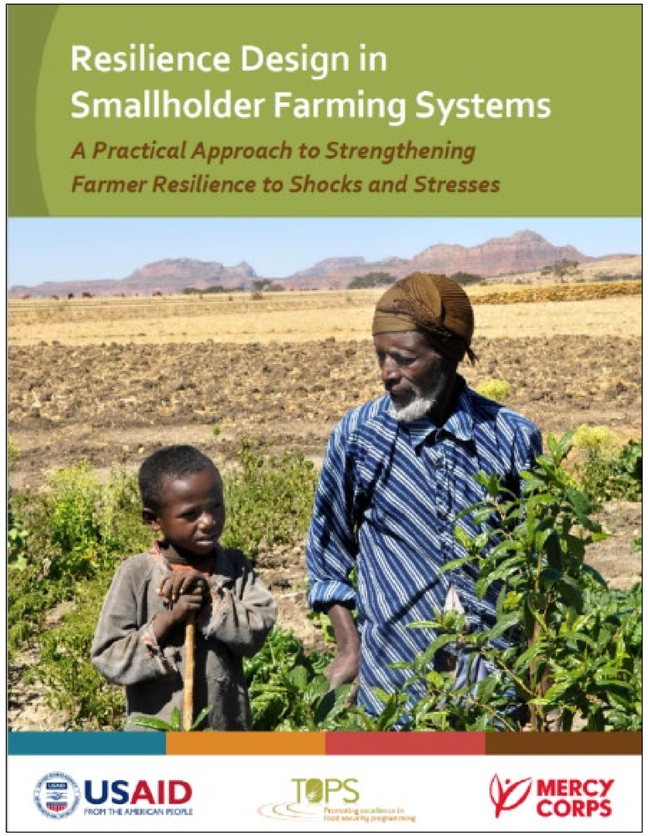
- Discuss with community members what practices should be featured at the demonstration site, including creating space for them to experiment with different types of organic fertilizer.
- Encourage community members to participate in establishing the demonstration site so they understand the new practices.
- Invite community members to maintain the demonstration site so they can see how crops are responding to the new practices.

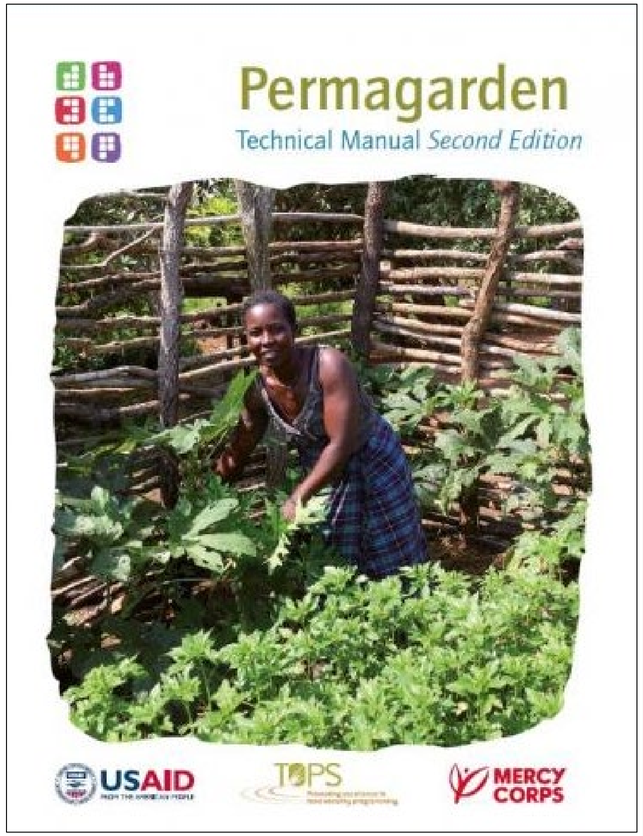
Plant crops desired by community members

- Use crops community members are familiar with and value so they can see how crop growth differs using the new practices.

Use a plot that is representative of land used by community members

- Avoid the temptation of selecting a prime piece of land for the demonstration site. Instead, demonstrate new techniques on land that closely resembles the conditions experienced by community members.





SCALE

For more resilient agriculture resources including manuals, training materials and monitoring tools:

www.fsnnetwork.org/scale

scale@mercycorps.org

This resource is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the SCALE Award and do not necessarily reflect the views of USAID or the United States Government.