ECHO® Asia Notes

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Backyard Vermicomposting Systems: Examples from Myanmar

by Bruce Gardiner, Solar Roots, Myanmar

Editor's Note: Bruce is Project Manager of Solar Roots, and runs a small demonstration farm in Pyin Oo Lwin, Myanmar. Bruce comes from an engineering background and offers regular trainings on his solar power technologies and vermicomposting systems among other things. Bruce can be reached at bruce.gardiner@yahoo.com]

Introduction to Vermiculture

There are over 6,000 species of worms in the world, many of them not even named or studied. However, the farmer is interested in two main categories of earthworms, namely "deep burrowers" and "surface dwellers". Deep burrowers include the common garden worm or Nightcrawler, (grey/pink color and about 15 cm long) and they eat soil mixed with decaying organic material. An early expert on worms was Charles Darwin, who established that earthworms process and enrich soil endlessly, and without whom, farming as we know it, would not be possible. The deep burrowers create long tunnels that go down almost 6 feet in depth, allowing deep penetration of water and oxygen. At the same time, deep burrowers bring up minerals that are incorporated into surface soil. The value of earthworms to the farmer cannot be overstated.

However, it is the surface dwelling worm, also called the composting worm, that I will concentrate on in this article. Composting is the process of decomposing and stabilizing organic material, mainly through the activity of micro-organisms along with larger decomposers, including worms. Decomposition happens naturally all around us, and by encouraging and enhancing this process, the farmer can speed up the composting process and increase the quality of the resulting organic material. Composting essentially breaks down complex compounds into simpler ones that plants can take up more easily. Composting with worms is called 'vermicomposting' and this produces an ideal soil amendment, full of microbes and nutrients, with excellent water retention and soil structure characteristics.

Note on nomenclature: the terms used in this field are various and there is not universal agreement as to their meaning. Here is my understanding and usage:

- **Vermiculture:** The intentional cultivation or rearing of earthworms and use of their ability to process organic material.
- **Vermicasts/Vermicastings:** The pure excrement produced by the worms, broken down from previously undegraded organic material. With some care, vermicasts can be harvested in their pure form from the top of the bin.
- **Vermicomposting:** Using worms to break down or 'bio-degrade' organic material for the purpose of creating a usable organic amendment.
- **Vermicompost:** The resulting mixture of pure worm castings, food remains and bedding once the bin has been harvested.

Background and History

It is thought that worms, in one form or another, have been present for up to 150 million years, so vermiculture has been happening for a considerable amount of time. But it has only been seriously studied and developed as an agricultural tool in the last 150 years. Since the advent of extremely powerful microscopes, we have access to the wondrous world of microbes. Farmers have been unknowingly applying vermicompost to their fields, mixed in with animal manure for millennia. Wherever you have a midden or dung heap, you are likely to find composting worms. Now, vermicomposting is a recognized subject and technology, and many universities include it in their curricula.

Types of Worms

There are about 6 or 7 different species of composting worms that have been 'domesticated' and kept for the castings that they produce. The most widely distributed worm is the Red Wiggler (*Eisenia fetida*), also called Brandling or Tiger worm. This type of

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ECHO Asia Impact Center
PO Box 64
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www.ECHOcommunity.org

Figure 1: *Sorting through a tray of Malaysian Blue (*Perionyx excavatus*) earthworms, also known as Indian Blues.*

Figure 2: *African Nightcrawler (*Eudrilus eugeniae*) earthworms, note the distinctive blue sheen.*

worm is native to Europe but is now found in worm farms all round the world. However, it is not so common in the wild in southeast Asia. Our native worm in Myanmar and everywhere between India and Malaysia is the Malaysian Blue worm (*Perionyx excavatus*) also called the Indian Blue worm. The second composting worm in Myanmar is the African Nightcrawler (*Eudrilus eugeniae*). As the name suggests, this worm is not native but was brought here, likely by NGO's and government projects. I keep both the Malaysian Blues and the African Nightcrawlers, and there are big differences between them.

Malaysian Blues: These native worms are commonly found in piles of cow manure, which is one of their favorite foods. They are 8 cm to 15 cm long and a dark red/brown color. A distinguishing feature is that when exposed to light, their head exhibits a translucent blue sheen (Figure 1). They are a very active worm, often thrashing wildly when touched or exposed to light. The Malaysian Blue reproduces prolifically and can quickly process large amounts of organic material. Then, why is it not the No. 1 composting worm in the world? Well, it does have one major drawback, which is its wandering nature. If living conditions are not to their liking or there is a thunderstorm, they are likely to try to escape, even if it means dying in such an attempt. Last year, I lost thousands of Malaysian Blues from my indoor worm farm during the rainy season. We don't fully understand this behavior, but it has forced me to give up keeping Malaysian Blues indoors. Luckily, they thrive outdoors!

African Nightcrawlers: These imported worms generally have to be purchased, and the going rate here is 100Kyats (7 cents US) per adult worm. You need at least 200 to get started. The African Night crawler is a much larger, more muscular worm, growing up to 15 cm in length and it also exhibits the distinctive blue sheen when exposed to light (Figure 2). However, it does not have the wanderlust of its Malaysian brother and indeed has a tranquil personality, preferring to laze about on the surface of the food. Thus, I am making a change for rainy season this year, where the Malaysian Blues will be kept in outdoor manure piles and the African Nightcrawlers will be kept in purpose-built worm bins indoors.

Preferred Growing Conditions

Composting worms are tough creatures, and can survive less than optimal surroundings, but to thrive, they need specific conditions, as follows:

Temperature: Composting worms will thrive between 15 and 25 degrees C (59-77 degrees F) but may die if exposed to extreme heat or cold. My Malaysians and Africans, both being tropical worms, are most comfortable at the higher end of that range. One way to ensure happy worms is to have a pile large enough for them to seek out the temperature that suits them best. In winter time with reduced temperatures, worm activity — eating, excreting, and reproducing — will slow down markedly but will pick up again when the weather warms.

Moisture: Worms need moist conditions, about 80% by weight, where the bedding feels like a wrung-out sponge. Squeeze it and one or two drops of water should come out, no more. Glistening skin on the worms is a sign of correct moisture. One mistake that beginners often make is to let the worm bin become anaerobic, or oxygen deficient, through lack of drainage. Much of the worm food will have a high water content, but even so, daily spraying is required in hot conditions.

Aeration: Worms 'breathe' through their skin and the composting process releases other gases that must be allowed to escape, so plenty of aeration is required. Remember, you are trying to create ideal conditions for the worms and the host of bacteria, fungi, and other decomposing creatures that inhabit the worm bin.

Food: Composting worms can eat almost any kind of decaying organic matter: kitchen scraps, agricultural waste, dead leaves, or animal manure, etc. Again, we must think along the thrive vs. survive continuum; are the worms thriving or just barely surviving? To get good consistent, high quality worm castings, one should provide good, consistent, high quality food. This takes more time, effort, and investment. Foods that worms dislike include: citrus, strong tasting vegetables/spices like onions and chili peppers, meat, dairy, and oily foods. It is easy to

Figure 3: *Continuous Flow-Through Vermicompost Bag method, using cordura-like fabric material.*

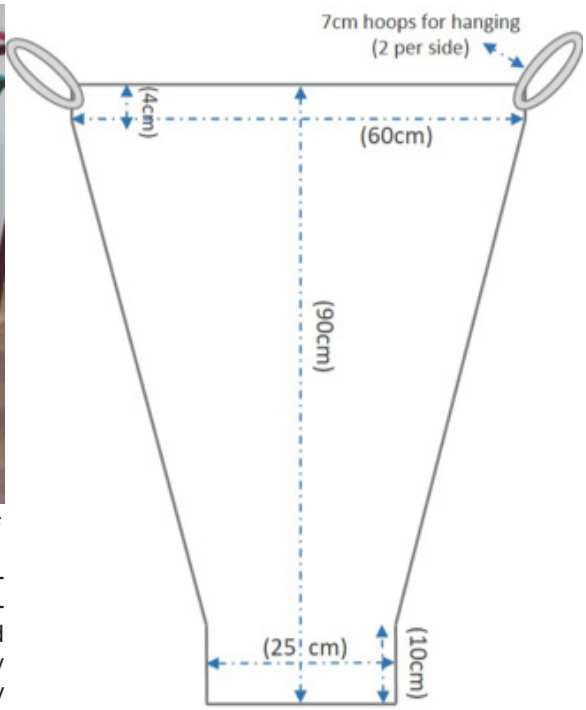

Figure 4: *Continuous Flow-Through Vermicomposting Bag design.*

observe when they avoid certain foods and quickly consume others (i.e. pumpkins, soft fruits, etc.). One important condition is that the food should be pre-composted to some degree. A large serving of fresh vegetables is likely to start composting thermophilically, producing intolerably high temperatures for the worms. It is possible for it to even go anaerobic, due to the high moisture content, producing foul-smelling black sludge. Food should be pre-composted, chopped fine and added only 1 or 2 inches deep. Overfeeding is usually more of a problem than underfeeding.

Bedding: When setting up your compost bin, you should place at least 15 cm of bedding material to provide the worms with a suitable habitat. I use compost that is at least one year old, but other choices are aged manure, coconut coir, or peat. Peat is not sustainably harvested in Myanmar, so I mention it only as example of the material structure that we are looking for. The bedding should be porous with good drainage. Later on, the food itself can also act as bedding. I feed chopped banana stalks mixed with cow manure, which is food and bedding in one.

Light: Composting worms cannot take exposure to strong light. Their skin is very light-sensitive, and if exposed, they dive down into the bedding immediately, the Malaysian Blues thrashing wildly as they do so.

Benefits and Harvesting Methods of Vermicasts

Worms can break down organic material very rapidly, resulting in a stable vermicompost with a better structure, microbial content, and more available nutrients than thermophilic composts. Other benefits include enhanced water retention, improved root growth, and superior cation exchange capacity (CEC). In short, vermicompost may just be the best natural, organic soil amendment that the farmer can use.

Vermicompost is most useful in a potting mix when added at around 20% by volume. A small handful can also be deposited at the bottom of the hole when transplanting seedlings. This gives new plants a good start in life, promoting stronger roots and improved disease resistance. For established plants, adding a top dressing of vermicompost will add fertility, retain moisture and generally improve soil condition on an on-going basis. Making vermicompost tea is another effective way of using your castings. My simple method is to place 5-10 handfuls of vermicompost in a strainer bag inside a 5 gallon bucket full of water, along with 6 bubbler stones connected to 3 small aquarium air pumps. I add 1 teaspoon of molasses and 2 teaspoons of EM (effective microorganisms) and leave it bubbling for 24-48 hours. The resulting tea is teeming with microbes and should be used within the first 12 hours. It can be used as a foliar spray or soil drench with a watering can. We find that it really helps plants that are fighting disease or struggling to get started.

There are several harvesting methods to choose from:

The Light Method: Dump the finished vermicompost on a flat surface exposed to strong light. The worms will immediately burrow down to get away from the light. After 10 minutes, scoop off the top level of worm-free castings. Continue this process until only the worms are left.

The Migration Method: This can be horizontal or vertical. Stop feeding the worms for 2 weeks, then add food to the top or one side of the bin. The hungry worms will migrate to the food, leaving the rest of the bin relatively worm-free. I use an especially enticing mixture of boiled and pureed potatoes, sweet potatoes, and carrots.

There are also the Continuous Flow Through Method and Pile Method that I use, which I go more into detail below.

Overview of Our Vermicomposting Systems

Vermicomposting can be done at any scale, from the smallest, using kitchen scraps, to the largest, using pre-composted manure moved around by front-loaders. The worm bin can be made of plastic, wood, concrete or even water-proof fabric. There are many websites and online videos that can provide more detail, but I would like to quickly describe the two systems that we use on our farm here in Myanmar.

The Continuous Flow Through (CFT) Method: The principle of operation is that you have a container open at the top and the bottom, although the bottom is kept closed until you are ready to harvest. Food is added through the top in 3 to 6 cm layers. After 3 to 6 months, the casting can be harvested from below, leaving most of the

worms undisturbed in the middle section of the bin.

I have made these systems from cordura-like backpack material, 200L oil drums, and metal or wood structures sheathed with plywood and flat metal roofing. I get the cordura-like fabric bags sewn up by a local tailor, according to my specifications. Simply, the bag is made of 4 tapering panels sewn together to make a conical shape (Figure 3, page 3). The dimensions are shown in the diagram on page 3 (Figure 4). This fabric has the dual advantages of being water-resistant yet still breathable. I have used these bags a lot during my learning process, as they give instant access for monitoring the worms and for showing them to visiting students. They are also easy to harvest from below, or when using the Migration system with especially attractive food.

A larger and more robust CFT bin is made from a used 200L oil drum (Figure 5). I cut the top off and also cut a hole 30cm x 45cm near the remaining base. Just above this hole I drill 7 smaller holes to accept 25mm galvanized pipes which have screws drilled into them (Figure 6). This set-up of pipes and screws with 3 or 4 sheets of cardboard laid on top provides the "floor" upon which I lay 15 cm of bedding and the then the worms, and lastly the food. I finally top off all my bins with another layer of cardboard as well as a jute or hessian sack. It takes about 3 months for the worms to eat the cardboard and leave enough castings to form a solid layer at the bottom. After 6 months, when the bin is almost full, the castings are harvested by turning the blue handles on the pipes, which scrapes off the bottom-most 50mm of dried castings without disturbing the worms at the top enjoying the food. Once these systems get going, they require less work and provide a regular supply of castings.

The Pile Method: This is done simply using a pile of cow manure or other pre-composted material, on the ground, surrounded by a hoop of mesh or bamboo (Figure 7). As long as food is added regularly and the pile is protected from the sun and the rain, native Malaysian Blue worms will arrive by themselves and produce great castings which can be harvested in about 6 months. If they decide to leave during a rainstorm, they will most likely return, because this pile has the best food in the neighbourhood.

Summary

Vermicomposting is a powerful tool that the farmer can harness to improve the structure and fertility of his/her soil. It is cheap and scalable. Even when the farmer sleeps, the worms are working hard to produce the best quality natural soil amendment. As consumer concern rises about food safety and health, the market for organically grown crops will only increase. On the large scale, vermicomposting can help societies manage organic solid waste and get a valuable by-product. I urge readers to reconsider the lowly earthworm and his works. It just could be that he is man's other best friend!

Figure 5: *Continuous Flow-Through 200L Vermicomposting Drum design (left). PVC handles are used to turn and release harvestable vermicasts from the bottom.*

Figure 6: *Continuous Flow-Through 200L Vermicomposting Drum design. Vermicompost sits on top of this rotating 'floor' that can be turned to release harvestable vermicasts from the bottom.*

Figure 7: *A larger outdoor manure worm composting pile, being sprayed down to keep moist on a hot day.*

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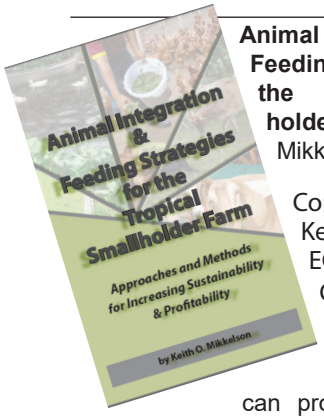
New Book Spotlight: Animal Integration & Feeding Strategies for the Tropical Smallholder Farm



Animal Integration & Feeding Strategies for the Tropical Smallholder Farm by Keith Mikkelson

Integrated livestock systems can provide many benefits. With careful planning and by starting small, most farmers will be able to incorporate cows, goats, chickens, or hogs and improve the stability of their farm. Crop residues can reduce feed costs, and manure can reduce fertilizer costs. Manure can also be used to produce biogas for cooking or heating, to reduce costs on the farm. Grazing livestock can help manage weeds and improve soil health.

This booklet was borne out of a need to help smallholder farmers re-integrate animals into their systems and use nutrients and energy wisely in order to reduce external inputs, increasing sustainability and profitability. It gives practical information, starter feed recipes, and much more, showcasing organic best practices occurring at the Aloha Farm in Palawan, The Philippines.

This booklet is based on five of Keith's prior articles that were written for ECHO Asia Notes, which include AN #20 Fish Feed, AN #25 Hog Feed, AN #28 Poultry Feed, AN #31 Ruminant Feeds, and AN #35 Animal Integration. This book will be available for purchase in our office and at ECHO Asia conference. Mr. Keith Mikkelson will be doing an afternoon workshop discussing these concepts further. Hope to see you there!

Here are excerpts from Chapter 1 (Asia Note 35) "Livestock Integration":

Properly managed livestock can bring the tropical farmer higher profits than some market vegetables and most grains. In permaculture, we say "integrate instead of segregate!" An example of this is the way farmers integrate their grazing livestock into seasonal cropping patterns. In traditional upland farmland systems, cattle and goats are left to graze in the forest or taken up onto higher ground away from the cropland during the growing season. When the harvest is over, the animals are brought back to the village to graze on the fallow croplands during the dry season. At the Aloha House Farm, we raise and integrate goats, chickens, ducks, cattle, and hogs. For example, our goats graze pasture and browse as well as feed on legume shrubs, and we feed some crop residues to the goats. With the integrated system, we are able to eliminate many feed costs and (with the manure we collect) also eliminate many fertilizer costs. We cut and carry fresh feed stock for goats, cows, chickens, and hogs; it requires labor, but we are able to minimize inputs.

...from Chapter 2 (AN20) "Integrating Fish":

With experimentation and careful record-keeping, a fish farmer can produce his/her own high-quality feed. In many countries, readily available meat grinders and pelletizers have made it possible to create economic floating feeds for tilapia, koi or catfish. Our unit was obtained in Chinatown, Bangkok, Thailand. It is an un-branded stainless-steel auger-driven meat mincer manufactured in China. We assembled it on a table at home and mounted it with a 1 hp motor. Before beginning, make sure you have a range of plate sizes to extrude your feed, so that feed and stock size can match. The sizes we use are in the 2-8 mm range for our 300-500 gram tilapia production. When we finish making the feed, we immediately dismantle and clean the auger, blade and plates. When done with a good auger-type grinder, very little effort is spent in the production of feeds. At Aloha House, two people can produce ten trays (approximately 45 kg) of moist feed in less than one hour.

...from Chapter 3 (AN25) "Integrating Hogs":

Corn-fed pork is a phenomenon that came about through a glut of low-cost maize production in industrialized countries. Modern corn has a higher carbohydrate level and a corresponding lower level of protein. By contrast, rice bran has twice the crude protein of corn, and is often less expensive. In a natural feed system, protein is the number one limiting factor in performance and growth of livestock; it is also the most expensive to purchase. If you keep the target protein level appropriate for the age of the animal, everything else will balance out with your natural feed. In creating your pig feed, you pay for protein. Old corn-based feed formulas are based on corn varieties that had more protein than the modern dent corn that permeates our supply chain (which also contains glyphosate residues and is often genetically modified). On Palawan, where Aloha House is located, corn is approximately twice the price and contains half the protein of rice bran, making corn protein four times more expensive than rice protein. We want natural feed supplies for our hogs to be economical and to assure the best end product.

...from Chapter 4 (AN28) "Integrating Poultry":

The fermenting activity of certain beneficial microorganisms during the production process can enhance the digestibility and shelf life of chicken feeds. According to one study, the use of microorganisms increased the crude protein in copra meal from 17.24% to 31.22%. An amino acid was also found to be greatly improved in quantity. Please note that not all flocks like a wet feed. You can mix feed without fermenting in the morning and use it immediately if your chickens do not appreciate fermented feeds, which tend to be wet. In addition to chicken feed, you can also ferment your feed for hogs, ducks, and fish with the help of diverse probiotic groups of microbes. However, we do not recommend fermentation for ruminant feeds.

...from Chapter 5 (AN31) "Integrating Ruminants":

Farmers feeding cows, goats, sheep, and buffalo should attempt to keep purchased inputs to a minimum. Farmers must balance the dietary needs of their animals with safety, comfort, and security from theft. No matter how ideal your goals for your ruminant herd, make sure you carefully plan and manage for the overall benefit of the animals and the farmer. Most small farms in SE Asia would do well to develop and manage some amount of pasture for ruminants, combined with a cut and carry strategy. Manure should be incorporated on the farm to maintain soil fertility for the forages and plants, and tighten nutrient cycling loops so that the benefits of integrated livestock will translate into more economical and sustainable food production.

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Regional Director of ECHO Asia

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"GSS is working to ensure that there are community-led seed libraries in the different areas of the Philippines."

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"...frameworks for 'nutrition-sensitive agriculture' interventions help us make sense of complex problems and identify solutions."

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"Our multi-functional club model is based on self-help, intergenerational participation, capacity building, and influencing."

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Jethro Adang
Director of Mindanao Baptist Rural Life Center

"Every farmer has unique passions and desires in life, although all farmers desire development."

Highlighted ECHO Asia Conference Site Visits
October 3, 2019
8:00 am - 4:30 pm

P'Ruan's Organic Growers Farm
&
ECHO Asia Farm and Seed Bank Tour

Warm Heart Sustainable Community Development Center

Spend a day learning from agricultural projects local to Chiang Mai, Thailand.

Call for Articles & Insights

If you are new to the ECHO Asia network, we wanted to highlight a few things that you may find add value to your free membership to ECHOcommunity.org and can help you be more effective.

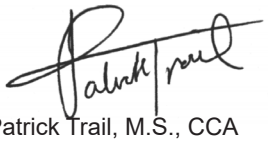
1. Please do remember that a "Development Worker" membership entitles you to 10 free trial packets of seed per year! If you would like more seed packets or larger quantities of some seeds (especially green manure/cover crops), we do have additional seed packets and bulk seeds for sale, and our seed bank catalog is available online.
2. Please also know that besides being written in English, our ECHO Asia Notes are translated and available for free download in Thai, Khmer, Burmese, Mandarin, Bahasa Indonesia, Vietnamese, and Hindi languages.
3. Additionally, we have a special place in the Asia section of ECHOcommunity for additional technical resources, free book downloads, and presentations from past ECHO Asia events and workshops.
4. If you have never joined us for an event, please consider doing so- there are several events happening in 2019 and we would love for you to join! Please go to the events page of ECHOcommunity.org to learn more.

In addition to using our information, we strongly encourage you to provide feedback to us in order to better know how to serve you and help us to refine our resources and delivery.

We encourage you to share success stories, lessons learned, insights, Facebook posts, etc. with us to keep us abreast about what you are trying and what is working in your context.

Additionally, if you have any ideas or would like to write an article for an upcoming ECHO Asia Note, we invite you to do so! Thank you for reading, and please do stay in touch!

Sincerely,



Patrick Trail, M.S., CCA
Research Coordinator & Agricultural Trainer

Daniela K. Riley, MBA
Office Manager

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