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Tanzania

Making Connections To Healthy Soils, Sustainable Agriculture in East Africa

Dairy cows and home-scale biodigesters have improved village life, yet many challenges remain for the future.

Don Lotter

MANY things have changed in East Africa since my parents took my brothers and I to Malawi in the Peace Corps in 1964. One of those changes, at least here in Tanzania, is that we no longer see any kwashiorkor disease in children, in which hair is lost or turns reddish and bellies distend, a type of severe malnutrition caused by the near-absence of protein in a diet with ample calories. Nutrition has clearly improved. One of the sources of this change is the availability of affordable fresh raw milk at the village level, a development that comes as a result of dairy cow introduction programs for small-scale farmers over the past 30 years. Nowadays a significant percentage of families in every village in northern Tanzania have dairy cows, producing a surplus of milk.

Two organic-waste-related developments stem from this increase in livestock at the village level. One, a negative, is that nearly all crop residues are harvested for animal fodder or grazed, leaving precious little to go into or on top of soils for fertility-building and maintenance. The second development, a positive, is that there is plenty of manure available for small-scale biogas production.

Shortage Of Organic Matter

I wage a daily good-natured battle with John, my Maasai assistant manager, who helps me oversee an organic vegetable growing operation for an orphanage outside of Arusha. John always wants to harvest the crop residues for our two cows, four milk goats and six pigs, and I usually want to get the residues into the soil. Our soil is sadly deficient in organic matter, even after a season of green manure crops. This is in a good part because the vegetable field is less than a year old, having replaced recurring maize on depleted soil. All of our livestock manure goes to the biogas digester, which converts nearly all organic matter to methane, leaving only nutrients in an effluent.

Tropical soils are generally more dependent on organic matter for fertility than temperate region soils, plus many, if not most, tropical agricultural soils are low in organic matter. Soils in many parts of the tropics, including Africa, are geologically old, weathered, leached, and are made up of what are known as secondary clays. These clays, which are

The introduction of dairy cows (left) has significantly improved nutrition but has increased demand for crop residues. Maize stubble is harvested for livestock fodder, and no soil-building crop is planted before the next maize crop.

Biogas digesters (top) are generally of the more labor-intensive buried brick-and-mortar type. A technician demonstrates a fuel pellet press, which compresses shredded biomass for use as stove fuel.

often reddish from iron oxides, unlike our young, glaciation-derived soils in North America and Europe, generally have a low nutrient-holding capacity. Decomposing organic matter, as well as post-decomposition humic substances, provide a critical source of nutrient-holding surfaces, among other benefits.

Warm-wet tropical climates make for high decomposition rates, further exacerbating the soil organic matter deficiency problem. Some countries such as Brazil have developed effective smallholder mulching practices that reduce soil disturbance and keep soil temperatures low, retaining much needed organic matter levels.

The deficit of organic matter in African agriculture can be resolved by intensifying crop production — especially by improving and tightening up crop rotations and polyculture combinations that include legumes and grasses, and by reducing soil disturbance by moving to minimum- and zero-tillage. The former increases the source for and the latter reduces the volatilization of organic matter.

Manure For Biogas

An upside of the increased livestock demand for fodder is that manure is plentiful for local biogas production. Small biogas digesters are being built all over Africa by rural households that have livestock, as well as at schools and roadside eateries. The numbers are still small, certainly far less than one percent of rural households, but awareness of biogas technology is growing. One biogas development worker estimates that about 30 percent of the units that she oversees the building of are for schools and community centers — with the rest being for households. Kenya and Tanzania represent two different approaches that I have seen. Kenya uses a less labor intensive, but also less sustainable approach to small-scale biogas, in which plastic bladders or barrels are used to decompose the waste and hold gas. In Tanzania, longer-lasting buried brick-and-mortar digesters are more common.

Biogas digesters produce a liquid that is mostly devoid of carbon but rich in nutrients. This effluent makes an excellent fertilizer for our tilapia fish ponds, since tilapia are aquatic plant feeders. Water from the fish ponds, which is drained for fish harvest, is great for irrigating and fertilizing the surrounding gardens and grassy areas. The cycle is completed when this vegetation is fed to livestock and humans (we have composting toilets here).

Biochar

The new kid on the organic-matter-and-tropical-soil-fertility block is biochar, essentially charcoal produced by heating (fire temperature) plant biomass in the absence of oxygen, which vaporizes everything except carbon chains and some tar. Biochar is causing a small revolution in tropical soil fertility management. Its surfaces hold nutrients for plant roots to access, it is microbe-friendly, and it doesn't decompose or leach away. Numerous field trials have shown higher crop yields, sometimes double that of conventional methods, in biochar-amended soils.

Currently in Africa, biochar as a soil amendment is a new concept, and knowledge of it hasn't reached more than a tiny fraction of farmers and agricultural development workers. I'm able to buy charcoal dust — a waste product — very cheaply from charcoal processing areas in the city of Arusha. These are places where bush-dwelling producers, mostly Maasai women walking with heavily-laden donkeys, bring charcoal. I don't expect the low prices to last a year as agriculturists learn the value of charcoal dust. Charcoal production is unsustainable in much of Africa where forests are being cut for the wood, but dry savannah areas, such as those surrounding Arusha, can support production when shrubs and trees that can regrow are used as the wood source.

Biochar-producing stoves that burn pellets that are waste-derived or sustainably produced are being introduced in Africa. These stoves have separate chambers for pyrolizing some of the pellets and producing biochar for soils. Pioneering efforts are being made by a few NGOs (non-governmental organizations) to quantify the amount of this stove-derived biochar going into soils, a form of long-term carbon sequestration, and to tap into global carbon offset market funds to pay the stove users. This may become a significant source of income for people in Africa. ■

Charcoal waste dust, used by the author to improve the fertility of tropical soils, is gathered at an urban charcoal market.

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