Green Manure Crops in Africa: A Report from the Field

by Roland Bunch

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Cover photo courtesy of Ana Galvis.

INSTITUTE FOR FOOD AND DEVELOPMENT POLICY

Farmers and program personnel in Mozambique are impressed about the incredible ability to survive a drought of the high-protein 60-day cowpeas that they have planted for the first time. All the crops in the background were stunted by last year's drought.

Dear Friends,

Back in 2009-10, during a 6-nation study I carried out in Africa for World Renew, I realized that because 80% of smallholder farmers in sub-Saharan Africa now have less than 2 hectares of land (roughly 5 acres), they are no longer able every year to have 3/4 of their land sitting idle (ie. in a fallow) and still feed their families with what's left. Fallowing is the way by which African farmers have kept their soil fertile for some 3,000 years. But as their plots have diminished in size (mostly because of population growth, but also because a lot of land has become wasteland), they have gradually reduced their customary fallow periods from 15 years to 10 years, 8 years, 4 years, and down to nothing. In most of sub-Saharan Africa, fallowing is now a thing of the past; it is in its death throes.

This is a once-in-human-history event, even though the rest of the world hasn't given it two lines of text in any leading newspaper (as far as I know). Yet it will have major, perhaps dire, consequences for tens of millions of people, because as fallowing dies out, the organic matter content of farmers' soils starts dropping, crop yields diminish, and people go hungry. My study found that yields of staple foods were decreasing by about 5 to 10% per year!

I predicted in a chapter of the *State of the World 2011* that the 150,000,000 people living in the rural areas of the 15 or so lowland, drought-prone countries of Africa could well be suffering from a major famine about five years from then. These last few months a number of news sources have said that a famine is stalking Africa even as I write. Already they are saying that the famine in Ethiopia is the worst in 50 years, and other countries, such as Somalia and South Africa, are also going to need huge amounts of food aid, stretching the world's emergency food supply to or beyond its limits.

These news sources attribute the drought to El Niño, because soil problems are unfortunately just plain invisible to most news reporters. Whether the predicted famine of 2016 is just a one-time El Niño phenomenon or the beginning of a long-term soil-depletion-based tragedy, only time will tell. Of course, it could well be some combination of both. What we do know is that of the approximately 25 nations around the world that are suffering from child stunting rates of over 40% (stunting is a degree of malnutrition or under-nutri-

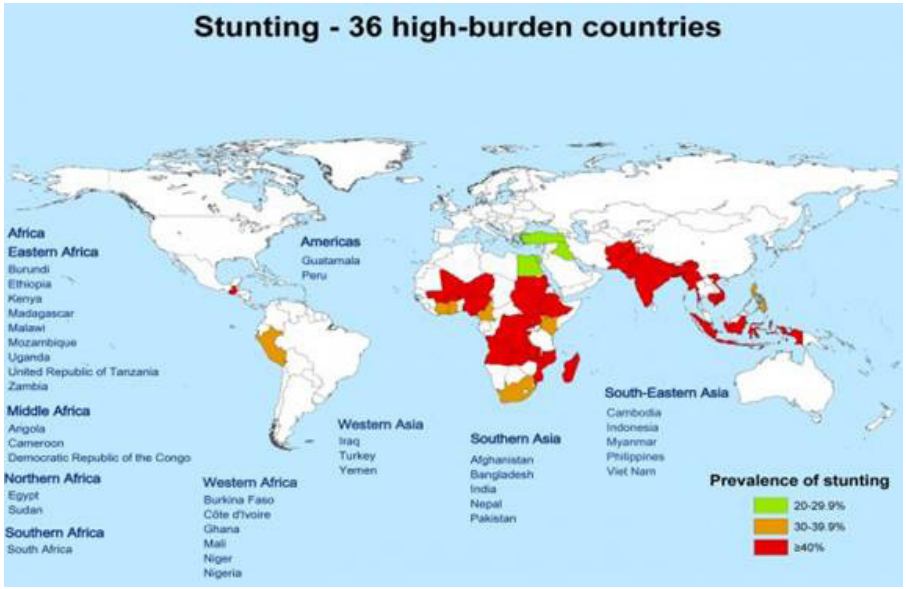
tion so severe that both the mental and physical capacity of the child are permanently damaged), 14 of those nations are among the lowland, drought-prone African nations that I signaled back in 2011. (See map below) It is a serious and chronic health crisis already, whether or not it is actually an official famine.

So what can be done? Asia and Latin America have already, by and large, gone through this process of the end of fallowing, but they had relatively large and growing industrial sectors with the large middle classes, high schools, universities and infrastructure that allow farm families to leave agriculture in relatively large numbers and still find a moderately decent life earning a living in other sectors of the economy. Africa does not have enough of any of these things. Sure, the flood of young people out of villages and into Africa's cities is huge —to the point that the average smallholder farmer in Africa is now over 50 years old. But even so, life on the farm is getting worse every year.

People could try to use chemical fertilizer to improve their yields, but fertilizer doesn't pay for itself on badly degraded soils, especially in droughty areas in which people pay for the fertilizer every year but all too often get no harvest in return. Fertilizer on depleted, droughty soils is just not an option. Some countries are subsidizing chemical fertilizer, but they are already losing their enthusiasm for this unsustainable option. The Minister of Agriculture of one African country told me that with the money they had spent on fertilizer subsidies over the previous five years, they could have built a fine new school in every village in the nation. Farmers could use animal manure, but many already do that, and the amount of manure they have isn't enough to maintain the fertility of even 10% of their land. They could make compost, but in most droughty areas they would very quickly run out of plant material to do this, and the costs of making enough compost to keep 2 hectares of land fertile would once again be prohibitive.

So green manure/cover crops (gm/ccs) are the only feasible and sustainable route farmers can take. (Gm/ccs are plants of any kind that farmers use in order to, among other things, fertilize the soil and/or help control weeds. Intercropped gm/ccs are, in effect, a fallowing system in which both the fallowing function and crop production are occurring simultaneously in the same field.) A farmer using gm/ccs can produce over 100 tons of biomass (green weight) on two hectares of land. By way of comparison, I have never heard of a smallholder farmer ever making and applying more than 10 tons of compost in a year. This quantity of biomass is more than enough not only to maintain the fields' fertility, but to gradually restore the soil, even on wastelands, to its naturally high fertility. Furthermore, this organic matter is produced all across his/her own field, so there are no transportation costs whatsoever, which is extremely important, as most smallholder farmers must carry all other soil amendments out to the fields either on an oxcart, on pack animals, or on their own backs and spread them by hand. Even more important, most of the green manure/cover crops we use also produce high-protein food, which usually can be consumed or sold in local markets.

The only problem here is that finding the right green manure/cover crop (gm/cc) for each situation takes a knowledge of scores of different leguminous plants and how to fit them into farmers' cropping systems. And whereas the Brazilians and a group of us working in Central America



Map #1: The lowland, drought-prone countries run across the entire Sahel, down the east coast of Africa, and across to the Pacific Ocean again. Chad and Somalia have insufficient statistics, but few people doubt they should be colored red. Tanzania should also be red according to recent information.

have spent some 32 years researching scores of possible systems, no one in Africa has anywhere near this amount of experience with gm/ccs.

Gradually I realized that I had to do more than just write a few articles. In 2011 I moved to Africa. My goal has been to identify or develop in each of ten nations, at least one widely applicable, successful green manure/cover crop system and promote it to the point that it is spreading spontaneously from one farmer to another. This would mean that when the crisis hits, other organizations would have somewhere within their own country or a neighboring one to find a proven solution to the crisis. Obviously such an ambitious goal could not be achieved by one person working alone, even if I did have a few hundred thousand dollars sitting in my back pocket, which I didn't. So I have been working together with a number of the world's top non-governmental organizations: Oxfam/America, Groundswell, the Canadian Foodgrains Bank, CARE and Catholic Relief Services.

To make a long story short, five years later, I have now been working, together with this wonderful group of people, in ten nations: Mali, Ethiopia, Uganda, Kenya, Rwanda, Tanzania, Mozambique, Malawi, Zambia and Madagascar. In Ethiopia and Uganda we haven't accomplished much, in Madagascar and Malawi we are just getting started, but thankfully, in five countries we have already developed very good gm/cc systems, and in two others we have identified excellent already-existing systems:

In Mali we have planted mother of cacao trees (*Gliricidia sepium*) with women's savings groups in 100 villages spread roughly across the center of the country. Most of these trees are now well over 6 meters tall. They will provide a light shade for the people's crops (excessive heat reduces yields in these areas by up to 30%). Even more than that, the trees' leaves fertilize the soil roughly as much as does an equivalent weight of cow manure. But what the farmers love most is that these trees produce high-quality fodder during the two months before the rain comes, which means their cattle will no longer be dying in large numbers toward the end of the dry seasons that follow droughty rainy seasons. The trees, unknown in Mali except in five or six villages until we started working there, are so highly valued now that the women have been selling seeds from their trees at between US $ 5.00 and 10.00 a kg to other farmers—a significant new source of income for them, and an activity that has already spread the trees to scores of new villages.

Photo #1: Savings group members walk through their plot of 4-year-old gliricidia trees in central Mali. These trees were planted in only 30-cm deep holes with no manure, no irrigation and in the villages' poorest soils, because we wanted to use a technology that would be simple, inexpensive, easily adopted by the poorest farmers and applicable across the Sahel. The wicker protections from goats and free-grazing cattle are the largest expense in adopting this technology (they were only necessary the first two years of the trees' growth). The women have not pruned the trees as heavily as they should have in order to maximize crop growth beneath them, because right now the women are making a lot more money from the gliricidia seeds than they do from the crops that grow beneath them. In time, of course, the seed will become plentiful and cheap, and the women's field crops will once again become their highest priority. The prunings from the trees will both fertilize the soil and provide plentiful firewood for use in the women's kitchens. The trees, as well as the soil whose organic matter content is increasing, will both sequester more and more carbon as time passes. Furthermore, the leaves are high-quality fodder and the flowers are edible (and in Central America, where the tree is native, they are highly appreciated—including by yours truly). Notice also the furrows under the trees where crops have been planted each year. Notice that when the photo was taken, the village's grazing animals would have precious little to eat if the gliricidia trees were not producing excellent fodder.

In Cameroon a farmer near the town of Bamenda noticed about 25 years ago that the soil around a tephrosia bush (*Tephrosia vogelii*) in town had become quite fertile, so he put a few seeds in his pocket and took them home to his village. Gradually, he developed an improved fallow system, whereby instead of leaving the land in natural fallow for 4 years in each 7-year rotational cycle, he would broadcast tephrosia seed over the land at the beginning of the fallow period. This simple process allowed him to reduce the fallow period to just one year, effectively almost doubling the amount of land he could grow crops on each year. The system has now spread spontaneously (no program was ever involved with this system) to over 2,000 farmers, who will in this way be able to maintain their soil fertility for another generation before they have to abandon fallowing altogether. (I haven't worked in Cameroon this last five years, but came to know this system about fifteen years ago, and consider it an extremely good system for the purposes of preventing the coming crisis.)

In Kenya a few farmers in one district have started planting mother of cacao trees on their terrace faces. These trees have now begun providing the same services that they are providing in Mali.

In Rwanda we have developed two gm/cc systems. In one case, farmers in a droughty area of northeast Rwanda needed some way of maintaining the soil moisture in their banana fields (a major subsistence and cash crop of the area). When the soil dries out during the dry season, their banana yields dropped almost by half. Last year, they tried planting velvet beans (*Mucuna pruriens*) in their fields, and the soil stayed moist throughout the year. Furthermore, their weeding work in the banana fields, which is done by women, was reduced by over 70%. This year, in addition to planting a lot more velvet bean, they are trying out lablab beans *(Lablab purpureum),* which will do much the same as the velvet beans, but will also provide an edible bean for themselves, which has a 23% protein content.

In southeastern Rwanda, another program has found farmers are very happy with the lablab beans they have intercropped in their maize. These beans will improve their soil fertility over time, and provide plenty of protein for their families six months out of the year. Furthermore, the plant's leaves can be sun-dried, and used as a ready source of protein throughout the entire year.

In Tanzania near Lake Victoria, farmers are doing roughly the same thing that they are in southeastern Rwanda. They have also been experimenting with four or five other gm/ccs that can easily be intercropped with maize.

In Zambia, Sebastian Scott, a young agronomist who has set up his own experimental farm, discovered that pigeon peas (*Cajanus cajan*) can be ratooned (i.e. cut off at ground level or just above it after harvest). This discovery is extremely important in droughty areas, because then the following year, the plant has the above-ground stature of a small bush that can grow up intercropped with maize and other crops, but it has the root structure of a two- to four-year-old plant, which gives it *much* more drought-resistance. As a result of this system and very minimal applications of animal manure, Sebastian's maize production has shot up from 1 t/ha to over 4 t/ha in seven years, with no expense of chemical fertilizer.

In Mozambique we may already be seeing the future of much of the rest of lowland, drought-prone Africa. The population pressure on the land is greater than in most of the rest of Africa, with the result that the soil is so poor that maize can no longer be grown. Much of the population lives on little more than cassava, a crop very resistant to poor soils but also nutritionally deficient. As a result, childhood stunting in many areas of Mozambique is nearing 50%.

This last year in Inhambane Province, it rained only three times during the cropping season, and one of these was right at planting time. Virtually no crops produced much of anything, but two crops grew quite well: 60-day cowpeas (Vigna unguiculata) that we had brought into the area as a very drought-resistant

Photo # 2: Ratooned pigeon pea plants in Mozambique. Note the thick stems, with newer shoots growing off them. Having been ratooned, their above-ground growth is that of about a year, but their root growth is that of two years, making them much more drought-resistant. The stunted maize plants in among the pigeon peas are testimony to the effects of the drought on most other crops. (This field has received only two rain storms since the week it was planted.) Also note that the previous years' organic matter is rotting in the field rather than having been burned off.

Farmers will now be able to feed their families, gain a solid income, laugh at most of their periodic droughts, and improve their soils, all at the same time, and at virtually no additional expense.

gm/cc, and the ratooned pigeon pea. For this particularly droughty area, we are working with a highly innovative system: intercropping maize, cowpeas and pigeon peas all in the same field, at the same time. The cowpea will be harvested before either of the other two crops will need the space it has occupied. The pigeon pea and maize will then continue to grow together, improving the soil year after year just as it has on Sebastian's farm.

Most years all three crops will be providing an edible grain, with two of them being very high in protein. In years of extreme drought, both the cowpeas and pigeon peas will produce quite well, and if the maize suffers so much it will obviously produce nothing, a second crop of 60-day cowpeas could provide an additional source of human food. In time, when the soil contains more organic matter, even the maize should resist

Photo #3: One might suspect that the maize in the previous photo was very stunted because the pigeon peas grew so fast that they shaded out the maize. But here, to the left, is the same pigeon pea field as above, with another field of intercropped maize at the right. The maize at the right is no better off than the maize under the pigeon peas, so the reason for the maize's lack of growth was, in fact, the lack of rain.

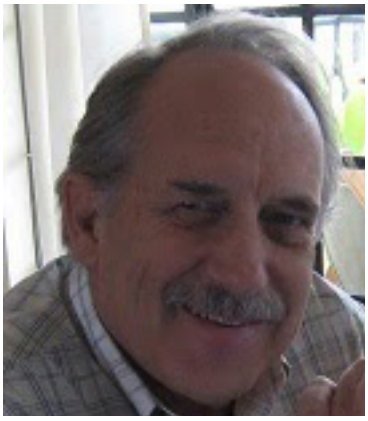
most droughts. And if the farmers also add mother of cacao trees to the system, the maize will probably produce fairly well every year. Such a system, even on just one hectare, will soon be producing a surplus of food, in which case the pigeon pea will serve as a very profitable cash crop, since Indian traders are paying extremely good prices for it to satisfy the growing demand of a burgeoning middle class in India.

In addition to these advances, a friend and modern hero from Australia, Tony Rinaudo, has spent over 30 years developing and spreading a gm/cc technique called FMNR, by which smallholder farmers naturally regenerate native trees. Using this system, farmers in lowland, drought-prone areas of Niger and Mali have populated over 6 million hectares with trees, many of which also fertilize the soil. Tony is presently working to spread this technology to a series of additional countries, including Ethiopia and Malawi.

These successes mean we have made extremely significant progress, but I dearly wish things were moving much faster. The news reports of a major drought this year could be our last wake-up call.

We may already be running out of time to prepare for the coming disaster.

Sincerely, Roland



Roland Bunch has worked in agricultural development for more than 42 years in more than 50 nations of Latin America, Africa and Asia. He has done consultancies with the Ford Foundation, Cornell University, CARE and the top non-governmental organizations from Canada, Great Britain, the Netherlands, Germany and Switzerland, as well as the governments of Guatemala, Honduras, Swaziland and Vietnam. In 1982, he published the book, *Two Ears of Corn, A Guide to People-Centered Agricultural Improvement,* which has since been published in ten languages and is an all-time best seller in the field of agricultural development. *Two Ears of Corn* pioneered the idea of development programs' organizing smallholder farmers to teach each other and organize experiments, both of which have now become major movements around the world under the names of "farmer-to-farmer extension" and "participatory technology development."

Starting in 1983, Roland began investigating the use of plants that are particularly good at fertilizing the soil, which are now called "green manure/cover crops." Together with an independent group of agronomists in southern Brazil, he has spearheaded the effort that has successfully put this technology on the agenda of development organizations around the world.

Roland has been nominated for the Global 500 Award, the End the Hunger Prize of the President of the United States, and the World Food Prize.