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Conservation Agriculture in East Africa: An Update

by Erwin Kinsey

Conservation agriculture (CA) has been promoted in East Africa through a number of initiatives over the past half year. In this article, we share what ECHO has gleaned from regional partners, in hopes that you can expand upon these successes and also promote further sharing on ECHO's website. Please share your CA experiences and questions on ECHOcommunity.org (go to the tab 'Groups', click 'Agricultural Techniques', click 'Conservation Agriculture')!

East Africa Symposium 2013

ECHO's second East Africa Symposium took place in February in Arusha, Tanzania. On the first day of the Symposium, presentations were given by Dr. Simon Lugandu of African Conservation Tillage, Eric Ruwona of Christian Care Zimbabwe, author Roland Bunch, Rachel Evans from University of Manitoba, and Alden Braul of the Canadian Foodgrains Bank. Their presentations are available online. Below is a summary of some key elements that I found useful from those presentations:

Alden Braul: "Sustainability of CA is measured by higher yields and the level and quality of adoption. From project evaluations in southern Africa, the reasons people were adopting [CA] related especially to reduced labor (82% of respondents), increased yields (72% of respondents), and not needing draught power (61% of respondents). However, these were posed against drawbacks that included lack of available mulch, increased time in preparing planting basins, and lack of markets for the increased production."

Roland Bunch: "You need farmers' knowledge and experience to guide you. Use of green manure/cover crops (GM/CCs) is the cheapest way to recuperate soils, and they succeed at zero cost (in terms of opportunity, labor, cash) while having a great impact." Roland's photos showed visually the profound impact that GM/CCs can have in reclaiming soil fertility, and the way they can fit into existing farming systems with add-on benefits. He emphasized that weed control, increased organic matter, and food production were also incentives guiding farmers' choices of certain GM/CCs over others. His new publication, *Restoring the Soil: A Guide for Using Green Manure/Cover Crops to Improve the Food Security of Smallholder Farmers*, is now available at the ECHO Impact Center in Arusha for $15 plus postage. There is also a forum on GM/CCs open to those registered with ECHOcommunity.org as development workers.

Rachel Evans: "Plants are nourished by the soil. We need to feed the soil to have healthy plants. Our research shows that this can be done most effectively through diverse crop rotations, reduced tillage, maintenance of soil cover, and inclusion of organic manures. Organic manures are needed to enhance nutrient uptake even from inorganic sources. Soil organisms are nourished by carbon from crop residues. Different soils need different management; there is no 'one size fits all'."

Dr. Simon Lugandu: In his overview of CA worldwide, Simon emphasized, "Good agronomic practices are part of CA, such as timely planting, proper plant spacing, and effective weed control (with and without herbicides). CA also includes use of external inputs such as improved seeds, judicious use of fertilizers and pesticides, crop-livestock integration, agro-forestry/fertiliser trees, live fences, and wind breaks."

Eric Ruwona: Eric shared his experience on what has made for success in Zimbabwe in adoption of CA. "The program must be focused on the poor, using hoe-based technology, locally available resources for inputs, local seed and fertilizers, and an emphasis on training and capacity building. Effective tools for convincing farmers include exchange visits to other successful farmers, and seeing results from farmer-to-farmer training. Free inputs discourage sustainability; only limited provision of free inputs should be considered, primarily through OPVs and community seed banks where markets do not function properly. Farmers need to use what they have in their hands, and projects should avoid creating dependency. This is one of the most difficult challenges of adoption."

Conservation Agriculture Forums: Let us hear from you!

Subsequent to the East Africa Symposium, groups interested in CA have formed and met in various places. A Conservation Agriculture movement seems to be forming, with a variety of interested constituents, such as farmers, NGOs, governments, faith-based organizations, for-profit compa-

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nies, equipment manufacturers, donors, environmentalists, and the UN agencies. While a CA movement is not new, and its advantages are becoming better known, the slow adoption rate by farmers in the region continues to frustrate various actors.

A hub/learning community based in Mwanza, Tanzania, organized an advanced-level CA training from 15 – 16th May with Bill Berry, a CA practitioner from South Africa working with the Tanzania Gatsby Trust. In Arusha, public and private CA stakeholders have been meeting monthly and have formed an Arusha CA Forum (ACAF), which aims to nurture and support CA initiatives in the northern zone of Tanzania.

ACAF was initially formed as a steering committee supported through the initiative of the Mennonite Central Committee, which called together like-minded individuals in 2011. ACAF, now transformed, continues to have well-attended meetings on a bi-monthly basis, and recently redefined its mission and objectives to enable it to measure its forward movement.

Exchange Visit to Zambia and Zimbabwe, Organized by African Conservation Tillage

During the last week of April 2013, I participated in a special tour to Zambia and Zimbabwe, arranged by African Conservation Tillage (ACT) for nationals of Ethiopia, South Sudan, Kenya, Uganda and Tanzania. The purpose of the trip was to share knowledge on practices, benefits and challenges of CA for both smallholders and large scale commercial farmers. The program included visits to and interactions with senior government officials, local agriculture government agencies, public and private research institutions, NGOs, farmers' unions, farmers, CA equipment manufacturers, and agricultural vocational colleges. The tour participants also brought with them a wealth of experience.

The first day was a time of sharing about the increasingly vulnerable state of African agriculture through the severe degradation of its farmlands. The stagnation or decline in farm productivity in many parts of Africa has translated into chronic food insecurity and growing poverty. However, the emphasis of the meetings was on the hope which CA brings to arrest this degradation, by reversing common, exploitative farming practices and by utilizing the amazingly regenerative potential of the land. Facilitators from ACT and from the other Zambian and Zimbabwean institutions that we visited gave presentations about what CA is, and why they feel that it is important. They described how to use CA principles in the field, and highlighted issues and challenges that farmers and extension personnel have encountered when they adopted and adapted CA. Finally, they suggested ways to adapt and disseminate CA approaches to farming, giving examples from experiences with CA in southern Africa.

By the end of the week, all participants were convinced to be part of a larger effort to develop and promote CA in Africa. On the final day, participants brainstormed ways to address the need to scale up CA in their respective countries. The trip successfully increased participants' awareness of CA and their resolve to promote adoption and adaptation.

In the pages that follow, I highlight what I learned from presentations by researchers and support organizations, and from farmers' testimonies as they shared their experiences and views of CA. They emphasized that not all of the experience with CA in Zambia and Zimbabwe is applicable in East Africa, but much indeed is transferable.

Challenges of Conventional Agriculture

- Plowing is problematic, for many reasons:
  - It is expensive (average of $55/hectare in Zambia).
  - It destroys the soil structure and degrades organic matter.
  - It involves much labor and time (an average of 12-15 hours per hectare).
  - Farmers are often left waiting for availability of oxen or tractors and do not plow and plant in a timely way to obtain the benefits of the first rains. On some soils, plowing only commences AFTER the rains begin, resulting in loss of timely planting and an inability to utilize the nitrogen flush of the first rains. Every day that planting is delayed after the ideal planting window results in a 1.5% yield decrease. (The ideal planting date can be learned by asking local farmers or the agricultural office; usually it is during the first week(s) of rains.)
  - Sometimes plowing must be done twice if too many weeds emerge, doubling the time and cost of land preparation.
  - It compacts soil below the plow layer.
  - It fosters more weed production.
  - It excessively engages women already heavily burdened with work, and children who end up missing school.
- Conventional methods of agriculture have resulted in inadequate crop yields and unmanageable numbers of weeds. Largely because of these, 30% of the cropped land was abandoned on average (even during good rainfall years) between 2000 and 2008 in Zambia.
- Ridging is common in southern Africa. Ridges are mounds of soil made throughout a field, ranging from 0.5 to 1 m in width and 0.3 to 0.5 m in height. They are dug to loosen the soil, bury sod, and provide drainage and access between cultivated areas. In Malawi, the Eastern Province of Zambia and southern Tanzania, combined ridges would extend over half the distance around the world! Ridging causes numerous problems:
  - Ridging disturbs the soil 100%. It is the equivalent of moving 300 tons of soil per hectare!
  - It is costly, similar to plowing, in terms of labor costs or hired oxen.
  - Ridging causes high erosion in the furrows. Soil disturbance leads to more soil compaction, impeded drainage, and capping of the soil after heavy rains, which slow plant growth.
  - Weeds concentrate on the ridges and weeding on ridges is more labor intensive than on flat ground, as soil must be banked up again against the ridge.
- Burning or removing crop residues is extremely common in southern Africa. This further degrades land. It leaves the land exposed to solar baking and dust/wind erosion during the dry season, and to sheet erosion when rains commence.
- Manure and other fertilizers are commonly applied by broadcasting. This is wasteful, because amounts to use are guessed at, and many plants do not obtain the benefits of fertilizers because of random application. Use of kraal manure means the manure contains lots of weed seeds; broadcasting the manure increases the number of weeds between the rows.
- Seeds are unevenly covered with soil in most conventional agriculture methods, so emergence of seed is uneven and areas often are either under-populated or need thinning. Seeds are usually excessively disturbed by ox-drawn cultivators, further reducing plant populations. Often cultivating is done twice during the season, and if the area to weed is too large, portions of the cropland are abandoned.
- Mono-cropping (growing just one crop over large areas of land) is prevalent and results in diminishing yields throughout Africa. Yields are declining as soil fertility has declined; carbon in the soil is oxidized, and nutrients are depleted. As erosion has continued unimpeded, and without mulch/

organic matter, the soils dry out quickly, lending to crop wilting during dry periods. Weeds compete excessively for nutrients if left uncontrolled.

Conservation Agriculture Addresses Farming Challenges

- Conservation Agriculture's three simple principles – disturb the soil as little as possible, keep the soil covered, and mix and rotate crops – are being put into practice at many different levels in Zambia and Zimbabwe by hundreds of thousands of farmers.
- Small farmers with limited acreage usually prepare planting basins 30 cm x 5 cm and 15-20 cm deep by using a narrow 'Zam' hoe during the dry season. They concentrate manure, fertilizers and lime in these basins, back-filling them to 5 cm depth so that they are ready for planting at the first rains. Farmers plant four maize or pulse seeds per basin, and thin them to an average of three plants if all of the seeds germinate. Farmers can prepare up to three or four hectares this way without hiring in oxen or tractors. Basins are spaced at a distance of 75 cm within rows and 75-90 cm between rows. In areas where livestock are scarce, farmers maintain all the crop residues as mulch in the fields. The production from planting basins outperforms either direct seeding or ox-drawn rippers followed by hand seeding. Water infiltration and retention is twice as high with basins as compared with conventional tillage or soil disturbed on ridges. Seed emergence is also higher, and fewer seeds are needed for planting.
- Some farmers are successfully utilizing GM/CCs, the most popular being *Lablab purpureus* and *Cajanus cajan*, with *Mucuna* spp. used in wetter areas. The GM/CCs are usually planted as relay crops when the maize has emerged to more than 30 cm in height. Rotations are usually maize followed by cotton followed by a pulse – bean, pigeon pea, green gram, or a GM/CC such as *Crotalaria* spp. In some areas, the best farmers are incorporating *Faidherbia albida* at a distance of 10 m between trees within and between rows in their fields. As a result, they can reduce fertilizer application by half in these fields.
- Farmers commonly rip the land rather than plow, to break open the hard pan and allow more water infiltration. A ripper moves a narrow chisel through the topsoil layer into the subsoil, breaking up compacted sod, in contrast to plowing which merely turns over the topsoil and creates a hard 'plow pan' at the top of the subsoil layer. Farmers have used Magoye Rippers which fit onto standard plows; the process takes 1/3 of the time of plowing or ridging, and can be done in the dry season or at the onset of rains. Soil disturbance is only 10% compared to 100% with plowing or ridging. Ripping the soil to a depth of 15 cm (by one or two operations through the furrow) will enable crops to penetrate deeper so that they show less signs of stress during dry periods. Ripping may be done each year in the same furrows as the previous year, and becomes easier in subsequent years. Basins are dug within the lines of soil that have been ripped. As an alternative to ripping, *Cajanus cajan* can be used in a rotation. Its aggressive roots can penetrate a hard pan.
- Farmers who rip furrows in their land commonly apply fertilizers, manure and lime in the open furrows created by the ripper, concentrating nutrients near to the seed and reducing guesswork of application. The same rip lines are used each year. Fertility in these furrows improves over time, because a crop following a legume benefits from the nitrogen that was fixed, and the crops following maize or cotton benefit from any residual fertilizers.
- Direct seeding is gaining popularity, despite a scarcity of direct seeder machines and farmers' general lack of capital to purchase them. Direct seeders have the advantages of best control of plant population and fertilizer placement, least labor during planting, least soil disturbance of all methods, and versatility (some planters can drill all the major crops). Direct seeding can be done into furrows produced from ripping. However, more care is needed in learning to calibrate the equipment to achieve appropriate levels of seeds and fertilizers. Also, direct seeding commences after the first rains, so where a direct seeder is owned by a group, some of the farmers will likely not be able to plant until after the ideal planting time.

- Weeds in the spaces between rows are reduced when that soil is left uncultivated, and especially when the soil is mulched or a GM/CC is introduced. CA promoters advocate use of herbicides (glyphosate initially) before or immediately after planting (but prior to crop emergence). This is done to control weeds, especially in early years of CA promotion, before cover crops and mulches have controlled most weeds. Other selective herbicides are used after crop emergence. Herbicides reduce labor of weeding by 60-80%, cost half the amount that hand weeding would, take 1/10th the time, and have a short-lived effect in the soil. It is especially important to keep weeds from going to seed. Use of herbicides for weed control is a major factor enabling small farmers to increase the area over which they can manage to grow crops. Maize is the preferred crop to use for training in herbicide use; it is critical to train farmers in correct herbicide product choice, application method, nozzle choice, sprayer maintenance, dilution, walking speed and safety measures.
- Farmers have seen their yields rise, even double, in the first season. They have viewed visible evidence of soil gaining fertility, and they have experienced their labor needs falling.
- Costs of production under CA are significantly reduced, use of inputs is reduced, and those that are purchased are more efficiently utilized.
- CA is 'climate smart,' providing good yields in bad years. Conventional agriculture, by contrast, is negatively affected by climate variations.

Conservation Agriculture needs to be contextualized in each environment. Research is needed, and must be aligned with CA dissemination. Recommendations for Zambia or Zimbabwe may not be accurate for East African countries where, for example, intercropping is more prevalent—but the principles of CA remain the same.

Challenges with Scale-up of Conservation Agriculture

- Conservation Agriculture must be promoted actively both by the private sector and with centralized support from the public sector. A good example of promotion by the private sector is the Zambian Farmers Union, www.conservationagriculture.org. Good examples of public sector support include the Golden Valley Agricultural Research Trust (www.gartzambia.org), which promotes agricultural research, training and extension in Zambia, and the Zimbabwe Ministry of Agriculture's involvement with the Zimbabwe CA Forum, hosted by FAO in Zimbabwe (www.acwg.co.zw). If CA is to spread rapidly, a concerted effort by both sectors is needed.
- A key role of the government is to create an enabling environment that includes such

things as tax/customs relief for CA related trade; promotion of training by extension staff as their core function; and, where possible, relieving extension staff from being agents of inputs or credit, which is actually a function of private sector participants such as machinery dealers and farmers unions. Where government provides inputs, there must be more timely delivery to farmers. One effective means is through a voucher system, which can be enhanced by limiting the percentages farmers can take as inputs and for implements.

- Researchers need to work with the private sector to develop sustainable and affordable solutions to mechanization.
- Mechanization, post-harvest grazing and weeding are the most severe constraints to adoption of CA.
- Other dilemmas remain unresolved:
  - Is organic CA a reality or a dream?
  - Can Africans control their cattle?
  - What are the best entry points to get CA to work? Addressing hardpans? Terracing with bunds? CA equipment?
  - Should the three CA principles be reduced to one or two in order to promote acceptance?
  - Farmers and machinery suppliers need to define other research agendas.
- Farmers can be effective as extensionists when trained as trainers and mobilized by appropriate incentives. The Farmer Field School is a typically successful means for improving adoption. Be sure to start where the farmers are; do not try to bring hoe-technologies to farmers with tractors, and vice versa. One size does not fit all.
- CA was first promoted among the poorest of farmers. Its success and adoption has been impeded by perceptions that it is inappropriate for large and middle scale farmers. CA needs to be promoted for all types of farmers. The concept that agriculture is a poor man's occupation needs to be dispelled so that youth will be attracted to farming.
- Where farmers are experiencing doubling of yields, stakeholders must review the value chain to improve either storage or markets.
- Grassroots players (farmers, extension workers, input suppliers, etc.) often lack information on what to do and where to do it. There is a need for training, identification of service providers and ways to link them together. This need underlines the importance of networks to promote CA programs over several seasons, which will increase farmers' confidence.
- CA promotion is a long-term activity and those who promote it need to take a long-term view. In Brazil, it has taken decades of concerted effort to achieve high levels of adoption. We should have a 20 to 30 year vision, and not be discouraged by a slow pace of progress.

Other Resources

Besides websites mentioned above, the following are good resources for CA:

African Conservation Tillage Network (ACT; www.act-africa.org) has a number of free online books, papers and booklets for download, including case studies from Ghana, Kenya, Tanzania, and Uganda. ACT also has manuals such as *Conservation Agriculture: A Manual for Farmers and Extension Workers in Africa*, IIRR & ACT, 2005.

Agricultural Research for Development, CIRAD (www.cirad.fr) has a number of CA resources in French available online.

Food and Agriculture Organization (FAO; www.fao.org/ag/ca) has a number of books and papers that promote CA. Among these is an initiative called Communities of Practice (CA-CoP), an information-sharing forum through which participants regularly email and share experiences with CA.

Foundations for Farming (www.foundations-forfarming.org/) and Farming God's Way (www.farming-gods-way.org/) both teach CA through applied hoe-based technologies.

Lindi and Mtwara Agribusiness Support (LIMAS; www.limas.or.tz) has produced good manuals in Kiswahili that are useful for promoting CA.

What's happening on ECHOcommunity.org? Log in first and you can…

Browse ECHO East Africa's online resources at

http://www.echocommunity.org/?page=EnglishResources

http://www.echocommunity.org/?page=SwahiliResources

Have a look at a document on Dryland Food Security authored by EA Director Erwin Kinsey entitled, "Food Security Technologies for Dry Areas."

Follow the group feed for GM/CC updates

http://www.echocommunity.org/group/green_manure_crops

Check the Community Calendar for upcoming events near you (including gatherings in Rwanda, Botswana, Tanzania, and the US)

http://www.echocommunity.org/events/event_list.asp

Keep an eye out for the upcoming publication of our Best Practices Note on Pastoralism

http://www.echocommunity.org/?page=BPN

Telfairia pedata: Oyster Nut, Kweme or Zanzibar Oil Vine

Introduction and uses

Telfairia pedata is a perennial climbing plant grown throughout eastern and central Africa, though it is native only to Tanzania and northern Mozambique. (A similar species, *Telfairia occidentalis*, is grown in West Africa.) It is grown for its large (4 cm in diameter) seeds, which resemble oysters and, thus, are known as "oyster nuts."

Oyster nuts are rich in protein (≈30%) and oil (over 60%), the oil of which is a good source of fat. Despite their high oil content, they can keep for up to eight years and remain palatable. Eaten roasted, boiled, or raw, their flavor is comparable to that of hazelnut or almond. One popular East African dish includes roasted oyster nuts, pounded into a paste, and cooked with fish in a banana leaf. In traditional Chagga society in Tanzania, oyster nuts are fed to nursing mothers to stimulate lactation and increase the flow of milk. The seeds are also pressed for cooking oil, and the seedcakes left over from this process are excellent as livestock fodder.

Botanical description

T. pedata is not a nut tree, but rather a member of the *Cucurbitaceae* family. Female plants produce purple-pink fringed flowers, which develop after fertilization into very large ellipsoid gourds that can weigh up to 15 kg. Each of these ribbed gourds contains 100 to 150 flat, oyster-shaped seeds ("nuts"). The seeds are opened in a manner much like shucking an oyster: aftercutting around the edge, one pries open the fibrous shells to extract the kernel. Vines become woody and can grow to 30 m in length with pedately compound leaves arranged spirally.

Cultivation and harvest

The oyster nut plant thrives in well-drained medium loam soils, and is resistant to drought. Plant the seeds 2.5 cm deep and 60 cm away from the tree trunk which will serve as a trellis. Allow only one or two per large tree, as the weight of the gourds can easily pull down weaker trees. Place some sticks alongside for the plant to climb up as an initial trellis. Seeds germinate within two or three weeks. Because plants are either male or female (dioecious), it is imperative to establish plants of both sexes to ensure fruit production. In one hectare, 10 to 15 males can adequately pollinate nearly 200 females. A local farmer in Tengeru taught us to differentiate the male and female seeds (the latter should have a larger indentation). Vines can be identified with certainty after flowering commences 1½ to 2 years after germination. Pollination is probably by insects; hand-pollination is challenging given the great heights at which the vines flower.

Time from flowering to ripening is about 4½ months. As the gourds ripen, they fall away from the vine, at which time the nuts embedded in a pulp can be removed and washed clean. If grown for consumption, spread the seeds out in the sun to dry. If you intend to propagate the seeds, note that they cannot survive desiccation and are most viable within two months of harvest. Stem cuttings root in 2 to 3 weeks, and this vegetative propagation can help balance the ratio of male to female vines.

Under good conditions, two harvests per year are possible. Commercial plantations can reach an annual seed yield of 3 to 7 tonnes per hectare. Plants have an economic life of 10 to 20 years.

The bulk of production remains in-country for home use and domestic markets. Oyster nut is commonly seen in the agroforestry systems of Mount Meru and Mount Kilimanjaro, where it is grown in conjunction with coffee and bananas.

Sources

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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 *EAN*? What did or did not work for you? Please let us know the results!