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Conservation Agriculture with Trees

Jean Twilingiyumukiza, Agriculture and Livelihoods Technical Advisor C/W Africa

Conservation Agriculture (CA) principles provide farmers with the means to grow crops productively and sustainably in the face of the tremendous challenges of climate change and environmental degradation. In order to maximize the benefits of CA, each farm should be considered as a living system, not just a place to grow annual crops. The goals of livestock raising, natural resource conservation, and tree management can either support or compete with CA practices.

Agroforestry systems integrate trees and shrubs with annual crops. Farmers in eastern DR Congo plant annual crops together with agroforestry trees (*Calliandra calothyrsus, Leucaena spp,* etc.) which produce nitrogen-rich mulch, firewood, and high-quality livestock fodder. In Burkina Faso, farmers grow moringa, papaya and other trees in association with their grain crops. In southern Africa, and throughout the Sahel, *Faidherbia albida* (apple ring acacia) provides dispersed shade to crops and livestock, fixes nitrogen, and also provides fuel wood and timber. In unimodal rainfall climates, *F. albida* has the unique advantage of producing leaves only during the dry season, and shedding them during the rainy season.

Faiderbia albida trees provide dispersed shade for CA maize and soyabean in Zambia.

Farmers adopt agroforestry practices in order to increase overall production, diversify income sources, and improve conditions for crop growth. In addition, agroforestry can contribute to maintenance of permanent soil cover, the backbone of CA. Covering the soil reduces its chances of being eroded by water or wind, increases water infiltration into the soil, conserves soil moisture through reduced evaporation, and reduces weed growth. Soil cover is generally provided by dead vegetative material (especially crop residues), growing food crops, and cover crops. However, maintaining permanent soil cover throughout the year is a major challenge for CA farmers everywhere. Agroforestry species supplement materials

provided by annual plants, thus increasing CA farmers' ability to keep their soils covered throughout the year.

A range of crop-friendly tree species are available which complement CA practices. Small-scale farmers generally prefer trees which fit into their annual cropping system and have multiple uses such as food, fodder, and fuelwood. A good agroforestry species should not compete for soil nutrients or water with associated/main crops, and leguminous trees can provide nitrogen for associated crops. For soil cover purposes, farmers should select agroforestry species which grow quickly and produce enough leaf biomass to supplement other sources of mulch.

Calliandra calothyrsus hedgerow on CA farm in Goma, DR Congo.

To achieve maximum benefits from integrating CA and trees, several management strategies have proven effective:

a. **Boundary planting and live fences**: Trees and shrubs planted around farm fields minimize competition with annual crops and protect crops from livestock grazing. Good species for boundary planting include *Gliricidia sepium, Erythrina spp., Spondias spp.*, and *Bursera simarouba*, all of which can be grown from cuttings. In order to provide extra protection from animals, these species are sometimes interplanted with thorny shrubs or *Euphorbia spp.* which repel animals with their caustic sap. ECHO Development Notes #116 provides more details on living fences.
b. **Contour hedgerow planting**: This practice involves dense planting (10-20 cm between plants) of single or double rows of agroforestry plants on contours spaced 10-20 m apart with food crops between. Ideal species are fast-growing leguminous and/or fodder trees including *Gliricidia sepium, Calliandra calothyrsus, Leucaena spp*. and *Sesbania sesban*. These trees should be cut at chest height several times during the growing season and used for mulch or livestock feed, but will regrow (coppice) each time. Additional information on hedgerow planting can be found in ECHO Technical Note #72 and the International Centre for Integrated Mountain Development.
c. **Dispersed trees on cropland**: In this strategy, multipurpose trees are planted at a spacing of 5-20 m depending on the species. In hotter environments the dispersed shade provided by these trees keeps soils cooler and conserves moisture, resulting in higher yields of annual crops. Appropriate species include *F. albida, Grevillea robusta, Alnus nepalensis, Melia volkensii, Moringa oleifera, Acacia spp.*, and many fruit species.
d. **Improved, rotational fallows**: When a field that has been under continuous cropping is left without cropping, fast-growing tree species can help speed the process of regenerating soil health and productivity. Species for improved fallows include *G. sepium, Tephrosia spp., C. calothyrsus, Leucaena spp., S. sesban,* etc.

In addition to the above benefits, integrating trees with CA crop production helps to sequester carbon, thus reducing the impact of farming on climate change. It also provides habitat for beneficial insects which can reduce damage from crop pests. With all these advantages, trees should be an integral part of CA wherever it is promoted! For more information, consult the ICRAF publication Conservation Agriculture with Trees: Principles and Practice.

Does Conservation Agriculture Reduce Labor Demands?

Mike Salomons, CFGB Agriculture & Livelihoods Technical Advisor

Conservation Agriculture (CA) has been widely adopted around the world because of its many proven benefits, including increased resilience to the impacts of climate change, increased yields, and improved environmental sustainability. However, the impact of CA on labor demands of smallholder farmers, especially women, remains contentious. Some claim that CA reduces labor for land preparation and weeding and spreads household labor more evenly through the cropping season. Others claim that labor burdens are shifted to women (and sometimes children). This article summarizes research and anecdotal evidence on the subject and provides recommendations for how to decrease labor burdens in CA.

Studies on the labor impacts of CA provide mixed evidence, with some showing lower labor demands under CA and others showing an increase (Montt and Luu, 2019). The labor impacts of CA depend to a large extent on the agricultural technology being used. Hoes (and which kind), animal traction (and which type), herbicide use, socio-economic status, fertility inputs, gender relations, labor sharing, and other factors greatly affect the relative labor demands of CA (Wekesah, *et al.*, 2019). The use of planting basins results in increased labor in most studies, and usually limits CA to plots under 0.25 ha. In contrast, many of our CA project farmers state adamantly that reduced labor is a significant benefit of CA! One explanation for this apparent contradiction is that the increased yield and climate resilience of planting basins may justify the increased labor, especially in semi-arid environments (Mupangwa, *et al.*, 2017). Even if labor per hectare of land increases, labor per kg of food, may decrease. A study of female farmers in Zimbabwe found that those who had sufficient labor and resources to implement all the prescribed components of CA were able to attain household food security (Hove and Gweme, 2018).

In contrast, mechanized CA technologies generally reduce labor demands according to published studies, especially when combined with herbicide use. For example, in eastern Zambia, animal-drawn direct seeders, rip lines and hand-held dibble stick planting resulted in roughly half the labor per hectare of conventional hand-hoe tillage (Mupangwa, *et al.*, 2017). Use of animal or tractor-drawn CA equipment may shift labor from women to men, especially if the alternative is field preparation with hand hoes. However, if mechanized CA results in heavier weed infestation, women's burden may be increased (Johansen, *et al.*, 2012) since many cultures consider weeding to be women's work. When mechanization shifts farmers from broadcast seeding to row planting, however, weeding becomes easier. Women in Ethiopia report that their husbands are willing to help with weeding of wheat and teff when they are planted in rows, whereas with broadcast seeding, weeding is too tedious for men.

In systems where CA increases labor, this burden is borne most often by women (Montt and Luu, 2019), especially where they have little control over resources they need to farm (Meinzen-Dick *et al.*, 2011). Female farmers generally have less access to labor-saving technologies associated with CA such as direct seeders, rippers, and herbicides; which in turn reduces the benefits that CA has on their livelihoods (Zulu-Mbata and Chapoto, 2018).

Digging basins demands significant labor, and can only be done on a small scale, but increased yields often justify the labor output.

Row-planting barley encourages Ethiopian men to help with weeding.

Recommendations

1. **Develop context specific recommendations**: Farming systems vary widely across sub-Saharan Africa, and what may be an effective and labor-saving agricultural practice in one area or in one year may not be what is needed in another area or year. Before promoting a particular CA practice, be sure to assess the impact of the practice within the social, economic, and environmental context (including labor impacts!) Be sure the practice has been thoroughly tested and adapted to the local context by local farmers.
2. **Pay attention to gender**: CA practices impact gender roles differently in different cultural and agricultural contexts. Too often climate smart technologies (including CA) have been designed without giving sufficient attention to the needs of women and girls and their limited access to capital, labor, time, and decision making (Anderson and Sriram, 2019). A solid gender analysis – including an understanding of how labor is distributed among men and women - can help avoid the promotion of CA

practices that may be environmentally positive but socioeconomically damaging (Murray, *et al*. 2016, Baudron, *et al*. 2019).

3. **Consider judicious use of herbicides**: As noted above, herbicide use can dramatically reduce CA labor demands, particularly the labor demand on women. However, misuse of pesticides poses significant health and environmental risks in many communities. Projects promoting herbicide use among small-scale farmers must also provide training on safe chemical use. Training materials on pesticide safety can be found on the ACT website.
4. **Promote "CA Plus"**: When farmers adopt only one of the three main elements of CA (such as minimum tillage) their overall labour demands often increase. However, when all the main elements of CA are adopted, their overall labour demands often decrease (Teklewold *et al*., 2013). In addition to promoting all three principles of a good CA system, additional technologies; such as soil fertility inputs, good quality seed, livestock integration, and post-harvest management; may address constraints and opportunities related to the local farming systems. For example, promoting agroforestry or green manure/cover crop systems in conjunction with CA can help ensure sufficient soil cover and reduce the labor associated with weeding.

Discussions from the Network

Neil Miller Our low-cost CA planter is moving forward. We added a fertilizer mechanism, and a cutting coulter, though unfortunately, it wasn't able to cut through tough weeds like the ones in this video. They will need to be cut in smaller pieces before planting, or moved and returned to the field after planting. We are working with a manufacturer in Tanzania and two in Ethiopia who think they can produce them for around $100. Let us know if you're interested!

Peter Woolner Looks promising. And wonderful that you are using local manufacturing. Would it be possible to incorporate some sort of 'trash wipper' to push the mulch away from the planting area?

Wondwesn Woldgiorgis Wow, new technology it gives relief for Ethiopian farmer.

Tesfahun Eyoel Neil, this is great contribution for Ethiopian farmers

John Kimathi Kirima Nice. When are we trying out on Kenyan soil?

Neil Miller Let me know how many you want to order!

Putso Nyathi Good to see locals being involved in innovation. All the best!!

Alemayehu Koysha Great to see this and Wolaita Soddo mechanization center is also trying its best to adapt and manufacture it in an affordable way for smallholder farmers.

Tilahun Bergene Thanks, this is great contribution for scale up of CA around East African smallholder CA farmers. It always should be easy to operate, manufacture, affordable and best fiting to local farming conditions!!

Nathaniel Korvah Wish u you guys success in your innovation.

ALTA Travel Schedules

JEAN TWILINGIYUMUKIZA

23, 24 and 27 December 2019
Ruhango, Bugesera, Kayonza, Gicumbi, Kirehe and Burera, Rwanda
Visits to GM/CC Research Sites

7-10 January 2020
South, Rwanda
Tearfund SEAD Project Visit

17-21 February 2020
Nairobi, Kenya
SUCA Partner Meeting

25-28 February 2020
TBD, Rwanda
Country-level Training Workshop

NEIL ROWE MILLER

2-7 December 2019
Soddo, Ethiopia
CA Master Trainer Workshop

15-18 January, 2020
Harare, Zimbabwe
ALTA orientation, KMTC project visit

19-24 January, 2020
Mzuzu, Malawi
Country-level Workshop

17-21 February, 2020
Nairobi, Kenya
CA Scale-Up Project Evaluation

22-27 February, 2020
Arusha, Tanzania
ALTA team meetings