Farm Mechanisation and Conservation Agriculture for Sustainable Intensification

As the first Green Revolution largely bypassed Africa, there are increasing calls for a second Green Revolution in the region. It is widely recognized that this will require a new form of intensification - often coined ‘sustainable intensification’ - for the required productivity gains to be reached with minimum negative environmental and social consequences. Several initiatives are now promoting sustainable intensification in Africa. A common feature of these interventions is the increased efficiency with which resources necessary to farming are being used. However, emphasis is clearly placed on land, nutrients and water, whilst farm power appears as the ‘forgotten resource’.

In contrast with the rest of the world, the farm power available per area of agricultural land has been declining, or at best stagnating, in sub-Saharan Africa (SSA). From the 1970s to the 2000s, the number of tractors shipped annually to SSA has declined steadily, while the number of draught animals has declined sharply in many areas due to feed shortage, droughts, and diseases. As a result, agriculture in SSA increasingly relies on human muscle power. In addition, the quantity and quality of agricultural labour have also declined in many parts of the region, as a result of rural-urban migration, HIV/AIDS and the growing number of female-headed households. A consequence of low farm mechanization is high labour drudgery, which affects women disproportionately (in, e.g. weeding, threshing, and transport by head-loading). Moreover, labour drudgery makes farming unattractive for the youth.

Therefore, sustainable intensification in SSA appears unlikely if the issue of inadequate and declining farm power is not addressed (1) by reducing power demand through the adoption of power saving crop production systems such as conservation agriculture (CA), and/or (2) by increasing power supply through appropriate and equitable mechanization.

The FACASI project tackles the issue of farm power in farming systems of Eastern and Southern Africa by tapping the synergies between CA and small-scale mechanization. The elimination of soil inversion (the most energy-demanding farming operation in rain fed agriculture) in CA reduces power requirements and makes the use of lower powered and more affordable tractors such as two-wheel tractors (2WTs) a viable option for crop establishment.
In turn, the spread of mechanization may increase the adoption of CA in SSA, as the lack of appropriate implements is recognized as one of the major constraints to CA adoption faced by African smallholders. The combination of mechanization and CA may also mitigate the soil degradation which is a frequently witnessed negative effect of mechanization. Another potential synergy between mechanization and CA may come from the reduced use of crop residues for animal fodder that is expected from a shift from animal draught power to tractor power, resulting in an increased fraction of crop residue potentially available for surface mulching. Tapping these synergies between small-scale mechanization and CA is made possible by the recent development of seeders and other implements for 2WTs manufactured by newly emergent industrial economies such as India, China, Brazil, and SSA itself.

To make small-scale mechanization viable, FACASI will draw from experience in Asia, and in particular Bangladesh. Although Bangladesh is characterized by small and fragmented fields and relies on small machines, its agriculture is one of the most mechanized of South Asia, far more than India’s, which relies on larger machines and receives far higher levels of public support. Only about one in thirty farmers actually owns a 2WT, while the majority of farmers access mechanization by this model of mechanization appears equitable as even the poorest farmers have access to 2WT-based services. This is made possible by the low cost of 2WTs – making their purchase possible for many farmers without support of a formal financial institution – and the use of the 2WT for multiple purposes including transport, post-harvest operations and water pumping, leading to high annual rates of return on investment. A major objective of FACASI will be to foster private sector involvement in innovative business models to effectively deliver mecha-

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**FACASI training sessions held in Kenya and Tanzania in January-February 2014 by R. J Esdaile**

The purpose of the training was to introduce and familiarise key players in Kenya and Tanzania to the operation and maintenance of two wheel tractors and associated equipment (mainly seed drills) The Principal trainers were Scott Justice (small farm mechanisation specialist) CIMMYT Nepal, and R. Jeff Esdaile, (co designer of the Gongli Africa seed drill) of Australia. They were assisted by Joseph Mutua (KENDAT) in Kenya, along with John Sariah and Wilson Baitani (CAMARTEC) in Tanzania.

Each training session was three days with day one in the lecture room, discussing the general operational principles of two wheel tractors and their implements. Practical demonstrations and ‘hands on’ operation of two wheel tractors and accompanying equipment were done in a nearby Field. Some two wheel tractors were available as power units for the demonstrations.

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Kenyan delegates calibrate Gongli Africa seed drill
Equipment for testing in Kenya included:
- Several types of Brazilian made small seed drills suitable for two wheel tractor.
- Morrison single row disc/tine seed drill.
- Gongli Africa mounted seed drill.
- National Agro (Indian made) semi-mounted two wheel tractor seed drill.
- Various Chinese made rotary tillage seed drills.
- Kenyan made two wheel tractor one tonne trailer.

In Tanzania, unfortunately most of the seed drills explained and demonstrated in Kenya were not available, as shipments of two wheel tractors, Chinese seed drills, Brazilian seed drills, and Indian seed drills did not arrive in time. We therefore did extensive testing and demonstration on the Gongli Africa seed drill hitched to some other two wheel tractors, as well as the Tanzanian made Intermech seed drill which was partly developed at CAMARTEC. A two wheel tractor Nandra seed drill, made in Moshi, Tanzania was also inspected although not tested in the field.

Lessons from the training
- Much more training is needed with two wheel tractor and associated implements, particularly with ‘hands on’ operators.
- Links need to be further developed with two wheel tractor retailers and other parties who are involved in two wheel tractor marketing (tractor mechanics, spare parts resellers etc.) This is so that adequate backup can be developed once significant numbers of two wheel tractor units are operational in the field.
- The Chinese made vertical spoon feed seed meters (as fitted to some Chinese seed drills) look extremely promising for use in all two wheel tractor seed drills. The limited field testing done both in Kenya and Tanzania showed that these meters do a good job of maize metering, despite only average quality maize seed being available. Further critical evaluation and testing as part of FACASI is required.

- Local East African potential manufacturers of two wheel tractor equipment need to be encouraged to continue development of seed drills and associated implements (Ndume, Intermech, Nandra, Mohamed Elmi, CAMARTEC,)
- Some of the other uses of two wheel tractor for agriculture should be emphasised so that the versatility of these traction units can be recognised (transport with trailer, operation of small irrigation pump, grain threshing, grain milling, hay making etc.)
- A re-design of some of the seed drills is required, so that superior ground following ability is incorporated into the soil engaging components of the planter. It was found that East African fields can be very uneven, due to old ploughing and tillage practice, cattle hoofmarks and trampling, termite mounds etc.

Subsequent to improvements in the design of the soil engaging components, it will be much simpler to fit an operator seat and steerable tail wheel to the two wheel tractor, along with a manually operated lift system. Incorporation of these features will allow easier operation in the field (such as turning at the end of the row) and fast movement of the tractor/seed drill combination between fields or farms.

There is still a lot to learn regarding ballasting and weight distribution of two wheel tractor with seed drills attached. Experience in both Kenya and Tanzania showed that extra weight can increase tractive ability in tough conditions.

(The author, Jeff Esdaile is already in the process of modifying a Gongli Africa seed drill to overcome some of the design defects observed during the Tanzanian and Kenyan training).
Two-wheel tractor seed drill modified for African smallholder maize farmers

By Frédéric Baudron

The Farm Mechanisation and Conservation Agriculture for Sustainable Intensification (FACASI) project addresses the decline of farm power in Africa. The Project is working with small holder farmers to deliver small mechanization based on inexpensive, two wheeled tractors and introduce powersaving technologies, such as conservation agriculture.

In March 2013, Participants evaluated the performance of the Gongli seeder—a seed drill sold in China under the typical conditions of maize small holder farmers in Kenya and Tanzania. Gongli Inventor Jeff Esdaile, engineers from the Centre for Agriculture Mechanisation and Rural Technology (CAMATEC) and engineers from the Kenya Network for Dissemination of Agricultural Technologies met at a CAMATEC workshop from 9 to 20 September in Arusha, Tanzania to modify the Gongil seeder and produce Gongil Africa.

The Original Seeder is well suited to seed small grain crops in close rows into fields without long loose residue or heavy weeds. For sowing maize in a typical field around Arusha, however, the machine had several shortfalls. It handled loose maize residues and heavy weeds poorly, the pressing wheels got in the way of the operator’s walk.

The seed and fertilizer hoppers were too high and blocked the operator’s visibility, the seed meters were not precise enough for maize planting and transporting the machine from field to Field required walking long distances because the machine could not be ridden and could not fit in a trailer.

The modified Gongli Africa+ features cutting discs that can be fitted in front of the standard tines for heavy mulch and weed loads. Two large back tires, used as pressing wheels in the field have been added as well as a platform for the operator to stand on, facilitating transport to and from the fields. Because the machine is used to sow minimum of two rows, the third bar was removed from the seeder. The seed and fertilizer hoppers have been lowered and finally, specialized seed metering systems for large seeds such as those of maize have been installed.

Results from initial field testing have been encouraging. Thorough field testing took place in Tanzania and Kenya. After minor modifications, the specifications for the GoAfrica+ will be sent to Gongli LTD for commercial manufacturing.

The Fitarelli 2 row 2 WT seed drill
News Briefs

The First African Congress on Conservation Agriculture

The First African Congress for Conservation Agriculture (1st ACCA) that took place from 18th to 31st March 2014 in Lusaka, Zambia brought together key Conservation Agriculture stakeholders, including farmers and their organizations, from the continent to interact and co-own a permanent Conservation Agriculture knowledge and information sharing platform that takes into account the needs of farmers, increased networking, partnerships and information sharing. A number of FACASI project partners presented papers at this congress. To access the papers [http://www.africacacongress.org/search/node/book%20of%20condensed%20papers](http://www.africacacongress.org/search/node/book%20of%20condensed%20papers)

A Tanzanian Mother takes charge of Change

On a hot August day near the village of Kilima Tembo, and amid the sounds of barking dogs and clucking chickens, Felista Mateo stepped out of the house she built by hand, walked into her fields, and proudly admired her maize crop. The plants reached toward the sun, verdant and strong. Her plot stood in stark contrast to neighboring fields, which were pocked by brittle, knee-high plants.

A few years ago, things did not look so promising for Felista. She had separated from her husband and was left alone to care for her four children. Felista is a slight woman, not much more than five-feet tall, but her appearance belies her strength. Typically, a separated woman is ostracized when she returns to her parents’ home. Felista refused to see her newfound independence as an affliction. In Kilima Tembo, women do not own land, but Felista set out to acquire a plot from her father. She was determined to succeed. After the elders of the Village Council gave their approval, Felista became an independent farmer.

“Through their own determination, and with support from local researchers, CIMMYT, ICRISAT, and organizations in Australia, sub-Saharan African farmers are applying improved maize-legume cropping systems to grow more food and make money.”

For more information: Mulugetta Mekuria, SIMLESA project leader (m.mekuria@cgiar.org)

About the FACASI project

Farm Mechanization & Conservation Agriculture for Sustainable Intensification (FACASI) is a project centered on accelerating the adoption of CA in Eastern and Southern Africa through the promotion of mechanized CA technologies. FACASI is a four year project from the March 2013 to February 2016 and implemented in Ethiopia, Kenya, Tanzania and Zimbabwe. The project is operating in eight sites (two per country) half of them selected as a subsets of existing ACIAR-funded project sites (SIMLESA) - Sustainable intensification of maize legume cropping systems for food security in Eastern and Southern Africa - and ZimCLIFS - Integrating crops and livestock for improved food security and livelihoods in rural (Zimbabwe), the other half representing sites where NARS have conducted long-term CA and/or mechanization work. The project is implemented mainly through national agricultural research centres (or national NGOs) and regional networks in each

The project has strong links with CGIAR, Australian and Asian partners who provide specific training on agricultural engineering, as well as mentoring, capacity building, and academic support. CIMMYT coordinates the project implementation through its Ethiopia office.

For more information

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