

MUSCLE TO MACHINES: CUTTING LABOUR DRUDGERY IN AFRICA

Drawing lessons from Australia, Bangladesh and India, a new ACIAR/AIFSC-funded project in Africa will help mechanise conservation agriculture and relieve women of exhausting manual labour.

KEY POINTS:

- A new project will evaluate and demonstrate the best two-wheel tractor (2WT)-based technology for conservation agriculture across four African countries. The tractors and equipment will be selected from Australia, Asia and Africa.
- It will test commercial systems to deliver 2WTs to African smallholders.
- The mechanisation is expected to benefit families on more than 35,000 farms, create jobs and relieve labour drudgery.

BY LINDA VERGNANI

While smallholder farmers in countries such as India and Bangladesh rely increasingly on mechanised equipment, including two-wheel tractors (2WTs), in Africa many impoverished farmers are caught in a time warp and still rely solely on human muscle power.

"When you look at the production means and when you look at the farm power available, the difference is really shocking between Africa and other regions," says Dr Frédéric Baudron, cropping system agronomist at the International Maize and Wheat Improvement Center (CIMMYT) in Addis Ababa, Ethiopia. "Yet Africa is meant to compete in a global market."

While some people have a "very bucolic idea" of traditional African farming, Dr Baudron says in reality hand ploughing, weeding and threshing, and tasks such as pounding grain in wooden stampers involve backbreaking work.

This drudgery often falls to women or children, who may be kept out of school to work in the fields.

In Sub-Saharan Africa most government-run tractor hire schemes have collapsed and many draught animals have died from drought or disease. "Shockingly, the number of tractors in



A CIMMYT-led project to promote rapid adoption of two-wheel tractor technology in eastern and southern Africa will help mechanise conservation agriculture.

Sub-Saharan Africa has declined from 235,000 in 1970 to 222,000 in 2000," Dr Baudron says.

Although African farmers—many of whom are women or elderly people—still rely on muscle power, labour is getting scarce and expensive. This follows the deaths of millions of able-bodied people in the AIDS pandemic, as well as increasing migration to the cities.

Now Dr Baudron is leading a CIMMYT project that aims to promote rapid adoption of 2WT technology for conservation agriculture (CA) in eastern and southern Africa.

"Our entry point is to mechanise conservation agriculture," Dr Baudron says. "We also want to look at other tasks we should mechanise as a priority so that we can release some of this labour for more productive, more rewarding use."

The four-year project will identify and demonstrate the best imported and local 2WT-driven technology for CA in eight sites in Tanzania, Kenya, Ethiopia and Zimbabwe.

Among the goals of the Farm mechanization and conservation agriculture for sustainable intensification (FACASI) project is to test commercial models for delivering 2WT technology to African smallholders. It received A\$3.9 million of funding from the new

Australian International Food Security Centre (AIFSC) within ACIAR.

More than 35,000 farms will benefit from the project, according to a report on FACASI by Dr Baudron and Dr Bruno Gérard, director of the Global Conservation Agricultural Program of CIMMYT.

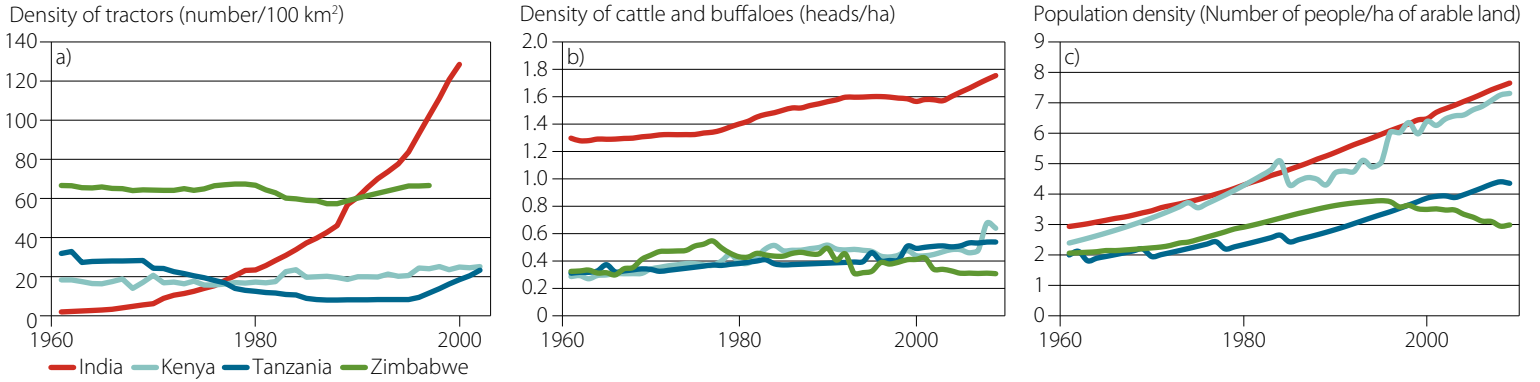
Smallholder farmers using 2WT-based CA are expected to increase their incomes by 50% and those adopting the equipment for transport, threshing and shelling to increase their incomes by 20%.

The project will also create jobs for about 360 rural service providers, who are likely to double their incomes. By the end of the project, the cumulative value of adopting 2WT technology will translate into an A\$18.5 million economic boost.

The mechanisation project will focus on communities already involved in CA through SIMLESA (Sustainable intensification of maize-legume cropping systems for food security in eastern and southern Africa) or ZimCLIFS (Integrating crops and livestock for improved security and livelihoods in rural Zimbabwe).

Local importers, tractor manufacturers and dealers will be trained in 2WT-based CA, including machine maintenance, agronomy and

Figure 1 African decline in farm mechanisation



Farm mechanisation in Sub-Saharan Africa has declined from 235,000 tractors in 1970 to 222,000 in 2000 (graph a). This is in contrast to other regions, where the number of tractors increased linearly (such as Latin America and the Caribbean) or exponentially (as in Asia). During the same period, the number of draught animals on the African continent declined sharply in many areas due to biomass shortage, droughts and diseases (graph b). The decline occurred even though population density (graph c) increased in the comparison countries.

mulch management. They will in turn train rural service providers. National policy workshops will target bottlenecks and opportunities for wider delivery of the technology, especially to poor and women farmers.

Dr Baudron says using cheaper, low-energy 2WT mechanisation for CA is “smart mechanisation”. It should avoid the problems agronomists observed in the 1980s when large-scale mechanisation using four-wheel tractors led to consolidation of farms, displacement of small farmers and job losses, as well as land degradation and erosion.

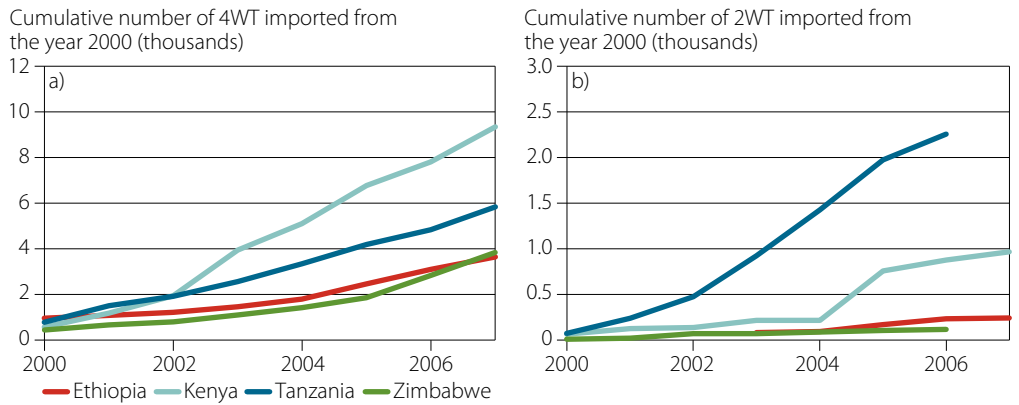
The project ties in with current government policies, programs or plans in Kenya, Ethiopia, Tanzania and Zimbabwe to give smallholders greater access to machinery. For example, in Tanzania following the 2009 and 2010 drought in which half the cattle and draught oxen died, the government imported more 2WTs from China and gave an 80% subsidy to smallholders to buy the vehicles.

The import of the 2WTs generated business opportunities, with local mechanics repairing vehicles and Tanzanian manufacturers developing rippers and planters.

Dr Baudron quotes a farmer in Karangai in north Tanzania who told him: “A two-wheel tractor is easier to maintain than oxen. It leaves you free, because it is non-living.” Another farmer commented that a person could work three to four acres of land a day using the small tractors compared with a quarter to half an acre using oxen.

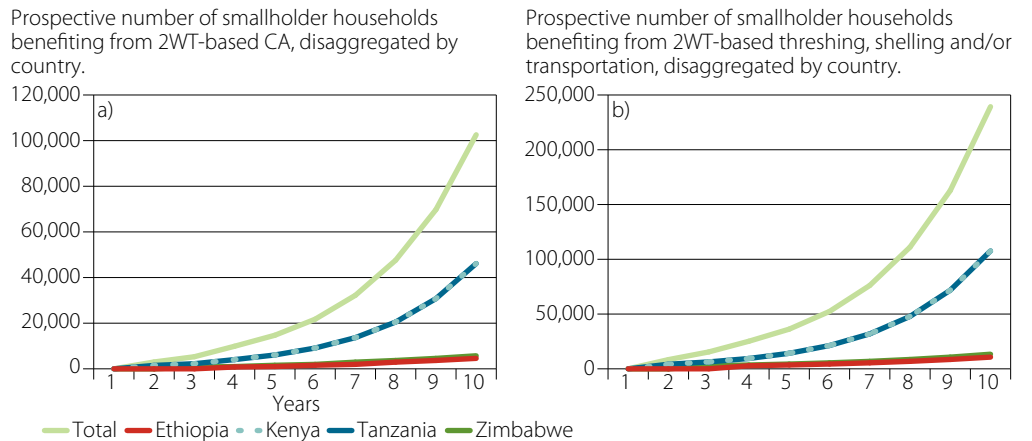
Dr John Dixon, senior adviser for cropping system economics at ACIAR and for the FACASI project, says: “The timing is perfect for another round of support for mechanisation in Africa.” It was tried 20 years ago by governments, but labour was still cheap and public-sector tractor schemes were poorly managed. “Now, with the support from many African

Figure 2 The forgotten resource—farm power



The need for sustainable intensification of farming in Sub-Saharan Africa is widely recognised. Although a lot of emphasis is being placed in current research for development work on increasing the efficiency with which land, water and nutrients are being used, farm power appears to be a ‘forgotten resource’. Yet farm power is in decline due to the collapse of most tractor-hire schemes, the decline in draught animals, and the impact of urban migration and pandemics on human labour. The resulting high labour drudgery disproportionately affects women.

Figure 3 Projected growth in benefits to smallholder households from an ACIAR project to reverse the decline in farm mechanisation in eastern and southern Africa.



governments to small-scale business, we believe that the environment is much better for using commercial models for small-scale mechanisation that will be within reach of

the smallholders.

“What’s quite intriguing about this project is it’s not about promoting mechanisation as such. It’s really about testing different

commercial models for the provision of small 2WTs and associated equipment for CA. And so the real focus is on small-scale business rather than on farmers or on factories."

According to Dr Dixon, FACASI will allow Africa to draw on the CA expertise of Australia, which leads the world in CA food production, and the small-scale mechanisation experience of South Asia.

The Indian Council of Agricultural Research recently hosted a small-scale mechanisation training workshop in Bhopal and Ludhiana for about 15 African businessmen, researchers and representatives of non-government organisations. "Later, African professionals will have a look at how Bangladesh has been so successful with 2WTs," Dr Dixon says.

"On top of that, China is very interested and China's 2WT companies have said that they will provide support for training in Africa as the sales of 2WTs begin to increase. So I think we've got an international hook-up orchestrated by Australia that should be of immense value to Africa."

Dr Dixon cites Bangladesh as the "stand-out example" of successful 2WT mechanisation. Following a policy shift that facilitated importing 2WTs from China 20 years ago, there was a revolution in small-scale agriculture in Bangladesh.

Dr Dixon says ACIAR's experience in Bangladesh shows that "it's small farmers, who pick up or purchase a 2WT and then become business providers by leasing or renting out those tractors with the equipment to their neighbours or even to farmers in other districts nearby."

The inaugural meeting of the mechanisation project, held in Arusha in Tanzania in March, was attended by about 60 researchers, business people, importers and manufacturers of 2WTs, representatives of finance and credit organisations and government officials.

Professor John Blackwell, professor of Innovative Agricultural Water Technologies at Charles Sturt University, who attended the meeting, says: "The project is about exploring clever ways to get the available machinery into the African market, through small businesses, importers, sellers and service providers."

The inventor of the Happy Seeder, which is widely used with four-wheel tractors for CA in India, Professor Blackwell is involved with evaluation and training for FACASI.

He says in Tanzania the group saw a few 2WTs, with trailers behind them, being used for transport rather than tilling or preparing land. "We want to introduce 2WTs and the required machinery, as an aid to CA that will save labour, preserve soil and preserve water.

"A lot of existing 2WT technology is

not suitable for achieving conservation agriculture in African conditions," Professor Blackwell says.

"We will encourage African innovators, mechanics and engineers to modify the available machines and equipment to suit their conditions."

The 2WTs are usually equipped with a rotary cultivator, which is the driving force for their uptake in Bangladesh's rice-paddy-based agriculture. However, rotary hoeing and conventional ploughing are contrary to the minimum-tillage principle of CA. Professor Blackwell says modifying rotary hoes to strip-till will be "a step in the right direction".

For minimum disturbance, the 2WT can also pull two shallow-depth tines or disc coulters for direct seeding.

While many large farms in Zimbabwe and Kenya are fully mechanised, Professor Blackwell says the 2WT-based mechanisation is aimed at millions of smallholders living on the poverty line. "Perhaps this small-scale mechanisation approach can get them out of the poverty trap. It will be a beginning."

The Food and Agriculture Organization (FAO) is among groups partnering with CIMMYT to implement the mechanisation project.

Josef Kienzle, agricultural engineer at the Plant Production and Protection Division of the FAO, says: "Farm power is a critical input for sustainable crop production intensification in the region; it is a limiting and scarce factor that can be mitigated by the provision of farm power in the form of 2WTs."

Melissa Wood, director of the AIFSC, believes the uptake of 2WTs could be even quicker in Africa because of labour shortages at critical times of the year. She notes: "Gender must be mainstreamed into all our research as the majority of smallholder farmers in south-east Africa are women. What we have found is women are quite able to handle these 2WTs. So we think that will fit very well with the current agenda for delivering gender responsive technologies." ■

PARTNER COUNTRIES

BANGLADESH, ETHIOPIA, INDIA,
KENYA, TANZANIA, ZIMBABWE

PROJECT: FSC/2012/047 Farm
mechanization and conservation
agriculture for sustainable intensification
(FACASI)

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THE FAST TRACK

If African maize farmers could rapidly adopt sustainable agricultural practices that increase their yields, it would make them less vulnerable to climate change shocks, improve food security and reduce poverty in the region.

This is the rationale behind the new Adoption Pathways study of 3,600 farming households in five African countries: Ethiopia, Kenya, Tanzania, Malawi and Mozambique. Researchers will assess how quickly smallholders in 220 farming communities take up sustainable agricultural intensification (SAI) technologies.

Sustainable agriculture allows farmers to produce more on the same plot of land while reducing environmental harm. Repeat studies of the same households in 2013 and 2016 will identify socioeconomic factors that speed up or hold back uptake of the improved practices.

The project, which is being funded by the Australian International Food Security Centre and managed by ACIAR, will identify policies that could encourage faster uptake of sustainable agriculture. It is expected to benefit about 130,000 farmers over 10 years and help address food shortages in the region.

Dr John Dixon, senior adviser and manager of ACIAR's Cropping Systems and Economics Research Program, says: "Rapid adoption of sustainable agriculture is a critical challenge across many parts of Africa, from Cape Town to Casablanca. If we can understand more about what causes adoption and especially what accelerates it, then we could get farmers to take up the agronomy, the conservation agriculture, the market access and institutional innovations much more quickly, so the benefits will come sooner. We can reduce poverty more quickly and avert and avoid many deaths associated with hunger and malnutrition."

The project is being undertaken in partnership with the International Wheat and Maize Improvement Center (CIMMYT). Collaborating institutions include the University of Queensland in Australia, the Ethiopian Institute of Agricultural Research and universities in Tanzania, Kenya, Mozambique and Malawi.

Project leader Dr Menale Kassie, an agricultural economist in the Socioeconomics Program of CIMMYT, says: "This Adoption Pathway project is mainly focusing on the uptake of intensification technologies such as: agronomic practices; use of fertiliser and improved varieties; maize and legume intercropping or rotation; and zero or minimum-tillage. These are the complementary conservation agriculture practices and technologies promoted by SIMLESA [Sustainable intensification of maize-legume cropping systems for food security in Eastern and Southern Africa project]."

The two Adoption Pathways surveys will be done in more than 500 villages where SIMLESA has introduced improved farming methods. The researchers will visit the same households where SIMLESA baseline data was gathered in 2010 to find out what changes smallholders have made.

While previous studies concentrated on specific SAI technologies, such as the uptake of fertiliser, the new study takes a more holistic approach. "We are trying to look at the drivers of adoption such as policies, market access and institutions. We also want to look at the role of extension services in influencing adoption of new technologies," Dr Kassie says.

"We will collect the same information from the same households over time. Adoption is a process that takes a while and the benefits of technologies may not be seen in the short term, especially with conservation agriculture."

Dr Kassie adds that even with short-term technologies, such as using fertiliser and improved seed, farmers are observed adopting these and then tomorrow or in the near future they drop the same technology. "So why is this happening? Why is this adoption and dis-adoption taking place?"

Researchers will also examine what farming practices and technologies women farmers use compared with men. They will look at the role of gender in agricultural development to see if there is a difference with technology adoption or approach to food security between female and male farmers, as well as between a wife and husband in the same house.

For example, farmers who have planted improved maize or legume varieties will be asked if they or their spouse took the decision to plant the new varieties, how they found out about these varieties and who got the credit or cash to buy the seeds.

According to a report on the project, the findings will "facilitate the formulation of robust pro-poor and gender-equitable policies" that promote the spread of SAI technologies and improve food security. Dr Dixon says the lessons learnt from this project will be useful for other projects and governments across Africa.

PARTNER COUNTRIES

ETHIOPIA, KENYA, MALAWI,
MOZAMBIQUE, TANZANIA

PROJECT: FSC/2012/024 Identifying
socioeconomic constraints to and incentives
for faster technology adoption: Pathways
to sustainable intensification in eastern and
southern Africa (Adoption Pathways)

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Farm mechanisation

In Keni South, located in eastern Kenya's Embu district, farms are still ploughed mainly by hand. Asliphon Nyaga farms a small plot of land, growing maize and sometimes bananas. She is like many women across eastern Africa, tending small plots of land and raising a family.

Input costs are rising and with little spare money Mrs Nyaga has to make choices about crops, purchasing expensive fertilisers and how to market any surplus produce. Labour is becoming scarcer and therefore more expensive.

In doing the work herself, Mrs Nyaga is typical of many farmers in rural Africa. Unable to afford to buy or hire a small tractor, and having no draught animals, she must till, weed and harvest her crops by hand, and work out how to move any surpluses to market herself.

The possibility of intensifying production without external help is remote, both in terms of labour or power and access to new farming techniques and crop varieties. Yet it is farmers such as Mrs Nyaga who are expected to carry much of the load in meeting increasing demand and sustainably increasing production in Sub-Saharan Africa.

ACIAR's Sustainable intensification of maize-legume cropping systems for food security in eastern and southern Africa (SIMLESA) project is working with farmers, including Mrs Nyaga, to introduce new farming practices and crop varieties. Through support from the project, delivered by the Kenyan National Agricultural Research Institute, Mrs Nyaga has learnt about conservation agriculture (CA), introduced legume crops and now uses manure and fertiliser. The result is improved yields.

CA is central to SIMLESA, which is adapting this approach to the unique needs of smallholder farmers across five east African nations. The approach acknowledges the realities of farming systems in each nation and adapts the introduction of CA to those realities. For example, in Ethiopia, where livestock is common, use of crop residues differs to that in Kenya.

The aim is to introduce smart CA approaches to boost yields. This will provide a platform for the farm mechanisation work to build on, accelerating adoption. Smart CA is helping Mrs Nyaga and many other farmers to boost yields and earn more income. For Mrs Nyaga, the future may extend to accessing mechanised labour, introduced through ACIAR's farm mechanisation research.

Trilateral partnership a first

Conservation agriculture (CA) is well established in parts of India, so much so that the country is now hosting African researchers interested in farm mechanisation. The visit was organised as part of ACIAR's farm mechanisation research project and is the first trilateral partnership between ACIAR, the Indian Council of Agricultural Research (ICAR), and the International Maize and Wheat Improvement Center (CIMMYT).

The training tour also represents a first in cooperation between the African nations of Kenya, Tanzania, Ethiopia and Zimbabwe, and India and Australia in agricultural research.

The Director General of ICAR, Dr S Ayyapan, says the exchange represents a strengthening of south-south collaboration by encouraging mutual learning and growth between countries. Dr Ayyapan says that India and Africa have many similar challenges and such exchanges offer a good model to carry forward future activities to benefit all involved.

The visit was organised and coordinated by CIMMYT in partnership with ICAR and the Central Institute of Agricultural Engineering (CIAE) in Bhopal. Other host institutions were: the Central Farm Machinery Training and Testing Institute Budni; Borlaug Institute for South Asia; PACS-machinery hire bank/cooperative; Punjab Agricultural University; National Agro Industries; Jagatjit Agro Technology; Dashmesh Mechanical Engineering Works; Amar Agro Industries; All India Machinery Manufacturers Association; CIMMYT on-farm CA sites and farmer cooperatives; Central Soil Salinity Research Institute; and the Directorate of Wheat Research in Karnal.

The delegation was led by the Farm power and conservation agriculture for sustainable intensification (FACASI) project coordinator, Dr Frédéric Baudron, and engineer Saidi Mkomwa, executive secretary of the African Conservation Tillage Network, during the first and second week respectively.

A feature of the exchange was three days of hands-on-training on manual, animal traction, and two-wheel and four-wheel tractor machinery at the CIAE. Participants also welcomed the opportunities to share stories and build a network of CA practitioners across several countries.

One of the main outcomes of the tour was the identification of CA equipment to match FACASI mechanisation needs.