



African Insect Science for Food and Health

icipe



Push–pull and physically disabled farmers: an appropriate agricultural technology for improving livelihoods

The smallholder farmers who make up 80% of the population of sub-Saharan Africa face many challenges in producing adequate and reliable grain harvests on which their livelihoods depend. These include virulent pests, invasive weeds and eroded soils with low fertility. These constraints are being made worse by increasingly erratic rainfall and longer seasonal droughts.

Push–pull is a conservation agriculture technology developed to tackle some of the natural resource problems faced by smallholder farmers in East Africa. The principal pest and weed problems in cereal production in this region are the stemborer, an insect pest, and striga, a parasitic weed. To tackle these two enemies, push–pull farmers establish perennial stands of two fodder crops, one between the rows of their main cereal crop, and the other around the field. The natural chemicals produced by these companion fodder plants provide effective control of both the stemborer and the striga.

When farmers adopt push–pull they not only achieve a dramatic and sustainable increase in cereal yields, but also benefit from enhanced soil fertility, obtain year-round fodder for their animals, and can now reap the benefits of using drought-tolerant companion plants.

While all the farmers in East Africa share the same natural resource and climate-related limitations, some also face additional challenges. Disabled farmers often struggle with the heavy physical labour demanded by agriculture. Perhaps equally restricting is the social exclusion and marginalisation which they face on a day-to-day basis, which all too often translates into others believing that disabled people cannot be farmers. For most rural disabled people, begging is the only alternative to farming.

Push–pull has proved to be an appropriate agricultural alternative for rural disabled people. Once a push–pull plot is established, relatively little labour is needed to produce a good harvest from a small area. The fodder produced on the plot is particularly appropriate for small, stall-fed livestock, which are more easily managed than larger, free-grazing animals. And disabled farmers who have successfully adopted push–pull have experienced a growth in confidence and independence which is a crucial part of successfully overcoming the challenges of disability.



Ezra Amoche, 55, is a disabled farmer who supports his family of six from a 1.5 acre smallholding in Vihiga district. Before he adopted push–pull in 2011, Ezra says that he could not feed his family because of poor yields caused by striga and stemborers. From his 30 m x 20 m maize plot, he previously harvested less than half a 90 kg bag of maize each season, but this has risen to two and a half bags since he adopted the technology.

Overcoming the challenges of disability...

The majority of disabled people in Africa face immense challenges in gaining a livelihood. They often have limited access to education, face discrimination on the grounds of disability in the job market, and encounter numerous infrastructural barriers. When disabled people are born into families that are already poor, the seeds of extreme poverty are often sown.

In addition to these considerable obstacles, people with disabilities are often perceived as second-class citizens, frequently suffering disdain, abusive language and even violence. This severely hinders their capacity to make an independent living.

But disabled people have ideas, skills and talents like anyone else. If these are supported and nurtured in the right way, there is enormous potential for them to overcome some of the barriers they face and replace poverty and hunger with sustainable livelihoods and food security.

...with an alternative approach to agriculture

Push-pull has already proven its success as a holistic technology that simultaneously addresses many of the constraints faced by smallholder farmers, dealing effectively with pests and weeds, increasing the productivity of crops and livestock, and supporting several important agro-ecosystem functions. But in recent years it has also become evident that it has special advantages for disabled farmers.

After the first cropping season, which is labour-intensive, push-pull technology significantly reduces the labour needed to produce grain in subsequent seasons. Digging and weeding – both heavy tasks,

particularly when striga is involved – are almost completely eliminated from the labour cycle.

Furthermore, push-pull produces a good yield of both grain and fodder from a small area. The fodder is suitable for a variety of smaller livestock, including poultry, rabbits, goats and sheep. These features of the technology are particularly important when labour and mobility are limited.

Experience has also shown that push-pull is very compatible with collective and group activities. In several cases, groups of disabled people are cultivating push-pull plots with collective labour, using the harvest as emergency food or savings, and sharing the fodder between them. The mutual support and solidarity of working together can be immensely empowering, and such collective fields are often also used as demonstration plots and outdoor classrooms.

What is push-pull?

Invented in 1997 by Dr Zeyaur Khan, Principal Scientist at the International Centre of Insect Physiology and Ecology (*icipe*) in Kenya, push-pull technology is a novel cropping system designed to integrate pest, weed and soil management in cereal-based farming systems. It involves driving cereal stemborers away from the crop by using a repellent intercrop plant, desmodium (the 'push'), while at the same time attracting stemborers with a border crop of Napier and Brachiaria grass trap plants (the 'pull'). Chemicals released by the desmodium roots also result in very effective control of the troublesome parasitic weed striga.

As well as controlling stemborers and striga, thereby increasing cereal yield, the push-pull companion plants provide high-value animal fodder, which farmers can sell or give to stall-fed dairy cows and other livestock. The



Jairus Ounza, wheelchair-bound since he was injured in an accident, raises rabbits with the fodder from the push-pull plot he and his family planted in 2011. The small animals are easy to manage and transport to market, their meat fetches a good price, and Jairus can comfortably collect the manure from their enclosures to return to the push-pull plots. His success in thinking up and developing this innovative, wheelchair-accessible enterprise clearly illustrates both how the talents and strengths of disabled people can be nurtured into a source of livelihood, and how push-pull can contribute to this.



desmodium also serves to increase soil fertility, prevent soil erosion and conserve moisture.

Since they began work on push-pull, Dr Khan and his team of scientists at *icipe* have consulted farmers at every stage of the development and adaptation of the technology and encouraged adopters to educate other farmers. This approach means that the spread of push-pull is rooted in a set of farmer-centred and inclusive extension practices.

Close relationships with farmers mean that scientists have been able to respond to changing needs and

circumstances by adapting the technology. In recent years, farmers began to report that the original push-pull companion plants, silverleaf desmodium and Napier grass, could not always withstand the hotter and more frequent seasonal dry spells. As a result, Dr Khan's research group at *icipe* carried out new research in collaboration with Professor John Pickett's group at the UK's Rothamsted Research, and in 2011 developed 'climate-smart' push-pull, which includes two drought-tolerant companion plants, greenleaf desmodium and Brachiaria grass.

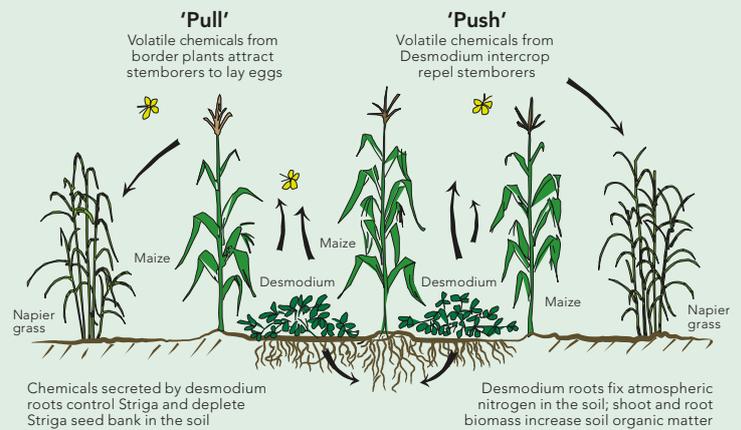
How does push-pull work?

Push-pull prevents stemborers attacking cereals by intercropping with a 'push' plant, such as desmodium, and planting around this intercrop a border of a stemborer-attractive 'pull' plant, such as Napier grass.

In addition to repelling or pushing the stemborers away from the crop, desmodium also suppresses the parasitic weed, striga. It stimulates germination of the striga seeds, then inhibits growth of its roots, thereby preventing its attachment to a host plant.

On top of controlling stemborers and striga, the leguminous desmodium intercrop fixes atmospheric nitrogen, adds organic matter to the soil, conserves soil moisture and enhances soil biodiversity, thereby improving soil health and fertility. It provides ground cover and, together with the surrounding grass trap crop, protects the soil against erosion.

See www.push-pull.net for more information.



Infestation with the parasitic weed *Striga hermonthica* leads to cereal yield losses of 30–100%.



The large stems of maize plants provide an ideal habitat for the larvae of stemborer moths.



A conventional push-pull plot planted with a maize crop. Push-pull was developed in 1997 and introduced to farmers in 1998 and uses silverleaf desmodium (*Desmodium uncinatum*) as an intercrop and Napier grass (*Pennisetum purpureum*) as a border crop.



A climate-smart push-pull field planted with sorghum. Climate-smart push-pull was developed in 2011 to withstand long droughts and high temperatures. Introduced to farmers in 2012, it uses two drought-tolerant species: greenleaf desmodium (*Desmodium intortum*) as an intercrop and Brachiaria grass (*Brachiaria cv mulato II*) as a border crop.

Spreading push-pull through strong partnerships and shared knowledge

Since conventional push-pull was first introduced to two groups of ten farmers in 1998, the technology has spread to nearly 70,000 farmers in Ethiopia, Kenya, Tanzania and Uganda. Its remarkable spread is based on several basic principles. Push-pull is:

- **Farmer-centred.** Farmers have been included at every stage of the scientific research which underpins push-pull and are recognized by *icipe* as the most important resource in the farming system. This means that their knowledge and practices, and the constraints they face, are respected and taken seriously.
- **Knowledge-intensive.** Dr Zeyaur Khan, who developed the technology and has led the push-pull programme from the outset, has always argued that push-pull functions most effectively when farmers understand how it works. This means that dissemination has always had a very strong focus on building the capacity of farmers. The technology has been extended to farmers by trained, district-based field workers who teach farmers how it works, usually using on-farm demonstration sites and holding regular field days. For the last fifteen years, they have also trained a network of farmer-teachers to recruit and support their peers in using push-pull, as

well as establishing farmer groups and facilitating farmer field schools.

- **Inclusive.** The technology has been extended in a deliberately inclusive way, allowing it to be adopted and used successfully by many different kinds of farmers, regardless of gender, age, physical ability, wealth or location.
- **Partnership-based.** The development, spread and adaptation of push-pull have been based on *icipe*'s strong partnerships with scientists, development organizations and local groups. In many cases, these partnerships have endured over many years, and have been a fundamental element in ensuring that the technology has been made available to as many farmers as possible and remains responsive to their needs.

These fundamental principles meant that when, in 2010, push-pull farmer-teacher Josiah Okonda met a group of disabled people in Kenya's Maseno district who were trying to develop their horticultural skills, their encounter triggered a new partnership for the spread of push-pull, and a new understanding that the technology could help disabled people towards independent livelihoods. The box opposite tells the story of the Maseno Depot Disabled Group.



Dr Zeyaur Khan, Principal Scientist at *icipe* who invented the push-pull technology and is the driving force behind its dissemination and uptake, makes frequent field visits to farmers to learn about how the technology is working in practice. Here, he is at the farm of Richard Ogalo, Secretary of Maseno Depot Disabled Group, where Richard's four-year-old son is helping to carry home freshly harvested Napier grass from push-pull to feed their dairy goats.

A pivotal partnership: the Maseno Depot Disabled Group and *icipe*

The Maseno Depot Disabled Group (MDDG) was founded in 2002 with 10 members. "We had to do something urgently," says Group Manager Richard Ogalo, "instead of just sitting, unemployed." The group – whose motto proudly states that "Disability is not inability!" – has since grown five-fold. It exists to share the talents and skills of disabled people in order to overcome their disability.

The MDDG meets every Wednesday, and over the last ten years their activities have included poultry farming and goat keeping, small-scale horticulture, rotational savings and advice to people living with HIV/AIDS.

In 2010, Maseno became a 'focal area' for Kenya's National Agriculture and Livestock Extension Programme. Under this approach, resources from the National Agriculture and Livestock Extension Programme (NALEP) are directed to targeted areas within each district. As a group within the focal area, MDDG participated in a NALEP Stakeholders Forum and accessed support to develop their agricultural and horticultural activities.

Engaging with NALEP brought MDDG into contact with Josiah Okonda, who had been elected as the Secretary of the NALEP Focal Area Development Committee by his fellow farmers in Maseno. In addition to his NALEP duties, Josiah is also a push-pull farmer-teacher. As the MDDG worked with NALEP to identify and analyze the constraints they faced in developing as farmers, Josiah suggested that push-pull might be a useful solution for them. Some members had already heard of the technology and visited a demonstration plot.

Josiah arranged a visit to the group by an *icipe* field technician who explained push-pull to the members and invited some to a field day in neighbouring Kisumu West district. This encounter was *icipe*'s first experience of working with a disabled farmers group.

Those who attended the field day remember it as a turning point in the fortunes of the MDDG. The well-attended event, which coincided with the official launch of the climate-smart version of push-pull, was held on the farm of Remjius Bwana of the Yenga Push-pull Farmers Group, an articulate and passionate advocate of the technology. The visitors from MDDG were convinced not only by the fine crop of maize on Remjius' push-pull plot, but also by their exposure to and conversations with experienced and knowledgeable farmers. When they returned home, the whole group unanimously decided to adopt the technology.

The MDDG subsequently planted their first communal plot on land offered by a local church. They were helped by *icipe* Field Technician Philip Akello and farmer-teacher Josiah Okonda, who were both very impressed with the members. "Given the opportunity," says Josiah, "they can respond to any call."

Three quarters of group's members have now also planted push-pull on their own family farms. When the church unexpectedly reclaimed its land, the group continued undaunted, leasing a new plot from a supporter and planting again from seed. This time, they carefully designed their plot with a view to educating others through demonstrating several different options for using the full range of push-pull companion plants.



Mary Atemo was one of the MDDG members who attended the field day and launch of climate-smart push-pull at Remjius Bwana's farm in Kisumu West. She subsequently adopted push-pull on her farm. In 2012, *icipe* facilitated her appearance on *Shamba Shape-up*, a weekly agricultural television programme on Kenya's Citizen TV station which broadcasts across the whole country. Since then, she says, "I have become a role model for other farmers to see."

The MDDG developed a strong relationship with *icipe*, and through this with other push-pull farmers. Before long the group had become a hub for the spread of push-pull among other disabled farmers and their groups. Members take tangible pride in explaining the science behind their plot, and telling their stories of how using the technology has transformed their lives.



Members of MDDG hosted a visit from *icipe*'s Governing Council in November 2012. Governing Council Chairman Professor John Pickett is an organic chemist at Rothamsted Research in the UK, and one of the scientists whose research on the chemical ecology of plant-insect relationships contributed to the development of push-pull.

Outcomes of push-pull for disabled farmers

Tackling hunger and poverty

Adopting push-pull has helped many farmers tackle hunger and poverty. The increases in grain yield it often brings make them more likely to be able to grow enough to feed their families. In addition, fodder, grain and milk are all commonly sold to raise the money needed to meet household needs, especially school fees. Rumona Mayoka's story shows how push-pull has helped members of her group move away from food insecurity.

Rumona, 36, is a charismatic woman who has shunned her disability. She founded the Emanyinya People with Disability Group in 2011, in her native Vihiga district. Together, members learn about different livelihood strategies, using many enterprises to try and enhance their agricultural practices, become food secure and generate income.

Rumona learned about push-pull from Mary Atemo of MDDG. She remembers that before hearing of push-pull, she had lost faith in agriculture, because her land was "devastated by striga." But having met Mary and seen her push-pull plot, Rumona says that she and her members "were convinced that this was a good technology," and in 2012 the group leased land from a neighbour and planted a joint learning and demonstration plot.

In the first season, the plot did not do well because the soil was too depleted of nutrients. But subsequent seasons produced more attractive yields, and Rumona is happy to report that all 38 members of her group have now adopted push-pull and are able to grow much more

of their own food. The group is planning to establish more demonstration plots and build a cereal store for their collective harvest.

"Poverty and hunger," says Rumona, "are great problems." Her vision is to teach all the farmers in her neighbourhood to use push-pull, so that everyone gets enough staple food.

Overcoming the barriers to entering agriculture

Many disabled people are held back from farming independently because of a lack of self-belief and the absence of encouragement from others. Berryl Atieno's story shows how push-pull helped her overcome these barriers to becoming a productive farmer.

Berryl grew up on her family's two-acre smallholding in Vihiga district. Under the 22-year-old's shy demeanour lie inner strength and a powerful determination to achieve. Despite her physical disability, she strived to equip herself for off-farm employment by completing her secondary education and taking a computer studies course to enhance her employment possibilities. But once qualified, she could not find work and became lonely and disillusioned. Wanting to find out what other disabled people do, she travelled 6 km from her home to see what the MDDG could offer her. "I was very impressed," she says, "and I was encouraged that I could do what other people could do in society, without depending on others."

After joining MDDG, Berryl learned about push-pull and reconsidered the possibility of an agricultural livelihood. She requested a small piece of land from her parents, and in 2012 they reluctantly gave her a very unproductive quarter-acre patch of their two-acre farm.



The Emanyinya People with Disability Group discuss their activities for the 2013 short rainy season. Chairperson Rumona Mayoka, third from left, listens attentively to the needs of her group.



Beryl Atieno is taught how to manage silverleaf desmodium by *icipe* Field Technician Dickens Nyagol. Her siblings are also eager learners.

"I proved that I could work alone. I tilled the land myself and my siblings only helped me to plant it," says Beryl proudly.

Beryl amazed her family by producing two 90 kg bags of maize in the short rains of 2012, and three in the long rains of 2013. This was a stark contrast to her mother's equal-sized plot, which yielded only 7 kg of maize, because of stemborers and striga. Her parents, inspired by their daughter's achievements, have subsequently adopted push-pull.

Integrating crops and livestock

Push-pull delivers its best outcomes when it is incorporated into mixed farming systems which integrate crops and livestock. In particular, feeding desmodium to dairy animals has a positive effect on milk production, which is not only beneficial to the diet of farm households, but which can also be sold. The story of Caleb Omino and the Maseno Disabled Self-help Group illustrates how livestock-centred self-help activities can benefit from the inclusion of push-pull in group activities.

Caleb Omino is a man of few words, but has a dignified presence and a great heart for his community. He is a founder member and Chairman of the Maseno Disabled Self-help Group, whose members are all either physically disabled or living positively with HIV/AIDS. The group started up in 2006 with the mission of providing its 45 members with sufficient nutrition.

It began by approaching the African Medical and Research Foundation (AMREF), a non-governmental organization which works to support many HIV-positive people. AMREF provided the group with two dairy goats and a buck. From this modest start, members now have ten dairy goats between them. The nutritious milk from the animals has considerably improved their diet.

But Caleb recalls that as the number of animals grew, so too did the demand for fodder. Faced with this challenge, and the problem of striga on their farms, the group sought to learn push-pull from their friends at MDDG. "We were very attracted by the quality of the plants we saw under push-pull," says Eric Opiyo, the group's Secretary.

Now, push-pull provides fodder for the group's dairy goats at the same time as significantly improving their individual grain yields, both of which bring the group much closer to achieving its mission.



Caleb Omino leads a meeting of the Maseno Disabled Self-help Group. Thirty-five of its 45 members have adopted the technology.

Ensuring the further spread of push-pull to disabled farmers

The experiences of these disabled farmers in Kenya clearly demonstrate that push-pull is an adaptable technology which fits their capacities and builds on their strengths. Those who have adopted it have improved their food security thanks to the increased grain yield, improved soil fertility and the year-round fodder that push-pull delivers.

But for many disabled push-pull farmers, the experience of being treated with respect while learning about the technology, and being encouraged to develop their talents through sharing their knowledge with others, has also built their confidence and self-esteem. As Rumona Mayoka says, "push-pull has taken us to a level where we no longer consider ourselves disabled, because we are farmer-teachers."

Push-pull has the potential to transform the lives and livelihoods of many more rural disabled people. Achieving this is a question of systematically supporting the spread of knowledge – from group to group and from farmer to farmer – which has already begun of its own accord. It also means continuing to raise the profile of push-pull as an agricultural alternative for disabled people, and encouraging disabled farmers to become positive role models for their peers.

Acknowledgements

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Berry! Atieno is on a mission to inspire other disabled people. She has written a poem celebrating what push-pull means to her, which she hopes will energize her peers and help further the spread of push-pull.

If Given a Chance

*Many a time
you have looked down upon us
when you see us
on the street,
crawling and begging.
But today,
we are on our toes.
Farming we can,
if only given a chance!*

*Gone are the days
that we needed help.
What we need now is
education and a conducive
environment,
and we shall change our lifestyle
and the world at large
through push-pull technology.
If only given a chance!*

*When you see us begging
stop giving to us,
but be like icipe people who
have taught us
how to depend on ourselves
through push-pull technology.
If only given a chance!*

*Do not judge us
when you see us
on a wheelchair or with a pair
of crutches.
These are just a support.
We can educate others on
maize farming,
poultry farming, rabbit rearing,
through push-pull technology,
If only given a chance!*