

# Push-pull and physically disabled farmers:

an appropriate agricultural technology for improving livelihoods

**T**he smallholder farmers who make up 80% of the population of Sub-Saharan Africa (SSA) face many challenges in producing adequate and reliable grain harvests on which their livelihoods depend. These constraints include ravaging pests, invasive weeds and eroded soils with low fertility, and they 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 smallholders in SSA, where the principal pest and weed problems in cereal production are stemborers and fall armyworm, both insect pests, and striga, a parasitic weed. To tackle these 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 plants provide effective control of insects and 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, year-round fodder for their animals, and reap the benefits of drought-tolerant companion plants.

While all cereal farmers in SSA face essentially the same natural resource and climate-related limitations, some have additional challenges. Disabled farmers often struggle with the heavy physical labour demanded by agriculture. Perhaps equally restricting is social exclusion and marginalisation, 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



Ezra Amoché, 55, is a disabled farmer who supports his family of six from a 1.5-acre smallholding in Vihiga County, Kenya. Before he adopted push-pull in 2011, Ezra says he could not feed his family because of poor yields caused by striga and stemborers. From his 30 × 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.

plot is established, relatively little labour is needed to produce a good harvest from a small area. The fodder produced is particularly appropriate for small, stall-fed livestock, which are easier to manage than larger, free-grazing animals. Disabled farmers who have successfully adopted push-pull have also experienced a growth in confidence and independence – a crucial part of successfully overcoming the challenges of disability.

## Overcoming the challenges of disability...

The majority of disabled people in Africa face immense challenges in gaining a livelihood. They may 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 perceived as second-class citizens, frequently suffering disdain, abusive language and even violence. This severely hinders their capacity to live independently. 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 barriers and replace poverty and hunger with sustainable livelihoods and food security.

## ...with an alternative approach to agriculture

Push-pull is a proven, holistic technology that simultaneously addresses many of the constraints faced by smallholders. It deals effectively with pests and weeds, increases the productivity of crops and livestock, and supports several important agro-ecosystem functions. It also has special advantages for disabled farmers.



The late Jairus Ounza, wheelchair-bound after he was injured in an accident, raised rabbits with the fodder from the push-pull plot he and his family planted in 2011. His success in developing this innovative, wheelchair-accessible enterprise clearly illustrates how the talents and strengths of disabled people can be nurtured into a livelihood, and how push-pull can contribute.

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-duty 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 small livestock, including poultry, rabbits, goats and sheep. These features are particularly important for those with limited labour and mobility.

Experience has also shown that push-pull is perfectly compatible with collective and group activities. Several disabled groups 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 gained when working together can be immensely empowering, and the collective fields are often used as demonstration plots and outdoor classrooms.

## What is push-pull?

Invented in 1997 by scientists at the International Centre of Insect Physiology and Ecology (*icipe*, Kenya) and Rothamsted Research (UK), 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 and fall armyworm 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 or brachiaria grass trap plants

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Jairus's brothers, Jophrey John Mwando and Nahman Kennedy Mwando, took over the family push-pull in October 2018 after Jairus's death. They value the project for the control of fall armyworm, and they feed desmodium fodder to two goats, two cows and chickens.

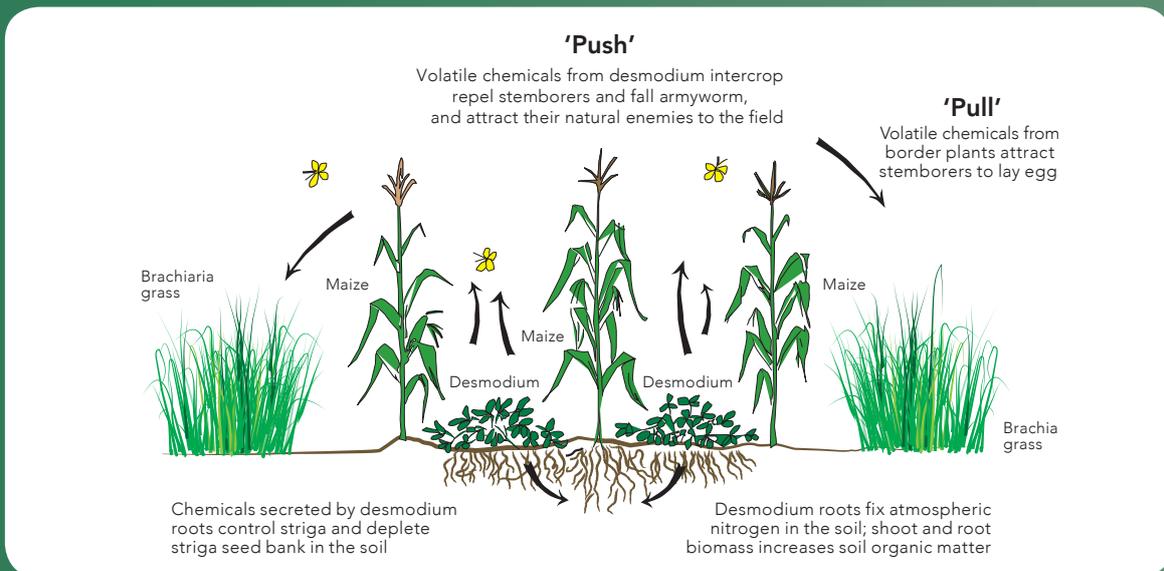
# How does push-pull work?

Push-pull prevents stemborers and fall armyworm attacking cereals by intercropping with a 'push' plant, desmodium, and planting a border of a stemborer-attractive 'pull' plant, Napier or brachiaria grass.

In addition to repelling or pushing the insect pests away from the crop, desmodium attracts natural enemies of insect pests and suppresses the parasitic weed, striga. It stimulates germination of the striga seeds, then inhibits growth of its roots, thereby preventing attachment to the host plant.

On top of controlling stemborers, fall armyworm 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](http://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 and sorghum plants provide an ideal habitat for the larvae of stemborer moths.



Fall armyworm is a recent arrival to Africa that has spread rapidly throughout the continent. The caterpillars feed on any stage of the maize crop from seedlings to mature, dry cobs, frequently causing complete crop loss.

A **conventional push-pull** plot planted with maize. Push-pull was developed in 1997 and introduced to farmers in 1998 using 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 'Mulato II'*) as a border crop.

(the 'pull'). Chemicals released by the desmodium roots also eliminate the troublesome parasitic weed striga.

As well as controlling stemborers and striga, thereby increasing cereal yields, the push-pull companion plants provide high-value animal fodder, which farmers can sell or feed to stall-fed dairy cows and other livestock. The desmodium also serves to increase soil fertility, prevent soil erosion and conserve moisture.

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

Close relationships with farmers help scientists to respond to changing needs and circumstances by adapting the technology. In the latter 2000s, 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, and that Napier grass was succumbing to bacterial Napier stunt disease. As a result, *icipe* scientists carried out new research, in collaboration with 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.

## Spreading push-pull through strong partnerships and shared knowledge

Since push-pull was first introduced to two groups of 10 farmers in 1998, the technology has spread to more than 230,000 farmers in SSA. 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 and are recognised by *icipe* as the most important resource in the farming system. Their knowledge and practices, and their constraints, are respected and taken seriously.

■ **Knowledge-intensive.** Professor Khan, who developed the technology and has led the push-pull programme from the outset, has always argued that



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

push-pull functions most effectively when farmers understand how it works. This means that dissemination has always focused on building the capacity of farmers. The technology has been disseminated by trained, sub-county-based field workers who teach farmers how it works, often through on-farm demonstrations and field days. They have also trained a network of farmer-teachers who recruit and support their peers, 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 are based on *icipe's* strong partnerships with scientists, development organisations and local groups. These partnerships have commonly endured over many years, and have been a fundamental element in ensuring the technology is 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 Kisumu County who were trying to develop their horticultural skills, the encounter triggered a new partnership and a new understanding that the technology could help disabled people build independent livelihoods (see box on p.5).

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



Mary Atemo attended the field day and launch of climate-smart push-pull at Remjius Bwana's farm in Kisumu West sub-county. 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 broadcast across the whole country. Since then, she says, "I have become a role model for other farmers to see."

The Maseno Depot Disabled Group (MDDG) was founded in 2002 with 10 members. "We had to do something urgently," says coordinator 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. MDDG meets every Wednesday, and over the past 15 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 in Kisumu County became a 'focal area' for Kenya's National Agriculture and Livestock Extension Programme (NALEP). Under this approach, resources from NALEP were directed to targeted areas within each sub-county. 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, elected as secretary of the NALEP Focal Area Development Committee by his fellow farmers. Josiah is a push-pull farmer-teacher. When MDDG worked with NALEP to identify and analyse the constraints facing their development as farmers, Josiah suggested push-pull as a potential solution. Some members had already heard of the technology through visiting a demonstration.

Josiah arranged for an *icipe* technician to explain push-pull to the group and invited members to a field day in neighbouring Kisumu West sub-county. This was *icipe*'s



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

first experience of working with a disabled farmers group. The attendees remember the day as a turning point in the fortunes of MDDG. The event coincided with the official launch of climate-smart push-pull, and was held on the farm of Remjius Bwana, an articulate and passionate advocate of the technology. The visitors from MDDG were convinced, not only by the fine crop of maize on Remjius's plot, but also by exposure to and conversations with experienced and knowledgeable farmers. When they returned home, the whole group unanimously decided to adopt the technology.

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, who were both very impressed with the members. "Given the opportunity," says Josiah, "they can respond to any call."

All of the 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 designed their plot with view to educating others through demonstrating several different options for using the full range of push-pull companion plants.

MDDG has developed a strong relationship with *icipe* and with other push-pull farmers. The group has also 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 plots, and telling their stories of how using the technology has transformed their lives. ■

## Outcomes of push–pull for disabled farmers

### Tackling hunger and poverty

Adopting push–pull has helped many farmers move away from hunger and poverty. Increases in grain yield mean they can often grow enough to feed their families, while fodder, grain and milk can be sold to raise money for household needs, especially school fees. Rumona Mayoka's story shows how push–pull has helped members of her group deal with food insecurity.

Rumona, 41, is a charismatic woman who has shunned her disability. In 2011 she founded the Emanyinya People with Disability Group in her native Vihiga County. Together, members learn about different livelihood strategies, developing different enterprises to help them become food secure and earn an income.

Rumona learned about push–pull from Mary Atemo of MDDG. She remembers that 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 other group members “were convinced that this was a good technology.” 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. 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 built a cereal store for their collective harvest, providing a reserve for any lean periods; the store is also used to store surplus harvest, to be sold when market prices are higher.

“Poverty and hunger,” says Ramona, “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 they lack self-belief and have no encouragement from others. Berryl Atieno's story tells how push–pull helped overcome these barriers to becoming a productive farmer.

Berryl grew up on her family's two-acre smallholding in Vihiga County. Under the 27-year-old's shy demeanour lies inner strength and a powerful determination to achieve. Despite her physical disability, she strived to equip herself for off-farm employment by completing secondary education and taking a computer studies course. But once qualified, she could not find work and became lonely and



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.



Berryl Atieno is taught how to manage desmodium by *icipe* field technician Dickens Nyagol. Her siblings are also eager learners.

disillusioned. Wanting to find out what other disabled people do, she travelled 6 km from her home to see what MDDG could offer. “I was very impressed,” she says, “and 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 farm. “I proved that I could work alone. I tilled the land myself and my siblings only helped me to plant it,” says Berryl proudly.

Berryl 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 in stark contrast to her mother’s equal-sized plot, which yielded only 7 kg of maize because of attack by stemborers and striga. Inspired by their daughter’s achievements, her parents have since adopted push-pull.

### **Integrating crops and livestock**

Push-pull delivers its best outcomes when it is incorporated into mixed crop-livestock systems. In particular, feeding desmodium to dairy animals has a positive effect on milk production, which not only benefits household diets, but also generates income. The story of Caleb Omino illustrates how livestock-centred self-help activities can benefit from push-pull.

Caleb Omino is a man of few words, but with 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 organisation working to support HIV-positive people. AMREF provided the group with two dairy goats and a buck. From this modest start, members now have more than 20 dairy goats between them. The nutritious milk from the animals has considerably improved their diet.

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.

**“ I WAS IMPRESSED AND ENCOURAGED THAT I COULD DO WHAT OTHER PEOPLE COULD DO IN SOCIETY, WITHOUT DEPENDING ON OTHERS.”**  
**BERRYL ATIENO, VIHIGA COUNTY, KENYA**

Now, push-pull provides fodder for the group’s dairy goats and significantly improves 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. All 48 group members have now adopted the technology.

## Ensuring the further spread of push-pull to disabled farmers

The experiences of disabled farmers in Kenya clearly demonstrate that push-pull is an adaptable technology that 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 year-round fodder it 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.

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Berryl 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 energise her peers and help further the spread of push-pull. Since adopting push-pull, Berryl's life has changed considerably. As a push-pull champion, she has travelled to Uganda and was invited by Biovision Foundation to Switzerland to talk about her experiences. She has extended her plot and continues to provide maize for her family and fodder for their cows. This has helped her family overcome the lack of finance that held her back from college, and in 2014 she embarked on a three-year diploma in agriculture.

## 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!

