



icipe
African Insect Science for Food and Health

From Lab to Land: Women in 'push-pull' agriculture



Cover photos:

Main: Farmer Lillian Wangombe in her push–pull maize plot, Trans-Nzoia district, Kenya.

Middle: PhD student Tigist Assefa in the lab at Mbita Point with the stemborer parasitoids (*Cotesia sesamiae*) she is using for a four-arm olfactometer bioassay.

Bottom: Farmer Alice Odima with a climate-smart push–pull plot of sorghum, Siaya, Kenya.

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In Kenya, Tanzania and Uganda, Karen Brock of Green Ink and Rachel Owino of *icipe*, under the direction of Prof. Zeyaur Khan and with the support of the push–pull team, carried out the *From Lab to Land* interviews and took the photographs.

In Ethiopia, interviews were carried out by Shifa Ballo, Sue Edwards and Yosef Garedew.

In the UK, supported by other members of the Green Ink team, Karen Brock wrote the report and Christel Chater designed and laid it out.

Dedication

We respectfully dedicate this report to all the scientists, extensionists and farmers who gave their time to talk to us and share their thoughts, and to all the other women like them who dedicate parts of their lives to making agriculture more sustainable.

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Foreword



At *icipe* we recognise that focusing on addressing gender disparities in access to, and benefits from, technologies, services and inputs can increase the productivity of agriculture and livestock systems, and is therefore central to improving security of food and nutrition.

From Lab to Land brings together the voices of women scientists, agricultural extensionists and farmers from across eastern Africa. The stories they tell relate the birth and development of push–pull, one of *icipe*'s longest-running and most successful programmes. It has now been more than two decades since the scientific discoveries that triggered the development of push–pull

technology, and women have been involved from the very start. In this report, they narrate their involvement with push–pull. In doing so, they offer a unique view of what it is like to be a woman in farming, in agricultural extension, and in science in Africa today.

I grew up in an Ethiopian village, bearing the unequal burden carried by rural African women. I have experienced the challenges and successes associated with African agriculture first-hand, from tending the field, through directing world-class laboratories, to leading this great institution, *icipe*. The experiences of these women resonate with me in an intimate way.

The oldest women in this report did not go to school, and tell stories of a world where it was uncommon for girls to finish primary education, let alone become farmer-teachers or doctors of entomology. Although that world still exists in many places and for many people, alongside it is another world where new things have become possible for girls and women. The youngest women here are from a generation where access to basic education is almost universal, and where far more people are pursuing post-secondary education, both vocational and academic. Their ambitions for themselves and their daughters are high.

From Lab to Land tells us about the changing roles of women in science and society; about their households and how decisions are made and resources accessed; and about the challenges women face as participants in three areas of modern life – farming, extension and science – that are traditionally dominated by men, particularly in Africa. They offer both experiences of how that traditional domination continues to play out, and the impact it has; but also examples of how women overcome the barriers to their participation.

These women are more than just farmers, extensionists and scientists. They are also daughters, sisters and mothers; they are teachers, preachers and health workers, hairdressers and shopkeepers, carers and providers. *From Lab to Land* highlights their voices: positive, funny, determined and insightful.

Dr Segenet Kelemu

Director General and Chief Executive Officer, International Centre of Insect Physiology and Ecology

August 2015

Introduction: From lab to land

From Lab to Land examines the worlds of farming, agricultural extension and basic and applied scientific research through the eyes of nearly 80 women who work in these fields in Ethiopia, Kenya, Tanzania and Uganda. What these women have in common is that they have all at one time or another been involved with the push-pull programme.

Push-pull is a 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 (the 'push'), while at the same time attracting them to a border crop of trap plants (the 'pull'). Chemicals released by the 'push' plants also effectively control a widespread noxious and parasitic weed, striga.

When farmers adopt push-pull, they not only achieve a dramatic and sustainable increase in cereal yields, but they also have to spend less time weeding their crops, and obtain year-round fodder for their animals.

Since the prototype push-pull system was developed in 1997 by Prof. Zeyaur Khan, Principal Scientist at *icipe*, an ongoing programme has ensured the development and dissemination of the technology. Scientists from many different disciplines have contributed new discoveries about the relationships between plants and insects that are at the heart of push-pull. Extension workers have taken the technology to rural communities in the Lake Victoria region and beyond. Many thousands of farmers have participated in evaluating the technology, and more than 100,000 have adopted it.

110,245 push-pull adopters:
59% women, 41% men

Women have contributed to the development and uptake of push-pull technology from lab to land: as scientific researchers, as practitioners of agricultural



"I see women as the future of agriculture in Africa, particularly sub-Saharan Africa," says Prof. Zeyaur Khan, leader of the push-pull programme and Principal Scientist since 1993. Prof. Khan is the recipient of the 2015 Louis Malassis International Prize for Outstanding Career in Agriculture for his contribution to the field of agriculture and food security.

research and extension, and as adopting farmers. In this report, they give voice to their experiences in a professional world where female scientists and extensionists remain in the minority, and an agricultural system where the female farmers who do most of the work of growing food for their households still do not always have control over the other resources they need to adopt technologies to make their farms more sustainable.

We also tell the stories of the many professional women succeeding against the odds, and the many ways that women farmers find to access what they need to put food on the table, send their children to school and conserve the resources that sustain them. For many scientists, extensionists and farmers, their involvement with push-pull has provided a turning point on a pathway to success.

What is push-pull and how does it work?

Push-pull is a companion planting technology that deals with two of the greatest enemies of the African cereal farmer – stemborer (an insect pest) and striga (a parasitic weed).

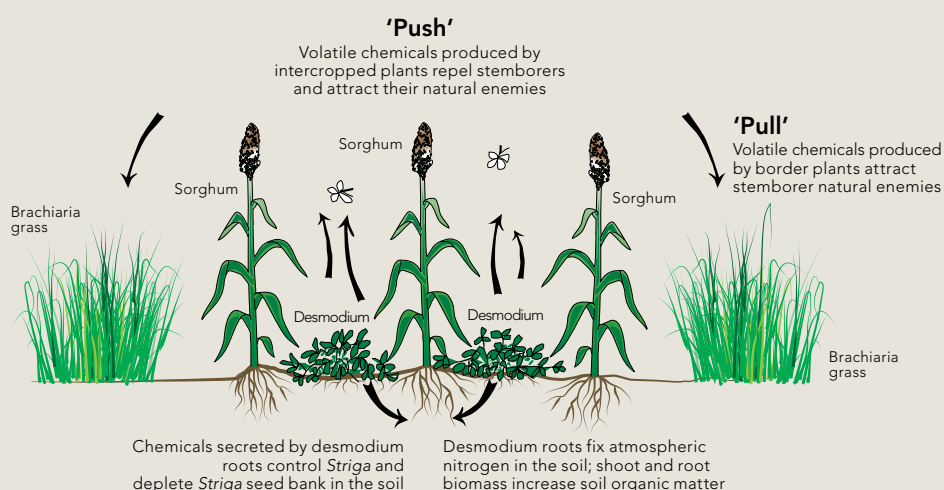


The larvae of several species of stemborer moth feed first on the leaves of the cereal plant, before going on to bore into the stem.

The parasitic weed *Striga hermonthica* attaches itself to the roots of the maize plant, robbing it of nourishment.

Push-pull prevents stemborers attacking food crops by intercropping the rows of cereals with desmodium, a 'push' plant, which repels the moth. The cereal and desmodium plot is surrounded with a border of a stemborer-attractive, 'pull' plant, such as Napier or brachiaria 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 their roots, thereby preventing their attachment to host plants.



On top of dealing with 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.



A conventional push-pull plot in Tanzania, planted with maize, and using silverleaf desmodium (*Desmodium uncinatum*) as an intercrop and Napier grass (*Pennisetum purpureum*) as a border crop.



In drought-tolerant, climate-smart push-pull, the companion plants are greenleaf desmodium (*Desmodium intortum*) (top) and brachiaria grass (*Brachiaria cv mulato II*) (bottom).

Why women?

Supporting women farmers to adopt appropriate, environmentally friendly technologies like push–pull is key to strengthening the sustainability of smallholder agriculture in Africa. When push–pull was initially developed, it was directed mostly towards food security. “And women,” explains Prof. Khan, “play important roles in agriculture and household nutrition – both vital parts of food security.”

In smallholder household agricultural systems, women do the majority of the work with crops. Technologies that reduce labour deliver particular benefits for women, and those that help increase grain production – by suppressing weeds, or feeding the soil – help fulfil the

traditionally female role of ‘putting food on the table’.

As Prof. Khan points out, “a technology that is not accepted by women will not provide food security for the household”. One of the reasons that push–pull, in both its conventional and climate-smart variants, has been adopted by so many women is that it is much more than simply ‘a solution to striga and stemborers’. In different agroecosystems, for different people, push–pull can mean less labour, improved soil fertility, more grain and hence increased income.

Although women do most of the farm work, they do not always have control over resources or decision-making. Although there are many examples of women who own animals and poultry

Women and agricultural labour

In this region of Africa, smallholder farmers grow food by cultivating a mixture of cereal, root, vegetable and fruit crops. Many also keep livestock, and dairy animals are widespread. From the crops and animals they raise on their land, families have to grow enough to eat, and to generate enough surplus to pay for their needs, particularly in education and health.

Cereals, especially maize, are at the heart of the agricultural systems of the Lake Victoria region, and at the centre of household economies and family diets. Cereal production is held back by a combination of factors including weeds, insect pests, declining soil fertility and erratic rainfall.

Women are seen as the backbone of this system. While some men do farm work with their families, many work outside the farm household, often living away from their wives and children for long periods of time. Some provide income and other resources to the farm; some do not.

Female-headed households are more common than they once were in eastern Africa, making up 39, 29 and 25 percent of rural households in Kenya, Tanzania and Uganda respectively. This is partly due to the high prevalence of HIV/AIDS, which has left many widows who continue to farm with poor health, and many dependents.

On most smallholder farms in Kenya, Tanzania and Uganda, women do most of the work in the fields. Women do 90 percent of the weeding, and it takes up 50–70 percent of total labour time¹. Three quarters of smallholder farms in sub-Saharan Africa are hand-weeded. Weeding striga – a plant with a dense network of underground parasitic roots – is particularly demanding of time and energy.

In addition to work on the crops, women and children often have responsibility for ensuring that livestock are fed. This often means walking long distances to cut fodder, and carrying it back to the farm.

As Debora Sande, a widow from Kenya’s Vihiga district remarks, “anything that eases work for a woman is an advantage”.



Hand-weeding striga is laborious and time-consuming, and is largely the responsibility of women.



Gathering fodder from outside the farm is often the work of women and children.

¹ Farming First and FAO (2015) *The Female Face of Farming*. <http://www.fao.org/gender/infographic/en/>



The Napier-fed cows on Dorcas Josephat's farm in Tanzania produce around 15 litres of milk a day, helping her pay school fees for her grand-daughter.

themselves, separate from those of their male relatives, the degree of control they exercise over the income that comes from selling milk, eggs, meat and young animals is mostly decided by men. "Ownership and control changes once production goes up and there is much to sell," explains Neema Machuri, a farmer in Tanzania. "The milk belongs to me as long as the cow produces less than 7 litres; anything above this is considered by our men to be beyond our management abilities."

Nonetheless, livestock are an important source of household income. By providing a steady supply of nutritious, drought-tolerant fodder throughout the year, push-pull not only decreases the amount of time spent gathering food for livestock, but also improves the health and productivity of their animals. Thanks to push-pull, there is often more milk for the family to drink, more milk to sell, and more calves and kids.



These women were among the first groups brought to the *icipe* Thomas Odhiambo Campus at Mbita Point to evaluate the potential of desmodium as a fodder crop.

Many push-pull farmers keep stall-fed animals to eat the fodder that they produce, and use the manure they gather from the stalls to fertilise their soil. In this kind of intensive, integrated crop-livestock system, push-pull can play a pivotal role, driving the cycling of nutrients between crops, animals and soil.

From the outset, the *icipe* scientists recognised the special importance of fodder to women, and its role in food security. Prof. Khan recalls that when the earliest results of the entomological research showed that there could be a pest-control system based on companion plants like Napier grass, molasses grass and desmodium, "we thought, 'will the farmers accept it?' And we thought that if it was accepted by women, if they agreed to use the grasses and the legumes, then it would be a success."

Since the very first farmer meetings about the technology were held in Trans-Nzoia and Suba districts in 1997, the push-pull team have deliberately consulted groups of women to get their feedback on the technology. "At every stage," says Prof. Khan, "we were able to identify women and interview them – still we do that, interview women for their feedback." For example, women's views were particularly important in selecting a new, drought-tolerant border plant when the team were developing the climate-smart variant of the technology. *Brachiaria*, the new 'pull' plant the *icipe* team eventually selected, was found by women to be easier to harvest and work with than Napier grass, the original trap plant.

As well as recognising the need for women farmers to accept the technology, Prof. Khan also saw the importance of building the capacity of female agricultural scientists, and of using the programme as a training ground for technology dissemination to women. As the next two sections report, the programme has made consistent efforts to recruit female students, research and extension staff, and farmer-teachers, with varying degrees of success, and with many lessons learned along the way. Broadly, there now is a sense that the tide may be turning for women in these areas. As Prof. Khan observes, "more women are now participating in agriculture and decision-making".

And what about men?

By focusing specifically on women's experiences and voices, this report largely excludes men. It does not do this as an attempt to underplay or



"Since I adopted push-pull," says Alan Metho, "I have recruited 70 people who are now practising. I am very proud of myself, and I am very proud of *icip*e."

invalidate either the role of men in agriculture, or in the story of push-pull technology, but rather to seek a uniquely female perspective on agriculture, extension and science, including the prevailing gender relations in all three areas.

The reality of African smallholder agriculture is that while women might provide the bulk of manual labour in the fields, men do participate in farming a great deal. Their roles are usually bush clearing, tilling land with ox ploughs and planting, but many of them weed and harvest crops, too. They also construct farm infrastructure like livestock pens and storage granaries, and market crops.

Many men have adopted push-pull. Although women are in the majority as adopters, more men than women have become farmer-teachers, and many men have also become champions of the technology, discussing it in public forums and sharing the approaches with their neighbours.

"Our husbands are farmers, and we help them. They appreciate our contribution. Nothing is as good as attending a training with your husband, because you get the information together."

Salome Mosabi, Tanzanian push-pull farmer.

Within the push-pull programme itself, although women are in the majority as farmers, men have dominated numerically as both scientists and extensionists. The spread of the technology has come about thanks to the efforts of the *icip*e field staff, mostly men, who travel from farm to farm in the area they cover, teaching the technology and supporting farmers to take it up.

The story of the development and spread of push-pull illustrates how men and women have different roles in the spread of agricultural technology, and that access to the resources necessary for adoption is gendered. It also provides a great many examples of men and women working together to sustainably intensify their agricultural production and improve their household food security.



Isaac Onyango, *icip*e field technician, has been visiting Paskalia Shikuku of the Mungao Sustainable Agriculture group for three years, and has supported her to spread the push-pull technology in her sub-location and beyond.

1. Lab:

Developing and deepening the science of push–pull

Developing push–pull technology and ensuring its adoption by farmers has involved scientists from a range of different disciplines. Bio-scientists – including biologists, chemists and insect specialists – have uncovered and continued to interrogate the plant–plant and plant–insect relationships that underpin the technology. Although centred at *icipe*, constant development and deepening of the natural science behind the push–pull programme has relied on partnerships with a range of organisations. The most important of these has been an enduring relationship with

Rothamsted Research in the UK, which began in 1993 with preliminary research on wild grasses as stemborer hosts funded by the Gatsby Charitable Foundation.

Over the years, as new scientific challenges have emerged, this partnership has provided new solutions. The research team has identified drought-tolerant companion plants to suit the changing climatic conditions faced by farmers, and found solutions to a dramatic increase in Napier stunt disease, which had a widespread impact on push–pull farms. They have also continued to roll

Foundations of push–pull: the partnership with Rothamsted

When Lesley Smart, a field research scientist at Rothamsted Research, visited *icipe* in 1994 and 1995, the role of her team was two-fold: to make substantive contributions to the Gatsby-funded research, and to review the progress of the project.

“Before the first visit,” she explains, “I’d already devised, with the statisticians, some 6 x 6m field trial designs to try and test the effects of the behaviour-modifying chemicals on insect populations. After the first year, we implemented one of these designs. In the second year, I set up another trial to look at the interaction between the trap crop and the main maize crop, which led to the start of the push–pull design.”

As well as Lesley’s detailed work on trial design and sampling regimes, Rothamsted scientists contributed their expertise on factors mediating insect–plant interactions at this early stage of the research. They also had the expertise and equipment needed to assess plant volatiles and help discover exactly what it was about the different plants that was attracting and repelling the insects. The partnership was vital in developing a technology that could be put into practice by farmers.

Although Lesley’s direct involvement in push–pull ended after her second visit in 1995, she continued to stay in touch with the programme, and contributed to several scientific articles about the technology. The partnership with Rothamsted went from strength to strength. Ten years later, in 2005, she also grew a small demonstration garden of sorghum plants with and without desmodium and striga to illustrate the technology at the UK’s world-famous Chelsea Flower Show.



Lesley Smart (third from left) designed the first field trial to test the effects of the push–pull intercrop plants on insect populations.



Mary Rabilo, a push–pull farmer (centre), demonstrated the push–pull technology at the Chelsea Flower Show in June 2005, using a demonstration garden grown by Lesley Smart. With Mary are Prof. John Pickett of Rothamsted Research (left) and George Genga, *icipe* staff.

back the frontiers of knowledge in areas like plant-to-plant communication – where plants induce neighbouring plants to modify their behaviour as a defence mechanism to pest attack – and the use of behaviour-modifying chemicals to control insect pests. This work helps in understanding the possibilities for future development of sustainable pest management strategies.

At the same time as the bio-science side of the technology has developed, social scientists – including agricultural economists, rural sociologists and adult educators – have carried out studies to understand the needs and preferences of farmers, their criteria for usable technologies, the ways they learn, and the barriers they face in adopting new technologies.

A fertile training ground for women

One of the most important ways that the push–pull team has reached out to women scientists, both social and natural, is through hosting the fieldwork of doctoral researchers registered at a number of different universities across eastern and southern Africa.

The natural science research of female PhD students has increased understanding of how push–pull works, but also helped the researchers themselves see how science can be applied.

16 PhD students: 8 women, 8 men

Table 1. Pathways of female doctoral researchers trained on the push–pull programme

	Subject of push–pull research	Country of origin	Current position
2000–03	Dr Linnet Gohole Effects of molasses grass (<i>Melinis multiflora</i>) on parasitisation of cereal stemborers in cereal-based cropping systems	Kenya	Director of Research and Innovation, University of Eldoret, Kenya East Africa Regional Representative, McKnight Foundation
2003–09	Dr Dorothy Masinde Socio-economic factors in technology development and adoption: An assessment of the push–pull technology controlling maize stemborers in Trans-Nzoia district	Kenya	Lecturer, Global Horticulture Systems, Iowa State University, USA
2006–12	Dr Lefu Lebesa Visual and olfactory cues used in host location by the blister beetle <i>Hycleus apicicornis</i> (Coleoptera: Meloidae), a pest of <i>Desmodium</i> (Fabaceae) species	Lesotho	Director, Department of Agricultural Research, Lesotho
2006–09	Dr Esther Njuguna The effects of information and technology characteristics in technology adoption for striga and stemborer control in Western Kenya	Kenya	Gender Scientist, Crop Research Programme Grain Legumes, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Kenya
2007–10	Dr Alice Murage Economic efficiency and effectiveness of dissemination pathways: a case study of push–pull technology for stemborers and striga weed control in Western Kenya	Kenya	Research Scientist, Kenya Agriculture and Livestock Research Organisation (KALRO) ²
2008–13	Dr Mary Koech Effect of <i>Desmodium</i> on soil fertility, striga control and maize production in Busia and Siaya counties, Western Kenya	Kenya	Research Scientist, KALRO
2012–15	Tigist Assefa Tolosa Chemical ecology of plant-to-plant communication and opportunities for maize stemborer management in Africa	Ethiopia	PhD candidate
2014–16	Ruth Taruss Economics of integrating push–pull technology in dairy–maize farming systems in Eastern Uganda	Kenya	PhD candidate

² KALRO was formerly known as the Kenyan Agricultural Research Institute (KARI). In the text of this report, we refer to KALRO in the present tense, but refer to KARI in past-tense recollections of our respondents.

Lefu Lebesa, for example, worked on the olfactory and visual cues of blister beetles, which are a pest of desmodium, with the aim of developing prototype pest control traps for farmers. For Lefu, the lessons learned from participating in “the whole cycle of developing something in the lab, testing in the traps in the screen house to see if they can work, then taking it out to see if it can actually mean something,” were as important to her as the new knowledge she gained about the insects themselves.

For the social scientists, whose interests lie in learning about people and society, the lessons were different. Esther Njuguna, whose research looked at three different aspects of how communication affects technology adoption, confesses that at first, she struggled to know what to do for her PhD. “I was a social scientist,” she remembers, “but they were all entomologists and breeders, and it was overwhelming.” Once she had been assisted in framing her research questions, however, she grew fascinated with adoption. “The influence my PhD had on me was the importance of looking at what happens where technologies hit the ground with human beings. And this is still the focus of my current work.”

In addition to the contributions from their original research, the push–pull programme has benefitted from its female doctoral scientists in other ways. The career paths of former students have provided a route to forging networks and strengthening important working relationships with other organisations that also focus on sustainable agricultural development, including several universities, the Kenya Agriculture and

Livestock Research Organisation (KALRO), the research centres of the Consultative Group for International Agricultural Research (CGIAR) system, and the McKnight Foundation.

Former doctoral students have also been instrumental in rolling back the geographic frontiers of the spread of push–pull. Some of Linnet Gohole’s current work with the McKnight Foundation, for example, concentrates on how push–pull can be adapted to overcome the challenges of adoption in Ethiopia (see also p. 24). Lefu Lebesa’s present position as a government agricultural research manager in Lesotho means that when striga recently arrived in her country, she was involved in quickly establishing a trial to evaluate different desmodium species from Southern Africa to adapt the technology to local conditions. Alice Murage, meanwhile, applied her understanding of dissemination pathways in Kenya to her subsequent work as head of the Uganda push–pull programme, overseeing a rapid expansion in spread.

In addition to these doctoral students, countless other postgraduate students have done short research projects with the push–pull programme. Furthermore, since 2000, the team has also hosted seven young scholars from the USA through a partnership with the World Food Prize Foundation, of whom five have been women (see Table 1).

7 World Food Prize interns:
5 women, 2 men



From her office at ICRISAT in Nairobi, Esther Njuguna now works with crop breeders on three continents to think about the gender impacts of their research throughout the different stages of design and implementation.

Inspiring young scholars

The World Food Prize Foundation's Borlaug-Ruan internships provide talented American high-school graduates with a chance to do short research projects in places where poverty and food insecurity are widespread.

Bian Li was the push-pull programme's first Borlaug-Ruan intern in 2000, studying the influence of culture and gender on household food security. "It opened my eyes," she says today. "It made me realise what I wanted to do; African agriculture turned out to be a passion and a career for me. Being on the ground helped me understand the issues, more so than from a textbook or in a classroom – that was what provided so many lessons which I still reflect back on now... It was about learning to ask the right questions." Bian is now a corporate development and value chain strategist, working on a project to leverage finance to upscale commercial agriculture in Africa.



"Being able to talk to women directly was very, very helpful," says Bian. "To see problems not just as related to soil and plants, but also the fundamental social hindrances at a systemic level."



Matilda Ouma (shown here with Anne Seccor Zwink) mentored all three of these interns. "She was an inspirational figure for me," says Bian Li.

Anne Seccor Zwink, who was raised on a large-scale conventional farm in the American Midwest, did her internship in 2006, studying the role of women's groups in push-pull dissemination. "Growing up," she says, "I was completely unaware of gender inequalities, especially related to the farm. We all completed our own specific tasks... but we worked as a family. The push-pull programme showed me that not every family operates the way my own did, and that women definitely face an uphill battle, even with regard to growing their own food." After completing her postgraduate studies, Anne returned to her family farm. She now runs a successful vineyard and winery that she established to diversify their production system, and remains interested in using non-conventional agricultural practices to improve crop productivity.



"Women are the main ones who provide for their families," says Sydney. "To hear about this is one thing, but to actually ... sit with those families, enter their homes, meet their children and see their struggles, it's just completely different."

Sydney Schrider, who went on to major in civil engineering, has been instrumental in setting up a non-profit organisation to develop household water filtration technologies in South Africa. She used her 2010 internship to study the relationship between gender, irrigation and food security. "Although men in households had a lot of decision-making power," she says, "you also found these incredibly powerful women in the community who would lead groups of farmers. You hear, here in America, about gender issues in other countries, gender roles in households – but to really see it play out ... was powerful."

For Sydney, Anne and Bian, their push-pull internships were turning points in shaping their views on gender inequalities, and the direction of their future careers.

Exposure to new ideas, situations and ways of working

For the female scientists who have participated in the push-pull programme at different stages of their careers, the experience has brought a range of benefits. The most obvious is the qualification itself: as Dorothy Masinde says, “once you have a PhD you have different opportunities – access to a higher level.” But there are also several associated capacities that are vital in pursuing a career in science. When Mary Koech won a German Academic Exchange (DAAD) scholarship for her doctoral work, she needed extra funds to pursue the programme, and she remembers Prof. Khan pushing her to write proposals and secure grants for her work. She places this skill on a par with learning how to properly manage and report on-farm trials.

For many respondents, an important benefit resulting from their push-pull work has been exposure to new situations, perspectives and ways of working. Linnet Gohole discussed three types of exposure she experienced during her PhD. First was her own exposure to “quality research”, which helped show her what was needed to “write papers, which you need in my career to move ahead.” Second was the international exposure her work received through being published. Third was the personal exposure to different values and views gained through attending international events, including a visit to Florida, USA, when *icipe* was requested to send researchers to a Flower and Garden Festival. “I was shocked,” Linnet recalls, “about how little people knew about Africa. Having that chance to enlighten them was interesting and satisfying.”

Lefu Lebesa, from Lesotho, remembers that exposure to Kenyan farmers presented her with



“Since getting my PhD I have leaped and leaped and leaped until I am in a position where I am a university lecturer,” says Linnet Gohole (right). “Some farmers are surprised when they know that I am so learned, and yet I am still working with them in the field.”



Lefu Lebesa extracting the chemical attractants of desmodium blister beetles, to help make traps for farmers to use. One of the things she noticed about Kenyan farmers was “how committed they are to helping you to discover something that is going to help them.”

eye-opening contrasts. “I had a chance to see farmers in another country, in another region... The farmers in Kenya, although they were still smallholders, I saw their drive to move – not only produce for food security, but to produce to have something extra, be entrepreneurial. This I learned and liked – and now I try to instil it in our farmers, to get them to move beyond what is sufficient for them, to provide more and contribute to the economy of the country.”

Similarly, when Jessica Cockburn travelled to Kenya from South Africa during her postgraduate work with sugar cane farmers, she was struck by the different approach to sustainable agriculture. She had studied and been inspired by push-pull during the entomology module of her undergraduate degree: “When I read papers about bringing ecological concepts into agriculture, I felt ‘yes, this sounds great, on paper’. But going over to Kenya and actually seeing small-scale farmers



“My PhD opened my way of thinking to another level,” says Dorothy Masinde (wearing red). “Although I was doing extension, which I was trained to do, I was thinking in a more critical way.”

farming in that way and it *working* – that it wasn't just a pipe-dream, that people are living their lives on agroecological farms – it was so good for me to see that. Especially in South Africa, where the agricultural sector is very much profit-driven, production-driven – yields, yields, yields – and any environmental agenda is seen almost as a threat to that paradigm.”

These reflections echo those of several women who mentioned the importance of learning to think critically as a key benefit of their time with the push-pull programme. Although Esther Njuguna now works as a gender scientist, her doctoral research did not focus on gender dynamics. Nonetheless, she says, it started her on the path to her current work. “The point of gender mainstreaming,” she argues, “is critical analysis of what you are doing to see how gender is relevant. This means putting science into a human situation.” The importance of critically applying science to real life was the underlying lesson she took forward from her PhD into her post-doctoral career.

Many former students also refer to the importance of learning about multi-disciplinarity and teamwork on the push-pull programme. Jessica Cockburn's participatory research with sugar cane farmers was partly funded by the sugar industry, and she “felt a bit of resistance from some of them towards social research and the more participatory systems thinking approach. So going off to a place where those things were the norm was very encouraging for me. It made me realise the approach I was taking was good, was important, was necessary.”

Lefu Lebesa particularly valued the atmosphere of working together in the push-pull programme, and the sense that “the different expertise of different people is actually used in the project to come up with something that is coherent ... that you are developing a product up to the end, using all the skills that you have.” Similarly, for Dorothy Masinde, there was a sense of being part of a team, of being involved in the different tasks of research, and of scientists engaging with farmers every step of the way. This left her with a strong conviction, which has informed her subsequent career in implementing development: “Before you develop your technology, you need to find out what people are doing, because you need to start with what the farmers have. You need to know what they are doing, and you need to know what their felt needs are.”



“Science can be brought to the people and the people can contribute and be part of the process,” says Jessica Cockburn.

Mothers, leaders, mentors: A new generation of women in science

During the time-span of the push-pull programme, opportunities have improved for women in science and development, and for female professionals in eastern Africa, particularly Kenya. The women we interviewed for this report put this down to a range of factors, including donor-funded activities to take account of the differences between men and women, quotas for employing women in public services enshrined in the 2011 Kenyan Constitution, the Ugandan government's approach to including women in governance, growing acceptance across the region of the importance of schooling girls, and steady progress towards the goal of universal primary education.

Times have changed. Sue Edwards of the Institute for Sustainable Development (ISD) in Ethiopia is one of *icipe*'s key partners in disseminating push-pull in that country. Forty years ago, when she worked at London's Kew Gardens as a trainee plant taxonomist, she “would get regular comments to the effect that I should be looking after my daughter and not plants”. This attitude and others like it were echoed by several respondents who were establishing their careers in the 1970s and 1980s. By contrast, when Tigist Assefa – an Ethiopian doctoral student in chemical ecology at *icipe* – was asked whether there had been any gender-specific challenges to her career in science, she replied: “No! I got a fellowship to support my MSc research, which led to international exposure and a visit to Sweden. There was a gender quota for that fellowship – so there are some benefits to being a woman.”

Many respondents described the support that exists for those female scientists who are in a position to make use of it. This ranged from the DAAD scholarships received by Mary Kifuko and Alice Murage, through a Research Fellowship for Career Enhancement that Linnet Gohole received from the CGIAR, to the grant from the United States Agency for International Development (USAID) that KALRO's Deputy Director General Felister Makini, a long-term partner of the push–pull programme, was awarded to receive training in the USA. But although such opportunities now exist, the attitudes that women encounter in their workplaces have not changed so quickly, and they remain in the minority as career scientists. What are the enduring barriers to entry, and what is important to succeeding?

The most frequently cited force that shapes women's career path in science is the tension between professional life and family life. When Tigist Assefa decided to pursue the opportunity of a PhD in Kenya, which she knew might never come again, she had to leave her infant son with his father and their family in Ethiopia for three years. Lefu Lebesa, who had two children below the age of five when she started her PhD, faced the decision to "leave the family or take the family ... In my case, I took them with me, and it wasn't easy. At the same time as you are trying to work hard, you are also still tending the family. In the end there was a separation between me and my husband. I prevailed – professionally and otherwise, I am OK. But it required a number of people being very sympathetic – my employer, my supervisors."

Mary Koech, now working at KALRO, notes that pregnancy and maternity leave stop women delivering at full potential and make them less likely to be promoted. She had a child during her

PhD, and "almost broke down" under the strain of having to travel and go to the field when the baby was still small. She points out that she could never have completed her research without her extended family, and in particular her husband, who sometimes went to the field with her and the baby.

A second force shaping women's career paths in science is negative attitudes and behaviours among some of their male colleagues, and cultural norms about which careers, subjects and courses are deemed to be appropriate 'for women'. In the words of Tanzanian plant breeder Everina Lukonge, "it is perceived that women can't perform". Despite the broader sense of positive change for women in science, there is also a sense that parallel changes in attitudes are slower in arriving.

Female scientists deal with negative perceptions in different ways. Lefu Lebesa says "you have to develop a confidence that makes you say 'I know that I am comfortable with doing this, and I am doing it as well as this male counterpart can do it, and I am not going to allow anyone else to think that I am inferior'. If you don't have the mentality of 'I can do it and I am not going to allow them to put me down', you are never going to make it as a woman scientist."

For Alice Murage, the key to overcoming prejudice is "doing things right. For example in my research career I finished my PhD in exactly three years and had four publications before I graduated. I had done the right thing *despite* being a woman – I earned that respect. I try to prove to people that even if I am a woman, I am managing it. Doing it right, that's the foundation of confidence."

Although increasing numbers of women scientists are, like Lefu and Alice, developing the confidence they need to succeed, significant barriers remain to achieving seniority and positions of leadership. When Prof. Khan encouraged Alice to apply for the job of leading the Uganda push–pull programme after she had finished her studies, she was apprehensive: "I'd never been a leader, I was always – you know, one of these women who just remain behind, who are there to be led." However, she applied for and was offered the job, and spent two years leading the development of a new programme. "It was really a challenge," she says now, "but it built me – it gave me the chance to discover, can I really do that?"

Of her experiences at KALRO, which have seen her progress from entry level, gain



Tigist Assefa in the screen house at *icip*'s Thomas Odhiambo Campus at Mbita Point, Kenya, with the maize and molasses grass plants she is monitoring to understand the chemical ecology of plant-to-plant communication.



"I want my daughter to be a great woman," says Mary Koech, research scientist at KALRO. "She is joining university in September – I want to see her somewhere. I love it when ladies are prospering."

her PhD, and then work at a more senior level, Mary Koech observes that when women occupy senior positions, "you are more or less equal – you [and the male scientists] work as colleagues and exchange ideas in the same ways. But at the junior level, ladies sometimes get stepped on." Deputy Director of KALRO Felister Makini observes that "there is goodwill towards getting more women managers. However at KALRO we have many highly qualified women with PhDs but many of them just won't bother to apply for management jobs because of their families ... and the time that management would require, which is more demanding than being a scientist. So sometimes it's the women themselves who don't want to be involved. But I would say we have quite a number who are competent – maybe what we have lacked is experience of management."

Across the range of women scientists we talked to, many spoke passionately about the mentors and role models – male and female –

who have been pivotal in triggering confidence to overcome barriers, providing advice on career paths or demonstrating inspirational values and attitudes. For Mary Koech, it was Prof. Okalebo at Moi University, who introduced her to primary research at a very early stage, and continued to mentor her and follow her career for many years. For Lefu Lebesa, it was Ian Tordoff, an enthusiastic entomology professor on her undergraduate degree who kindled her passion for insects. For Bian Li and Anne Seccor Zwink it was Matilda Ouma, the *icipe* research assistant who taught them so much about Africa and agriculture. For Jessica Cockburn, it was Inge Kotze, Head of WWF's Sustainable Agriculture programme, who was involved in her research on sugar cane.

Several of the push-pull women have gone on to become mentors and role models themselves, particularly with the aim of encouraging girls and women into careers in the sciences. Lefu Lebesa is part of Women in Science and Technology, a group that goes into schools and on air in Lesotho to publicise the importance of science. Bian Li has co-founded a global platform to engage young people in agricultural entrepreneurship and is an Oxfam Sisters on the Planet Ambassador. As a civil engineering student, Sydney Schrider spent two years doing elementary and middle school outreach, hosting events to bring local elementary and middle school girls to her university to experience science. But, as many of these women observe, simply doing their science, and doing it to a high degree of excellence, is the best way to be effective as role models for the coming generations of female scientists that will follow in their footsteps.



By the time Alice Murage (standing) left Uganda after two years with the push-pull programme, over 9000 additional farmers had adopted the technology.

2. From Lab to Land: Disseminating and spreading push–pull technology

The push–pull programme has always aimed to attain gender parity in the uptake of the technology, and to include female extension agents as staff and partners. Encouraging female farmers to adopt push–pull has meant developing extension pathways that stand a good chance of reaching women. Trying to increase the participation of women as field staff, technicians and peer educators, on the other hand, means overcoming some of the barriers to women working in agricultural extension: worldwide, only 15 percent of extension agents are women.³

The women extensionists interviewed for this report almost all mentioned the problem of transport in rural areas; most extensionists ride motorbikes, not something that all women are prepared to do. They also cited the difficulties of balancing family responsibilities with a job that involves a great deal of travel, the challenges of being taken seriously by farmers, and overcoming the attitude that ‘it is not the job for a woman’.

As the chart below shows, the push–pull programme has been extremely successful in reaching female farmers, but less successful in attracting female extension officers and the farmer-teachers that support them. Prof. Khan notes that “when we advertise positions for field staff, we say women will be given preference, but unfortunately there are very few women applicants”. Although this demonstrates that it is not necessary to have female extension staff to reach women farmers, the programme is nonetheless continuing with its efforts to recruit more women. One recent success was in Uganda, where several new women farmer-teachers were appointed.

In the rest of this section we discuss different aspects of the dissemination of push–pull through the eyes of some of the women involved. As well as discussing what shapes



As research technician on the push–pull programme in Uganda, Rose Ndagire collects data from farmers and assists in trainings. She says she is sometimes ignored by male farmers, but emphasises that “you have to show respect, and be very, very patient”.

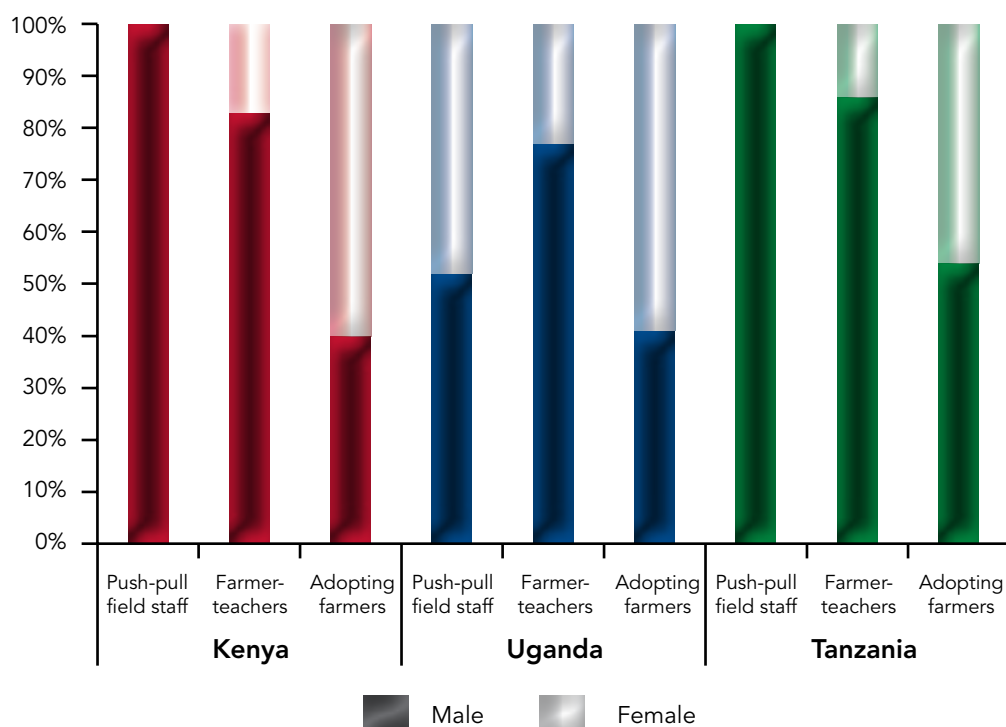
dissemination and the uptake of agricultural technologies by women, the women also examine some of the challenges of exporting push–pull’s dissemination model to different social and agricultural contexts.

A knowledge-intensive, people-centred extension model

During its early years, the push–pull programme developed a successful knowledge-intensive, people-centred model of extension in Kenya. The subsequent spread of the technology to other

3 Farming First and FAO (2015) *The Female Face of Farming*. <http://www.fao.org/gender/infographic/en/>

Gender balance of field staff, farmer-teachers and adopting farmers for three push-pull country programmes



countries has been based on slightly different versions of this model.

In Kenya and Uganda, a network of *icip*e programme technicians and field assistants – mostly young men – are on the front line of push-pull dissemination. They are supported by a cadre of farmer-teachers – adopting farmers who have been selected to work with extension staff and support dissemination.

In the push-pull programme's extension model, its staff are fully equipped to teach farmers and extension staff from other organisations about push-pull, carry out on-farm visits, prepare new push-pull plots, and share seeds for the companion plants with farmers. Demonstration plots are at the centre of this system. These are outdoor classrooms where farmers learn about how to plant and maintain a push-pull plot, as well as seeing tangible evidence of the benefits of the technology. They also provide locations for field days that expose hundreds of people at a time to the technology.

Extension staff provide on-going support, training and capacity-building, and work alongside farmers to understand any emerging problems with implementation. They work mainly with groups of farmers – some existing, and some formed specifically to spread push-pull –



Members of the Pioneer Self-Help group in Kenya's Siaya district lead the way to their push-pull demonstration plot. When the group formed, it was all women – as one member commented, “men here cannot form groups, it is seen as a women's thing”. But some men asked to join later, and there are now 17 female and 6 male members.

but also with existing structures such as farmer field schools. In Western Kenyan culture, there is a strong tradition of women forming self-help groups and, over the last two decades, most farmers' groups in the region have come to

Farmer-teachers in the neighbourhood



Name: Consolata James, b. 1953, widow

Household: 7, husband works away as electrician

Education: Completed primary education, left school in the first year of junior secondary

Occupation: Farmer; preacher in the General Assembly of the Church of God in East Africa (Kenya)

Consolata adopted push-pull in 2002. She was part of a small group of farmers who had attended a push-pull demonstration held as part of a World Agroforestry Centre training on agroforestry, and were then invited to Mbita Point to learn more. In 2003 she became a farmer-teacher and expanded her plots in 2007 and 2015. She has less time for farming now that she also has her responsibilities as a preacher, but she continues to cultivate her own plots.

"When Prof. Khan invited us to Mbita," Consolata remembers, "I was the only woman among 11 men. Only a few of us spread it to others – and I spread it the most. I think many men hoped that they would get paid – but when they realised it was skills only, they dropped. But I realised that the skills were the most valuable."

"I am a grandmother of push-pull: I have given birth to lots of push-pull farmers and they have given birth to others."



One of Consolata's grandsons took the grass from her push-pull plot to give a neighbouring pig farmer, resulting in the loan of this pair of pigs. The boy will care for them until they produce piglets, which he will be allowed to keep.



Name: Maureen Ambubi, b. 1962, widow

Household: 3

Education: Completed primary school

Occupation: Farmer

Maureen, who adopted push-pull in 2003, learned about the technology from Consolata and joined the push-pull group that had been formed by the first ten adopters. She has gone on to teach the technology to many others. The group continues to be active and has helped Maureen "to interact with many people, giving me a lot of exposure to other farmers. Members assist each other when there is trouble or when there is a funeral – it has come to be like a family." In 2014, Maureen travelled to Zambia to share her knowledge of push-pull with other farmers from across the continent.

When she adopted push-pull, Maureen was a widow with three small children and a single dairy cow. Now, 12 years later, one of her daughters is a university graduate, and her two other children hold college diplomas. The costs of their education were met by the sale of milk and calves from their mother's desmodium-fed cows.



The increased productivity of her dairy cows has been an important benefit of push-pull for Maureen, who sells milk in her neighbourhood.



Name: Deborah Sande, b. 1968, widow

Household: 4

Education: Class 7

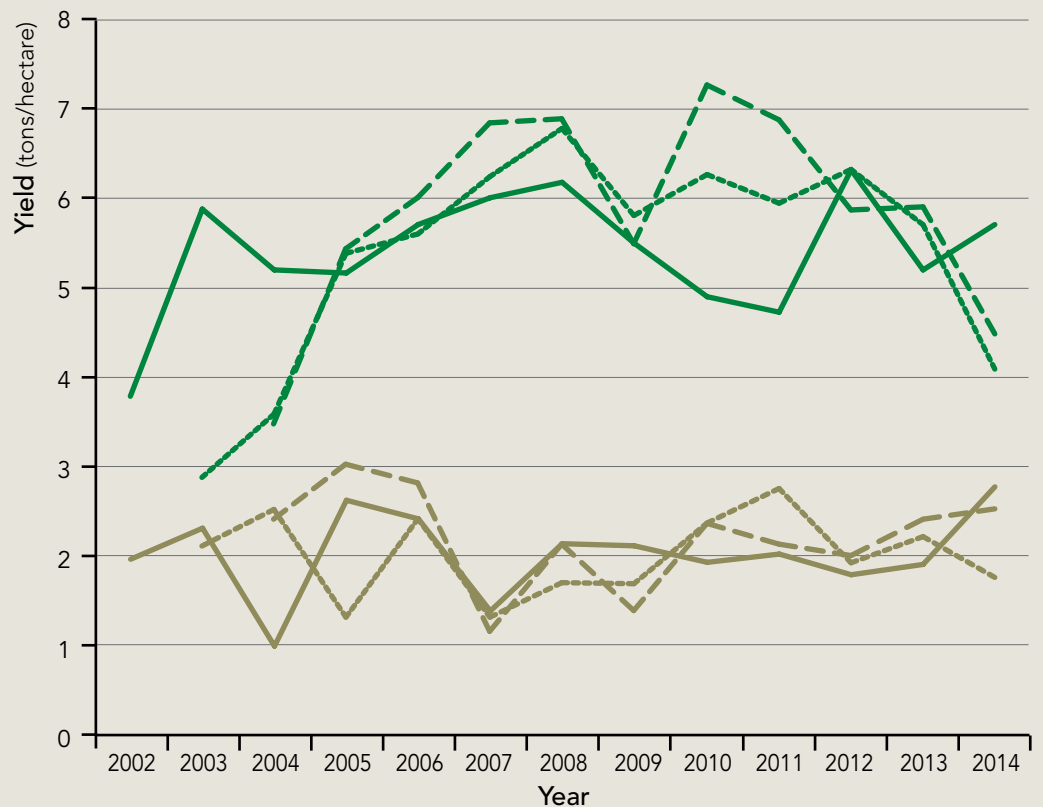
Occupation: Farmer

Deborah adopted push-pull after admiring her neighbour Maureen's plot. Maureen told her about the trainings and she attended, planting her first plot in 2004 and her second in 2005. She already had a cow, but with an assured supply of fodder, she built a zero grazing unit and brought in a dairy animal.

Five years later, Deborah's husband died. Their older daughter had just started university. The sale of maize from push-pull plots helped to make sure she was able to finish, and Deborah now pays school fees for her second daughter, a grandson, and an adopted orphan.

"It is women who stay with children and bring them up. My husband used to chip in – but after his death, push-pull became my husband, because I had no support from elsewhere."

Every year since these farmers adopted push-pull, *icipe* technicians have recorded the yield from their push-pull plot and another maize plot grown without push-pull. The results clearly show both seasonal variability and sustained higher yields from push-pull plots.



contain a majority of women. Furthermore, many implementing organisations and donor agencies whose work targets women have triggered the formation of women's groups. So working with groups is one way of reaching female farmers.

But working with groups is not the whole story. Matilda Ouma, who had worked as a government extension officer, was a research assistant on the push-pull programme from 2001 until 2009. She participated in the development of a push-pull curriculum for farmer field schools. In the box opposite, she reflects on what she learned about how best to approach women farmers.

Alongside direct engagement with farmers, the push-pull extension model in Kenya also included the development of a media profile for the technology – it has featured on national radio and TV, as well as in the print media – and publicity efforts by push-pull 'champions', well-known people who back the technology. Ensuring that female role models are fully represented in such campaigns is an important part of convincing women farmers to adopt the technology.

Although this model has driven the spread of push-pull, the programme has also actively cultivated partnerships for dissemination with

other organisations, both governmental and non-governmental. In the course of their work, the pathways of *icipe* extension staff cross those of extensionists from other agencies, public and private, that are working in rural areas. This has led to the organic growth of day-to-day partnerships between different organisations, which mean that push-pull can be added to an existing set of options for improving nutrition, promoting sustainable crop-livestock integration or increasing milk production. In some cases, these partnerships remain ad-hoc and local; in others, they have been formalised and have proved to significantly increase the spread of the technology.

Partnerships with government

Government agricultural research and extension organisations across East Africa have been greatly reduced in size and scope in the wake of the privatisation that followed structural adjustment. But in Kenya, Tanzania and Uganda, individual and institutional partnerships with government actors remain pivotal to disseminating push-pull. And there are many female government extension staff who have embraced push-pull and offer useful perspectives on the role of women in technology dissemination.



Sarah Obama (left), grandmother of the President of the USA, is one of push-pull's most prominent ambassadors. She has two demonstration plots on her farm and shows them to the many visitors that she receives. Here, she is shaking hands with Prof. Zeyaur Khan.

Fitting in with what women are doing

"The main principle is experiential learning. Women and children traditionally do the labour in African agriculture; women are closer to the land. So you target women by developing the pathways that you are using to fit what they are doing. When a farmer field school is based in a village, it is able to engage women farmers when they are available – to bond to their programme. For example, you avoid market days – or you come on a day when you know the local merry-go-round [rotational credit] group is meeting anyway. It is easy to overcome challenges that way.

An additional pathway I have used is participatory video – it is a powerful tool for engaging women. It is very effective in terms of time, because you can repeat any lesson instantly. Women can handle it very easily. It is still true that literacy levels are lower among women, so this is a good way of getting through to them. Women's working schedules are very heavy, but participatory video is very flexible, you can facilitate

it so that they can use it whenever it is needed. They can learn in the absence of staff, and go back to look over things again."

Matilda Ouma, former push-pull research assistant.



Matilda Ouma (second from left) showing farmers how to plant the Napier grass border around a push-pull plot.

In Kenya, Felister Makini, now Deputy Director of KALRO, recalls the long relationship between *icipi* and the government's agricultural research agency. This began with KARI's involvement in searching out and selecting potential companion plants when the technology was being developed. It continued through the participation of KARI farmer groups when push-pull was still in its experimental stage, and through Felister's own involvement in an advisory panel of the non-governmental organisation (NGO) Farm Africa, which selected a proposal for funding the scaling up of the technology. She was Chair of the Steering Committee for the Climate-Smart Push-Pull (Adopt) Project. "We've worked so closely together," she says. "Push-pull has helped with feed shortages, stemborers and striga – hitting them all with one stone. That is a great plus for us, because we are also doing research towards solving these problems. The Farm Africa grant for upscaling funded some



"Push-pull technology goes hand-in-hand with KALRO," says KALRO Deputy Director General Felister Makini (right). "It has been a very effective partnership."

of our scientists to scale push–pull up in other regions, where *icipi* wasn't working."

The partnership between *icipi* and the Ministry of Agriculture's extension agents in rural areas has thrived on mutually beneficial individual relationships. Lorna Wanyama, Ward Agricultural Officer in Busia district, describes working with *icipi* field assistant Peter Osire. "We have bonded!" she says. "The Ministry of Agriculture has given me a motorbike, but I do not know how to ride. So Moses has become my rider and we go to farmers together. I have farmer groups and farmer field schools – and so assist in identifying and recruiting farmers for push–pull."

Several of the Kenyan female extension officers we talked to emphasised how the position of women in both agriculture and agricultural extension has changed during their careers. Twenty years ago, Mary Odhiambo, a Divisional Livestock Extension Officer in Homa Bay, engaged with more male than female farmers, but it is now roughly half and half. What has changed? "Women still provide the labour, but now they have more of a stake in making decisions. Women want to learn, but men are reluctant. Women's attitudes have changed – they now seek more advice."



"Having women in senior positions," says Felistus Magomu, "encourages us to be confident."

Pamela Liech, a Principal Agricultural Officer in Homa Bay, comments on the subject of the government's quota of employing 30 percent women: "Men feel like women are being given a free thing. There are many problems to being accepted, being taken seriously. The efforts are there, but cultural practices do not change." By contrast, Phoebe Adunde, a Ward Extension Officer in Rongo, notes that although "women are in a minority as ward extension officers – and society can look down on you – we are making gender equality more acceptable. We empower women more, so that they feel they can have a position in society."

In Uganda, *icipi*'s partnership with the government has mostly been with the Poverty Alleviation Department (PAD), which operates in several parts of eastern Uganda where the push–pull programme is active. Felistus Magomu, a Special Presidential Assistant working in State House, points out: "*icipi* needs farmers, and PAD needs knowledge and expertise – it is a golden opportunity for partnership." Rose Nasirimbi, a PAD field officer, emphasises how she and her *icipi* partners work as a team. "We move together in every corner," she says. "PAD helps with translating into local languages, sensitising and bringing farmers, identifying places where striga is a problem, and getting involved in monitoring once push–pull has been adopted."

Felistus says that the President appoints PAD staff, and that most of those working at the senior level are female – there are only four men at headquarters, and 15 women – but that the physical demands of the job at the lower levels mean that there are only two female field officers, including Rose. Felistus and Rose agree that although PAD targets women, it does so through households; here, seeking the permission of men is still very important. As Rose says, "we explain things to men first, and then women are targeted once the men know what is going on."

In Tanzania, where partnerships with NGOs have been the most important vehicle for disseminating push–pull, individual government extension agents have nonetheless played a significant role in bringing the technology to farmers. In the box opposite, Field Officer Epi Baguma reflects on her experiences in extending push–pull in an environment where women have not come to the fore socially in the same way that they have in Kenya.

Practicing what you teach



Name: Epiphania (Epi) Baguma, b. 1985

Education: Diploma of General Agriculture

Job: Government Agricultural Field Officer, Bunda district, Tanzania

"Everyone has their own ambitions," says Epi Baguma, "and working in agriculture was mine." She loved biology in school, though it was perceived to be "a tough subject for girls," and was influenced by an uncle who was an agricultural officer. There are not many women at agricultural colleges in Tanzania – Epi was one of six, out of a class of 35 – and even fewer in government extension offices. "At the start," she says, "it was not easy."

Push-pull is one of the technologies that Epi extends to farmers. One of the challenges she faces is the persistent cultural belief in Tanzania that some crops are 'for men' and some are 'for women'; maize and sorghum, with their potential for high yields, are seen as men's crops. Epi tries to help women and men to combine their efforts, and to cultivate all kinds of crops. One of the most powerful tools she uses to bring women push-pull

adopters on board is practising what she teaches, by growing sorghum on a push-pull plot at her own home.

Epi usually works with mixed groups of male and female farmers, but women often have feelings of low self-confidence in group settings. "The trick," she says, "is how you bring people together." She has a number of strategies for including women, including calling women-only meetings before mixed group meetings, dividing tasks at trainings to show men that women can make useful contributions to establishing push-pull plots, and taking her farmers on exchange visits to groups where women are appreciated and given opportunities.

Epi says that, in her view, women often do better than men as adopters. She says they are more likely to take the time to follow up, and to follow trainings to the letter.

"Women in Tanzania," says Epi, "have been left behind for some time. But they are able, when they are enabled."



Partnerships with NGOs

The innovation in the way that push-pull was disseminated was that they involved NGOs. Using an NGO like Heifer International to upscale the technology – that was very unusual.

Felister Makini

Push-pull is far more than just a solution for striga and stemborers. It is also a route to reducing agricultural labour, improving household nutrition and ensuring a steady supply of fodder. These qualities have made it an excellent fit in the programmes of several of the region's NGOs, especially those dealing with sustainable agriculture, livestock production and support to those living with HIV/AIDS.

The most important partnership is with the NGO Heifer International, which aims to end hunger and alleviate poverty by helping families achieve self-reliance. It works with community farmer groups to build their capacity in sustainable agriculture and livestock production, the key to which is developing diverse sources of food and income. Once the group members are trained and each member has established a reliable supply of fodder, Heifer distributes livestock to 75 percent of group members.

The families receiving animals give the first female offspring to other trained group members who have made similar preparations, through a process known as 'passing on the gift'. Heifer International's programmes across the world embrace an integrated community development approach based on a set of 12 principles known as 'cornerstones' for sustainable development, one of which is gender and family focus. The organisation also sees gender equity as central to its success.

Heifer International is *icipe's* main partner for push-pull implementation in Kenya and Tanzania. Push-pull is a good way for Heifer International to ensure that groups can provide adequate fodder to keep the livestock they distribute healthy and productive. But the technology also works well for them because many group members are HIV positive, and therefore facing the twin challenges of maintaining their health through anti-retroviral drugs and a nutritious diet, and reduced capacity for agricultural labour.

Heifer also participates in training government extension staff in push-pull. Mary Odhiambo has been trained twice in push-pull, first by the Ministry of Agriculture in 2012 and then by Heifer International in 2014. She says the second training was more successful; she has subsequently trained five groups of around 30 farmers, and seen more than half of the members adopt the technology.



"The Heifer push-pull training was deeper and more practical" says Mary Odhiambo. "The groups are ready, so it is building on something that is already there and adding practical skills."

Integrating push-pull into holistic change

Name: Lillian Ouma, b. 1979

Education: College diploma in Education

Job: School teacher, farmer, farmer-teacher

Lillian Ouma is a busy woman. As well as working as a schoolteacher, she does some of the farm work on a smallholding that includes two push-pull plots, a kitchen garden and a bulking plot of stunt-resistant Napier grass. She also finds time to be a farmer-teacher and an active member and office-holder in the Jiinue ('Lift yourself up') group. "I squeeze my time!" she laughs.

The Jiinue group formed in 2006 when *icipe* first came to their part of Busia district to disseminate push-pull, and Lillian and several of her neighbours adopted it. Lillian was initially the group's secretary and was responsible for writing their successful proposal to become a Heifer International group. She received a dairy cow from Heifer in 2011 and has passed on a female calf to a member of a neighbouring group.

Before 2006, life was very different. "We were doing things without knowledge," she says, "just doing it endlessly, wasting time and energy but not

harvesting much." Since getting push-pull and, with support from Heifer International, moving towards a more diverse, integrated and sustainable crop-livestock system, "my life has changed holistically: financially, from the sale of maize and milk; socially, through being in a group that shares ideas; mentally, as we are now educated; and emotionally, because we are at peace, with enough food."

The Jiinue group has both male and female members, who participate equally in meetings and activities – 'full participation' being one of the Heifer cornerstones. At home, although Lillian does most of the farm work, her husband – also a schoolteacher – shares many of the tasks and takes responsibility for milking the cow every morning and evening. "That is not common in this place," says Lillian, "but for those who are knowledgeable, who have been trained, you can do this and be role models for others."



In 2015, Lillian bought a pig, which eats some of the fodder from her push-pull plot, to generate income from the sale of piglets. Her next planned venture is a poultry unit. "My objective," she says, "is improvement."

New frontiers: Extending push-pull in Ethiopia

The Kenyan dissemination model has been adapted for the Lake Victoria regions of Tanzania and Uganda, with some success. But the challenges of exporting push-pull to Ethiopia and reaching women farmers are more complex.

In 2011, the Ethiopian NGO Institute for Sustainable Development (ISD) was mandated to extend push-pull in the sorghum-growing belt of the country, where striga and stemborers are a common problem. ISD's director, Sue Edwards, says that they catalyse change by facilitating local actors to combine new approaches with their own traditional knowledge and resources. Since 2011, push-pull has been one of these new approaches.

After ISD has trained farmers in the technology, their staff and government extensionists follow up. This is reinforced through exchange visits, field days and travelling seminars where farmers meet with extension personnel, local administrators and their peers to exchange information and reinforce good practices. ISD staff member Sara Misgina says that people have seen the technology reduces weeds, and this has resulted in it being scaled out to other places beyond ISD's project areas.



Sue Edwards checks sorghum stems for stemborer larvae in a striga-infested field in Bizet, Tigray.

Thanks to a very different political history from Kenya, Tanzania and Uganda, relatively few farmers in rural Ethiopia are members of community-based groups, so an exact replication of the group approach to dissemination is not an option. All farmers are members of their local *kebele* (peasant association), which is part of the structure of local government. So ISD works with individual households, government extension officers and farmer training centres to forge the pathways needed to spread push-pull. As in the Lake Victoria countries, they also support respected farmers and influential local people to adopt. One example is Tigrayan priest Keshi Welay who has established demonstration plots of push-pull with maize and sorghum on his 20 x 20 m farm.

Gender roles in Ethiopian society and agriculture differ from the Lake Victoria countries. Women in rural Ethiopia can face significant social and cultural constraints to their participation in public spaces. Government extension officer Aragaw Said Imam, who has two female colleagues in the district extension office, says it is very difficult to get female farmers to come to trainings.

In terms of the gendered division of labour, women are traditionally responsible for weeding and men for ploughing, but men take on most of the work for the main crops, while women tend to focus on vegetable production. Female push-pull adopters in Ethiopia frequently identify better fodder as the push-pull benefit they value the most, in contrast with those in the Lake Victoria countries, who more often mentioned grain.

Another key difference is that in the drier rainfed systems of Ethiopia, farmers are accustomed to rotating their crops every season, selecting crops according to their perceptions of the fertility of the soil and when the rainy season is coming in. Those farmers who have taken up push-pull establish one small plot on a fragment of their farm and continue with their existing cropping practices on the remainder. One adopting farmer, Zewdie Said Yesuf, says that she has ploughed and re-sown the push-pull plants every season since she started using the technology, according to the prevailing rhythm of rotation on her family farm.

Even more than in the most densely populated areas of Western Kenya, push-pull



Ethiopian farmer Mulu Negese encourages other women to come to her home, where she teaches them how to use the technology. She believes that neighbourly contact is the best way to reach other women.

farmers in Ethiopia very often farm tiny fragments of land. Female farmer Ayal Abera, for example, supports her three children and herself by growing maize, sorghum, chilli and onions on a 40 x 40 m plot. She has no animals of her own, but uses the fodder she grows to feed her father's oxen.

These differences in context currently present some barriers to widespread push-pull uptake in Ethiopia. But Sue Edwards notes that many farmers like Zewdie have modified the standard technology to fit with how they can make it work or what they want it to do within their context. One of these modifications has led to the observation that desmodium seems to suppress another significant parasitic weed, broomrape (*Orobancha*), that negatively affects vegetable production; female farmer Hiwot

Behere has used push-pull on her tomatoes and carrots and got good results. It seems that one way to share the benefits of push-pull with Ethiopian women farmers may be to build on the experiments and innovations that are happening on the ground.

Linnet Gohole, in her role as East Africa Regional Representative of the McKnight Foundation, concurs. "In McKnight," she says, "we are trying to work to get solutions that suit many contexts. We are running away from situations where scientists ... make recommendations, but farmers can't afford to follow them." As such, the Foundation is supporting work with ISD and *icipe* to develop 'push-pull plus' in Ethiopia, to shape the basic principles of the technology to the experiences and needs of farmers.

3. Land:

Push–pull and women farmers

This section discusses what shapes the experiences of women farmers who adopt push–pull technology. It examines not only the benefits of adoption, but some of the difficulties. As Dr Hailu Girma, head of the push–pull programme in Uganda, points out, “push–pull is not a silver bullet.” The technology is not, for example, available to all women – for a range of reasons – and does not radically transform the life of every woman who adopts it. It is only through gaining a better understanding of these challenges that it will be possible to extend the benefits of the technology to more female farmers.

Land

Access to land, including clear and secure tenure, is an important determinant of the ability of any agricultural household to invest in their farm. This is particularly true for push–pull: the perennial companion plants mean that the benefits of the technology can be maximised only if a plot remains in place year after year.

Most of the women we interviewed farm land that has been passed down through their husband’s family, sub-divided between the brothers in each generation; this is also true of most widows. But although this is the most frequent mechanism for accessing land, some

women own land outright in their own name, and some rent it, paying with cash or (particularly in Ethiopia) a proportion of the crop they grow. One Ethiopian adopter was allocated land by a government relocation programme which moved poor landless farmers from another region. Within these different routes to land access, however, lie a range of circumstances that shape women’s capacity to adopt and sustain push–pull.

Eunice Atieno, a Kenyan farmer-teacher, neatly sums up the gender dynamics of access to inherited family land. “Men know that their wives have to have land,” she says, “because they do most of the work. And most men are happy to give it, as long as they see a good harvest.” Among the women farmers we talked to, there were numerous examples of harmonious extended households where this basic dynamic functions well; even though men have the ultimate power in deciding what happens to land, men and women work in partnership to ensure that it meets the needs of their household, and easily reach agreement about the adoption of new technologies. But, as the story of Ugandan farmer-teacher Rita Ochwo shows, households exist within the networks of extended family and clan, which have a powerful influence on access to farmland.

Women who buy land



As well as being a farmer, widow Teresa Korinda is the caretaker at an agribusiness premises where she has lived since 1991, a farmer-teacher, and the proprietor of an agro-veterinary supplies shop in Kenya’s Rachuonyo district.

She has the use of an acre of land where she lives. But she also owns what she calls “my miracle land”, a second acre that she managed to purchase outright, paying in instalments during a brief period when she had a steady wage. It is on this acre that she has planted her two push–pull demonstration plots. “I am queen of this land,” she says.

A farmer-teacher without a plot



Name: Rita Ochwo, b. 1975

Education: Completed junior secondary school

Job: Farmer, farmer-teacher

Rita Ochwo, who lives in Uganda's Tororo district, was first interviewed for a push-pull publication in 2013. In *Stories of our Success*, her story was about her enthusiasm for teaching push-pull to her peers, and her quiet determination to diversify her economic activities to build a better life for herself, her husband and their four children. From the push-pull plot she planted in 2009, she was producing enough maize to last the year, and had been slowly building up a small flock of goats by buying one animal each season. She had invested three times in batches of fertilised chicken eggs, which she hatched before fattening the chicks with desmodium and grain to sell at market.

In 2015, when Rita was interviewed for this report, she explained that, at the moment, she had no push-pull plot. The land she had been cultivating had come to her through her husband's clan, and in 2014 they decided that she had been overworking it. Her father-in-law took the decision to re-allocate the land between his sons, and he gave the land under Rita's push-pull plot to her husband's

younger brother, who has dug up her push-pull plants and sown a cash crop of groundnuts on the 'exhausted' soil. Rita's husband was allocated a new piece of land, but Rita cannot start work on a new push-pull plot there until the current incumbent has harvested their cassava.

Rita and her husband were both upset and angry about the loss of their most productive asset, but knew there was nothing they could do. Rita is resigned to starting again, but is determined and has her husband's full support; at least this time, she says, they know that the sub-division and allocation is final, and that they have secure tenure of the new plot. From the savings she had made from the sale of the poultry she was raising in 2013, Rita bought a small plot in the local trading centre, with a skeleton building on it. Her next plan is to save enough money to buy a roof, and then rent out the rooms, and maybe even start a shop. Meanwhile, she continues to support other farmers to learn push-pull, a farmer-teacher without a demonstration plot.

A few stands of Napier grass are all that has been saved from Rita's former push-pull plot, now covered with a groundnut monocrop.

She has successfully argued that she should be allowed to use this Napier as material to establish her new plot.





"I will keep putting push-pull on hired land," says Pauline Atela, "because I need cereals to feed the children."

Another challenge of farming inherited family land is the diminishing size of the plots, which are sub-divided for inheritance each generation. Rose Wafula, a Ugandan farmer-teacher, points out that "the challenge for [push-pull] uptake is shortage of land. Farmers here are used to mixed farming – they plant maize and beans, then when the maize is finished they take it up and plant cassava in the spaces left. You cannot do this with a push-pull plot, but they do not want to lose their cassava." Rose advises farmers to put a very small plot aside for push-pull and to keep the rest for mixed farming.

Although secure tenure is the ideal scenario for push-pull adoption, some farmers take the risk of establishing their plots on rented land. Pauline Atela farms family land in Kenya's Nyando district but found that push-pull did not do well on the heavy clay soil there. She has since hired land four times to re-establish push-pull, but on every occasion, its owners have taken the land back. As a passionate advocate of the technology, she told them not to destroy the plots; some did, and some did not. Pauline's need to produce food means that she intends to keep establishing push-pull on rented land.

Widows face an especially uncertain situation regarding land tenure. A great deal depends on their relationship with the family of their late husband. Social worker Dede Iscah, who works with the Kenya AIDS Response Programme, explains that "leadership and access to resources has changed in female-headed households. But even though women may be taking the lead when their husbands have died, they still face challenges. Brothers of their husbands still control the land and other resources."

In some cases, relationships are good and widows continue cultivating and even inherit their husband's land. Paskalia Shikuku, a push-pull farmer in Siaya district, returned to her husband's family home after his death, farmed his ancestral land, and received the same share as her husband's brother when her father-in-law subdivided the holding. But for some widows, things do not go so well. In Uganda's Tororo district, Mary Nanjala was widowed in 2007. Her husband had inherited land from his father, which she inherited on his death, but there was a conflict in the clan and 1.5 acres was sold. The loss of this land compounded the loss of her husband's salary as a water engineer. Now, in very poor health herself, she feeds eight children and her brother-in-law from a 2.5 acre holding, which includes half an acre of push-pull. "My whole life is there on the push-pull plot," says Mary "because I have a houseful to feed."

Decision-making

Although women do the majority of agricultural work, if a man is present in the household, he has the ultimate power to make decisions about the farm. Many women push-pull farmers who work in partnership with men discussed the dynamics of persuasion and what is needed to convince men to take up a new technology.

Rumona Mayoka, a disabled farmer from Kenya's Vihiga district, wanted to adopt push-pull



"I tried my level best to make push-pull succeed," says Rumona Mayoka, whose husband eventually agreed to let her establish a 0.25 acre plot on their land.

Persistence pays dividends

Name: Neema Machuri, b. 1980

Education: Completed primary school

Occupation: Farmer

Neema Machuri and her husband both work on a five-acre farm where they cultivate maize, beans, cassava and cotton in Tanzania's Bunda district. Neema is a member of a Heifer International group and adopted push-pull in 2013.

At first, says Neema, "my husband did not want me to go to the group. But I remained persistent. I ensured that each time I came back from a meeting, I came with something new, with some benefit. And he found it very difficult to refuse. When he realised he could not stop me, he joined me instead."

When the group had developed sufficiently, Heifer International called a meeting to introduce goat, dairy and poultry projects, and asked them to choose which they would like to adopt. "Women mostly went for goats and poultry," says Neema, "but I went for dairy. I told my husband and he said 'it will be too difficult for you'. But I said 'no, I will manage,' and said that if he refused me,

I would ask for land from a neighbour. In the end he accepted, but told me to expect no support from him."

The other women in the group also tried to discourage her, saying that dairying was too much physical labour for a woman, but Neema wanted a dairy cow. She started the application process and began constructing a unit. Her husband, realising that there was no stopping her, chipped in with time and money for the construction. "And when the animal finally came, he was very happy," she says.

When the group was introduced to push-pull the year after Neema received her cow, her husband accepted the new technology. He helps Neema on the push-pull plot because, she says, he can see that is where the fodder comes from. With her nutritious diet, the dairy cow gives 12 litres of milk a day, and the couple have been able to invest the profit from their milk sales in digging a well in the compound.



"To be able to achieve everything you want," says Neema, "you have to start from the heart – have a vision – and then you will do it even if you are refused. I remained persistent."

when she discovered that it needed less labour than conventional maize production. "But," she says, "it is a hard thing to convince a man that you want to be a push-pull farmer – they trust their own ways of planting." Even though Rumona's husband works away from the farm as a mason, he was reluctant for her to establish a plot on the farm. "My trick was to persuade my husband to let me start with a very small plot, and then make it a success," Rumona says. Her strategy worked: she now supplements her income from tailoring with push-pull maize. As group chairperson, she has also visited husbands of other group members "who are having trouble persuading, and helped them to get small plots."

Such demonstration plots are important; Risper Ouso, one of the first push-pull farmer-teachers in Kenya's Mbita district, says that for many men, seeing the evidence of an established, productive push-pull plot was pivotal in successfully persuading them. And Grace Anyange, a farmer-teacher from Kisumu West district, suggests that including men in groups is absolutely vital to ensuring women's adoption of push-pull. "Men have to be in the group because decisions about farm resources are involved," she says. "Men need to know these things. If they are in the group, you don't have to explain everything again when you get home. It is important to try and get men to join groups, to get their interest." As she points out, "If my husband hadn't gone to that first group meeting [where he heard about push-pull], we wouldn't be where we are today."

In Tanzania, however, gendered power relations in households remain more rigid and

traditional than in Kenya, and women can face an even more difficult struggle in persuading men to take up new agricultural practices. Push-pull farmer Dorcas Josephat says that not all women in her group have been able to adopt. She has a disabled husband, and says that this allows her more control over decisions than is normally the case. She says that many women try to be submissive and obtain their husband's permission by being "good women who deserve to be rewarded"; this has worked for some, but not all. Fortunately, persistence and determination sometimes allow women to prevail, as Neema Machuri's story shows.

Labour

One of the most appealing characteristics of push-pull technology for women is that it means less weeding. In Ethiopia, before Taitu Yassim Adera and Zewdie Said Yesuf adopted push-pull, the only way they could tackle striga was to pull out the stems when they emerged, which was time-consuming and not particularly effective. Reducing the labour they have to invest is one of the things they value most about push-pull.

As well as reducing the labour needed for weeding, establishing the perennial companion plants on a permanent push-pull plot also bypasses the need to dig over or plough the whole plot each season. Although this is traditionally a job for men, it is a task for which female-headed households still have to find a solution. Millicent Achieng, a farmer-teacher in Kenya's Homa Bay district, says that she saves money because she no longer has to hire oxen for ploughing.

Push-pull also offers significant labour savings in gathering fodder for animals. Neema Machuri used to spend an average of 2.5 hours every day gathering and carrying fodder for her cows, but now only needs to do this very occasionally during the dry season. Also in Tanzania, Salome Mosabi says that providing fodder is the main way that push-pull makes women's work easier, while Rebecca Thomas says that cut-and-carry push-pull fodder is the key to making dairying a profitable strategy on her farm.

Despite these undoubted labour-saving benefits once push-pull is established, adopting the technology requires a great deal of labour in the first season, to ensure that the companion plants are correctly weeded and well established. This investment is also needed to expand a plot in subsequent seasons. So for a farmer like



"The main challenge of being a woman farmer is the time taken up by weeding," says Ugandan farmer Immaculate Adilu (right). "Push-pull is good because there is not so much weeding."

Determined to dig deep



Name: Beryl Atieno, b. 1991

Education: Studying for a college diploma in agriculture

Occupation: Farmer, student

Beryl Atieno is an extraordinary young woman. The second-born of five children, she grew up on her family's two-acre smallholding in Kenya's Vihiga district. Disabled since birth, she struggled with depression when she left school after completing her secondary education, feeling isolated and disillusioned when she could not find work. To find out what other disabled people did for a living, she started attending meetings of the Maseno Depot Disabled Group. There, she found encouragement and support, and began to develop her conviction that she could succeed despite her disability, and fend for herself without depending on other people.

Several members of the group had adopted push-pull, and Beryl visited members' homes to discover more about how the technology could be implemented by farmers whose disabilities reduced their capacity to labour in their fields. Despite her inexperience of farm work, she decided to see if push-pull would work for her. She asked her parents for a small plot, but they resisted. "They thought that it would end up being a burden," says Beryl, "and that they would have to

hire labour. But I persisted. I gave them examples of other disabled farmers. So they finally agreed to give me a 10 x 25m plot, as a trial."

Beryl appears quiet and shy, but beneath this exterior she has a steely determination. "I wanted to prove that I would not be a burden," she says, "and I promised to do all the work myself." With the exception of some help from her siblings on planting day, she kept her promise. "This changed my life," she says. "I see that I can do anything a normal person can do, can do even more, through hard work. It also led to a yearning to go beyond farming and find knowledge about agriculture."

Since then, Beryl's life has changed considerably. She has become a champion of push-pull and has travelled to Uganda and 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 began to fulfil her yearning by studying for a three-year diploma in agriculture.

In the future, Beryl wants to go beyond her diploma in agriculture. "I would like to become a scientist," she says, "and to discover things that people have not discovered yet."



Mary Nanjala in Uganda, her own poor health, a shortage of labour in the household and a lack of income to hire labour mean that her desire to expand her push-pull plot is likely to remain unfulfilled.

In Ethiopia, the initial heavy demand for labour is an obstacle to adoption. Households are based around nuclear rather than extended families, which means that less labour is available than in the multi-generational extended households of the Lake Victoria region. Although there are strong traditions of collective farming, Sue Edwards says “when it comes to field management for something like push-pull, which is knowledge intensive, you can’t just borrow farmers from adjacent fields, or families, like you can with harvesting, sowing or even weeding – when people will normally get together to work in a group. For push-pull, the optimum labour you have available is what you have in your family.” Sometimes, this is not enough.

Many female farmers do find ways around the need for labour. Some, particularly members of Heifer International groups, work in small groups on each others’ farms until each member has established a plot. Others cultivate a collective group plot, sharing the outputs, adding them to group-saving schemes or using the fodder to increase the health and productivity of pass-on livestock. Others, like Beryl Atieno, use their own labour, succeeding against all expectations.

Food

Most of the female farmers interviewed for this report see ‘putting food on the table’ as a woman’s basic responsibility to her children. In the words of Bilha Wekesa, who farmed while her husband was a schoolteacher, “he educated the children; I fed them.”

Push-pull increases cereal yields. Many push-pull farmers describe themselves as food secure, meaning that they produce enough grain to last from one agricultural season to the next, and most of those who have not yet attained this goal are getting closer. Mary Otuoma, who farms a single acre, says that “my priority has always been to have enough until the next harvest”. Last season, having added a fourth push-pull plot to her farm, she obtained a surplus for the first time, and had some maize to sell.

Grace Anyange and her husband support a household of 13 people on their three-acre farm. They adopted push-pull in 2012 and have since



Grace Anyange has been a farmer-teacher since 2013. “Now other people are food secure too,” she says, “and this makes them love me and my work. They pray for me every day because I have made a difference in their lives.”

added three more plots, one each year. Before adopting the technology, Grace says, “we could only go two months with our own maize – this meant that I had to look for coping strategies, and we had to go without. Now we can feed this huge family.”

In Kisumu West district, Margaret Anyango works as a tailor and a farmer, while her husband is a driver. She first adopted push-pull in 2009, and now three-quarters of her one acre holding is under the technology. She no longer buys maize from the market, and is in a position to hold onto



“When people are constrained nutritionally and financially it puts a strain on family relations,” says Margaret Anyango. “When you have to ask for money or food and it is refused, there are fights. I have peace of mind now, I don’t have to ask for anything. I am seen as an asset.”

the surplus maize from her plots to sell in the hungry season when the market price is high. Because she grows enough for them to eat, she says, the money from her husband's job can be used for school fees and savings.

Money

Meeting the basic needs of life increasingly demands money. Push-pull can generate money in a number of ways, and for many women it is a route to income that they can control, deciding whether to spend, save or invest it in their farms.

For Dorcas Josephat in Tanzania, extra income is the single most positive benefit of adopting push-pull. It comes from selling surplus maize, manure and milk when animals are producing well, manure, and – during dry periods – fodder. “I think if I’d had this income earlier,” reflects Dorcas, “more of my children would have gone further in school.”

In Uganda, Eunice Baraza also sells fodder, because her one ox and one pig cannot eat all that she produces. She sells for cash, but customers also exchange fodder for milk, which she needs to feed her family. She produces more maize from her push-pull plots than her family can consume, and sells it to pay school fees. She also saves in a local share option savings group. Like Eunice, Rumona Mayoka puts money from fodder sales in her ‘merry-go-round’ savings group. She has no animals of her own, but lives in an area where many people keep dairy cows, ensuring a constant demand for her desmodium and brachiaria.

In Kenya’s Trans-Nzoia district, Bilha Weseka was one of the earliest adopters of push-pull, planting her first plot in 1998. Not long afterwards she acquired her first dairy cow, and since then she has sold milk every day – it is, she says, “our daily bread.” When her first-born son, who was inspired by her efforts as a farmer-teacher, wanted to study for a certificate in sustainable organic agriculture, it was KShs 16,000 from the sale of desmodium seed from his mother’s bulking plot, added to his own savings, that secured his place.

Millicent Achieng is using the skills she has developed as a farmer-teacher to generate an income. She is in demand as a facilitator and is paid to train groups on sustainable agricultural production – including push-pull – for international NGO Plan International. Shortly after we interviewed her, she was also due to start conducting five-day trainings for a second NGO.



“Before push-pull,” says Mary Onyango, “I had nothing to sell”. Now she makes money by selling a kid every six months, and from surplus milk. When there was excess desmodium and brachiaria, she sold it for KShs 200 a bale and used it to build a brick poultry house.



Bakelech Tesfaye bought an ox for 4,000 birr, fed it with her push-pull fodder for six weeks, and then sold it for 14,300 birr. She plans to use the profit to commence building a house outside Addis Ababa.

As well as being an important source of income, Millicent says that she feels this is particularly important work for other women: “As a woman, when you do this, other women are attracted – they see that even a woman like themselves can give good information.”

Health

In regions where poverty and HIV/AIDS are both widespread, staying in good health is a multi-dimensional challenge. At its foundation is a good diet – obtained by producing nutritious food on farms and in home gardens. There are many female-headed households where a widow, often HIV positive, is responsible for feeding many dependents, often including her own children and the orphans of members of her husband’s extended family. Diet is particularly important for HIV-positive people taking antiretroviral drugs, as these work well only when the person taking them is well nourished.

A better diet to live longer



Name: Dede Iscah, b. 1972

Education: Diploma in social work, currently studying for a degree in community development

Occupation: Community Integration Officer, Kenya AIDS Response Programme

Dede Iscah supports community groups whose members live with HIV/AIDS. "Our approach to women is to help them in groups," she explains, "because it is a way they can share their difficulties, and it makes them easier to work with. We found that around HIV, women will not express themselves if men are there, and that men will always try to dominate." Dede has brought members of her women's groups to Mbita Point to learn about push-pull and to be trained by *icipe* staff. She explains how push-pull came to fit into her work.

When Dede first joined Catholic Relief Services (CRS) as a social worker, experience with anti-retroviral (ARV) drugs was at its earliest stages. She remembers making home visits to people using ARVs and seeing that nutrition was a problem, and the drugs work only when you are eating well. In 2004, she began raising this issue in CRS, and asking what other organisations were

doing about supporting people's nutrition. She approached Heifer International and, "we began to move together. The Heifer International package then was goats and poultry – but this still left the problem of how is the goat going to feed?" In 2009, she learned about push-pull and *icipe*. "We became partners," she says. "Food was still the main issue, how to feed the family."

"Push-pull has gone well, though at the start it can be very difficult and heavy – especially for women who are ill and have many small children. But I encouraged them consistently, farmers learned from other farmers, and we divided the groups into cells [for communal work], which really helped. I have seen that push-pull has an impact on the lifespan of individuals. When nutrition is doing well and drugs are doing well, people prolong their lives. Push-pull is great for this, and the impact is beyond the individual farm."

For these widows in the Kalando Push-pull Group, better yields of milk and maize are key to maintaining a healthy diet, and one of the advantages of group membership is that "if one is sick, we can all come together for labour."





Salome Mosabi feeds Napier grass to her cows and desmodium to her chickens.

Many of the groups *icipi* and its partners work with have been formed as a way for people living with HIV/AIDS to support each other, sharing their difficulties and finding ways to keep themselves and their families going. A range of NGO programmes, like that of CRS (see box), sustain these groups, providing training on sustainable crop-livestock production technologies, healthcare, and capacity- and group-building activities. Push-pull fits extremely well into this integrated model, as a technology that produces a high yield from a small area with a minimum of labour, and where a structured system of shared labour can help farmers in poor health.

A good diet is essential also for those who are in good health. As Paskalia Shikuku points out, it is also the foundation of preventative medicine: "Medical fees are greatly reduced because we are eating better," she says. Push-pull contributes to a healthy, balanced diet through its food crop and fodder crop components. As well as increasing the production of staple foods, it triggers increased household production of protein in the form of milk, meat and eggs.

In Tanzania, Salome Mosabi's two local-breed cows produce more milk than they used to before she started feeding them push-pull fodder. "Before there was only half a cup of milk," she says, "but now there is enough for

everyone to have milk in their tea!" She also feeds desmodium to her chickens; having started with five birds, she now has a flock of about a hundred. Salome says that "nutrition in the family has improved – we can eat meat when we want, and the birds lay more regularly so the children can have eggs when they want."

Other farmers emphasise the health benefits of farming without pesticides or fertilisers and using natural methods of pest control like push-pull. Millicent Achieng says, "wherever I go I talk to people, and I tell them that our health is maintained well with organic farming."

Several adopting farmers and farmer-teachers in Kenya are also community health workers. At different times, Risper Ouso, Mary Atemo and Eunice Atieno have all integrated push-pull into their health-related activities. Eunice, a farmer-teacher from Rachuonyo district says, "push-pull gained me recognition by different stakeholders in agriculture and health. I was elected to represent and voice out issues in different forums. I was selected as a community health worker, trained in seminars – people learn from me and have invited me to train others on issues of malnutrition." She has also participated in a study on the deaths of under-fives. "They see me as a widow whose children have not suffered from malnutrition," says Eunice. "I am used as an example of what other people need to do."

Knowledge

Knowledge is a strong thread running through the push–pull story. The technology’s most obvious and widespread contribution to knowledge is through helping raise what is needed to pay ‘school fees’, the catch-all name given to the costs of education from the primary to the postgraduate level. But push–pull extension also supports peer education, as well as life-long and experiential learning, in many cases building the confidence and social standing of adult adopters, both female and male.

Across the region, among most of those interviewed, education is viewed as a pathway to future prosperity. The idea of bettering your children’s chances in life by buying the best education you can afford for them is deeply ingrained. The Kenyan respondents in particular placed a high value on educating girls, and there were many cases of sisters and brothers within one family reaching the same level of education.

Ethiopian farmer Ayal Abera lives with her two sons and daughter and is divorced from her husband, who she was forced to marry when she was still a child. She sees that helping her daughter continue her education is the main way to ensure she avoids her mother’s fate. But while she wants all her children to attend to their education, she also makes sure they learn how to farm in their spare time.

As well as being a champion of push–pull, Sarah Obama – who was born in 1922 and did not go to school – is passionate about education. With the profits from her farm and large-scale push–pull-based dairy operation, she has paid for the education of many orphans. “I want every child to go to school,” she says. “I am quick to support girl-children for education if they are left alone. Push–pull gives food to feed children – and gives excess to sell for school fees.”

The many female farmer-teachers the push–pull programme has trained, and the peer farmers trained by Heifer International who teach push–pull as part of their sustainable agriculture module, are appreciative of the diverse skills and

capacities they have developed. “When I go, and I see what I have taught being understood and used – this makes me happy,” says Mary Onyango. “Being a peer farmer has made me learn more about farming. Farmers look up to me and this challenges me to come up with new things.” She reflects on the continuing importance of farming in a world where people are more highly educated than when she was a girl. “A better education is now needed to improve farming, and this training starts at home. Learning and education can happen throughout life. Even if a child grows and gets a job, they still have to be interested in and know about farming, and continue with it.”

Over the years, the push–pull programme has also supported adopters to understand the science behind the technology, to experiment and to share learning with other farmers. These three themes come together in the story of Rosemary Oriema, a Ugandan farmer who is hosting several experiments to understand the challenges that farmers in Tororo district are facing with implementation.



“Without education there are no opportunities,” says Sarah Obama.

Living her passion



Name: Rosemary Oriema, b. 1958

Education: Diploma in education

Occupation: Retired school-teacher and NGO farmer-trainer, runs a tree nursery

On the edge of Tororo town in Uganda lies the Agricultural Cooperative Training Institute. It has become run-down in recent years, although it still hosts some training and has a livestock unit. When former farmer-trainer Rosemary Oriema became aware that it had some unused fields, she requested a plot on which to establish a tree nursery to raise seedlings to sell to farmers. Training is in Rosemary's blood, and she teaches the farmers who come to the nursery for trees about a range of sustainable agricultural practices.

Rosemary became aware of push-pull when she met Alice Murage during her time as head of the push-pull programme in Uganda, and realised how well the technology fitted in with the other practices she shares with farmers. When Alice's successor Dr Haile Girma arrived, he also met Rosemary and realised that the land around her nursery would make an ideal location to carry out field trials to continue developing the technology.

The fields around the nursery now contain a demonstration plot, an agronomic trial to evaluate the cost-effectiveness and correct management of desmodium seeds, and a multiplication plot for desmodium and sorghum. A student from a local agricultural college is doing her dissertation on managing and monitoring a long-term trial. Students who learn about push-pull on their courses visit the site to see the technology in action.

For Dr Girma, this is a place to seek responses to the implementation challenges – such as difficulties germinating desmodium seed – reported by farmers and technicians. For Rosemary, it is a "learning site", a place to deepen her knowledge of how push-pull works, to share learning about the technology, and to add value to it by hosting research. "I am doing this," she says, "because I want to continue to live my passion. My family were all farmers, my grandfather was a great farmer, and I love nature."

Rosemary and Dr Girma discuss how to monitor shoot-fly infestation on the brachiaria in the push-pull demonstration plot.



Conclusion

This report shows the diverse roles that women have played in the development and extension of push–pull technology. It presents lessons from the technology’s Kenyan heartland, where spread has been rooted in women’s groups, through Uganda and to Tanzania and Ethiopia, where push–pull must take slightly different pathways to reach women through different systems of gender relations in agriculture.

Lessons from the first 20 years of push–pull dissemination show that women can take up push–pull when they have land, labour, tools and seeds, and enough decision-making power. If, as push–pull farmers, they are supported as peer educators, advocates and role models, they can enable others to adopt, as well as often strengthening their social position within their and households. Maintaining the high levels of uptake by female farmers requires an agenda for interlinked changes in a number of different areas.

- Improve access to, participation in and benefits from push–pull for women, ensuring that they have the necessary capacities and assets to take up the technology.
- Seek partnerships with the structures and interventions that exist to support women on the ground – governmental and non-governmental – in particular to support women from labour-poor households to adopt through work on communal group plots.
- Use technology dissemination pathways that are appropriate and affordable to women and men, respecting the diversity of their social and economic contexts.
- Continue with ongoing direct efforts and policy advocacy to get more women into scientific and agricultural careers, in Africa and overseas.



“This programme made us change as women,” says Kenyan farmer Paskalia Shikuku. “Women are now at the front in this area. At barazas, women are standing and teaching. We have to fight, not just wait to be given things.”

The International Centre of Insect Physiology and Ecology (*icipe*) was established in 1970 in direct response to the need for alternative and environmentally friendly pest and vector management strategies. Headquartered in Nairobi, Kenya, *icipe* is mandated to conduct research and develop methods for pest control that are effective, selective, non-polluting, non-resistance inducing, and affordable to resource-limited rural and urban communities. *icipe*'s mandate further extends to the conservation and utilisation of Africa's rich insect biodiversity.

icipe focuses on sustainable development, including human health, as the basis for development, and the environment, as the foundation for sustainability. Working with a holistic and integrated approach through the 4H paradigm – Human, Animal, Plant and Environmental Health – *icipe* aims at improving the overall well-being of communities in tropical Africa by addressing the interlinked problems of poverty, poor health, low agricultural productivity and degradation of the environment.



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