Context-Sensitive Action

The Development of Push-Pull Farming in Africa

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Maize interplanted with desmodium. (Photo: ICIPE)

It is easy to find countless examples of how we human beings are destructive and undermine not only our own existence but that of the planet as a whole. But there are also many cases—ones that often do not find their way into the news—that show human creativity and engagement at its best. Here I present a project in Africa that can give us hope and from which we can learn much about the characteristics of context-sensitive human engagement.

> The Obinga family are subsistence farmers who eke out a living on the Kenyan shore of Lake Victoria. It is not an easy life; their farm is small and rainfall is often unreliable…. Years of cereal cropping without inputs had reduced soil fertility and the maize plants were being attacked by insect pests and parasitic weeds. The family's thin zebu cows produced little milk, and herding them along the roadside to find forage was a full-time job for the children. Meanwhile, Mrs Obinga was constantly engaged in the backbreaking, seemingly fruitless task of weeding the fields. The granary was empty, the family frequently went hungry, and there was no maize left over to sell. That meant no money to invest in fertilizer or other inputs to improve the situation. The family seemed trapped in a downward spiral of declining yields and deepening poverty and hunger. (Gatsby Report, 2005, p. 1)

Such stories are not at all uncommon in Africa. But the downward spiral is not inevitable. The situation can change, and it has for the better for many small farmers. The shift began with a change in farming practices. Actually, it began with a perceived need and an idea.

In 1970 Thomas Odhiambo founded the International Centre of Insect Physiology and Ecology (ICIPE) as a research organization that would work on problems faced by families like the Obingas. As an insect physiologist, Odhiambo knew well how insects could devastate a maize crop. But he also knew that providing insecticides was not the answer: poor farmers could not afford them, and supplying them through government or international development programs would only mask the problem by increasing dependency on

outside sources. In addition, widespread pesticide use would lead to increasing pest resistance. Wasn't there another way, a way of working that would both address the insect problem and increase the farmer's independence? As Hans Herren, director of ICIPE from 1994 to 2005, remarks, "there was an opportunity here in Africa to implement knowledge on biological control, not only in natural ways, but in a very sustainable way when nobody talked about sustainability" (http://www.silentkillerfilm.org/interview_herren.html).

Caterpillars (larvae) of certain moth species called stemborers decimate on average between 20 and 40 percent of maize grown in Africa—and maize is the main food crop. Sometimes nearly the entire crop is lost. The female moth lays eggs on the maize plant and then caterpillars eat their way into the stem tissue of maize, feed on it, and thereby weaken or kill the plant.

A mature field. Napier grass (on far right) is planted on the borders of a field, with desmodium planted in between the rows of maize. (Photo: ICIPE)

Extensive Observation & Experimentation

Stemborers existed in Africa before maize was introduced and have a variety of plants they can feed on. So the ICIPE scientists asked: Are there other plants that might be even more attractive to stemborers than maize? If so, farmers could plant them around their fields to attract the stemborers away from the maize. They also knew that not all plants are attacked by stemborers and that some plants produce substances (semiochemicals) that lead insects to avoid them. So they asked a second question: Might there be plants that could repel stemborers? If so, these plants could be interplanted with maize to "push" the stemborers away. These questions could only be answered by extensive research: it was necessary to gather many different plant species and investigate the degree to which stemborer females would lay their eggs on the plants.

The research team investigated 400 species of wild grasses (maize is a member of the grass family). About 30 of the wild grasses were found to attract egg-laying females. A few of these did more than this: they also attracted wasps that lay their eggs in the stemborer caterpillars. When the wasp eggs develop into larvae, they feed on the organs of the stemborer caterpillar and kill it. So these plants not only attract stemborers but also, via the wasps, reduce their numbers. One particular plant, Napier grass, attracts egg-laying females, but when the larvae bore into the stem the plant exudes a sticky material that traps the caterpillar so that it cannot pupate and metamorphose into a moth. Since Napier grass is also known as a fodder plant for livestock, it seemed to be an ideal plant to use in field trials. When plots of maize were surrounded by a perimeter of Napier grass, the plots were beset with between 39 and 52 percent fewer stemborer larvae than maize plots without the perimeter of Napier grass. This was a promising beginning.

While the researchers were investigating the 400 different kinds of grass, the head of the project, Zeyaur Khan, was struck by the strong sweet smell of a plant called molasses grass. He then noticed that a plot of this grass had inadvertently been planted next to a plot of maize and that "there was little stemborer damage on the maize closest to the molasses grass, but the other side of the plot was heavily infested" (Gatsby Report, p. 4). This is one of those fascinating instances that can be found again and again in creative research efforts: a person attends to something he or she could easily have overlooked and the fortuitous observation becomes the basis of further important work. It shows how important the openness to new perceptions can be in science.

In this case, field trials were carried out in which molasses grass was planted in between the rows of maize. The results were impressive: whereas in the control maize plots without molasses grass 39 percent of the plants were stemborer infested, only 4.6 percent of the maize plants were infested when they had molasses grass as their neighbors (an 88 percent reduction in infestation).

Scientists and Farmers in Dialogue

The next step—or the next phase in this story of orchestrated action—was critical. The scientists had developed a promising approach to pest management. It was relatively simple and did not require that farmers buy expensive inputs. But would farmers want it? Clearly it was important to communicate with farmers—to open a conversation. And the subsequent successes of ICIPE's efforts show that the organization understood the farmers as partners in a developing dialogue. It was not a matter of the experts telling the farmer how to do things "right" and then leaving, as happens in the classic advice monologue.

Initial conversations with farmers revealed skepticism. The idea sounded too good to be true. Would it really work? ICIPE established a garden in which maize was intercropped with molasses grass and surrounded by Napier grass. Farmers were invited to see the results with their own eyes—something very different from simply hearing about a promising idea. More dialogue occurred and some farmers expressed interest in carrying out on-farm trials. Two different areas in Kenya were selected for the trials—one wet and fertile and the other arid and unfertile. "Farmer days" were held in the regions to discuss the new practice and "modifications were made to allow for current agricultural practices" (Hassanali et al. 2008, p. 615). Most farmers ended up planting one row of molasses grass for every five or six rows of maize and the fields were planted with a border of Napier grass (or sometimes Sudan grass, another stemborer attractor). This approach became known as "push-pull." Molasses grass "pushes" the stemborers away while Napier grass "pulls" and subsequently traps them. Farmers saw the positive results and the method became more popular.

One benefit of this farming method is that the farmers lose fewer maize plants and therefore their yields increase. But beyond that, both molasses grass and Napier grass provide fodder for livestock. This allows farmers to feed their livestock better and increase milk production. Some farmers have extra fodder that they can sell, and with this income buy a new cow.

Unintended Positive Effects

Because the scientists were interested in listening to the farmers, they developed the push-pull method further in new directions that had additional beneficial effects that were in part wholly unexpected. Traditionally, some farmers plant an edible bean in between rows of maize. They asked whether the scientists could find a bean that would repel stemborers and therefore replace molasses grass. The scientists responded by carrying out a survey of legumes (bean family plants) as possible "push" plants. While they did not find an edible legume they did find one, silverleaf (Desmodium), which was a good fodder crop. As a legume it has the additional advantage of improving soil quality by enriching the soil with nitrogen.

In the test plots ICIPE scientists made a further—and wholly surprising—observation: "All our experimental plots are infested with striga [a weed]. So imagine our amazement when we found that maize plots with a Desmodium [silverleaf] intercrop not only had little stemborer damage but also became virtually free of striga after only two seasons" (Gatsby Report, p. 5). Striga is a parasitic weed that, after germination, connects with the roots of the host plant and draws nutrients from it. Therefore, the weed can have devastating effects on crop yields. It is an especially large problem for farmers in the wet and fertile areas. They were eager to plant silverleaf as the "push" intercrop and had good results. The suppression of striga growth led to even greater maize yields.

The change began with a few hundred farmers in 1997, and by 2011 over 40,000 farmers were using the push-pull method, mainly in Kenya but also in Uganda and Tanzania. The Obinga family, described at the beginning of this article, was one of those families that adopted push-pull, and their lives changed dramatically after two years:

> Fields of tall, strong maize plants promise ample food for the next six months; three crossbred dairy cows enjoy a plentiful supply of fodder brought to their stall; the children drink milk every day; and sales of milk, maize and fodder grass bring in vital cash to spend on daily necessities and to invest in farm and household improvements. (Gatsby Report, 2005, p. 1)

A cow feeding on Napier grass and desmodium harvested from push-pull fields. (Photo: ICIPE)

Prior to using the push-pull method, the Obingas harvested about half a bag of maize (45 kg) from a 20 x 30 meter field. With push-pull farming they harvested two bags (180 kg).

Both farmers with very small farms (less than an acre) and ones with larger farms (100 acres) have adopted push-pull, and, as already mentioned, it can be applied in arid or wet regions and areas with poor or rich soil. This adaptability of the approach to different conditions is important and is enhanced by the efforts of both farmers and scientists to modify techniques depending on the specific ecological, agricultural, economic and social conditions. Farmers are not simply given a recipe to follow.

Partnership, Not Control

From an agro-ecological perspective the push-pull project is remarkable. Two seemingly simple additions to the farming practice bear fruit in a variety of ways. Napier grass not only attracts the stemborer away from maize, it reduces the numbers of stemborers by trapping them and by attracting wasps that parasitize stemborers, attracts other natural predators of stemborers such as ants and earwigs, provides fodder for livestock, and serves as a windbreak that protects the maize plants from falling over in strong winds. Silverleaf repels stemborers, suppresses the growth of a prevalent weed, improves soil fertility, acts as a ground cover to reduce soil temperatures and water evaporation, and provides fodder for animals. Both Napier grass and silverleaf are perennials, so they need planting only once; with less bare soil, there is also less erosion. The careful and thoughtful introduction of these two plants into maize fields stimulated a whole array of ecological relations to develop that enhance overall vitality and resilience.

The spread of the approach has been a team effort by scientists and farmers. One key development was that some of the farmers who were using the push-pull approach became "farmer-teachers." They receive further instruction about the method by ICIPE staff and then visit a few farms on a regular basis; they also stay in contact with the ICIPE staff so that there is both ongoing practice, exchange, and training.

It's clear that collaboration is a central feature of this effort: scientists look to nature for ways of modifying one-sided agricultural practices so that nature becomes a partner and not an adversary. Scientists and farmers are also partners. ICIPE collaborates with a research institute in the UK that works mainly on determining the physiological details of plant-insect interactions. African agricultural extension services are also involved. Something that is easily overlooked is the attitude of the funders of such projects. As the Gatsby Foundation, one of the major funders of this work, states in a 2005 report (pp. 23-4):

> In 1994, when Gatsby began supporting research on maize stemborers, push-pull was little more than a promising idea in the minds of an informal global network of chemical ecologists. That it has now become mainstream thinking in several national research systems is due in large part to the freedom enjoyed by the scientists involved to pursue new research directions as these arose—and in particular the links between the environmental aspects of the technology and its implications for poverty eradication…. The flexibility of the project's funding mechanisms was a key factor in maintaining the open-ended nature of the work.

This is an approach to funding that allows creative work to happen—it allows project members to explore, take up new directions as they appear, and respond to changing situations and insights.

As with any project, challenges arise that aren't expected. For example, as more farmers began to apply the push-pull method, a shortage of silverleaf seed arose. The seed had previously been imported from Australia. Some farmers began raising extra plots of silverleaf primarily for seed production. Then a seed company was contacted and encouraged to go into the silverleaf seed business and provide contracts to farmers to produce silverleaf seed. In this way the supply of seed grew and farmers had a new source of income. However, if farmers plant larger fields of silverleaf as a monocrop, pest pressure will likely increase, as it typically does when just one crop is planted. Scientists are currently investigating pests of silverleaf with the hope of finding plants that repel or attract silverleaf pests. This shows that the work never stops. One cannot simply establish a system that works by itself. That's an illusion. What is needed is the wakeful attention to new developments and their possible effects so that dynamic processes are followed and new ideas and flexible strategies can be developed.

Characteristics of Context-sensitive Action

The push-pull work shows how human beings have gone about the work of establishing a healthy relation to one another and the planet. Here I distill some of the key features of context-sensitive action that we can keep in mind in any project we are working on.

Attentiveness/Observation. The push-pull work has its roots in countless observations made by ecologists and

Photo: ICIPE

entomologists about the relations between plants and insects. But there is also the attentiveness to the concrete situations of the different farmers and to the concerns that the farmers express. The farmers observe the effects of different techniques and follow changes. Attentiveness and observation never stop in a living enterprise. They provide stimulation for new ideas and correctives to ideas or practices that have become stuck or routine. Ongoing attentiveness and observation is a commitment to staying open to what is concretely given. The push-pull work shows on the one hand the importance of systematic and detailed observation (to find the push and pull plants) and on the other hand the gifts that come from open attentiveness, which, for example, led the researcher to discover "by chance" molasses grass as a good push plant.

Ideas/Insight. Without the generation of guiding ideas, there would be no push-pull method. The many observations of agro-ecosystems formed the basis of the insight that when humans create monocultures of crops, they are in a sense inviting the demise of the crops by attracting insects, weeds, or other organisms that can thrive under one-sided conditions. To work against this tendency ICIPE decided to look for ways to create more diverse and thereby resilient conditions, working with, rather than against, nature. This is a central guiding idea that motivated the development of the push-pull method.

Interest/Compassion. One of the main motivations for the push-pull work was to help poor African farmers establish more sustainable livelihoods. It was not born out of self-interest. There was perception of great want and the desire to do something to help. In other words, the people at ICIPE were interested in the plight of their fellow human beings, felt compassion, and wanted to work to better the situation. Without such feelings that bring us out of ourselves and let us dwell as empathetic beings among other beings, good works would not occur.

Cultivating Relations. The work of the ICIPE scientists is all about getting to know the relations between plants and insects, and then working with these relations in practical applications. But the relational insights of the scientists are not enough. Dialogue between farmers and push-pull technicians and scientists started early in the project.

This cooperation remains essential and continues to this day. The scientists cooperate with other scientists and ICIPE interfaces with a variety of governmental agencies, nongovernmental organizations, and funders. This is not just a matter of networking, but of cultivating relations through which the work of each member enhances the work of the others.

Staying in Process. The scientific investigation of plants and pests doesn't stop, and adaptations of existing methods are continually developed. New forms of communication between farmers and scientists are tried out. It is expected that unexpected challenges will arise—and they do and are addressed. The funders responded to such challenges; they didn't focus rigidly on projected outcomes. Challenges can morph into opportunities, such as when farmers begin planting silverleaf for seed production. Context-sensitive action always remains engaged—active and at the same time responsive, with a willingness to change and take new directions.

Keeping a Focus. There is danger in flexibility inasmuch as there are so many needs and so many problems. If one project were to try and address them all, it could become too diffuse and dissipate its energies and resources. It's interesting that before silverleaf was discovered as a means to suppress the growth of the weed striga, a government agricultural officer visited ICIPE scientists and asked whether they might be able to address striga, which was such a problem for many maize farmers. They said "no", which is perhaps surprising, but also intriguing. Their

reason? They knew that they are entomologists with an expertise in insect pests and that they did not have an expertise in plant pests. They didn't want to stray too far afield. Little did they know at the time that their context-sensitive approach within their specialty would in the end lead them to a solution for the striga problem! But this unintended solution to a weed problem arose out of their following their pathway as plant-insect interaction specialists and at the same time staying open to observing unexpected effects. This points to the importance of knowing what you do best and sticking to that, while at the same time having the willingness to be stretched. There is a real tension here, but it is a tension that brings life into the process. The ICIPE scientists work within some self-set boundaries, but also know they need to venture into some unfamiliar territory in order to stimulate fruitful change. So, for example, the ICIPE scientists work to establish and uphold real dialogue with farmers—something they were not trained to do as scientists.

There is no "one way." ICIPE works from the perspective of agricultural insect pest control. This is a specific entryway and from one perspective addresses a narrow problem: insect pests of maize. But from another perspective the push-pull project addresses hunger and poverty in Africa. There are many other possible entryways. So, for example, there is a project called "Integrated Management of Child Health" that began in 1997 in a number of African countries. Often when a mother brought her child to a rural clinic, she met the "old 'factory-line' method where practitioners often made a quick guess at what was wrong with the patient and dispensed standard medication" (IRDC/CRDI 2004). Through the new project the health care staff of participating clinics is trained to take more time to look at the whole child, including its diet and eating habits. The program involves "a participatory process with the community [that] developed actions tailored to regional variations rather than a predesigned uniform strategy." The project has led to "substantial improvements in health and micronutrient status in each of the five African countries including reduction in iron-deficiency anemia, sustained broad coverage with vitamin A supplements, improved dietary diversity and community development and empowerment." It is clear that although the push-pull project and the health care project differ greatly in content focus, the quality of engagement is similar. Both are context-sensitive.

Wholeness. It is not contradictory that an approach that is specific can also be holistic. In fact, that is crucial. The specificity grounds the approach and holism relates to the effort to establish and orchestrate relations that mutually support each other. Through such activities, synergies arise that give the work a kind of organic integrity and resilience that characterize a living organism. Because human beings—their ideas, feelings, goals, and concrete actions—are part of this emerging social-ecological organism, its character is highly dependent on the ability of people to perceive vital relations and to respond to new situations with creative and concrete ideas. In this sense a small, local project can be dynamically whole while a large and multifaceted project can be fragmented. It is not the particular content or the scope of the project that makes it whole; it is the quality of human engagement.

SOURCES

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