



# **AGROECOLOGY** *in* **ACTION**

Ten essays exploring the role of innovation  
in achieving agroecological outcomes





## Introduction

**Addressing the challenges facing our global food system – from rising demand to rising temperatures – requires concerted action from across the agricultural sector and its value chain.**

Agroecology has returned to the global spotlight as one approach to bring farmers closer to meeting these challenges.

Agroecology emerged as a science which supports food security and sustainable agriculture. In the 1960s, it was studied as the interaction between crops and the environment. In short, it can help us understand agriculture’s impact on our natural resource base.

Since then, many definitions of agroecology have evolved. Promoting farming systems that are beneficial to producers and society, as well as the earth’s ecosystems has become a central theme, prompting the concept of agroecology to become synonymous with outcomes such as resource use efficiency, optimizing external inputs and improving soil health.

Farming First’s supporters from around the world are working to incorporate agroecology with innovation to achieve these outcomes. By using agroecology as a scientific and analytical tool to gauge agriculture’s impacts on economic, ecological and social dimensions, we can help farmers make good decisions towards sustainability and productivity, for people and the planet.

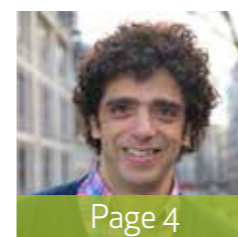
In this collection of essays from Farming First supporters and external experts, we explore what agroecology looks like for farmers across the globe. How can technology and innovation support farmers? How can we balance the need to produce food for an ever-growing population with the need to protect the planet? How can we put farmers at the heart of our decision-making?

From tackling pests in Africa, to improving soil health in Latin America, these essays demonstrate the role innovation can play in achieving agroecological outcomes that will bring us closer to meeting the ambitious Sustainable Development Goals.

Join us, as we take a look at agroecology in action.



## Table of contents



### Forest Friendly Farming in Ethiopia

By Nicolas Mounard, CEO of Farm Africa

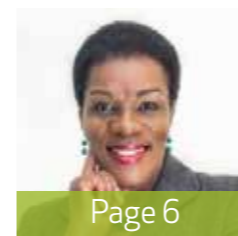
Page 4



### Building Healthier Soils and a Healthier Planet

By Dr. J. Scott Angle, President and CEO of IFDC

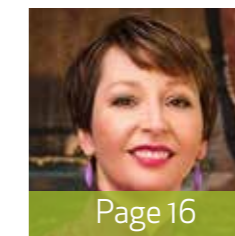
Page 14



### Conserving Africa’s Precious Resource Base While Fighting Hunger

By Kalongo Chitengi, Zambia Country Director of Self Help Africa

Page 6



### Using Innovation as a Pathway to Sustainability

By Robynne Anderson, Chair of the International Agri-Food Network

Page 16



### Harnessing Nature for Improved Ecological Resilience

By Professor Tim Benton, University of Leeds

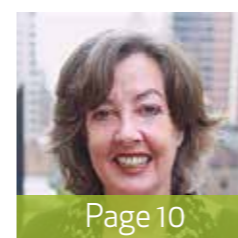
Page 8



### Science-Based, Smarter Farming for Africa

By Ishmael Sunga, CEO of SACA

Page 18



### Keeping Pests at Bay in the Safest Way

By Claire Starkey, President of Fintrac

Page 10



### Promoting Balance and Complementarity in Global Agriculture

By Professor Pedro Sanchez, University of Florida

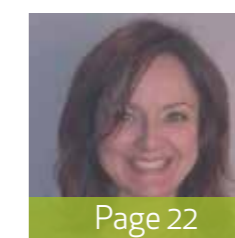
Page 20



### Harnessing the Power of Orphan Crops

By Howard-Yana Shapiro, Chief Agricultural Officer, of Mars Global

Page 12

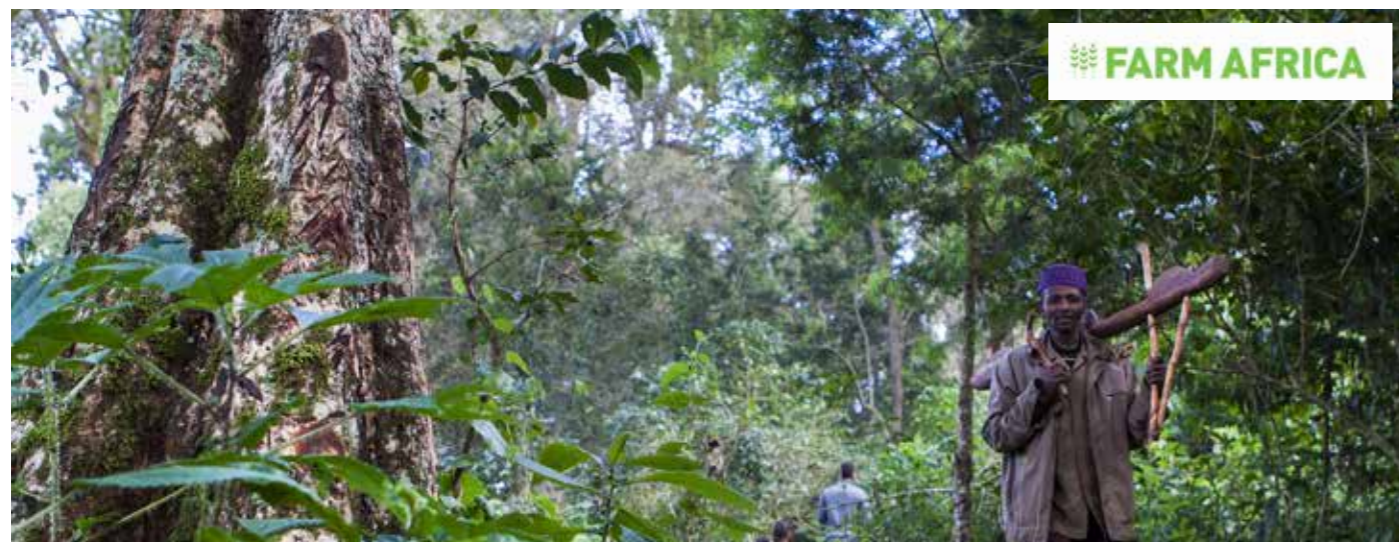


### Investing in Technology Transfer to Ensure No Farmer is Left Behind

By Arianna Guilodori, Secretary General of the World Farmers Organization

Page 22





## Forest-Friendly Farming in Ethiopia



**Nicolas Mounard, CEO of Farm Africa, urges action to rescue the ailing voluntary carbon market, which forest communities in Ethiopia are counting on. Building farmers' incomes from forest-friendly businesses and the sale of carbon credits is the first approach profiled in our new blog series "Agroecology in Action".**

The tension that exists between agriculture and environmental conservation is one of the oldest on record. Balancing the needs of rural people to utilise natural resources to eat and earn an income with the global need to protect the environment is a tall order - but there are many ways it can be achieved.

At Farm Africa, finding the equilibrium between these two priorities is in our DNA. In Africa, where hunger levels are high and productivity is low, boosting the productivity of smallholder farmers is vital. But the environmental cost of farming must be minimised. Future generations depend on the continent's vast forests and watersheds remaining intact.

The term "agroecology" was coined over 50 years ago to describe the interactions between agriculture and the environment. Now more than ever, as food production is threatened by a changing climate, rising populations and a dwindling resource base, we need to strive to find effective ways to balance these two priorities.

Farm Africa is taking action with the principles of agroecology in mind. Our programmes analyse ecosystems and work with communities on solutions that will benefit both farmers and the local environment.

**"BALANCING THE NEEDS OF RURAL PEOPLE TO UTILISE NATURAL RESOURCES TO EAT AND EARN AN INCOME WITH THE GLOBAL NEED TO PROTECT THE ENVIRONMENT IS A TALL ORDER - BUT THERE ARE MANY WAYS IT CAN BE ACHIEVED."**

Taking Ethiopia as an example. In the low-level rangelands of the Oromia region, this usually involves improving options for animal feed so that grazing can be kept out of protected areas. At mid-range altitudes, where livelihoods depend more on farming than livestock keeping, we have been working to introduce high-yielding potato varieties so that more crops can be produced on less land. One recent success story however, comes from the highland forests of the Bale eco-region in the Oromia region of Ethiopia.

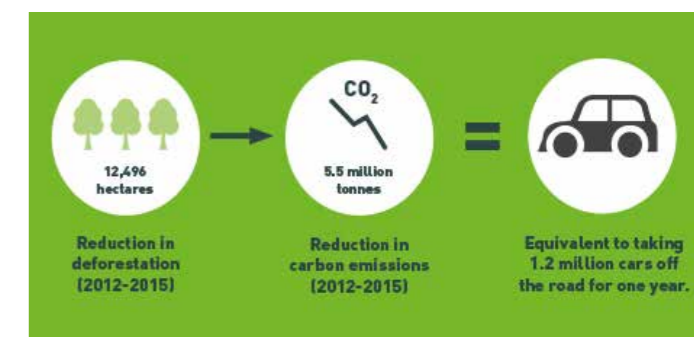
### Building forest-friendly livelihoods in Bale

Due to high poverty levels in Bale, the government has found it difficult to control rising levels of deforestation. People are driven to cut down the forest for food and firewood. Farm Africa has been working in the region since 2006, helping the community develop forest-friendly businesses, such as beekeeping and forest coffee production. These businesses have provided economic incentives to reduce the land clearing that was previously occurring. Tree planting and the introduction of improved cookstoves have also helped to reduce the unsustainable harvest of fuelwood.

The benefits are clear for farmers like Tahir Malima. Before, he was making 20-30 Ethiopian birr per kilo of coffee (\$0.30). When his co-operative signed an agreement with the local government to take part in forest management, he received training on coffee harvesting, drying and storing methods to preserve the coffee's unique flavour and to allow his co-operative to command a better price at the market. He now sells coffee at up to 50 Ethiopian birr per kg, meaning he no longer needs to cut down trees to supplement the money he makes from coffee. He has invested his additional income in his children's education, and beamed with pride as he showed us the new home he has built with a corrugated iron roof that affords far greater protection from the elements.

However, the income that forest-based enterprises generates tends to be small compared to what could be earned by converting forests into cropland. This fact spurred Farm Africa to introduce a supplementary source of income for forest communities to further incentivise them to protect the forest: the sale of carbon credits.

In environmental terms, Farm Africa estimates that the combination of income from forest enterprises and the anticipation of income from the sale of carbon credits in the Bale region has saved 12,496 hectares of forest between 2012 and 2015. The reduced deforestation stopped 5.5 million tonnes of carbon dioxide (MTCO<sub>2</sub>) from being released into the atmosphere, the equivalent to taking 1.2 million passenger-driven vehicles off the road for one year, according to the United States Environmental Protection Agency.



To combat deforestation, forest degradation and land use change which accounts for approximately 12 per cent of carbon emissions, the United Nations Framework Convention on Climate Change (UNFCCC) developed the REDD+ initiative, a scheme that enables developing countries to sell carbon credits for reductions in carbon emissions generated by avoided deforestation and forest degradation. Communities like those we work with in Bale have shown that curbing deforestation and reducing carbon emissions through this pathway is possible, and that this can be done sustainably.

### Urging action to rescue an ailing carbon market

The concept behind REDD+ was simple and compelling: communities would be paid for conserving their local forests. The deal was straightforward: don't cut down trees, prevent carbon emissions and earn a living by selling carbon credits. Forest communities stepped forward, made the effort and generated the credits. Sadly, there is a major discrepancy in the supply and demand. Millions of tonnes of carbon credits are languishing unsold. The volume traded on the voluntary market fell sharply in 2016 by 24%, and credits equal to 56.2 metric tonnes of carbon dioxide were reported as unsold across the market that year.

The market is on the point of collapse, with an ever-increasing supply of credits far exceeding the private sector's demand for them. Collapse of the market could spell disaster for global efforts to curb deforestation and reduce carbon emissions. Carbon credits have been generated in good faith by forest communities in anticipation of being financially rewarded for their conservation efforts, but that income has failed to materialise. This means they could return to having to convert forests into agricultural land to feed themselves. They have been let down by the global private sector's lack of will to pay for conservation.



Promoting forest-friendly livelihoods has proven to be an effective way to advance both agricultural and environmental goals, the balancing act at the heart of agroecology. Now is the time for companies and governments, those most responsible for high carbon emissions, to step up to make the effort to ensure communities receive the reward they expect and deserve for protecting forests and reducing emissions.





## Conserving Africa's Precious Resource Base While Fighting Hunger



**Kalongo Chitengi, Zambia Country Director of Self Help Africa, discusses the innovations farmers in her region are putting to use - from conservation farming to improved seed.**

Rosemary Chate's seven children gather around the table inside their home in Malela, a village in Zambia's remote Northern Province. They dig their spoons into bowls of food prepared by their mother – for the second time that day.

Not long ago Rosemary's family would assemble to eat just once a day – their resources, for many months each year, were so thin that they needed to ration their food supplies to just a single family meal.

This is the reality for millions of African farmers like Rosemary. Many challenges on the continent are driving down farmers' yields. Farmers lack access to inputs that farmers in developed countries have utilised for decades - from quality seeds and herbicides, to the right type of fertilizer for their undernourished soils. The hand hoe – even in this century – is still the main tool for smallholder families. Migration to urban areas and the impact of AIDS have left many rural homesteads with a labour shortage.

Climate change has also emerged as another adaption challenge rural families have to grapple with. Changes in the climate have brought with them not only drought and flooding, but new plant diseases and insect attacks. The fall armyworm in sub-Saharan Africa has caused tremendous damage. This unpredictable reality has made crop management very difficult, and indigenous knowledge alone can no longer suffice.

African farmers need scientific innovation – from low to high tech – to face these challenges. Yet preserving Africa's environment, its most precious resources after its people, is also a high priority.

**THIS IS ONE OF THE FUNDAMENTAL CONCERNS OF AGROECOLOGY – ENSURING FARMERS CAN PRODUCE FOOD AND EARN A GOOD LIVING, WHILE KEEPING THE NATURAL RESOURCE BASE INTACT.**

With the right approaches that blend traditional knowledge with scientific innovation, this can be achieved.

At Self Help Africa, we are working with farmers to achieve this through the implementation of conservation agriculture. In Zambia alone, we have reached over 80,000 farmers in the last five years.

Conservation farming involves a combination of approaches. First, farmers are encouraged to intercrop a variety of species, such as groundnuts, which can naturally fix nitrogen to the soil, and cassava, for example. This ensures maximum use of a piece of land that has been cleared – producing more food with less resources.

Crop rotation and mulching, along with an integrated use of mineral and organic fertilizers are also part conservation agriculture.

59-year old Felister Namfukwe has seen the benefits of this farming approach. Not only are her soils healthier, but her income is as well. With the help of her sons and her profits from groundnuts, she is building a new home made of brick, replacing her previous mud home.

**“BEING PART OF THIS (SELF HELP AFRICA) PROJECT HAS LIGHTENED MY BURDEN,”**



We also work with local farmers to build their capacity to grow good quality seed, and to strengthen community based seed systems. Recycling seed is a common practice in Africa, when access to better seed is scarce. However, recycled seed loses its efficacy.

We are currently working with 300 seed growers across the country, who are multiplying seeds that are more able to cope with climate extremes, are higher yielding and more resistant to pests and disease.

In Zambia's remote Western Province, the Kamasika Seed Growers Association illustrates how effective community-based seed multiplication is assisting local food production in the face of climate change.

The group received training and support in seed multiplication techniques from Self Help Africa and government advisors on the technical requirements for producing certifiable seed. The farmers were then linked to a new state-run seed testing laboratory, established with support from Self Help Africa in nearby Mongu town, to ensure that the seed being produced met the requisite germination, moisture content and other standards required to attain certification.

The group has since opened several retail shops where they sell farm inputs, including certified groundnut, bean, sorghum, maize and vegetable seed that they are producing, and supply to several thousand smallholder farmers across the Province.

African farmers are most at risk from rising temperatures and persistent hunger. We must ensure they have access to all the tools and technologies necessary to thrive in the face of these threats.





## Harnessing Nature for Improved Ecological Resilience



**What is agroecology? How can farmers be encouraged to adopt its principles? Professor Tim Benton, Dean of Strategic Research at Leeds University and former UK Global Food Security Champion answers these questions.**

In scientific terms, “agroecology” refers to the application of ecological principles to agriculture – that is, harnessing nature to support agricultural production. Our planet depends on its ecological resilience, and it is important to find more sustainable methods of growing produce to allow production to be repeated time and time again.

Well known methods include crop rotation – planting a sequence of crops that will naturally improve soil fertility – or enhancing natural enemies to control pests on a farm.

From a science perspective, it is also credible to apply a “mix and match” approach, in which natural methods can work in synergy with more conventional farming methods. Using biology to control pests or rotations to grow fertility allows synthetic inputs to be used in more targeted ways, when, and where, they are most needed. If you are enhancing natural pest control, pesticides can become a last, rather than first, resort.

This can also apply to soil health. Severely degraded soils may produce too little yield to allow mulching for soil improvement and to encourage water retention. If you can use fertilizer to boost yields, you would then have enough biomass to use as both feed and compost in the future. This could well be beneficial to the environment in the long run.

### Why agroecology matters now

Our food system faces a number of challenges. Greenhouse gas emissions must be reduced, yet our food supply to underpin healthy, nutritious diets, must continue to be secured. Our natural capital, soils, water, biodiversity must be maintained over the long term, so we can benefit from the services it provides.

Yet our food system doesn’t work well for many people. Under half the world’s population is a healthy weight, and more people are obese than underweight. Malnutrition in all its forms is driving an increasing global health crisis.

**“OUR PLANET DEPENDS ON ITS ECOLOGICAL RESILIENCE, AND IT IS IMPORTANT TO FIND MORE SUSTAINABLE METHODS OF GROWING PRODUCE TO ALLOW PRODUCTION TO BE REPEATED TIME AND TIME AGAIN.”**

We need to think about transformational changes in how we farm and what we farm. This requires a shift in our mindset to focus not only on quantity but also quality and diversity of food. If we concentrate on designing a food system based on healthy diets, with low waste, we can create space where agroecological methods can better underpin agriculture.

Of course, these changes are not always easy or quick. Take the agroecological approach of conservation agriculture, for example. This relies on intercropping, minimal soil disturbance, and the use of cover crops to retain moisture and nutrients. This has been shown to improve yields whilst protecting soil health – but it can take several years before a farmer sees the benefits. For a subsistence farmer, this may simply not be a sacrifice he or she is willing to make unless they are somehow supported to do so.

### Incentivizing the uptake of agroecology

Payment for ecosystem services is one way of incentivizing developing world farmers to adopt agroecological approaches. For example, in the districts upstream of the Shire River of Southern Malawi, we found that the adoption of conservation agriculture can reduce soil and sediment loss by around 65 per cent. When soil and sediment flow downstream, they severely disrupt the production of hydropower. Local hydropower plants are currently paying up to \$150,000 per ton of sediment for its removal. However, if the electricity provider were to make payments instead to farmers, to encourage the adoption of conservation agriculture upstream, we estimate this would cost between \$7 – \$2,000 per ton of sediment avoided. In this way, farmers, the energy suppliers and citizens would all gain from more sustainable farming.



Malawian farmer Grace Malaitcha on her maize plot, which she cultivates using conservation agriculture (CA) practices. Patrick Wall / CIMMYT

This could also come in the form of adding a source of additional income for farmers. In Southern Côte d’Ivoire, Integrated Soil Fertility Management that intercropped cowpea with cassava – the main staple crop in the region – was developed. Drought tolerant, weed resistant and early maturing varieties of cassava were planted alongside cowpea, and fertilized with a mix of composted chicken manure and micro-doses (5 grams) of nitrogen, phosphorus and potassium per plant. Not only did cassava yields triple, but farmers were able to gain additional income from the cowpea, which could be harvested twice before the cassava crops reached maturity. Reduced weeding time and the high market value of cowpea caused the profitability to increase from around 200 to 2,500 Euros per hectare – all while the poor, sandy soils were benefitting from a fertility regime to replenish them for future use.

A financial reward to promote agroecological practices would be beneficial in the rest of the world too. Our food system is still underpinned by market incentives (in the form of subsidies) to produce a few commodity crops for the global market. There are six main breadbasket regions that produce the eight crops that provide around 75 per cent of the world’s calories. These crops (mostly cereals and grains) are calorie-rich, and because they are produced at very large scale, they are cheap and freely available. For many, this means that food waste, and over-consuming calories, becomes economically rational.

We need to make it more economically attractive to grow better and more diverse food, (particularly more fruit and vegetables) even if it means less food being produced (as our global food system is under 50 per cent efficient, there is lots of scope for improving the system). This will involve creating market incentives. In a sense, we have already done this to assist the transition from fossil fuels to renewable energy – by removing just a few per cent from the subsidies of fossil fuels and applying these to renewable energy, the playing field was levelled enough to allow for the latter to take off. Therefore, a rebalancing of subsidies to allow markets to provide food for health could make a huge difference.

People and the planet should be at the heart of food systems. Encouraging the adoption of agricultural practices that work alongside nature will allow us to move towards a more sustainable food system providing healthy diets for all. This will require collaborations and innovations across the whole value chain.





## Keeping Pests at Bay in the Safest Way



**Fall armyworm. Coffee borer. Tomato leaf miner. These pests threaten harvests and livelihoods daily. Claire Starkey, President of Fintrac tells Farming First how her team works with farmers to create maximum pest resistance with minimal environmental impact using Integrated Pest Management.**

Agroecology is all about helping farmers to be good environmental stewards. At Fintrac, this is a core tenet of our work. Why? Because it is the ultimate triple win: for farmers, for consumers of the goods they produce and for the planet.

We know we need to protect the earth for future generations. But farmers also need to act sustainably to protect their shorter-term profitability: if they do not look after the natural resources they rely on, they will not get the yields they need to earn a living and feed their families.

Let's say a family buys a cow. At first, the animal is producing plenty of milk. But over time, if the cow is not nourished properly, she produces less. The same analogy applies to crop production. When you first plant a seed, it may yield good results. But if you continue to reuse that same seed, it loses its effectiveness while also stripping the soil of essential nutrients, significantly reducing yields. That is why we focus so much attention on the transfer of good agricultural practices that protect vital water resources and build up soil health.

In other words, farmers optimise agricultural outcomes – and incomes – by following agroecological approaches that keep ecosystems healthy. In the last three years alone, Fintrac has supported local partners in putting 630,000 hectares of land into sustainable production across Africa, Asia, and Latin America.

**“WE KNOW WE NEED TO PROTECT THE EARTH FOR FUTURE GENERATIONS. BUT FARMERS ALSO NEED TO ACT SUSTAINABLY TO PROTECT THEIR SHORTER-TERM PROFITABILITY: IF THEY DO NOT LOOK AFTER THE NATURAL RESOURCES THEY RELY ON, THEY WILL NOT GET THE YIELDS THEY NEED TO EARN A LIVING AND FEED THEIR FAMILIES.”**

### Another season, another pest

One of the biggest challenges facing the farmers we work with all over the world is the invasion of harmful pests. Notorious bugs like the fall armyworm right now in Africa, or the coffee borer in Latin America, show up season after season and threaten the food supply and livelihoods of vulnerable communities.

To combat this, Fintrac prioritises and facilitates training in Integrated Pest Management (IPM) techniques. IPM practices allow farmers to achieve maximum disease and pest control with minimal environmental impact.

It starts with prevention. Proper weeding and land preparation, along with planting natural live barriers, can go a long way to preventing pests from taking hold. Using pest- and disease-resistant seeds also sets farmers at an advantage. Once crops are planted, adequate crop nutrition and good water management practices help plants stay healthy. Regular health checks help detect any pest or disease infestation early.

But what happens, when despite our best efforts, pests do attack? The first port of call is proper identification of the problem. We work with a network of field technicians that visit farmers to diagnose the issue and offer advice on how to take action when crops are affected.

Where possible, the next step is biological control, which can range from simple sticky traps to sophisticated microbial inoculants, which are referred to as “beneficial bacteria” that are developed from a crop’s natural enemies, such as bacteria, fungi and viruses. In Kenya, we worked with a local biologics company to train hundreds of vegetable farmers on the use of tuta traps to control a tomato leaf miner outbreak. These traps use a substance known as a pheromone to lure pests onto a sticky trap; a low-cost and safe method that helped farmers salvage what could have otherwise been a lost season.



A sticky pheromone trap attracts and captures the pest. (World Vegetable Center)

Through a partnership with a Malawian company, we are promoting the use of microbial inoculants to promote plant health and boost resistance to disease or infestation. Our partner has so far distributed these Nitrofix inoculants to thousands of farmers across Malawi.

Unfortunately, in some cases, this is not sufficient. We then might need to use agrochemicals, which requires expanding the knowledge and capacity of both farmers and governments to handle them. We have helped public sector agencies to refine pesticide control measures for example, which not only protect human health and the environment, but ensure crops destined for the international market comply with standards such as minimum crop residue requirements.

For farmers, training in safe use is essential, including guidelines for chemical selection, application, storage and disposal. In Honduras, farmers were trained on how to triple wash and perforate pesticide containers, which were then collected by safe disposal service teams. One of those farmer clients, Emiliano Dominquez, who had been in danger of having his food and income source wiped out by aphids, instead saw crop yields increase six-fold as a result of integrating IPM into his on-farm practices.

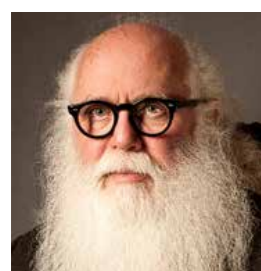
When the environment is healthy and productive, farmers can grow abundant food for their families and the global market. It is therefore essential we work to beat challenges such as pests and diseases with the most sustainable and sensible approaches we can to protect our planet. After all, it is the only one we have.







## Harnessing the Power of Orphan Crops



**Howard-Yana Shapiro, Chief Agricultural Officer of Mars, discusses how orphan crops can benefit African farmers and the wider world, and achieve agroecological outcomes.**

Africa has thus far missed out on having its own 'green revolution'. One reason for this is that it has no large, homogenous ecosystem, such as India's Deccan Plateau. Any approach to boost productivity and food security must fit Africa's myriad, small and distinct ecosystems.

The term agroecology refers to using ecological processes in agriculture, and maintaining balanced and healthy ecosystems. Pursuing an agricultural revolution that makes use of

African crops that are already adapted, already grown and eaten by local farmers, would therefore be a good place to start.

At the African Orphan Crops Consortium (AOCC) our goal is to improve these varieties – "orphan" in that they have received very little scientific attention – so that they are more nutritious, higher yielding and hardier in the face of weeds, pests and the changing climate that is already altering Africa's smallholder cropping systems. We do this by working to sequence the genomes of 101 of these important African orphan food crops and making the data publicly available, and training African scientists to make rapid improvements to them, benefitting smallholder farmers and consumers across the continent.

This plan was hatched back in 2011 by myself at Mars, Incorporated, Ibrahim Mayaki at the New Partnership for Africa's Development, and Tony Simons, Director General of the World Agroforestry Centre (ICRAF). It quickly won the backing of the African Heads of State meeting at the African Union Assembly. Today the consortium contains 15 government organisations, scientific and agricultural bodies, universities, companies, regional organisations and NGOs, along with a network of 20 agricultural and horticultural organisations.

The AOCC's African Plant Breeding Academy (AfpBA), based at ICRAF in Nairobi, will have trained 84 of its target 250 African plant scientists to work on the genome 'maps' by the end of 2018.

This approach could benefit the 600 million who constitute Africa's rural population, most of whom grow much of their own food.

**"OUR WORK SERVES TO PRESERVE AND IMPROVE THESE SPECIES, SO THEY CAN CONTINUE TO PERFORM THESE IMPORTANT NATURAL FUNCTIONS."**

### How does this relate to agroecology?

First, more than a quarter of the chosen species are trees, such as the baobab, the leaves of which contain twice as much calcium as spinach, three times the vitamin C of oranges and four times more potassium than a banana. Many of these tree crops are native to their ecosystems and provide other benefits, such as shade, water management and food for wildlife. Our work serves to preserve and improve these species, so they can continue to perform these important natural functions.

Second, many of the crops being sequenced have been in their given regions for a few centuries, are non-invasive and do not harm the local ecosystems. A cornerstone of agroecology is to maintain balance in ecosystems. Protecting and improving native crops will lead to increased diversity on farms, which will contribute to this goal.

Finally, using genetic interventions to make these crops more resilient and adaptable to a changing environment often means farmers need to apply fewer additional inputs to them in order to harvest a bumper crop.

Africa seems unable to get enough of the orphan crops approach. Two members of the 2017 class have started a continuing education program for MS-level scientists in their home country of Ethiopia. Four graduates from West Africa are collaborating to raise funding for training more than 70 graduate students on breeding of orphan crops. Members of the 2017 class are establishing an African Plant Breeders Association to cover the whole continent.

### The benefits of orphan crops

The AfpBA and its lab have some of the best sequencing equipment in the world, certainly the best in Africa. Students – and these students are already among the best plant scientists in their countries – can use the equipment, but graduates also continue to have access to it.

One great benefit of this approach to education is that it is either done locally by AfpBA graduates or in Nairobi. The plant scientists are not taken to Europe or the United States, only to stay and contribute to Africa's brain drain.



African custard apple, from Meru county in Kenya. Credit: Ake Mamo / ICRAF

The UN Food and Agriculture Organization (FAO) decided recently to join the consortium. This has led to an ambitious letter of intent between the two organizations. It calls upon the two to work together to assist FAO member countries to develop and implement appropriate policies, regulations and laws that facilitate the genetic improvement of orphan crops; to strengthen institutional and human capacities of FAO member countries activities for research and development, especially in molecular genetics, plant breeding and seed delivery systems, and to advocate for enhanced crop diversification, crop rotations, associations and crop sequencing in a way that orphan crops are integrated and can become part and parcel of sustainable cropping systems.

We believe this could help spread the benefits of orphan crops throughout the planet. Already there has been talk of a Chinese Orphan Crop Consortium and an Indian Orphan Crop Consortium.

As The Economist's science editor commented after a visit to our facility last year:

"Bananas, mangoes, pineapples and pawpaws are all tropical fruit that have gone global. If some of Africa's orphan crops, suitably improved by genetic knowledge, were to follow suit, the benefits to African farmers would be huge."

This future is within grasp, and can be done by harnessing the power of what nature already has to offer.





## Building Healthier Soils and a Healthier Planet



**Only healthy soils will be able to fulfil the Herculean task of growing the food our planet requires - both now and in the future. Dr. J. Scott Angle, President and CEO of IFDC, discusses how the agroecological approach of Integrated Soil Fertility Management can build healthier soils and a healthier planet.**

In the late eighties, the water quality and aquatic life of Chesapeake Bay were under threat. As human activity and farming in the region had increased, so had its impacts on the local environment.

That is when a group of scientists, including myself, founded the Maryland Centre for Agroecology. Our mission then is how I would define agroecology now – creating a roadmap to help farmers be productive, while reducing their impact on the environment.

In the case of Chesapeake Bay, this relied a great deal on encouraging farmers to only apply nutrients from the right source, in the right place, at the right time and the right rate (known as the 4Rs of nutrient stewardship). This results in less cost for the farmer, less runoff into the environment, and also allows the plant to use the nutrients that are applied more effectively. Planting cover crops to absorb nutrients before they reach the bay has also gone a long way to solving this challenge.

### Pleasing the wizard and the prophet

Agroecology seeks to merge two visions of farming: one that seeks to grow the right quantity and quality of food, with one that protects natural resources. These two visions can, and should be balanced to create approaches that can deliver on both objectives.

In Charles C. Mann's bestselling book "The Wizard and the Prophet", he personifies these two approaches as scientists Norman Borlaug, hailed as the man who saved a billion lives through his high yielding wheat variety, and William Vogt, the intellectual forefather of the environmental movement, who was fiercely cautious of using more than the environment had to give.

Although the book was unable to reconcile the perspectives of these two men, it is not only possible, but essential that we as global community are able to. We need to produce more food for our growing population – that is an undisputed fact. We will have ten billion people on the planet by 2050, but no additional land or water. So it is agriculture's job to harness approaches from the environmental community, such as organic or conservation farming that can be integrated into more traditional agriculture.

### Integrated Soil Fertility Management: When organic meets mineral

A great example of this is Integrated Soil Fertility Management (ISFM), which relies on application of both organic and mineral fertilizer to achieve optimum soil health. Improving soil health so it can perform natural functions such as carbon capture and water retention is a cornerstone of agroecology. Organic fertilizer is incredibly important,

as it is a natural source of nutrients and organic matter. Unfortunately, there is just not enough of it. To have enough manure to produce enough food for the growing population, we would need a great deal more animals on the planet, which have their own impact on the environment. Therefore, farmers should be encouraged to use all the organic matter that they can, and then supplement it with mineral fertilizers. This is Integrated Soil Fertility Management.

**"AGROECOLOGY SEEKS TO MERGE TWO VISIONS OF FARMING: ONE THAT SEEKS TO GROW THE RIGHT QUANTITY AND QUALITY OF FOOD, WITH ONE THAT PROTECTS NATURAL RESOURCES. THESE TWO VISIONS CAN, AND SHOULD BE BALANCED TO CREATE APPROACHES THAT CAN DELIVER ON BOTH OBJECTIVES."**

Mineral fertilizer can be more precise in directing nutrients to the plant. Custom blends can be produced that address the exact soil deficiencies in the region. They can be coated, to ensure that the nutrient is released slowly over time, in a way that allows the plant to absorb it effectively. They can be compacted into briquettes and placed deep near the roots, which also improves its efficiency.

Fertilizer is in fact responsible for 50 per cent of the food grown worldwide. In regions like Africa, where up to 60 per cent of soils are estimated to be degraded, it is possible to double, if not triple or quadruple yields through the judicious use of the right fertilizer.

But it is not only the crop that can be harvested and eaten or sold that benefits. Crops that have been nourished adequately also have a much larger root system. These are made from carbon dioxide that was pulled out of the atmosphere by the plant, and then incorporated into the soil as soil organic matter. It can be argued, therefore, that the proper use of fertilizer can actually become a solution to the problem of excess greenhouse gases, as it helps us capture carbon out of the atmosphere and tie it up in the soil. When soil has more organic matter, it has greater water holding capacity, it can store more micronutrients and suppress disease, but crucially it is able to hold carbon in the soil for tens of thousands of years that would otherwise exist in the atmosphere and contribute to climate change.

It is very important to manage the application of these products appropriately. We would struggle to eliminate them completely, because we have to grow the food we need. The goal instead should be to use them in a way that maximizes their efficiency, which ISFM promotes.



Other ISFM strategies include crop rotation, legume introduction, and crop-livestock integration systems.

For Sunday Oyo, who has benefitted from our 2Scale project in Nigeria, the use of ISFM has unlocked much needed credit to expand his farming business. He gained access to hybrid seeds of tomato, and was educated on good agronomic practices such as trellising the tomatoes to avoid rotting. Thanks to a combination of fertilizers applied in the right quantities and in the right time and place, Sunday was able to quadruple his yields – a feat previously unthinkable.

Fertile and productive soils are vital components of stable societies, and ISFM strategies protect these. As one ancient Sanskrit text states, "Upon this handful of soil our survival depends. Husband it, and it will grow our food, our fuel and our shelter and surround us with beauty. Abuse it and the soil will collapse and die, taking humanity with it."

Our reliance on the soil is as strong today as it was then, and we need to adopt agroecological practices that will help us protect it for future generations that will rely on it too.





## Using Innovation as a Pathway to Sustainability



**Can innovation and agroecology work together to improve food security and sustainability? Chair of the International Agri-Food Network, Robynne Anderson, thinks so.**

Fifty years ago, agroecology emerged as a discipline focused on studying the interaction between crops and the environment. Over the decades, it has helped increase our understanding of agriculture's environmental impact.

Fast forward to 2018, and the challenge of feeding seven billion people sustainably has become increasingly urgent. For the third consecutive year, hunger levels have risen. 84 per cent of the world's hungry live in poverty in rural areas. The vast majority are farmers themselves.

At the same time, the upcoming Intergovernmental Panel on Climate Change report is expected to tell us we are falling behind in the fight against climate change. The agriculture sector, as both a victim and a culprit of climate change, has an important role to play in both adapting to new climactic realities and minimising emissions, while continuing to feed the world.

We are going in the wrong direction. Agroecology can help us get back on track.

Agroecology seeks to apply ecological principles in order to design and manage agro-ecosystems in more sustainable ways. As such, it supports the development of best practices, integrated solutions, and techniques that allow agriculture to minimise its ecological footprint.

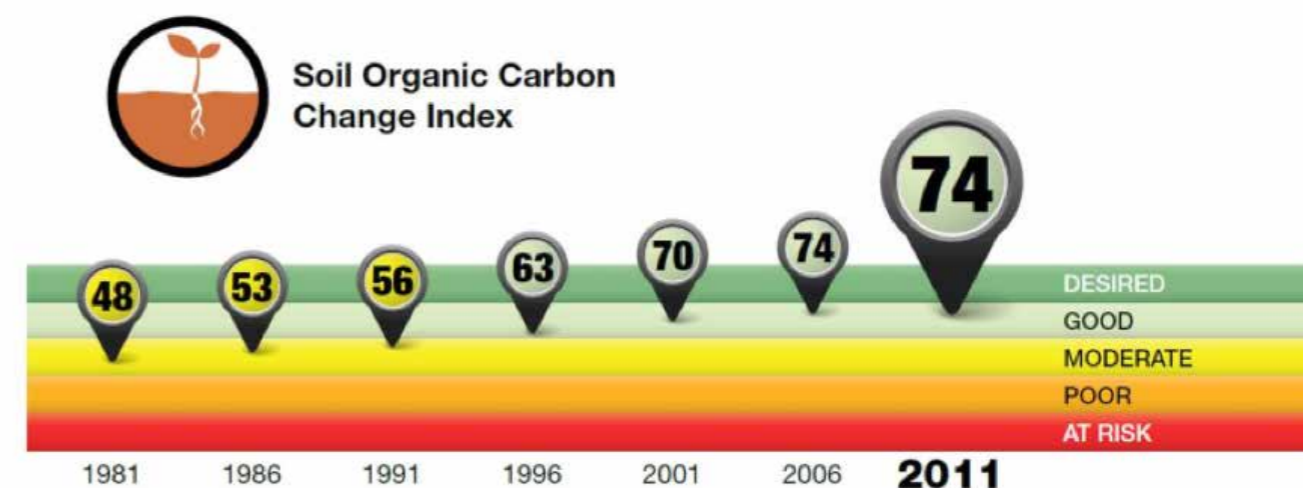
There are many ways this can be achieved, particularly when innovation is able to play role.

Optimising external inputs and improving soil health are two key agroecological outcomes the United Nations has identified. Work to achieve this in sub-Saharan Africa, where inputs are less accessible and soil health is poor, is well underway.

The African Agricultural Technology Foundation is applying biotechnology approaches to produce rice that is both efficient in its use of nitrogen and water. This means the 20 million or more smallholder farmers that depend on rice as a staple food need to use less of these two crucial inputs. Less nitrogen is lost, soils become healthier, and crops can grow even when water is scarce.

**IT IS ALSO IMPORTANT TO REMEMBER THAT AGROECOLOGY CAN APPLY TO FARMS OF ANY SIZE, IN ANY REGION OF THE WORLD. AGROECOLOGY AND HIGH PRODUCTIVITY - WHETHER YOU ARE FARMING 200 HECTARES IN IOWA OR HALF A HECTARE IN ZIMBABWE - ARE NOT MUTUALLY EXCLUSIVE.**

In Canada, where my family farms, the use of minimum tillage systems have dramatically improved soil health. The advent of modern varieties, direct seeding systems, and better crop rotation have allowed these systems to proliferate and with them an improvement in the soil organic carbon change index and reduced soil erosion.



**Source(s):** Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series – Report #4

The third pillar of agroecology is recognising that agriculture is centered around people. As such, taking an agroecological approach means we must enable farmers, to both make a decent living, and have good knowledge of best practices that suit their environment.

There is not one particular set of farming practices that fits all different ecological conditions or farming systems. This is why SDG 2.3 calls for farmers to be trained in both indigenous and modern farming techniques, integrating traditional knowledge and scientific practices to achieve the best outcomes for food security and quality, sustainability and rural livelihoods. This can include using traditional crops, and supporting them with modern knowledge and inputs to maximize their efficiency. It supports biodiversity and agroecological practices.

Agriculture has a huge capacity to achieve sustainable outcomes. We must not limit options for farmers, but leave room for creativity and innovation in order to get there.

By taking integrated approaches, we can strengthen the interactions between plants, animals, humans and the environment for food security and nutrition. We can enhance productivity at the same time as improving nutrition, conserving the natural resource base and attaining more sustainable and innovative food systems. The realization of the Sustainable Development Goals depends on this – we must make sure farmers are equipped with the tools they need to take us there.





## Science-Based, Smarter Farming for Africa



**For Ishmael Sunga, CEO of the Southern African Confederation of Agricultural Unions (SACAU) there is no doubt that scientific innovations can play a role in enabling African farmers to do more, with less.**

African farmers, the majority of whom are smallholders, face myriad challenges. These challenges are related to the entire cycle of farming, from pre-investment and production to post-production and marketing. They result in low volumes, low productivity, low quality products, and high post-harvest losses. Typically, farmers operate in a high-risk-low-return environment.

Agricultural systems across the world are becoming increasingly complex and dynamic. We are more aware than ever of the interactions between agriculture and our environment.

As such, farming has become more information and knowledge intensive, science-based and data-driven. African farmers, most at risk due to rising temperatures, rising population growth and rising hunger, need more than most to access information and technology that can help them overcome these challenges.

Is it possible for African farmers, already faced with low yields and high risks, to balance increased production with protecting the environment? The answer is yes. There are several elements to this. The adoption of good agricultural practices is a good starting point, to enable farmers to do more with less or with the same.

There is no doubt that the adoption of scientific innovations can play a role in this.

**IMPROVED SEEDS AND ANIMAL BREEDS LESSEN AGRICULTURE'S BURDEN ON THE ENVIRONMENT, BY REDUCING THE AMOUNT OF WATER A CROP NEEDS, OR IMPROVING THE AMOUNT OF MILK A COW CAN PRODUCE, FOR EXAMPLE.**

Keeping crops and animals healthy with products that can fight disease are also critical, provided they are used in a responsible way that does not harm the agroecosystem, but works to enhance it long-term.

Increasing the level of awareness, understanding and appreciation of farmers, consumers and society in general, on the impact that the current production models have on the environment, is also important. However, there is a need to incentivise farmers to invest in the long-term sustainability of their farms. Technical and financial support is needed to support farmers to undertake the necessary investments that will be needed in migrating to more responsible production systems that support agroecological outcomes such as improved soil health, effective recycling of waste, and improved resource efficiency.

### The power of ICT for African Agriculture

Agriculture has become more complex and continues to change. In order to effectively respond to this, there is need to harness the power of Information and Communication Technologies (ICTs) as a platform for wide scale dissemination of information and knowledge to farmers in a timely and regular way.

This calls for investment in backbone "public good" ICT infrastructure and rural energy, which will enable connectivity, without which the African farmer remains socially, geographically and economically isolated. Connectivity will also facilitate the use of smart handheld digital devices that can be deployed for scientific measuring and testing to enhance production and marketing.

Pocket-sized sensors that detect the amount of nitrogen a plant requires, for example are now being used on African farms. The data collected helps farmers make better decisions on precisely how much fertilizer to apply, to reduce loss into the environment. Known as "precision agriculture", this high-tech approach will go a long way to helping farmers put good agricultural practices into action, and move closer to farming systems that improve the health of the overall agroecosystem.

### Boosting mechanization for smarter farming

The recently published 2018 report on mechanisation by The Malabo Montpellier Panel, titled "Mechanized", provides recommendations for African policymakers on steps to transform Africa's agricultural value chains. The importance of government investment in supportive infrastructure in areas such as irrigation, transport and electricity are highlighted, in order to allow African farmers to utilise new machines and technologies that will both enable market access and help African farmers make smarter use of natural resources.

Innovations such as solar-powered driers for fresh fruit and vegetables, or solar powered cold stations, for example, will allow farmers to slash the amount of energy needed to produce food. Pedal pumps that facilitate water supply to farms are also not dependent on fossil fuels and draw a relatively small amount of water from wells and lakes. A study conducted in Magoma, Tanzania, revealed that with the use of the pedal pump, farmers were able to double their yield.

Farmers can do more with the current resources at their disposal, if equipped with the right scientific knowledge. Scientific knowledge is the basis we must draw from to make African farming both productive and sustainable.







## Promoting Balance and Complementarity in Global Agriculture



**Where in the world are agroecological approaches building soil health, beating pests and helping farmers stay productive while protecting the planet? Pedro Sanchez, Research Professor of Tropical Soil Science at the University of Florida explores.**

Simply put, agroecology is a form of agriculture that takes maximum advantage of ecological processes.

In some situations, nature is able to function as a closed system; take a tropical forest for example. When nutrients are finely balanced in the system, they are recycled, meaning there is no need for extra nutrient inputs to be added.

Agriculture however, requires a regular harvesting of crops. This results in large amounts of essential nutrients being removed from the soil. Agroecological approaches must return these vital components to the soil, to ensure the soil stays healthy and can continue to grow the crops we require. This can be achieved through efficient fertilization— mineral, organic, or for the best results, both.

Brazilian agriculture has made great use of agroecology. As a major soybean producer, they developed effective methods of applying rhizobium bacteria, which allows soybeans to naturally fix nitrogen from the air into the soil. Nitrogen is an extremely important mineral for soil health and plant growth, and by using this approach, Brazilian farmers have been able to use nature's processes to the maximum. However, soybeans cannot grow with nitrogen alone; they also need phosphorus. As there is no natural process to fix phosphorus into the soil, it must be added in the form of mineral fertilizers, applied carefully in the correct amounts. This is a prime example of an instance where it is necessary to supplement so-called natural techniques with manmade technologies.

**“SIMPLY PUT, AGROECOLOGY IS A FORM OF AGRICULTURE THAT TAKES MAXIMUM ADVANTAGE OF ECOLOGICAL PROCESSES.”**

The same approach applies for conservation agriculture. This practice, which centres on minimum disturbance of the soil to improve soil health, also demands several other practices to be put in place at the same time. Herbicides are required, for example, to kill weeds that are no longer being destroyed when the soil is turned over. Crops must be rotated, to eliminate pests and diseases. Crop residues need to be placed on the soil to protect it and add an organic source of nutrients, and these must be supplemented with precise amounts of the right fertilizer. Only when all of these approaches are applied, both natural and manmade, can conservation agriculture meet its goal of producing food and protecting soils.

### Competition and complementarity

Plants naturally compete with but also complement each other. These are two ecological principles that must be balanced when implementing agroecological approaches – competition must be reduced and complementarity maintained or increased.

Agroforestry provides a good example of how this works. Planting nitrogen-fixing trees together with crops that will benefit from the additional nitrogen has showed wonderful results. However, we must keep in mind that a nitrogen-fixing tree is likely to outcompete a plant for light, water and nutrients.

As these examples suggest, the agroecological system is much more complex than it may appear – when you alter one part of the system, another must be altered to redress the balance. In this case, spacing and timing can play a big role in reducing competition. For example, plant the crop first, and allow it to grow. Later, plant the nitrogen-fixing tree at an adequate spacing. Then, when the crop is harvested, the tree will have time to grow with less competition and fix large quantities of nitrogen that the next crop can use.

### Halting the march of the deadly fall armyworm

I just returned from Zambia, where the invasive pest, the fall armyworm, is decimating maize crops as it is doing all over Africa. Farmers are at a loss for how to control the attacks. Fall armyworm does have natural enemies in the Americas where it originated, but they did not migrate to Africa with it. We need to find the enemies that are going to halt the devastation it is causing. This is called biological control. This was successfully done to combat the cassava mealy bug in Africa, when swarms of parasitic wasps from one of cassava's centres of origin in Paraguay were released all over Africa and led to the pest's eventual decline. Research is underway for similar kinds of interventions, but farmers need an arsenal of solutions now, as an integrated pest management (IPM) approach.

One technique could offer much hope. Bt maize is a maize plant that has a naturally occurring soil bacterium, *Bacillus thuringiensis*, bred into it. This results in the crop killing the insects that bite it, like the fall armyworm, while the plant remains completely safe for humans and to other insects that do not attack the crop. This In-built pest resistance is a natural function of many plants, but has been developed by scientists for maize to safeguard this important staple crop, a cornerstone of Africa's food system. The benefit of this approach is that farmers need to use fewer agrochemicals that might also kill beneficial insects – these can be left alone to perform their natural functions. This, therefore seems to me to be a very agroecological approach that can be added as part of a successful IPM strategy.

Although Bt maize has been utilized extensively in the US, Brazil and South Africa, many African countries do not allow the use of genetically modified technologies. However, in the face of this seemingly unstoppable pest that is wiping out harvests and is likely to leave nations hungry, it may be time to revisit this decision. Zambian scientists I spoke with told me it was a lack of data about the effects of genetically modified crops that prompted them the rule against its use in 2005. Now that such scientific proof exists showing there is no damage to human health or the environment caused by their use, this policy may be reconsidered. It will ultimately be the decision of countries themselves to determine what works for them best, but my hope is that they accept a change that is based on the science. Companies responsible for the breeding have offered to share germplasm with African breeders at no cost, so they may develop their own varieties that would function well in their own environments.

We have come a long way in improving farming practices, to ensure environmental impacts are kept to a minimum. Through careful management of ecological principles, using a range of techniques to promote balance and complementarity, we can ensure our global population is well fed, and our planet is well protected, for generations to come.



Fields affected by Fall Armyworm in Southern Malawi in 2017. Credit: CIMMYT/C. Thierfelde





## Investing in Technology Transfer to Ensure no Farmer is Left Behind



**From the Ivory Coast to Austria, farmers are putting innovations to use that contribute to both productivity and sustainability. Making technologies financially viable for farmers will be critical to achieving sustainable development, explains Arianna Giuliadori, Secretary General of the World Farmers' Organization.**

Farming lies at the heart of many of the world's most urgent challenges. The farming sector will therefore play a key role in defining the path for future sustainable solutions.

Protecting our environment for future generations is a prime example. Every day, the world's farmers go to their fields with three objectives. To provide nutritious food for their families and the global market. To earn a living, ensuring that their families can experience decent livelihood. And more importantly than ever, to protect the environment they rely on, which is their vital 'production factor'.

Climate change is one of the greatest challenges of the 21st century. Farmers are on the frontline of this change, as the lives and livelihoods of those who feed, clothe and fuel the world are directly affected by a changing climate and weather extremes.

At the same time, agriculture is expected to meet the future needs of an estimated 10 billion population by 2050. Consequently, agricultural production will not only need to increase but also to improve. In other terms, it is not only about "producing more" but also "producing better". Along with food, global demand for water, energy and land will also increase, putting additional pressure on the world's natural resources and threatening the very ecosystems we rely upon.

**AGRICULTURE AND THE ENVIRONMENT ARE INEXTRICABLY LINKED. THE CONCEPT OF AGROECOLOGY SEEKS TO BALANCE FOOD PRODUCTION WITH ENVIRONMENTAL PROTECTION, WHILE PUTTING THE NEEDS OF PEOPLE PRODUCING AND CONSUMING FOOD, FIRST.**

Farmers, who have access to the right tools and technologies are able to make better decisions that support both sustainability in its three dimensions (environmental, social and economic), as well as productivity. When empowered, farmers are mighty allies in the journey towards sustainability worldwide.

To achieve this objective, farmers must be on the cutting edge of the innovations available to optimise the use of natural resources in agriculture. It is necessary to invest in R&D from the perspectives of the farmers, so that their very specific needs and expectations can be met and the best available knowledge can reach each and every farmer on the farm.

### Conservation agriculture in South Africa

For example, there are a number of best management practices that farmers can adopt to improve the quantity and quality of our freshwater supply that are worth sharing.

In South Africa, conservation is going a long way to restore degraded soils. Three key pillars of conservation agriculture are practiced: reduced tillage of the soil, permanent soil cover, and diversification of crops grown in sequences. This can also be supported by the integrated use of both organic and mineral fertilizers, where appropriate. As a result, farmers are seeing both higher productivity and profitability, as well as improvements in soil health and the environment. We call this "green prosperity". In addition, as less mechanically ploughing is carried out, carbon emissions will go down. Soil moisture increases, thus improving resilience in times of drought – a recurrent challenge in South Africa.

### Cocoa producers commit to climate change mitigation in Ivory Coast

Furthermore, farmers can be empowered to preserve natural ecosystems, alongside farming activities. WFO Ivorian member organization RIAD - Réseau Ivoirien pour une Agriculture Durable is carrying out a reforestation project, focusing on creating areas of community forests in five cocoa-producing regions in Ivory Coast. Tropical forests play a key role in fighting against climate change. These forests also satisfy the essential local needs by regulating the temperatures, helping generate rainfall, and purifying the air and water. Healthy forests help rural communities thrive.

The management of plots of land will be entrusted to cocoa producers and their organizations under the supervision of forest rangers. The main objective of the project is to enhance climate change mitigation by increasing the forest cover. This will be a win-win for the farmers, as it will mitigate the rise in the average temperatures and its related effects, as forests facilitate bio sequestration of atmospheric carbon dioxide.

### Biodiesel production using sunflowers

Solutions to reduce use of fossil fuels on farms also exist. Several years ago, Alfred Papst, an Austrian farmer began pressing the oil out of sunflower seeds and mixing it with diesel for use as a substitute fuel for his tractors. This novel approach convinced other farmers in the Fürstenfeld region to look further into the possibility of using vegetable oil as a fuel. Quickly, people began advocating for local fuel production and eventually, a joint venture was formed "FürstenÖLfeld" was formed. The oil mill, which has been in operation since September 2005, is located on the grounds of a biogas plant, where part of the press cake can be used for the production of heat and electricity. The vegetable oil production system is operated in a continuous process and has a capacity to produce up to 60 kg of oil-bearing seeds per hour – enough to produce 37,200 litres of vegetable oil.

The raw material "sunflower" is grown by the members of the vegetable oil joint venture. This ensures long-term availability of the raw material supply. The vegetable oil mill produces about 30,000 litres of vegetable oil per year. On average, that volume is sufficient to farm approximately 280 hectares of land per year using a locally produced, eco-friendly fuel. If this environmentally sustainable raw material could be utilised for mobility purposes, the carbon dioxide footprint would be reduced by some 81 tonnes per year.

These best practices should not remain as an exception. These stories first need to be told, and then incentivized or made financially viable.

We therefore need an ambitious framework particularly for farmers in developing countries, so that farmers can embrace innovation, adopt new technologies and improve their livelihoods through access to market. It is about financing their empowerment, their investments and their skills acquisition, with a special attention to tailor-made local solutions, being aware that "one size fits all" cannot be the right answer.

True transformation requires greater ambition, innovation and the scaling up to ensure no farmer is left behind. Farmers of the world stand ready to actively contribute to this challenging and exciting process.







Farming First is one of the most diverse and active agricultural coalitions in the world. It enjoys the support of 185+ organisations representing the world's farmers, scientists and engineers as well as relevant agribusiness associations and civil society organisations. With one shared voice, Farming First aims to build consensus and drive awareness of agriculture's crucial role within sustainable development. Together, we call on decision-makers to embed a farmer-centric, science-based, dynamic approach for the agricultural sector on diverse issues such as food security, climate change and gender equality.

Additional photos provided courtesy of: Farm Africa, Mitchell Maher (IFPRI), IDFC, Georgina Smith (CIAT), CropLife International, Self Help Africa, Ake Mamo (ICRAF), CIMMYT, Neil Palmer (CIAT), Marchmont Communications, Nestle.

 @FarmingFirst  
 Farming First  
 FarmingFirst.TV

[www.farmingfirst.org/agroecology](http://www.farmingfirst.org/agroecology)