03 | 2015 - 31.1

FARMING MATTERS

Experiences in family farming and agroecology

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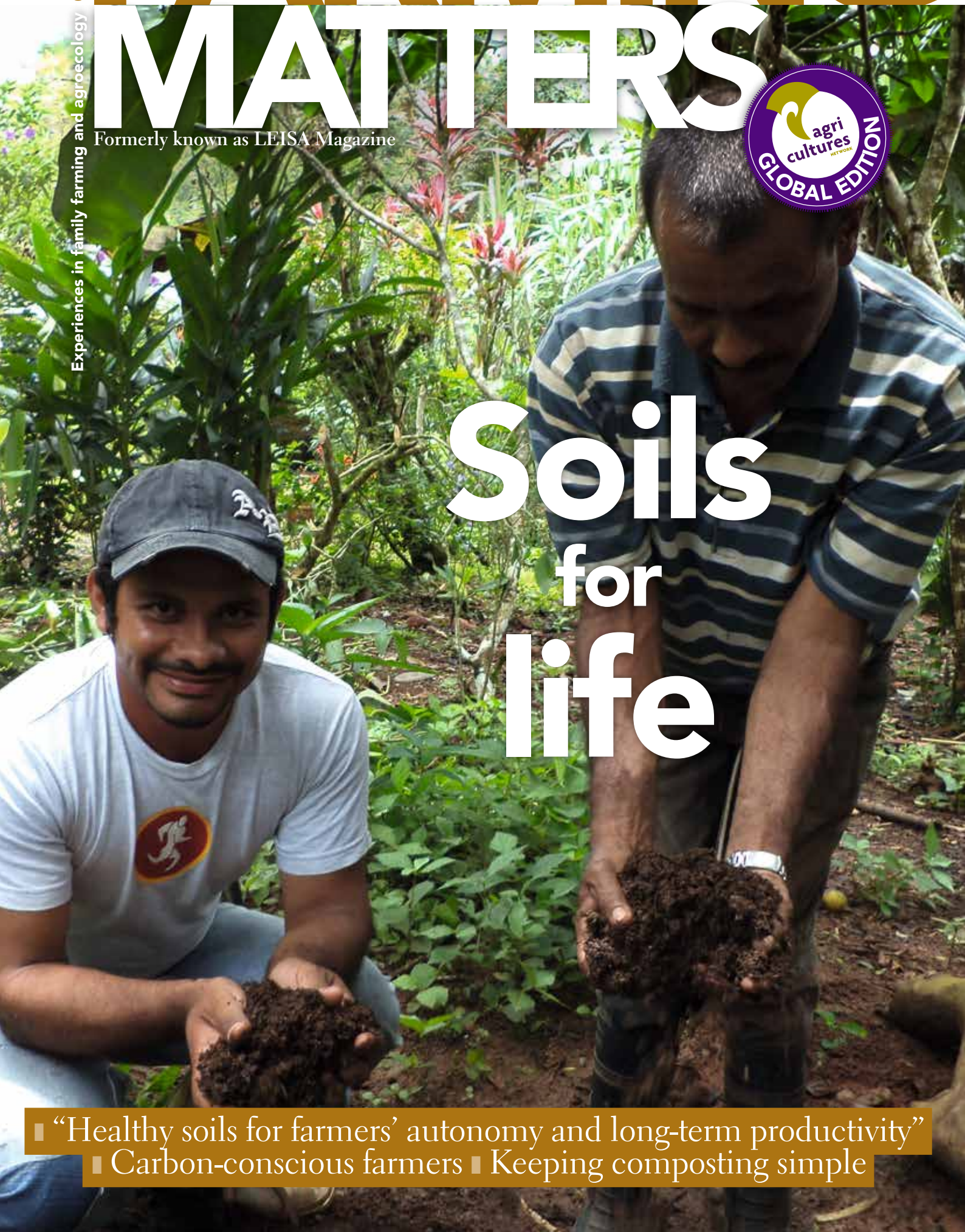

Soils for life

"Healthy soils for farmers' autonomy and long-term productivity"

Carbon-conscious farmers

Keeping composting simple

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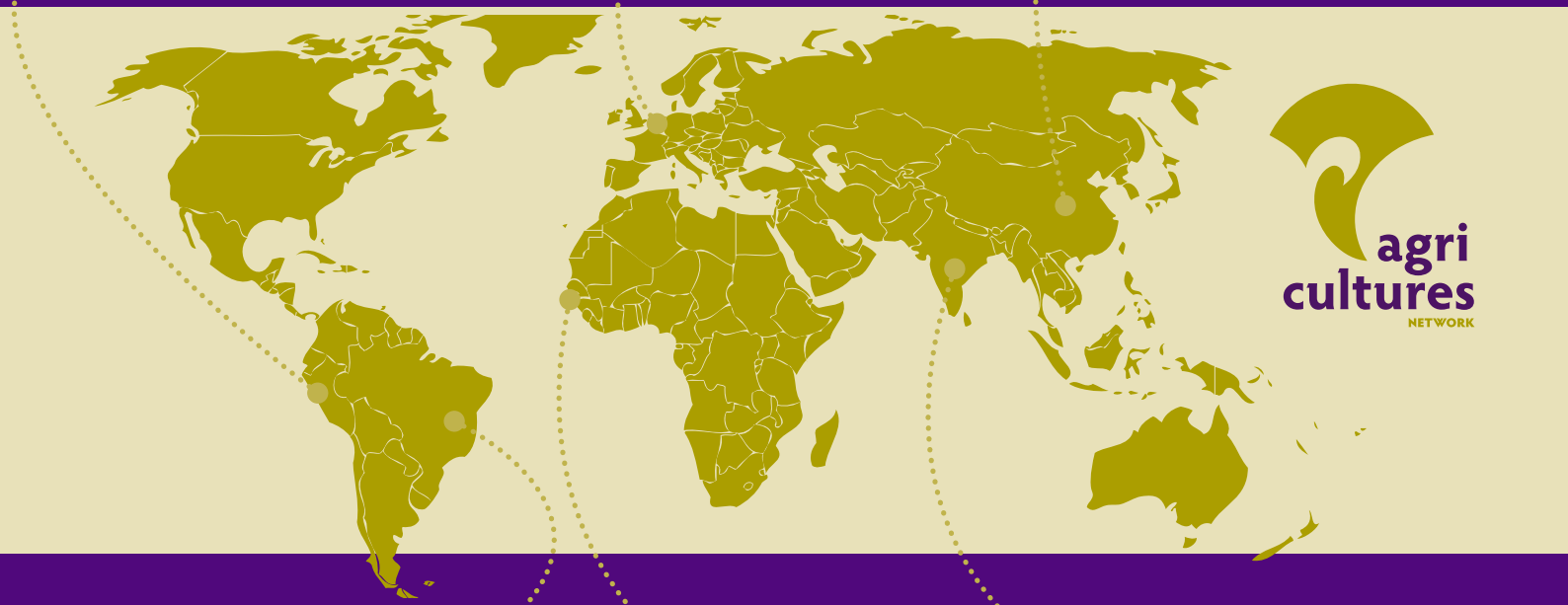

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The minerals in our soil are also in our crops

My name is Nico Vandevannet. It is because of the life in our soil that we are able to grow about 40 types of delicious and healthy crops on our farm of six hectares called 'The Living Earth'. Located in the town of Hertsberge in Belgium, my family has farmed this land for generations. My father decided to transition to organic farming in 1999, and we are careful to protect and nurture soil life, with all its useful fungi, bacteria, and animals such as earth worms.

We disturb the soil as little as possible so that there is always enough organic matter for soil organisms to feed on and live in. That is why we no longer till the land. We also leave the soil covered in winter, when we don't grow much. After harvesting, I pile the crop residues in compost heaps. Incorporating compost helps close the nutrient cycle on the farm. Now, only our cabbages need a little bit of organic fertilizer. We have very long rotations of over seven years to avoid exhausting the soil, with crops such as California bluebell, chicory, leek, potato, strawberries and cabbage. On field edges we plant flowers which provide shelter, food and refuge to various organisms.

I am convinced that the balance between the nutrients and minerals in our soil can also be found in our crops, and that the food we produce is healthy and nutritious. And this is appreciated by our customers, who we talk to both in our on-farm shop and at farmers' markets.

Farming this way is hard work, but in the end we are rewarded with healthy soils, healthy crops *and* healthy people. And there is an added advantage: healthy soils that are rich in organic matter, are better able to hold water. So in light of climate change, healthy soils are also an investment in the future.

Interview by **BioForum Vlaanderen**, the organisation for organic farming and food in Flanders, Belgium.
Photo: Frank Toussaint

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Making good use of scarce water

With climate changing, water is becoming the most critical natural resource. Much more than an economic resource, it is vital for the survival of every living being. Moreover the population is growing and competition for water between different sectors is intensifying.

Agriculture is the biggest water user, with irrigation accounting for 70% of global water withdrawals. The Green Revolution has led to the vast increase and overexploitation of ground and surface water for irrigation. The demand for increased production in areas that were traditionally rainfed has forced farmers to increase their use of irrigation. But water scarcity has motivated farmers to search for new options to manage water.

Key to our understanding of water is that it is a *finite resource*. It is not saved merely by using less of it. It is saved only if it is kept in a recoverable form. And the role of biodiversity across landscapes is crucial for this, regulating the movement and quality of water above, below and on the earths' surface. The challenge is to create water efficient farming systems within landscapes that maintain healthy water cycles. What measures are being taken to address this challenge? What is the role of policy in safeguarding the water resources, for its safe and efficient use in agriculture, human and animal consumption?

Issue 31.3 of *Farming Matters* will look at efficient ways of using water for agriculture. Many farmers have created their own solutions, through bettering traditional management or by adapting or creating new technical alternatives. We invite you to share your experiences with strategies for efficient water management: water harvesting; cheap and efficient irrigation systems; agronomic practices such as the System of Rice Intensification; or revitalising the use of traditional drought tolerant seeds and crops. Do also share your strategies that take a landscape perspective and your stories about innovative water governance systems that encourage a fair distribution and efficient use of water in agricultural landscapes.

Articles for the September 2015 issue of Farming Matters should be sent to the editors before 1st of June 2015
Email: info@farmingmatters.org

Soils – the roots of agroecology and family farming

Healthy soils contribute to resilient food production. Soil carbon is a key to healthy soils but, today we see the long-term consequences of agricultural management that has neglected soil carbon – degraded soils, polluted waters, and unprecedented rates of hunger and malnutrition. There are good examples of agroecological practices that were developed by farmers who have long known the importance of soil carbon. Yet, in many cases these practices are being re-learnt, adapted and new practices are being developed to reconnect with the soil and rebuild soil carbon. This issue of Farming Matters explores and celebrates such old and new practices for living soils.

ILEIA Team

"*Soils constitute the foundation for agricultural development, essential ecosystem functions and food security and hence are key to sustaining life on Earth.*" With these words, the General Assembly of the United Nations declared 2015 the International Year of Soils (IYS). This turns our attention to a crucial resource that sustains farming, and life, but which has been very much neglected in dominant agricultural thinking and doing. But reviving soils and building our collective knowledge on soil health can only be effective if carried out in close collaboration with the 500 million farming families who are important custodians of the world's soil. The IYS therefore builds rather seamlessly on the 2014 International Year of Family Farming.

Healthy soils contribute greatly to more resilient farming systems and the livelihoods of farming communities. And soil organic matter is key, and thus the cornerstone for sustainable food production everywhere. Most family farmers have always known this. They have developed successful agroecological strategies to increase organic matter in their soils using fallows, extended fallows, cover crops, green manures,

Photo: Francisco Nogueira

mulch, and the incorporation of these, and crop residues and compost, into their living soils. Traditional and innovative examples of these are presented in this issue of *Farming Matters*.

Healthy soils

Soil health, understood as the continued capacity of soil to function as a vital living system, is essential in maintaining plant, animal, and human health. Key to soil health and soil fertility is organic matter. Although this is known, degraded soils worldwide highlight the seriousness of the gap between theory and practice. Sole addition of chemical fertilizers to soils, without also adding organic matter is part of the problem, as also explained by Roland Bunch on page 43. Re-balancing this situation requires renewed emphasis on organic matter, which means current constraints must be overcome – from local shortages of biomass to lost knowledge and oversimplified systems.

Why did we forget about this?

Before the 1940s, organic matter was a key theme at international soil conferences. There is an almost forgotten wealth of knowledge based on very practical research on the value and management of organic matter (see page 32). This was agroecology before the term was coined. But things changed after the Second World War. Organic matter became neglected, and not by accident. The process of artificially producing nitrogen was originally developed for the explosives industry, but then the resulting chemical was also applied in agriculture when it was made into 'fertilizer'. The impact on maize yields was so dramatic that researchers and policy makers became convinced that chemical fertilizer could solve global hunger.

With this new emphasis on chemical fertilizers, world renowned researchers working on soil organic matter were systematically neglected. Scientific journals were no longer interested in publishing their research, and they were no longer invited to international conferences. Subsequently, the importance of soil organic matter also dropped off agricultural curricula and from policy, extension and investment agendas. Under the influence of the economic and

Photo: Ousséni Diallo

Soil organic matter is 'black gold'

Soil organic matter is made up of a wide variety of living and dead plant and animal material. In agriculture, this can range from leaf mulch to manure and compost. This 'black gold' is a basic building block of soil life that supports plants to grow and thrive. It is important in several ways, mainly by enhancing soil life and increasing the water and nutrient holding capacity. How does that work?

The key component in organic matter is carbon. The process of 'decay' of organic matter is in fact a result of it being 'consumed' as a food by the multitude of organisms in the soils, who then transfer this carbon into their own tissues or excrete it in other forms. These organisms range from millions of different species of fungi and bacteria, and insects and other arthropods, from the microscopic to larger creatures like earthworms that we know well. This process also causes the breaking down and recombination of a range of compounds into forms that can be more readily absorbed by plant roots. This forms a part of the process that in soil science is called mineralisation. It is key in nutrient cycling processes that help soils to produce healthy crops. Soil life also forms symbiotic relationships with plant roots, nitrogen is fixed and provided to plants in exchange for sugars, and nutrients such as phosphorus are solubilised for uptake by crops.

Building up soil organic matter also plays a second role: in climate change mitigation. The more carbon that is incorporated in soils, as part of organic matter, the more CO_2 that is fixed. In short, soil organic matter improves soil structure, drainage and aeration; increases water and nutrient storage capacity; increases the activity and number of soil microorganisms and encourages macrofauna, such as earthworms and termites, which loosen soil and improves soil structure even further.

political power of the chemical industry, new crop varieties and production methods that required large quantities of fertilizer were promoted. Slowly then, this belief, pushed by industry, narrowed the view of researchers, education, policy makers and extension staff and became the norm. Chemical fertilizers were so much easier to apply a few bags of fertilizers than the bulky organic matter that also demanded mixed farming. And, the trend towards simplification, away from mixed farming and specialising in either livestock or crops, gave further currency to this narrow approach to soil fertility management. Agroecological methods for building and maintaining a healthy, living and resilient soil were largely forgotten.

The consequences

With the use of chemical fertilizers and new varieties, crop yields increased, especially so in some parts of the world. But now, many farmers are experiencing diminishing returns per unit of fertilizer, needing to apply more and more each season (see 'Keeping composting simple' on page 18). This is largely due to the lack of soil organic matter and thus the soil's lost capacity to sustain soil life and retain water and nutrients. Pollution from excess nutrients and eroded soil particles entering waterways are additional long-term consequences of this historical mismanagement.

And, was hunger eliminated, or even reduced, in the process? The total food production per capita increased but there are more hungry and malnourished people today than ever in the history of humanity. This shows that hunger is a distribution problem rather than a production problem. There is food enough for all but it does not reach the poorest, while it's estimated that about one third of all food produced worldwide is lost or wasted.

With the globalisation of our food systems, we are also confronting a growing global imbalance. Nutrients are mined from the soil in one part of the world, and exported in the form of crops to other parts, leading to problems on both sides, as explained by Irene Cardoso on page 28.

So, it is high time that we look in another direction to reverse this situation of soil degradation. We need to look towards practices that will remain affordable and productive for generations to come and that do not demand ever increasing amounts of non-renewable resources.

Soils and agroecology

Faced with ever degrading soils many family farmers have devised new or reinvented traditional practices to restore and improve their soils – and with success. Agroecological practices help counter soil degradation and increase farmers' resilience and autonomy. This issue of *Farming Matters* presents the experiences of farmers who are working successfully, together with others, to improve the health of their soil and their lives.

Photo: Aspen Edge

Farmers have been developing agroecological practices for time immemorial. But, worldwide, and as Rita Uwaka points out on page 9, many farmers and particularly youth may need to re-learn the lost language of the soil. On page 34 Alejandro Bonifacio describes traditional fallow systems that farmers in the southern altiplano of Bolivia are working to preserve.

Jonathon Smith (page 10) describes a growing network of carbon farmers in the UK who are developing and sharing knowledge on healthy soils and, influencing policy makers in the process. Sara Delaney (page 22) shows how experiments with agroecological practices are long-term investments in healthy soils but also in healthy communities.

The agroecological practices presented on these pages are all built from the ground up and based on farmers' knowledge. This cannot be underestimated, and should be valued more by society at large and especially by scientists. Georges Félix (page 14)explains how recommendations to mulch with crop residues often lead to trade-offs between feeding livestock and covering the soil, but that farmers come up with innovative solutions to deal with such dilemmas. Pablo Tittonell, *Farming Matters*' new columnist for 2015, explains why scientists need to listen to farmers and highlights that healthy soils are teeming with life that we need to better understand.

The experiences presented here provide a taste of encouraging initiatives that are unfolding across the world. This issue of *Farming Matters* shows that careful soil management practices developed over many years offer revealing insights into improving soil health. And the benefits are both local – food security and resilience for farming communities – and global – with contributions to climate change adaptation and mitigation. With agroecology we can build soils for life!

Enriching the soul of the soil

Soil marks the beginning and end of all life forms. As the foundation for agriculture, soil provides us with food, fuel, feed and fibre. It acts as a water filter, medicine bank, and is a habitat for billions of organisms. This makes mankind dependent on soil, irrespective of creed, race, place or age.

In Nigeria, our rich arable soil is becoming a shadow of its former self. Every day it bleeds with toxic chemicals from millions of oil barrels emptied into the earth's bowels, through oil spillage, especially in the Niger Delta. Pollutants like heavy metals leach from mining sites, as in Zamfara, Plateau, Enugu and Ondo States. We see deforestation, unsustainable logging practices and conversion of forests into large monoculture pesticide-dependent plantations. And so our soils lose their soul, their organic matter, lowering yields, and leading to hunger, inflation, poverty, migration to cities, and many other accompanying social evils.

Millions of Nigerian youths who have the option to take up farming can no longer do so because of the degraded nature of our living soils. The question is, who will take care of mother earth if this vibrant section of our society that holds such enormous potential, is led astray?

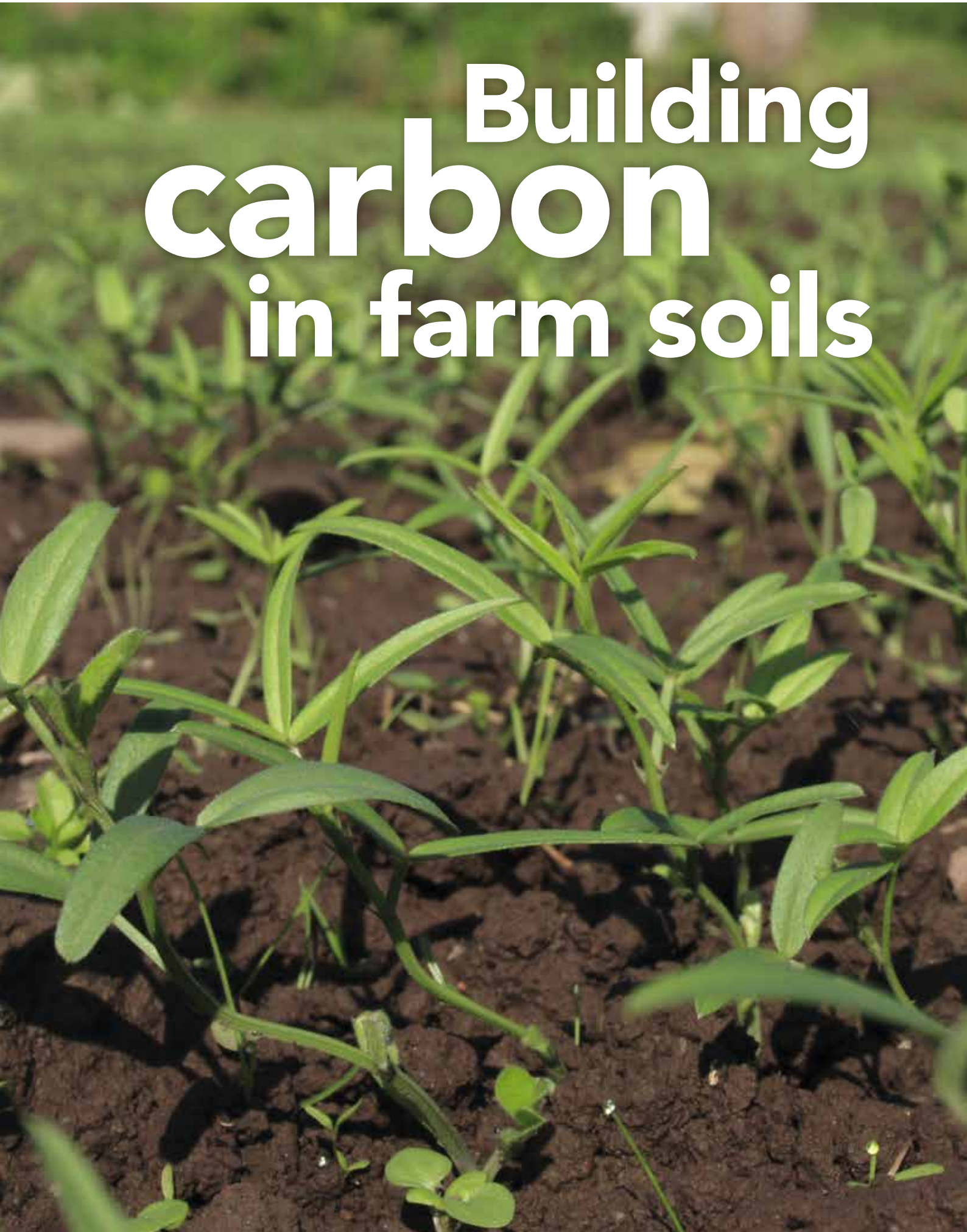
The glaring exclusion of youth in policy discussions and decision making relating to forests, oil and soil management is destroying the future for younger generations. We must build the capacity of our youth, male and female, so they can adapt to the emerging and impending threats to our ecosystems that are the basis of a safe environment and good quality of life.

Allowing youths to offer their opinions and experiences in shaping their future will help to break the poverty in our soils and our souls that we see today. Young people should be introduced to innovative, environmentally friendly and sustainable practices, fusing traditional and local solutions to cure our ailing soils. We must encourage young graduates who have ventured into farming to use traditional soil management to enhance rural food production, instead of destabilising existing local food systems under any pretext.

Every day, our soil cries. It is ever more important that we understand the pressures we put on our soils and take the necessary steps to reverse this. The future is not for the dead and the dying. It is for you and I. And it begins with you and I.

Rita Ikponmwosa Uwaka (age 34) (riouwaka@gmail.com) is the Forest and Biodiversity Project Officer at Environmental Rights Action/Friends of the Earth, Nigeria.

Building carbon in farm soils



Carbon-conscious farmers in the UK work with nature not against it, concerned about the health of their soils for future generations. They use principles of 'feeding the soil not the plant', understanding and encouraging soil biology, and harvesting sunlight to maximum effect. These farmers understand that we must repair damaged soils, and reduce our dependency on chemical fertilizers made from non-renewable fossil fuels and that also reduce soil health. These farmers are serious about building carbon in their soils, and their approaches are backed up by hard science.

Jonathan Smith

"The health of soil, plant, animal and man is one and indivisible." So wrote organic pioneer Eve Balfour in 1943, in 'The Living Soil'. Since then, we have moved to industrial agriculture dependent on agrochemicals, heavy machinery and fossil fuels. In doing so, soils in the UK, like those in other countries, have become severely depleted especially where cereals and other annual crops are grown. Nearly all the organic matter stored in the soil – that precious resource upon which we all depend for food – has been 'mined' and converted into ever-increasing crop yields supported by chemical fertilizers. But fast-forward to 2014, and many carbon-conscious British farmers are not just endorsing Balfour's message, but are also putting it into practice with enthusiasm.

An important part of the journey began in 2009, when we set up the Farm Carbon Cutting Toolkit (http://farmcarbontoolkit.org.uk). We are a not for profit organisation based in the UK, run by farmers for farmers. The catalyst to start was the realisation that farmers have such an important role to play in reducing greenhouse gas emissions and sequestering carbon and so few organisations were involved.

Through an online community, social media, writing articles for magazines and actual events, we encourage, inform and enable farmers and growers to reduce carbon emissions from their businesses. The two main tools are a Carbon Calculator that enables producers to accurately quantify their carbon footprint, and a Toolkit which gives advice, support and information on practical methods of reducing emissions and increasing sequestration.

The work is on-going, we are hoping to influence the work of thousands of farmers and growers across the UK. And,the principles and practices we promote are largely applicable to farms across all temperate regions of the world.

Minimising carbon losses Building soil carbon is relatively straightforward: minimise carbon losses to the atmosphere, and maximise additions of carbon to the soil. Preventing carbon losses is commonly overlooked but is of critical importance. Soil carbon is converted to CO_2 by

Soil carbon and climate change

Agriculture is a major contributor to carbon emissions, but the impact of farming on climate change can be reduced. Farming and forestry are almost unique as industries that could absorb more carbon than they release. The atmospheric carbon that could be absorbed in well-managed soils is extraordinary. Soil carbon expert Rattan Lal estimates the potential for soil carbon sequestration across the world as "*equivalent to a draw-down of about 50 parts per million of atmospheric CO_2 by 2100*". This amazing figure proves that fixing carbon in soils is one of the few practical means we currently have to actually reduce global atmospheric CO_2 levels. Building up soil organic matter is a win–win situation for the fight against climate change as well as soil health and crop yields, and must become the focus of farmers everywhere.

Through events such as soil carbon days we aim to encourage, inform and enable farmers to reduce the carbon emissions from their businesses. Photo: Jonathan Smith

oxidisation, the most common causes being deforestation, erosion and cultivation.

On my farm on the Isles of Scilly, I grow a range of organic fruit and vegetables using both mechanical and manual cultivation. My overall strategy is to minimise the depth and frequency of cultivation, and use cover crops and plastic mulches, reducing erosion and exposure of my soil to oxidation.

In Oxfordshire, Julian Gold grows arable crops such as wheat and oil seed rape on the 800 hectare estate he mangages. But he is very serious about looking after his soils, and has been working hard to reduce chemical inputs and increase soil carbon whilst maintaining profitability. He uses satellite guided tractors that only drive over a fifth of any field, minimising tractor tyre pressure and soil compaction. No ploughs or rotavators are used, only shallow discs and harrows. This has lead to a significant increase in earthworm populations and improved soil quality.

Maximising carbon gains

The next step maximises carbon inputs to your farming system. In temperate areas, the main ways are adding compost, manure, biochar, green manure and cover crops. Rob Richmond is a dairy farmer in Gloucestershire who has increased soil organic matter at an extraordinary rate whilst maintaining high milk yields. He studied how to increase soil carbon on a worldwide tour, and adapted practices he witnessed on his own farm. Rob talks about three types of organic matter: green, brown and black. Green carbon includes lush cover crops, good food for soil bacteria. Brown carbon includes crop residues, mature cover crops and animal manures that become stable organic matter. Black carbon is the most stable form, including mature compost and biochar, and has a very important role in soil stability.

My own farm is next to the sea. I apply large amounts of seaweed, an excellent source of organic matter for my dry sandy soils. Like many organic vegetable growers, green manures are also an important part of my crop rotation, with a quarter of my land at any one time being under leguminous (nitrogen-fixing) plants like clover, or non-legumes such as mustard and phacelia.

A diverse crop rotation builds good soil structure as it allows variations in cultivation requirements, nutrient demands, and plant rooting depths, as well as providing opportunities for introducing green manures, and breaking up pest and disease cycles. Vegetable grower Iain Tolhurst in the Thames Valley has an extremely diverse rotation and needs to buy no manure or fertilizers. At least a quarter of his farm is covered at any one time with a two-year green manure such as alfalfa, and large amounts of organic matter are added when it is ploughed in. It's worth noting that perennial crops, such as fruit and nut trees, are also inherently

Direct drilling onto a field where the previous crop's residues were used to keep the soil covered. Photo: Julian Gold

better for soils, requiring little or no cultivation and sequestering carbon through their root exudates.

Improving soil health Soil ecosystems are extraordinarily diverse and resilient, yet poorly understood. There are thousands of species of bacteria, fungi and insects in healthy soils, some beneficial to plants, others harmful. "Feed the soil, not the plant" is an old mantra of organic farmers, but that is as relevant today as it was 50 years ago.

Martin Howard farms 160 hectares in the Tamar Valley, and has seen life breathed back into his soils by a combination of minimising soil compaction from overusing his farm machinery, increasing soil aeration, and introducing beneficial bacteria and fungi using root drenches. He sows a diverse range of forage species, and applies compost and manure, and has seen steady improvements in soil structure, pasture productivity, animal health and yield. Martin believes that soil biology is the key to a healthy soil. This mirrors what scientists have proved, that a well-functioning soil ecosystem is better able to turn organic matter into stable soil carbon, so a healthy soil is one that is better able to sequester carbon.

Measuring changes beneath your feet In order to understand what is happening to soil carbon, we need to accurately measure the changes in organic matter every year. In Europe, we recommend doing this every spring or autumn, and after a year you can see if levels are rising or falling. Different fields may show different trends, so the farm as a whole must be considered by adding up measurements from all fields.

> "Feed the soil, not the plant" is an old mantra of organic farmers that is as relevant today as it was 50 years ago.

With this, you can see whether your farm management practices are losing, maintaining, or building soil organic matter, and you can target management changes to individual fields. With an organic matter increase of 0.1% (e.g. from 4.0 to 4.1%), an extra 8.9 tonnes of CO_2 will be sequestered per hectare per year. This shows the huge potential of changing farming practices to climate change mitigation, while also improving soil health, yields and profits.

Rob Richmond has seen a significant increase of organic matter and improved soil structure by applying compost, growing diverse and deep-rooting grass swards, and 'mob stocking'. This is where a large herd of livestock intensively graze a small area of tall grass right down in a few days before being moved on to the next patch. Rob describes how, under the right management, pastures can sequester CO_2 at a rate of 20 tonnes per hectare per year. He uses a complex mix of forage species including clover, vetch and alfalfa that grow robustly, are good companion plants, and allow him to graze and rest his land for optimum efficiency. Furthermore, his soils retain more water and his cows are healthier.

Following such basic principles and practices as these British farmers are using, it is possible to not only sequester carbon in soils, but to also improve soil health and structure, increase yields, and improve profits. The Farm Carbon Cutting Toolkit website has many free resources and detailed information on how to build soil carbon and get in touch with carbon-conscious farmers doing it, providing accurate, up to date and accessible information, to inspire, inform and enable positive change.

Jonathan Smith (jonathan@scillyorganics.com) is an organic farmer in the Isles of Scilly, off the south western coast of the UK, and a scientist and activist with a special interest in building up carbon in agricultural soils.

Measuring organic matter

- Treat each field separately.
- Measure in spring or autumn avoiding hot, cold, dry or wet extremes.
- Measure at least a month after any cultivations. Take a sample core 30 cm deep using a soil auger or spade, but removing the top 5 cm that may contain undecomposed organic matter.
- Walk a 'W' shape across the field, taking up to 25 samples in each field, mixed thoroughly in a bucket.
- Remove weeds, stones or lumps of organic matter, and put about 0.5 kg of this well-mixed soil in a plastic bag, labelling it clearly with date and field number/name.
- Send your soil sample immediately to an agricultural laboratory for soil organic matter analysis, asking for measurement by 'loss on ignition', with results to two decimal places.
- Repeat same time the following year.

From slash and burn to 'slash and mulch'

In semi-arid cropping regions of West Africa, fallow periods are getting shorter. As land becomes more scarce, farmers are not able to give their soils enough time to rest. This is leading to depletion of soil organic matter, severely threatening soil fertility and damaging soil structure. In the worst cases, crops hardly yield anything anymore. But this is not an option for family farmers. In Burkina Faso, some have found ways to restore their soils that have been dubbed 'slash and mulch'. The improvement and spread of these techniques also proves the importance of partnerships between farmers and researchers in developing locally suited practices.

Georges Félix

Idrissa Ouédraogo lives in Yilou, a village in the Central Plateau of Burkina Faso, with his wife Fatimata Sawadogo, and their children Nafisatou and Felicité. They grow mainly sorghum and cowpea, and also raise chickens, sheep and goats on a plot Idrissa was given some years ago as a gift from an elder. The soil had a hard surface crust and was completely degraded (known locally as *zippélé*). Nothing would grow on it, not even grasses. But Idrissa had a vision. He knew he had to bring back the native vegetation if he wanted to grow food. And he knew which shrub he needed, *baagandé*, or camel's foot (*Piliostigma reticulatum*).

Idrissa first built stone bunds along contours of his plot to decrease rainwater runoff. This was supported by PATECORE, a development project that financed the installation of soil conservation measures by farmers throughout the region. Then, branches of camel's foot, including leaves and pods, were cut from the surrounding scrub and added as mulch to the *zippélé* areas. After a few weeks, he noticed that some of the pods sprouted and camel's foot was growing on the field. Months later, Idrissa allowed cattle to feed on the plot during the dry season. The animals would consume the fruits of this shrub while leaving precious manure on the field. When the rains started, the seeds, partly digested by the animals, sprouted from the manure on the field, beginning a process of re-greening the degraded land. Clever! His job during the first years of this experiment was to observe what would happen and how the land would react.

Idrissa's use of camel's foot, one of the most abundant shrubs in the landscape, has added value, indeed. The shrub not only helps restore the soil, but also has

Idrissa knew he had to bring the native vegetation back if he wanted to grow food. Photo: Georges Félix

many uses, being a valuable multipurpose plant. Bark is used to make ropes, leaves to wrap food, pods are a rich fodder for animals, and branches as fuel wood for cooking. Local farming families know all this, but the additional function of using branches as a mulch to restore degraded lands may encourage farming families to plant more native shrubs on and around their fields.

Catching and holding the rain

Food production in Yilou, semi-arid Burkina Faso and in much of dryland Africa, is supported by only three to four months of rainfall each year. The main crops around Yilou are sorghum, cowpea, sesame, okra and other vegetables, hibiscus, and maize around the homesteads. But producing enough food to sustain family nutrition year round is an enormous challenge. Typically, farmers quickly prepare their land at the start of the rains in early June, plant by mid-June, and hope that the rains are abundant and evenly spread throughout the season.

Next to treasured rainfall, soil organic matter is the next most critical ingredient for productive rainfed farming. Basically, rainfall must be able to penetrate the soil *and* be held there for the crops to use in the weeks after the rain fell. A soil profile that is rich in soil organic matter is better able to perform these two functions.

As rainfall is short and intense, with only an average of 500-600 mm each year, minimising runoff and increasing infiltration are crucial. Also, the more soil is covered, more rain infiltrates and less will evaporate. And reducing runoff with physical barriers such as stone bunds and mulch has the added benefit of reducing soil erosion and sediment loss, an important step in rehabilitating degraded lands.

Agronomists' offerings complement farmers' knowledge

Minimum tillage and crop diversification are agronomic techniques, besides stone bunds and mulches, long known and used by West African farmers. NGOs in the region have also promoted Conservation Agriculture, which encourages a third principle: permanent soil cover. Agronomists recommend using crop residues as mulch to cover the soil. However, farmers prefer to use crop residues as animal feed. This limits the quantity of residues available as mulch. What to do when farming

Farming families have come up with their own innovations.

families have to choose between feeding their soils and feeding their cows?

This is where farmers' own expertise comes in, such as in Idrissa's case. Farming families have come up with their own innovations. Modifications to complement these and make better use of their resources are the result of combining agronomists' technical knowledge and farmers' experiential knowledge.

The result: crusted soils become useable again, with enough organic matter and storing enough water to grow crops.

Farmers in Yilou are well aware that they need crop residues for the soil and their livestock, too. They have, however, found a way to get around this trade-off. Instead of using only crop residues for mulch (in this case sorghum stalks), farmers like Idrissa also cut and add branches of native shrubs such as camel's foot that grows in the surrounding landscape. And this has proven to be a successful strategy that allows for sufficient soil cover.

The patches of Yilou's soil that are covered with mulch attract termites. Just a few weeks before the sowing season, the termites consume straw, leaves and branches, burrow them into the soil, and open up underground tunnels. These tunnels channel the rainfall, helping water to infiltrate into the soil rather than running off. The result: crusted soils become useable again, with enough organic matter and storing enough water to grow crops. Farmers in Yilou have observed that crops on such newly restored patches outperform the rest of the field. This new approach, called 'slash and mulch', and using only local resources, is kick starting the process of rebuilding soil organic matter.

This is enhanced by farmers' careful observations. Their soil quality varies, with patches of very good soil intertwined with patches of compacted and crusted soil. So, farmers are precise in their practices and mulch the patches that they see need restoration. They have developed *precision agriculture* in this semi-arid context. Instead of using global positioning systems, local in-depth knowledge of the soil and the environment is guiding management for this ecological intensification of agriculture.

Ideas worth spreading

'Slash and mulch' was developed by elders in Yilou and has been spreading within the region for more than 50 years. To better understand how the system works, participatory action research began in 2013, involving local farmers and agronomists. Experiments on farmers' fields and research stations are underway to evaluate how different amounts of mulch impact crop yields. Farmer field schools and learning sessions where farmers play with different management scenarios, so called 'companion modelling platforms', have also been initiated.

Preliminary results on pilot tests in Yilou have shown that mulching with two tonnes of camel's foot per hectare doubled sorghum yields. But even the highest crop yields of around one tonne per hectare are still relatively poor in comparison with other regions, and farmers are busy discussing the successes but also the limitations of their innovation. Some of

Crusted soils yield sorghum again after branches of camel's foot are cut from the surrounding scrub and added as mulch. Photos: Georges Félix




Farmers and agronomists are conducting experiments to find a balance between crop yields, feeding their cattle and improving the soil. Photos: George Félix

them acknowledge that there used to be much more vegetation in the landscape, and consider that having more trees and shrubs is what they want and need to restore their soil.

A youth came one day to Idrissa's farm from another village 35 km south of Yilou to harvest camel's foot bark. He wanted to make rope out of the plant and travelled so far because in his own village, Tem Gorki, there is virtually no camel's foot left since farmers generally slash and burn them. Idrissa shared his wisdom with the youth: "Instead of harvesting the bark, take some seeds and plant them." He explained that the technique is simple: "If you don't have shrubs on your field, just pick some mature fruits and leave the seeds in water for one night, make a little planting hole in your field and place the seeds with a bit of soil; after three weeks you will see them grow." The young boy followed the advice and came back a year later with a chicken to thank Idrissa.

Learning from experience

Farmers in Yilou know well that crop production is only possible with careful management of soil organic matter, especially where rainfall is limited and increasingly unreliable. Mulching soils with branches from native shrubs, and regenerating native vegetation are two practical ways to rebuild lost soil organic matter and to be able to continue farming.

Of course, camel's foot has a number of benefits on the field but it cannot occupy the largest share of cropping lands and, its presence should not compete with crops nor interfere with tillage operations. But, when using 'slash and mulch', doubling sorghum yields easily compensates for growing camel's foot on part of the cropping land. One of the next challenges is to find the most suitable density of camel's foot shrubs to produce the most food with the least work.

Collaboration between farmers and agronomists can lead to practical, innovative and technically sound solutions. Putting into practice the Conservation Agriculture principle of maintaining permanent soil cover and overcoming the trade-off between feeding animals or mulching the soil, is only possible when farmers and researchers share their knowledge and start experimenting together. There are farmer innovators throughout the whole of semi-arid West Africa. Their innovations need to be understood, explored, and extended, to ensure that life is brought back to their degraded lands and they can produce sufficient food to feed themselves.

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Keeping composting simple

More than two decades ago in the Irrawaddy delta in Myanmar, farmers began planting two rice crops each year. Rice production increased, but for how long? Depleted organic matter and acidification are now affecting soil health, and farmers who can't afford fertilizer are seeing their rice yields declining. This is why 200 farmers started to compost rice straw. With this they have been able to maintain rice yields and reduce fertilizer costs. They are still improving their composting techniques and some are starting to experiment with green manures.

Celine Allaverdian and Stephane Fayon

The Irrawaddy delta is Myanmar's rice bowl. Most land is used to grow paddy rice, and all farmers grow a monsoon and a summer rice crop, using either fresh or brackish water. Once rare, double rice cropping was heavily promoted by government extensionists in the 1990s as part of national food policy. Before the introduction of summer paddy, most farmers planted rice in the monsoon season and a legume in the dry summer season, usually green gram, black gram or groundnut. The legume contributed to soil fertility by fixing nitrogen from the atmosphere and via crop residues incorporated as green manure. Regular flooding during the monsoon also helps add to soil fertility as the water carries nutrient-bearing silts and clays. The introduction of rice double cropping at the expense of a legume in the rotation, has upset the balance of the system, and induced a large increase in the use of chemical fertilizers and a decline in soil health.

According to farmers in the Ayeyarwaddy region, rice yields have been going down over the past ten years. The cause? Reduced soil organic matter, lowering soil fertility and increasing soil acidity (to pH 4). Families typically farm 3-4 hectares, but keep few livestock. Most families have a few pigs and ducks, a couple of buffalos for traction, but cattle are rare. Manure is limited. But many farmers are finding it increasingly difficult to buy more and more fertilizer each year, leading to a cycle of debt.

What to do with rice straw? With double cropping and not many animals, rice straw is abundant in the delta. After harvest, large heaps can be seen everywhere, most remaining in the fields the whole year until they are finally burnt or thrown into nearby rivers, with only the decomposed bottom part of the mound used as an organic fertilizer. The abundance of straw and other green matter suggests the huge potential of compost to rebuild soil health in the delta. But their soils need much more organic matter, and composting can transform the abundantly available rice straw and other plants into forms of organic matter to provide nutrients and reduce acidity.

GRET gets involved In 2008, cyclone Nargis devastated the delta killing more than 150 000 people and destroying homes and farm assets of hundreds of thousands more. The NGO GRET started a programme of emergency assistance, but which progressively transformed into a number of agroecology initiatives with family farmers. Today, GRET works in 88 villages, with two main target groups, landless and resource-poor farmers, and rice farmers with at least two hectares and who sell rice in local markets, and provide extension services, support farmer to farmer knowledge sharing, and support community business organisations. And most recently GRET started a composting programme in the delta area and green manure trials in both the delta and western Myanmar.

Simplicity The first step was to encourage our five local extensionists to use an agroecological way of thinking, focusing on soil health, and different composting methods were demonstrated and discussed.

And when they started sharing their knowledge on composting with 300 farmers in 30 villages, the key message was: "Anybody can do it and with any locally available biomass – the key words being simplicity, flexibility, and affordability." During hands-on training sessions, groups of farmers helped to make compost piles and a few weeks later, turned them and saw the composting process. Farmers immediately began to make their own compost piles, landless farmers for their home gardens using neighbours' rice straw mixed with household waste and pig and poultry manure.

Overturning composting myths

Throughout our work with family farmers around the world, views on composting have often surprised us. Composting is probably the most widely promoted practice by NGOs under the banner of agroecology. But agroecological development programmes are disappointing when restricted to certain techniques and don't explore complementary practices such as green manures, crop associations and rotations. And many misconceptions remain. "Composting needs specific infrastructure and materials such as cement pits, plastic tanks, special fencing, tarpaulins and nets." WRONG! "Composting needs special formulas and specific ingredients such as effective micro-organisms." WRONG AGAIN! These can speed up and improve composting but must not be promoted as essential. Perfect prescriptions are an enemy of good results, and such myths deter wider adoption as they depend on costly external inputs, and more labour and hassle. As one farmer told us, "Have you ever tried to shovel compost out of a cement pit? It is truly backbreaking!" Extra costs and effort discourage farmers and development workers, sometimes to the point of abandoning composting as a technique all together.

In 8-12 weeks, the straw from a hectare of paddy can produce 2.5 tonnes of good quality compost. Photo: U Kyaw Saing

Rice farmers first produced compost for their rice nurseries and seed plots, but producing enough compost for all their fields was a challenge.

Compost made easy

In 8-12 weeks, the straw from a hectare of paddy can produce 2.5 tonnes of good quality compost, which when added to the soil provides 50 kg of nitrogen, or 40-50% of the total nitrogen requirements of a rice crop. Cutting fertilizer costs by half is a huge advantage for farmers as they struggle with debt from the need to buy more and more fertilizer each year.

The basic compost combination is dry matter, fresh green matter and a microbial input. Rice straw, dried leaves and even coconut fibre are good sources of dry matter. Freshly cut leaves and weeds, banana trunks, water hyacinth, or any plants in and around the fields and gardens are used as green matter. The microbial input helps to transform the biomass into the nutrient-rich material we call compost, whether it is fresh soil, forest humus, animal manure or fresh compost. Handfuls of wood ash add phosphorus and potassium and even the basic combination can be adapted. If a farmer has no more green matter, he will still get compost but of a different quality. And if manure is in short supply, it helps to add a diluted solution of cow or pig dung with rice straw and other dry matter. This promotes the growth of microbes, nitrogen content and decomposition, and is a cheap and easy way to overcome the lack of green matter or manure.

Needs time

Depending on the materials, four people can build a compost pile of about 10-12 cubic metres in a day, yielding 1-2 tonnes of compost after 8-12 weeks. But labour is a problem. As one farmer, Mr U Maung Aye said, "Compost making is made difficult by our time and labour constraints, especially for collecting the materials needed to make a big compost pile." So, farmers and scientists are now testing various labour saving mixtures, piling techniques and microbial solutions. The latest trial is on making compost piles during rice threshing, with microbial solutions sprayed onto the straw to promote decomposition.

But even with optimised composting approaches, most farmers still can't produce enough for all of their fields, so additional soil building practices are needed. The once common practice of rotating rice with a legume is being revived. One year ago 16 farmers started experimenting with black gram as a green manure, and GRET will help to analyse the results. They plan to also start experimenting with other green manure species that produce more biomass and are resistant to water logging.

But quickly spread

Over the past year, farmers have built more than 200 compost piles, are testing different techniques and are already experiencing benefits. Cost savings by reducing fertilizer purchases are immediately felt, as one farmer noted: "Composting takes more time but it is more effective. When I only apply chemical fertilizer, my field flushes green for two weeks. But when I apply both compost and fertilizer, the paddy keeps its bright green colour for much longer." One 'compost fan' even bought a cow to scale up his production and has set up an impressive composting unit.

The short-term outcomes have been strikingly positive, not only because farmers have so readily started their own experiments, but also because the soil health benefits are already evident. The medium and longer term impacts should be even more promising for the Irrawaddy delta, as farmers continue to experiment with compost and other complementary practices.

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Over the past year farmers have built over 200 compost piles and are already experiencing the benefits. Photo: Myo Kyaw Kyaw

Catching up with farmers' knowledge in the IYS

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The United Nations is bringing a welcome impetus to the call for sustainable soil management in the International Year of Soils (IYS). I see how the IYS presents opportunities, responsibilities and challenges. The world must use this chance to revisit concepts and methods used to guide agricultural science and soil management, and build on farmers' empirical knowledge about soils.

Historically, soil scientists learnt from farmers' knowledge to unravel the complex interplay between nature and farming (see for example the works of Jethro Tull on the effects of horse-hoeing on soil quality from 1733!). But soil management practices and technologies in modern industrial agriculture have upset this dialogue with assumptions that are often based on an oversimplified understanding of nature.

Let's take the example of soil biology. In the past, it was common to hear experts say that nutrient release processes in the soil are the same in forests, pastures and agricultural fields where chemical fertilizers are applied. But ever-evolving science now shows us that this is not true. Today, we are able to map the DNA of soil microorganisms, and can identify the species present, how they relate to each other, and how they contribute to soil functions. In other words, we have found new ways to unravel and better understand the ecological networks in our soils, how they are affected by farm management, and how they impact the resilience of agroecosystems.

Understanding the complex interactions and synergies in the soil is essential in the science and practice of agroecology. Cutting-edge research shows that in organically managed soils, the interactions between species are more complex than in soils managed with chemical fertilizers or nutrient-rich slurry. It shows that such complex interactions contribute to better retention and timely release of nutrients – and this builds healthier soils and reduces environmental impacts. Farmers are more than often very aware of the links between the life in their soils, crop yields, and the ability to sustain them – or, in scientific language: between soil biodiversity and resource efficiency. They adapt their practices following detailed observation over many years.

These links, long known to farmers, can now be understood in more detail through DNA mapping and other laboratory techniques. And as is commonly the case in recent history, advances in agricultural science are really just about research catching up with farmers' knowledge. It is my hope that the International Year of Soils will foster a true *dialogue of wisdoms*, bringing farmer knowledge and scientific knowledge closer together again, to build better opportunities for sustainable soil management.

Organised communities build healthier soils

Farmers who are trying to build up healthy soil on their land can find it a particularly prolonged process. Work with local community organisation in Nicaragua, however, shows that results can be seen relatively quickly and achieved on a broad scale, with a long-term farmer-led strategy. From its origins in the 1970s, The Council of Protestant Churches in Nicaragua (CEPAD) has been learning continuously and adapting its approach. And one of the key things they have learned is that if farmers want to build healthy soils, they have to start with healthy community organisations.

Sara Delaney, Denis Garcia and Audrey White

Since the 1960s, the general trend towards monoculture, plantations and industrial agriculture has shaped large parts of Nicaragua's landscape. Expanding sugar, cotton, coffee and cattle farming have caused increasing deforestation, which in combination with the increased use of chemical fertilizers and pesticides, has led to soil erosion and a decline in the fertility and quality of the soil that remains. It did not take long for many of Nicaragua's family farmers to see and recognise that soil degradation was threatening their livelihoods and ability to produce enough nutritious food. But what could they do?

In the 1980s, when the impacts of soil degradation became evident, the government did not seem concerned about protecting soil and water resources. There were many NGOs working on environmental issues and rural development, but relatively few projects and programmes had the aim of reversing soil degradation. CEPAD, a partner of Episcopal Relief & Development, was one of these organisations. From 1974 to 2004, CEPAD worked with farming families to help them take full advantage of their available land and improve the quality of the soil. Long periods were spent with rural communities to identify key challenges and develop strategies to address them. Soil and water conservation and reduction of agrochemical use came out as priorities that guided farmer-led experiments.

A knowledge network

The experiments generated much new knowledge, and it became evident that an effective process for knowledge sharing within communities was needed, in order to allow the scaling up of the best agroecological practices for healthy soils.

As a response to this, each community participating in CEPAD programmes now nominates 'Community Agricultural Promoters' (*Promotores Agrícolas Comunidad*, PACs). They represent their group at three training sessions each year, and are then responsible for teaching and accompanying five farmers in their own communities, as they introduce and adapt the new practices on their land. In addition, a series of exchange workshops are organised every year, in which the promoters act as facilitators and teachers, and farmers can all share their experiences.

Now, CEPAD works in a community for five to six years, allowing them to complete a three-year training cycle with two separate groups of promoters and the five accompanying farmers. This process enables them to share a core set of principles with other people in the wider community, while at the same time building an organised community network to share knowledge and offer long-term support as the farmers adopt and adapt some of the new practices. In the past six years,

Their soils are now 'alive' again, with more worms, improved structure and water holding capacity.

CEPAD has worked with more than 1200 farmers in 43 communities across the country. The use of these soil enhancing practices has resulted in dramatic changes. Erosion is greatly reduced, and farmers report that their soils are now 'alive' again, noting more worms, improved structure and water holding capacity.

Focus on the soil

The combination of soil quality and land management can make the difference between producing enough food to live and eat well, or not. The families that CEPAD works with farm between 0.5 and 4 hectares, on which many grow mainly maize, beans and coffee, amongst other crops. With a few chickens and pigs, farming provides food for the average family of seven people, along with some cash income. The head of a household will also usually work a few days a week on a larger farm or in another industry, to bring in extra money.

An infiltration trench with a living boundary used to stop soil erosion. Photo: Sara Delaney.

90% of farmers supported by CEPAD have adopted 'living erosion control' such as planting along contours. Photo: Sara Delaney

However, farming communities across Nicaragua face varying challenges, so a key principle for CEPAD is supporting communities in choosing the solutions that best fit their own specific circumstances. For Antonio Hernández Ramírez and his family, who lives in San Francisco Libre, a relatively dry part of the country, it is a challenge to store enough moisture in the soils to ensure a reasonable harvest during the dry season. Antonio focused on a combination of enriching his soils with organic matter by using mulch and compost, and reducing risks of soil erosion by building contour bunds. He explains: "Now, I don't burn the leaves that fall from forest trees, but leave them on the soil to maintain soil moisture." He remembers when his plot only supported weeds but now he harvests plenty of food from the increasingly healthy soil: "I harvested 400 cushaw squash (*pipián*), 60 peppers (*chiltoma*) and 9 butternut squash (*avote*) this past season. This is enough to consume some with my family, share some with friends and sell some on the market."

In another region, Moises de Jesus Garcia Chavez explains how he has stopped using chemical fertilizers and pesticides. Instead, he chose to begin producing compost, and has reduced pests and diseases by diversifying the range of crops he grows. "I am saving about US$100 each year by not buying agrochemicals. And I have seen my land transformed for the good of my family and my community, with more food, improved soils and improved habitats for wildlife in the area."

Patience pays

Change does not happen overnight, but in speaking with farmers that have employed these strategies, it is clear that most begin to see visible changes within the first year. Octavio Saldaña Delgadillo, a PAC, explained, "After we add compost, the plants absorb nutrients, and the soil texture starts to change a little. So far I only have a small layer of better soil, and it will take time to improve more." He explained in more detail the steps he was taking, including the use of natural pesticides and erosion control, and concluded: "This is a process. The change has been little by little." Octavio is working hard and waiting for the day when he can stop working as a builder to earn extra income, and concentrate full time on the land he loves.

Another PAC , Juana Francisca López Saldaña, explained how she is working patiently to renew the land she obtained for herself after her husband's death. Talking about the recent drought, she explained that while it had been a challenge, the actions she took had helped. "One of the advantages of using compost and improving our soil is being able to retain water in the soil for a longer time."

Learning and adopting

A survey of 471 farmers who were supported by CEPAD between 2009 and 2012, showed that about 90% adopted 'living erosion control', such as planting grasses or other plants along contour lines to slow runoff and increase

Farmers working together to make compost. Photo: Sara Delaney

Octavio enjoys the benefits of soil conservation and looks forward to the day when he can stop working as a builder for extra income. Photo: Sara Delaney

CEPAD staff make frequent visits to farmers' fields. Photo: Sara Delaney

the percolation of water into the soil. Uptake of soil fertility measures such as use of biofertilizers, green manures and compost was equally impressive, with 70%, 80% and 100% of farmers using each practice, respectively.

One of the factors for this success was that the new practices were developed over long periods, and farmers were involved every step of the way, from identifying their key challenges to experimenting with new strategies. But, based on more than 30 years of experience in Nicaragua, CEPAD also knows of many cases where farmers stop using their new practices at the end of the training cycle. An important lesson from this has been that it is important to focus on fewer and simpler techniques. They have found that 'less is more', and plan to continue developing the most suitable techniques together with farmers. Continuous evaluation, feedback and learning is paying off, and is helping to better meet farmers needs in the future.

Talking about trust

While reflecting on the widespread uptake in these new soil-building practices, it is clear that the long-term, farmer-led experiments helped to develop the most suitable soil conservation practices. Yet, farmers repeatedly raise trust and confidence as the two main reasons for success. Farmers talk about how, when they first started using some new techniques, their neighbours would laugh at them or tell them they were crazy. But they persevered because they trusted what they had learnt and the advice they were given. And, farmers who are trying out new practices have other farmers in their own community, especially the PAC, who shows them what they can do and provides a place to turn for help. This is another relationship of trust that helps each farmer to keep going, especially when the work is difficult or the change is slow.

They found that 'less is more', and will continue developing techniques together with farmers.

As Program Director Evenor Jerez said, "When producers, families, men and women are more organised and integrated, success is much easier to achieve." This type of strategic community engagement is allowing farmers like Juana and Octavio not only to improve their soil, but it also helps them to become advocates and teachers for their neighbours – a result which is worth trying to learn from and emulate. Healthy community organisations help build healthy soils.

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Farmers worldwide know that their choice of practices is key to the health of their soils. And this, in turn, is key to producing healthy food. But healthy soils, in many cases, are not the norm and so farmers must restore degraded lands. Here we see four different examples that offer a range of practical techniques that are successfully building healthier soils.

Iran

Better soil, and better tasting food

In northern Iran, rice farming follows the green revolution, using various pesticides, fertilizers, and high yielding crop varieties. Drastic changes to this well-set system have not been possible, so, on our family farm we started a step-wise approach, introducing novel practices one by one, and firstly on a small part of our land, increasing the area and attracting more interest as the years went by. With roots in agricultural management and environmental activism, we were motivated to try and influence more people to question the increasingly industrial food system and how this is related to the way we farm. Firstly we introduced Trichogramma wasps as natural enemies of the stem borer pest, to good effect. Following a reduction in pesticide use, next we cut the use of chemical fertilizers. Using organic fertilizers also increased pest resistance and improved crop quality, and small reductions in crop yields proved only temporary. We tried wood-based and tea-based composts too, and ploughed in rice straw and husks, leading to improved soil structure, and crop yields – on average a tonne per hectare higher than before. Our customers are also very satisfied, saying that our rice and all our other crops taste better, and we are seeing a growing demand for our special rice. The successes we have seen, and shown to others, are now promoting the scaling up of these approaches over larger areas.


Photo:Soroush Marzban

For more information, contact Soroush Marzban (soroush.marzban@gmail.com), a family farmer and student of farm machinery engineering and agricultural management.

India

Carbon capturing with the 'Saguna Rice Technique'

Saguna Baug is an inspiring story of transformation of 20 hectares of highly degraded ancestral land in Maharastra, India into a productive farm with cereal crops, multipurpose trees, livestock and aquatic fauna. It is also a story on how perseverance can fuel innovation to reverse the growth decline in agriculture by innovating appropriate practices to enrich soil with organic carbon. Early attempts by the farmer Chandrashekhar Bhadsavle failed, until he invested in three hectares of ponds. These yield 8 tonnes of fish and 10 truckloads of bamboo every year and attract much beneficial wildlife, besides being an essential reserve of irrigation water. But most importantly, has been the Saguna Rice Technique, sowing 3-4 seeds every 25 cm on permanent raised beds with no ploughing, puddling or transplanting, reducing erosion, improving soil quality, and 30-40% less labour is needed. Zero tillage is followed religiously, with the roots of the previous crop preventing the soil from cracking, adds organic carbon to the soil, and improves moisture holding capacity, reducing 'water footprints' of the next crop by as much as 40-50%. Rice matures earlier too, and two crops can be taken in a year, and the Regional Agriculture Research Station in Karjat is now conducting field trials using the technique.

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Photo: Sudhirendar Sharma

Egypt

Sand + waste = fertile soil

The ancient agricultural system of the Nile valley is now plagued by excessive use of chemical fertilizers, outdated and harmful pesticides, and inadequate tenure regulations. Family farming is rapidly disappearing, with high costs of leasing land and buying inputs, and a fluctuating water supply, and ever more people migrate to Cairo. Then, enter Mrs Rawya Mansour. With no farming experience, she decided to try and help farming communities by trying ways to use agricultural waste and produce organic soil amendments and biogas. Her farm has attracted local youth who learn how to make compost from rice straw, chicken manure, and other readily available ingredients, and with addition of biochar, this biofertilizer turned the sandy desert soil into highly fertile farmland with little need for chemical fertilizer. Mrs Mansour's soil also holds more water, helped by mulching, with rice straw also suppressing weed growth and absorbing salts from the soil. Farmers saw the yield increases and the better tasting vegetables, and they started making compost in their own farms, and mixing with biochar. Mrs Mansour's innovations and energy is converted into the spread of agroecological practices, and helping to liberate farmers from a dependency on chemical inputs.


Photo: www.rimamsco.com

For more information, contact Tarek Soliman (tareksoliman143@gmail.com). Tarek has a Masters in agroecology, is a freelance consultant on sustainable food production and works with civil society organisations on the right to food.

Nigeria

'Super vegetable gardens' from biochar

Using charcoal to improve soil fertility is an age-old practice, but scientists are now re-discovering its value. A single application of 5-20 tonnes per hectare can double crop yields and provide long-lasting benefits by activating soil microorganisms and increasing water retention capacity. In north central Nigeria, land degradation is extreme, with nutrients removed by constant cultivation not replenished. In 2011, Pro-Natura and the A. P. Leventis Ornithological Research Institute together started work with communities in Lamingo on the Jos plateau, and has demonstrated the effectiveness of biochar on increasing yields and food security, with greatest benefits when incorporated into sustainable agroecological systems alongside a host of other techniques enhancing biodiversity and enriching soil organic matter. A hundred farming families now reap the rewards from their highly productive biochar-enriched 'super vegetable gardens', built from kits, along with a suite of complementary innovations. Imported kits are good as pilots, but components may be readily substituted with local materials. Farmers have shown great interest, and besides learning about biochar, they are also trained in tree propagation, landscape ecology, and planting shelterbelts and living fences. In the words of Al Gore, former US Vice President, the use of biochar is "One of the most exciting new strategies for restoring carbon to depleted soils, and sequestering significant amounts of carbon dioxide for a thousand years and more."


Photo: Ibrahim Karau

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Photo: Roberta Monteiro

"Healthy soils give family farmers autonomy, resilience and long-term productivity"

"If you have a healthy, living soil, you have healthy plants and healthy people. These three things are closely linked." Irene Cardoso, a professor of soil science at the Federal University of Viçosa and a member of ILEIA's board is passionate about soils and family farmers. In her role as president of the Brazilian Agroecology Association, she advocates for greater support for family farmers to take better care of their soils. "Family farmers live from the soil, but they also live on the soil."

Interview: Janneke Bruil

What links family farmers and soils? This depends on the type of agriculture you are looking at. In industrial agriculture, the soil is regarded as little more than a substrate to which fertilizer and seeds are added. In this type of agriculture, which requires expensive inputs and creates an unhealthy environment, family farmers may lose everything.

However, in sustainable agriculture or agroecology, the soil is very important. Good soil quality gives farmers autonomy, resilience and long-term productivity. This is why healthy soil is important for family farmers. But family farmers are also important for soils, because building and maintaining healthy soils requires work – exactly what family farmers do. Many farmers all over the world tell me "the land has to function" and they know *they* have to make it function. As they work *with* nature all the time, they see the difference between living soil and degraded soil. They see that a plant growing in healthy soil does not need fertilizer. But very few of them use the word soil, and talk only about land. Why? 'Soil' is a more scientific word. The term 'land' implies a more integrated approach, referring to political and social debates around access, ownership and control. For example, farmers don't ask for soil reform, but for land reform.

Family farmers live *from* the soil, but they also live *on* the soil. Their children will inherit the soil with the quality they leave it. The soil is almost part of the family. And you can hear farmers all over the world saying that "the land is our mother." What is also important about family farmers, are the women. Women family farmers tend to have a stronger connection to the land, and a better awareness of the importance of food sovereignty and food security than men.

Can you give a good example of how farmers improved their soil? In 1993, me and other people from the University of Viçosa worked with CTA, an NGO promoting agroecology in the Zona da Mata, in contacting the union of coffee farmers in the nearby town of Araponga. Using Participatory Rural Appraisal methods, we identified the main problems and needs. The farmers were clear that their biggest problem was poor soils: "The land is weak" they said. Technical staff already knew this, but the important thing was that farmers also recognised this explicitly. We set up a committee called 'Strong Land', and farmers came up with some very effective solutions to increase soil organic matter, including green manure, cutting and not uprooting weeds. The technical staff proposed agroforestry systems (planting trees in and around their fields). And it worked. The soil, once recovered, became alive again, and the practices are spreading.

The success was helped by using participatory methods, discussing the problems and planning actions together with farmers. What also helped was working with their ideas. The only *new* practice we proposed was agroforestry, the rest they knew, or at least some of them remembered it from the past.

> "They wanted to repair their 'poisoned' land after decades of applying fertilizer and pesticides."

What makes this story so relevant? Extension services and universities usually tell farmers to follow new, 'modern' techniques. What we see in our region though, is that farmers who want to follow another path can do so if they have the opportunity. We noticed that participation is important: the most experienced farmers sharing their knowledge with others and taking decisions together. This was significant in the historical context. The farmers wanted to use better farming practices to repair their 'poisoned' land after decades of applying excessive amounts of fertilizer and pesticides. Such practices were part of the Green Revolution technologies that started in Brazil during

The success was helped by using participatory methods, discussing the problems and planning actions together with farmers. Photo: Daniel Mancio

Farmers came up with some very effective solutions to increase soil organic matter. Photo: Daniel Mancio

the 1964-84 dictatorship. The government supported these technologies with new policies, changing agricultural university curricula and reorganising extension services. As a consequence, university research and research-based extension promoted the use of pesticides, fertilizers, mechanisation, irrigation, and hybrid seeds that later developed into GMOs. All these supported monoculture production, further encouraged by the banks who offered farmers low-interest credit for investing in these technologies.

How did the Brazilian agroecology movement start?

With the Green Revolution, production increased in some places, but not in others. And the rate of increase declined too, as the soil became degraded. Our agronomists said: "if you switch from food crops to producing monoculture coffee, you will earn more money to buy your food." But what happened is that farmers got into debt and went bankrupt. Production of only one crop makes farmers entirely dependent on international commodity markets. Those farmers who switched to coffee could not afford to buy food when the price went down, and they no longer produced their own food. Small-scale farmers could not pay their debts, and many abandoned their farms and moved to the cities. And there were other consequences: land became poisoned, soils died, food and water quality deteriorated. So these Green Revolution approaches went against food security *and* food sovereignty. Some farmers resisted this, however, and continued to farm the way they used to – at least on part of their land. This became a *cultural* resistance because it was about the way people live and about being respectful to the efforts and investments of their parents and grandparents. These few farmers kept the traditional knowledge about soil health alive, and this later fed a new way of thinking. With the re-democratisation of Brazil, we looked for better practices, and we turned to these farmers, with the unions, grass root organisations linked to churches and other groups, and we saw the start of the agroecology movement in Brazil.

Does Brazil's national agroecology policy support soils sufficiently?

Our National Plan for Agroecology and Organic Production (PLANAPO), launched in 2012, supports family farmers and biodiversity. But the link with soils is only indirect, and this is a mistake in my view. We are now discussing the second PLANAPO, and it is good that this is happening in the International Year of Soils, as the role of soils in agroecology should be highlighted, with explicit reference to what measures are needed for good quality soil. In that way, PLANAPO can raise awareness and support better practices. For example, we do not want heavy machines that damage soil structure but lighter machines, and PLANAPO can support the development of such technology, as well as launch a credit programme for soil conservation.

How does the global food system impact soils around the world?

There are many worldwide policies and practices that connect our soils, in good and bad ways. Our soils in Brazil are red and yellow because of the iron oxide they contain. As iron oxide locks up phosphorus, there is less of this available for plants. So we import thousands of tonnes of it, for example from Africa, and add it to our savannah soils to produce soya beans. The soya is then exported to Europe for livestock feed. But European soils do not contain high levels of iron oxide, so the excess phosphorus we originally imported from Africa is leached out and

ends up polluting European soils and water. This is an example of how the nutrient cycle is not closed in the global food system, and this has severe impacts on soils worldwide. In another perverse example, Brazil imports 92% of the potassium used in its agriculture, including for coffee production. But coffee bean skins contain a lot of potassium which could be a great ecological fertilizer if returned to the soil. What was happening in recent years was that foreign companies were buying coffee skins to produce 'clean' energy in Europe. The argument was that Brazilian farmers were polluting the environment as the skins were put into piles and left to rot. This is true, but there would have been another solution: to process the coffee locally and leave the skins on the land, so that Brazilian coffee skins could fertilize Brazilian soils.

> "I call mycorrhiza the Facebook of the soil."

How can we change power imbalances between farmers and big business? In the name of productivity, policy makers are protecting the sectors that produce the most. There are few possibilities to question this. This will change, but only with time. Private companies are not more important than citizens. We have to start a new cycle of development, based on deepened democracy and participation, which looks beyond elections every four years. It is a long process, but there is no other way. And we are already seeing some changes, in empowered farmers, in some companies being open to discussion, and in progressive individuals within certain companies.

So what is your message for the IYS? Everybody wants to see healthy soils, but few want to talk about what degrades the soil in the first place. And we have to do so in order to change things. The real cause of the problem is the way we have been treating soil as a mere 'container' to add fertilizer, pesticides and GMO seeds. We must understand that the soil has to be kept alive, whereas pesticides kill soil life. When you think of it, soil life needs the same as a human being: a house (a good soil structure so that organisms can live there), a clean environment (no chemicals), water (but not too much), air and food. To get these conditions, farmers have to work with biodiversity, there is no other way. And a healthy soil has lots of life, each organism doing its own job. Some of them fix nitrogen, others decompose, some aerate, and so on. So we must take care of our networks, above ground and below ground. For example, I call mycorrhiza, which are soil fungi, the *Facebook of the soil*. They have the information about the soil and they are constantly engaged in exchanges with plant roots. We need to support these networks and use organic matter, no poison, and little or no tillage. Heavy tillage and heavy machinery destroy soil structure, destroy the house of the soil organisms. And even if chemical fertilizers are used, organic matter is needed. But with good soil quality and enough organic matter, you can decrease or stop using chemical fertilizers. If we feed the soil, we can feed the world."

Women play a key role in the Brazilian agroecology movement. Photo: Laura Eggens

Soil Atlas 2015: Facts and Figures about Earth, Land and Fields

D. Bartz (ed.), 2015. Heinrich Böhl Foundation, Berlin and Institute for Advanced Sustainability Studies, Potsdam, Germany, 66 pages.

Soils are the basis of our food production and much more, and this book explains much and in an easily readable way. Short pieces of text and infographics make the messages clear. For example, in explaining the global picture of the rate at which we are losing soil to erosion, contamination and declining soil fertility. But this book also covers the role of soils in land policy, tenure, mining, urbanisation, 'green' cities and traditional systems. Although there is an emphasis on where we are going wrong, the Soil Atlas does also showcase positive experiences. From innovative grazing techniques keeping pastoralists on their land, cooperation between farmers to stop soil erosion, and to urban design that includes food production – the message is clear. Whether a farmer or not, soils concern us all, and soil conservation deserves global attention.

Permaculture Research: Soil Test Handbook

C. Warburton-Brown and T. Kemeny, 2015. The Permaculture Association, Leeds, UK, 13 pages.

Permaculture seeks to create systems where natural soil fertility is fostered and describes a healthy soil as having three main characteristics; rich and diverse biological life, good structure and available nutrients. This handbook outlines how to conduct 'farmer-friendly' soil tests requiring no special training or equipment, and focuses on the first two characteristics of a healthy soil. The tests cover a range of soil properties including, drainage, earthworm population, pH, soil texture, topsoil depth and soil compaction. Instructions for carrying out the tests are clear and

More on soils

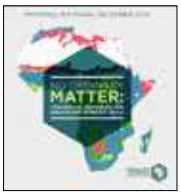
Attempts to uncover the mysteries of soils date back to ancient times. Four thousand years ago, Zoroaster described the wheel of life, death, decay and life in which the soil plays a pivotal role, and which laid the basis for Vrksyurveda, the ancient Indian science of plants and farming techniques. This knowledge came to Europe in later classics, such as 'Farmers for Forty Centuries, Permanent Agriculture in China, Korea and Japan' published in 1911 by Franklin Hiram King, who was impressed by the high productivity and long term sustainability of agricultural practices in 'the Orient', and how farmers recycled everything possible. The book is currently reviving in reprints and is an excellent read.

Another classic is 'An Agricultural Testament' by Sir Albert Howard from1940, describing how the industrial revolution is destroying the earth's capital – the soil. He related soil fertility to human health but proposed solutions too, including the famous Indore composting method.

Essential reading must also include Lady Eve Balfour's 'The Living Soil' from 1943, and which inspired the founding of the Soil Association three years later. The book provides evidence of health benefits of the organic food and how compost-based fertilizers raise healthier plants than chemical fertilizers, the reasons resting in soil life, and was considered a distinct threat to the new fertilizer industry.

Another critic of industrial agriculture is Fukuoka from Japan. In his 'The One Straw Revolution' from 1975, he describes the 'do-nothing' technique in which enriching the soil plays a central role, and sustainable practices that eliminate the need of pesticides, fertilizers, tillage and avoid heavy and tedious work. Fukuoka probably builds on one of the fundamental principles in Taoism, *wu wei*, meaning "do nothing .... against the laws of nature."

easy to follow. It is available online (www.permaculture.org.uk/research/soil-yield-and-biodiversity-tests-project), accompanied by the 'soil advice handbook' which helps to interpret test results. This is a practical resource for farmers who want to learn more about soil testing, and the Permaculture Association welcomes feedback from farmers around the world so that they can keep improving them.



No Ordinary Matter: Conserving, Restoring and Enhancing Africa's Soils

K. Glatzel, G. Conway, E. Alpert and S. Brittain, 2014. The Montpellier Panel, Montpellier, France, 40 pages.

Soil is a resource that has for too long been neglected in the policy realm. This report is a strong plea to donors and governments, to adopt a long-term vision and backed by adequate financial support, to help farmers nurture, conserve and restore their soils. This book looks at the extent of soil degradation in Africa and the role of traditional and ecological approaches to building up soil organic matter and biota. Climate change, and the need for both mitigation and adaptation, is highlighted as an urgent reason why agricultural management must aim to build soil carbon and resilient systems. Recommendations range from the grassroots, building on existing local and traditional knowledge, to higher level policy decisions such as attributing values to land degradation, and securing land rights that create incentives to invest in the soil.

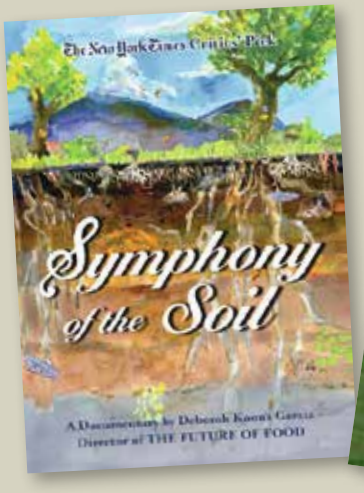
Three key films about soil

Soil Farmers (2015, 45m, Dutch with English subtitles; www.bodemboeren.nl)

Five Dutch farmers share why and how they continuously experiment with ways to manage their soils more sustainably. Together, these farmers are part of a 'new soil story' based on old, (sometimes forgotten) and new (sometimes surprising) knowledge. They build their natural capital: healthy soil life with plenty of air, water, carbon and minerals. Co-produced by ILEIA.

Symphony of the Soil (2012, 104m, English with subtitle options in Spanish, French, Chinese, German, Italian, Portuguese; www.symphonyofthesoil.com)

Drawing from ancient knowledge and cutting edge science, Symphony of the Soil is an artistic exploration. By understanding the relationships between soil, water, the atmosphere, plants, animals and human beings, it uncovers the complex nature of soil, as well as the use and misuse of soil in agriculture, deforestation and development. Filmed on four continents, featuring both scientists and farmers, the film highlights possibilities for healthy soil management.



DIRT! The movie (2009, 126m, English with German subtitle option; www.dirtthemovie.org)

Narrated by Jaime Lee Curtis, this film brings to life the environmental, economic, social and political impact that the soil has. It shares the stories of experts from all over the world who are working to harness the beauty and power of a respectful and mutually beneficial relationship with soil.

Traditional fallows support resilient farming on semi-arid sandy soils

The arid southern highlands of the Bolivian Andes are a harsh environment for even the most hardened farmers. The 'quinoa boom' and the move to mechanisation have led to shortened fallows and a drastic drop in soil organic matter. The dry sandy soils and the natural vegetation they support are increasingly degraded, but in the face of climate change and higher risks of drought, frosts and hailstorms, technical recommendations pay little attention to soil health. Farmers in the community of Lloco, however, have preserved their traditional practices that care for their fragile sandy soils and maintain resilience.

Alejandro Bonifacio Flores

The southern *altiplano* of Bolivia is characterised by the aridity and fragility of its soils. Only small areas of the hillsides are suitable for cropping, mainly potatoes, quinoa and barley, with the vast plains reserved for pastures that support llamas (*Lama glama*). Most farming families have access to both cropping and grazing land, and these are complementary components in local farming systems.

Mechanisation and the expansion of quinoa in the past two decades have undermined the sustainability of farming in the southern *altiplano*, with the introduction of tractors and rising quinoa prices having driven the changes. More land is going under the plough, upsetting the delicate balance between crops, pasture and fallows, destroying native vegetation, exposing soils to wind erosion, and damaging soil structure through compaction. Moreover, the expansion of land sown to quinoa has lead to less fallow and in-

creased demand for manure. But with relatively few animals, manure is becoming increasingly scarce, and since 2005 the price has increased fivefold.

Farmers in Lloco, a community in Orinoca County, have witnessed extensive soil degradation in neighbouring communities where tractors were introduced 15 years ago. But Lloco, like other communities in the county, are different because their sandy soils are scattered with sand dunes. This has not allowed the same increase in tractor use or land converted to quinoa, as in the communities, where there are no sand dunes. Their traditional farming system has come under far less pressure, but they are still worried about increasing soil degradation and especially because climate change is making farming more difficult. As a farmer in Lloco, Casiano García, says, "the rainy season in Lloco used to be between December and February but now it doesn't start raining until the middle of January. This is a disaster for our potatoes and pastures." As a consequence, the Lloco community is taking steps to preserve and adapt their traditional system to save their soil and their livelihoods.

Evolving systems Their sandy soils are so fragile because they have such low natural levels of organic matter and are inherently low in nutrients. Moreover, agriculture in high altitude arid lands, between 3500 and 4000 metres above sea level, has a high risk of crop failure due to frost, drought and hail. Under these conditions, building and maintaining organic matter is key to maintaining soil structure, water storage, beneficial micro-organisms, and other physical and biochemical properties that support plant growth.

Such fragility is why, over millennia, farmers have learnt to cultivate only small areas but each with a high diversity of crops and use extended fallow periods, alongside pasture for raising livestock. This combination supports increased resilience to adverse weather, and with careful management of fallows, manure and mulch, the soil is relatively well protected.

Manure is collected from the grazing areas.
Photo: Alejandro Bonifacio

A delicate balance Maintaining the balance between crops, animals and fallows ensures that there is enough manure, an essential source of nutrients and organic matter. But the fallow must also be long enough to allow for adequate regeneration of native vegetation that protects soil from wind erosion and provides an important source of mulching material that further adds to building up soil organic matter.

Fifty years ago, land would be left fallow for at least 30 years but now, the trend is to reduce fallow length to two or three years and in extreme cases to just one year. Thirty years of fallow allows many different grasses, shrubs and legumes to regenerate. Important grasses such as sikuya (*Stipa ichu*) are used as mulching material, shrubs such as *Paratrephia lepidophylla* serve as living barriers, fuel and medicines and legumes such as salqa or q'ila-q'ila (*Lupinus subacaulis*, *L. otto-buchieni*, *L. montanus*) help to build soil fertility. The fallow lands also host wildlife such as high plateau armadillos (*Chaetophractus Nationi*), camelids and migratory birds.

> The balance between crops, animals and fallows ensures that there is enough manure.

A typical Lloco family grows mainly potato for home consumption and quinoa for both home consumption and cash income. They plant barley for animal feed, but in some years, barley is also eaten at home. Additional food and income comes from llama production. They used to raise sheep, introduced by the Spanish, but most families have abandoned this because sheep prefer improved grassland and need shepherding, whereas llamas can roam freely and tolerate lower quality pasture. And with youth migrating to the cities in search of jobs, there was no one left to tend the flocks.

Fallow, manure and mulch After a 'typical' 20 to 30 year fallow, site preparation begins 3-12 months before the rainy season. The tallest shrubs are cut, leaving cut material on the ground as mulch and leaving the smaller shrubs and herbs alone. Manure is moved from grazing areas and piled where the shrubs were cut and covered with straw to reduce nutrient loss from strong winds that are common. Most families in Lloco collect manure from their own llama herds, otherwise they have to ex-



After the tallest shrubs are cut and left on the ground as mulch, manure from the grazing areas is piled on the fields, dug into the soil and covered with sikuya straw to protect it from erosion and maintain moisture. Photos: Alejandro Bonifacio

change or buy it from families with larger grazing areas.

In the middle of the short rains which usually last only two months (January and February), manure is spread evenly over the fields and hoed in, before the soil is covered with straw from a common unpalatable local grass called sikuya. The straw protects against erosion, against the sun, and reduces the soil from drying out during the cold and dry months. Timing of this activity is crucial, to maximise soil moisture and nutrients, in preparation for planting six months later. Crops are sown in advance of the rainy season, so that there is enough time to complete a growing cycle before the onset of winter. Potatoes are planted for two to three consecutive years before being followed by quinoa and barley. The typical rotation may be described as potato-potato-potato-barley, potato-potato-quinoa-barley or potato-quinoa, depending on the soil fertility and soil humidity.

Resilient food production

These traditional practices bring resilience to the Lloco food production system. While frosts and drought can always reduce yields, all production is never lost as happens in neighbouring communities, where the soil and native vegetation are degraded. For example, in 2003 most communities of Orinoca County lost their quinoa and potato crops to frost but the Lloco farmers managed to harvest potatoes. In addition, their healthy soil means a lower incidence of potato weevil, potato moth and late blight, the main potato pests and diseases in the Andes.

Ongoing challenges

The challenges of working these sandy soils are more than just technical. The traditional system of the Lloco community requires knowledge, skills, and is labour intensive. The knowledge needs to be shared between generations and the labour should not discourage youth from farming. For example, they are exploring small tools for pruning bushes and preparing straw mulch, equipment for transporting manure and, adapting motorcycles for farming, as ways to reduce labour requirements.

Another challenge faced in Lloco is the disconnect between their traditional knowledge and the advice given from local extensionists. Technical recommendations for their type of soil are either to stop farming altogether, or to stop cultivation and only raise livestock. However, farmers have developed their own resilient food production systems. They have proven that their system works, and technicians should listen to them, and begin a dialogue between traditional and scientific knowledge. More scientists are starting to work with farmers in Lloco, to find explanations for the fertility and moisture holding capacity of their sandy soils, and to learn about the reproductive cycles of the native grasses, shrubs and legumes.

The management of native vegetation and manure as sources of organic matter has been developed according to the needs of family farming in arid lands. Techniques developed by farmers of Lloco are appropriate for resilient, sustainable agriculture in such drylands, and have so far also been able to withstand market pressures such as the 'quinoa boom'. And, seeing is believing – neighbouring communities are starting to listen to the Lloco farmers because they have seen their healthy crops, healthy soils and their products for sale on the market. With more climate change expected, such resilient systems need to be preserved more than ever before.

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Healthy soils are essential for healthy lives

Marcela Villarreal (OPC-Director@fao.org) is the Director of the Office for Partnerships, Advocacy and Capacity Development of the Food and Agriculture Organization of the United Nations (FAO).

Soils are fundamental to life on Earth. They constitute the foundation of agricultural development and ecological sustainability and constitute the basis for food, feed, fuel and fibre production. Soils also provide many critical ecological services such as clean water, nutrient cycle regulation and hydrological cycle moderation. They are the greatest pool of terrestrial organic carbon, contain one quarter of global biodiversity and provide a habitat for seed dispersion and dissemination of the gene pool. Soils also provide construction materials and are the foundation for construction.

Soil is a non-renewable natural resource; its loss is not recoverable in the context of a human lifespan. The maintenance or enhancement of global soil resources is essential for humanity's overarching need for food security and nutrition, climate change adaptation and mitigation and overall sustainable development.

Soil needs to be managed in a sustainable way. This will be achieved when the supporting, provisioning, regulating, and cultural services provided by soil are maintained or enhanced without significantly impairing either the soil functions that enable those services or biodiversity.

Human pressures on soil resources are reaching critical limits, inherently reducing or eliminating soil functions critical to human well-being. Soil degradation is a pervasive process that in its various forms affects all regions. One third of all global soils are already degraded, affecting mainly smallholders and family farmers, who are responsible for 80% of the food production in value terms.

There is an urgent need for concerted efforts to ensure the sustainable management of soils to ensure sustainability and food security and nutrition for all. As the facilitating UN agency of the International Year of Soils 2015, FAO is striving to bring the issue of sustainable soil management to the forefront of public attention and to generate new momentum. The urgency of acting on soils is particularly important in the face of population growth, climate change and the competing demands on fertile soils.

The International Year of Soils constitutes a key platform to raise awareness on the importance of soils for human well being through the provision of various essential ecosystem services. This platform will be vital for advocating for the sustainable management of soil resources as part of the post 2015 development agenda. Healthy soils are essential for healthy lives. The IYS will ensure that this simple message is translated into strong action.

Videos inspire farmers to experiment

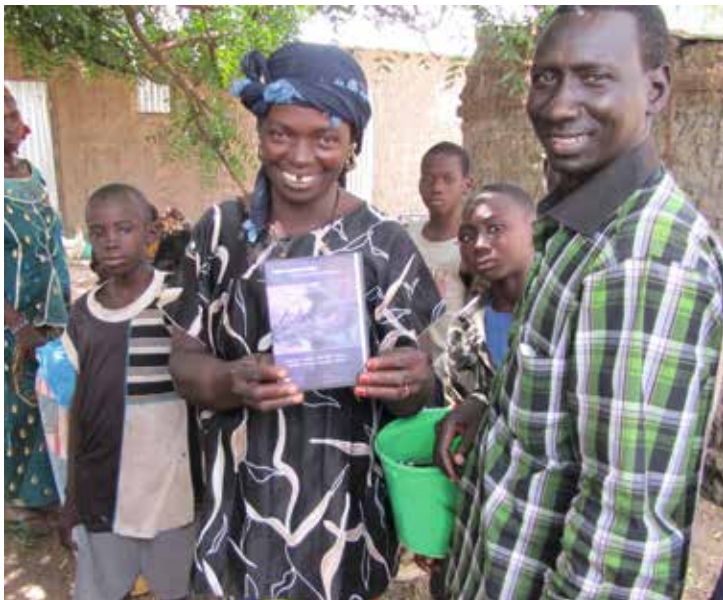
Healthy soils are the foundation for healthy crops. And in sub-Saharan Africa, fertile soils are doubly important, as they help to reduce infestation by striga, or witchweed, which can seriously reduce cereal yields. A series of films featuring farmers showing what they have achieved with compost is having a big impact. And these are achieving more than striga control – they are enabling farmers in Mali, Ghana, Niger and Tanzania to learn, share their ideas with each other and to improve their soil.

Jeffery Bentley and Paul Van Mele

Striga is a damaging parasitic weed that lives on the roots of sorghum, millet, maize and rice. It sucks its food from the crop and does not rely on the soil. While the red-flowered striga is found in eastern and southern Africa, the purple-flowered one grows across the whole continent. It prefers poor soils where the cereal crops are generally weak, and when attacked, striga can decimate an entire crop. Striga management requires a combination of weed control and soil fertility management. This has proved to be a challenge, in part because of striga's unusual ecology, and suggests that new creative thinking and techniques that help to build soil organic matter and support soil life would help.

In response to this, researchers from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) set up farmer field schools in Mali, Ghana, Niger and Tanzania in 2007, to learn and experiment with different striga control options. Farmers saw clearly that striga is more common in poor soils than in healthy, fertile ones. This helped to understand that soil fertility is a key to controlling striga, especially by using compost. It is more effective than manure or chemical fertilizer because it is full of healthy micro-organisms that attack striga seeds in the soil.

Christine Keita with a Striga DVD.
Photo: Paul van Mele



Léwa Kamaté closes the loop by feeding his rabbits with sweet potato leaves and returning the rabbit manure to his compost pile. Photo: Jeffery Bentley

Seeing is believing

Using video is an effective way for farmers to share ideas with each other, and to stimulate creative ways of working to improve soil. Four years after starting the farmer field schools, a series of ten videos were produced on 'Fighting striga and improving soil fertility'. The videos featured graduate farmers explaining the effective techniques they had learnt, and how they had adapted them to their own conditions. The videos also included impressive animations that clearly explained the biology and ecology of striga, i.e. how it develops underground and why it reduces crop yields.

One of the videos shows farmers in dry, northeastern Mali, who learnt how to make compost in pits by mixing cereal straw and stalks with ash, manure and water so the tough plant matter would quickly decompose. They learnt from their own experience that incorporating compost into the soil helps to reduce striga infestations, and increases crop yields. Previously, they had only composted manure, and they were delighted to realise that by adding plant material they could produce much more organic fertilizer. And by making the compost in pits, it would hold more moisture and compost quicker.

The ten videos were translated into more than 20 languages and are freely available from the NGO Access Agriculture (http://www.accessagriculture.org/). Besides English, French, Portuguese and the videos are also in Kiswahili, Hausa, Bambara, Bariba, Bomu, Buli, Chichewa, Dagaari, Dagbani, Dendi, Frafra, Conja, Kikuyu, Kusaal, Luo, Mooré, Nago, Peulh/Fulfulde, Sisaala, Wolof and Zarma. More than 50 000 DVDs have been distributed by ICRISAT, and with the help of farmer and community organisations, farmers across Africa have been inspired to learn from these farmer field schools.

Spreading messages

In 2013, we visited the village of Souara in Mali, and met the farmers who had been in an FFS and later appeared on the compost video. Two years after filming, every household had a full compost pit covered with a layer of earth to keep it moist. We also saw new compost pits in other villages where people had only watched the videos, showing that the videos have had an impact.

Creative ideas

The videos proved successful because they did not promote a single technology – they show what can be done and why it works. After watching the videos, farmers grasp the principles that underlie practices such as composting, and are more motivated and confident to start experimenting.

Léwa Kamaté, a young man from the village of Togo, in Mali, watched the videos, and took us to see his compost pit. But he used the compost for growing vegetables and not in his sorghum fields to help control striga. This was Léwa's first creative departure from the video. Léwa saw that compost pits should be covered with straw or earth, but he covered his with a living layer of sweet potato plants. He then uses the sweet potato leaves to feed rabbits and adds the rabbit dung to the compost. Another creative adaptation!

A group of farmers in the village of N'Tonasso watched the striga videos in 2012 and are still talking about them today. One farmer, Alou Goïta, said that he made a compost pit after watching the videos, a metre wide, five metres long and 1.5 metres deep. He had emptied the compost pit once and refilled it with household refuse, ash and maize husks for next year's compost. The looks of surprise on his neighbour's faces, and the pride in Alou's, showed that most of them had no idea about his innovation. No doubt some of them are now thinking about following his example.

The spread and development of composting, and building healthy, fertile soils is an important part of the fight against striga. And, when creative solutions are most needed, videos can be an excellent medium for sharing information, and stimulating innovation amongst communities.

Jeffery Bentley (jeff@agroinsight.com) is an agricultural anthropologist working on farmers' creative responses to new challenges. **Paul Van Mele** (paul@agroinsight.com) is an agricultural scientist and co-founder of Access Agriculture.

Alou Goïta has already emptied and refilled his compost pit once. Photo: Jeffery Bentley

Organic waste for land restoration

In Central Asia, unsustainable land management has turned large areas of productive land into wastelands. "Not possible, no water, too hot…" has for a long time been the standard response from locals when asked why there has been so little effort to reverse natural resource degradation. But in recent years, innovative farmers like Ruzimatov Mahmudjon have successfully challenged this perception by clever strategies that use local organic waste materials.

Frank Löwen

Ruzimatov Mahmudjon lives with his family in a mountainous area of Isfara District in northern Tajikistan. Farming is not easy. The area is very dry, with long, hot summers. And the little rain, about 300 mm a year, generally falls during the winter months that are too cold for crops to grow. Like many family farmers, Mr Mahmudjon owns a small irrigated plot, 600 square metres, that he uses for fruit and vegetable production and as a tree nursery. He occasionally rents additional land to grow wheat and other staple crops and he also works as a wage labourer for larger farmers.

Located at the foot of an eroded mountain range, Mr Mahmudjon´s community has over the past 10 years repeatedly been affected by floods and debris flows, which even put the village school under threat. Members of the community decided to establish water diversion structures and dams above the village. However, the established structures had to be periodically repaired and reinforced. This was hardly a sustainable solution.

Degraded and underutilised land

This situation is not unique to Mr Mahmudjon's community. Most of Tajikistan's territory consists of mountainous rain fed land which in many areas, due to decades of overgrazing and deforestation, has become highly degraded. Soil erosion and declining soil organic matter have reduced soil fertility to the point that large tracts of the country are nowadays described as marginal or as wasteland. Land is producing less, rainfall has become erratic and communities are at risk of disasters in the form of floods, mud and debris flows.

New techniques for land restoration

In 2011, with support from the European Union, communities which had reported increasing problems with land degradation and flash floods learnt how to use locally available resources to integrate food production with land restoration. Efficient water use, returning as much organic material back into the soils and the planting of selected shrub and tree species, that are able to grow even under harsh conditions, were at the core of the initiative. This was the starting point for the communities' own experiments with land restoration, which eventually led to the development of further innovations by farmers such as Mr Mahmudjon.

Mr Mahmudjon did not attend any of the training sessions but later heard some neighbours speaking about them and they shared some of the training materials with him. Curious to see whether the simple techniques could really work, he decided at the start of 2012 to establish his own experimental plot of half a hectare on a compacted and stony area above the village. His efforts consisted of planting drought tolerant shrubs and trees, adding organic waste to planting holes and covering his soil with organic matter. The opportunity to restore wastelands with waste materials seemed like a win-win situation said Mr Mahmudjon, "first, I was motivated by the idea to protect the school and the parts of the village that were at risk from floods, and then I realised that we can also get economic benefits from those wastelands."

Choosing wisely

One element of Mr Mahmudjon's strategy was to select the right trees. At the beginning he mainly planted highly drought tolerant shrub and tree species, such as almond, mulberry, pomegranate, a local highly drought tolerant elm species (*Ulmus pumila*), hawthorn, Russian olive (*Eleagenus angustifolia*), Chinese date (*Ziziphus jujuba*), pistachio and juniper. These trees are able to establish, even under harsh environmental conditions, and they develop strong and deep root systems, which allows them to survive even long periods of hot and dry weather with little to no irrigation.

Mr Mahmudjon's first seedlings from 2011 helped to gradually improve the local microclimate. And in 2014, this gave Mahmudjon the confidence to introduce walnut and different varieties of apricots, which require more water and better soil. In addition, he started to experiment with lucerne and other nitrogen fixing legume plants for enhanced ground cover and soil improvement.

Hands on training on land assessment and restoration techniques. Photo: Frank Löwen

Ruzimov's reforestation plot contributes to regreening the degraded hills above his village. Photo: Frank Löwen

As much organic matter as possible

In addition to that, Mr Mahmudjon applied large amounts of organic matter in each planting hole. According to the original training materials, one or two buckets of well rotted animal manure should be added to the planting hole of each seedling, to increase the soil's capacity to retain water. It is understood that one tonne of dry, well decomposed organic material can store between 1000 and 1500 litres of water. However, Mr Mahmudjon considered the long, dry and hot summer season and the lack of water at his reforestation site, and he decided more was needed. He applied up to 15 kg of humid animal manure per tree, and in addition incorporated large amounts of organic waste from a local cotton carding machine. These machines are used by the local population to periodically clean and soften pillows and mattresses filled with cotton fibre. The waste material, old cotton fibre, was considered useless by local people and was available for free. Mr Mahmudjon recognised this to be a valuable resource to support his reforestation efforts.

From wasteland to productive slopes

The application of manure and cotton fibre on the soil and in tree holes proved highly suitable to improve the physical and chemical properties of the soil, and promote plant growth. The manure provides readily available nutrients for plant growth and increases the general water holding capacity of the soils. The additionally applied cotton fibre seems to further improve the soils physical structure, thereby raising its water holding capacity. Combined with the careful selection of drought-tolerant tree and shrub species, this meant that the demand for irrigation water during the first years after planting was drastically reduced. Mr Mahmudjon waters his seedlings during the heat of the dry summer only once every 40 days, instead of every second week. With his planting technique, Mr Mahmudjon has brought down irrigation water requirements to about 30% of the commonly applied rate. This has more than compensated him for the extra effort when he planted the seedlings.

With the idea to further save time and labour, he recently constructed a simple rainwater harvesting structure, which will directly supply his reforestation site with irrigation water. His next ideas are to experiment with small drip irrigation equipment.

In Tajikistan all land formally belongs to the state and can only be leased. For his reforestation plot, Mr Mahmudjon currently holds an informal lease agreement with the local authorities. However, he is trying to get a forest farm certificate, which according to the current version of Tajikistan's Land Code, provides rights for 20 years, with the possibility for extension. There are more and more voices in Tajikistan urging the government to increase the duration of the first lease period in order to stimulate community based efforts for reforestation, such as Mr Mahmudjon's.

Innovation brings optimism

Through his efforts, Mr Mahmudjon has seen an amazing 95% survival rate of his seedlings up to now, and after three years, some of his plantings such as pomegranate already started to produce their first fruits. He plans to use part of the increased fruit production for family consumption, and to sell part of the harvest for a new and welcome cash income.

Mr Mahmudjon more than doubled the size of his reforestation plot, which today covers 1.25 hectares. Stimulated by this experience, six of his neighbours have set up additional reforestation plots on another four hectares of former wasteland. In addition, farmers from neighbouring villages have also started to establish reforestation sites, covering another 5 ha. And, they have identified more local possibilities to exploit organic waste material to restore degraded soils. Large amounts of cotton fibre from cotton processing factories, bark and sawdust from sawmills, and wastes from nearby markets are other freely available organic resources.

To spread these practices even further, there is a need to overcome doubts that degraded land can become productive once again. But Mr Mahmudjon is extremely optimistic that his results will convince people: "My reforestation plot shows that even wastelands with lots of stones and no connection to major irrigation facilities can be converted into something very useful."

All in all Mr Mahmudjon´s experience is a good example of how organic waste, instead of contributing to contamination, can support land and soil restoration. More integrated and efficient use of locally available resources offers huge potential for more productive use of degraded lands.

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Restoring our soils by learning from history

Most of our ideas about soils ignore the millions of years before mankind started farming. But what happened during the 99.9% of a soil's history contains very important lessons. So let us celebrate the International Year of Soils by looking at what that history can tell us – and build on those lessons for the future.

Roland Bunch

In the tropical world, fallowing kept farmers' soils fertile for thousands of years by providing 70 to 95% of their soil organic matter. But today, since most smallholder farmers possess less than 2 hectares of land, in a large part because of population growth, fallowing is in its death throes. As a result, the developing world is experiencing a severe soil organic matter crisis.

The soil organic matter crisis is critical because soils are being so rapidly damaged and depleted, because soil fertility has become the primary limiting factor for the world's smallholder farmers, and because restoring the soil is a 'foundational technology'. If a farmer adopts a new cassava variety, it may improve his or her cassava production, but it will do almost nothing for the farmer's maize, bean, vegetable or animal production. But if the farmer successfully improves her or his soil, it will have a major impact on everything else, too. Foundational technologies, such as soil restoration, can therefore provide the basis for the sustainable, long-term development of an entire farm.

Soil fertility has become the primary limiting factor for the world's smallholder farmers.

In Honduras, farmers experimenting with green manure cover crops produced over five times more maize when intercropping with mucuna.
Photo: Roland Bunch

Three myths Looking at soil history will debunk three commonly held myths about soil restoration. The first myth is that productive soils will inevitably deteriorate over time. For instance, in all long-term experiments carried out in Africa, even those including chemical fertilizer, decreasing fertility was found. This loss of fertility correlated with decreasing soil organic matter levels and the resulting availability of nutrients. But humid tropical forests the world over, by maintaining the soil organic matter content, have maintained impressively high levels of biomass productivity for millions of years, with no fertilizers and often on very infertile soils.

The second common belief to go out the window is that soils need to be ploughed to stay friable and productive. Tropical forest soils were never ploughed, yet after millions of years they are far more friable and naturally productive than most agricultural soils. In fact, family farmers who convert forest land rarely plough it during the first year. Doing so would be 'like ploughing the sea', as Simón Bolívar once remarked. Rarely do we need to plough land unless we have previously degraded it.

The third myth is that good modern farmers must use monocrops. But tropical forests maintain biodiversity and thereby increase soil quality *and* productivity. And the oft-repeated claim that phosphorus will limit productivity because of the phosphorus lost in grain harvests is based on seriously faulty nutrient assessment studies. Furthermore, crops grown with a biodiverse mulch will feed directly from the mulch, just as tropical forests do. In this situation, most phosphorus in annual crops spends 1-8 months in the mulch before being taken up by the crop, and after less than a year, will once again return to the mulch. In contrast, only 10% of chemical phosphorus applied to soils is used the first year, about 5% the second year, and less each year thereafter. Therefore, with a biodiverse mulch, each atom of phosphorus can produce about 15 times more biomass than it can from fertilizer.

A movement that transformed agriculture Interestingly, and not at all by chance, three of these lessons from history coincide with the three principles of the Conservation Agricul-

The three principles of Conservation Agriculture

Plough the soil as little as possible. This is also known as no-till, zero tillage or minimum tillage. This practice maintains soil structure, reduces damage to soil organisms, reduces soil losses to erosion, reduces loss of organic matter and nitrogen and saves labor and expenses. On the other hand, weed control will suffer without ploughing, and farmers using animal traction may need to start using new equipment.

Keep the soil covered. Mulching prevents erosion, provides a constant, well-balanced source of nutrients, protects the soil from the hot sun, greatly reduces soil moisture losses, and helps control weeds. The main problem in maintaining year-round soil cover is that crop residues are seldom sufficient.

Maintain biodiversity and use green manure/cover crops. In Conservation Agriculture, farmers use rotations and intercropping to maintain biodiversity. These practices reduce the risk of pests and diseases, support soil micro-organisms and use water and nutrients in the whole soil profile more effectively. An essential component of such a system are green manure/cover crops. These are defined as any plant, whether a tree, bush, vine or crawler, that fertilizes the soil or controls weeds. They include multi-purpose grain legumes and can often provide high-protein food for sale or consumption. Unlike traditional green manures, they are rarely cut down in the flowering stage and are rarely ploughed into the soil. They can thereby control the increased weed problem caused by lack of tillage and produce plenty of *in situ* biomass to keep the soil covered.

ture movement that began in Brazil in the early 1980s. These are (1) plough the soil as little as possible, (2) keep the soil covered, and (3) maintain biodiversity. In 35 years, this movement has transformed the agriculture of 3 million farmers on 30 million hectares in Brazil and Paraguay, and has spread to some 30 other nations. Farmers' yields have doubled or tripled, reaching up to eight tonnes per hectare of maize. Between 1992 and 2012, the same one litre of diesel came to produce seven times more grain. Over a 22-year period, Conservation Agriculture has resulted in soils with higher levels of organic matter and available nitrogen, phosphorus, potassium, calcium and magnesium, and with lower acidity. In the meantime, the per-hectare use of nitrogenous chemical fertilizer has fallen. In long term experiments, Conservation Agriculture produced a 64% increase in organic carbon in the top 10 cm of the soil. Needless to say, the world desperately needs more such successes.

Conservation Agriculture's increasing yields also show that we do not need to resort to subsidised chemical fertilizer – subsidies that are tremendously expensive. The current President of Zambia told me that with what the government spent on fertilizer subsidies in the last few years, they could have built a school in every village across the country. Furthermore, cheap fertilizer reduces the incentives of farmers to produce the biomass that will improve their soil in the long-term. That is, all this wasted money not only cannot solve the basic, underlying problem of soil depletion, instead, it makes it worse.

Legumes as green manure/cover crops

Green manure/cover crops are crucial. It is often said that nature can only produce a few centimetres of topsoil in 100 years, but experience in country after country has shown that farmers using green manure/cover crops can produce a centimetre of topsoil every three to four years. In fact, when using edible legume species, the value of the grain often exceeds the costs of production, so the net cost of restoring soil fertility over decades is actually negative. Chemical fertilizer will never compete with that price! But fertilizer *can* supplement green manure/cover crops. When smallholder soils reach a productivity of about 3 tonnes per hectare, fertilizers can be profitably used. At this level of soil productivity, the fertilizer will produce a greater yield response with lower risks.

Experience around the world shows that it takes about 20 to 25 tonnes per hectare per year (green weight) of leguminous biomass to maintain soil fertility over time. Never in 40 years have I heard of a smallholder farmer using 20 tonnes of fresh compost or animal manure each year. Most smallholder farmers don't have enough animals to produce this amount of manure, and composting requires too much labour to be cost effective for most subsistence crops. But dozens of legumes can produce double or triple this amount of biomass. Runner beans (*Phaseolus coccineus*) and mucuna (*Mucuna spp.*) can easily produce 70 tonnes per hectare per year, lablab beans (*Dolichos lablab*) and jackbeans (*Canavalia ensiformis*) 50 to 60 tonnes per hectare per year, and pigeon peas (*Cajanus cajan*), densely planted, can produce about 30 tonnes.

An estimated 25 000 people, between Mexico, Honduras, Guatemala and Belize, have been using mucuna as a green manure cover crop for over 50 years Photo: Roland Bunch

Dispersed shade

Some farmers are adding trees as 'dispersed shade' to their Conservation Agriculture. The trees' light shade reduces the excessive midday heat that decreases crop productivity in the lowland tropics. Trees are also extremely drought resistant because of their deep root systems; the fertilizing leaves are out of reach of free-grazing animals; trees preserve moisture in the soil through lowered soil surface temperatures and reduced wind velocity; and they can provide firewood and fodder. Furthermore, as climate change occurs, farmers can merely cut fewer branches off their trees, so the crops underneath will continue to enjoy optimum ambient temperatures. Two important species from tropical America and dryland Africa, respectively, are *Gliricidia sepium* and *Faidherbia albida*.

Interestingly, Conservation Agriculture with trees is ecologically about as close as one can get to producing food in a forest. In 35 years of intensive learning, we've travelled right back to where mankind started thousands of years ago.

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Members of the AgriCultures Network are working together to advance family farming and agroecology, drawing lessons from farmers' fields, sharing knowledge, and working with social movements for policy change. Here are some of our latest updates.

India: Kitchen gardens for improved nutrition

To contribute to better nutrition for family farmers, AME Foundation is working with women farmers in 20 villages in Dharmapuri, India. At the end of 2014, around 800 farming families without access to irrigation had established kitchen gardens, which provide improved nutrition and some income to the families. By recycling their available water, the women now grow healthy vegetables all year round, instead of only a few months a year. The initiative has also contributed to social bonding within and between families.

This is very significant considering farmers in the region are facing frequent crop failures and increased production costs. The situation is made worse because the region, suffers from acute water scarcity and degraded soils. J. Krishnan of AME Foundation tells us that, "With frequent crop failure, families and livestock are often deprived of important sources of protein. When we started our kitchen garden programme in 2010, we were hoping to improve this situation. And when we look back now and see the changes, we can say it has been a great success."

Initially, about 400 women established kitchen gardens with 13 types of vegetable seeds. They started getting good harvests of vegetables, which were used for consumption and for selling in the local markets. This caught the attention of others, and by the end of 2014 the idea had spread from village to village to 800 families.

With increased access to vegetables on a daily basis, these families save around Rs.2100 each month and no longer need to travel to the market. To overcome water shortages, women started reusing kitchen waste water, which amounted to 40-50 litres per day. J. Krishnan: "Importantly, these kitchen gardens have become a source of strengthened families and social bonding."

Brazil/Senegal: Agroecology for resilience in semi-arid regions

Farmers' knowledge and agroecological experiences are cornerstones of resilience. This was the main message coming from the international seminar, Building Agroeco-

logical Resilience in Semi-arid Regions, which took place in Campina Grande in Brazil, 21-23 January, 2015. The seminar followed two days of field visits to agroecological initiatives, and attracted a few hundred farmers, researchers, activists and policy makers. The AgriCultures Network supported the seminar and network members from AS-PTA (Brazil) and IED Afrique (Senegal) attended.

Speaking at the seminar, Souleymane Cissé of IED Afrique emphasised that climate change and droughts are responsible for degradation of 67% of land in the Sahel, where 60% of the food is produced by family farmers. This impacts food security, with 16 million malnourished people in the region. However, Souleymane pointed out that "the revival of traditional agroecological practices has contributed to reversing the situation of hunger and malnutrition, and also to reducing migration of young people from rural areas to European countries." Although agroecology is relatively unknown in Africa as compared to Brazil, he notes that it is making advances both in practice and in policy.

Paulo Petersen of AS-PTA asserted that: "Access to land must be democratised and public policies reoriented, so that the experience of family farmers who manage to successfully live with semi-arid conditions can be multiplied, broadened and consolidated."

The outcomes of the seminar will feed into Brazil's second National Plan for Agroecology and Organic Production and in the country's position for the United Nations conference on desertification in Cancún.

Mali: Social movements define agroecology

At the end of February, around 300 peasants, fisher folk, pastoralists and indigenous peoples from all continents gathered in the town of Sélingué in Mali with the aim to articulate their vision of agroecology. The forum came at the right moment, as the term agroecology is becoming increasingly popular, but may also be used for purposes that go against the interests of small scale food producers. Janneke Bruil of ILEIA took part in the documentation team of the Forum. At the end of the event, a declaration was drafted that states that "As smallholders, we defend our dignity when we choose to produce in an agroecological way. (…) The dialogue of our various forms of knowledge is based on respectful listening and on the collective construction of shared decisions. (…) Policy makers must respect and support our agroecological processes rather than continuing to support the forces that destroy us. We call on our fellow peoples to join us in the collective task of collectively constructing agroecology as part of our popular struggles to build a better world, a world based on mutual respect, social justice, equity, solidarity and harmony with our Mother Earth."

The full declaration and more news can be found at *www.agriculturesnetwork.org*

COLOPHON

Farming Matters
Experiences in family farming and agroecology

Farming Matters is published quarterly by ILEIA

www.farmingmatters.org

ileia
Centre for learning on sustainable agriculture

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Subscriptions
Subscription rate for one year (four issues): organisations € 45,- individuals € 15,-.
Online subscriptions are free. Subscribe at www.farmingmatters.org

The AgriCultures Network
ILEIA is a member of the AgriCultures Network; six organisations that provide information on agroecology and family farming worldwide, and that publish: LEISA revista de agroecología (Latin America in Spanish), LEISA India (in English, Hindi, Kannada, Marathi, Oriya, Punjabi, Tamil, Telugu), AGRIDAPE (West Africa, in French), Agriculturas, Experiências em Agroecologia (Brazil , in Portuguese)), 可持续农业 (China , in Mandarin).

Layout
Yvonne Dijkshoorn - Twin Media bv, Culemborg, the Netherlands

Printing
Koninklijke BDU Grafisch Bedrijf B.V., Barneveld, the Netherlands.

Funding
ILEIA is grateful for the support of Sida, the Swedish International Development Cooperation Agency.

Cover photo
Taken in Nicaragua by Sara Delaney.

Volume 31.1
ISSN: 2210-6499

"BUILDING UP SOIL ORGANIC MATTER IS A WIN-WIN SITUATION FOR THE FIGHT AGAINST CLIMATE CHANGE AS WELL AS SOIL HEALTH AND CROP YIELDS"

Jonathan Smith, page 10

"Young people should be introduced to innovative, environmentally friendly and sustainable practices, fusing traditional and local solutions to cure our ailing soils."

Rita Uwaka, page 9

"I am saving about US$100 each year by not buying agrochemicals. And I have seen my land transformed for the good of my family and my community"

Moises de Jesus Garcia Chavez, page 22

"IT IS MY HOPE THAT THE INTERNATIONAL YEAR OF SOILS WILL FOSTER A TRUE DIALOGUE OF WISDOMS, BRINGING FARMER KNOWLEDGE AND SCIENTIFIC KNOWLEDGE CLOSER TOGETHER AGAIN"

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Farming Matters is published by ILEIA, the centre for learning on sustainable agriculture. ILEIA is a member of the AgriCultures Network, a global network of organisations that shares knowledge on agroecology and family farming.
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