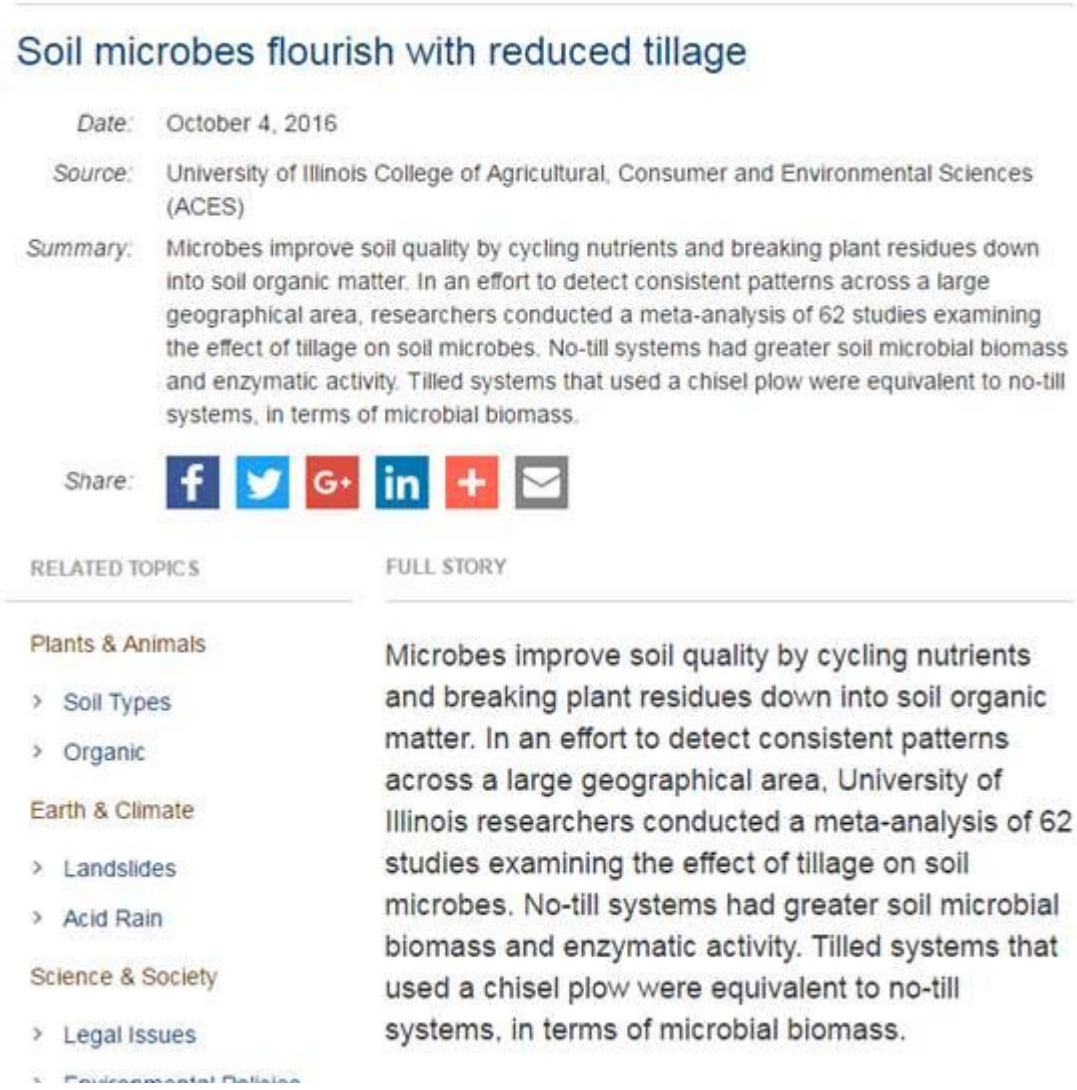
HI Everyone,

Sorry about the delay in getting this CoP daily digest out – we are under temporary new management. Brian will return end of November.

In this edition, there are pieces on carbon storage, archaeology, soil teacher guides, biochar, salinity and fracking, infographics, soil as art and more.



Soil microbes flourish with reduced tillage

Date: October 4, 2016

Source: University of Illinois College of Agricultural, Consumer and Environmental Sciences (ACES)

Summary: Microbes improve soil quality by cycling nutrients and breaking plant residues down into soil organic matter. In an effort to detect consistent patterns across a large geographical area, researchers conducted a meta-analysis of 62 studies examining the effect of tillage on soil microbes. No-till systems had greater soil microbial biomass and enzymatic activity. Tilled systems that used a chisel plow were equivalent to no-till systems, in terms of microbial biomass.

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- Acid Rain

Science & Society
- Legal Issues

FULL STORY

Microbes improve soil quality by cycling nutrients and breaking plant residues down into soil organic matter. In an effort to detect consistent patterns across a large geographical area, University of Illinois researchers conducted a meta-analysis of 62 studies examining the effect of tillage on soil microbes. No-till systems had greater soil microbial biomass and enzymatic activity. Tilled systems that used a chisel plow were equivalent to no-till systems, in terms of microbial biomass.

https://www.sciencedaily.com/releases/2016/10/161004125836.htm

TRADING FARMLAND FOR NITROGEN PROTECTION

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By Adityarup "Rup" Chakravorty

Excess nitrogen from agricultural runoff can enter surface waters with devastating effects. Algal blooms and fish kills are a just a couple of possible consequences. But riparian buffer zones – areas of grasses, perennials, or trees – between farmlands and streams or rivers can help.

"Riparian buffer zones are nature's hydraulic shock absorbers," says Deanna Osmond, a soil scientist at North Carolina State University. They can reduce pollution and provide habitat for wildlife. Trees can hold stream banks together and provide food for animals. These buffer zones can also dampen the flow of agricultural runoff. This can lead to lower amounts of nitrogen reaching streams and rivers.

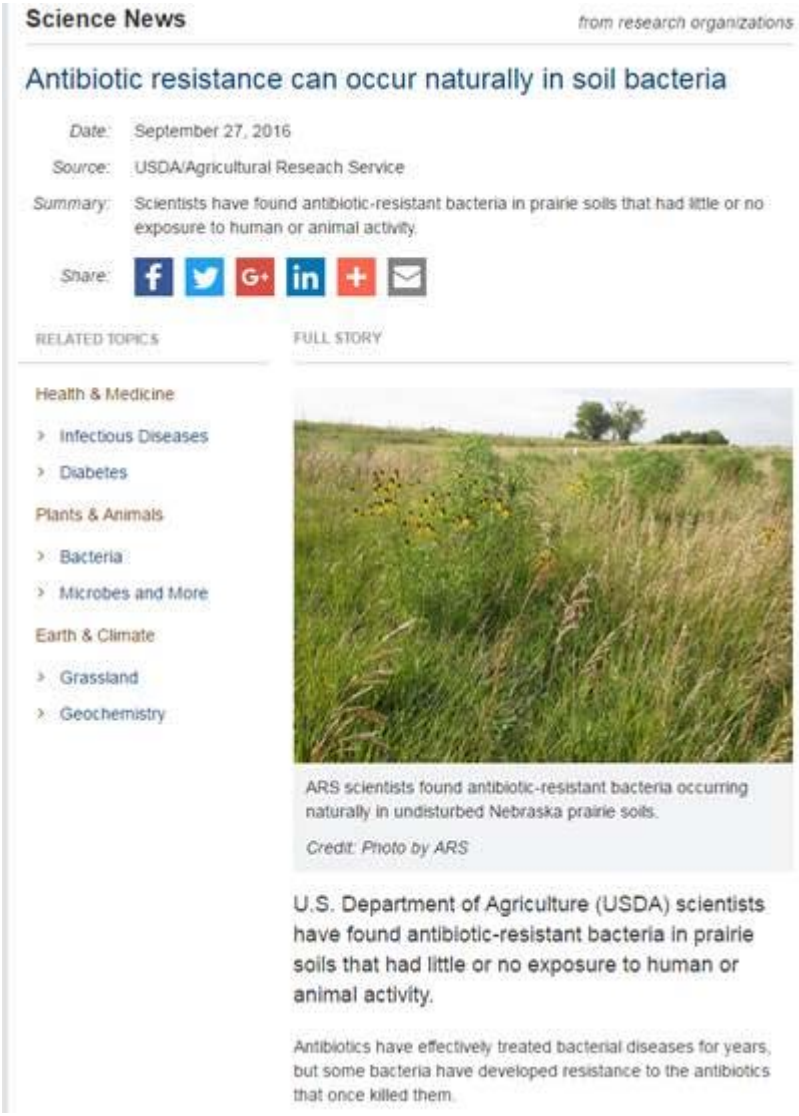
But what kind of vegetation makes buffer zones most efficient at removing nitrogen from runoff? That is the question that Osmond and her colleagues set out to answer.

Their recent study showed that – at least for some areas – it doesn't matter what kind of vegetation buffer zones are made up of. There appeared to be no significant differences in how efficiently they removed nitrogen from agricultural runoff.

Irrespective of vegetation type, wider buffer zones were more effective than narrower ones. It is important to consider the width of buffers, says Osmond. "There is a trade-off between productive farmlands and buffer zones." Farmers cannot grow crops in buffer zones.

View of trees and switchgrass buffer plots from the field. The tubes in front are for sampling ground water depth. Photo credit Wes Childress

https://www.soils.org/discover-soils/trading-farmland-nitrogen-protection



Science News *from research organizations*

Antibiotic resistance can occur naturally in soil bacteria

Date: September 27, 2016

Source: USDA/Agricultural Reseach Service

Summary: Scientists have found antibiotic-resistant bacteria in prairie soils that had little or no exposure to human or animal activity.

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Health & Medicine
- Infectious Diseases
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- Geochemistry

FULL STORY

ARS scientists found antibiotic-resistant bacteria occurring naturally in undisturbed Nebraska prairie soils.

Credit: Photo by ARS

U.S. Department of Agriculture (USDA) scientists have found antibiotic-resistant bacteria in prairie soils that had little or no exposure to human or animal activity.

Antibiotics have effectively treated bacterial diseases for years, but some bacteria have developed resistance to the antibiotics that once killed them.

https://www.sciencedaily.com/releases/2016/09/160927151524.htm

Earthquake risk: New fault discovered in earthquake-prone Southern California region

Date: October 4, 2016

Source: Scripps Institution of Oceanography

Summary: A swarm of nearly 200 small earthquakes that shook Southern California residents in the Salton Sea area last week raised concerns they might trigger a larger earthquake on the southern San Andreas Fault. At the same time, scientists published their recent discovery of a potentially significant fault that lies along the eastern edge of the Salton Sea.

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FULL STORY

https://www.sciencedaily.com/releases/2016/10/161004135207.htm

Horticulture hub for robot research could bear fruit within a couple of years, even in internet blackspots

ABC Rural By Anna Vidot

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Posted Thu at 1:58pm

PHOTO: Robots could help fruit and vegetable farmers monitor, manage and eventually harvest their crops.
(Supplied: Horticulture Innovation Australia)

Robotics researchers say they are specifically designing technology that will work for farmers, even if internet and mobile phones do not.

MAP: Sydney 2000

The University of Sydney's Australian Centre for Field Robotics has been running trials of agricultural robots for some time, and said the first commercially available tech could be available for early-adopter farmers within a couple of years.

http://www.abc.net.au/news/2016-10-06/horticulture-innovation-funds-establish-robot-research-hub/7908502

Rain enthusiast calls on fellow catchers to join Australia-wide network and fill data gaps

ABC Rural By Danielle Grindlay

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Updated yesterday at 6:14pm

Severe flooding has prompted an American climatologist to call on tens of thousands of volunteer rain catchers, in a bid to fill forecast gaps back in 1997.

And a consultant in western Victoria is hoping recent flooding on home soil will prompt a surge of followers to replicate the program.

Hamilton's Brad Henderson envisions a centralised website that collates and maps rainfall tipped from basic gauges spread across Australia.

At this stage he has just 20 volunteers, which is not far behind what Colorado's Nolan Doesken had when he embarked on the same project nearly 20 years ago.

Today the Community Collaborative Rain, Hail and Snow — or CoCoRAHs — network compiles data from 20,000 volunteers spread across all 50 of the United States.

'Rain doesn't fall the same'

CoCoRAHs is based on the understanding that "rain doesn't fall the same on all" and volunteers provide localised data that often greatly differs to that of official gauges positioned just kilometres away.

Mr Doesken's was compelled to create the network after flash flooding caused five fatalities and "hundreds of millions of dollars" worth of damage in Fort Collins.

PHOTO: Hamilton consultant Brad Henderson is hoping to create a nation-wide network of rain catchers. (Danielle Grindlay)

MAP: Hamilton 3300

00:00 00:00

AUDIO: Nolan Doesken, who created a network of 20,000 volunteer rain catchers in the US, says Australia has the capacity to do the same. (ABC Rural)

http://www.abc.net.au/news/2016-10-06/rain-weather-flood-drought-cocorahs-network/7909372

Ord Stage 3 a pie in the sky project that is going nowhere says Northern Land Council boss

ABC Rural By Matt Brann

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Updated yesterday at 4:24pm

PHOTO: Joe Morrison says Aboriginal people have been treated like pawns in the rush to expand the Ord. (Matt Brann)

The Northern Land Council chief executive Joe Morrison says the plan to expand the Ord Irrigation Scheme into the Northern Territory is a "pie in the sky" project, which "is going nowhere".

Delivering this year's Nugget Coombs Memorial Lecture in Darwin, Mr Morrison gave a scathing review of the Ord Stage 3 proposal.

RELATED STORY: NT Government unveils new plan for developing Ord Stage 3

RELATED STORY: Land in the Northern Territory earmarked for Ord expansion

RELATED STORY: Lack of scale crushing KAI's sugar dream

MAP: Kununurra 6743

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http://www.abc.net.au/news/2016-10-06/ord-stage-three-going-nowhere-says-nlc-joe-morrison/7908620

Our best shot at cooling the planet might be right under our feet

Jason Hickel

Studies suggest that regenerating soil by turning our backs on industrial farming holds the key to tackling climate change

Cracked soil by a village in Iran abandoned by farmers because water reserves ran dry due to overuse. Photograph: Atta Kenare/AFP/Getty Images

It's getting hot out there. Every one of the past 14 months has broken the global temperature record. Ice cover in the Arctic sea just hit a new low, at 525,000 square miles less than normal. And apparently we're not doing much to stop it: according to Professor Kevin Anderson, one of Britain's leading climate scientists, we've already blown our chances of keeping global warming below the "safe" threshold of 1.5 degrees.

https://www.theguardian.com/global-development-professionals-network/2016/sep/10/soil-our-best-shot-at-cooling-the-planet-might-be-right-under-our-feet

Soil carbon storage not the climate change fix it was thought, research finds

Soil's potential to soak up planet-warming carbon dioxide has been overestimated by as much as 40%, say scientists

Scientists have found that a large amount of the greenhouse gas that it was previously thought could be stored in the soil will actually stay in the atmosphere. Photograph: Bullit Marquez/AP

Hopes that large amounts of planet-warming carbon dioxide could be buried in soils appear to be grossly misplaced, with new research finding that the ground will soak up far less carbon over the coming century than previously thought.

Radiocarbon dating of soils, when combined with previous models of carbon uptake, has shown the widely assumed potential for carbon sequestration to combat climate change has been overestimated by as much as 40%.

Scientists from the University of California, Irvine (UCI) found that models used by the UN's Intergovernmental Panel on Climate Change (IPCC) assume a much

https://www.theguardian.com/environment/2016/sep/22/soil-carbon-storage-not-the-climate-change-fix-it-was-thought-research-finds

Greener pastures: the dairy farmers committed to sustainability

Biological farming, conservation planning and water recycling are part of a concerted push to make the milk industry more 'carbon confident'

A Victorian dairy herd. Dairy farmers have set a national target to reduce industry greenhouse emissions by 30% by 2020. Photograph: Reuters

It was a soil bacteria course in New Zealand that convinced Reggie Davis to change his farming methods.

The fourth-generation Victorian dairy farmer had become increasingly concerned by the costs, chemicals and time involved in the use of nitrate fertilisers to maintain - what was considered to be - high-quality pasture for his dairy herd.

"I've always regarded myself as a progressive farmer, open to new ideas," he says.

https://www.theguardian.com/sustainable-business/2016/sep/23/greener-pastures-the-dairy-farmers-committed-to-sustainability

Salt's secret success in ancient Chaco Canyon

October 3, 2016 by Melanie Scheffl

Broken-rock ruins of a Great House showing a diversity of architecture in Chaco Canyon, New Mexico. Credit: University of Cincinnati

A team of University of Cincinnati researchers had to go deep to uncover brand new knowledge that they say will "shake up" the archaeological field in the southwestern United States.

http://phys.org/news/2016-10-salt-secret-success-ancient-chaco.html

Biochar improves crop growth and climate

October 3, 2016

Biochar has a positive impact on soil nutrient cycles resulting in marked increases in yield as a project funded by the FWF could show. Credit: Rebecca Hood-Nowotny

http://phys.org/news/2016-10-biochar-crop-growth-climate.html

Researchers explore possibilities of growing plants on Mars

October 3, 2016

Researchers at Florida Institute of Technology grew Outredgeous lettuce in a preliminary experiment comparing, from left to right, potting soil, Martian regolith simulant with added nutrients, and simulant without nutrients. Credit: NASA/Dimitri Gerondidakis.

http://phys.org/news/2016-10-explore-possibilities-mars.html

SOLUTION BLOOMING FOR FRACKING SPILLS?

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By Adityarup "Rup" Chakravorty

North Dakota's oil boom can have a salty side-effect. Wastewater from oil drilling and hydraulic fracturing – or fracking – is often laden with salts and can spill, contaminating soils. In 2014, for example, 42 such brine spills per week, on average, were recorded in North Dakota.

Brine spills introduce so much salt into the soil that local vegetation cannot survive. The salts stay around for decades, even centuries. That prevents growth of plants, putting valuable land out of production.

In a recent study, researchers at North Dakota State University tested a method that extracted a large percentage of the salt present in soils contaminated by brine spills.

Researchers applied a chemical – ferric hexacyanoferrate – to samples of brine-contaminated soils in the laboratory. After seven days, 29-57% of the salts were pulled to the surface for easier removal, depending on the type of soil being tested.

The salt crystals formed on the soil surfaces "were high in water content and very easy to remove," says Aaron Daigh, one of the researchers. This technique still needs to be field-tested, but shows promise as a quick and simple way to clean up salt-contaminated soils.

"The traditional methods used to remove salt from soils contaminated by brine spills either take too long or involve removing the soil itself," says Daigh. Excavating contaminated soil and moving it to designated areas only relocates the problem. Salts remain in those soils.

A 50-year-old saltwater (brine) spill in North Dakota leaves the soil bare of plants due to the high amount of salts in the soil. Brine spills can occur on or off oil well pads causing damage to equipment and taking portions of land out of agricultural production. Photo credit Aaron Klaustermeier.

Other methods attempt to push the salts below the level plant roots can reach. But that's often a temporary fix. The salts can dissolve in groundwater and move back up through the soil.

https://www.soils.org/disdcover-soils/story/solution-blooming-fracking-spills

INTERSECTION OF SOIL HEALTH, PRODUCTION

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By Rossie Izlar

Plant scientist Ann Bybee-Finley says her first field experiment was humbling. "I felt like a very small scientist in a very big world," she said.

Bybee-Finley researches intercropping at Cornell University. Intercropping is a complex practice of farming where different plant species are grown in the same space. Most conventional farmers only plant one crop per field or plot. This practice, called monoculture farming, is more convenient for farmers, but it can make the plants more vulnerable. For example, if one plant gets a disease, the others are likely to catch it. Weeds are more likely to find a home in spaces that are very similar. As a result, monoculture farming can be dependent on expensive synthetic chemicals to ward off weeds and diseases.

Examining the field site as the sun was setting for the next day's harvest halfway through the growing season. Most farming is monoculture, in which each plot is one type of plant. Intercropping, or planting multiple species together, provides a backup for farmers if one crop fails because of disease, pests, or weather. Photo credit Chris Pelzer.

Droughts and other weather events can also damage entire monoculture fields. Bybee-Finley says a bad drought in 2012 shaped her vision of agriculture. "The stories of crop failure made me want to understand how to make farming practices more resilient, especially as climate change makes extreme weather events more frequent."

https://www.soils.org/discover-soils/story/intersection-soil-health-production

ORGANIC PANIC: FINDING THE RIGHT COMBINATION

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By Danielle St. Louis

Organic vegetables are popular. However, growing them is notoriously high-maintenance for farmers. Researchers are trying to identify the best ways to grow these crops in order to keep the shelves stocked.

Growing organic vegetables is labor intensive, says Craig Cogger. Cogger is a researcher for the Department of Crop and Soil Sciences at Washington State University. "Weed management, amendment choice, and cover crop management are particularly challenging when growing vegetables in an organic system," he explains.

Andrew Lawson cultivating lettuce at the WSU Puyallup Long Term Organic Farming Systems Research and Demonstration Site. Photo credit Doug Collins

Farmers have been using a mix-and-match approach to practices for growing their organic veggies. Which combination of practices was best, however, was uncertain.

Cogger and colleagues studied twelve different combinations of practices over the course of ten years to see what worked best. Their study included three types of cropping systems. One system planted a fall cover crop, another used a relay-planted cover crop, and the third system was a short-term grazed pasture. Two types of amendments were included in the study. Amendments are additions of organic materials to the soil to improve the soil's condition. One amendment was a compost mixture of

https://www.soils.org/discover-soils/story/organic-panic-finding-right-combination

This has been out for a little while now – but for those who haven't seen it yet…http://www.soilsinschools.com.au/

2015 International Year of Soils

SOILS ARE THE FOUNDATION FOR VEGETATION

Fertile soil supports plant growth by providing plants with nutrients, acting as a water holding tank, and serving as the substrate to which plants anchor their roots.

Vegetation, tree cover and forests prevent soil degradation and desertification by stabilizing the soil, maintaining water and nutrient cycling, and reducing water and wind erosion.

SOILS AND CROPS

Food security and nutrition rely on healthy soils.

The nutrient content of a plant's tissues is directly related to the nutrient content of the soil and its ability to exchange nutrients and water with the plant's roots.

Nutrient depletion takes place in intensive agricultural systems and is linked to the practice of monoculture.

Crop rotation is critical to preserving and eventually improving soil health.

Crops protect soil against soil erosion agents (e.g. water and wind) and improve soil structure by:

- **rooting**
- **enriching soil nutrients** by providing organic matter
- establishing **symbiotic relationships** with soil bacteria

SOILS AND PASTURE

Grasses found on pasturelands protect the soil against soil erosion and support soil biological activities.

The **livestock sector** provides food and income for **1 billion** of the world's poor.

26% of the earth's terrestrial surface is occupied by grazing

Grazing and overgrazing remove the soil cover, fostering soil erosion and reducing important soil functions such as climate regulation.

Grass type and pasture rotation help keep the soil system functional.

As global demand for meat and dairy products continues to rise, soil protection and conservation on pasturelands becomes even more critical.

SOILS AND FORESTS

Forests provide livelihoods for more than a **1 billion** people and are vital for conservation of biodiversity, energy supply, and soil and water protection.

Nearly **1/3** of the total carbon in terrestrial ecosystems is captured in forests.

The use of solid biofuels, including wood, is predicted to grow, along with the expansion of agricultural lands **putting at risk the capacity of forest soils to act as carbon sinks in the future.**

As a result of the conversion of forests and native grasslands to croplands,

the soil's capacity to act as a carbon sink can decrease by **20-40%**

Sustainable soil management is important to address the growing food demand caused by population growth.

fao.org/soils-2015

Food and Agriculture Organization of the United Nations

#IYS2015

2015 International Year of Soils

SOILS STORE AND FILTER WATER

Soils improve food security and our resilience to floods and droughts

Healthy soils with a high organic matter content can **store large amounts of water.** This is crucial for maintaining food production while also improving resilience to floods and droughts.

What is soil moisture?

Soil moisture content is the amount of water in the soil (by weight).

The maximum amount of water that a soil can retain depends on:

- the soil's **texture** and **structure**
- **organic matter** content
- **rooting** depth

×20

Soil organic matter **can retain about 20 times its weight in water.**

Soil moisture and food security

Water is the "lifeblood" of agriculture — improved soil moisture management is **critical for sustainable food production.**

Inhibiting a soil's capacity to accept, retain, release and transmit water **reduces its productivity.**

The great challenge for the future will be increasing food production with less water.

As most smallholder farmers in developing countries rely on rain-fed **agriculture,** improved soil moisture optimization and management is crucial.

Over cultivation, overgrazing and deforestation strain soil and water resources by reducing topsoil and vegetation cover, and **lead to dependence on irrigated cropping.**

Meeting food security targets requires sustainable agricultural policies that ensure improved soil quality and water retention.

Improving soil moisture

Many sustainable agricultural and land management practices can improve soil moisture retention:

- Residue covers, cover crops and mulching
- Conservation agriculture
- Knowledge-based precision irrigation
- Conservation tillage
- Capture of runoff from adjacent lands
- Zero-tillage
- Rainwater harvesting

Efficient use of water, reduced use of pesticides and improvements in soil health **can lead to average crop yield increases of 79%**

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SOILS HELP TO COMBAT AND ADAPT TO CLIMATE CHANGE

Healthy soils provide the largest store of terrestrial carbon.

Poorly managed soils

If soils are managed poorly or cultivated through unsustainable agricultural practices, soil carbon can be released into the atmosphere in the form of carbon dioxide (CO_2), which can contribute to climate change.

Climate change represents a serious threat to global food security.

The steady conversion of grassland and forestland to cropland and grazing lands has resulted in **historic losses of soil carbon worldwide.**

10% CO_2

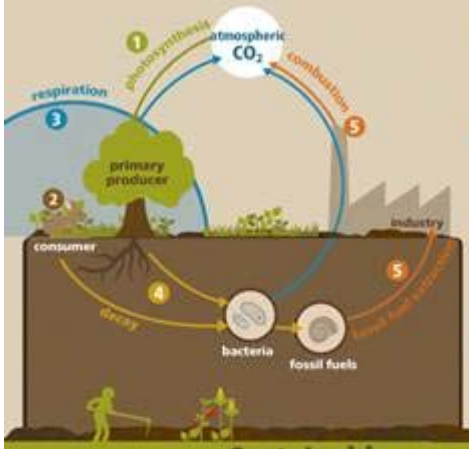
Land-use conversions and drainage of organic soils for cultivation are responsible for about **10% of all greenhouse gas emissions.**

Greenhouse gas emissions from agriculture, forestry and fisheries **have nearly doubled over the past 50 years.**

Without greater efforts to reduce them, **they could increase an additional 30% by 2050.**

Soils and the Carbon Cycle

The carbon cycle is the exchange of carbon (in various forms, e.g., carbon dioxide) between the atmosphere, ocean, terrestrial biosphere and geological deposits.



1. Plants use CO_2 from the atmosphere, water from the soil and sunlight to make their own food and grow in a process called **photosynthesis**. The carbon they absorb from the air becomes part of the plant.
2. **Animals** that feed on the plants pass the carbon compounds along the food chain.
3. Most of the carbon the animals consume is converted into CO_2 as they breathe (**respiration**), and is released back into the atmosphere.
4. When the animals and plants die, the dead organisms are eaten by decomposers in the soil (bacteria and fungi) and the carbon in their bodies is again returned to the atmosphere as CO_2.
5. In some cases, the dead plants and animals are buried and turn into **fossil fuels**, such as coal and oil, over millions of years. Humans burn fossil fuels to create energy, which sends most of the carbon back into the atmosphere in the form of CO_2.

Sustainably managed soils

When managed sustainably soils can play an important role in climate change mitigation through carbon sequestration (C) and by decreasing greenhouse gas emissions in the atmosphere.

By restoring degraded soils and adopting soil conservation practices...

...there is major potential to **decrease the emission of greenhouse gases from agriculture, enhance carbon sequestration and build resilience** to climate change.

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INTRODUCTION TO LET'S GET DIRTY

Let's Get Dirty is an Art in Soil initiative by the Queensland Branch of Soil Science Australia informed by the arts industry. Both art and science are carried out as cultural acts valuing their environments and creativity, harnessing sense, and seeking to provide change via abstract models of our world. Let's Get Dirty will follow numerous Artists' journeys over a six month period creating a piece of art inspired by soil. The Let's Get Dirty theme has a playfulness and cheekiness, inviting people to become curios and explore the world of soils. Dirt is often associated with negative experiences, but this couldn't be more wrong; without dirt, there would not be life. In this way we are reclaiming the notion of 'dirty' as a positive one for all society.

So, come on: "Let's Get Dirty"!

http://www.artinsoil.org/

Amazing soil murals

https://www.facebook.com/exploristscience/videos/985762944855235/

So appropriately the quote to end this CoP edition is .

“Land really is the best art.”– Andy Warhol