2015

IMPACT REPORT Q2

SECOND QUARTER

People,

Place,

Promise

College of Tropical Agriculture and Human Resources

University of Hawai'i at Mānoa

The founding college of the University of Hawai'i, established 1907

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People, Place, Promise

Grounded

"Around 95% of the world's food is grown in the soil, and it is estimated that a quarter of the earth's biodiversity is contained within it."

The United Nations has declared 2015 the International Year of Soils, calling the soil a "silent ally" and an "almost forgotten resource" in matters of food security, resilience to climate change, watershed and erosion management, and a host of other pressing concerns. Around 95% of the world's food is grown in the soil, and it is estimated that a quarter of the earth's biodiversity is contained within it.

CTAHR has long understood the importance of the soil both in Hawai'i and throughout the world; it is the focus of a variety of research, education, and outreach in the College. Specialists and researchers are highlighting the importance of building up soil with sustainable agricultural practices and demonstrating to community partners the ways to best do it. The Hawai'i Soil Atlas maps the areas of every one of the diverse soil types in the Islands, offering important information for builders, planners, and growers. A recent PhD graduate in Natural Resources and Environmental Management is bringing soil-conservation practices like cover-cropping and no-till systems to her native India. And both home and commercial growers benefit from the personalized soil nutrient and chemical analyses offered by the Agricultural Diagnostic Services Center.

Keeping our soil healthy and productive is critical for agriculture, the environment, and all of us—and so is the work done by the College to maintain and improve soil quality.

Aloha,

Maria Gallo

Maria Gallo, Ph.D.
Dean and Director for Research and Cooperative Extension

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Digging for Answers

What's in your ground? Representative areas for the various soil types have been generally established, and knowing them is an important first step. But there's so much more to learn about any individual plot of soil: does it harbor fungi, viruses, or other pathogens? Has it been tainted by chemicals, such as pesticide residues or gasoline spills? Is there a high buildup of salt? What is its nutrient content, and what should be added to nourish what will be planted there?

CTAHR's Agricultural Diagnostic Service Center (ADSC) research staff conduct chemical analyses of soils, plant tissue, and water and nutrient solutions, and then give recommendations about the conditions they've discovered. They receive around 25 requests and questions a week from home gardeners and commercial farmers, estimates Raymond Uchida, O'ahu County administrator and the director of ADSC. The office also provides workshops and other training, including a recent briefing for managers of a popular home and garden chain on the importance of soil analysis.

ADSC processes approximately 2,000–2,500 soil analyses per year.

Since analyses are performed on a small sample of soil from an entire garden or field, the sample must be representative. Home gardeners should gather a composite sample made up of 5–10 subsamples per 100 sq. ft., collected over the entire planting area. One-inch-thick slices of the soil, cut 4–8 inches deep, are mixed well in a bucket, and 2 cups' worth is removed for the sample. It can be dropped off at the nearest county Extension office, at the Pearl City Urban Garden Center, or at the ADSC office on the UH Manoa campus. Also necessary is the soil sample information form appended to this CTAHR publication, which also provides more detailed instructions about collecting the sample: www.ctahr.hawaii.edu/oc/freepubs/pdf/SCM-9.pdf.

Mr. Uchida suggests that at the very least, gardeners should buy a kit from a garden store to determine soil pH—that's the most important information. But the ADSC's full analyses and recommendations are well worth getting: they can help growers enhance yields, more efficiently utilize resources, save money, and preserve the environment. Commercial taro growers, for example, learned they could reduce the amount of nitrogen they added to their lo'i by 25%, increasing profits and improving the surrounding soil quality. Isn't it time to do a little digging?

The ADSC staff: Desmond Ogata, Ray Uchida, Sharon Yee, Sonia Campbell, Julana Abe, and Robert Huang.

Where the Soils Are

You may never have heard of a mollisol or a dystric inceptisol or be able to tell one from the other, but these and other soil types are literally the basis of all life, in the Islands and beyond. It's vital to understand what soil you're dealing with and what its characteristics are, whether you're growing an orchard, digging a fishpond, or building a road or house. Varying physical, chemical, and biological properties mean different soils perform differently; they're suited to specific uses and require specific management. Jonathan Deenik's Hawai'i Soil Atlas gives growers, builders, and other interested professionals and community members this information, and more.

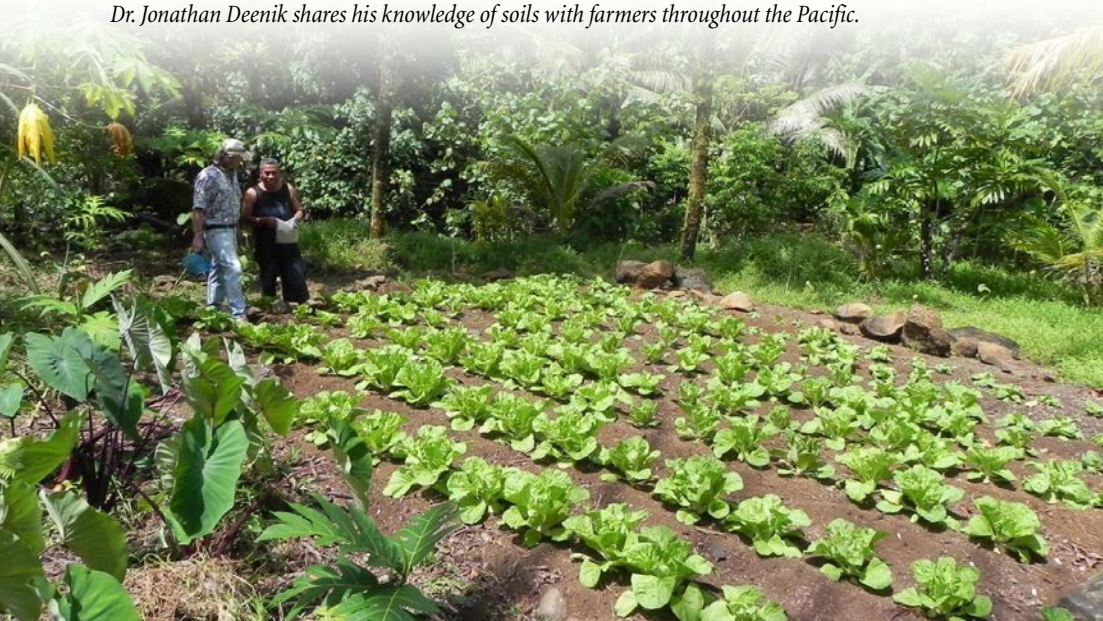
Dr. Jonathan Deenik taking a forest soil sample.

Despite their small total landmass, the Hawaiian Islands have tremendous diversity in soil types—57 on the island of Kaua'i alone! Soil-forming factors such as climate, topography, biota, and parent material can vary dramatically over small distances: soils formed on the dry leeward coastal plains differ from those in the wet upland forests or those formed from recent lava flows or volcanic ash deposits. The Interactive Soil Map portion of the Atlas makes such distinctions clear. Here's the link to the Interactive Soil Map: http://gis.ctahr.hawaii.edu/SoilAtlas#map.

Dr. Deenik, a specialist in the Department of Tropical Plant and Soil Sciences, worked with Joshua Silva, a recent MS graduate from TPSS, associate professor Tomoaki Miura, researcher Russell Yost, and IT technicians Nathan Dorman and William Connor to create the Soil Map, which allows users to locate, identify, and learn about any soil in the Hawaiian Islands. It condenses key data from the USDA NRCS Hawaii Soil Survey into a language and format understandable to a wide audience. Scrolling over a map or typing in an area name, users get concise descriptions of Hawai'i's 297 different soil and land cover types, with general information on topographic location and climate and more detail on soil attributes like water retention, fertility, acidity/alkalinity, organic matter, and physical structure.

The Atlas also includes essential plant nutrients and properties related to soil productivity, including target levels to enable diagnosis of nutrient sufficiency/deficiency. There are supplemental maps showing additional characteristics such as soil shrink–swell potential, a glossary, and further resources. In short, it's a one-stop guide to what's beneath your feet—one that may well make you rethink just what you're walking all over.

Dr. Jonathan Deenik shares his knowledge of soils with farmers throughout the Pacific.



Sustaining Soil, Sustaining Lives

What grows—or won't grow—in the soil, and why, is at the heart of natural resource and environmental management (NREM). Travis Idol, associate professor in NREM, focuses on nutrient cycling, conservation agriculture, and sustainable intensification, making him the ideal advisor for Aliza Pradhan in her research into the increasing problem of low crop yield due to poor soil fertility and erosion in the rain-fed uplands of her native Odisha, India.

Dr. Pradhan, who earned her PhD in May 2015 and has returned to India to continue her research, theorized that more sustainable conservation agriculture production systems (CAPS) would help to maintain soil quality, improving crop production as well as farmers' livelihood. However, since the benefits of conservation agriculture may take a decade to fully manifest, she needed to identify shorter-term indicators to show whether the system was improving.

Dr. Travis Idol (second from right) with other SMARTS team members visiting CAPS trials.

Many Odisha farmers grow maize in single-crop systems using conventional tillage—repeatedly weeding, hoeing, and otherwise disturbing the soil. But recent research shows when soil is left as undisturbed as possible, erosion is reduced and soil nutrients conserved. Reduced tillage is an important CAPS practice, as is intercropping—growing compatible plants together instead of a single crop—and cover cropping, growing plants between crop cycles that enrich the soil and keep it from washing away.

Dr. Pradhan adapted CAPS practices to traditional Indian systems at a research station in Odisha over three years. She assessed the soil's physical, chemical, and biological properties and processes, showing that reduced tillage, cowpea–maize intercropping, and cover-cropping with mustard—also an important Indian seasoning—not only improved soil quality; it increased system productivity by 124% and net benefits to farmers by 204% over traditional systems. And the longer the new systems continued, the greater their benefits.

Because the yield and income improvements were so striking, and because Dr. Pradhan used variations on familiar crops and technologies, she believes such CAPS should be acceptable and attractive for smallholder farmers in the area. Not only that, but using these systems creates a better soil environment for agricultural sustainability, allowing them to sustainably intensify crop production to meet increased future household income and nutritional needs.

The research was funded by USAID and Feed the Future Innovation Lab for Collaborative Research on Sustainable Agriculture and Natural Resource Management (SANREM) through a University of Hawai'i and Orissa University of Agriculture & Technology collaborative project, Sustainable Management of Agro-Ecological Resources for Tribal Societies (SMARTS).

Dr. Aliza Pradhan (fourth from left) visiting CAPS trials with the SMARTS team.

Not Just Dirt

The humble soil's status has undergone a dramatic shift in recent years. Once it was considered little more than a physical matrix, providing a place for roots to develop—the bulk of the plant's needs were thought to come from external applications of chemical fertilizer and water, and its defenses from chemical pesticides.

However, yield declines after growing the same crops on the same fields, with few or no rotations, caused many farmers and researchers to reconsider. They found that these declines were often caused by a combination of soil problems: nutrient imbalances, salt accumulation from years of chemical fertilizer, compaction, and opportunistic soil pests and diseases fostered by monoculture planting and extensive soil-disturbing tillage.

Dr. Hector Valenzuela has worked with both home growers and ag professionals.

Building and maintaining soil health and quality can help to tackle all these issues. The soil is now recognized as an entire biome, with a biodiversity of microbes and fauna rivaling the diversity of plant and animal life in the Amazon! Its rich biological life facilitates synergistic ecological functions, resulting in better water and nutrient relations as well as improved internal mechanisms of biological pest control.

Hector Valenzuela and Koon-Hui Wang of the Department of Plant and Environmental Protection Sciences are helping growers improve the quality of their soil—and their crops. Dr. Valenzuela, who established the state's first organic research plots in 1993, has given many lectures, presentations, and workshops, and much hands-on help, concerning soil quality, preparation, and regeneration; bioremediation; soil and water management; agroecology; and sustainability. He's worked with both home growers and ag professionals to improve crop viability and nutrition, including a six-year "home-gardening" project in Mānoa Valley to grow specialty crops with minimal external inputs, and a project helping farmers on the Kohala Coast to use improved irrigation practices and cover-cropping to build soil quality and increase the phytochemical content of medicinal herbs.

Cover-cropping is also an important facet of Dr. Wang's research and outreach programs. Cover crops prevent soil erosion, reduce nutrient leaching, add organic matter, improve soil health, and suppress plant-parasitic nematodes and weeds. They can also reduce foliar insect pests and pathogens, while leguminous cover crops can contribute significant nitrogen to the soil. Dr. Wang's numerous field days, workshops, publications, and presentations describe how best to practice conservation cover cropping in Hawai'i. At root, the work of both centers around a basic theme: healthy soil makes for healthy plants—and more sustainable planting systems.

Dr. Koon-Hui Wang shows community participants how to improve soil health at a recent field day.