

The Impact of Soil on Climate Change and Human Health

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Concerns about climate change, the health of our planet, and the effects that these have on the future of humanity have been prevalent for decades. As a species we have attempted numerous measures to help mitigate the crisis that we have imposed on our climate, but none have seemed to pan out too well. The topic just seems insurmountable at times. It may not be as complicated as we think though.

In a recent presentation at Purdue University, Cornell professor and crop expert Dr. Alison Power claimed that crop diversity is an integral part of promoting environmental health. As part of this claim, Dr. Power asserted that a more diverse array of crops on one piece of land improves soil health. According to Dr. Power, by exposing soil to a variety of crops, soil can retain nutrients better than it would if one type of crop is planted repeatedly. [1]

This poses a few questions: first, what is soil health? According to the United States Department of Agriculture, soil health is, "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans." [2] A significant aspect of this is the fertility of soil, which is, "the ability of a soil to sustain plant growth by providing essential plant nutrients." [3]

So, how does the health of soil affect its fertility, how does this affect human health, and how do both relate to the climate crisis?

The relationship between the health of soil and its fertility is undeniable, but soil health goes much further than affecting crops. According to an article posted by Arizona University, "healthy soils can sustain their ecosystems (plants, animals, and microbes) over a long time by providing benefits such as improved water-holding capacity and nutrient cycling, reduced nutrient runoff and soil erosion, and potentially enhanced crop yields." [4]

Given that healthy soil is better at sustaining so many of these important environmental aspects we

must consider what healthy soil is. At North Carolina State University, a soil is considered ideal when it consists of roughly 45 percent minerals, 25 percent water, 25 percent air, and 5 percent organic matter. [5] This is considered ideal because it provides the best soil profile for absorption of water and nutrients.

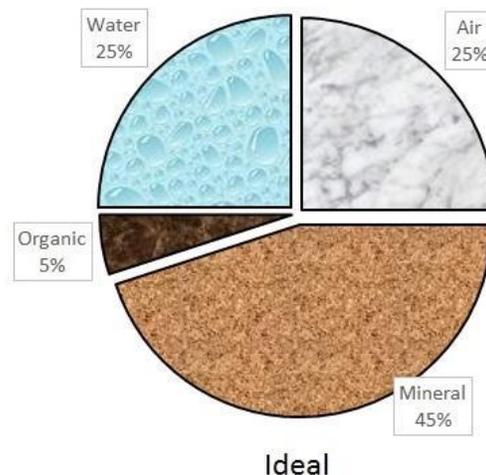


Figure 1. A depiction of Ideal soil makeup promoting overall soil health. (N.C. Brady, and R.R. Weil. 2004. Elements of the Nature and Properties of Soils, 2nd Edition. Atlanta, GA: Prentice Hall. <https://content.ces.ncsu.edu/extension-gardener-handbook/1-soils-and-plant-nutrients>)

Soil is not quite that simple, however. Beyond the profile of the soil, its pH plays a significant role in its ability to yield consistent, healthy crops. [6] Furthermore, the ability for crops to continue growing relies upon the ability of the soil to provide each of the 17 required nutrients. These nutrients are broken into categories of macronutrients (Nitrogen, Phosphorus, and Potassium), while the remaining 14 are considered micronutrients. The macronutrients are considered the most important for survival of crops, as they require the greatest amounts of macronutrients, while they can survive on smaller amounts of the micronutrients. [7] While

micronutrients may not be required in as great amounts, they play a vital role in crop health, and the more abundant they are, the healthier the crops are. In short, healthier soil produces healthier crops. As soil health affects its crops, the chain continues. We include these crops in our diet, and they have a direct effect on our health. [8] Back to those nutrients. These nutrients, which are broken down by the human body, provide different functions.

Much like in plants, the bulk of our energy is derived from macronutrients. [9] Our macronutrients, however, are carbohydrates, proteins, and fats. While most energy comes from macronutrients, many other functions are aided by micronutrients. [10] Beans for example are known for having high protein levels, but they are also high in fiber, an important micronutrient for the maintenance of gut health and digestive function. [11]

While macronutrients are relatively easy to consume in sufficient amounts, getting proper levels of certain micronutrients can be a bit more difficult, hence why fruits and vegetables are so widely emphasized for their nutritional value. [12]

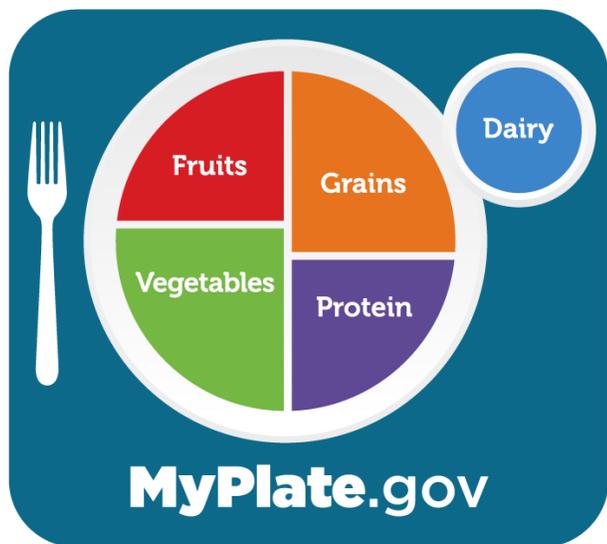


Figure 2. A depiction of the U.S. Government recommended daily intake of fruits and vegetables. (My Plate. <https://www.myplate.gov/resources/graphics/myplate-graphics>)

Diet related health is not solely dependent on the amount or variety of crops in one’s diet though. The ability for nutrients consumed to be absorbed and utilized is called nutrient bioavailability. [13] This is where soil health comes into play with human health. Crops that are consumed but have come from less fertile soil sources not only taste bad, but they also do not have as many nutrients readily available. [14] In contrast, crops that come from rich, healthy soil will be considered more bioavailable, meaning they provide a greater source of nutrients for the body.

We can see that human health is extremely dependent on the health of the planet. [15] Perhaps the best part about this is that, for the most part, we get out of the environment what we put into it. As such, we must protect the health of our soil to see the benefits in our own health as well. During her presentation at Purdue, Dr. Power advocated for the use of farming technique such as cover cropping and slash and burn agriculture, which add resilience to farmland. This resilience is helpful in preparation for extreme weather brought on by climate change, but it is also healthier for the soil altogether. [16]

As we move into the future, we must place more emphasis on environmental health. In doing so, we are also investing in our health and our ability to enjoy healthy lives. [17]

Notes

- [1] Alison Power, "Global Crop Diversity in Farming Communities," Aronson Family Lecture Series, Purdue Honors College, February 28, 2022.
- [2] "Soil Health," Natural Resources Conservation Service, United States Department of Agriculture, Accessed March 9, 2022, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/>.
- [3] "Soil Fertility," Global Soil Partnership, Food and Agriculture Organization of the United Nations, Accessed March 9, 2022, <https://www.fao.org/global-soil-partnership/areas-of-work/soil-fertility/en>.
- [4] "Soil Fertility and Soil Health." Cooperative Extension | The University of Arizona, January 11, 2022. <https://extension.arizona.edu/yavapai-soil-fertility-soil-health>.
- [5] "1. Soils and Plant Nutrients." NC State Extension Publications. Accessed March 27, 2022. <https://content.ces.ncsu.edu/extension-gardener-handbook/1-soils-and-plant-nutrients>.
- [6] "1. Soils and Plant Nutrients."
- [7] "1. Soils and Plant Nutrients."
- [8] Alida Melse-Boonstra, "Bioavailability of Micronutrients From Nutrient-Dense Whole Foods: Zooming in on Dairy, Vegetables, and Fruits," *Frontiers in Nutrition* 7 (July 24, 2020): 101, [10.3389/fnut.2020.00101](https://doi.org/10.3389/fnut.2020.00101).
- [9] Brian Lindshield, "Energy-Yielding Macronutrients." Human Nutrition. Oregon State University, August 1, 2019. <https://open.oregonstate.edu/humannutrition/chapter/chapter-2-energy-yielding-macronutrients/>.
- [10] "Micronutrients Have Major Impact on Health." Harvard Health, February 15, 2021. <https://www.health.harvard.edu/staying-healthy/micronutrients-have-major-impact-on-health>.
- [11] "Black Beans Help Fix Insulin Resistance and Gut Bacteria Balance." Black Beans Help Fix Insulin Resistance and Gut Bacteria Balance: USDA ARS. Accessed March 29, 2022. <https://www.ars.usda.gov/news-events/news/research-news/2021/black-beans-help-fix-insulin-resistance-and-gut-bacteria-balance/>.
- [12] "Fruits." MyPlate. Accessed March 28, 2022. <https://www.myplate.gov/eat-healthy/fruits>.
- [13] Mike Espy, "Bioavailability: How the Nutrients in Food Become Available to Our Bodies." HealthGuidance.org |, December 8, 2019. <https://www.healthguidance.org/entry/6265/1/bioavailability-how-the-nutrients-in-food-become-available-to-our-bodies.html>.
- [14] Espy, "Bioavailability"
- [15] David A. Sinclair and Matthew D. LaPlante, "Chapter 8. The Shape of Things to Come," in *Lifespan: Why We Age—and Why We Don't Have To* (London: Harper Thorsons, 2021), 22-24.
- [16] Alison Power, "Global Crop Diversity in Farming Communities," Aronson Family Lecture Series, Purdue Honors College, February 28, 2022.
- [17] Sinclair and LaPlante, *Lifespan*, 222-224