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[151] Deposits of sodium nitrate, also known as saltpeter, are mined in deserts throughout the world, and it is used in a number of chemical processes besides manufacturing fertilizers.
[152] Actually, Liebig was partially correct. Plants in the legume family (including beans, acacia trees, and alfalfa) as well as some small aquatic plants in the genus *Azolla*, and trees in the genus *Alnus* (alder), form a symbiotic relationship with bacteria on their root systems that collect nitrogen directly from the atmosphere and make it available to the plants, in return for a portion of the sugars the plants produce in their leaves through photosynthesis. Non-legume plants generally benefit directly from nitrogen fertilizers, but legumes only benefit marginally, if at all.
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[154] In 2022, the estimated average corn yield in the US was 172 bushels per acre. Corn is typically fertilized with nitrogen at a rate of about 1.2 lbs of nitrogen per bushel. ("US corn and soybean production down from September," Newsroom, National Agricultural Statistics Service, United States Department of Agriculture, October 2022, https://www.nass.usda.gov/Newsroom/2022/10-12-2022.php#:~:text=1%2C%20corn%20yields%20are%20expected,unchanged%20from%20the%20previous%20forecast.; and Jim Camberato, R. L. Nielsen, and Dan Quinn, "Nitrogen Management Guidelines for Corn in Indiana" Purdue University Department of Agronomy, updated April 2022, https://www.agry.purdue.edu/ext/corn/news/timeless/NitrogenMgmt.pdf.)
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[165] One kilogram equals 2.2 pounds, and one hectare equals 2.47 acres. One kilogram per hectare equals 0.89 lbs/acre.
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[175] Tim Crews, “Will becoming local here get us there?” *The Land Report*, no. 108 (Spring 2014): 4–11, https://landinstitute.org/wp-content/uploads/2016/09/Land-Report-108.pdf. The chicken manure Dan DeSutter applied to his farm contained nitrogen that was very likely fixed through the Haber-Bosch process, derived from the feed the chickens were fed. It is an indirect path for synthetically derived nutrients that Dr. Crews describes as “dumpster diving for nutrients.”

[176] The Foreword, written by Secretary of Agriculture Henry A. Wallace, just a few years after the Dust Bowl had ended, began with this paragraph: “The Earth is the mother of us all―plants, animals, and men. The phosphorus and calcium of the earth build our skeletons and nervous systems. Everything else our bodies need except air and sun comes from the earth. Nature treats the earth kindly. Man treats her harshly. He overplows the cropland, overgrazes the pastureland, and overcuts the timberland. He destroys millions of acres completely. He pours fertility year after year into the cities, which in turn pour what they do not use down the sewers into the rivers and the ocean. The flood problem insofar as it is man-made is chiefly the result of overplowing, overgrazing, and overcutting of timber. This terribly destructive process is excusable in a young civilization. It is not excusable in the United States in the year 1938.” (U.S. Department of Agriculture, *Soils and Men: Yearbook of Agriculture 1938* [Washington, D.C.]).

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[178] This story is being told by farmers to each other throughout the country. A Google search on “soil health” in December 2019 yielded 2,590,000 hits. As Jim had described, the 2019 tables of contents of a dozen prominent farm magazines, including *No-Till Farmer*, John Deere’s *The Furrow*, and *Farm Journal*, included at least one article in each edition that focused on utilizing cover crops, reducing tillage, and cutting fertilizer and farm chemical use. The practices have begun to stick and are gaining momentum rapidly.

[179] Tim Crews, personal communication, 2023.

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