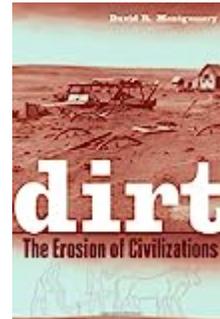




**David R. Montgomery.** *Dirt: The Erosion of Civilizations*. Berkeley: University of California Press, 2007. xi + 285 pp. \$24.95 (cloth), ISBN 978-0-520-24870-0.



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## **Agro-Ecology: Farming with Brains**

Geomorphologist and University of Washington professor of earth and space sciences David R. Montgomery has produced a ten-chapter cultural and social history of soil. It explains why the way societies treated soil influenced their longevity and in so doing provides a strong commentary for the future of civilizations. In his introduction, Montgomery informs us that “good soil is not just dirt.” It is a “biological orgy recycling the dead back into new life” (p. 1). Many past societies mined their soil to fuel their growth and accelerated soil erosion faster than soil was produced. Others managed to “reinvest” in their land and maintained or improved their soil. Most civilizations, excluding the fertile valleys where agriculture began, have lasted between 800 and 2000 years (30 to 70 generations) and prospered as long as there was new land to plough or continued soil productivity. Most fell apart when either was not possible; those that lasted either learned how to conserve soil or had environments that naturally “refreshed the dirt” (p. 236). Hence, the shelf life of a civilization in the broadest sense is “limited by the time needed for agricultural production to occupy the available arable land and then erode through the topsoil. How long it takes to regenerate the soil

in a particular climate and geologic setting defines the time required to reestablish an agricultural civilization—providing of course that the soil is allowed to rebuild” (p. 236). In chapter 2 Montgomery explains how Charles Darwin helped open the door for the modern view of soil as “the skin of the earth” (p. 12) and details the significant contribution UC Berkeley professor Hans Jenny made in the 1940s to soil ecology when he identified the five key factors that governed soil formation: parent materials (rocks), climate, organisms, topography, and time. Montgomery also explains the system that soil scientists use to describe different soil layers (the O, A, B, C horizons), the main characteristics of soil, and those factors that influence soil erosion. Being the skin of the earth, soil is, Montgomery concludes, really “the frontier between geology and biology” (p. 23).

The second part of the book consists of series of case studies tied together largely in a geographic and chronological fashion. In chapters 3 and 4, Montgomery examines soil practices in old-world societies. He begins by offering a critique of the “competing oasis” and “cultural evolution” hypotheses as theories for the origin of agri-

culture, both of which gained considerable currency during the last century. People at Abu Hureyra (the headwaters of the Euphrates River in modern Syria) were forced into the labor-intensive business of agriculture between 13,000 and 10,500 years ago for a number of reasons including climatic shifts, population densities, and few options to move elsewhere (pp. 30-31). Subsequent development of more intensive and effective subsistence methods enabled human populations in that region to grow beyond levels that could be supported by hunting and gathering, and eventually for the first time in history, communities came to “depend on enhancing the productivity of natural ecosystems just to stay even, let alone grow” (p. 34). Crop production and animal husbandry enhanced each other and maximized food production, and in the process, human population began to double every thousand years. Yet shortly after societies began to settle into agricultural practices, soil erosion and degradation caused by intensive agriculture and goat grazing began to undermine entire crop yields and forced abandonment of whole villages. In order to survive, communities were eventually pushed onto more marginal lands, and irrigation systems requiring considerable technical expertise and organizational control were introduced, spawning the “inseparable twins of bureaucracy and government” (p. 37). Private property was born, class distinctions grew as not everyone had to spend their time in the fields in order to eat, and writings in the form of cuneiform indentations in clay tablets, were produced in order to help a diversifying society “manage food production and distribution” (p. 38). Eventually, salinization, extensive erosion from upland farming, and other accumulating effects of soil degradation began to plague these early civilizations. The decline of these once-great societies followed as populations outstripped productive capacities and pushed agriculture onto “the surrounding slopes initiating cycles of ‘soil mining’” (p. 47).

In his case studies of ancient Greece and the Italian peninsula, Montgomery dispels the idea deeply rooted in Western mythology that ancient peoples lived in harmony with their environment; most societies followed a path of slow and steady population growth followed by an abrupt decline (p. 50). In Greece, pre-Bronze Age agriculture was highly diversified as sheep, goats, cows, and pigs were kept on small, intensively worked farms. After the introduction of the plow and a shift away from diversified and small-scale production to large plantations, soil erosion began to exceed soil production (pp. 54-55). Similarly, immigrants from the east introduced agriculture to the Italian peninsula sometime between 4000

and 5000 BC and its earliest farms relied on mixed-cereal cultivation and animal husbandry. Early Italian farmers were sophisticated in their knowledge of farming, using techniques such as crop rotations and manure. But once iron became widely available around 500 BC, metal tools were responsible for extensive deforestation. Thereafter, the peninsula’s *cultura promiscua* was superseded by less agro-ecologically friendly practices such as the ox and plow, which saved labor but required twice as much land to feed a family. Soil erosion increased as a result of deforestation and plowing of hillsides, sediment-choked rivers followed, and eventually large worn-out hills and new marshy valleys meant that “formerly cultivated regions were becoming pastures of little use beyond grazing” (p. 58). In time, towns emptied, and contrary to the conventional wisdom that wars were responsible for the depopulation of the Roman countryside, small farms had disappeared during a period of unprecedented peace and Rome itself “did not so much collapse as consume itself” (pp. 63-67). In the third part of the study, Montgomery turns away from the old world and transitions to the new. In chapter 5 he explains how the way Europeans treated their soil helped to launch their explorations in the New World. European prehistory is the story of the migration of agricultural peoples into the region (in about 5300 BC) followed by accelerated soil erosion, a period of low population density, and then clearing and farming before an eventual population rebound (p. 88). Europe’s best soils had been cleared of forest by about 1200 AD and by the end of the next century Europe’s population began farming marginal lands (p.91). A final push followed in the century and a half after the Black Plague as Europe’s climate slid from the medieval warm period into a Little Ice Age (approx. 1430 to 1850 AD). Beginning in the 18th century European powers harnessed the agricultural capabilities of their colonies and by the end of the 19th century many European countries relied on their colonies for food as Europeans eventually outsourced food production in favour of industrial economies (pp.,108-110).

Montgomery considers how Virginia’s place as a colonial economy impacted its land use in chapter 6. He concludes that its colonial status left little incentive to turn to growing a variety of crops since tobacco yielded the highest return. Hence Virginia became a “factory for turning topsoil into tobacco” (p. 119). By the end of the eighteenth century in the United States it was routine to comment on the depleted state of colonial soils. Though their philosophies about citizens wearing soil down differed, Thomas Jefferson and George Washington both worried about the destructive nature of colonial agricul-

tural practices. Washington attributed it to ignorance of proper farming methods whilst Jefferson attributed it to greed (p. 125). Although Americans early in the nineteenth century began to recognize the need to “safeguard and restore soil fertility,” by the 1840s the problem of soil exhaustion was not restricted to the Northeast, nor the South, and addresses to agricultural societies in Kentucky and Tennessee warned that the new states were rapidly becoming like the old in “squandering their productive soils” (p. 129). British geologist Charles Lyell, who toured the South during this period, commented on this fact, as did agricultural periodicals throughout the country which “assaulted the twin evils of soil erosion and exhaustion” (p. 133).

Chapter 7 begins with a story that will be familiar to many environmental historians: the transformation of the Great Plains following increased settlement and the introduction of labor-saving devices such as John Deere’s plow and Cyrus McCormick’s mechanized harvester. Between 1870 and 1900, U.S. harvesters had opened up as much virgin land to cultivation as they had done in the previous two centuries and consequently by 1900, half the potential farmland in the United States was under cultivation. Tractors arrived around 1900 and by 1917 hundreds of companies were producing smaller models before market consolidation left the lion’s share in the hands of John Deere and International Harvester. Soil stewardship fared poorly in these years, Montgomery concludes, as mechanization made it more cost-effective to just plow more land than worry about soil loss. The cost of machines was more than many small farms could afford, debt loads and bankruptcies increased, and greater concentration of industry followed, setting the stage for the dust bowl in the 1930s. Several million tractors were working U.S. fields by the 1950s, ten times as many as the 1920s, and mechanization, like slave labor in the South (which is discussed in detail earlier in the book), meant doing the same thing everywhere rather than adapting agricultural methods suited to the land. The economic and social trends that drove mechanization turned farming into an industry and accelerated soil loss as “soil became a commodity”—“the cheapest of many inputs to agricultural manufacturing” (p. 160). In this chapter Montgomery writes that soil erosion was also a problem in communist countries, as the USSR faced challenges similar to the West, from the five-year plans beginning in the 1920s, through Nikita Khrushchev’s virgin land campaigns of the 1950s and 1960s (a key case study in the book being the Aral Sea disaster) and beyond the disintegration of the Soviet Union. Montgomery further

expands his window to consider the colonial legacy in the African Sahel, and the Indian and Ethiopian crises of the 1970s and 1980s.

In chapter 8 Montgomery sketches the major scientific advances fundamental to soil chemistry, including discoveries made by Daniel Rutherford, Antoine Lavoisier, Humphrey Davy, Friederich Wohler, Justu von Leibig and John Bennet Lawes. He also considers the evolution of fertilizer use in the United States by chronicling the debates between Eugene Hilgard and U.S. Department of Agriculture Bureau of Soils chief Milton Whitney over the underlying reasons for soil fertility just as a new concept was evolving of soils as ecological systems. Capitalist agriculture in this period is pushing nature’s limits in new directions. Fritz Haber’s successful attempt to sustain production of liquid ammonia was commercialized by Badische Anilin-und Sodafabrik (BASF) chemist Carl Bosh (now known as the Haber-Bosch process) and by the late 1990s the world’s chemical industry produced more than 150 million tons of ammonia per year (99 percent of which is supplied by the Haber-Bosch process). As the agricultural output of industrialized countries doubled in the second half of the twentieth century, “soil productivity became divorced from the condition of the land as industrialized agrochemistry ramped up crop yields” (p. 197). Large-scale monoculture and fertilizers meant manure and animal husbandry were no longer needed to maintain soil fertility.

At about the same time mechanization transformed agriculture, the modern organic farming movement coalesced around the ideas of Sir Albert Howard and Edward Faulkner concerning large-scale composting and planting without plowing (p. 202), and the second half of the chapter extols the economic, social, and soil conservation benefits of organic and no-till farming. With the end of cheap oil and a shrinking base of arable land the world needs a new model of how to feed everyone. Island societies have sometimes “consumed their future and descended into brutal competition for arable land” (p. 216) (as in the case of Easter Island, Mangaia, Iceland, Haiti), and sometimes offered a possible solution to this crisis (Tikopia, Cuba); they are the focus of Montgomery’s chapter 9.

Montgomery’s conclusion: we are running out of dirt we cannot afford to lose. We must reform agricultural practices in both industrialized and developing countries to retain soil fertility which is a renewable resource only at a “glacial pace” and failure to do so will make age-old debates about whether technology has the capacity

to meet societies growing agricultural needs, irrelevant. We must prevent soil erosion and by the time fossil fuels are exhausted we need to have radically restructured agricultural practices to sustain soil fertility or to have found massive new sources of cheap energy if planning to rely on fertilizers (which he does not believe to be sustainable). Strong governments are needed to take a leadership role and to set our societies long-term priorities in soil stewardship since market forces, while effective as drivers in other social institutions, do not work in agriculture. Classical economic theories such as those put forward by Adam Smith, Keynesians, and orthodox Marxists share one common blind spot in their present analysis of existing conditions, which is the “false assumption that the value of finite resources is equal to the cost of using them, extracting them, or replacing them with other resources” (p. 235).

Montgomery has produced a fine study that cycles through history, builds on a series of case studies, and makes comparisons across significant periods of time—all of which make this book an enjoyable read. While I have stitched together the major topics discussed in

this study, these pages contain more than can be captured in a brief review. Environmental and world historians will find this book a worthwhile venture. Some will find contentious its argument that a reorientated capitalism in a new agrarian revolution, with a new philosophical basis that treats soil as a locally adapted biological system rather than a chemical system (i.e., one based on biology and ecology rather than chemistry and genetics), might provide a roadmap for a sustainable future (pp. 240-241). Yet fortunately this is not a central theme of the study. For even as discussed in Montgomery’s book, governments have seldom provided the kind of leadership needed to solve the soil crisis. On the other hand, whether agriculture will trump industrialism as a new agro-ecological ethos emerges and dominates the planet’s thinking about the future of civilizations, and the extent to which its toolbox will include ideas such as organic and no-till farming, only time will tell. What we do know is that in the future, historians who study the rise and fall of civilizations must acknowledge the important questions raised by Montgomery’s groundbreaking work.

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