CLIMATE AND CAUSATION IN AFRICAN HISTORY

By James C. McCann

Perceptions of the relationship between climate and history in the historical scholarship of Europe, America, and Africa have changed substantially in the last three decades. The dominant approach in European historiography in this period has been one that emphasized climate as one aspect of total or *Annales* history championed by historians such as Emmanuel Leroy Ladurie, whose interest in climate history evolved as a natural consequence of work on agricultural and economic change. Others within the same tradition have called for an examination of subtle patterns of social effects rather than a chronicling of climatic crisis.[1] For American history, the issue of climate germinated almost directly from Walter Prescott Webb's 1931 *The Great Plains,* whose central agrument drew a primary distinction between the humid east and the arid central plains, and later by William Cronon's *Changes in the Land* (for New England) and Donald Worster's *Rivers of Empire* and *Dust Bowl* (for the arid West).[2]

For Africa, concern over climate's historical role emerged as an immediate response to contemporary crises of drought in the 1968–1972 drought in the African Sahel, Ethiopia's twin famines in the 1972–1974 and 1984–1986 periods, and again in the 1990s, and following the extended drought in southern Africa in the mid-1980s. In Africa's case the approach to climatic data, human/environmental interaction with climate, and basic issues of methodology began with a false start and a basic misunderstanding of the distinction between a history of climate crises, and more fundamental causal relationships between climate and human activity. This paper will look at the role of climate as a theme within the historiography of Africa and will suggest ways in which new work on African environmental historiography has come to offer a valuable comparative case for environmental history as a whole.

In contrast to early writing on African climate history, there has been a general agreement within European *Annales* historiography that direct, one-to-one cause and effect relationships between climate and human action had provided a false lead and that historians needed to develop a more sophisticated methodology to account for those relationships. Jan DeVries, a historian of northern Europe, adopts the Braudelian perspective, suggesting that climate can have indirect effects that can be

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[1] Emmanuel Leroy Ladurie, *Time of Feast, Times of Famine: A History of Climate Since the Year 1000* (Garden City, 1971), 1–2. For the alternative view, see Jan DeVries, "Measuring the Impact of Climate on History: The Search for Appropriate Methodologies," in Robert Rotberg and Theodore Rabb, eds., *Climate and History: An Interdisciplinary History* (Princeton, 1981), 50.

[2] Walter Prescott Webb, *The Great Plains* (Boston, 1931); William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York, 1983); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York, 1986).

short-term, conjunctural, or long-term.[3] He was particularly critical of historians who linked periods of political and economic crisis with climate without thoroughly exhausting more mundane economic or political causation. The French *Annaliste* Leroy Ladurie, for his part, argues strongly that climate's effect on human action must be mediated, first by climate's effect on the physical environment (harvests, forests, water resources, forage), and then the consequent effects on the human habitat, epidemiology, and, of course, demography. In particular, he advocated the collection of historical climate data untainted by anthropogenic factors such as economic forces or the intricacies of agricultural production.

Historians Reid Bryson and Christine Paddock push this perspective on human-climate linkages further by suggesting the principle of "limiting factors"—i.e., the particular feature of a given ecology that can be measured over time and that restricts human economic activity. Temperature, rainfall, and sharp divisions of the seasons are examples of key factors affecting agriculture and economic activity.[4] A small spatial or temporal variation in critical climate variables can produce a substantial effect on production. For example, in Iceland where temperature is the key climate variable (or "limiting factor"), a difference of one degree centigrade in annual temperature can decrease the length of the growing season by 27 percent and thus affect farmers' crop options.[5]

DeVries argues in more specific terms that the influence of climate on preindustrial economies can be advanced by hypothesizing a link between one aspect of climate and a particular activity (such as the effect of temperature on dairy production). At the same time he cautions that human societies' ability to respond to long-term patterns of change in climate creates a "shifting parameter" that will make many direct causal relations between climate and events difficult to measure. He suggests therefore a research focus that looks at the broad range of human adjustments to specific features of the climate rather than seeking purely physical effects, for example looking at farmer strategies for crop mixing (a trademark feature of African agriculture) rather than climate's technical effect on one crop.[6] In this perspective social institutions function as adaptive agencies for the distribution of resources and limiting of risk. The essential relationship that the historian can empirically measure and test thus is between an adaptive social system, limiting (or enhancing) factors of technology, and a limiting variable of climate, such as rainfall or temperature.

In Africa it is rainfall rather than temperature that is the most relevant climatic limiting factor of food production.[7] The timing of rainfall and its particular relation-

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[3] DeVries, "Measuring the Impact," 19.

[4] Reid Bryson and Christine Paddock, "On the Climates of History," in Rotberg and Rabb, eds., *Climate and History,* 3–4.

[5] Bryson and Paddock, "Climates of History," 8–9.

[6] DeVries, "Measuring the Impact," 28–29. For discussion of African agriculture as a "craft" of crop mixing, see John Illife, *Africa: The History of a Continent* (Cambridge, 1995), 268.

[7] Rasmussen, "Global Climatic Change," 8; Nicholson, "Methodology," 38. Glantz's argument that a meteorological drought is far less damaging than an agricultural drought is an important illustration of this point. He defines an agricultural drought as "the lack of adequate soil

ship to the constellation of labor, cropping patterns, and capital requirements of a specific African farming system is a critical but neglected aspect of both the historical and contemporary development of rural society and economy. It is, after all, the patterns of seasonal rainfall that trigger social and economic processes of labor, renewal of resources (food, seed, cash crops, and forage) and the shortage or abundance of harvests.

The writing of climate history in Africa is a comparatively recent phenomenon, stimulated largely by crises of food supply and perceptions of natural resource degradation in the past two decades.[8] Moreover, writing on the history of the Africa climate has ignored the precedents of methodology and theme in both European and North American environmental historiography. The dominant approach has clearly been the anthropomorphic concern with establishing a direct relationship between drought and human activity, particularly as a cause of famine, migration, and demographic change. Attempts to draw climate data from oral sources have been a less than successful derivative of the otherwise valuable methological contribution of African historians.[9] The primary focus of such research has been the effects of short-term climate crises, usually in the form of drought. Where limited time series of climatic variability exist, historians have analyzed them on the basis of interannual variations (year-to-year fluctuation), such as measuring drought on the basis of aggregate statistics of precipitation. The paucity of genuine climatic data is a general problem in Africa, where rainfall time series and research on proxy data (tree rings, lake bed cores, or glacier cores) remain either unavailable or underinvestigated.

Remarkably, the primary concerns of European and American historians of climate—the construction of time series and the avoidance of anthropogenic indicators—did not much concern historians of Africa, while the American West's theme of aridity as a narrative metaphor of human struggle has had much greater appeal.[10] But unlike Americanist colleagues with solid data on weather and historical conditions of moisture, historians of Africa writing on issues of climate have ventured ambitious conclusions on the basis of extremely weak historical data, drawing broad conclusions about effects of climate on economic, social, and demographic

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moisture to sustain a crop's growth and production." G. Michael Glantz, "Drought, Famine, and the Seasons in Sub-Saharan Africa," in R. Huss-Ashmore and S. Katz, eds., *Anthropological Perspectives on the African Famine* (New York, 1987), 15.

[8] Sharon Nicholson's "The Methodology of Historical Climate Reconstruction and Its Application in Africa," *Journal of African History* 20 (1979), 31–49, broke ground in the field of African climatology in a form accessible to historians. That same year J. B. Webster published his edited volume *Chronology, Migration, and Drought in Interlacustrine Africa* (New York, 1979), which sought rather direct linkages between climate and historical patterns.

[9] The exception to this trend is clearly Nicholson, who takes great care to describe possibilities for identifying proxy and standard techniques of climatology. Nicholson, "Methodology," 33–55.

[10] See, for example, David Anderson, "Depression, Dust Bowl, Demography, and Drought: The Colonial State and Soil Conservation in East Africa During the 1930s," *African Affairs* 83 (1984), 321–43.

change. Joseph Miller's work on the climate history of Angola, for example, sidesteps the lack of data on rainfall by arguing that:

> Drought is subjectively defined by its sufferers in terms of disappointed expectations of rain and his dissonant cognition of his circumstances. Thus subjective records of human responses to weather available for early centuries may be as useful for assessing the general significance of major droughts in West Central African history as the problematic instrumental record of more recent times.[11]

In this formulation, the question of human perceptions of past events becomes a satisfactory or even a superior substitute for Leroy Ladurie's meticulously assembled climatic times series.[12]

In a more outlandish vein, J. B. Webster's 1979 edited volume *Chronology, Migation, and Drought in Interlacustrine Africa* invoked an embarrassingly uncritical use of oral sources to reconstruct East African climate and demographic history in a way that was at best overoptimistic and at worst grossly incompetent. Ralph Herring's chapter in that volume, for example, studied records of the Rodah Nilometer and concluded that a slight increase in Nilometer levels during the seventeenth century must have meant "a period of agricultural prosperity in Uganda." His formulation not only ignored the role of the Blue Nile (rising in the Ethiopian highlands, not Uganda) in determining seasonal Nile levels at Cairo, but reduced agricultural production purely to the effects of aggregate rainfall. [13]

In recent years historians and climatologists have moved in more promising directions attempting to assemble evidence of climatic epochs in African history that may shed light on the historical economic trends and political events. Sharon Nicholson, an historical meteorologist, was among the first to reconstruct the climate history of Africa from both historical and hydrological sources. Using historical accounts, evidence of lake levels, and other proxy indicators of past climate conditions, she argued that the West African Sahel experienced several climate epochs over the course of the 800 A.D.–1600 A.D. period when, in succession, the Sahel empire states of Ghana, Mali, and Songhay developed, thrived, and declined. She hypothesized that the period c. 800 A.D. to 1300 A.D.was relatively

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[11] Joseph Miller, "The Significance of Drought, Disease, and Famine in the Agriculturally Marginal Zones of West Central Africa," *Journal of African History* 23 (1982), 20. By contrast Eugene Rasmussen provides a more standard definition: "Drought implies an extended and significant negative departure in rainfall relative to the regime around which society has stabilized." See Eugene Rasmussan, "Global Climate Change and Variability Effects of Drought and Desertification," in Michael Glantz, ed., *Drought and Hunger in Africa: Denying Famine a Future* (Cambridge, 1987), 8.

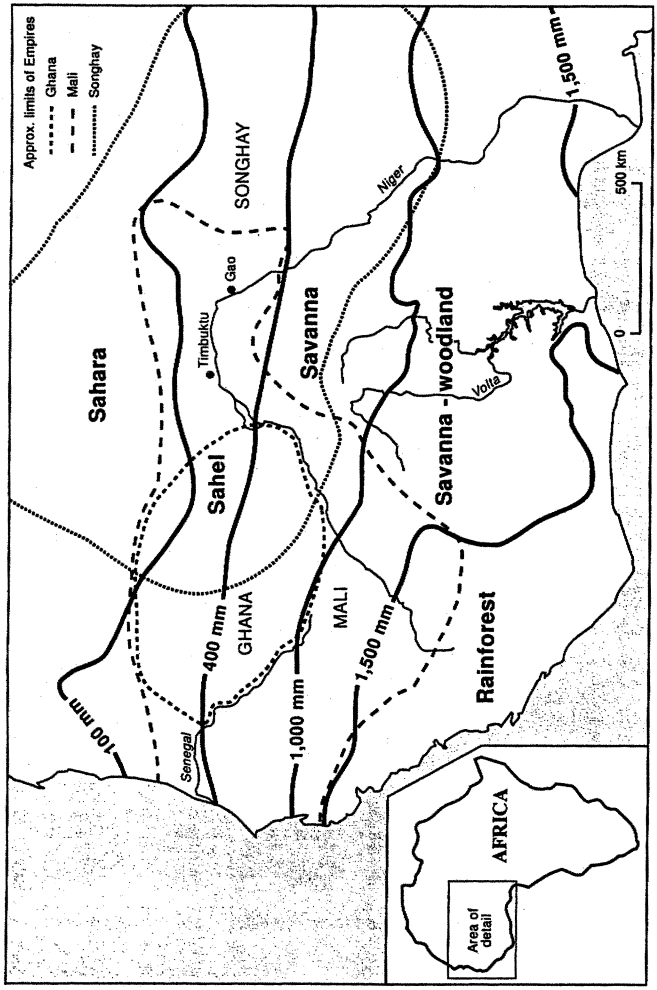
[12] Having established the Africanist agenda of the viability of oral evidence, Miller then agrees with Jill Dias's article from the same journal a year earlier pointing out that the bulk of rainfall records for Angola derives from missionary and colonial written records. See Miller, "Significance," 17, 20; and Jill Dias, "Famine and Disease in the History of Angola, 1830–1930," *Journal of African History* 22 (1981), 349.

[13] R. B. Herring, "Hydrology and Chronolgy: The Rodah Nilometer as an Aid in Dating Interlacustrine History," in J.B. Webster, ed.,*Chronology, Migration, and Drought.*

wet, followed by the drier 1300 to 1450 span, followed, again, by a wetter period from the late fifteenth to the late eighteenth century.[14]

Beginning from Sharon Nicholson's climate data on Africa, two historical monographs, George Brooks's *Landlords and Strangers: Ecology, Society, and Trade in West Africa, 1000–1630* and James Webb's *A Desert Frontier: Ecological and Economic Change along the Western Sahel, 1600–1850,* have more recently extrapolated and defined two contrasting patterns of environmental and historical change in the West African Sahel. Both historians delimit key West African historical zones not by fixed geographical boundaries but by shifting rainfall boundaries (isohytes) that generate particular types of vegetation and humidity, imposing specific constraints on human activity. The 100 mm rainfall zone separates the Sahara from the Sahel, while the 400 mm line demarcates the Sahel's southern edge and the zone where cultivation of drought-tolerant crops like sorghum and millet is possible (see map). South of the 400 mm line is the savanna itself, the zone that Mande oral narratives call the "bright" country where Sundiata and his royal Keita clan founded the Mali empire in the middle of the thirteenth century.

[14]Sharon Nicholson, "A Climatic Chronology for Africa," 75–81, 251–54, cited in James Webb, *Desert Frontier: Ecological and Economic Change along the Western Sahel, 1600–1850* (Madison, 1995), 4–5.



The Climatic Zones of West Africa

Further south below the savanna lies the 1000 mm isohyte, which defines the woodland savanna, and marks the limits of the tsetse fly (*Glossina morsitans*) habitat, a barrier over which livestock (especially horses and cattle) and those dependent on them dared not trespass. Cattle, horses, sheep, donkeys, and camels all risked death from the sleeping sickness carried by the flies. Of West African livestock, only the humpless longhorn Ndama cattle carried a genetic resistance to trypanosomiasis. The humped zebu breeds (*Bos indicus*) most common in Africa as a whole were relatively late arrivals in West Africa (only about 1400 years ago). The hardy zebu tolerated dry conditions well but succumbed easily to the trypanosomes of the more humid areas of West Africa.[15] On the side of human disease, malaria's domain also moved with the shifting seasonal bands of moisture and movements of rainfall boundaries over the longer term.

Food supplies also historically reflect moisture in their type and reliability. Sorghum and millet, West Africa's historic cereal crops, are drought-resistant but long-maturing and offer relatively low yields per unit of land. Maize, which arrived after 1500, offered much higher yields, double cropping in some areas, and earlier maturity than Africa's indigenous cereal crops. Maize was ready to harvest or consume green months earlier and flourished in humid and semi-humid zones but quickly disappeared in many areas in the nineteenth century when annual rainfall fell below 400–500 mm.[16]

What George Brooks's *Landlords and Strangers* adds to our understanding of the history of the Sahel and its great empire systems is his attempt to connect specific human activities such as cavalry raids and iron smithing to the dynamic of shifting and swaying West African ecological boundaries. During periods of less aridity the agricultural frontier moved north, allowing cereal-producing farmers to expand their settlements into the Sahel, thus pushing the political frontiers of their ruling elite further north toward key trans-Saharan trade routes. In these times of greater moisture the domain of the tsetse also crept north, restraining the mobility of horse-borne warriors who raided peoples at the southern edge of the savanna. The 1000 mm isohyte (the tsetse frontier) provided a protective screen for the agricultural peoples who had often fallen victims to slave-raiding horsed warriors in drier conditions, tsetse, in effect, providing an effective defense against invasion.

Brooks points out that over the past two millennia, the tsetse zone has fluctuated as much as 200 kilometers north to south, thus altering both the geography of local livestock economies and regional military advantage. Much of the Mali empire's historical expansion south closer to sources of gold and kola (e.g., between 1250 and 1450 A.D.) took place during a generally dry period, which allowed its cavalry to push Mali's formal hegemony to the edge of the forest from

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[15] George Brooks, *Landlords and Strangers: Ecology, Society, and Trade in West Africa, 1000–1630* (Boulder, 1993), 12–13. For further information on the genetics, distribution, and origins of African cattle breeds, see J.E.O Rege, G.S. Aboagye, and C.L. Tawah, "Shorthorn Cattle of West Africa: I. Origin, Distribution, Classification, and Statistics," in *World Animal Review* 78, 1 (1994), 2–13; and C. Meghan, D.E. MacHugh, and D.G. Bradley, "Genetic Characterization and West African Cattle," *World Animal Review* 78, 1 (1994), 59–66.

[16] Webb, *Desert Frontier*, 8.

where their merchants influenced newly emerging forest kingdoms in the eighteenth century (see map above).[17]

Brooks argues that the 1000 to 1500 period was dry, encouraging Mande smiths and merchants south into the savanna woodlands where they planted the seeds of the Mali empire's enduring cultural diaspora. The retreat of the tsetse barrier as much as 200 kilometers south, according to Brooks, further enhanced Mali's military interests, allowing them to use their cavalry up to the edge of the forest. Brooks thus sees the decline of Mali and the rise of Songhay in similar environmental terms. Dry conditions in the Sahel forced Tuareg camel pastoralists south, where they established control of Timbuktu in 1483, and the southern movement of the tsetse zone allowed Mali's southern enemies, such as the Mossi, to mobilize horsed warriors against them. Finally, Brooks argues, the brief wet period from 1500 to 1630 set the terms for both Songhay's enrichment through trade and its demise, since wet conditions along the caravan route expanded trade networks across the desert but eventually tempted the expansion-minded Moroccan king al-Mansur to launch a conquering army across the desert to capture what he thought was the golden prize of the trans-Saharan trade.

This neatly packaged view of environment's effect on history is appealing since it links events directly to environmental factors. Yet without clear and more precise data on the period 800–1600, tying historical events and trends to climate is a misleading exercise. Brooks's data offer plausible historical arguments about the effects of the environment on historical events, but they fundamentally disagree with Nicholson's evidence about the sequencing of "wet" and "dry" epochs. Nor does Brooks's environment determinism account for the year-to-year and season-to-season variation in rainfall that recent farming systems research indicates profoundly affects local economic cycles, agriculture, and pastoralism.

The real value of linking environment to historical process may lie in a more subtle, nuanced view of how environmental conditions set a context for social and historical interaction. James Webb, a historian of West Africa's arid zones, persuasively documents a consistent trend toward a drying climate.[18] Rather than attempting to identify specific events of human history related to climate, however, he describes the dynamics of agro-ecological zones such as the "Sahelian Cattle Zone" and the "Great Camel Zone," whose movement he traces over time and whose dynamics he describes in terms of ecological limits of the livestock economy at the core of the human context. His approach emphasizes the fluidity of these ecological economies' movement over time that underlay Sahelian political empires and the actions of local human social actors.

Webb's reconstruction of climate patterns allows him to argue that in the year 1600 the major zones of camel herding, cattle herding, and rainfed agriculture were approximately 200–300 kilometers north of their position 250 years later. By 1850 the Sahelian Cattle Zone had descended south into lands that had once been primar-

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[17]For an example of this influence see Ivor Wilks, "The Northern Factor in Ashanti History: Begho and the Mande," *Journal of African History* 2, 1 (1961).

[18]Webb, *Desert Frontier*, 4–5.

ily agricultural; the farming frontier had receding in advance of it. In other words, pastures at the northern edge of the Sahel that had at the end of the Songhay empire primarily nourished cattle, by the opening of the colonial period supported only camel herding.[19]

Such changes also have interesting and important implications for human geography, seasonal livestock movement, and the calendar of human and livestock disease. What the first generations of European colonial forces saw when they arrived in West Africa was therefore not age-old structures but a fairly new configuration of human settlement. Key historical events like the nineteenth-century jihads of Usuman don Fodio and al-Hajj Umar in fact had taken place in a setting of ecological adjustments that must at least have influenced military field strategies and the logistics of feeding the faithful, if they did not determine the movements' intellectual foundations.[20]

Webb points not to the relationship of specific historical events and ecology but to more subtle processes of environmental and cultural changes that dominated the savanna-Sahel zone in the twilight years after the decline of the great empire states. He argues that the general shifts in climate/ecology/economy that took place between the fourteenth and the seventeenth century brought desert, savanna, and Sahelian peoples in closer contact and conflict producing a new historical identity that blended the economies and historical traditions of the Arab, Amazigh (or Berber), and Mande peoples. The growth of Timbuktu from a community of 10,000 persons in 1325 to a commercial/intellectual center of 30,000–50,000 people in 1591 was part of this process rooted in ecological change, but not simply and directly attributable to it.

Webb also describes a darker side of the emerging regional economy of the seventeenth century. The trade and political relations that emerged between peoples of the southward-moving desert's edge and peoples of the savanna had harsh consequences for many as a regional slave and horse trade expanded in the seventeenth century—a trade that, for a time, rivaled the trans-Atlantic trade from the West African coast. The means of production was military strength and mobility (in which the camel played a large part), which produced human booty. As Webb states: "Viewed over the long term, it appears that as the southern shore of the desert moved southward and waves of political violence broke onto the savanna, Black Africans were caught in the undertow."[21] Ecological change in this case expanded zones of conflict and the loss of human freedom.

Taken from the perspective of environmental history as a whole, therefore, the political history of the savanna assumes a new richness. The physical environment of the great empire states was not a fixed canvas, but a shape-shifting stage that demanded a continuing set of adaptations of economic base and political structure.

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[19]Ibid., 10–11.

[20]For West African jihads see Marilyn Waldman, "The Fulani Jihad: A Reassessment," *Journal of African History* 6 (1966), 333 ff; and David Robinson, *The Holy War of Umar Tal: The Western Sudan in the Nineteenth Century* (Oxford, 1985).

[21]Webb, *Desert Frontier*, 16, 26.

Such a view of the environmental canvas of history should not diminish the importance of political leadership or human agency. If anything, an appreciation of the environmental context of the history of the West African savanna enriches our appreciation of the skill of leadership and social dynamism of West African political culture and the adaptability of African farmers. When the states of the Niger Valley finally succumbed in the late sixteenth century, the end was due to a wider set of factors than an invading army from Morocco or even an encroaching desert edge. These factors included decreasing farm productivity, the retreat of livestock herds in favor of camel husbandry, and the loss of population to slavery. If the new forms of politics and economics pointed out by Webb's work were a grim epilogue to an historical process of state-building, they were also a prologue to the birth of the new Atlantic world in which Africa and a new ecological stage played a major role.

Desertification: Africa's Hand-Made Climate?

In 1987 the highly regarded PBS science program NOVA broadcast a documentary film entitled "The Desert Doesn't Bloom Here Anymore." The film played on the public memory of the 1972–1974 famine by presenting striking images of despoiled arid landscapes from West Africa and from the western United States. In both cases, the film argued, the cumulative weight of human action had transformed a delicately balanced natural order into environmental disaster. In the U.S. example, mismanagement on corporate farms had led to declining productivity and poisoning of the soil; degradation in the African case, from Burkina Faso, resulted from human destruction of the vegetative cover, inducing both famine and the ominous advance of the southern edge of the Sahara desert. Footage of the Burkinabe village showed bleak brown landscapes and conditions of stark poverty, images particularly effective with a viewing audience from green temperate latitudes. Computer-generated animation of a Sahelian landscape showed the disappearance of trees and the southern creep of the desert. The thesis was that the historical weight of human abuse under rapid population growth and the search for profit had created degraded land and had made permanent changes in both landscapes and the regional climate.

"The Desert Doesn't Bloom Here Anymore" had an ideological message hidden in its reportage—bad land management by humans creates deserts. The argument was not just dogma, it had a basis in contemporary science. In 1974 Joseph Otterman, an Israeli climate scientist who had worked in Israel's Negev Desert, published his research hypothesis that posited a relationship between drought and the loss of vegetative cover. Specifically, he argued that bare, highly reflective soils in semi-arid zones would increase surface "albedo" (reflectivity), and reduce convective processes, thus resulting in decreased rainfall.[22] Otterman attributed vegetative change to overgrazing, though one could easily extend his thesis include to other economic activity that exposed the soil, such as tree-cutting and annual cropping. Thus in this view day-to-day human activities, especially tasks performed by women, were responsible for creating drought. This scientific hypothesis seem-

[22]J. Otterman, "Baring High-Albedo Soils by Overgrazing: A Hypothesized Desertification Mechanism," *Science* 186 (1974), 531–33.

ingly confirmed a popular suspicion in the West that African farmers and herders had brought on their own crisis.

A year after Otterman published his hypothesis, M.I.T. climatologist Jule Charney proposed a similar cause for desertification that pointed a finger directly at local land use as the agent of climatic change. Charney argued that changes in vegetative cover could indeed increase aridity. He held that desertification was not the result of a single causal factor but an ever-tightening chain of events that began with the removal of plant cover, followed by a loss of the soils' moisture retention, resulting in a reduction of rainfall that, in turn, further reduced vegetation. With this science as a backdrop, the Nova film's pessimistic images of West African farmers closed the Neo-Malthusian circle: under severe population growth, African farmers had occupied fragile lands and their poor land management had pushed the Sahel into a slide toward desert.[23]

The science of the 1970s did not evolve from a *tabula rasa* but added to an existing set of conclusions about the presence and origins of desertification in Africa from an earlier historical epoch. Anthropologist Jeremy Swift has pieced together a fascinating chronicle of colonial land studies of the late 1930s, which argued that the Sahara Desert was advancing at an alarming and measurable rate. The most widely distributed and influential of these reports, by the colonial forester E.P. Stebbing, held that the desert's advance was the result of desiccation and climate change whose root cause was human misuse of resources. As a result of these findings from across colonial Africa, French forester A. Aubrèville coined the term "desertification" to describe the human-induced process of land degradation in the West African Sahel.[24]

Swift observed an important incentive for the spread of these stories within colonial governments and, later, international donors. Placing blame on African farmers and pastoralists external agents justified colonial rule, central planning, and the urban control of rural resources. In the postindependence era desertification, however vaguely defined and applied, a justification of coercion and paternalism by urban elites, was already rather firmly in place by the time the African Sahel experienced the severe droughts of the mid- 1970s.

Based on early colonial assertions, embryonic scientific hypotheses, and popular assumptions of the 1970s, the idea of human agency in African climate change diffused subtly into international policy and media representations of the late 1970s, 1980s, and 1990s. In 1977, for example, the influential environmentalist

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[23]J. G. Charney, "Dynamics of Deserts and Drought in the Sahel," *Quarterly Journal of the Royal Meteorological Society*, 101 (1975), 193–202. Also see Mike Hulme and Mick Kelly, "Exploring the Links Between Desertification and Climate Change," *Environment* 35 (July/August 1993), 5–55, 39–45.

[24]Jeremy Swift, "Desertification Narratives, Winners and Losers," in Melissa Leach and Robin Mearns, eds., *The Lie of the Land: Challenging Received Wisdom on the African Environment* (Oxford, 1996), 73–90. At the forest edge an analogous process of alleged degradation has been called "derived savanna." For a fuller explication of this debate see James Fairhead and Melissa Leach, *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic* (Cambridge, 1996).

group Worldwatch Institute and its director Lester Brown officially linked the Sahara's advance with such African land use practices as overgrazing, increased cultivation, and firewood gathering. In that same year the United Nations Conference on Desertification asserted specific figures for desertification: 10 percent of the earth's surface was "man-made" desert and another 19 percent was under threat by human mismanagement. By the mid-1980s linking African farmers and pastoralists with advancing desert was commonplace in the popular press, even in such reputable organs as *National Geographic*, which projected the definitive aura of science and richly illustrated the degradation narrative.[25]

But what does actual evidence from the past contribute to this issue? In fact, empirical historical evidence and new findings in the science of climatology present a very different set of causes for the African Sahel's crises of the late twentieth century. In this new research, there is evidence that human action and population growth indeed has changed the physical landscape by altering vegetative cover, but the meaning and direction of that change contradicts the human degradation narrative.

In the late 1970s a new counterveiling historical perspective on the Sahel's crisis of desertification came from climate historian Sharon Nicholson (see above), who combined the evidence from historical landscape descriptions, modern climate models, and research on lake levels from Lake Chad to reconstruct a history of desiccation of the Sahel.[26] From this evidence and rainfall data for the past twenty-five years, it is clear that the Sahel's climate patterns since 1970 represents the most dramatic sustained decline in rainfall ever recorded anywhere in the world. Nicholson's historical study plus the work of George Brooks and James Webb linking climate to historical processes put recent climate crises in perspective. Recurrent drought periods lasting one or two decades have been a persistent feature of the Sahel over the past five hundred years. The most recent period, however, has been remarkable in its low levels of moisture. The Lake Chad levels in particular indicate that the late-twentieth-century desiccation is at least as severe as any in the last millennium.[27]

Pessimists, however, could also read Nicholson's 1978 evidence, as confirming the cumulative nature of the climatic crises and the role of increasing population pressure and mismanagement as the cause. The current generation of climate science, however, casts an entirely different light on Nicholson's results, pointing to extra-African sources rather than human activity, as the cause of the Sahel's climatic catastrophe.

Climatologist Peter Lamb as early as 1978 had differed with the anthropogenic (human cause) thesis by pointing out the connection between oceanic conditions in

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[25]E. Eckholm and L. R. Brown, *Worldwatch Paper* 13 (Washington, D.C.: Worldwatch Institute, 1977), 1; United Nations Conference on Desertification, *Round-Up Plan of Action and Resolutions* (New York, 1977), 2, cited in Swift, "Desertification," 80; W. S. Ellis, "Africa's Sahel: The Stricken Land," *National Geographic* 172 (August 1987).

[26]S. E. Nicholson, "Climatic Variations in the Sahel and Other Africa Regions During the Past Five Centuries," *Journal of Arid Environments* 1 (1978), 3–24.

[27] Hulme and Kelly "Exploring the Links," 10.

the Atlantic and African climates.[28] By the early 1990s more science and consciously historical studies began to accumulate evidence to challenge the human degradation narrative for the Sahel and adjacent zones. In 1991 data from polar-orbiting satellites examined the movements of Sahelian vegetation over the 1980 to 1990 period in relation to annual changes in rainfall. This study showed that the Sahara's southern edge had indeed moved, but that it has fluctuated both north and south depending on the levels of each year's rainfall. It argued that previous evidence had been both overly localized and anecdotal.[29] Other work, this time at the British Meteorological Office, also reevaluated the evidence for vegetation's effect on the Sahelian climate. This research indicated that while land surface feedback can play a minor role in sustaining drought, ocean temperatures (especially the Hadley circulation in the North Atlantic) had a far greater role in determining rainfall patterns by affecting the position of the Inter Tropical Convergence Zone (ITCZ). These larger oceanic conditions may result, in turn, from the effects of global warming that appear to differ between northern and southern hemispheres.

This new body of research also supports Lamb's evidence pointing to a causal effect between lower ocean surface temperatures in the Atlantic north of the equator and higher ones to the south. There may therefore be some reason to believe that the Sahel's recent desiccation has been a product of an overall global warming that has occurred in the second half of the twentieth century.[30] Desertification therefore seems more attributable to global climatic processes than to local human action. From this new perspective, farm-level actions along the edge of the desert may well be responses to long-term climate change rather than causes of desert encroachment. In this context a number of new studies of African land use have offered fresh insights into the relationship between African peoples, population, and landscapes. In other words, the African farmers in "The Desert Doesn't Bloom Here Anymore" were more likely to be victims of a changing environment than its perpetrators.

Intra-annual Patterns: The Seasons

Despite the examples above, approaches to climate within African historiography overall have not seriously addressed either the problems of climate data or the development of a methodology appropriate to types of climate evidence available in preliterate societies. There have been few if any attempts, for example, explicitly to link questions of climate to micro-level studies of communities, villages, or ethnic groups that have been the hallmark units of analysis within Africanist historical and social science scholarship. Studies such as those described above have taken place on a national or regional scale on the basis of interannual patterns of climate impact that provide little or no foundation for establishing a precise relationship between

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[28]Peter J. Lamb, "Large-Scale Tropical Atlantic Surface Circulation Patterns Associated with Sub-Saharan Weather Anomalies," *Tellus* 30 (1978), 240–51.

[29]Compton Tucker, Harold E. Dregne, and Wilbur W. Newcomb, "Expansion and Contraction of the Sahara Desert from 1980–1990," *Science* 253 (July 1991), 299–301. Also see "Satellites Expose Myth of Marching Sahara," *Science News* 140 (July 20, 1991), 38.

[30]Hulme and Kelly, "Exploring the Links," 40–41.

the effect of climate on local social, economic, and political life. African ecological and climate history would be far better served by a focus on the reconstruction of climatic and ecological systems, as in Webb's approach, rather than on crises. In Africa, the role of interannual variation—the seasons—has a far greater potential for describing historical interaction between human populations and their physical environment.

Africa's annual cycle of weather is seasonally predictable as a pattern, if at times erratic on a year to year basis. The winds that bring moisture to Africa north of the equator move in patterns from south to the north of the equator with the rotation of the earth toward the sun in the summer months (June to September). The movement of the turbulence north of the equator brings summer rains in the northern hemisphere. The onset of these rains has a remarkable effect. Within two weeks brown, lifeless landscapes turn green, seeds germinate, and chemical reactions within soils make nutrients available to plants. In sharp contrast, from December through March air masses from the north dominate, creating a long dry season as the rain-producing ITCZ turbulence moves south of the equator. In the dry season fields ripen for harvest, pasture grasses shift into dormancy, and livestock migrate to pasture near water sources. Several years of short or delayed rains, however, constitute drought, historically a common occurrence in much of Africa. Yet vegetation patterns, animal movements, and human economies in Africa have adjusted to these repetitive patterns over several millennia.

Over the longer geological time frame Africa's climate has been more often dry than wet and more often warmer than cooler. Its seasonal transitions from wet to dry and the most dramatic anywhere. These long-term fluctuations have been significant during epochs of human history in which Africa social institutions and economic strategies evolved with the experience of human communities and individual farmers, hunters, and pastoralists. In his ambitious synthesis *Africa: History of a Continent*, John Iliffe offers the generalization that Africa's agricultural systems were historically mobile, a strategy to adapt to the environment and the climate rather than transforming them. Seasonal movement of people, domestic livestock, and animals was such an adaptation. As Iliffe suggests, most livestock economies in Africa chose to follow the movement of moisture and pasture rather than stockpiling their animals' food supply. Choices to migrate by herders of camels, cattle, sheep, or goats were finely tuned judgments about those species' needs for food and moisture, as well as their capacity to work and serve as a form of wealth.

Yet, as always, there has been an infinite set of variations and exceptions. In northern Ethiopia farmers did not move with the seasons but rotated the planting of cereals, pulses (peas and beans), and fallowing in a fashion finely tuned to the arrival and departure of summer rains followed by a long dry season. In Eastern Sudan, camel-herding Hadendowa planted sorghum in moist riverain soils and then retreated with their animals to distant wet season pastures until the harvest was ready eight months later. Farmers in northeast Zambia practiced *citemene*, a system of shifting seasonal agriculture that required large tracts of land but maximized

scarce soil nutrients.[31] In East Africa the Maasai historically followed pasture with their herds of cattle and goats, carefully avoiding full contact with thickets of acacia scrub infested with tsetse flies bearing deadly sleeping sickness (trypanosomiasis).

In previous generations, historians have seen climate's role in human activity as the effect of average long-term conditions that either permitted particular economic activities or restricted them. Social science research held that rainfall or temperature figures averaged over a period of time indicated the viability of certain agricultural or pastoral regimes. A certain threshold average of rainfall, for example, determined the viability of maize versus wheat production, rice versus cotton, or cassava versus bananas. By the late 1980s, however, studies of poverty in agricultural communities and climatological impact studies came to appreciate the importance of inter-annual variation in climate, particularly rainfall, as demonstrated in recent African droughts.[32] By the early 1980s micro-level community studies went further to demonstrate the critical nature of intra-annual variations in climate and agricultural cycles of labor and food availability. In 1981 Robert Chambers and a group of social scientists meeting at the University of Sussex developed guidelines for understanding the effects of the distribution of climatic features intra-annually, what they called "seasonality."[33] Others have expanded the idea, noting the obvious fact that the greatest demand on agricultural labor at harvest in most agrarian systems necessarily precedes the greatest supply of food.[34]

The great problem with seasonality is that the onset of seasons and levels of rainfall vary, while the Chambers model operates on the basis of an average year. In the actual rainfall regime faced by farmers, the question has been whether rains that began last year on June 12th will do so again this year and whether the level will be sufficient to begin the full cycle of events necessary to plant and harvest a crop. The uncertainty of levels from one year to the next underlies farm-level decisions historically. Farmers may well know the general features of seasonality within their farming system but they cannot predict the more subtle annual variations of the seasons' onset and duration and thus must build risk aversion strategies around these uncertainties. In most areas of Africa historically prone to drought, year-to-year variability is a strong feature: climatic data show rather conclusively that the lower the annual total, the greater the degree of variability.[35] Thus the seasonality models must incorporate the idea that economic and social institutions interpret the effects of climate and, over time, become part of social adaptation.

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[31] Henrietta Moore and Megan Vaughan, *Cutting Down Trees: Gender, Nutrition, and Agriculture in Northern Rhodesia* (Portsmouth, N.H., 1994).

[32] Glantz, "Drought, Famine, and the Seasons," 2.

[33] Robert Chambers, Richard Longhurst, and Arnold Pacey, eds., *Seasonal Dimensions to Rural Poverty* (London, 1981).

[34] For an excellent discussion of the seasonality of food supply, see Jane Guyer, "Synchronizing Seasonalities: From Season's Income to Daily Diet in a Partially Commercialized Rural Economy (Southern Cameroon)," in David Sahn, ed., *Causes and Implications of Seasonal Variation in Household Food Security* (Washington, D.C., 1987), 1.

[35] Ramussen, "Global Climate Change," 7; and Glantz, "Drought, Famine, and the Seasons," 8.

The best measure of the climate in which farm decisions have been made and rural institutions and strategies have adapted over time is one that takes into account questions of the rhythm of the seasons in both human and climatic activity, i.e., links between the agricultural cycle and climate, as well as variability within each. This approach operates not in terms of mean rainfall figures calculated on an annual or monthly basis (the most commonly cited statistics) but on raw figures of monthly rainfall calculated on the basis of variability or a regional or local level over twenty years or more. The coefficient of variation calculated on a monthly or ten-daily basis provides an indicator of seasonal variation over time as well as the range of variation for rainfall over time.[36] This approach thus allows the reconstruction of key climatic patterns in which farming systems developed historically; it emphasizes normative *ranges* rather than fixed patterns and avoids the temptation to explain climate and social responses to it as a series of idiosyncratic crises.[37]

Annual rainfall totals in Africa may change drastically over time and cannot be reliably proven to be cyclical or to form patterns historically reconstructable from contemporary data, whereas variability is a function of more immutable geophysical features such as topography and elevation.[38] The study of seasons and variability does not rely on absolute figures but on the more reliable indicator of patterns verifiable from recent empirical data and the principle that variability itself was a part of local climate and therefore a factor in development of human seasonal strategies over time. These strategies include interaction with the basic features of farming/social systems: crops and crop mix, technology, the timing of labor demands, livestock/crop integration, and soil characteristics.

Though there is good evidence from the perspective of the *longue durèe* that some aspects of the seasons can change over time or within distinct epochs of high or low rainfall, the principles of variation appear to be fairly consistent. If we do not have reliable rainfall data for formative periods of highland Ethiopian history, for example, we can at least provide analysis based on patterns of variation and not rely solely on anecdotal and subjective evidence of crises such as droughts. This approach has important implications for areas where historical climate data are weak, since historical patterns of variability within the between seasons can be established with more recent and reliable time series data. In Africa, where annual rainfall time series data prior to World War II are unavailable, historians have here-

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[36] The coefficient of variation is the standard deviation divided by the mean; the lower the coefficient the higher the reliability of rainfall. This calculation is now commonly used by climatologists as the standard measure of climate variation. Meteorology uses often ten-day periods rather than seven-day weeks.

[37] The social and agronomic responses to such climate patterns should therefore by the focus of research on climate social interaction. For an example of such work, see James C. McCann, "The Social Impact of Drought in Ethiopia: Oxen, Households, and Some Implications for Rehabilitation," in Glantz, ed., *Drought and Hunger*, 245–68.

[38] I am grateful to former Boston University physical geographer Chi-ho Sham on this issue.

tofore tended to resort to anecdotal information or mean annual figures to explain widespread social and political effects of climate.[39]

The relationship between these patterns of climate and human adaption raises questions critical to the field of climate history as well as agricultural history. Establishing the exact nature of relations between social-economic activity, military campaigns, ritual calendars, and seasonal rhythms of climate has major implications for understanding the long-term development of social institutions in African agricultural communities. The climate/social response effect is not direct, but is rather mediated through such environmental factors as forage availability, crop responses, soil characteristics, and such socioeconomic patterns as institutions of labor exchange, kinship obligations, indebtedness, and property distribution.

Effects of particular climate characteristics on human action are not uniform but vary across the economic and social landscape. The experience of seasonal variation on a particular social and technical production system produces, over time, a distinct bundle of socially acceptable and expected strategies that contribute to and are influenced by political, social, and economic norms. Arguing from her Beti (Cameroon) fieldwork, Jane Guyer has noted with respect to seasonal variation that:

> Through living in a particular social and ecological environment over time people develop a known repertoire of strategies which become part of customary knowledge, socially maintained as a resource and predictably mobilized when the need arises. The mediation of seasonal income and daily needs entails a whole system of culturally and socially buttressed practices.[40]

This approach suggests less environmental determinism than a need for more complete understanding of the historical conditions under which societies and local communities developed economic and social strategies.[41]

Seasonal needs for labor, for example, may not be the sole determinant of whether horizontal ties of cooperation develop over vertical patron-client relations, but they may strengthen or alter existing institutions for labor exchange between social units. Bryson and Paddock suggest that climate variables such as the timing of rainfall can affect the mix of crops, use techniques, and choice of occupations through factors of risk and profitability.[42] In the case of northern Ethiopia, the indebtedness resulting from inconsistent spring (*belg*) rains has over time strongly reinforced local stratification. Conversely, changes in the political or economic environment can alter specific effects of a seasonal regime. For northern Nigeria

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[39] Examples of this tendency are Miller, "The Significance of Drought"; Diaz, "Famine and Disease"; and Gregory Maddox, "Njaa: Food Shortages and Farming in Tanzania between the Wars," *International Journal of African Historical Studies* 19 (1986), 17–34.

[40] Guyer, "Synchronizing Seasonalities," 1.

[41] Michael Watts, "The Sociology of Seasonal Food Shortages in Hausaland," in Chambers et al., *Seasonal Dimensions*, 201, notes dangers of environmental determinism and points to evidence that the effects of seasonality can and do change along with relations of production.

[42] Bryson and Paddock, "The Climates of History," 3.

Michael Watts argues convincingly that the new political economy of colonial rule altered the social and economic impact of seasonal climate variation.[43] Thus, precise historical and social circumstances create a range of seasonal effects and each situation must receive particular attention.

Climate in the New African Environmental Historiography

Over the course of the past decade research and writing on African environmental history has expanded in its scope and deepened in its sophistication. In particular this new African environmental history has moved dramatically away from its reductionist beginnings to put the natural world into full play alongside social and political institutions of local peoples and regional social formations. At another level of analysis, the new work also historicizes Africa's political ecology of natural resource use. The beginnings of this movement were evident in the influential volume *Conservation in Africa* edited by Richard Grove and David Anderson, which examined colonial policies governing natural resource use (terracing, livestock management, hunting, forest policy). Other writing, on Tanzania in particular, widened the focus on colonial policy to emphasize the evidence of ecological control of disease, natural vegetation, and food security. The pioneering works were Helge Kjekshus's *Ecology Control and Economic Development in East African History* (Berkeley, 1977) and Juhani Koponen's *People and Production in Late Precolonial Tanzania* (Jyväskylä, 1988). A remarkable measure of how far work on the environment has come can be seen in the essays included in *Custodians of the Land: Ecology and Culture in the History of Tanzania,* edited by Gregory Maddox, James Giblin, and Isaria Kimambo, a volume that presents fine examples of a new generation of scholarship by historians based on field interviews and formal ecological training.[44] A further theme in the most recent research has moved one step further in looking at local cognitive dimensions of environmental history.[45]

As the field of African environmental history has grown in depth and scope in recent years, how has its treatment of climate as a "limiting factor" or as a part of historical conjuncture changed or infused itself into the analysis of historical ecology? In truth, the new generation of environmental history takes the explicit study of climate in no more serious a fashion than did the earlier generation. One notable exception is the masterful work of James Giblin that examines seriously the linkage between precolonial political authority and control over rainfall as one dimension of

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[43] Watts, "Sociology of Seasonal Food Shortages," 201.

[44] Gregory Maddox, James Giblin, and Isaria Kimambo, eds., *Custodians of the Land: Ecology and Culture in the History of Tanzania* (Athens, Ohio, 1996).

[45] For new work on cognitive issues in environmental history, see Yusufu Qwaray Lawi, "May the Spider Web Blind Witches and Wild Animals: Local Knowledge and the Political Ecology of Natural Resource Use in Iraqwland, Tanzania, 1900–1985" (Ph.D. dissertation, Boston University, 1999); and Tamara Giles-Vernick, "We Wander Like Birds: Migration, Indigeneity, and the Fabrication of Frontiers in the Sangha Basin of Equatorial Africa," *Environmental History* 4, 2 (1999), 168–97.

overall social well-being within a political community (Handeni District in northeastern Tanzania).[46]

If climate is not an explicit interest of this generation, however, the new work still consciously offers a far thicker context of social, cognitive, and economic history in which we can understand human agency and engagements with the natural world, including climate. This new richness of social context of resources use and congnitive structures of human and natural domains comes from works by Robert Harms, Jan Vansina, Gregory Maddox, David Anderson, Richard Waller, Elias Mandala, Jamie Monson, Yusufu Lawi, Tamara Giles-Vernick, and others.[47] With this emerging depth of research and theory, simplistic climatic reductionism is no longer a temptation. The new African environmental historiography thus weaves the nuances of seasonality and longer-term social adaptations to climate crises into a coherent historical fabric that both recognizes local patterns and accommodates global change in political ecology.

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[46] James Giblin, *The Politics of Environmental Control in Northeastern Tanzania, 1840–1940* (Philadelphia, 1993).

[47] See the works of these scholars cited above, plus Robert Harms, *Games Against Nature: An Eco-cultural History of the Nunu of Equatorial Africa* (Cambridge, 1987); Jan Vansina, *Paths in the Rainforests: Toward a History of Political Tradition in Equatorial Africa* (Madison, 1990); Gregory Maddox, "Mtunya: Famine in Central Tanzania, 1917–1920," *Journal of African History* 31, 2 (1990), 181–98; Richard Waller, "Emutai: Crisis and Response in Maasailand, 1883–1902," in Douglas Johnson and David Anderson, eds., *The Ecology of Survival: Case Studies from Northeast African History* (Boulder, Colo., 1988), 73–112; Elias Mandala, *Work and Control in a Peasant Economy: A History of the Lower Tchiri Valley* (Madison, 1990); Jamie Monson, "Canoe-Building Under Colonialism: Forestry and Food Policies in the Inner Kilombero Valley," in Giblin, Maddox, and Kimambo, eds., *Custodians of the Land*, 200–212.