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Title

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Permalink

<https://escholarship.org/uc/item/2ps5c9tr>

Journal

American Indian Culture and Research Journal , 22(3)

ISSN

0161-6463

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Publication Date

1998-06-01

DOI

10.17953

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Crops, Cattle, and Capital: Agrarian Political Ecology in Canyons de Chelly and del Muerto

TRACY J. ANDREWS

In 1863, on the heels of quieting the turmoil of this country's civil war, the U.S. government turned attention to finding a final solution for ongoing conflicts with the Navajo. To this end, plans were initiated to destroy Navajo livestock and horticultural resources in several critical production areas. By the winter of 1864, crops and herds had been severely reduced; on January 6th, a military expedition set out to deliver the final blow "at that traditional target of Navajoland" and the focus of this study—Canyon de Chelly and its major tributary, Canyon del Muerto. The Navajo were coerced through direct military domination or the threat of starvation into relocating to what was planned as a small agricultural reserve along the Pecos River in eastern New Mexico, near Fort Sumner—a place the Navajo call Hwéeldi. This plan followed decades of federal-Indian policy characterized by Jacksonian-era removals of Native Americans out of the path of the progressive westward expansion of Euro-American colonial settlement.¹

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Removing the Navajo far from their home area served the U.S. national interests of pacifying, reforming, and ultimately "civilizing" Native Americans. As the head of the New Mexico military command described, the removal and incarceration of the Navajo was necessary because, "only away from the haunts and hills and hiding places of their country," could Navajo children have full opportunity to be Christianized and acquire "new modes of life." Across much of the contemporary United States, the template for this process throughout the nineteenth and into the early twentieth century included assigning families to individual ownership of small farms that were expected to provide an adequate subsistence resource base.²

In the Southwest, regional political economic goals also focused on gaining access to arable land, as well as to the highly anticipated, although as of yet undocumented, mineral wealth of "Navajo country." New Mexico's governor pinpointed the immediate impetus for the removal policy when he noted in his 1863 address to the Legislative Assembly,

Navajos occupy the finest grazing districts within our limits, and ... infest a mining region extending two hundred miles north by ... the same extent east and west ... [thus] an immense [Euro-American] pastoral and mining population is excluded from its occupation and the treasures of mineral wealth that is known to exist ... have remained untouched. The public interest demands that this condition of things should cease to exist.³

In concert with national policies, it was thought that lasting peace could be attained only when the Navajo, "like the Pueblos become an agricultural people and cease to be nomads."⁴ Creating an agricultural economic base to replace the Navajo's more diverse hunting/farming/livestock subsistence practices was expected, both to require less land (hence freeing more resources for non-Indians) and to facilitate exerting control over a more settled and localized farming population.⁵

The agricultural development experiment at Fort Sumner was a failure, undermined by "[f]raud, alkaline soil, weather, bureaucratic bungling, and administrative factionalism," while many Navajos died from disease and starvation in the wake of this ill-conceived vision. In 1868, a treaty was drawn up creating the initial segment of the contemporary Navajo reservation across what is now northern Arizona, southern Utah, and

northwestern New Mexico. The Navajo who survived Fort Sumner were allowed to return to that small portion of their former area. The mineral wealth in precious metals had not materialized, American colonial interests stretched to the Pacific Coast leaving no more "unoccupied lands" to absorb displaced Indian peoples, and non-Indian settlers in the region maintained a fear and hostile distrust of the Navajo. Hence, for U.S. national and regional interests, it was most expedient to restrict them to a defined, and still fairly remote, section of their homeland.⁶

The U.S. military and Anglo-European settlers' descriptions of encounters with Navajos focused on their livestock raiding; however, from the earliest historical records there are descriptions of Navajo farming. Archeological data indicate that the Navajo moved into the American Southwest as hunters and gatherers sometime before 1500 A.D. Here—in what the Navajo call Dinétah, their homeland—they took up small-scale agriculture among the tributaries of the San Juan River in northern New Mexico, probably borrowing farming techniques from nearby Puebloan Indians. Stock raising—focused on sheep, and to a lesser extent cattle, obtained from the Spanish—became an increasingly important component of the Navajo subsistence base. Along river drainages, however, and in many canyon and mountain locations, fields of corn and other vegetable crops continued to contribute significantly to household subsistence. In areas with sufficient rainfall, dry farming was possible; indigenous irrigation practices included locating fields where they could be watered by intercepted flood waters, and annually building dikes in flatland areas to contain spring floods. Rather than simply following nomadic seasonal movements determined by livestock pasturage needs, the location and availability of arable farm sites often had a major impact on Navajo settlement and livestock grazing patterns.⁷

One area that was particularly known for the extent and quality of its farm sites was Canyon de Chelly and its major tributary Canyon del Muerto, located in northeastern Arizona near the center of the contemporary Navajo Nation. Since the 1700s these canyons have been considered a Navajo "heartland," and they were one of three sites suggested for development as "agricultural pueblos" to accommodate Navajo resettlement prior to the Fort Sumner experiment.⁸ Their unique topographic features, including a high water table, afforded

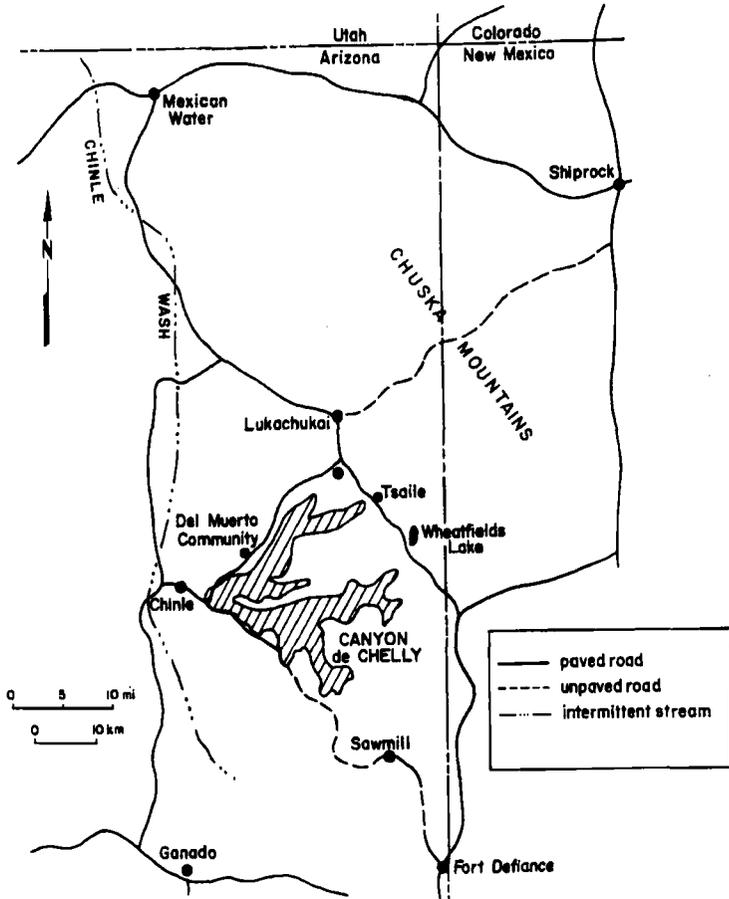


Figure 1: The Canyons in Regional Perspective

not only an unusually dependable horticultural base, but also a natural refuge that provided shelter from intruders until the middle of the nineteenth century. Military reports describe expansive fields, “laid out with farmer-like taste, and supplied with *acequias* for irrigation.” Unlike other areas, canyon Navajos employed indigenous systems of ditch irrigation as well as floodwater farming.⁹

Canyons de Chelly and del Muerto are usually referred to as a single social and economic community, as well as being subsumed under one topographic designation—Canyon de Chelly. This perspective highlights their linked natural environment and accents the general similarities between them as

examples of indigenous Navajo farming communities within a society widely described as pastoral. However, my ethnographic surveys of contemporary canyon families (93 percent interviewed) and their field production histories (97 percent of farm sites) reveal important distinctions in the land-use history of Canyon de Chelly as compared to Canyon del Muerto.¹⁰ These differences reflect variability not only within the natural resource base, but also in several critical sociocultural factors, including household and farm socioeconomic characteristics. This diversity is often overshadowed by the common designation of the canyons as a single geopolitical unit, encompassing a presumably homogeneous physical and cultural landscape.

This paper examines the differential impacts of a constellation of factors on Navajo farming and ranching, including government-sponsored resource-management programs in and adjacent to the canyons. In part, these programs reflected both general U.S. federal-Indian policies and regional political economic interests; they sought to "improv[e] the [canyon] environment" in support of broader goals of integrating Navajos into the fabric of American culture and the national economy as family-based subsistence farmers and ranchers, while supporting regional hydroelectric and commercial agribusiness development interests linked to the West's growing non-Native population.¹¹

As Jorgensen has noted for the United States in general, and Aberle, White, Levy, Kelley, and others for the Navajo in particular, the "underdevelopment" of Native American economies has been a consequence of processes that drive the "development" of non-Native commercial interests. Such analyses, whether focused nationally or on world-systems linkages, identify significant basic commonalities in political economic contexts and outcomes of dependency and underdevelopment.¹² A political ecology approach links these macro-level factors to the micro-level context of human-environment relations through focusing attention on potential complexity in local ecologies and family socioeconomic characteristics as forces shaping land-use practices. In addition, cultural perspectives regarding land use that carry meanings and valuation priorities must be considered—for, in tandem, these form the critical context for understanding historical land-use patterns, as well as the configuration of contemporary options.¹³

ECOLOGICAL DIVERSITY: THE MICRO-LEVEL CONTEXT.

The Navajo Nation is situated within the Colorado Plateau topographic province. The Defiance Plateau, a highly localized uplift, lies along the Arizona-New Mexico border in a narrow band approximately thirty to forty miles wide and one hundred miles long.¹⁴ Canyon de Chelly and its main tributary Canyon del Muerto were incised into the Defiance Plateau by the downcutting of large perennial streams flowing westward from the nearby Chuska Mountains as the eastern section of the Plateau gradually uplifted (Figure 1). The streams maintained their natural meanders as they cut through initial layers of conglomerates and underlying Permian sandstones to form the dramatically twisted and curved vermilion canyons of the present day.

The canyons' oldest, and deepest geological feature, the Supai Formation, has been of great significance for human occupation. Because this sandstone layer is relatively impermeable to groundwater, the Supai Formation has helped create a high water table—an invaluable asset to agricultural pursuits for at least one thousand years.¹⁵ Within the canyon system, however, the amount of arable land and available water varies due to natural topographic and geologic factors, as well as to the impact of human use and alteration of the environment.

The Canyon System Environment

The Navajo Nation spans an area described as semiarid, and the canyons ordinarily receive low levels of mean annual precipitation (about ten to eleven inches) because of their location in a high desert plateau surrounded by mountains to the northeast, east, and southeast.¹⁶ Most of the precipitation occurs in summer rains that arrive in the form of short and extremely violent thunderstorms, often so localized that they water no more than a few hundred acres. The average length of the growing season is 145 days, but freezes into late June are not uncommon.¹⁷ Successful farming would seem extremely uncertain under these precarious climatic conditions, yet from the earliest written records in the 1700s, the canyon system has been described as an important agricultural center for the Navajo. In the 1930s, Hill still contrasted it with other areas on

the reservation, noting that he had never heard of crop failure occurring in the canyons from lack of water.¹⁸

A number of factors distinctive to the canyons have tended to buffer the effect of low and unpredictable rainfall. Spring snowmelt in the nearby Chuska Mountains normally results in stream runoff throughout the canyons, so some fields can be irrigated before they are planted and into the critical early growth period.¹⁹ The water table also remained fairly high during the summer due to the impermeable underlying Supai Formation. Recently, however, vertical erosion and lowering of the water table has affected land-use options and agricultural production potential in some canyon areas.

Across the southern Colorado Plateau, primary (or major) natural erosional cycles have occurred at regular intervals (roughly every 550 years) during the last two thousand years. From the prehistoric Anasazi through the contemporary Navajo occupation of Canyons de Chelly and del Muerto, a complex combination of human factors also has influenced the local environment. Archeological data indicate that the initial prehistoric occupants found cottonwood, willow, and other riparian vegetation in abundance along the canyon bottomlands. With population increase, local plant resources were progressively depleted, although the extent of the resulting vegetation reduction can only be inferred.²⁰

The most recent major erosional cycle in the region began in the late 1880s. By the turn of the century, photographs show that the lower and middle reaches of the canyons were covered mainly with low grasses, and only a scattering of streamside trees and shrubs.²¹ Reports describing the threatened destruction of a number of the canyons' large prehistoric Anasazi sites by natural lateral meandering of the canyon streams, and the growing evidence of vandalization through pot hunting, became a focus of scholarly concern. To protect the canyons' archeological resources, they were designated a national monument in 1931, and extensive erosion-control projects were undertaken in the canyons by the National Park Service (NPS), Soil Conservation Service (SCS), Indian Irrigation Service (IIS), Bureau of Indian Affairs (BIA), and other federal agencies.²² For example, the streambeds of the lower and middle sections of both canyons now are lined with thick stands of large cottonwoods as a result of vegetation planting programs.

While linked physiographically, the concept of a single social "community" encompassing both canyons more accu-

rately reflects a response to outside political factors, whether it be military depredations; the designation of the canyon system as a national monument; or Navajo Nation, federal land management, and other governmental divisions. Since the earliest Navajo occupation, important distinctions have existed between the social and land-use histories of the two canyons. Even at present, some families using land in Canyon del Muerto report having never visited or traveled into de Chelly, and vice versa. Since they do not have any relatives in the "other canyon," they indicated that they had "no business going there." Intermarriage between de Chelly and del Muerto families occurs, but landholdings generally remain distinct.²³

The Physical Landscapes

Canyon de Chelly is approximately twenty-seven miles long, while Canyon del Muerto is nearly eighteen miles in length. Most farming occurs in the lower one-third to one-half of each canyon and their main tributaries. Following De Harport, the main de Chelly canyon can be divided roughly into three topographic zones. In the lower section, between its mouth and the junction with Canyon del Muerto, the sandy floodplain of the Rio de Chelly occupies much of the canyon floor. Here, cultivable bottomland is largely restricted to the mouths of small side canyons and "alcoves," or small areas containing arable land hollowed out of the canyons' walls by natural erosion processes.²⁴ This section of de Chelly is usually dry throughout the summer except after intense rainstorms, which can flood the lower canyon. However, even when there is no flow through the stream channel, water can be obtained in numerous locations by digging shallow wells, usually no more than two to three feet deep.

The streambed is more restricted in the middle section of Canyon de Chelly. Arable land is more abundant, particularly on alluvial terraces on either side of the stream. Waterflow is similar to the pattern in the lower section but severe vertical and lateral erosion has washed away portions of many fields and seriously threatens others. In places, banks more than fifteen feet in height have been eroded. In the upper section of Canyon de Chelly, the stream channel is even more restricted, and the increasing development of talus at the base of the

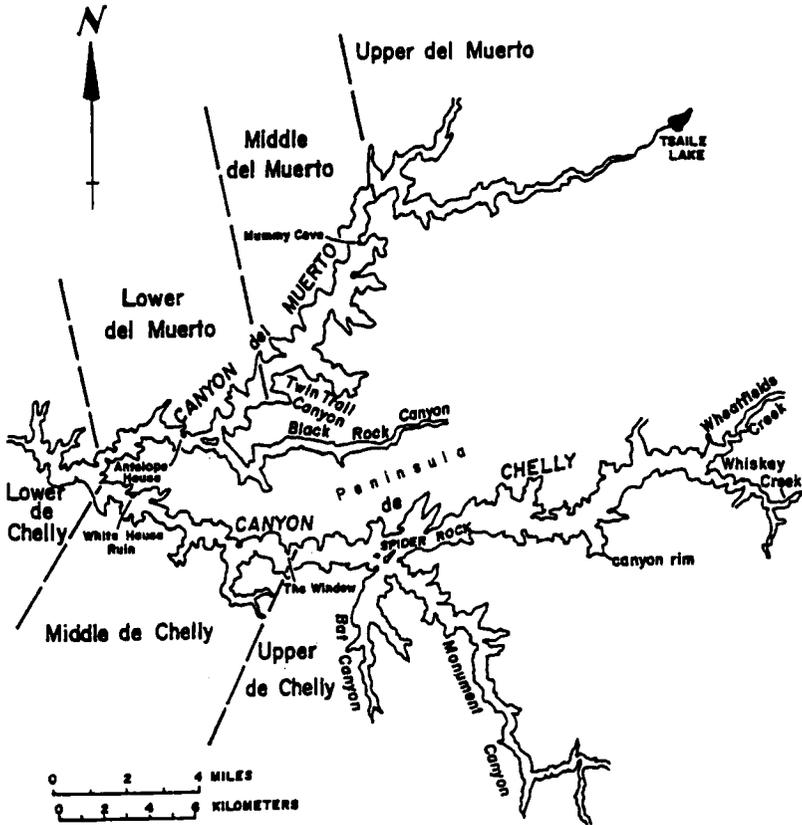


Figure 2: The Research Area, Topographic Units

canyon walls significantly restricts areas of arable land. Canyon residents pointed out only a handful of garden sites that were ever planted above Spider Rock, where the land has always been used primarily for seasonal livestock grazing.²⁵

Canyon del Muerto can also be roughly divided into three topographic zones.²⁶ It is consistently narrower than de Chelly and, especially within the first four miles above its mouth, is more sinuous—as described below, these are important distinctions for field irrigation. In the first few miles of the main del Muerto canyon, streamflow usually has not cut banks more than two to four feet deep, and the stream channel is relatively clear of vegetation. Moving further up canyon, stream channelization and vertical erosion increases, and vegetation has migrated into the streambed.²⁷ In the middle section of the

canyon, del Muerto widens and straightens and the channel deepens and narrows. Erosion has created a terracing effect in many places. Fields often are located on two different levels, one almost adjacent to the streambed and another on a ridge as much as eight to ten feet above the wash. In the upper section of Canyon del Muerto, talus slopes significantly reduce the amount of arable land. The last field area in del Muerto is at a farm about five miles above Mummy Cave, but most of the land is used now for seasonal livestock grazing.

The natural meandering of both canyons produces local changes in the stream channel, resulting in irregular profiles and water table levels. In this steep-walled and often narrow canyon environment, crop production also is influenced by microenvironmental contrasts in field locations with respect to sunlight (north or south-facing exposures), and rain runoff from the canyon rims one thousand feet above, which create cascading waterfalls with severe erosive potential after summer storms. Human use of, and attempts to manage, the canyons' natural landscapes has further complicated the picture.

THE POLITICAL ECONOMIC CONTEXT

Locally, jurisdictional issues are not just long-standing, but ongoing, and undoubtedly will take on increasing importance with the growing popularity of the canyons as a tourism site. Designating Canyon de Chelly, Canyon del Muerto, and their tributaries as a national monument created a sociopolitical context in which local residents, the Navajo Nation, and the U.S. National Park Service continue to have overlapping, and sometimes competing, interests. These interests include managing the fragile semiarid canyon environment, developing the area's economic potential while presenting a showcase setting for the outside world, protecting the canyons as a place of traditional religious and cultural significance to the Navajo, and meeting the everyday concerns of canyon families for whom the land is part of their lives and household economies.

The Geopolitical Setting

The western edge of the original 1868 Navajo reservation passed just outside the mouth of Canyon de Chelly. After the

release from Fort Sumner, there was a gradual resettlement of the canyons by Navajos returning to their home area, rejoining those who had avoided incarceration.²⁸ Scientific expeditions in the canyons began in the 1870s, initially as part of the Wheeler Survey, and then motivated by discovery of the canyons' prehistoric Anasazi ruins. Sightseers were lured to the canyons by popularized journal accounts; while they have long been a regional attraction, national and international visitation has increased consistently in recent years.

Establishing the canyons as a national monument has been characterized by a long history of conflicting opinions regarding the responsibilities of the separate federal, Navajo Nation, and tribal community agencies towards the local Navajo population, including jurisdictional rights to enforce regulations limiting Navajo land-use activities.²⁹ An important complicating factor for the Park Service's presence in the canyons is the fact that title to the land remains with the Navajo Nation, rather than with the National Park Service—a nearly unique situation.

Generally, the NPS is responsible for administering the prehistoric ruins in the canyons, as well as "other features of scientific and historical interest."³⁰ During the 1930s, '40s, and '50s, the restoration and protection of prehistoric ruins was administered by the NPS, while the SCS, Civilian Conservation Corps (CCC), and IIS also financed major erosion-control projects with the goal of aiding agricultural efforts by stabilizing the stream banks through building spider jetty fences and revetments, as well as through large-scale vegetation plantings. Jurisdictional disputes arose that focused, for example, on the plans of Indian Service agronomists and SCS experts to introduce non-native plants into the canyons. This is against general NPS policy for the areas it administers, but eventually the SCS position took precedence since it was assumed such efforts would create a "better environment" for the canyon Navajo.³¹ By the late 1960s, financial priorities routed funds away from erosion-control efforts, and the NPS applied much of its personnel and funds towards enforcement of the monument's rules and regulations due to the tremendous increases in numbers of visitors.³²

The political setting is further complicated by the variety of federal and Navajo Nation administrative agencies with jurisdiction in the area. In 1927, the Navajo reservation began to be divided into geographically defined community-based organi-

zations called chapters, each of which now exerts some local autonomy over economic and political matters within its boundaries, and sends representatives to the general Navajo Nation Tribal Council. The reservation also is divided into nineteen land management and grazing districts, each with elected committees responsible for conservation and management of livestock within its boundaries, and each including several chapters.³³ The canyons themselves are located within the Chinle Chapter area, in District 10. However, many canyon families have residences, hold livestock grazing permits, and/or use grazing land on the mesa top between Canyon del Muerto and Canyon de Chelly (also referred to as the "Peninsula" in local colloquial terminology; see Figure 2) and at varying distances from the canyon rims. Therefore, they belong to different chapters, which also may be included in separate grazing districts.

Canyon families often expressed frustration about efforts to obtain assistance from the chapters with erosion or other problems occurring in the canyons—they are viewed as a fairly small group with very specialized concerns. If they are members of any chapter other than Chinle, the canyons are outside the jurisdiction of the political unit to which they must appeal. Further, the only access into the canyons available to wagons and motorized vehicles is at the mouth of Canyon de Chelly, and flooding, spring runoff, or winter ice regularly make vehicular travel impossible. Even under "good" conditions, a four-wheel-drive vehicle is advisable for anyone who is not well versed in canyon driving conditions. Resource management agencies, whether tribal or federal, are cautious about spending time and money on trips into the canyons, particularly since erosion-control projects are costly to install and often ephemeral.

During the past fifteen years, attempts to develop resource management and use plans for the monument, which will be implemented into the next century, have variously involved the Navajo Nation, the NPS, the SCS, and the BIA. At present, the Navajo Nation again is exploring the possibility and implications of assuming administrative control for Canyon de Chelly National Monument. Any proposed land-use restrictions or management plans cannot be assumed to impact all families in the same way, and the attitudes and goals of canyon residents vary regarding appropriate land-tenure procedures or beneficial changes.³⁴

Regional Political Economy in the Post-Reservation Period

As the Navajo gradually migrated to the south and west of their Dinéyah homeland, stock raising, focused primarily on sheep and goats, became an increasingly important component of the subsistence base. Beginning with the earliest historical records of the de Chelly area, reports consistently showed that peach orchards, wheat, corn, and beans growing in the canyons and crop production were extensive. Stock grazing has been a regular aspect of Navajo land use in the canyons, yet within these confined settings pasturage is limited, farming took precedence, and crops were regularly traded for livestock.³⁵

After the failure of the resettlement plan at Fort Sumner, and with their livestock herds severely reduced, the Navajo were allowed to return to the new reservation. Early government plans envisioned agriculture as the main economic base in this small segment of the Navajo's former territory, and the Treaty of 1868 included substantially greater funding for farming tools and seed than for livestock. Since it was too late in the year to allow for planting of crops, the Navajo were issued supplies to support them through the winter of 1868-69. However, due to insufficient crop production, declining availability of wild game, and the still small herd sizes, a ten-year period of treaty payments followed the initial allocations.³⁶

The de Chelly canyon system was one of a few areas within the new reservation boundaries where indigenous farming could be practiced with considerable dependability. In 1869, only one year after the return from Fort Sumner and following a harsh winter and summer drought, the one crop that survived in the canyons, albeit minimally so, was peaches; Jett concludes that orchards were "completely reestablished by the 1880s."³⁷ At that time, the canyons were noted as a major Navajo gathering site during the harvest seasons for corn, melons, and especially peaches, which were and continue to be one of the most sought-after trade items. Several orchards apparently still contain peach trees descendent from those that escaped military destruction, or they have grown back from remnants left standing.³⁸ On the other hand, the canyon Navajo were considered poor as a consequence of depending mainly on agriculture rather than livestock production.³⁹

Along with farming, the BIA also encouraged the Navajo to increase their livestock holdings as a complementary avenue to

self-sufficiency—which they did with unexpected success. The original reservation was gradually expanded in size, yet public lands adjacent to the reservation provided critical pasturage for the growing herds, and consequently many Navajo families resided off-reservation. The increasing emphasis on livestock production, in combination with the limited access to suitable agricultural land within the reservation, led to less reliance on farming in the Navajo economic base. Yet subsistence agriculture remained an important source of flour and other food items until regular access to trading posts provided alternative food sources.⁴⁰

With permission of federal agents, a few trading posts—the initial local links to the external market economy—were licensed across the large, remote reservation. Many more opened adjacent to the reservation where trading activities were less regulated. The Navajo economy generally, as well as in the de Chelly area, was profoundly affected by the building of the A&P (formerly A.T. & S.F.) Railway through the southern part of the reservation in the early 1880s and an ensuing network of trading posts that was established.⁴¹ Livestock and crops became potential commercial trade items, initiating a shift to increasing dependence on the market economy to circulate resources among families and across regions of the reservation with varying land-use potentials. Many canyon farmers spoke of using part of their annual harvests to pay off debts to the trader for food supplies acquired over the previous winter, beginning a process that resulted in the loss of a “self-sustaining indigenous political economy ... and replacing help from other families with trading-post credit as the main source of economic security.”⁴² Although the Navajo did not favor cattle as food, beef was definitely preferred to mutton by non-Indians, and by the late 1880s a few of the wealthiest Navajo began to increase their cattle holdings as commercial investments.

The growth of national markets for commercial livestock enterprises, including sheep wool and beef, attracted increasing numbers of non-Navajo ranchers to the region who competed successfully for access to public grazing land. The lack of adequate water sources on reservation land, combined with declining access to adjacent off-reservation areas, meant that by the early 1900s, Navajos found it increasingly difficult to support their growing livestock holdings—the numbers of sheep and goats, in particular, had increased dramatically.⁴³

At the same time, a regional drought was contributing to

pasturage degradation, and erosion of stream channels and gully-cutting was diminishing indigenous floodwater farming options across the reservation. As the tribal population increased, successful livestock production was targeted as the major threat to the diminishing carrying capacity of the semi-arid reservation lands.⁴⁴ Long-standing debates persist today over the causes of and remedies for soil erosion and extensive channel entrenchment across the Colorado Plateau.⁴⁵ Debate focuses on the primacy of either climatic change or land-use practices, and specifically livestock grazing, as the key causal factor. While the soil conservation-overgrazing relationship was the accepted explanation behind most federal and tribal policies aimed at curtailing erosion and restoring Navajo rangeland, paleoclimatic reconstructions conducted during the last twenty years, combined with analyses of historical annual sediment yield records, point to the greater significance of hydro-climatic change.⁴⁶ This is not to deny the existence of overgrazing on the Navajo reservation; high-use areas near water sources and homesteads were particularly vulnerable. But recent studies indicate that prior to the regional drought erosion was not a problem in other equally heavily grazed areas, and that channel entrenchment occurred prehistorically without livestock grazing pressures.

Federal policies regarding soil conservation in the American West developed in the late 1800s with respect to conserving national forests in humid or temperate climatic zones. Scientific studies linking fluvial processes and soil conservation progressed slowly until the early 1930s. By then national concern over the Midwest's dust bowl conditions, and development of the Hoover Dam Project (then Boulder Dam) to meet power and water control/supply demands for commercial agriculture and urban expansion in Southern California, fueled intense interest in the Colorado River Basin. Most specifically, it was feared that sediments eroding from the Colorado Plateau, and from Navajo reservation lands in particular, would create unwanted fill behind the dam and undermine the project goals. As Graf notes, "the Navajo Nation was a likely candidate for 'rehabilitation' because the federal government had more political control over the conduct of Indian grazing than elsewhere, because overgrazing was known to occur on the reservation, and because overgrazing was suspected as the cause of high sediment yields."⁴⁷

In the 1930s, federally mandated voluntary and forced live-

stock-reduction programs were carried out on the Navajo reservation. Initially, they were supported by Commissioner of Indian Affairs John Collier as the basis for promoting Navajo self-sufficiency and economic recovery within the broader context of New Deal reform programs. Collier intended to prevent further overgrazing, thereby avoiding the potential collapse of all Navajo livestock production, and he also wanted to reclaim rangeland through conservation programs. Some dissenting scientific voices, and those of many Navajo, early on claimed that climatic change, not simply overgrazing, was a critical component of local erosion problems. However, to protect regional water and power development the strength of political interests focused conservation efforts on reducing Navajo livestock—"practically 'Public Enemy No. 1' in causing the Colorado Silt problem"—which was expected to result in a quick fix.⁴⁸ The reduction programs left all but the largest Navajo stockowners unable to support themselves by traditional economic pursuits. Range conservation efforts generally limited herd sizes to below subsistence levels, and introduced a system of restricting grazing to areas for which individuals held a specific permit—leading many Navajo families into impoverishment, dislocation, and dependency. Contemporary tribal range-management efforts, involving potential fencing, reducing herd sizes, and introducing grazing permit fees, are often met with protests reflecting the suffering, disruption, and limited effectiveness of Collier-era programs.⁴⁹

Federally sponsored conservation projects of the 1930s and early '40s were designed to address national concerns for reclaiming farmland from dust bowl conditions and to provide employment opportunities during the Depression. On the Navajo and many other Indian reservations, they also were applied to develop viable rangeland for remaining livestock and to control erosion—for example through the building of wells and dams in and adjacent to the canyons. Too often the erosion-control efforts were ill-suited to their task, but emergency appropriations under the New Deal programs (CCC, SCS, etc.) provided the BIA with more funds than it received as an agency on its own, and created the most significant penetration of the wage economy into the reservation to date. Two parallel avenues for long-term economic development were proposed. For the Navajo whose herd sizes remained at sufficient levels after reduction, livestock management for maximum commercial productivity was envisioned. However,

Navajo small-family operations, sustained by limited and precarious federal funds, had little competitive chance compared with investment capital resources of the growing corporate agribusiness enterprises. Regional markets were limited, and the distant national markets were out of reach.⁵⁰

Alternatively, and with the conviction that livestock could only support a limited number of families on the reservation, land-management attention focused on developing agriculture as the exclusive economic base for more Navajos, especially through irrigation projects. Government efforts to develop small-scale irrigation farming in the Chinle Valley (which drains the Rio de Chelly) just northwest of the canyons, and to the east in the Wheatfields area, had begun in the late 1880s. By the 1930s and '40s, the pace and scope of erosion control and irrigation agriculture projects picked up dramatically across several regions of the reservation, continuing into the early 1960s. Programs generally were planned to develop subsistence farms, no more than ten to twenty acres in size. Navajos soon expressed growing concern over the environmental damage caused by poorly planned erosion-control works and by overirrigation, which turned soils alkaline and unusable when intensively farmed. While government planners surmised that Navajos would not, or could not, make "productive" use of the promised twenty-acre parcels, Navajos on the Shiprock-Fruitland project argued that anything smaller could not possibly provide subsistence support; their interest was, in fact, to develop profit-making enterprises. Subsistence farming on ten-acre parcels remained the dominant goal of similar irrigation programs through the late 1950s, in part to provide land assignments to the greatest number of families possible. On the wider regional and national levels, the economic viability of such small-scale, family-managed operations had begun to diminish significantly at least thirty years earlier.⁵¹

Farming developments to the east of the canyons in the Tsaille-Wheatfields areas attracted increasing numbers of families; alfalfa was introduced and reported to be the major local crop by 1928. Most of this harvest sold commercially nearby at Fort Defiance, where there was a local market for alfalfa because many of the largest, Navajo family-based cattle ranches on the reservation were located in the Tsaille-Wheatfields area.⁵² Traders apparently influenced the early production of alfalfa in the canyons; they were particularly interested in having canyon families grow alfalfa for payment of their debts. The commercial ben-

efits of alfalfa production accrued mainly to the traders, who also could secure profits from selling feed crops to the regional market of Anglo-American cattle ranchers. In some cases, traders supplied the alfalfa seed, while other canyon families indicate they were given seed in partial payment for work on government-sponsored erosion-control projects in the 1930s and '40s.

Initially, canyon families had little interest in keeping the alfalfa for their own use since horses could usually find adequate forage without requiring much, if any, supplementation, and most people in the de Chelly area owned only a few cattle at best. However, beginning in the 1950s, tribal programs supported the development of fenced and seeded range management units for small-scale cattle ranching operations located on plateau lands between the canyons and along easterly reaches of del Muerto's rim. For some families this initiated new priorities for land use in the canyons. The proportion of cattle as compared to sheep and goats in herds across the reservation increased between 1950 and 1975, and particularly after 1965. This trend appears to be continuing into the 1990s. Managing cattle is less labor intensive than sheep and goat herds, and so offers more flexibility in meeting wage-income employment schedules. However, cattle raising tends to be more capital intensive and thus is an option for only a limited number of Navajos. Support of commercial cattle operations, whether by federal or tribal programs, potentially enhances and sustains differences in income levels among the Navajo, with outcomes that will be examined for families in Canyons de Chelly and del Muerto.⁵³

Through the 1960s, attempts at agricultural development were made in several locations across the reservation. The philosophy slowly changed to assigning larger tracts of land, but funding for government-sponsored programs generally began to be earmarked for education rather than for direct services, such as erosion control and irrigation projects.⁵⁴ One final plan, the Navajo Indian Irrigation Project (NIIP), evolved into the only tribal commercial agricultural enterprise. The idea of using water from the San Juan River to irrigate nearby Navajo farms dated to the late 1800s; however, surveys relating to a formal project did not begin until 1945, with the project completed and water running in 1976. A tribal corporation, the Navajo Agricultural Products Industries (NAPI), was created to manage and farm the NIIP, reflecting the recognition that available program models for creating individual family subsistence farms were not tenable. From 1987 to 1992, between

40,000 and 46,000 acres were under crop production through the NIIP, which plans to triple that amount in coming years. Corn and beans are the major crops, followed by alfalfa, and NAPI operates a feedlot for more than 35,000 cattle annually. Winter fields are leased out as cattle feed, sometimes serving international interests from Mexico. The NAPI has been a profit-making enterprise, but since the late 1980s and into the early 1990s per-acre crop production yields have been uneven, and high capital expenses to maintain the seventy-one-mile canal system, as well as competition from national and international agribusiness corporations, keep benefits in check.⁵⁵

The ability of traditional economic activities to provide a viable subsistence base for most Navajos diminished rapidly after 1940. Within a decade, cash from sporadic wage labor off- and on-reservation, and from social assistance programs began to contribute a greater proportion of per-capita income.⁵⁶ For families with farm sites in Canyons de Chelly and del Muerto, involvement in off-reservation wage jobs began to reduce the availability of agricultural labor, and adherence to work schedules due to local wage employment affected the scheduling of agricultural activities—which by necessity have frequently become restricted to weekends. For others, access to the limited number of local, steady wage-work jobs meant cash was available for farm and ranch investments. Increasingly, capital-dependent farming practices are considered essential given the canyons' changing environmental and economic context.

AGRARIAN ECOLOGY AND LAND-USE PATTERNS

The annual cycle of land-use activities in the canyons focuses on farming, pomology, and livestock grazing, with the first of greater importance for most families. Environmental changes have differentially affected the *potential* for agricultural production between Canyon de Chelly and Canyon del Muerto, and changing land-use patterns reflect broader political economic processes as well as local sociocultural factors, including the powerful symbolic meanings Navajos attach to the canyons.⁵⁷

Transforming Human and Physical Landscapes

As partial compensation for the forcible reduction of livestock holdings in the 1930s, wage-work opportunities were provided

through major erosion-control programs implemented across the Navajo reservation. The associated programs designed for Canyons de Chelly and del Muerto had a significant impact on the natural resource base. From a regional perspective that encompasses the entire Little Colorado River Basin, paleoclimatic reconstructions and analyses of historical annual sediment yield records provide important generalizations linking climatic change and widespread erosion. However, in smaller, single drainages or in more restricted areas such as the de Chelly canyon system, human land-use practices and attempts to manage and transform natural environments can have significant impact—in some cases triggering erosion or exacerbating the effects of climatic change.⁵⁸

In Canyons de Chelly and del Muerto, the original erosion-control plans proposed constructing a double line of fences along the stream banks, with willows, cottonwoods, grasses, and so forth planted in between. One goal was to create a permanent barrier to the lateral meandering of the streamflow through both canyons. From the 1930s through the 1960s, the IIS, NPS, SCS, and other agencies organized the building of dikes and revetments and the planting of tens of thousands of seedlings along stream banks. Several non-native plant species were introduced, and tamarisk, willow, and carrizo or “luka” reeds (Anglicized spelling of the Navajo word for reed, *lók’aa’*; *Phragmites communis*) have spread dramatically from the sites where they were deliberately planted. In fact, less than ten years after the initiation of these plantings, the introduced vegetation had flourished so successfully near archeological sites that it had to be cut back to prevent root damage to the structures.⁵⁹

In line with regional political economic interests and conservation policies, the proposed “ideal solution” to erosion in the canyons at one point involved removing all livestock and restricting use of the canyons exclusively to farming operations. After a three-year trial program, there was such resentment towards the grazing restriction that this approach was dropped. Another goal of the fenceline was to cause a natural deposition of silt to build up behind it, and thus to reclaim more farm area.⁶⁰ The underlying sociocultural rehabilitation theme also focused on promoting “further development of the Indians’ private holdings” in the canyons.⁶¹ Canyon peaches were already a famous trade item among the Navajo and seedlings of other varieties of fruit trees were provided to canyon farmers to encourage continuous crop production on small farm sites.

In many areas of the canyons, stream banks were effectively stabilized through these erosion-control efforts; however, this type of artificial restriction of the floodplain can contribute significantly to channel entrenchment in constricted canyon environments. When constrained, the streamload cannot dissipate as much of its volume through lateral meandering, resulting in a greater vertical force.⁶² At present, many of the erosion- and water-control structures built within field areas are nearly buried or have fallen into disuse. In some cases, vertical erosion has left them too far above the streambed to be effective for flood irrigation, while in others, family socioeconomic circumstances have resulted in an insufficient farming labor force or created other priorities. Elsewhere, families have begun cutting down the cottonwood plantings where they have grown to form tall, dense fencerows that shade crops and compete for the limited water supply. During the last twenty years, a steady progression of vegetation has been migrating into the stream channels throughout the middle and into the lower sections of both canyons. Where the vegetation has choked the channel and belabored the streamflow, adjacent embankments are subject to water saturation and can be more easily eroded.⁶³

Land-use practices in areas adjacent to Canyons de Chelly and del Muerto also have influenced erosional processes in the canyons; for example, grazing and logging on the canyon rims and watershed areas affect runoff into the canyons. Reservation timber-harvesting programs based in the mountains east of the canyons have contributed some jobs and tribal revenues for most of this century. Now primarily managed by the Navajo Nation, the Navajo Forest Products Industry's harvest goals are being scrutinized as potentially damaging to an extremely limited resource. Reforestation reportedly is not offsetting the rate of harvesting, due in part to grazing pressures on potential replanting acreage.⁶⁴

Canyon farmers describe the building of dams in the headwaters of both Canyons de Chelly and del Muerto as diminishing the extent and duration of waterflow through the canyons, and thereby reducing crop production. The dams were designed to assist irrigation development in the adjacent Tsaille-Wheatfields areas, and to provide tribal income from recreational use of the lakes that formed behind them. The dams also were intended to assist farming in the canyons by decreasing the erosive damage from heavy spring runoff and flash floods, and by making the runoff more consistent through

the use of floodgates. The floodgates reportedly have worked only intermittently, however, and then water-release schedules are geared towards optimal conditions for recreational use of the lakes or feed-crop irrigation east of the canyons.

Finally, the volume of motorized vehicle traffic using the canyons' streambeds for a roadway has increased steadily, and this type of activity also can contribute to channel entrenchment. Such traffic reflects both the increasing availability of vehicles as the common form of family transportation to field sites in the canyons and the growing popularity of Canyon de Chelly National Monument as a tourist site.⁶⁵ For example, a concessionaire is licensed to take large tour trucks up the lower reaches of both canyons several times daily.

Intersecting Crop Production Potentials and Constraints

The location of fields within the canyons is a critical factor in crop production. At present, canyon farmers are not at liberty to choose their field locations annually because: (1) the agricultural land base within the canyons is restricted and in some places declining, and (2) recognized ownership claims have been established for all arable land. Field placement now represents settlement and farm location choices made in the past, and for several long-established canyon lineages such decisions were made at least 150 years ago.

Dry farming is practiced throughout the canyons, and where the water table remains fairly high, fluctuations in rainfall are less consequential than in many areas of the reservation. Where irrigation is possible, small brush-diversion dams are built annually in the wash to channel streamflow via a ditch into the field area. In Canyon del Muerto, several miles of fields along the north side of the streambed are irrigated by a canal that extends from a large crib and rock diversion dam, located above Twin Trail Canyon. Throughout both canyons, however, vertical erosion has left many areas so far above the streambed that it is impossible to inundate the fields without mechanized equipment, sometimes including pumps. Not all canyon families consider such activities worth the effort or are able to attain the required capital to purchase farm machinery.

Fortuitous natural topographic differences within and between the canyons also influence irrigation possibilities; the options are more limited in Canyon de Chelly due to the wider,

straighter nature of the canyon in areas where most farms are located.⁶⁶ An irrigation-diversion dam similar to the one in Canyon del Muerto above Twin Trail would probably be impossible to construct in de Chelly because no suitable location exists. Further, in Canyon de Chelly streamflow has trimmed back embankments or lowered the streambed to the extent that ditch irrigation is possible only at a few fields near the canyon mouth and its junction with del Muerto.

By contrast, many more fields in Canyon del Muerto remain at a level where access to streamflow is not a severe problem. This is particularly true in the narrower, more twisted sections of its lower reaches. The meandering nature of the streambed provides suitable locations for the small brush- and log-diversion dams and feeder ditches needed to control water for irrigation,⁶⁷ and may serve to reduce runoff velocity somewhat. Erosion is definitely a problem in both canyons, and flooding makes most "permanent" irrigation projects untenable in either de Chelly or del Muerto. However, up to the present, the control of runoff has remained more feasible in Canyon del Muerto, and differential access to water is reflected in the types of crops grown in each canyon.

Changing Land-Use Patterns

Since the late 1800s, nearly two hundred field areas have been used in both canyons. Field locations have remained quite stable for more than sixty years, although particularly in Canyon de Chelly some fields have been completely eroded away, while others are not in production every year. In some cases, a family's agricultural fields are no longer farmed. Alternatively, there is usually great concern for using viable grazing territory within a family's acknowledged canyon land-use area and/or harvesting the fruit tree crop. A complex set of ecological variables, described in detail elsewhere, influences the annual cycle of contemporary agricultural production in the canyons. For the canyon system, I documented field-production histories over at least a fifty-year time period (early 1930s through early 1980s) including size of field areas, crop type, acreage of irrigated versus dry-farmed fields, and other land-use and land-tenure information.⁶⁸ In some areas, the information has been periodically updated through 1995. I draw a general distinction between "food" crops, which refer to corn, squash, melons, and

other plants cultivated for human consumption, and "feed," which refers to alfalfa and a small amount of oats used for livestock. Unlike food crops, to assure even moderate production levels of alfalfa, special field preparation is required including plowing, dragging, and leveling of the ground as well as irrigation.

Within the canyon system as a whole, several important changes in land-use patterns have occurred since the early 1900s.⁶⁹ First, the amount of land actually in crop production has decreased by slightly more than one hundred acres. This drop of over 30 percent is substantially greater than a normal fluctuation, which I estimate at about 10 to 15 percent in any given year. Second, while the total amount of irrigated agricultural land has declined by about 30 percent, the proportion of the total acreage in irrigated alfalfa has increased. This translates into a decrease in acreage in irrigated food crops and an increase in the proportion of dry-farmed food crops. Finally, fenced acreage used for grazing has increased considerably since the 1930s. Attention to local-level variability in ecological and socioeconomic factors, combined with a historical perspective based on diachronic data, reveals differences between Canyons de Chelly and del Muerto in patterns linking crop production, cattle ranching, and capital.

In Canyon de Chelly, there were sixty-one separate fenced areas in 1980-81; about 25 percent were used only for grazing, and 10 percent had not been used for many years and were essentially abandoned for farming purposes. Over time, there has been a considerable reduction (44 percent) in the acreage planted in Canyon de Chelly, and the average field size has decreased by half. Approximately 20 percent of the agricultural land in de Chelly was irrigated in 1935, probably indicating the maximum amount of irrigable land. In 1981, none of the fields in de Chelly were irrigated. A decline in irrigated land was evident in 1955, and in part reflects problems with erosion. Another pattern evident in de Chelly is the emphasis on food over feed crop production; no cuttings were obtained from the single acre of dry-farm alfalfa sowed there in the early 1980s.

As noted earlier, productive alfalfa fields require irrigation, obviously a limiting factor in de Chelly. However, even if there was irrigable land, that alone would not be sufficient incentive for a family to invest in feed crop production. Livestock ownership information was obtained from 31 (88.6 percent) of the land-using families in Canyon de Chelly. Only nine (29 per-

cent) of the de Chelly families own cattle, averaging eighteen head apiece. In 1981, the largest single cattle-holding family from de Chelly owned fifty-five head. Their livestock constituted 34 percent of the total number of cattle owned by all de Chelly families, which were grazed solely on a fenced tribal range-management unit on the Peninsula.

No tribally supported cattle management units have been established along the south rim of de Chelly, and without fenced and seeded areas, establishing a viable cattle ranching operation would be nearly impossible. Most de Chelly families simply lack the necessary capital to start such an enterprise on their own. Further, without considerable labor and capital investment, their canyon farmland cannot be irrigated to support the feed crop useful for such an operation.

In 1980-81, there were 115 separate fenced areas in Canyon del Muerto, with 14 percent used only for grazing. About 5 percent had not been used for many years and were essentially abandoned for farming. The largest proportion of irrigated land in del Muerto (45 percent) occurred during the middle (ca. 1955) period. The proportion of total farmland irrigated at present is nearly identical to that in the early 1900s, but slightly less than the 45 percent figure recorded for the mid-1950s. The 16 percent decrease in total acreage farmed in Canyon del Muerto, compared to the high figure in 1955, is just beyond the upper end of a normal annual fluctuation. In fact, there were new field areas being brought into production in 1981 that had previously only been used as grazing land. The one steady change in type of crop production has been the increase in the proportion of the total acreage planted in irrigated feed crops, although the actual acreage has declined slightly. Even in Canyon del Muerto, streambed erosion has made irrigation more difficult along its middle section, which historically has been the major area for alfalfa production.

In comparing the two canyons, not only is more land farmed in Canyon del Muerto, but in the most recent time period, 38 percent of the land was irrigated. The highest figure for de Chelly was 19 percent, and that was in the 1930s. Further, 17 percent of the acreage in del Muerto is used for feed crop production, while in Canyon de Chelly, only an essentially unproductive 2 percent is planted in alfalfa. Not all irrigated land in del Muerto is used for alfalfa, and, as discussed below, families that grow alfalfa do not all do so for the same purpose.

Livestock information was obtained for 90 percent of the

del Muerto families; all major cattle owners were contracted. By comparison with de Chelly, families from del Muerto own fewer sheep and goats but twice as many cattle. The percentage of cattle-owning families from del Muerto (54 percent) is considerably higher than that from de Chelly (29 percent), but cattle ownership is less widely distributed among del Muerto families. Thirty percent of the cattle-owning families in de Chelly held 56 percent of the cattle. By comparison, 16 percent of del Muerto families own 56 percent of the cattle, and only 8 percent of the families own 42 percent of the cattle. Ownership of cattle management units or large grazing areas on the north rim above Canyon del Muerto and on the Peninsula are critical factors for the largest cattle-owning families.

Crops, Cattle and Capital

The establishment of fenced and seeded range-management units adjacent to the canyons for small-scale, family-based cattle ranching enterprises is fairly recent. Several factors influence the feasibility of a given family developing such an operation, including: (1) having some family members involved in regular wage work so cash is available for investment in the cattle operation; (2) having members who can regularly contribute essential labor; and/or (3) holding traditional grazing rights to land designated by the Tribal Bureau of Land Operations as appropriate for fencing and seeding as a range-management unit. In such cases, the initial cash investment required of a family is low, as cattle can be acquired through subsidized loans to be repaid as ranches become profitable.

Cattle were the designated stock for these range units in part because they do not crop the forage as closely as do sheep and goats. With cattle, grazing activities also are limited to transferring animals among various sections within the fenced range unit. This reduces both the energy requirements and risk of more traditional sheep and goat grazing patterns. For some families, the incentive was to release their children from traditional grazing responsibilities and allow them to pursue educational and wage-work opportunities. Cattle are infrequently butchered for home consumption; rather they are viewed as more of a capital investment if only for the short term. Cattle may also be considered a more attractive capital investment since calves generally net a higher price per pound than lambs.⁷⁰

In the 1930s, most families who grew alfalfa in the canyons sold it to local traders to pay off winter food bills; currently alfalfa is used mainly for livestock, specifically for cattle. The impetus to maintain alfalfa production and invest the necessary capital in farm equipment is largely influenced by the direct benefits obtainable for their cattle ranching operation. Especially when winter snows cover the rangeland, cattle raised on the fenced management units require consistent supplies of feed. These families use not only all their alfalfa for cattle feed, but most of their corn crop as well, noting that they grow more alfalfa for stock feed and less corn for home use than their parents did twenty years ago. These families have members with permanent or regular seasonal wage employment, and their major economic investments focus on cattle ranching directly or indirectly through crop production decisions regarding canyon farmland. Since the mid-1930s, the ratio of alfalfa to corn grown in the canyons increased somewhat, but the total acreage in alfalfa declined slightly. This decline may reflect the fact that growing alfalfa without tractors and baling machinery is now considered uneconomic and that it is no longer a lucrative trade item at nearby trading posts or food markets.

No canyon family depends on farming and livestock production as its main source of income or food, and the capital investment requirements for farming can be significant. For example, gasoline costs for vehicle transportation alone are considerable; farm sites are often located seven to fifteen miles up the canyon, requiring travel in low gears up the streambed and often through one to two feet of waterflow or equally deep soft sand. Frequent farm visits are requisite for transporting equipment, planting, weeding, irrigating, and hauling out crops that ripen at various times, including baled hay. On the other hand, one family was able to sell enough alfalfa to cover their child's college tuition expenses, and they did so instead of using it for their cattle's winter feed. In order to meet the tuition fee deadline, they sold the alfalfa during the summer when feed prices were lower, and then had to buy feed at the higher winter price. While they probably made little profit, they had cash when it was needed, and this householding economic pattern is common.⁷¹ A number of the younger members of canyon families, however, have been encouraged to envision cattle ranching as a potential full-time business enterprise.

LAND IS LIFE: CULTURAL TOPOGRAPHY

In discussing why particular fields currently are not farmed, non-Natives and canyon residents alike occasionally commented that "people are lazy," or that some families receive public assistance so they "aren't interested in the land." While these may be relevant issues in a few cases, generally a much more complex set of factors, including effects of natural environmental change and human alterations of the landscape, as well as family socioeconomic histories, structure the current *potential* for agricultural production. Also, the "humanized nature" at the focus of an integrative political ecology approach to understanding land-use practices must assess local sentiments towards land—for the canyons, these are charged with multiple meanings, including social identities and ritual places.⁷²

How such sentiments intersect with "interest" in canyon land, or with field-specific crop production, varies along several dimensions. Farming in the canyons is at least minimally capital *dependent* for all families. Fortuitous settlement histories, however, going back into the last century, have left some families with land-use areas in locations especially hard hit by recent erosion. Few families can afford the capital *intensive* practices now required to assure crop production at these sites, or at least cannot afford such expenditures every year. In any event, most people now depend on trucks for transportation up canyon and on tractors to plow their fields. As a result, fields frequently aren't planted until the spring runoff has subsided sufficiently so that vehicles are able to negotiate the trip up the canyon floor. In some years this is after the prime planting period, which results in low crop production or in fields being left fallow. On the other hand, trucks make it possible to fit in short visits to fields around wage-work schedules, most often evenings and on weekends. Overall, a decline in the length of annual canyon residence is not a good general index of involvement in farming activities or of concern for the land. In fact, the continual building of new fences, combined with the number of land disputes, point to the strong sentiments local Navajo families have for the canyons.

To Care For the Land

Ongoing land disputes are not necessarily focused on prime crop production or grazing sites. While the Euro-American

concept of "use" usually implies physical manipulation of or activity on the land, when discussing land tenure ideology or "rules" as well as actual practices, canyon families most often described their responsibility as being "to care for the land." Some residents described canyon land as being considered available for appropriation if it was not "used" for five or seven years.⁷³ However, there was no clear consensus regarding what activities were required to stave off the enforcement of such a time limit. One person remarked that he knew that an area of land was being cared for because the fence surrounding it was in good repair, although there were no other visible signs of altering the landscape. On the other hand, a woman described how she recently began planting food crops again on her field after it had remained "untouched" for sixteen years because of an ownership rights dispute with a sibling. No one who knew anything about the history of that field area would question that it was being cared for, and quite intensely so, during that time period.

While the term *ownership* often implies the notion of private property, reservation land was granted to all Navajos as communal property, held in trust for them by the federal government. "Inherited-use ownership" more accurately describes early ethnographic accounts of customary rights to farm land among the Navajo, and is summarized as follows:

[an individual] who owns farm or range land can only control it for a limited period, and no "owner" can give away or otherwise alienate land from his family. Furthermore, in this matrilineal society, the real "owners" are the wife and children, and the husband is hardly more than a trustee for them.⁷⁴

About 60 percent of respondents from each canyon described the matrilineal principle ("rule"), or choosing a close matrilineal clan member as an heir, as the customary standard or expectation for farmland transfers. They explained that a man may either leave with another woman (taking his labor with him), or he may marry a woman who isn't really interested in the land and her family might gain rights to it. In short, as one woman from del Muerto described, to give farm land to a man is "like throwing away food."

Among canyon residents, however, rule statements regarding land tenure and inheritance practices vary. In general, land-

tenure practices represent one way a society organizes itself for the distribution of, and rights to, resources. Inheritance patterns reflect not only a society's system of kinship and descent, but also ecological factors and hence its land-use patterns. The relationship between ideology and land-tenure behavior is less well documented, and while detailed discussion is beyond the scope of this paper, several points merit consideration.⁷⁵

Although studies from communities across the reservation note variations in some aspects of Navajo social organization (inheritance being one), they concur on several issues, including the Navajo system of matrilineal descent and matrilineal clans and phratries.⁷⁶ Aberle suggests that the variability is a result of changes from a prior matrilineal state that preceded the entry of the Navajo into the Southwest. Matrilineages, or even small clans, may have controlled agricultural land during the earliest period of Navajo settlement in the Southwest, before pastoralism came to dominate economic activities in most areas and wage work took on increasing importance.⁷⁷

Since the canyons comprise one of the few remaining areas of indigenous Navajo agriculture, I anticipated finding evidence of the control and transmission of farmland by matrilineages. I further expected matrilineal inheritance of fields to decrease over time as the impact of wage labor and environmental change altered the importance of agriculture in the economic base and diminished the productivity of some canyon land. I analyzed more than four hundred cases of actual land transfers (as distinct from rule statements) in both canyons since the 1880s.⁷⁸ Matrilineal transfers represented about 50 percent of all cases, and there was a slight but not significant decline over time in the occurrence of matrilineal transfers as compared to nonmatrilineal transfers.

However, when inheritance data was compared by canyon, significantly different patterns of matrilineal versus non-matrilineal transfers emerged, which I explain as related to the distinctive land-use histories of Canyons de Chelly and del Muerto. When all time periods were collapsed, matrilineal transfers were significantly more frequent in Canyon de Chelly, and here matrilineal transfers were characterized over time by the expected steady decline in occurrence.

By contrast, from the earliest time period, matrilineal land inheritance was less common in Canyon del Muerto—another facet of the differing social and economic histories of the two canyons since at least the 1880s. Specifically, irrigated land and

fields used for feed crop production were transferred along matrilineal lines less often than were dry fields or those planted in food crops. Cattle ranching and irrigation are predominantly male activities, a tendency which may be reflected in the lower occurrence of matrilineal transfers in Canyon del Muerto. Here, labor- and capital-investment requirements of irrigation and feed crop production have encouraged giving a greater priority to cash and labor availability considerations than to the desire to keep land within a matrilineal kin group.

Levy, Henderson, and I identified patterned differences in adherence to matrilineal principles in Navajo social organization that reflect regional variations in resource use and socioeconomic status across the reservation.⁷⁹ The variability found on the local level in Canyons de Chelly and del Muerto is reflected in broader Navajo cultural processes, although this potential is often overlooked in macro-level analyses based on assumptions about sociocultural homogeneity.

Another factor influencing land-tenure practices is the increasing focus on acquiring formal, and individualized, land permits. Aside from livestock permits, a system also was established for issuing documents assigning land rights to individuals for areas being developed as government-sponsored irrigation projects. Farms of carefully measured dimensions were distributed to Navajo families, and it was anticipated that individual "ownership" would provide an incentive for labor and capital investment in these irrigated holdings. Of particular concern was the practice of issuing assignment papers to the male heads of household.⁸⁰ This also was the common practice for livestock-grazing permits and, in tandem, such assignments altered Navajo women's involvement and control over a variety of resources critical in the traditional subsistence resource base.

While not part of an irrigation project, official permits for "ownership" of traditional use areas in the canyons began to appear when disputes over land holdings started to be referred for government mediation by tribal chapter officials, and then to the tribal courts. A few such permits were issued as early as the 1930s, but most were drawn up after 1950.⁸¹ In probate cases, tribal courts have acknowledged claims of the spouses and children of livestock and irrigation project permit holders. However, the significance of "traditional" inheritance principles in such cases remains moot, particularly with respect to areas outside irrigation projects, and generally is considered on a case-by-case basis.⁸²

Heightened interest in defining canyon property boundaries also is reflected in the decline of unfenced field areas by the 1950s. The concern over obtaining a "paper" permit to solidify and protect land claims legitimized in tribal courts, combined with the increasing population pressure on a limited and in fact diminishing productive resource base, has added to an increasing tone of exclusiveness in canyon land ownership.⁸³

There are entrepreneurial voices among the respondents who spoke of buying land permits to gain access to a greater amount of canyon land, with the goal of increasing their production of alfalfa or expanding their livestock grazing area. Not all canyon families have the necessary capital or labor available to farm their land actively every year, and a few families, or more often individual family members acting on their own, have been induced to "sell" their use rights to canyon fields. As a continuing trend, this creates a situation in which fewer people control use rights to land in the canyons and will result in greater extremes of wealth stratification. Management policies often consider canyon land "unused" if crops aren't being produced, and in the late 1980s one planner suggested to me that Navajo family land rights should be redistributed to individuals who would "really" use the land—that is, intensify crop production. Aside from contributing to the consolidation of land holdings, such a proposal overlooks the fact that for families of moderate to low income levels, the contribution of canyon crop production often takes on particular importance. They usually have less ability to capitalize, yet canyon crop production makes a greater contribution to their household economies. Among canyon families, such circumstances also are associated with a greater emphasis on matrilineal inheritance practices.⁸⁴

There have long been references to *pobres* and *ricos*, or the poor and wealthy, among Navajo families based on livestock ownership. In the canyons, it is mainly the interest in acquiring suitable areas for feed crop production, or additional grazing areas for livestock, that will exacerbate such differences. At present, several factors characteristic to this case continue to constrain the inequalities from becoming solidified: The access to investment capital is through wage work that is generally fluctuating and/or from off-reservation sources, the support from economic development programs is inconsistent, the canyon environment remains unwilling to be "managed" for long, and

human-land attachments continue for reasons beyond commodity valuation.⁸⁵

Ritual Landscapes

People seek social meanings in land, as well as economic production from it. The valuing of canyon land as a cultural or social "resource" is undeniable. Concern for maintaining control of the land—at times intensely expressed—is not simply related to prime agricultural or grazing sites. After years away, some young adults are trying to reclaim the production potential of long-untended vegetable crop areas and orchards. Their parents often said they specifically wanted to release these same children from the burden of farming and livestock responsibilities, so they could attend school and acquire a good education. To the parents, this was the road to a better way of life. For the children, however, the impetus to farm the family's land is not described solely in terms of economic costs or benefits; the canyons symbolize both a connection to a past they have claimed as deserving of respect and a place many intend to defend from appropriation in the future.

Almost 80 percent of the canyon families claimed the traditional Navajo religion as their single, or shared, religious affiliation.⁸⁶ Navajo religion is generally place-bound, and numerous sites of significance in Navajo origin legends and religious beliefs are located within Canyon de Chelly and Canyon del Muerto. Navajo religion also focuses on health and healing; corn pollen is a critical element of ceremonies whose efficacy depends in part on attendance by large numbers of relatives—who must be fed. The "use" of food crops for such ceremonies and, generally, in sharing with extended kin and friends, was a major reason many families gave for cultivating their canyon land. This does not require high yield levels to provide meaningful returns; such benefits cross-cut and often overshadow any entrepreneurial interests, and they cannot be replaced by the purchase price of a permit.

Other levels of meaning are expressed by canyon families that clearly extend beyond interests in the land's immediate crop production or grazing potential. For example, a man in his early thirties described how he and a whole generation of young men had left the reservation after their schooling had promised great things in the "white man's world." He had

lived off-reservation for awhile, eventually becoming disillusioned with the prospects. He, as others, "had to" return home to fix fence lines or farm and spend time in the canyons because it was the only place he could be "well" again. In this sense, the canyons are a place that bring health and "life," regardless of what is physically occurring at the land.

CONCLUSION: PROGRAM PLANS AND LOCAL REALITIES

The "risks" and "economics" of farming in the canyons are relative to: (1) the family's major source of income, which is never agriculture, (2) the production potential of the land, and (3) the uses to which the crops are put. In essence, productive "capacity" is, in part, relative to family circumstances. Among canyon families, those who do not farm the land often cannot afford vehicles or their own tractors and equipment, nor can they hire others to plow their fields. Farm production increasingly is related to having cash available to support it, along with the ability to risk unreliable returns. Families with these options may also be interested in acquiring more canyon agricultural land and will "buy" permits or "lease" use areas. Land management policy that focuses solely on increasing crop production encourages capital-intensive measures that may, in fact, contribute to ecological damage in the semiarid canyon environment and overextend the land's sustainable crop production potential, not to mention family economic resources. Further, it ignores cultural constructions of meaningful valuations for land which include variable land-use practices, including potential exclusion of crop production.

In Canyon del Muerto, the development of range-management programs in support of small-scale cattle ranches provides an incentive to grow alfalfa for a family's own livestock as well as for sale. Further, topographic and physiographic features of del Muerto make it possible to ditch-irrigate some fields, a requirement for alfalfa production. Hence, the incentive as well as the opportunity for alfalfa production exists in Canyon del Muerto.

Tribally supported cattle ranches were not established along the south rim of Canyon de Chelly, and without fenced and seeded management units, developing such enterprises is nearly impossible. Most de Chelly families simply lack the nec-

essary capital to start such an enterprise on their own. Without considerable labor and possibly investment in water pumps, their canyon land can't be irrigated to support the feed crop useful for such an operation, and growing alfalfa without tractors or baling machinery now is impractical.

In Canyon del Muerto, a higher percentage of families than in de Chelly own cattle, but ownership is less widely distributed throughout del Muerto families; that is, wealth is more concentrated when there are a few managed range operations which will support larger holdings. A series of low rainfall years in the late 1980s and early 1990s, however, reduced streamflow through the canyons and limited the ability to irrigate in del Muerto. Some alfalfa crops died out, and the members of at least one del Muerto family is unsure whether they will invest in replanting. They could not irrigate regularly without a considerable increase in their capital and labor investment, including the use of mechanical water pumps. Without this alfalfa crop, the cost of keeping their cattle fed over the winter months became almost unmanageable, and so they have reduced the size of their livestock holdings. For the time being, the canyons no longer offer this family a unique environmental setting for the feed crop production that was a key factor supporting their goal of operating a profitable, small-scale ranching business. The prospects for accomplishing this goal also have long been constrained by the dominance of agribusiness and corporate ranching enterprises over the regional and national market economy.

One important factor that contributed to successful annual crop production in the late 1800s was extended family use of several fields located at noncontiguous sites, sometimes miles apart, within a canyon. The fields were in different types of microenvironments, and if factors such as early frost or spring runoff flooding affected production at one site, others were likely to be successful. Within larger extended families, crops from several separate fields continue to be shared, but this hedge against crop failure now is not generally an option, and within the canyons—as across the reservation—land use areas are not expandable.

Family socioeconomic histories, fortuitous settlement choices, the differential effects of erosion, and the variable ability to marshal capital and labor all combine to create important differences in family circumstances and land-use patterns, as well as potentials, in the canyons. People have inherited varying quantities and qualities of agrarian resources; government pro-

grams affect families with varying socioeconomic characteristics differently; and within a canyon system environment that may appear, even at a second glance, to contain a generally uniform resource base, the crop production potential of farm sites varies enormously.⁸⁷ Over the years, attempts to constrain and manage the environment to serve human land-use designs have resulted in short-term benefits, but also long-term drawbacks.

The historical failure of federal agrarian development programs on Indian reservations at times has been generalized to "cultural" features of Native groups, including indigenous subsistence strategies that were inconsistent with farming or "cultural resistance" to change.⁸⁸ The canyons provide examples of successful indigenous farming practices whose productivity began to diminish partly due to the impact of programs designed to further develop and enhance their agricultural potential. In other cases, Navajo families turned away from government-sponsored irrigation-agriculture programs because they wanted more profitable enterprises than they recognized would be possible on their assigned five- to ten-acre parcels. Examples of successful Native indigenous farming practices, and institutional flexibility in adapting to farming among groups whose traditional economies did not include agriculture, are numerous—when programs fit with local ecologies and were supportable in regional economies. But the template for federal-Indian agricultural programs was regularly unsuitable to specific reservation settings, and Native peoples often recognized this before program administrators.

Recent federal-Indian policies in many cases may have shifted away from natural resource control/management (ANCSA, water rights, and fishing rights as some notable exceptions) to more symbolic arenas of managing contested ethnic identities.⁸⁸ However, on the ground level—literally—Native peoples are living with the legacies of past policies and their differential and divisive impacts. Programs to control, change, or restrict land-use practices in the canyons have not had the same impact on all families, nor will further management plans engender the same response in the canyons' physical or social environments. Human attachments to land reflect cultural, political, and economic valuations. It is no longer possible to treat these as separate areas either of analytic anthropological inquiry, or program planning; such knowledge is critical for understanding the context and human consequences of future land management policies.

ACKNOWLEDGMENTS

The Navajo Nation granted permission for my research in Canyons de Chelly and del Muerto, and the National Park Service cooperated in allowing me access into Canyon de Chelly National Monument. Funding was provided by grants through the University of Arizona Anthropology Department, Bureau of Ethnic Research, School of Renewable Natural Resources, and the Graduate Student Development Fund. The analysis and write-up of this research was accomplished in part while I was supported by a Weatherhead Resident Scholar Fellowship at the School of American Research, Santa Fe, New Mexico. I also would like to thank the two *American Indian Culture and Research Journal* anonymous referees for carefully reviewing this manuscript and for their editorial suggestions. I alone am responsible for any errors in fact or interpretation.

This paper is dedicated to the late Robert Netting. As a teacher and mentor, he provided unwavering support and interest—offered with a rare combination of humanity, lively scholarship, and good humor.

NOTES

1. Lynn R. Bailey, *The Long Walk: A History of the Navajo Wars 1846-1868* (Los Angeles: Westernlore Press, 1964), vii, 163; G. P. Castile and R. L. Bee, eds., *State and Reservation: New Perspectives on Federal Indian Policy, Introduction* (Tucson: University of Arizona Press, 1992), 2-3; G. P. Castile, "Native North Americans and the National Question," in *The Political Economy of North American Indians*, ed. John H. Moore (Norman: University of Oklahoma Press, 1993), 271-271; Robert W. Young and William Morgan, *The Navajo Language* (Albuquerque: University of New Mexico Press, 1980), 463. Navajo language orthography throughout this paper follows Robert W. Young and William Morgan, *The Navajo Language* (Albuquerque: University of New Mexico Press, 1980).

2. Peter Iverson, *The Navajo Nation* (Westport, CT: Greenwood Press, 1981), 9; Joseph G. Jorgensen, "A Century of Political Economic Effects of American Indian Society, 1880-1980," *The Journal of Ethnic Studies* 6:3 (1978):10-15; Robert L. Bee, *Crosscurrents Along the Colorado: The Impact of Government Policy on the Quechan Indians* (Tucson: University of Arizona Press, 1981), 66, 80-89; Leonard A. Carlson, "Learning to Farm: Indian Land Tenure and Farming Before the Dawes Act," *Property Rights and Indian Economics: The Political Economy Forum* (Lanham, MD: Rowman & Littlefield Publishers, 1992), 67-69;

Donald L. Parman, *Indians and the American West* (Bloomington: Indiana University Press, 1994), 1-10; G. P. Castile, "Indian Sign: Hegemony and Symbolism in Federal Indian Policy," *State and Reservation*, (1992), 165-68.

3. As cited in Bailey, *The Long Walk*, 172-3. Governor Connelly's presumptions of mineral wealth were fueled by the territory's new military commander, Brigadier General James H. Carleton, who concluded in 1663 that, "There is every evidence that a country as rich if not richer in mineral wealth than California, extends from the Rio Grande, northwesterly, all the way across to Washoe." While precious metals were never discovered in significant quantities, the eventual discovery of oil on the Navajo reservation led, as Aberle notes, "to the creation of a Tribal Council in 1923, to legitimate oil leases that permitted appropriation of Navajo resources, but not the development of the Navajo economy." David F. Aberle, "The Lessons of Navajo Livestock; cf. Lawrence C. Kelly, *The Navajo Indians and Federal Indian Policy* (Tucson: University of Arizona Press, 1968). Subsequent extraction of major uranium and coal reserves which happened to be located on the Navajo reservation earned significant returns for the tribe, but they were paltry in contrast to profits for non-Indians. See Jerrold E. Levy, "Who Benefits From Energy Resource Development: The Special Case of Navajo Indians," *The Social Science Journal* 17:1 (1980): 1-19.

4. Iverson, *The Navajo Nation*, 9.

5. Jorgensen, "A Century of Political Economic Effects," 10-11; Parman, *Indians and the American West*, 22; R. Douglas Hurt, *Indian Agriculture in America* (Lawrence: University of Kansas Press, 1987), 96-101, 109-112; Garrick Bailey and Roberta Glenn Bailey, *A History of the Navajos: The Reservation Years* (Santa Fe: School of American Research Press, 1986), 45; see Parker Shipton, "Land and Culture in Tropical Africa: Soils, Symbols and the Metaphysics of the Mundane," *Annual Reviews in Anthropology* 23 (1994): esp. 358, for a broader international perspective on ecological and sociocultural impacts of development-program attempts to sedentarize and encourage individual rights over land.

6. Iverson, *The Navajo Nation*, 9; Klara Kelley, *Navajo Land Use: An Ethnoarchaeological Study* (New York: Academic Press, 1986), 7; Bailey and Bailey, *A History of the Navajo*, 291.

7. David M. Brugge, "Navajo and Western Pueblo History," *The Smoke Signal* 25 (1972): 90-112; David M. Brugge, "Navajo Prehistory and History to 1850," in *Southwest*, ed. A. Ortiz, *Handbook of North American Indians*, Vol. 10, William C. Sturtevant, gen. ed. (Washington, DC: Smithsonian Institution, 1983), 489-501; W.W. Hill, "The Agricultural and Hunting Methods of the Navajo Indians," *Yale University Publications in Anthropology* 18 (New Haven, CT: Yale University Press, 1938), 14-21; Richard White, *The Roots of Dependency: Subsistence, Environment and Social Change Among the Choctaws, Pawnees, and Navajos* (Lincoln: University of Nebraska Press, 1983), 222-224 (cf. especially reference to Adams, *Shonto: A Study of the Role of the Trader in a Modern Navajo Community* [1963], which documents the influence into the the 1950s of field site locations on grazing practices in a predominantly sheepherding area).

8. Bailey and Bailey, *A History of the Navajos*, 45.
9. Richard Van Valkenburgh, *Dine Bideyah* (U.S. Department of the Interior, Office of Indian Affairs, Window Rock, Arizona: Navajo Service, 1941), 18-25; David F. Aberle, "Navajo," in *Matrilineal Kinship*, eds. David M. Schneider and Kathleen Gough (Berkeley: University of California Press, 1961), 101; U.S. War Department, *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, prep. by Lt. Col. R. N. Scott (Washington, DC: U.S. Government Printing Office, 1902), series 1, vol. 34, 1, chap. 46:77. There is no way of knowing what type of ditches or canals Pfeiffer was describing when he used the Spanish word *acequias*. Since his observations were made in winter, the term may indicate fairly substantial structures that had survived the summer floods.
10. My analyses of changing Navajo land-use and land-tenure patterns in the canyons is based on ethnohistorical accounts and historical records, as well as ethnographic research during the past twenty years.
11. Robert W. Young, *The Navajo Yearbook*, The Navajo Agency (Washington, DC: U.S. Government Printing Office, 1961), 121-123, 126; Bailey and Bailey, *A History of the Navajo*, 106; Parman, *Indians and the American West*, 10, 22; White, *The Roots of Dependency* (1983); William Graf, "Fluvial Erosion and Federal Public Policy in the Navajo Nation," *Physical Geography* 7:2 (1986); Hurt, *Indian Agriculture in America*, 154-166. Bee, *Crosscurrents Along the Colorado* (1981).
12. Joseph G. Jorgensen, *The Sun Dance Religion: Power for the Powerless* (Chicago: University of Chicago Press, 1972); "A Century of Political Economic Effects," "Energy, Agriculture, and Social Science in the American West," in *Native Americans and Energy Development* (Cambridge: Anthropology Resource Center, 1978); "Federal Policies, American Indian Politics and the New Federalism," *American Indian Culture and Research Journal* 10:2 (1986); *Oil Age Eskimos* (Berkeley and Los Angeles: University of California Press, 1990); David F. Aberle, "A Plan for Navajo Economic Development," *Toward Economic Development for Native American Communities, a Compendium of Papers Submitted to the Subcommittee on Economy in Government of the Joint Economic Committee*, 91st Congress, 1st sess., Joint Committee Print, Vol. 1 (Washington, DC: U.S. Government Printing Office, 1969); Aberle, "Navajo Economic Development," *Handbook of North American Indians*; Levy, "Who Benefits From Energy Resource Development"; White, *The Roots of Dependency*, 248-249, 312-313; Kelley, *Navajo Land Use*, 1986; L. D. Weiss, *The Development of Capitalism in the Navajo Nation: A Political-Economic History*, Studies in Marxism, Vol. 15. (Minneapolis: MEP Publications, 1984); cf. John H. Moore, ed., *The Political Economy of North American Indians* (Norman: University of Oklahoma Press, 1993), 11-15; Eric Wolf, *Europe and the People Without History* (Berkeley: University of California, 1982); Sidney Mintz, *Sweetness and Power: The Place of Sugar in Modern History* (New York: Viking Press, 1985); Daniel Boxberger, *To Fish in Common: The Ethnohistory of Lummi Salmon Fishing* (Lincoln: University of Nebraska Press, 1989).

13. Susan C. Stonich, *I Am Destroying the Land: The Political Ecology of Poverty and Environmental Destruction in Honduras* (Boulder: Westview Press, 1993), 25; James Greenberg and Thomas K. Park, "Political Ecology," *Journal of Political Ecology* 1 (1994): 1-12; D. H. Johnson, "Political Ecology in the Upper Nile: Twentieth Century Expansion of the Pastoral Common Economy," *Journal of African History* 30:3 (1989): 463-486; Linda HersHKovitz, "Political Ecology and Environmental Management in the Loess Plateau, China," *Human Ecology* 21:4 (1993): 327-353; Thomas Sheridan, *Where the Dove Calls: The Political Ecology of a Peasant Corporate Community in Northwestern Mexico* (Tucson: University of Arizona Press, 1988); Piers Blaikie and Harold Brookfield, *Land Degradation and Society* (London and New York: Methuen, 1987). Cf. Robert Mc Netting, *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture* (Stanford: Stanford University Press, 1993), 7, 21; John W. Bennett, "Ecosystems, Environmentalism, Resource Conservation, and Anthropological Research," in *The Ecosystem Approach in Anthropology*, ed. Emilio Moran (Ann Arbor: University of Michigan Press, 1983), 435, 437, 454.

14. H. E. Gregory, "The Navajo Country: A Geographic and Hydrographic Reconnaissance of Parts of Arizona, New Mexico and Utah," *U.S. Geological Survey Water-Supply Paper 380* (Washington, DC: U.S. Government Printing Office, 1916), 34-36.

15. M. E. Cooley, J. W. Harshbarger, J. P. Akers, and W. F. Hardt, "Regional Hydrogeography of the Navajo and Hopi Reservations, Arizona, New Mexico and Utah," *Geological Survey Professional Paper 521, A & B* (Washington, DC: U.S. Government Printing Office, 1969), A38; James McDonald, "An Archaeological Assessment of Canyon de Chelly National Monument," *Western Archaeological Center Publications in Anthropology* 5 (Washington, DC: U. S. Government Printing Office, 1976), 2.

16. William H. Sellers and Richard H. Hill, *Arizona Climate 1931-1972* (Tucson: University of Arizona Press, 1974), 132-133, 312-313; *Navajo Nation FAX 93: A Statistical Abstract of the Navajo Nation* (Division of Economic Development, Navajo Nation, Window Rock, Arizona, 1994), 59-64.

17. Tracy J. Andrews, "Descent, Land Use and Inheritance: Navajo Land Tenure Patterns in Canyon de Chelly and Canyon del Muerto," Unpublished Ph.D. dissertation (University Microfilms, Department of Anthropology, University of Arizona, Tucson, 1985), 117.

18. Hill, "The Agricultural and Hunting Methods," 25.

19. Andrews, "Descent, Land Use and Inheritance," 119.

20. Jeffrey S. Dean, Robert Euler, George Gummerman, Fred Plog, Richard Hevley, and Thor Karlstrom, "Human Behavior, Demography, and Paleoenvironment on the Colorado Plateau," *American Antiquity* 50 (1985); Thor N.V. Karlstrom, "Alluvial Chronology and Hydrologic Change of Black Mesa and Nearby Regions," in *The Anasazi in a Changing Environment*, ed. George Gummerman (Cambridge: Cambridge University Press, 1988), 64; A. E. Dennis, "The Natural Vegetation of Canyon de Chelly, Northeastern Arizona," *The Kiva* 41 (1975): 18.

21. Secondary erosional cycles appear to occur across the Colorado Plateau at about 250- to 275-year intervals (Jeffery S. Dean, personal communication, 1998; cf. Karlstrom, "Alluvial Chronology," 1988). During the summer of 1979, I unexpectedly found evidence in del Muerto for this regional chronology (see also note 27 below). Erosion exposed oak stumps in the streambed above Antelope House for the first time in the five years I had been working in the canyons, and I found no canyon family who remembered ever having seen them before. Radio carbon samples from the buried oak stumps dated to the late 1700s and early 1800s (Thor Karlstrom, personal communication), perhaps indicating a period of vegetation recovery after the prehistoric Anasazi abandonment and prior to extensive Navajo use of the canyons. It also suggests a different stream channel configuration since the oak could not have survived in the current sandy floodplain environment, and now grow only on talus slopes in the middle and upper reaches of the canyon.

22. Cosmos Mindeleff, "Cliff Ruins of Canyon de Chelly, Arizona," *Bureau of American Ethnology, Annual Report 16* (Washington, DC: U.S. Government Printing Office, 1897), 73-198; John Wesley Powell, "Explorations in the Southwest: Work of Mr. James Stevenson," *Bureau of American Ethnology Annual Report 4:XXXIV-XXXVI* (Washington, DC: U.S. Govt. Printing Office, 1886); David M. Brugge and Raymond Wilson, *Administrative History of Canyon de Chelly National Monument* (National Park Service, Washington, DC: U.S. Government Printing Office, 1976).

23. Andrews, "Descent, Land Use and Inheritance," 275-76; Tracy J. Andrews, "Ecological and Historical Perspectives on Navajo Land Use and Settlement Patterns in Canyons de Chelly and del Muerto," *Journal of Anthropological Research* 47:1 (1991): 39-40, 45-47.

24. David De Harport, "Archaeological Survey of Canyon de Chelly, Northeastern Arizona, A Puebloan Community Through Time," Ph.D. dissertation (Department of Anthropology, Harvard University, 1959), 81-87; Andrews, "Descent, Land Use and Inheritance," 108-110.

25. Two large tributaries, Monument and Bat Canyons, join de Chelly in this area and were included in this study. They are used mostly for grazing, and contain only limited areas of cultivable land with very few active farms.

26. "Canyon del Muerto," when referred to in comparison to "Canyon de Chelly," designates the del Muerto canyon itself and its major tributaries, Black Rock and Twin Trail Canyons. Farms located in these tributary canyons were included in this study because neither the land-using families nor the field types differ significantly from those found in the main del Muerto canyon.

27. It was in this area of the streambed where, in 1979, I found oak stumps for the first time in the five years I had been working at the canyons. Radiocarbon dating linked them both to a regional secondary erosional cycle chronology, as well as to ethnohistorical accounts of microenvironmental differences influencing early Navajo settlement patterns in the canyons (see also note 20). While no canyon family remembered ever having seen them before, several people recalled hearing now-deceased elderly relatives describe how

extensive the vegetation had been in Canyon de Muerto in the past—long before the erosion-control plantings of the 1930s began. Similar stumps were not exposed in the streambed of Canyon de Chelly, where canyon family histories indicate that the earliest Navajo settlements in the canyon system occurred—in part because del Muerto's dense vegetation made it less attractive. This area provides an indication of the pace of change in the canyon environment: When I first found the oak stumps, they stood out dramatically in what was a fairly flat, sparsely vegetated section of the canyon. The stream channel has since migrated, and eroded vertically to the extent that NPS had to construct a footbridge across it to assist people visiting Antelope House ruin. Further, during the summer of 1997, the oaks were nearly impossible to find among the thickets of tamarisk, Russian olive, and other vegetation growing in the streambed.

28. Andrews, "Descent, Land Use and Inheritance"; Navajo Community College, *Navajo Stories of the Long Walk* (Tsaile, AZ: Navajo Community College Press, 1973); for summaries of the growth of the Navajo land base, see Bailey and Bailey, *A History of the Navajos*, 78-81, 114-117.

29. Brugge and Wilson, *Administrative History*, see especially, 257-264; "Nation May Take Over Parks," *Navajo Times* 36:16 (May 1, 1997): 1-2.

30. *Ibid.*, 17.

31. *Ibid.*, 64.

32. Brugge and Wilson, *Administrative History*, 246; *Navajo Nation FAX* 93 (1994), 22, 127.

33. James F. Downs, "Animal Husbandry in Navajo Society and Culture," *University of California Publications in Anthropology* 1 (Berkeley: University of California Press, 1964), 86-87; White, *The Roots of Dependency*, 276; Robert W. Young, *A Political History of the Navajo Tribe* (Tsaile: Navajo Community College Press, 1978), 66-67; Tom T. Sasaki, *Fruitland, New Mexico: A Navaho Community in Transition* (Ithaca: Cornell University Press, 1960).

34. "Nation May Take Over Parks," *Navajo Times* (1997): 1-2. No systematic ethnographic research, particularly regarding land-use patterns, had been completed in the canyons prior to my research, although numerous archeological excavations and surveys had been conducted. My research was not designed as an "applied" anthropological study, nor was it funded or initiated by either the NPS or the Navajo Nation, although permission from both was a prerequisite. With the growing concern for land-use management in and around the canyons, this study took on the additional burden of being viewed as an information source for agencies attempting to find "solutions" to the often conflicting priorities of protecting the scenery and archeology for posterity, and the everyday realities of making a living for the canyon families. This study probably should make the job of Navajo Nation, Park Service, and other planners more difficult, but only in the sense that it documents the complexity of factors influencing Navajo land-use patterns and land-tenure practices in Canyon de Chelly and Canyon del Muerto.

35. Major E. Backus, "An Account of the Navajos of New Mexico," *Archives*

of *Aboriginal Knowledge: Information Respecting the History, Conditions and Prospects of the Indian Tribes of the United States*, ed. Henry R. Schoolcraft (Philadelphia: J. P. Lippincott and Co., 1854), 212, as cited in Pamela C. Magers, "Navajo Settlement in Canyon del Muerto," Unpublished Ph.D. dissertation, (Department of Anthropology, University of Arizona, Tucson, 1976): 47; Bailey, *The Long Walk*, 34.

36. Bailey and Bailey, *A History of the Navajos*, 45-46; Edward Spicer, *Cycles of Conquest* (Tucson: University of Arizona Press, 1962), 220. David M. Brugge, "Navajo and Western Pueblo History," *The Smoke Signal* 25:90 (1972): 107.

37. S.C. Jett, "History of Fruit Tree Raising among the Navajo," *Agricultural History* 51 (1977): 696.

38. Andrews, "Descent, Land Use and Inheritance" (1985), 172-173; Tracy J. Andrews, "Navajo Land Use and Settlement Patterns in Canyon de Chelly and Canyon del Muerto," Unpublished manuscript prepared for Canyon de Chelly National Monument, Division of Interpretation (on file NPS, Chinle, AZ, 1990), 67. I sent seeds from several canyon peach orchards regarded as descendents of the old, non-commercial trees to two agricultural research laboratories of the U.S. Department of Agriculture for study. While those sent to the California lab have not been productive, seeds sent to the Georgia lab did germinate and a fair peach crop was produced in 1984. As reported by W. R. Okie (Research Horticulturist, 1985, personal communication):

The fruit was small, white-fleshed, freestone, with very little red color in the skin. It ripened August 1 ... which is very late by commercial standards. Generally, the seedlings were quite uniform, which is typical of heirloom varieties that have been seed propagated for many generations, but uncharacteristic of commercial material... The only other similar types in our collection are a group of seedlings from the mountains of Southern Mexico and a semi-wild variety imported from China fifty years ago. My conclusion is that the[se] ... peaches are not closely related to commercial material.

Commercial peaches, apples, pears, plums, and apricots are also grown in the canyons.

39. C. Mindeleff, "Navaho Houses," *Seventeenth Annual Report of the Bureau of American Ethnology for the Years 1895-1896* (Washington, DC: U.S. Government Printing Office, 1898), 483; Andrews, "Descent, Land Use and Inheritance," 190-191; J. G. Walker and O. L. Shepard, *The Navaho Reconnaissance: A Military Exploration of the Navajo Country in 1859*, foreword, annotations, and index by L. R. Bailey (Los Angeles: Westernlore Press, 1964), 47.

40. Kelly, *Navajo Indians and Federal Policy*, 158; Bailey and Bailey, *A History of the Navajos*, 76-78.

41. D. F. Johnston, "An Analysis of Sources of Information on the

Population of the Navaho," Smithsonian Institution, *Bureau of American Ethnology Bulletin* 197 (Washington, DC: U.S. Government Printing Office, 1966), 25; L. D. Weiss, "The Development of Capitalism in the Navajo Nation: A Political-Economic History," *Studies in Marxism*, Vol. 15 (Minneapolis: MEP Publications, 1984), 130; Aberle, "Navajo Economic Development," *Handbook of North American Indians*, 642; Frank McNitt, *The Indian Traders* (Norman: University of Oklahoma Press, 1962), 49; Brugge and Wilson, *Administrative History*, 284; Kelley, *Navajo Land Use*, 1986.

42. Kelley, *Navajo Land Use*, 8. The generally non-Indian trading post operators enjoyed the most commercial benefits from this shift to production for the market, a process that is variously interpreted as initiating Navajo "access" to the national economy (Bailey and Bailey, *A History of the Navajo*, 77-78), as contrasted to initiating exploitation by, and dependence on, the national capitalist economic interests and generating profits for traders (Kelley, *Navajo Land Use*; Weiss, "The Development of Capitalism in the Navajo Nation" (1984). Later, when the availability of off-reservation wage work began to increase in the 1940s and '50s, Bailey and Bailey (p. 270) note that through "[t]he judicious use of credit ... many traders minimized the amount of cash that was available to the Navajos, maximized the income of the posts, and gave traders enormous economic control over their customers."

43. White, *The Roots of Dependency*, 230-35; Bailey and Bailey, *A History of the Navajos*, 83-85.

44. Aberle, "A Plan for Navajo Economic Development" (1969); Johnston, "An Analysis of Sources of Information," 38-40.

45. R. V. Cooke and R. W. Reeves, *Arroyos and Environmental Change in the American South-West* (London: Oxford University Press, 1976); Gary Rydout, "A Summary of Recent Environmental Changes in Canyon de Chelly National Monument and Observations on their Causes," Manuscript on file at the Western Archaeological Center, National Park Service, Tucson (1985); Graf, "Fluvial Erosion and Federal Public Policy," 101-102.

46. Dean, et al., "Human Behavior, Demography, and Paleoenvironment" (1985); Graf, "Fluvial Erosion and Federal Public Policy," 109-110; Eric Force and Wayne Howell, "Holocene Depositional History and Anasazi Occupation in McElmo Canyon, Southwestern Colorado," *Arizona State Museum Archaeological Series* 188 (Tucson: University of Arizona Press, 1997).

47. Bee, *Crosscurrents Along the Colorado* (1981); Norris Hundley, *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (Berkeley: University of California Press, 1975); P. L. Fradkin, *A River No More: The Colorado River and the West* (New York: Alfred A Knopf, 1981) as cited in Graf, "Fluvial Erosion and Federal Public Policy" (1986); White, *The Roots of Dependency*, 250-251; Graf, "Fluvial Erosion and Federal Public Policy," 104.

48. Cited by Graf, "Fluvial Erosion," 104, from Bureau of Indian Affairs, *Annual Report of Navajo District* (Washington, DC: U.S. Government Printing Office, 1937), 51-52; Hurt, *Indian Agriculture in America*, 178-181; Bailey and Bailey, *A History of the Navajos*, 182.

49. J. F. Downs, *Animal Husbandry in Navajo Society and Culture* (Berkeley: University of California Press, 1964), 20; Aberle, "Navajo Economic Development," 642; cf. "Letters to the Editor," *Navajo Times* (Window Rock, Arizona, 1997): 36 (27).

50. Young, *The Navajo Yearbook*, 166, 172-176; Jorgensen, "A Century of Political Economic Effects," 17-22; White, *The Roots of Dependency*, 255-59, 273; Weiss, *The Development of Capitalism in the Navajo Nation*, 138-39; Hurt, *Indian Agriculture in America*, 175-177, 233.

51. Young, *The Navajo Yearbook*, 120-133; Sasaki, *Fruitland, New Mexico*, 12, 36-46; Jorgensen, "A Century of Political Economic Effects," 15, 21-22; Aberle, "A Plan for Navajo Economic Development (1969); Aberle, "Navajo Economic Development" (1983); Hurt, *Indian Agriculture in America*, 187-191.

52. J. W. Hoover, "Navajo Nomadism," *Geographical Review* 21 (1931): 431-438; Bailey and Bailey, *A History of the Navajo*, 143.

53. Young, *The Navajo Yearbook*, 166; Weiss, *The Development of Capitalism in the Navajo Nation*, 139-140; Bailey and Bailey, *A History of the Navajo*, 245-248; Kelley, *Navajo Land Use*, 205; *Navajo Nation FAX* 93 (1994), 68-71 summarizes 1992 livestock figures for the reservation as a whole, excepting the Eastern Navajo agency which had not provided data that year.

54. Young, *The Navajo Yearbook*, 127, 177.

55. Young, *The Navajo Yearbook*, 129-133; Bailey and Bailey, *A History of the Navajo*, 249; *Navajo Nation Profile*, Division of Community Development, Navajo Nation, Window Rock, Arizona (1995; based on 1990 census); *Navajo Nation FAX* 93 (1994), 29, 65-66; "The Navajo Nation," special edition prepared for *Indian Country Today* (1995): 24-25.

56. Young, *Navajo Yearbook* (1961); Bailey and Bailey, *A History of the Navajo*; Aberle "A Plan for Navajo Economic Development" (1969); Kelley, *Navajo Land Use* (1986).

57. Tracy J. Andrews, "Ecology and Ethnology: Elements of Social Change in Canyon de Chelly and Canyon del Muerto, Two Navajo Agricultural Communities," Paper presented at the Annual Meeting of the American Anthropological Association, Los Angeles (December 1981); Andrews, "Descent, Land Use and Inheritance" (1985); Andrews, "Ecological and Historical Perspectives on Navajo Land Use and Settlement Variability" (1991), 39-67; Tracy J. Andrews, "Land is Life: Ecology, Navajo Land Tenure and the Significance of Place," Paper presented at the 91st Annual Meeting of the American Anthropological Association, San Francisco (December 1992).

58. Cooke and Reeves, *Arroyos and Environmental Change* (1976); Graf, "Fluvial Erosion and Federal Public Policy" (1986); Dean, et al., "Human Behavior, Demography, and Paleoenvironment" (1985); Force and Howell, "Holocene Depositional History" (1997).

59. Brugge and Wilson, *Administrative History*, 62, 64, 89. Brugge and Wilson include annual information from Park Service records concerning erosion-control programs in the canyons initiated by NPS and other agencies. While not occurring every year, the following figures provide an indication of the

scale on which these plantings were carried out at regular intervals: In 1946, 10,000 willow and luka reeds and, in 1963, 16,300 Russian olives, golden leaf willows, and cottonwood seedlings, were planted. Also, in 1936 Australian tamarisks were planted—a species not listed in a 1934 survey of existing vegetation in Canyon de Chelly.

60. Brugge and Wilson, *Administrative History*, 61.

61. *Ibid.*, 62.

62. Cooke and Reeves, *Arroyos and Environmental Change* (1976).

63. Rydout, "A Summary of Recent Environmental Changes" (1985); personal communication, 1990. Regionally, a secondary (minor) depositional period now seems to be unfolding (Jeffrey Dean, 1998, personal communication). How this will converge with the canyons' "humanized" environment is moot. The extensive spread of non-native plantings, as well as past and present erosion—"control" activities, have significantly altered the local ecologies of vegetation, floodplain configuration, stream channelization, and hydrologic profiles. In the canyons, this depositional period could be associated with a somewhat higher water table, and moderate fill sequences (rather than erosion)—possibly burying areas of current vegetation. The long-buried oak stumps found in the Canyon del Muerto streambed probably underwent a similar process. On the other hand, a higher water table could create an even more favorable environment for the continuing migration of vegetation plantings into the stream channel. The canyon system microenvironments probably are sufficiently variable to support both outcomes.

64. *Navajo Nation Fax* (1993), 75; LeGrand Einbender-Velez, "Navajo Forestry Faces a Cultural Challenge" *Cultural Survival Quarterly* (Spring 1993): 32-34.

65. In 1992, annual visitation was recorded at almost 1.8 million people; *Navajo Nation Fax* (1993), 127.

66. Andrews, "Descent, Land Use and Inheritance," 182.

67. Andrews, "Descent, Land Use and Inheritance," 182.

68. Andrews, "Descent, Land Use and Inheritance," 165-193; Andrews, "Ecological and Historical Perspectives on Navajo Land Use and Settlement Variability" (1991); a series of NPS maps of the canyons from the mid-1930s includes information on soil types, stream erosion, field locations, and crops. These maps provided a historical database for comparison with information about contemporary agricultural activities, which I obtained through on-site observation of farms and detailed interviews with canyon families. I conducted a systematic survey of all canyon land-use areas between May 1980 and September 1981, and information for a number of areas has been updated periodically through 1995. Comparison with the 1930s maps indicates that there has been little change in the location of planted acreage, excepting fields damaged by stream erosion or by runoff from the canyon walls.

69. Andrews, "Descent, Land Use and Inheritance" (1985); Andrews, "Ecological and Historical Perspectives on Navajo Land Use and Settlement Variability" (1991).

70. William Y. Adams and Lorraine T. Ruffing, "Shonto Revisited: Measures of Social and Economic Change in a Navajo Community, 1955-1971," *American Anthropologist* 79:1 (1977): 58-93.

71. Aberle, "The Lessons of Navajo Livestock Reduction," 64; Aberle, "Navajo Economic Development," 1983; Jorgensen, "Energy, Agriculture, and Social Science" (1978); cf. Joseph G. Jorgensen, "Alaska Natives and the Protestant Ethic," *Research in Human Capital and Development* 10 (1996).

72. Greenberg and Park, "Political Ecology," 1; cf. Netting, *Smallholders, Householders*, 7.

73. Andrews, "Land is Life" (1992); Andrews, "Descent, Land Use and Inheritance," 217-255.

74. Clyde Kluckhohn and Dorothea Leighton, *The Navaho*, revised edition (New York: The Century Company, 1962 [1946]), 106; Hill, "The Agricultural and Hunting Methods" (1938).

75. Robert Mc Netting, "Territory, Property and Tenure," in *Behavioral and Social Science Research: A National Resource*, National Research Council Publication no. 3297, part 2 (Washington DC: National Academy Press, 1982); Netting, *Smallholders, Householders*, 157-188; Shipton, *Land and Culture in Tropical Africa* (1994); Andrews "Land is Life," 1992; Andrews, "Descent, Land Use and Inheritance," 246-254. The relationship between ideology or norms (as statements of culturally appropriate behavior) and actual, observed human behavior has been the focus of much anthropological debate. Research efforts generally have focused on either ideology or on observed behavior, and systematic data from the same study has not often been available to explore the linkage between them. Seventy individuals, from 75 percent of the families who participated in this study, responded to open-ended questions about norms or rules for transferring farm land, and my analysis of the association of these normative statements with land-transfer histories is ongoing (Andrews, "Land is Life," 1992). Cf. Netting, *Smallholders, Householders*, 6, for the change in Kofyar household group composition and structure in conjunction with changing conditions of economic production, without an associated adjustment in cultural expectations for household membership or other aspects of social organization. He notes, "Kofyar customary systems of meanings remained intact and did not constrain substantial nonrandom changes in social behavior."

76. For a detailed analysis addressing several aspects of contemporary Navajo social organization, including clan regulation of marriage, residence patterns, and inheritance, based on data from a number of communities, see Jerrold E. Levy, Eric B. Henderson, and Tracy J. Andrews, "The Effects of Regional Variation and Temporal Change on Matrilineal Elements of Navajo Social Organization," *Journal of Anthropological Research* 45:4 (1989).

77. David F. Aberle, "Navajo," in *Matrilineal Kinship*, eds. David M. Schneider and Kathleen Gough (Berkeley: University of California Press, 1961), 96-201; David F. Aberle, "Navajo Coresidential Kin Groups and Lineages," *Journal of Anthropological Research* 37 (1981):1-7; David F. Aberle, "A Century of

Navajo Kinship Change," *Canadian Journal of Anthropology* 2 (1981): 21-36; Isidore Dyen and David F. Aberle, *Lexical Reconstruction: The Case of Proto-Athapaskan Kinship System* (Cambridge: Cambridge University Press, 1974). Note that matrilineal kinship and social organization are not synonymous with the term *matriarchy* as employed by several nineteenth-century Western European theorists (most notably L. H. Morgan, *Ancient Society*, New York: Holt, 1877) in social evolutionary schemes discredited by subsequent accumulation of worldwide, cross-cultural data.

78. Andrews, "Descent, Land Use and Inheritance," 217-255; Levy, Henderson, and Andrews, "The Effects of Regional Variation," 370-373.

79. Levy, Henderson and Andrews, "The Effects of Regional Variation" (1989).

80. Sasaki, *Fruitland, New Mexico*, 18-51; esp. 41.

81. See Weiss, *The Development of Capitalism in the Navajo Nation*, 139-140; Kelley, *Navajo Land Use* (1986).

82. Another complicating factor concerns the location of decision-making authority regarding permit assignments, which has fluctuated between the local chapter level and regional land boards linked to broader tribal government jurisdiction and resource management interests. Other customary social rules in this matrilineal society are also being debated, for example, the prohibition against marriage into one's own clan, which recently has been considered for inclusion in Navajo Nation legal code.

83. Andrews, "Land is Life," 1992; cf. Weiss, *The Development of Capitalism in the Navajo Nation*, 138-140 and Kelley, *Navajo Land Use*, 204-205.

84. Andrews, "Descent, Land Use and Inheritance," 246-254; Levy, Henderson and Andrews, "The Effects of Regional Variation" (1991).

85. Cf. Netting, *Smallholders, Householders*, 2, 12, documenting even more intensified farm production circumstances, where significant inequalities in wealth exist without become rigidly stratified so as to exclude fluctuations in socioeconomic mobility.

86. Andrews, "Land is Life," 1992.

87. Cf. Francisco J. Pichon, "Land-Use Strategies in the Amazon Frontier: Farm-Level Evidence from Ecuador," *Human Organization* 55:4 (1996).

88. Tracy J. Andrews, Book Review of *Neither Wolf Nor Dog*, by David Rich Lewis, in the *American Indian Culture and Research Journal* 20:4 (1996): 244-248; Carlson, *Learning to Farm*, 1992.

89. Castile, *Indian Sign*, 1992; Castile, *Native North Americans and the National Question*, 1993; Robert L. Bee, "Riding the Paper Tiger," in *State and Reservation*, 1992.