INTRODUCTION

Colonization has been shown to have sweeping effects on indigenous households in different parts of the world, including Sub-Saharan Africa, Mexico, the southeastern United States, and the southwestern United States, where many of these indigenous groups are subsistence farmers (e.g., Netting et al. 1989; Pavao-Zuckerman 2007; Pavao-Zuckerman and LaMotta 2007; Spielmann 1989; Spielmann et al. 2009; Stone 1994; VanDerwarker et al. 2013). Previously, much of the research regarding colonization focused on the destructive effects that colonization had on indigenous subsistence farmers, including the decimation of population due to introduced diseases, the acculturation of indigenous groups into the colonial regime, and the loss of agricultural biodiversity as indigenous farmers increased their focus on introduced cash crops (e.g., Bolton 1919; Corkran 1967; Hackenberg 1962; Russell 1908; Swanton 1998). In recent decades, however, archaeologists and ethnographers have shown how indigenous communities frequently act as dynamic responders, not passive recipients, to these colonizing groups, sometimes resulting in significant economic success for them.
“Economic success” here is defined as an indigenous group being able to maintain economic independence from colonizing groups (DeJong 2009; Kowalewski 2006; Netting et al. 1989; Pavao-Zuckerman and LaMotta 2007; VanDerwarker et al. 2013).

While valuable research has been done on the impacts of Spanish colonization on indigenous southwestern populations (e.g., Pavao-Zuckerman and LaMotta 2007; Pavao-Zuckerman 2011; Sheridan 2006; Spielmann et al. 2006, 2009; Tarcan 2005), their groups of focus, including the Salinas pueblos along the Rio Grande and O’odham groups in extreme southern Arizona, were under the direct control of the Spanish missions, resulting in forced tribute payments and new subsistence strategies. The O’odham along the middle Gila River, however, provide an interesting counterpoint to this research. During the 1700s and early 1800s, the majority of Spanish population and influence was restricted to extreme southern Arizona, mostly focused in areas south of Tucson (Figure 13.1), where missions, such as San Xavier del Bac and Tumacácori, exerted control over indigenous populations in the region (Bolton 1919; see also Lauren E. Jelinek and Dale S. Brenneman, chapter 10 in this volume).

Due to fear of Apache raiding along the middle Gila River Valley, the Spanish never missionized the middle Gila River, and the Gila O’odham remained peripheral to colonial developments in the Pimería Alta (Wells et al. 2004; Wilson 1999), leading to differences in the economic development between the O’odham along the middle Gila River and indigenous groups in other parts of the Southwest. The Gila O’odham, then, represented a frontier for the Spanish moving into the Pimería Alta. Despite being a frontier region, however, historic documents indicate that the Gila O’odham were actively trading with the Spanish to the south, mostly through other indigenous groups in the Pimería Alta (Dunne 1955; Ezell 1961), but because they were never missionized, they were not subject to tribute payments to the Spanish (Wilson 1999). Thus, research on the Gila O’odham reactions to colonization can help clarify how groups changed in contexts in which indigenous groups were not under direct control of their colonizing groups.

The O’odham along the middle Gila River also had access to plenty of irrigable land and perennial water, unlike their indigenous neighbors to the south, allowing for productive agricultural land and the potential to irrigate, like their Hohokam ancestors (see Woodson 2010 for extensive background on prehistoric irrigation agriculture along the middle Gila). The Hohokam built the largest irrigation system in the New World north of Peru prior to Spanish contact, which resulted in the production of prodigious amounts of surplus for these desert dwellers. Uncertainty exists concerning the relationship between the prehistoric Hohokam and the historic O’odham in the Phoenix Basin, and archaeological evidence from the period after the Hohokam collapse (ca. 1450) and before first contact with the Spanish by Eusebio Kino in 1694 is scant (Loendorf 2010).
Despite the uncertainly in connection between the Hohokam and O’odham, historic documents can provide insight into how the O’odham altered their agricultural system in response to colonization. These documents indicate that throughout the 1700 and 1800s, the Gila O’odham adapted to incoming Spanish and American groups in ways that resulted in great economic success (DeJong 2009). Historic documents are replete with numerous accounts of how
the Spanish and, later, Americans relied on the agricultural production of the O’odham for food and materials (e.g., Dobyns 1961). How, then, did the O’odham adapt their agricultural system to the influx of new people, crops, and markets into the middle Gila River? Using demographic, archaeological, and historical data from Spanish and American sources, I argue in this chapter that the O’odham successfully intensified agricultural production throughout the 1700 and 1800s to meet the market demands of incoming Spanish missionaries and American explorers, resulting in great economic success for the O’odham.

The middle Gila River is now managed by the Gila River Indian Community (GRIC; Figure 13.1) providing an excellent opportunity to study the social and ecological effects of the transition from subsistence agriculture to a market economy during the historic period, because the Gila O’odham provide (1) a case study of direct versus indirect colonial impacts on economic strategies, (2) an example study of agricultural intensification in a colonial context, and (3) a reimplementation of strategies of intensification from their prehistoric Hohokam ancestors. With the city of Phoenix rapidly growing outward into the desert formerly managed by the Hohokam and now the O’odham, the GRIC has prevented urbanization along the middle Gila River, preserving archaeological resources that can be linked to historic sources to understand the economic, social, and environmental dynamics during colonization. The chronology used in this chapter is based on major external events that affected O’odham economic strategies. The early historic, or Spanish/Mexican period, ranged from 1684 to 1848. The late historic, or American, period began in 1848 (Wilson 1999).

**COLONIZATION AND THE INTENSIFICATION OF RESOURCE PROCUREMENT**

Archaeologists working in the US Southwest have documented how indigenous communities adapted to Spanish colonization, including patterns of agricultural intensification, increased animal procurement and processing through the adoption of livestock, and changing crop and, thus, diet diversity (see chapter by Barnet Pavao-Zuckerman, chapter 11 in this volume; Pavao-Zuckerman and LaMotta 2007; Sheridan 1988, 2006; Spielmann 1989; Spielmann et al. 2009; Tarcan 2005; Trigg 2003, 2005). In the northern Southwest, for example, Carmen Tarcan (2005) studied how hunting and diet changed among the Zuni throughout the historic period. The Spanish introduced grazing animals, such as sheep and goats, that the Zuni rapidly adopted, according to zooarchaeological evidence. Tarcan (2005) also found, however, that high amounts of native animals—deer and antelope—were also found in the zooarchaeological assemblage. Tarcan (2005) argues that while the Zuni readily adopted Spanish animals, diet, and technologies, the Zuni also strove to maintain traditional indigenous hunting practices by continuing to hunt deer and antelope.
In southern Arizona, near Tucson, Barnet Pavao-Zuckerman and Vincent LaMotta (Pavao-Zuckerman and LaMotta 2007) argue that the O’odham actively resisted adopting Spanish-introduced livestock during the first part of Spanish missionization. The O’odham around these missions actively slaughtered livestock and refused to participate in their care. They explain, “the O’odham may have viewed the introduction of livestock as a threat to traditional lifeways and intentionally destroyed the animals to repulse that threat. The O’odham had no prior experience with domesticated livestock, and animal husbandry makes demands on labor, scheduling, infrastructure, and land use that were entirely novel to O’odham households” (Pavao-Zuckerman and LaMotta 2007:259). While the O’odham in this part of the Pimería Alta eventually adopted livestock husbandry, especially cattle, it is clear that they actively attempted to maintain indigenous subsistence strategies during Spanish colonization.

This O’odham group was under the direct control of the Spanish and were compelled to pay tribute and to change subsistence strategies in response to direct Spanish demands. The O’odham along the middle Gila River, however, were never under the direct control of the Spanish and were not subject to tribute payment, leaving them free to economically respond to colonization. How, then, did O’odham alter their agricultural system with Spanish colonization? Here, I focus on one specific strategy incorporated by the O’odham in response to colonization: the intensification of agriculture in response to introduced market economies. The intensification of agriculture is defined as any attempt to add more labor to a field in order to increase agricultural production for a given field area. Strategies to intensify agriculture include terracing, multicropping, addition of fertilizer, and, most importantly for the middle Gila River, the construction of infrastructure, such as irrigation canals (Boserup 1965; Erickson 2006; Netting et al. 1989).

AGRICULTURE, ECONOMIC DEVELOPMENT, AND LAND-USE INTENSIFICATION ON THE MIDDLE GILA RIVER

To address how O’odham agriculture changed during Spanish and American colonization, agricultural intensification is analyzed through archaeological, historic, and ethnographic evidence on the middle Gila River during the historic period (1694–1950). These data indicate that with challenges such as variable streamflow, low annual precipitation, and colonization, the O’odham nonetheless created a highly productive agricultural system that created surplus for barter and the market likely using strategies employed by their ancestors—the Hohokam—prehistorically.

I argue in the following sections that the O’odham intensified agriculture as they adopted Old World crops, such as wheat, with the introduction of a market economy with the entrance of the Spanish in the region in the late 1600s. In order to measure the intensification of agriculture during the historic period,
I analyze historic sources from Spanish missionaries (the early historic period, 1697–1848) and the US explorers and military (the late historic period, 1848–1950) to document an increase in population density (with the combination of settlement extent and demographic estimates), the adoption of intensive irrigation, and an increase in maize and wheat yields. These measures indicate that with increasing population density and access to market demand, the O’odham intensified agriculture by adopting intensive irrigation to produce crops to sell to Spanish and American incomers. Other researchers (DeJong 2009; Doelle 1981; Rice et al. 1983; Wilson 1999) have assembled many of these numbers, but their calculations are checked, when possible, and restructured for the purposes of this chapter. These documents provide data on where settlements are located, population size, irrigated acreage, and the amount of crops produced in certain years, and can provide insight into the level of aggregation and crop production over time, both of which are important indicators of agricultural intensification.

**Agricultural and Economic Growth during the Protohistoric (1450–1694) and the Early Historic Periods (1694–mid 1800s)**

The collapse of the prehistoric Hohokam cultural system ushered in the Protohistoric Period (ca. 1450 to 1694) on the middle Gila River. The Protohistoric Period has been little studied by archaeologists due to the scarcity of archaeological materials, probably due to small and scattered populations at this time (see Jelinek and Brenneman, chapter 10 in this volume; Loendorf 2010; Wells, Loendorf, and Woodson 2004). Early historic observers in the region doubted the relationship between the substantial archaeological remains left by the Hohokam and the small populations remaining on the landscape during the early historic period (Fewkes 1912; Russell 1908). Due to the differences in the archaeological record between the Classic Period Hohokam and the Protohistoric O’odham, some researchers speculated that the Hohokam and the O’odham were distinct cultural groups (e.g., Russell 1908). However, most O’odham have long claimed continuity with the Hohokam, despite the uncertainty in the archaeological record (Loendorf 2010). Recent archaeological and historic research has taken a more nuanced view of the processes affecting historic populations and has strongly demonstrated continuity in artifacts, most specifically lithics and ceramics, between the prehistoric Hohokam and the historic O’odham (Doelle 2002; Loendorf 2010; Wells et al. 2004).

The small, dispersed O’odham populations occupying the middle Gila River Valley were first recorded by Father Eusebio Kino, who arrived in the region in 1694 (Bolton 1919). For information dating back to the arrival of Kino little remains in the archaeological record, so limited archaeological investigation has been done and we are largely reliant on historic Spanish documents for
information about the O’odham interactions with the Spanish. (Wilson 1999). While Kino recorded little about the agricultural systems of these Protohistoric populations, he documented five to seven ranchería villages spread out along the middle Gila River with no supravillage organization (Winter 1973). With the entrance of Kino also came many Spanish-introduced crops and goods—such as the horse, wheat, and metal tools—which the Gila O’odham acquired shortly after Kino’s arrival, though it remains unknown when exactly the O’odham were first introduced to these technologies and resources (Dunne 1955 documents extensive use of these goods in the mid-1700s).

Shortly after the arrival of Kino and throughout the 1700s, Apache raiding of O’odham villages increased throughout the 1700s. The introduction of the horse allowed the Apache to more efficiently steal from the O’odham (Rice et al. 1983; see also chapters by Pavao-Zuckerman [11], and J. Homer Thiel [12], this volume). Kino noted many instances of early Apache raiding throughout the Pimería Alta (the middle Gila River represented the extreme northern section of this region), but raiding did not become an issue on the middle Gila until after his arrival. With the increase in Apache raiding, the O’odham were forced to move their rancherías toward the center of the valley, aggregating in defense against the mobile Apache (Hackenberg 1962; Rice et al. 1983). The danger of raiding also prevented the Spanish from missionizing the middle Gila River, but did not prevent the Spanish from trading with the O’odham through other indigenous groups who entered the middle Gila River to assist with seasonal harvests (Dunne 1955).

In 1821, Mexico gained independence from Spain, ending Spanish control of the Pimería Alta, but little changed for the O’odham on the middle Gila River and their interactions with the Spanish and Mexican colonizers (DeJong 2009; Wilson 1999). The mid-1800s, however, brought many changes at different scales to the middle Gila River. During the Mexican American War, the US federal government took control of the middle Gila River in 1846 and increased the military presence in the region. This amplified military presence led to a decrease in Apache raiding in the mid- to late 1800s, allowing for more people to enter the region. In 1848, gold was discovered in California and the Southern Trail was established through the middle Gila leading to an estimated 60,000 people moving through the region from 1849 to 1851 (Dobyns 1961). These new American explorers relied heavily on the O’odham along the middle Gila, and the O’odham responded by further expanding their irrigated acreage and increasing emphasis on wheat production. In 1854, the Gadsden Purchase officially made the territory south of the Gila River to today’s border with Mexico part of the United States. In 1859, the federal government established the first reservation in Arizona—the Gila River Indian Community—officially recognizing the Gila O’odham as a native group in the region (Wilson 1999).
Over the course of these external changes in the 1700 and 1800s, the O’odham adapted to Spanish and American introductions of new crops and goods, Apache on horseback raiding their villages, and colonizers needing access to food sources. Regardless of these rapid social changes, this time was a period of great economic success for the O’odham living along the middle Gila River, as they sold a surplus of crops to the influx of newcomers, who created a new demand for wheat. These incoming groups relied on O’odham agricultural success, and the intensification of agriculture proved to be an economic boon for the O’odham during this time. In the following sections, I argue that during the historic period (1) settlement patterns and demographic estimates indicate increasing population density, (2) increasing population densities led to the creation of a tribal government, allowing for a cooperative structure necessary for a complex irrigation system, and (3) intensive irrigation agriculture and wheat were adopted to meet the demands of a market economy. These factors denote that O’odham agriculture shifted from subsistence-based agriculture, of a kind largely practiced by their ancestors prehistorically, to a more intensive, cash-based agricultural system in response to the introduction of market economies.

*Increase in Population Density*

One of the main drivers of the intensification of agriculture and land use is increasing population density (Boserup 1965; Netting 1993). To argue this process occurred on the middle Gila, I use data on the settlement extent of historic rancherías and demographic estimates during the historic period. Consequently, O’odham agriculturalists most likely intensified agricultural production to maintain previously high yields of agricultural crops on a smaller extent of land. The increase in population density also had important implications for the ability to create a tribal government and to construct and manage a large-scale irrigation system.

Figure 13.2 shows the extent of Pima settlement along the middle Gila River from 1702 to 1877. Glen Rice and colleagues (1983) previously compiled these data (from Ezell 1961 and Hackenberg 1962) to show the level of aggregation across the middle Gila River during the historic period. The extent of settlement (in miles) shows how much of the landscape along the middle Gila River was occupied during a given year, and thus provides insight into the level of aggregation. For example, a larger extent of settlement indicates that the settlements were more dispersed across the landscape.

As Figure 13.2 shows, the extent of settlement decreased throughout the historic period, as O’odham villagers aggregated together in response to increased Apache raiding. This process continued until the late 1800s, when extent expanded again in response to the loss of water upstream and the reduction of Apache raiding due to the presence of the American military. Although settlement extent
shrank throughout the historic period, population data are needed to confirm that population numbers remained the same on a smaller extent of land, indicating an increase in local population density. For example, settlement extent could be shrinking due to a loss of population from Spanish-introduced diseases, resulting in extensive mortality for indigenous groups across the Americas.

Figure 13.3 shows the best estimates of population during the historic period and tells a complicated story of demographic highs and lows (Bell 1869; Dunne 1955). These numbers were drawn from estimates in Spanish diaries and, later, US censuses, so they reflect rough estimates of population numbers and not exact counts. Population appears to undergo demographic shifts over the historic period, though it is unclear whether these shifts are real or a product of imprecise estimates made by incoming explorers. Overall, however, the data on both settlement extent and population indicate that population density increased during the historic period, especially from the initial population observed when the Spanish first arrived in the late 1600s, until population loss in the late 1800s due to the
reduction of water on the middle Gila River. With population increasing to 4,000–6,000 people after initial Spanish observations, the O’odham still fell victim to diseases introduced by the Spanish (see Garcés 1965 for documentation of vomiting and fevers), but the population lost from disease was replaced by in-migration from other indigenous groups, such as the Cocomaricopas, who sought refuge with the Gila O’odham from the Apache (Bolton 1919; Doelle 1981, 2002).

Regardless of these shifts, population appears to have generally increased throughout the historic period, resulting in increased population density. Many authors cite different reasons for this increasing aggregation. Rice and colleagues (1983) argue that this aggregation is intrinsically linked to Apache raiding, and statements made in early Spanish documents strengthen this argument. Jacobo Sedelmayr, a Spanish missionary, for example, describes unpopulated stretches, or buffer zones, upstream and downstream from the core of O’odham

**FIGURE 13.3.** Population numbers of the middle Gila River Valley from historic documents (compiled by Doelle [1981] from Spanish diaries and American censuses).
settlements along the Gila River to protect themselves against the Apache in the mid 1700s (cited in Dunne 1955). The aggregation across the landscape is also correlated with increased production of wheat, but that increase in wheat production is likely a product of the aggregation, not the cause, with a greater population density allowing for available labor to construct irrigation canals. Regardless, the aggregation of population to the center of the GRIC could have occurred for defensive or economic reasons and resulted in a population density increase, allowing for the creation of political structures necessary for an intensive irrigation system.

Development of a Tribal Government Necessary for Intensive Irrigation

Population growth and aggregation had important implications for tribal life and leadership during the 1700s. Numerous studies of prehistoric Hohokam irrigation systems indicate that a multivillage organizational system was needed to adequately distribute water and to maintain and construct canals (e.g., Howard 2006; Hunt et al. 2005; Woodson 2010). Without a cooperative or organizational structure, large-scale canal systems would not have been economically viable. Indeed, Kyle Woodson (2003) argues that the lack of an irrigation canal system when the Spanish first arrived was not due to a lack of knowledge of irrigation. Instead, he maintains, low population density and the lack of a centralized tribal government restricted the ability of the O’odham to cooperatively organize a large-scale irrigation system.

In 1694, prior to the aggregation in the mid-1700s, Father Kino observed no centralized authority above the village level (Bolton 1919). By the mid-1700s, new aggregated settlements along the middle Gila River had created a centralized tribal authority, which had not been previously documented during the historic period (Bolton 1919; Ezell 1961; Winter 1973). It appears that a new leader of this centralized tribal authority grew out of the previous position of “war chief,” but the beginnings of this tribal leadership remain unknown (Winter 1973). The creation of this position and a tribal council, however, indicates changing social relationships among the previously scattered rancherías. This centralized tribal authority, led by one man known as “Crow Head,” organized the middle Gila villages, and Joseph Winter argues, “the growing need for cooperation necessitated by raiding, and possibly by irrigation, fostered the rise of the tribal leader and the tribal council” (Winter 1973:74).

As Winter (1973) suggests, the centralization of leadership, by providing a framework of cooperation for developing more complex agricultural systems, may have been instrumental in the (re)adoption of irrigation among the middle Gila villages, which is documented in historic observations at that time, and the increased production of agricultural crops (Hunt et al. 2005). Thus, the creation of a tribal authority, likely growing out of increasing population density from
the aggregation of settlements, allowed for the creation of cooperative agreements for the successful management of a large-scale irrigation system during the historic period, leading to the intensification of agriculture in response to new market-economy demands.

Expansion of Intensive Irrigation and the Adoption of Wheat for a Market Economy

The use of new strategies, including the adoption of large-scale irrigation, to increase agricultural production is another key indicator of the intensification of land use. Early Spanish documents provide important insights into agricultural production along the middle Gila River during the early historic period (e.g., Bolton 1920; Dunne 1955). While they do not provide specific quantities of harvested crops on a defined plot of land, their descriptions are essential to understanding how the intensity of agriculture across the landscape changed during the historic period. These documents provide background concerning how agricultural strategies changed and intensified during the historic period with the construction of large-scale irrigation systems, evidence of the entrance of the O’odham into the market economy, and data that the irrigated acreage expanded and agricultural yields increased throughout this time. These documents indicate that, during the historic period, the O’odham went from cultivating maize, beans, and squash for subsistence purposes without irrigation to cultivating sizeable tracts of mostly wheat (and some maize) with large-scale irrigation systems for sale to the Spanish and the Americans. All of these lines of evidence indicate that agriculture intensified throughout the historic period.

After the prehistoric Hohokam canal system fell into disuse in the mid-1400s, no canals are known to have been constructed anywhere in southern Arizona from about 1450 until 1744 (Bolton 1919; Wells et al. 2004; Wilcox 1981; Woodson 2003). Historians argue whether O’odham groups were even practicing irrigation when the Spanish first arrived (Castetter and Bell 1942; Ezell 1961; Hackenberg 1962; Winter 1973). Spanish missionaries briefly mentioned an irrigation agricultural system on the middle Gila River during the mid-1700s (Dunne 1955; Ezell 1961), but these documents are notoriously unreliable as they rarely focus on the agricultural system of the O’odham. Kino briefly mentioned fields of maize along the middle Gila River in 1697, but did not record the use of irrigation canals (Bolton 1919). In fact, most of the statements made by Kino and one of his traveling companions, Manje, in documents from the late 1600s indicate that no canals were observed at all. While they did not specifically mention irrigation on the middle Gila River, Manje wrote this observation when their expedition had subsequently made it farther west to the Cocomaricopas areas along the Colorado River: “I do not doubt that by constructing irrigation canals they could cultivate much more land, but these natives do not use canals to
irrigate their lands; they simply wait for the water and with the great flood the 
river banks are inundated, and when the flood goes down they plant some of 
the bends and low spots” (Burrus 1971:438). This statement has led many authors 
to believe that Manje never observed canal use during his travels throughout 
southern Arizona (Doelle 1981; Wilson 1999; Winter 1973). Regardless of the 
uncertainty in the use of irrigation canals at Spanish contact, it appears that 
the O’odham were practicing extensive agriculture of maize, beans, and squash 
without the use of intensive, *large-scale* irrigation systems evident later in the 
historic period (Figure 13.4).

By the time Sedelmayr arrived on the middle Gila in 1744, one O’odham vil-
lage out of the seven known to exist at that time was growing Spanish-introduced 
wheat with river-fed irrigation (Dunne 1955; Ezell 1961). Interestingly, the other 
villages still cultivated the traditional crops of maize, beans, and squash with-
out irrigation at this time. Sedelmayr documented that the Gila O’odham also 
produced a considerable surplus, necessitating the use of labor from Tohono 
O’odham to the south to assist with seasonal harvests. The Tohono O’odham, 
who were in much greater contact with Spanish missions to the south, ultimately 
acted as trade brokers between the Gila O’odham and the Spanish, facilitating 
the trade of agricultural surplus and the increasing initiation of the Gila River 
O’odham into the emerging colonial barter and cash economy.

**Figure 13.4.** Map of middle Gila River historic canals and villages (aggregated through time).
By the 1770s, this picture of the O’odham agricultural system had changed significantly, and land use continued to intensify. A mere twenty-six years after Sedelmayr documented his travels, in 1770, another Spanish missionary, Francisco Garcés (1965), observed that wheat rivaled maize as the major crop being grown by the Gila O’odham and that all villages were growing crops with an irrigation system. When Juan Bautista de Anza entered the region in 1776, all O’odham villages were growing wheat with irrigation agriculture, indicating a rapid shift from maize to wheat production in the mid- to late 1700s, though maize continued to be cultivated in some fields (Ezell 1961; Winter 1973). Anza writes, “The fields of wheat which they now possess are so large that, standing in the middle of them, one cannot see the ends, because of their great length. They are very wide, too, embracing the whole width of the valley on both sides” (Bolton 1920:179). Anza, like Sedelmayr before him, also documents the use of Tohono O’odham labor to assist with the harvest of surplus agricultural production and to act as trade facilitators between the Spanish and the O’odham living along the Gila River.

The continued construction of irrigation canals and the adoption of wheat by the O’odham continued through the early and mid-1800s. The mid-1800s was a time of great economic and agricultural growth for the O’odham, as the risk of Apache raiding decreased and the numbers of outsiders entering the region increased. Because of this increasing demand for food from Spanish explorers and the United States military, the O’odham appear to have been fully committed to cash and barter economies by 1850 (Doelle 2002; DeJong 2009; Wilson 1999). Although details of this transition from the barter only to the cash and barter economy remain unclear, the O’odham appear to have shifted from focusing on producing agricultural crops for their own consumption to obtaining goods and other foods in exchange for their crops. Spanish and American colonizers, entering an unfamiliar environment, depended on the O’odham to provide them with food, leading the O’odham to produce crops for the market for which the O’odham received horses, metal agricultural tools, and other goods.

David DeJong (2009) undertook an analysis of agricultural data collected by the US. Bureau of Indian Affairs from the mid-1800s to the early 1900s, documenting the expansion of agriculture and the continued widespread adoption of wheat. Along with showing the increase in farmed acreage in the mid-1800s, DeJong (2009) also documented major changes in crop production. First, the selling of maize to the US military decreased over time and remained secondary to wheat production. The O’odham likely grew more wheat in response to increased demand from the US military. Second, the total cultivation of crops, especially wheat, increased during the mid-1800s, similar to the increase seen in cultivated acreage (DeJong 2009:7).
Figure 13.5 shows the amount of acreage farmed in select years from 1850 to 1921, and Figure 13.6 illustrates changes in wheat and maize production along the middle Gila River by O’odham groups between 1887 and 1899. For the first part of the period, the acreage of agricultural land increased, and the cultivation of maize decreased over time and was secondary to wheat production by the mid-1800s. These increases in irrigated acreage and wheat production during the early and mid-1850s is linked to higher demand and opportunities resulting from the influx of Anglo-American explorers and the military, who needed foodstuffs in this new environment (DeJong 2009; Wilson 1999). This increase in irrigated acreage and wheat production changed, though, with the decrease in water availability in the Gila River. In the late 1860s, non-Native Americans moved into regions upstream, drawing water off the river for their own irrigated fields. By the 1880s, the agricultural productivity of the middle Gila became severely limited due to lack of water, as reflected in the decreased amount of agricultural productivity and irrigable land used during these years (see Figures 13.5 and 13.6). Regardless, the data from the Bureau of Indian Affairs indicates that wheat was rapidly adopted, and maize was essentially abandoned at this time due to the low amount of corn being sold on the market (though it was still likely being grown by the O’odham, for subsistence purposes, which is not reflected in documents of crop sale to non-Native Americans).

It is likely, however, that the O’odham continued to cultivate maize and wheat during different times of the year. Some researchers have argued that wheat was rapidly adopted into the O’odham agricultural calendar for two reasons: (1) newcomers in the region provided a strong demand for the crop, and (2) wheat grew well in the winter months of southern Arizona, while maize grew well in the summer months, the two grains perfectly complementing each other in the O’odham agricultural calendar (Castetter and Bell 1942; Doelle 1981, 2002). Based on these sources, the O’odham planted the first crop of wheat in December in dedicated fields for wheat; a second crop of maize, beans, and squashes in early March; and a third crop of maize in July (Castetter and Bell 1942; DeJong 2011; Southworth 1919). Indeed, many ethnographic and historic sources in the early to mid-1900s also document the O’odham using traditional digging sticks to monocrop maize and wheat in separate fields and during different seasons of the year, though these observations occurred after the loss of water on the Gila, which drastically changed the O’odham’s ability to participate in market exchange (see Castetter and Bell 1942; Ezell 1961; Russell 1908).

**CONCLUSIONS**

Historic and ethnographic sources document a wide variety of changes to the O’odham agricultural system throughout colonization during the historic
period. In this chapter, I argued that increases in population density, the creation of a political structure to allow for cooperative irrigation, and the adoption of a large-scale canal system and production of wheat indicate that the O’odham intensified agriculture throughout the historic period in order to meet the market demands introduced by the Spanish and American colonizers. The initial aggregation of O’odham settlements and the introduction of new crops and technologies in the mid-1700s set into motion a complex series of decisions, including the creation of a tribal council, the expansion of agricultural production, the construction of new canals to open more acreage for farming, and the addition of wheat into the O’odham agricultural regime.

The 1700s and early 1800s were a time of great economic success for the O’odham, as they actively participated in a market economy, trading their agricultural crops for colonial wares, including metals, from non-Native Americans entering the region. This economic success exploded over the following decades, as records show the O’odham were selling record quantities of crops to travelers
Interestingly enough, the O’odham had freedom to adapt to colonization due to the lack of direct Spanish influence and control over the region. The O’odham along the middle Gila River responded to the Spanish colonial regime by maintaining agricultural strategies that had been used by their prehistoric ancestors, the Hohokam, for centuries. Later, to participate in, and meet the demands of, new markets, they turned to traditional practices, including the reintroduction and expansion of irrigated agriculture.

This economic success changed, however, with the loss of water along the middle Gila River in the late 1800s due to non-Native American farmers moving upstream and diverting water for irrigation in areas such as Coolidge and Florence in eastern Arizona. With the loss of water, the O’odham faced mass poverty and starvation. Because agricultural production was greatly reduced at this time, the O’odham resorted to a number of strategies to avoid these fates, including relying on federal food donations (DeJong 2009), moving upstream of designated reservation areas to try to capture irrigation water before the river dried up (DeJong 2011), harvesting mesquite along the river to sell as firewood.

**FIGURE 13.6.** Grain production on Gila River Indian Community (adapted from DeJong [2009]; source: US Bureau of Indian Affairs, Annual Report of the Commissioner of Indian Affairs [Pima Agency], 1887–1925).
to the city of Phoenix (Bigler 2007; DeJong 2011), and migrating to Phoenix to obtain available service jobs (DeJong 2011). Despite these efforts, the loss of water resulted in extreme poverty. While the O’odham along the middle Gila River experienced great economic success for the first periods of the colonial era, the increase in population upstream resulted in devastation to O’odham economic and agricultural success—a legacy that persists today.

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