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A DESCRIPTION OF AGRICULTURE PRODUCTION IN THE COLORADO RIVER BASIN ¹

Christopher Appleby and James Pritchett ²

The Colorado River Basin (Figure 1) is one of the most critical sources of water in the West spanning seven US states and two states in Mexico. This river's remarkable reach includes providing water to more than 30 million people and irrigating nearly four million acres of agricultural land. The river's energy powers more than 4,200 MW of electrical capacity to households and industry. However, the river is at risk because increasing water demands and climate change are jeopardizing water security.

This report represents the first of a two part study on the Colorado River Basin (CRB). The objective of the report is to summarize the agriculture water use within the upper and lower Colorado River Basins. For a summary on water transfers in the CRB, refer to "A Description of Water Transfers in the Colorado River Basin" (Appleby & Pritchett, 2011). For the unabridged report, refer to the Colorado Water Institute at <http://cwi.colostate.edu>.

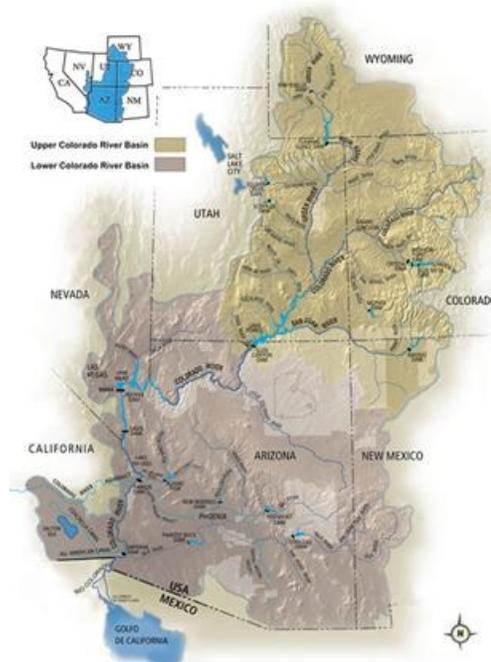


Figure 1. Colorado River Basin.
<http://www.gcdamp.gov/aboutamp/crb.html>

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² Authors are graduate research assistant and associate professor in the Department of Agricultural and Resource Economics, Colorado State University. Contact information James Pritchett, B327 Clark Bldg. Campus Mail 1172, Dept. of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO 80523-1172. 970-491-5496 (w) and james.pritchett@colostate.edu.

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Agriculture Water Use in the CRB

When obtaining data on agriculture water use in the CRB, two sources are of particular importance. The first is the Watersheds Report, which is a specific aggregation of responses to the US Census of Agriculture into watershed and hydrologic unit codes defined by the US Geological Survey. These water resource regions (WRR) are subdivided into subregions (4-digit Hydrologic Unit Code [HUC] level) based on water flow patterns from the major rivers within the region. The subregions are further divided into basins (6-digit HUC level) (Table 1). In this analysis the Upper Colorado (WRR 14) and the Lower Colorado (WRR 15) are considered. The second source is the Farm and Ranch Irrigation Survey (FRIS), which is statistical sampling performed at five year intervals by NASS to supplement the US Census of Agriculture.

Water Use for the Upper Colorado (14) from the Watersheds Report

Irrigated cropping in the Upper Colorado Water Resource Region (WRR) directly supports livestock, equine and dairy production. More than 1 million animals were inventoried in the Upper Basin in 2007, and irrigated agriculture provides critical inputs for these

crops. The 2007 crop mix can be characterized by hay crops (55%), irrigated pasture (37%) grains (5%) and other crops (4%).

Irrigated crops were produced by 12,814 farms in 2007, which is an increase of 2,346 farms over 2002. The growth in farms occurs primarily among the smallest size classifications, perhaps due to the increased incidence of exurban farmsteads in the West, as well as due to intergenerational transfer from parents to multiple children. In the latter case, children may frequently be absentee landowners, and farm management is actually performed by a local operator with a rental agreement. Irrigated farm numbers increased in every HUC in the upper basin with the greatest percentage increase in the Upper and Lower San Juan HUC's.

Farmland under irrigation also increased between 2002 and 2007 from 1.17 million acres to 1.38 million acres. The greatest increase in irrigated acres is reported in the Upper and Lower San Juan HUC's. Care must be taken when interpreting these descriptive statistics. The Census of Agriculture is a self reported survey and thus represents a snapshot of a point in time. Climatic

Table 1. The 6-digit HUC's that comprises Water Resource Region 14 and 15³

<i>Upper Colorado (14)</i>	HUC		<i>Lower Colorado (15)</i>	HUC
Colorado Headwaters	140100		Lower Colorado-Lake Mead	150100
Gunnison	140200		Little Colorado	150200
Upper Colorado - Dolores	140300		Lower Colorado-Lake Mead	150301
Upper Green	140401		Bill Williams	150302
Great Divide Close Basin	140402		Upper Gila	150400
White-Yampa	140500		Middle Gila	150501
Lower Green	140600		San Pedro-Willcox	150502
Upper Colorado Dirty Devil	140700		Santa Cruz	150503
Upper San Juan	140801		Salt	150601
Lower San Juan	140802		Verde	150602
			Lower Gila-Agua Fria	150701
<i>California Region (18)</i>			Lower Gila	150702
Salton Sea	181002		Rio Sonoyta	150801
			Rio De La Concepcion	150802
			Rio De Bavispe	150803

³ The Imperial Irrigation District (IID) is not included in the Lower Colorado Basin Water Resource Region, but it does receive water resources from the CRB. The IID is part of the California Region and Salton Sea HUC.

conditions, such as depleted supplies of stored water, may mean that fewer irrigated acres are reported in a water short year vis a vis a year in which water supplies are more substantial. Interviews suggest that many acres in the Upper and Lower San Juan were fallowed because of the drought in 2002.

Water Use for the Lower Colorado (15) from the Watersheds Report

Agricultural activity in the Lower Colorado WRR (including the Imperial Irrigation District [IID]) is more varied and generates greater sales per irrigated acre than what is found in the Upper Basin. In part, the greater agricultural activity is the result of a longer growing season and closer proximity to large urban food markets and distribution infrastructure. Table 2 summarizes the WRR 15 crop mix in 2003 and 2008. Notable is an increase in hay production, a perennial crop, and a decrease in cotton production in the Lower Basin. Changes in the crop mix are likely due to economic profitability rather than water use, as alfalfa’s season-long consumptive use of water is substantially higher than that of cotton. Recent increases in worldwide cotton prices may reverse the decline in cotton’s share of the crop mix.

Table 2. Crop Mix of Harvested Acres in the Lower Colorado WRR 15 and IID

	2003	2008
Hay Crops	30%	39%
Cotton	25%	15%
Vegetables	15%	11%
Wheat	13%	14%
Orchards	4%	3%
Pasture	4%	5%
Other	8%	12%

The Watersheds Report lists an increase of 613 irrigated farms between 2002 and 2007 in the Lower Colorado Basin Water Resource Region, but it is worthwhile to separate out the changes by 6 digit HUC’s and the IID. Irrigated farm numbers increased in all HUC’s except for the Lower Colorado (HUC 150301), the Middle Gila (HUC 150501), the San Pedro-Wilcox (HUC 150502), the Santa Cruz (HUC 150503), the Salt (150601), the Lower Gila – Agua Fria (150701) and the Lower Gila (150702), as well as the IID. These HUC’s are primarily located in lower-central portion of Arizona – an area in which municipal development was occurring rapidly.

Land under irrigation in the Lower Colorado WRR decreased substantially as indicated by the Watersheds Report. In 2002, 1.6 million acres were reported as compared to 1.42 million acres in 2007. The Imperial Irrigation District’s irrigated acres were reduced by 106,000 acres in the same time interval, in part due to water transfers, but also because farm managers may seek to fallow acres if it is economically advantageous to cease production rather than taking a loss on a particular crop. Irrigated acreage reductions were noted in ten of the fifteen HUC’s for the Lower Colorado Water Resources Region, with the greatest share of irrigated acres declining in the Rio De La Soynota (43% reduction or 11,493 acres) and the Middle Gila (17% reduction or 26,298 reduction) in irrigated acres.

Trends

The FRIS reports that the total number of farms in the Upper Colorado Basin increased by 1,700 between 2003 and 2008, with small farms (less than 49 acres) accounting for 50 percent of the total number of farms in 2003 and a remarkable 71 percent of the total in 2008. This dramatic increase in the number of small farms follows a pattern of exurban development in the Intermountain West. Small farms account for 9 percent of irrigated cropland in the Upper Colorado Basin, with the largest farms (2,000 acres or more) taking up 23 percent of the irrigated cropland. The middle size classifications (50 acres to 1,999 irrigated acres per farm) are becoming smaller in terms of the number of farms (28% in 2008) though they still crop 2/3 of the irrigated acres.

The Lower Colorado Basin follows a similar trend in farm size as is observed in the Upper Colorado WRR. However, the irrigated acres are more concentrated in larger farm size categories. Farms reporting more than 2,000 acres of irrigated cropping are controlling more than 520,000 acres in the 2008 FRIS, a 21% increase from the reported level of irrigated acres in 2003. Farms with 1,000 acres of irrigated cropland or more control nearly three-quarters of all irrigated land in the Lower Colorado WRR. Small farms constitute two-thirds of the farm numbers in the Lower Colorado WRR, but only control 3% of the irrigated acreage.

Water Efficiency and Conservation

The FRIS asks survey respondents a variety of questions about how water is applied to irrigated cropland. The application categories include gravity, sprinkler (center pivot, sideroll, linear), drip or low flow irrigation and subirrigation. The primary application method in the Upper Colorado WRR is gravity irrigation,

which is utilized on 73% of the irrigated acres reported in the 2008 FRIS. The remaining 27% of irrigated acres utilize sprinkler application. Drip and subsurface irrigation are not used in any significant way in the Upper Colorado WRR. Of the sprinkler types, sideroll irrigation is reported on 60% of sprinkler irrigated lands; however, the share of sideroll irrigation decreased by 15% between 2003 and 2008, and this share is replaced by center pivot irrigation.

Similar to the Upper Colorado WRR, the Lower Colorado WRR uses gravity irrigation for more than three-quarters of its irrigated cropland as reported in the 2008 FRIS. Sprinkler irrigation comprises 18% of application to irrigated cropland in this region and more extensive use of drip or low flow (5%) is noted. Unlike the Upper Colorado WRR, center pivot irrigation makes three-fourths of the sprinkler irrigated acreage with nearly identical shares for solid set (9%), sideroll (9%) and linear (7%) in the remainder.

Conservation Practices

The FRIS asks respondents to indicate if they have improved water or energy conservation during the last five years, and then note the improvements that occurred as a result of the adopted practices. Table 3

summarizes benefits reported by farms engaging in improved conservation by water resource region. Between 2003 and 2008, improvements increased in both WRR 14 and WRR 15. The vast majority of respondents indicate that their improvements resulted in increased yields, and that the amount of water applied decreased, especially in the Lower Colorado WRR (62% in 2003 and 75% in 2008).

Respondents to the FRIS are asked to report the barriers that prevented them from adopting water or energy conservation practices. Localized drought may play a significant role in explaining these differences between years, as illustrated in Table 4. The recent liquidity

Table 3. Benefits in Improvements Made in Energy and Water Conservation in last 5 Years*

	Upper Colorado WRR 14		Lower Colorado WRR 15	
	2003	2008	2003	2008
Number of Farms Reporting	2,761	3,476	1,213	1,291
Number of Irrigated Acres Improved	502,148	525,153	479,263	520,077
Acre Feet of Applied Water Represented	829,455	1,066,886	2,194,766	2,833,633
Percent of Farms Reporting				
Improved Crop Yield or Quality	50%	59%	68%	64%
Reduced Energy Cost	10%	16%	34%	48%
Reduced Water Applied	40%	47%	62%	75%
Reduced Labor Costs	28%	41%	32%	54%
Reduced Fertilizer or Pesticide Losses	12%	15%	11%	30%
Reduced Soil Erosion	36%	37%	47%	59%
Reduced Tailwater	25%	34%	30%	39%
Other	21%	16%	6%	1%

*Information from the FRIS is based on a stratified sampling of surveyed responses, so Table 3's results are not the result of a census of all operations.

Table 4. Barriers to Adopting Water or Energy Conservation (Percentage of Farms)

	Upper CO WRR 14		Lower CO WRR 15	
	2003	2008	2003	2008
Investigating improvements not a priority	9%	42%	8%	48%
Risk of reduced yield or poor crop quality	6%	4%	6%	15%
Physical field/crop condition limits system improvements	8%	9%	9%	12%
Improvements will not reduce costs enough to cover installation costs	19%	13%	11%	6%
Cannot finance improvements	12%	27%	8%	41%
Landlord will not share in cost	2%	2%	9%	6%
Uncertainty about future availability of water	15%	7%	13%	19%
Will not be farming this operation long enough to justify improvements	2%	4%	3%	16%
Other	6%	28%	11%	25%

crisis in agricultural lending may explain the dramatic increase in ‘cannot finance improvements’ between 2003 and 2008.

Conclusions

The Colorado River Basin is a vital resource of water for irrigation and agricultural interests. Summary points include:

- Overall, irrigated agriculture in the Upper Colorado WRR 15 is not declining—irrigated acres increased slightly between 2002 and 2007.
- The distribution of farms is trending toward an industry with many small irrigated farms that produce a smaller share of household income, and fewer large farms that support the majority of irrigated cropping. It is unclear how this might influence future conservation and water management practices, or future water transactions.
- Gravity irrigation is the primary irrigation method for both the Upper Colorado and Lower Colorado, as reported in the 2008 FRIS.
- Benefits for farms engaged in improved conservation practiced improved for both the WRR 14 and WRR 15.

Limitations of Analysis

Inference drawn from the data in this report is limited by its scope and the manner in which it is summarized. More specifically:

- Agricultural statistics represent a snapshot in time and are not a dynamic portrayal of

events. As an example, significant drought in the CRB may mean that irrigated cropping in 2002 was less than might be expected under a “normal” water year. Similarly, economic returns can influence the amount of cropland that is irrigated versus that which is fallowed.

- It is difficult to link irrigated cropping statistics to the source of water. In particular, irrigation water may come from river diversion, reservoir storage, alluvial groundwater or confined aquifer sources, if not a combination of all of these.
- The Farm and Ranch Irrigation survey is very useful in providing insight into some of the production practices used on irrigated farms in the CRB. However it is a stratified sampling of farms and not a census of practices. A future opportunity is to use the USDAS-ERS-ARMS survey data to uncover additional insights into management practices. This data is available for use only in special tabulations or with special training and access at a limited number of locations.
- It is difficult to link irrigated cropping statistics from the Watersheds Report to the source of water. In particular, irrigation water may come from river diversion, reservoir storage, alluvial groundwater or confined aquifer sources, if not a combination of all of these. As a result, it is difficult to use these statistics to draw conclusions of how the flows of the CRB are impacted by changes in irrigated cropping reported in this study.

Sources

1. University of California, Santa Barbara, Donald Bren School of Environmental Science and Management, Water Transfer Database. http://www.bren.ucsb.edu/news/water_transfers.htm
Note that transactions were updated through February 2009.
2. US Census of Agriculture, Farm and Ranch Irrigation Survey (various issues). US Department of Agriculture, National Agriculture
Statistics Service. http://www.agcensus.usda.gov/Publications/2007/Farm_and_Ranch_Irrigation_Survey/index.asp
3. US Census of Agriculture, Watersheds Report. US Department of Agriculture, National Agriculture Statistics Service. http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Watersheds/index.asp