Summary of Results from Survey Research Laboratory's Arkansas Crop Irrigation Survey

Final

Prepared for

The University of Arkansas

December 2017

Prepared by

Northern Economics

Anchorage
880 H Street
Suite 210
Anchorage, Alaska 99501
Phone: 907.274.5600
Fax: 907.274.5601

Seattle
1455 NW Leary Way
Suite 400
Seattle, WA 98107
Phone: 206.747.8475

Email: mail@norecon.com

PROFESSIONAL CONSULTING SERVICES IN APPLIED ECONOMICS AND SOCIAL SCIENCES

Principals:
Patrick Burden, M.S. – Chairman
Marcus L. Hartley, M.S. – President
Michael Fisher, MBA – Principal
Diane Sauer – Office Manager

Consultants:
Logan Blair, M.S.
Leah Cuyno, Ph.D.
Michael Downs, Ph.D.
Gary Eaton, M.S.
Michelle Humphrey, M.S.
Don Schug, Ph.D.
Katharine Wellman, Ph.D.

Administrative Staff:
Terri McCoy, B.A. – Editor

Northern Economics

880 H Street, Suite 210
Anchorage, Alaska 99501
Phone: 907.274-5600
Fax: 907.274-5601

1455 NW Leary Way, Suite 400
Seattle, WA 98107
Phone: 206.747.8475
Email: mail@norecon.com

Preparers

Team Member	Project Role
Marcus Harley	Principal in Charge
Logan Blair	Project Manager and Author
Terri McCoy	Editor

Please cite as: Northern Economics, Inc. Summary of Results from Survey Research Laboratory's Arkansas Crop Irrigation Survey. Prepared for The University of Arkansas. December 2017.

Contents

Table	Page

Figure **Page**

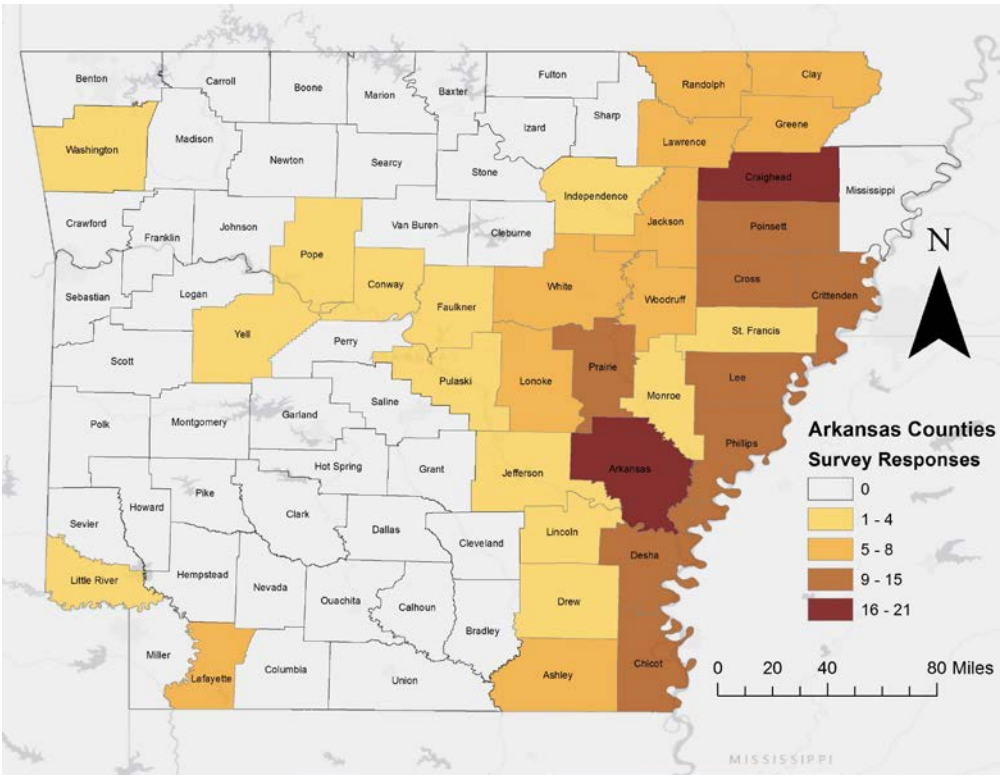
1 Introduction

In October of 2016, Survey Research Laboratory (Edwards, 2010), a division of the Social Science Research Center at Mississippi State University, conducted a phone survey of agricultural producers located in the state of Arkansas. The survey consisted of 146 regular, and 228 potential random questions designed to better understand irrigation use among producers. The purpose of this report is to provide a series of tables and figures that summarize results of the survey in a way that is useful to agricultural stakeholders and researchers alike.

Out of 3,712 commercial farms identified using Dun & Bradstreet data, the Survey Research Laboratory received 231 responses, 32 of which were pilot surveys, and 199 complete. Survey Research Laboratory logs show that most nonresponses (1,321) came from no answer, busy signal, or voicemail. The remainder of the failed attempts were because of a disconnected number, a "landowner only" response,[1] refusal, or other issue.

While response rates do not inherently point toward higher agricultural intensity, survey responses varied drastically by county. Arkansas, Craighead, Cross, Crittenden, and Desha Counties represented the most responses per county (Figure 1), and rates in general dramatically increased moving from western Arkansas to eastern Arkansas. Counties bordering the Mississippi river provided a consistently higher response rate compared to other regions of the state.

Figure 1. Total Survey Responses by Arkansas Counties



[1] Respondents were required to be either the farm operator only, or a land owner and operator to participate in the survey.

2 Table Organization and Farm Categories

The tables in the following sections summarize responses by survey topic, and farm category.

Section 3 summarizes irrigation related functions such as water delivery methods, field leveling, water sources, pump fuel, storage, scheduling, and conservation programs.

Section 4 summarizes demographic information like years of farming experience and formal education.

Where appropriate, tables are repeated using multiple farm groupings—such as farm size, respondent's years of experience or crop group—which are discussed in more detail below.

The size of agricultural producers in Arkansas varies widely. Producer responses were placed into four size groups, based on the number of irrigated acres reported, so that each contained roughly the same number of responses. Table 1 shows that more irrigated acres of soybean are farmed than any other crop type in the survey, regardless of farm size. Irrigated acres of rice, corn, cotton, sorghum and peanuts follow the prevalence of soybean respectively, except for farms with less than 1,000 acres, which reported slightly more irrigated sorghum acres than cotton, and farms with 3,200 acres or more, which reported more irrigated peanut acres than sorghum.

Table 1. Crop Distribution by Farm Size (Acres)

Farm Size	All Farms	Total Irrigated Acres	Soybean	Rice	Corn	Cotton	Sorghum	Peanuts
			Irrigated Acres					
			(% of Total Irrigated Acres)[1]					
All Farms	231	600,747	304,363	172,107	79,757	31,475	7,830	5,215
			51	29	13	5	1	1
3,200+ Irrigated Acres	59	349,870	168,647	99,459	51,314	22,350	2,900	5,200
			48	28	15	6	1	1
1,901-3,200 Irrigated Acres	56	145,578	76,700	43,228	16,200	5,180	4,270	0
			53	30	11	4	3	0
1,001-1,900 Irrigated Acres	54	78,804	44,485	21,846	8,158	3,815	500	0
			56	28	10	5	1	0
0-1,000 Irrigated Acres	62	26,495	14,531	7,574	4,085	130	160	15
			55	29	15	0	1	0

[1] Rounded to the nearest percent.

A respondent's years of farming experience varied considerably in the survey. To summarize results that might vary with experience, this report grouped experience into eight categories, each containing roughly the same number of responses (Table 2). This grouping shows that producers with more farming experience tend to manage farms with fewer irrigated acres than those with less farming experience. Soybean remained the most grown crop among all experience groups, while rice, corn, cotton, sorghum, and peanuts are generally grown on fewer irrigated acres respectively. Corn production appears to be disproportionally favored by producers with 21 to 28 years of experience, while farmers with 29 to 34 years of experience grow much more cotton than any other experience group.

Table 2. Crop Distribution by Years of Farming Experience (Acres)

Years of Experience	All Farms	Total Irrigated Acres	Soybean	Rice	Corn	Cotton	Sorghum	Peanuts
			Irrigated Acres					
			(%)					
All Farms	231	600,747	304,363	172,107	79,757	31,475	7,830	5,215
			51	29	13	5	1	1
0-14	33	104,132	57,552	28,481	13,359	2,740	1,500	500
			55	27	13	3	1	0
15-21	29	74,491	37,034	22,692	8,630	2,600	3,020	515
			50	30	12	3	4	1
21-28	28	103,946	43,235	23,691	24,835	6,935	1,250	4,000
			42	23	24	7	1	4
29-34	31	99,337	50,685	31,655	5,487	11,370	140	0
			51	32	6	11	0	0
35-39	22	65,068	31,185	25,103	6,580	2,000	200	0
			48	39	10	3	0	0
40-44	31	59,250	33,800	13,200	10,570	880	800	0
			57	22	18	1	1	0
45-50	29	47,195	25,035	13,400	6,210	1,950	400	200
			53	28	13	4	1	0
Greater than 50	26	44,528	24,637	12,685	3,686	3,000	520	0
			55	28	8	7	1	0
Unknown or Refused	2	2,800	1,200	1,200	400	0	0	0
			43	43	14	0	0	0

A single producer can produce one, or multiple crops in any given year. For example, a soybean producer may also grow some corn, while another farm might produce equal amount of soybean, rice, corn, and cotton. Except for rice, the survey does not attribute responses to any specific crop—meaning that if summarized by individual crops, the same response may be counted multiple times, once for each crop a respondent produces. To avoid a double counting issue, this analysis assigns unique crop groupings based on overall crop composition. Table 3 breaks down crop groupings as follows:

- Predominantly soybean—soybean reported on greater than 60 percent of irrigated acres,
- Predominantly rice—rice reported on greater than 60 percent of irrigated acres,
- Predominantly corn—corn reported on greater than 60 percent of irrigated acres,
- Predominantly cotton—cotton reported on greater than 60 percent of irrigated acres,
- Predominantly sorghum—sorghum reported on greater than 60 percent of irrigated acres,
- Soybean and rice—only soybean and rice, each on 40 to 60 percent of irrigated acres,
- Soybean and corn—only soybean and corn, each on 40 to 60 percent of irrigated acres,
- Soybean and cotton—only soybean and cotton, each on 40 to 60 percent of irrigated acres,

- Multiple Crops—more than two crops, none representing more than 60 percent of irrigated acres,
- Other—crop pairs without soybean, and responses that did not give irrigated acres by crop.

Table 3. Crop Distribution by Crop Group (Acres)

Crop Group	All Farms	Total Irrigated Acres	Soybean	Rice	Corn	Cotton	Sorghum	Peanuts
			Irrigated Acres					
			(% of Total Irrigated Acres)					
All Farms	231	600,747	304,363	172,107	79,757	31,475	7,830	5,215
			51	29	13	5	1	1
Predominantly soybean	79	162,786	125,027	22,950	10,724	2,965	1,120	0
			77	14	7	2	1	0
Predominantly rice	15	20,030	3,860	15,600	570	0	0	0
			19	78	3	0	0	0
Predominantly corn	8	27,779	3,550	4,000	20,229	0	0	0
			13	14	73	0	0	0
Predominantly cotton	2	3,715	500	0	0	3,215	0	0
			13	0	0	87	0	0
Predominantly sorghum	1	140	0	0	0	0	140	0
			0	0	0	0	100	0
Soybean and rice	27	75,511	38,289	37,222	0	0	0	0
			51	49	0	0	0	0
Soybean and corn	8	12,500	6,025	0	6,475	0	0	0
			48	0	52	0	0	0
Soybean and cotton	1	1,700	700	0	0	1,000	0	0
			41	0	0	59	0	0
Multiple Crops	75	278,001	116,912	86,435	38,609	24,295	6,550	5,200
			42	31	14	9	2	2
Other	15	18,585	9,500	5,900	3,150	0	20	15
			51	32	17	0	0	0

Some producers indicated that their farm contains much more than 60 percent of a single crop type. For example, Table 3 shows that farms within the predominantly soybean category contain 77 percent irrigated soybean acres in total, predominantly rice farms contain 78 percent rice, predominantly corn farms contain 73 percent corn, predominantly cotton farms contain 87 percent cotton, and the (single) predominantly sorghum response reported 100 percent sorghum.

Finally, readers should be cautioned that unlike farm size and farming experience groups, crop groupings were not designed to contain a similar number of farms. Over half of the responses, 154 out of 231, fall under either the predominantly soybean, or multiple crops grouping, while the smallest group, predominantly sorghum, contains only one response.

3 Irrigation Topics

The agricultural survey is largely dedicated to water management and irrigation habits of Arkansas Producers. This section discusses responses to irrigation questions in more detail.

3.1 Irrigation Methods

Table 4 summarizes responses to questions about the use of furrow, flood, border, and micro irrigation by producers, and is organized by crop group. Note that there can be multiple irrigation methods per farm.

Out of the 231 responses, 161 producers indicated using furrow irrigation exclusively on at least part of their farm. Alternatively, 138 farms indicated that they use flood irrigation exclusively for non-rice crops, such as soybeans and corn in levee fields. Out of the 231 producers, 128 indicated that they alternate between flood and furrow irrigation for crop combinations like levee rice and row water soybean. A total of 143 farms indicated that they use continuous flood irrigation on their rice acres specifically. Thirty respondents indicated using border irrigation on some, or all their irrigated acres. Three respondents mentioned using micro irrigation.

As shown in Table 4, the makeup of a farm's crops largely drives irrigation decisions. For example, among respondents that produce predominantly soybean, continuous furrow was the most commonly cited form of irrigation, while respondents in the multiple crops category use continuous and exclusive flood techniques more frequently than continuous furrow. This reflects the fact that soybean crops likely benefit from continuous furrow irrigation, while there could be efficiencies from continuous flood irrigation for multiple, or rotating crops.

Table 4. Furrow, Flood, Border, and Micro Irrigation by Crop Group

Crop Group	All Farms	Continuous Furrow	Continuous Flood (Rice Crops Only)	Exclusively Flood (not rice)	Alternate Flood and Furrow	Border irrigation	Micro irrigation
		Number of Farms[1]					
Predominantly soybean	79	56	33	36	35	9	0
Predominantly rice	15	9	13	9	6	4	1
Predominantly corn	8	3	3	4	4	1	0
Predominantly cotton	2	2	0	0	0	0	0
Predominantly sorghum	1	0	0	0	0	0	0
Soybean and rice	27	21	23	23	22	3	0
Soybean and corn	8	5	0	2	3	1	0
Soybean and cotton	1	1	0	1	0	0	0
Multiple Crops	75	52	62	55	49	11	0
Other	15	12	9	8	9	1	2
Total	231	161	143	138	128	30	3

[1] There can be multiple irrigation methods per farm. Therefore, the sum of various irrigation methods does not equal all farms.

Table 5 presents the same information as in Table 4, but summarizes irrigation methods by crop grouping. Table 5 also presents irrigated acres as a percent of total irrigated acres within each crop grouping.

Table 5. Furrow, Flood, Border, and Micro Irrigation by Crop Group (Acres)

Crop Group	All Farms	Total Irrigated Acres[1]	Continuous Furrow	Continuous Flood (Rice Crops Only)	Exclusively Flood (not rice)	Alternate Flood and Furrow	Border	Micro-irrigation
			Irrigated Acres					
			(% of Total Irrigated Acres)					
All Farms	231	716,470	223,892	144,466	142,486	184,075	21,291	260
			31	20	20	26	3	0
Predominantly soybean	79	165,913	68,693	20,525	25,480	41,865	9,350	0
			41	12	15	25	6	0
Predominantly rice	15	34,237	5,316	13,130	9,086	5,570	1,075	60
			16	38	27	16	3	0
Predominantly corn	8	34,151	4,070	6,700	5,031	18,250	100	0
			12	20	15	53	0	0
Predominantly cotton	2	2,850	2,850	0	0	0	0	0
			100	0	0	0	0	0
Predominantly sorghum[2]	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			N/A	N/A	N/A	N/A	N/A	N/A
Soybean and rice	27	110,106	24,461	28,722	33,446	19,977	3,500	0
			22	26	30	18	3	0
Soybean and corn	8	14,201	6,850	0	501	4,950	1,900	0
			48	0	4	35	13	0
Soybean and cotton	1	1,000	500	0	500	0	0	0
			50	0	50	0	0	0
Multiple Crops	75	315,139	100,771	68,689	60,041	80,282	5,356	0
			32	22	19	25	2	0
Other	15	38,873	10,381	6,700	8,401	13,181	10	200
			27	17	22	34	0	1

[1]Total irrigated acres by irrigation method is different from total irrigated acres by crop, because figures come from different survey questions. Respondents may irrigate the same acres using multiple methods, use different methods than those asked about in the survey, or give inconsistent figures.

[2]Respondent listed irrigated acres when referring to crop type, but did not indicate irrigated acres when asked about irrigation methods.

Table 6 provides information about field leveling, and water delivery for respondents that produce crops other than rice, and is organized by crop group. Note that there could be multiple leveling and water delivery system per producer.

As shown in Table 6, 176 out of 231 respondents indicated field leveling techniques, including zero grade, precision grade, constant slope, warped surface, or optisurface. End blocking, cutback, and deep tillage irrigation were used on 113 farms, or 48 percent of the total, while 70, 63, 31, and 12 producers respectively indicated the use of center pivot, computerized hole selection, surge, and portable center pivot.

After field leveling, the most preferred irrigation method in most crop categories was end blocking, cutback, and deep tillage.

Table 6. Field Leveling and Water Delivery Systems by Crop Group

Crop Group	All Farms	Leveled[1]	End Blocking, Cutback, and Deep Tillage	Center Pivot	Computerized Hole Selection	Surge	Portable Center Pivot
		Number of Farms[2]					
Predominantly soybean	79	61	34	25	27	5	3
Predominantly rice	15	11	5	3	2	3	0
Predominantly corn	8	4	2	4	1	2	1
Predominantly cotton	2	2	2	2	1	2	1
Predominantly sorghum	1	0	0	0	0	0	0
Soybean and rice	27	23	14	3	4	6	1
Soybean and corn	8	4	4	3	3	2	0
Soybean and cotton	1	1	0	1	1	0	0
Multiple Crops	75	58	45	26	23	8	5
Other	15	12	7	3	1	3	1
Total	231	176	113	70	63	31	12

[1] Refers to leveling by zero grade precision grade, constant slope, warped surface, or optisurface.
[2] There can be multiple leveling and water delivery systems per farm. Therefore, the sum of various leveling and delivery systems does not equal all farms.

Table 7 presents the same information as in Table 6, but summarizes leveling and water delivery methods by crop grouping. Table 7 also presents irrigated acres as a percent of total irrigated acres within each crop grouping.

Table 7. Field Leveling and Water Delivery Systems by Crop Group (Acres)

Farm Group	All Farms	Total Irrigated Acres[1]	Leveled	End Blocking, Cutback, and Deep Tillage	Center Pivot	Computerized Hole Selection	Surge	Portable Center Pivot
			Irrigated Acres					
			(% of Total Irrigated Acres)					
All Farms	231	585,162	277,702	163,160	60,125	68,902	12,146	3,127
			47	28	10	12	2	1
Predominantly soybean	79	185,246	72,729	51,295	29,025	29,417	1,760	1,020
			39	28	16	16	1	1
Predominantly rice	15	21,175	11,885	7,300	860	520	610	0
			56	34	4	2	3	0
Predominantly corn	8	25,562	22,210	680	2,490	40	140	2
			87	3	10	0	1	0
Predominantly cotton	2	8,655	2,850	1,900	1,150	1,800	880	75
			33	22	13	21	10	1
Predominantly sorghum[2]	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			N/A	N/A	N/A	N/A	N/A	N/A
Soybean and rice	27	70,703	33,187	26,875	880	5,130	4,491	140
			47	38	1	7	6	0
Soybean and corn	8	9,660	3,590	1,755	2,010	2,165	140	0
			37	18	21	22	1	0
Soybean and cotton	1	2,500	500	0	1,500	500	0	0
			20	0	60	20	0	0
Multiple Crops	75	241,151	116,911	67,735	21,650	29,030	3,945	1,880
			48	28	9	12	2	1
Other	15	20,510	13,840	5,620	560	300	180	10
			67	27	3	1	1	0

[1]Total irrigated acres by irrigation method is different from total irrigated acres by crop, because figures come from different survey questions. Respondents may irrigate the same acres using multiple methods, use different methods than those asked about in the survey, or give inconsistent figures.

[2]Respondent listed irrigated acres when referring to crop type, but did not indicate irrigated acres when asked about irrigation methods.

Table 8 respondents were asked questions regarding irrigation on rice producing acres only. Since the type of crop (rice) is already inherently defined by the survey question, Table 8 is organized by farm size. Like Table 4 and Table 6, respondents could indicate multiple irrigation practices per farm.

More respondents with larger farms mentioned growing rice than respondents with smaller farms. This is likely because larger farms can produce multiple crops, including rice, whereas smaller farms may have to concentrate on one or two crops. It is possible that smaller farms do not choose

to produce rice as often as larger farms because of the need for specialized irrigation and field preparation.

Precision grade leveling was used by a 122 out of 165 rice producers, and contour levees were employed by 87 producers, or 52 percent of all rice producing farms. Only 43 out of 165 respondents indicated using zero grade methods.

Table 8. Rice-Specific Irrigation Methods by Farm Size

Farm Size	Rice Producing Farms	Precision Grade	Contour Levee	Multiple Inlet[1]	Zero Grade
		Number of Farms[2,3]			
3,200+ Irrigated Acres	50	42	30	30	16
1,901-3,200 Irrigated Acres	44	33	25	22	12
1,001-1,900 Irrigated Acres	37	27	19	18	10
0-1,000 Irrigated Acres	34	20	13	11	5
Total	165	122	87	81	43

[1] Includes contour levee or precision grade fields that use multiple inlet rice.

[2] Refers only to farms that produce rice.

[3] There can be multiple irrigation methods per farm. Therefore, the sum of various irrigation systems does not equal all farms.

Table 9 presents the same information as in Table 8, but presents rice-specific irrigation acres as a percent of total irrigated acres within each farm size grouping.

Table 9. Rice-Specific Irrigation Methods by Farm Size (Acres)

Farm Size	All Rice Producing Farms	Total Crops (Irrigated rice acres)	Precision Grade	Contour Levee	Multiple Inlet	Zero Grade
			Irrigated Acres			
			(% of Total Irrigated Acres)			
All Farms	165	242,334	95,380	58,769	76,889	11,296
			39	24	32	5
3200+ Irrigated Acres	50	139,030	58,945	28,440	47,515	4,130
			42	20	34	3
1901-3200 Irrigated Acres	44	59,738	21,348	18,035	17,895	2,460
			36	30	30	4
1001-1900 Irrigated Acres	37	34,417	11,897	9,072	9,262	4,186
			35	26	27	12
0-1000 Irrigated Acres	34	9,149	3,190	3,222	2,217	520
			35	35	24	6

3.2 Water Sources for Irrigation

Table 10 summarizes the various water sources used by producers in the survey to irrigate their fields, and is organized by farm size. Groundwater was the most widely used water source for irrigation in the survey regardless of farm size, followed by surface water. Only 4 out of 231

responses indicated that they used water from an irrigation district. Water recovery and storage, such as the use of a reservoir with tail water recovery, tail water ditch, or surface water, was employed by 55, 42, and 35 producers respectively.

The survey shows that there are roughly just as many small farms using ground water as large farms. However, results indicate that large farms (Greater than 1,000 acres) are more likely to use surface water than small farms, and are also more likely to engage in various recovery and storage activities.

Table 10. Water Source and Management for Irrigation by Farm Size

Farm Size	All Farms	Groundwater	Surface water	Reservoir with tail water recovery	Recycled by reservoir or tail water ditch no outside source	Surface water in reservoir	Irrigation district
		Number of Farms[1]					
3,200+ Irrigated Acres	59	59	25	17	15	12	2
1,901-3,200 Irrigated Acres	56	53	25	15	9	10	0
1,001-1,900 Irrigated Acres	54	47	24	15	11	7	1
0-1,000 Irrigated Acres	62	52	11	8	7	6	1
Total	231	211	85	55	42	35	4

[1] There can be multiple water sources and management methods per farm. Therefore, the sum of various water sources and management methods does not equal all farms.

Table 11 provides the same water recovery and storage information as Table 10, but groups responses by crop group.

Table 11. Water Source and Management for Irrigation by Crop Group

Crop Group	All Farms	Groundwater	Surface water	Reservoir with tail water recovery	Recycled by reservoir or tail water ditch no outside source	Surface water in reservoir	Irrigation district
		Number of Farms[1]					
Predominantly soybean	79	74	20	11	10	7	1
Predominantly rice	15	14	8	0	2	2	0
Predominantly corn	8	7	1	1	1	1	1
Predominantly cotton	2	2	0	0	0	0	0
Predominantly sorghum	1	1	0	0	0	0	0
Soybean and rice	27	23	11	7	8	6	0
Soybean and corn	8	6	3	1	0	1	0
Soybean and cotton	1	1	0	0	0	0	0
Multiple Crops	75	71	35	29	19	14	2
Other	15	12	7	6	2	4	0
Total	231	211	85	55	42	35	4

[1] There can be multiple water sources and management methods per farm. Therefore, the sum of various water sources and management methods does not equal all farms.

Given the prevalence of groundwater use for irrigation, Table 12 asks if farmers have seen a fluctuation in their groundwater levels, and is organized by the size of a respondent's farm.

Overwhelmingly, 117 out of 211, or 55 percent of ground water users, indicated that their groundwater depth has not changed, while 57 ground water users, or 27 percent, indicated that the depth-to-water level has decreased. It appears that decreases in depth-to-water levels were noticed on large farms more frequently than on small farms. There are 27 respondents indicated that the depth-to-groundwater increased, and 10 did not know.

Table 12. Ground Water Characteristics by Farm Size

Farm Size	All Farms that use Groundwater	Depth-to-water did not change	Depth-to-water decreased	Depth-to-water increased	Don't Know
		Number of Farms[1]			
3,200+ Irrigated Acres	59	37	16	6	0
1,901-3,200 Irrigated Acres	53	26	17	6	4
1,001-1,900 Irrigated Acres	47	22	14	10	1
0-1,000 Irrigated Acres	52	32	10	5	5
Total	211	117	57	27	10

[1] Respondents who used groundwater could only give one response to the question about their water level.

As indicated in Table 13, an overwhelming number of respondents do not believe that there is a water shortage on their farms, while a large majority believe that there is a water shortage in Arkansas as a whole. All producers answered the question, "Do you have water shortage on your farm?" However, when asked about the state, 29 producers "did not know", and 1 refused to answer.

Table 13. Water Shortage Sentiment by Farm Size

Farm Size	Water shortage on your farm?[1]		Water shortage in your state?			
	No	Yes	No	Yes	Don't Know	Refused
3,200+ Irrigated Acres	52	7	11	40	7	1
1,901-3,200 Irrigated Acres	44	9	8	41	6	0
1,001-1,900 Irrigated Acres	37	10	6	39	4	0
0-1,000 Irrigated Acres	47	5	11	30	12	0
Total	180	31	36	150	29	1

3.3 Water Pumps and Efficiency

Water pumps are necessary to draw and pressurize ground and surface water for use in irrigation. Pump systems may also incorporate timers and flow meters to better monitor pumping activities. Table 14 shows that almost all—225 out of 231—producers reported the use of water pumps on their farm. As expected, the average number of pumps per acre is highly dependent on the size of the farm. Farms containing 3,200 acres or more use an average of 0.009 water pumps per irrigated acre, while farms with fewer than 1,000 acres indicated using an average of 0.021 pumps per irrigated acre.

In terms of supplementary pumping technologies, 48 percent of farms with 3,200 acres or more indicated using flow meters, while the use of flow meter drops to 20 percent for farms under 1,000 acres. The use of water pump timers also varies depending on farm size. Large farms reported 33 percent pump timer use, but only 11 percent of farms that fall within 1,001 to 1,900 acres indicated

the use of timers. Despite their smaller size, 20 percent of farms with fewer than 1,000 acres used pump timers in the survey.

Table 14. Water Pump Characteristics by Farm Size

Farm Size	Number of farms[1]	Indicated pump use[1]	Average number of irrigated acres per pump[1]	Use flow meters (%)[2]	Use pump timers (%)[2]
3,200+ Irrigated Acres	59	58	111	48	33
1,901-3,200 Irrigated Acres	56	54	91	39	24
1,001-1,900 Irrigated Acres	54	53	91	34	11
0-1,000 Irrigated Acres	62	60	45	20	20
Total/Average/Total%	231	225	77	35	22

[1] Do not include zeros, "unknown" answers, or refusal.
[2] Reflects a "Yes" response divided by all farms.

Fuel used to power irrigation pumps varies widely depending on the age, size, and purpose of the pump. The survey asked each respondent how many pumps they use, and to break out their pumps by the fuel type. Based on this information, Table 15 provides the percentage of each fuel used. In total, 49 percent of all pumps listed in the survey were powered by diesel, 42 percent electric, 4 percent natural gas, and the remainder were powered by either propane, dual fuels, or other energy sources. Farms smaller than 3,200 acres were mostly split between using diesel and electric powered pumps. However, farms that are larger than 3,200 acres appear to favor diesel.

Table 15. Water Pump Fuel Source by Farm Size

	Diesel	Electric	Natural Gas	Propane	Dual fuel	Other energy source
Farm Size	(% of Fuels Used)[1]					
3,200+ Irrigated Acres	51	36	5	1	0	1
1,901-3,200 Irrigated Acres	47	53	2	1	0	0
1,001-19,00 Irrigated Acres	50	44	3	2	0	0
0-1,000 Irrigated Acres	44	50	2	2	0	1
Average (of total)	49	42	4	1	0	1

[1] Calculated as the sum of pumps powered by given fuel, divided by the total number of pumps.

Farms frequently adopt new irrigation techniques to reduce pumping time and water use, as fuel and water availability are some of the costliest, and most volatile, inputs in agricultural production. Respondents were asked if any changes in irrigation methods led to a decrease in the amount of pumping time needed to irrigate, and if so, by what percent. Table 16 reports the average percent decrease in pumping time reported by irrigation method and farm size. Table 16 also gives the number of farms reporting in parentheses. Producers reported that zero grade methods provided the largest reduction in pumping time, on average, when considering all farm sizes, while storage reservoirs provided the largest decrease in pumping time, on average, for farms smaller than 1,000 acres.

Table 16. Pumping Time Decrease from Irrigation Method by Farm Size

	Zero grade	Storage reservoir	Tail-water recovery	Multiple inlet for rice	Scheduling methods	Surge	Computerized hole Selection	End blocking	Deep tillage	Center pivot
	Average % Pumping Time Decrees[1,2]									
Farm Size	(Number of Farms)									
3200+ Irrigated Acres	29	18	17	17	12	17	0	8	1	4
	16	21	31	46	12	9	2	21	36	32
1901-3200 Irrigated Acres	28	24	23	15	17	9	N/A	10	8	3
	12	19	26	40	7	13	0	20	30	20
1001-1900 Irrigated Acres	26	19	17	13	13	3	8	8	4	6
	11	22	28	32	6	10	3	15	36	11
0-1000 Irrigated Acres	18	20	16	8	13	18	15	8	5	4
	5	19	19	26	6	10	3	15	25	12
Average (All Responses)	27	20	18	14	13	12	9	8	4	4
Total (Number of Farms)	44	81	104	144	31	42	8	71	127	75

[1] Zero indicates that the producer found that there was no effect on pumping time.

[2] N/A signals that the respondent(s) did not know if there was an effect, or refused to answer, and that there were no other responses in the category to provide an average.

Table 17 provides the same water recovery and storage information as Table 16, but groups responses by crop group.

Table 17. Pumping Time Decrease from Irrigation Method by Crop Group

	Zero grade	Storage reservoir	Tail-water recovery	Multiple inlet for rice	Scheduling methods	Surge	Computerized hole Selection	End blocking	Deep tillage	Center pivot
	Average % Pumping Time Decrees[1,2]									
Crop Group	(Number of Farms)									
Predominantly soybean	35	19	16	15	10	5	13	10	3	4
	6	21	22	32	9	7	3	17	43	26
Predominantly rice	32	38	40	13	N/A	5	8	4	0	0
	4	3	6	14	0	4	2	6	5	2
Predominantly corn	1	23	20	40	5	18	N/A	5	3	10
	2	3	1	2	2	2	0	1	5	4
Predominantly cotton	N/A	N/A	N/A	N/A	5	13	N/A	N/A	5	5
	0	0	0	0	1	2	0	0	2	2
Predominantly sorghum	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	0	0	0	0	0	0	0	0	0	0
Soybean and rice	24	13	13	10	5	13	N/A	9	7	0
	8	10	14	26	3	6	0	10	10	3
Soybean and corn	0	53	38	N/A	20	50	15	10	10	0

	1	4	4	0	1	3	1	1	7	4
Soybean and cotton	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25	0
	0	0	0	0	0	0	0	0	1	1
Multiple Crops	28	19	20	16	18	15	0	8	4	4
	20	33	49	63	14	12	1	31	48	29
Other	30	5	5	7	10	1	N/A	13	9	15
	3	7	8	7	1	6	1	5	6	4
Average (All Responses)	27	20	18	14	13	12	9	8	4	4
Total (Number of Farms)	44	81	104	144	31	42	8	71	127	75

[1] Zero indicates that the producer found that there was no effect on pumping time.

[2] N/A signals that the respondent(s) did not know if there was an effect, or refused to answer, and that there were no other responses in the category to provide an average.

3.4 Water Recovery and Storage

As shown in Table 16, water recovery and storage are important factors in reducing overall pumping time. Table 18 summarizes the number of producers in the survey that indicated using tailwater recovery, water storage, and the number of reservoirs used. In total, only 104 out of 231 respondents indicated using a tailwater recovery system, and 79 indicated water storage. Water storage and tailwater recovery were equally cited by respondents that produce predominantly soybean, and soybean and corn. However, farms that produced predominantly rice, soybean and rice, and multiple crops, more frequently reported having tailwater recovery systems than water storage.

Table 18. Water Recovery, Storage, and Number of Reservoirs by Crop Group

		Tailwater Recovery	Water Storage	1 Reservoir	2 Reservoir	3-8 Reservoirs	> 8 Reservoir
Crop Group	All Farms	Number of Farms					
Predominantly soybean	79	22	21	11	4	6	0
Predominantly rice	15	6	3	2	1	0	0
Predominantly corn	8	1	3	2	0	1	0
Predominantly cotton	2	0	0	0	0	0	0
Predominantly sorghum	1	0	0	0	0	0	0
Soybean and rice	27	14	9	7	2	0	0
Soybean and corn	8	4	4	1	2	1	0
Soybean and cotton	1	0	0	0	0	0	0
Multiple Crops	75	49	33	17	5	9	2
Other	15	8	6	3	1	2	0
Total	231	104	79	43	15	19	2

Table 19 provides the same water recovery and storage information as Table 16, but groups responses by farm size. The most interesting takeaway from this grouping, is that while the number of farms using water storage is mostly constant across size groups, tailwater recovery is used more frequently by producers with over 1,000 than producers with under 1,000 acres.

Table 19. Water Recovery, Storage, and Number of Reservoirs by Farm Size

Farm Size	All Farms	Tailwater Recovery	Water Storage	1 reservoir	2 reservoirs	3-8 reservoirs	> 8 reservoirs
		Number of Farms					
3,200+ Irrigated Acres	59	31	20	12	1	5	2
1,901-3,200 Irrigated Acres	56	26	19	10	6	3	0
1,001-1,900 Irrigated Acres	54	28	22	8	5	9	0
0-1,000 Irrigated Acres	62	19	18	13	3	2	0
Total	231	104	79	43	15	19	2

3.5 Irrigation Schedule

Producers reported that adopting irrigation scheduling methods led to a 13 percent decrease in pumping time on average (Table 16). Respondents were asked to expand on the various scheduling methods that they use, which are summarized in Table 20. Respondents could name multiple scheduling methods.

Scheduling based on visual crop stress was mentioned by more producers than any other method, regardless of crop category. Non-visual methods, such as routine scheduling probe or feel methods, followed visual crop stress in popularity.

Table 20. Irrigation Scheduling Methods by Crop Group

Crop Group	All Farms	Visual crop stress	Routine scheduling	Probe or feel method	Neighbor/other local farmers	Soil moisture	Computerized scheduler	ET or atmometer	Woodruff charts	Canopy temperature
		Number of Farms								
Predominantly soybean	79	59	29	19	8	5	4	1	2	0
Predominantly rice	15	12	4	5	1	1	0	0	0	1
Predominantly corn	8	4	4	1	1	1	1	0	0	0
Predominantly cotton	2	2	0	0	0	0	0	1	0	0
Predominantly sorghum	1	1	0	0	0	0	0	0	0	0
Soybean and rice	27	19	6	8	2	2	1	0	0	0
Soybean and corn	8	5	2	3	2	2	1	2	0	0
Soybean and cotton	1	1	0	0	0	0	0	0	0	0
Multiple Crops	75	51	27	20	7	10	6	3	0	0
Other	15	9	5	3	2	1	0	0	1	0
Total	231	163	77	59	23	22	13	7	3	1

Table 21 summarizes the same scheduling information as Table 20, but groups information by the respondent's years of farming experience. The use of various scheduling methods is surprisingly uniform between experience levels, except for respondents with 0 to 14 years of experience, who indicated using non-visual methods more frequently than more experienced producers.

Table 21. Irrigation Scheduling Methods by Years of Experience

Years of Experience	All Farms	visual crop stress	Routine scheduling stress	Probe or feel method	Neighbor/other local farmers	Soil moisture	Computerized scheduler	ET or atmometer	Woodruff charts	Canopy temperature
		Number of Farms								
0-14	33	21	16	10	6	7	3	1	1	1
15-21	29	20	9	6	2	4	1	2	1	0
21-28	28	23	10	9	4	3	0	1	0	0
29-34	31	24	5	9	3	3	1	1	0	0
35-39	22	13	8	5	0	0	3	0	1	0
40-44	31	20	7	6	2	4	3	1	0	0
45-50	29	22	12	5	4	0	2	0	0	0
Greater than 50	26	20	9	8	2	1	0	1	0	0
Unknown or Refused	2	0	1	1	0	0	0	0	0	0
Total	231	163	77	59	23	22	13	7	3	1

3.6 Special Programs

Table 22 summarizes producers' participation in various environmental quality and conservation programs. The goal of these programs is generally to improve water quality, reduce soil erosion and protect wildlife habitat that might be impacted by intensive agriculture. Shown in Table 22, 161 out of 231 producers in the survey indicated that they take part in some environmental or conservation program. The Environmental Quality Incentive Program and Conservation Reserve Programs are roughly equally subscribed to, while other conservation programs and the Regional conservation partnership program was mentioned fewer times overall.

Table 22. Environmental Quality and Conservation Program Participation by Farm Size

Farm Size	All Farms	Participated in at least one program[1]	Environmental quality incentive program	Conservation reserve program	Other conservation program	Regional conservation partnership
			Number of Farms[2]			
3,200+ Irrigated Acres	59	47	33	28	26	13
1,901-3,200 Irrigated Acres	56	41	28	27	17	4
1,001-1,900 Irrigated Acres	54	41	24	27	11	8
0-1,000 Irrigated Acres	62	32	19	18	12	7
Total	231	161	104	100	66	32

[1] Indicated at least one program including "other conservation program"

[2] Respondents could indicate participation in more than one conservation or environmental program.

Respondents from larger farms indicated that they participated in conservation or environmental initiatives consistently more than respondents from small farms regardless of the specific program. As shown in Table 23, it also appears that when considering any program, producers with fewer

than 14 years of experience took part in conservation or environmental programs more frequently than those with more experience.

Table 23. Environmental Quality and Conservation Program Participation by Years of Farming Experience

Years of Experience	All Farms	Participated in at least one program[1]	Environmental quality incentive program	Conservation reserve program	Other conservation program	Regional conservation partnership
			Number of Farms[2]			
0-14	33	26	19	13	15	7
15-21	29	17	12	10	8	2
21-28	28	21	17	12	12	6
29-34	31	21	9	11	9	3
35-39	22	16	9	13	4	2
40-44	31	19	11	13	7	4
45-50	29	25	15	17	8	3
Greater than 50	26	14	11	9	3	4
Unknown or Refused	2	2	1	2	0	1
Total	231	161	104	100	66	32

[1] Indicated at least one program including "other conservation program"

[2] Respondents could indicate participation in more than one conservation or environmental program.

Producers were asked whether they were aware of the Arkansas state tax credit program that allows them to claim up to $9,000 in credits for conversion to surface water or land leveling, and then asked if they have taken the credit and what it was used for. Table 24 shows that while 105 producers were aware of such a tax credit, only 41 used it. The most popular use of the credit was for land leveling, followed by constructing impoundments to use available surface water, conversion from ground water to surface water, and others. Out of the 41 producers who reported using the credits, only three owned or ran farms with fewer than 1,000 acres.

Table 24. Tax Credit Awareness and Use by Farm Size

Farm Size	Aware of State Tax program	Used State Tax program	Land leveling	Construction of impoundments	Conversion from ground water to surface water	Other
	Number of Farms[1]					
3,200+ Irrigated Acres	33	14	9	3	0	0
1,901-3,200 Irrigated Acres	20	9	4	3	2	3
1,001-1,900 Irrigated Acres	28	15	4	4	6	2
0-1,000 Irrigated Acres	24	3	1	1	0	1
Total	105	41	18	11	8	6

[1] Tax program could be used for more than one listed use. Respondents could indicate using the tax program, but refused to say what they used it for. Therefore, the number of respondents that indicated using the tax program and the items that it was applied to do not always equal.

4 Demographics

This section departs from irrigation-specific questions, and discusses demographic and socioeconomic information gathered by the survey.

4.1 Farming Experience and Education

Table 25 reports the average years of experience of producers in the survey, as well as the percent of respondents that received a formal agricultural education. The average farming experience for all 231 respondents is 33 years. Soybean and corn farms report the highest average years of experience at 41, while several different crop categories report a low average of 30 years of experience.

In total, 57 percent of respondents had received formal agricultural education. However, since the number of farms in each category are not equal, the percentage of producers with formal education varies widely between crop groups in Table 25.

Table 25. Farming Experience and Formal Education by Crop Group

Crop Group	All Farms	Average Years of Farm Experience	Average Formal Farming Education (%)[1]
Predominantly soybean	79	33	62
Predominantly rice	15	38	57
Predominantly corn	8	30	67
Predominantly cotton	2	30	50
Predominantly sorghum	1	30	0
Soybean and rice	27	31	52
Soybean and corn	8	41	63
Soybean and cotton	1	30	0
Multiple Crops	75	30	58
Other	15	38	31
Total	231	33	57

[1] Calculated as the number of respondents who answered yes to receiving formal farming education, divided by total respondents.

Table 26 provides the same information on experience and education, grouped by farm size. Producers from farms that were smaller than 3,200 acres reported an average of 35 years of experience. However, respondents from farms larger than 3,200 acres reported an average of 26 years of experience. Around 53 to 69 percent of producers in the survey from farms greater than 1,000 acres reported having a formal education, but only 48 percent of respondents from farms smaller than 1,000 acres reported receiving formal farming education.

Table 26. Farming Experience and Formal Education by Farm Size

Farm Size	All Farms	Average Years of Farm Experience	Average Formal Farming Education (%)
3,200+ Irrigated Acres	59	26	53
1,901-3,200 Irrigated Acres	56	35	69
1,001-1,900 Irrigated Acres	54	35	59
0-1,000 Irrigated Acres	62	35	48
Total	231	33	57

[1]Calculated as the number of respondents who answered yes to receiving formal farming education, divided by total respondents.

4.2 Household Income

Table 27 summarizes respondent's household income by crop group. The most frequently cited household income bracket (before taxes) was $75,000 to $100,000, not counting producers who did not know, or refused to answer. Frequency within crop groups looks to be normally distributed around $75,000 to $100,000, except for farms producing multiple crops, which show a distribution skewed toward higher household incomes.

Table 27. Household Income before Taxes in 2014 by Crop Group

	$0 to $50,000	$50,000 to $75,000	$75,000 to $100,000	$100,000 to $150,000	$150,000 to $300,000	More than $300,000	Refused or Unknown
Crop Group	Number of Farms[1]						
Predominantly soybean	8	13	13	10	9	9	17
Predominantly rice	3	1	4	0	1	0	6
Predominantly corn	3	1	1	2	1	0	0
Predominantly cotton	0	0	0	0	0	2	0
Predominantly sorghum	0	0	0	0	0	0	1
Soybean and rice	2	1	5	4	4	1	10
Soybean and corn	4	0	1	1	0	1	1
Soybean and cotton	0	0	0	1	0	0	0
Multiple Crops	6	8	13	10	12	10	16
Other	4	1	2	2	4	1	1
Total	30	25	39	30	31	24	52

[1]Revenue brackets were simplified from 14 categories in the original survey, to 7.

Table 28 summarizes respondents' household income by farm size. Out of thirty producers reporting a household income less than $50,000, 16 are from farms smaller than 1,000 acres. Alternatively, 25 out of 39 producers reporting a household income of $75,000 to $100,000 are from farms larger than 1,900 acres. The size of the farm does not appear to be a major factor in household incomes above $100,000.

Table 28. Household Income Before Taxes in 2014 by Farm Size

	$0 to $50,000	$50,000 to $75,000	$75,000 to $100,000	$100,000 to $150,000	$150,000 to $300,000	More than $300,000	Refused or Unknown
Farm Size	Number of Farms[1]						
3,200+ Irrigated Acres	6	5	11	9	8	7	13
1,901-3,200 Irrigated Acres	3	7	14	7	5	5	15
1,001-1,900 Irrigated Acres	5	8	7	7	9	7	11
0-1,000 Irrigated Acres	16	5	7	7	9	5	13
Total	30	25	39	30	31	24	52

[1] Revenue brackets were simplified from 14 categories in the original survey, to 7.

5 Appendix

Survey Question Codes by Table

In the index below, the table found in this report is given on the left, and the survey questions used to populate it are listed on the right for reference.[2]

Table Number	Survey Questions
Table 1. Crop Distribution by Farm Size (Acres)	NEI_14, NEI_13, Q137_3_new, Q137_4_new, Q137_1_new, Q137_2_new, Q137_6_new, Q137_5_new
Table 2. Crop Distribution by Years of Farming Experience (Acres)	NEI_19, NEI_13, Q137_3_new, Q137_4_new, Q137_1_new, Q137_2_new, Q137_6_new, Q137_5_new
Table 3. Crop Distribution by Crop Group (Acres)	NEI_12, NEI_13, Q137_3_new, Q137_4_new, Q137_1_new, Q137_2_new, Q137_6_new, Q137_5_new
Table 4. Furrow, Flood, Border, and Micro Irrigation by Crop Group	NEI_12, Q28c_new, Q103_1, Q28b_new, Q28a_new, Q30, Q31
Table 5. Furrow, Flood, Border, and Micro Irrigation by Crop Group (Acres)	NEI_12, Q28c_new, Q103_1, Q28b_new, Q28a_new, Q30, Q32
Table 6. Field Leveling and Water Delivery Systems by Crop Group	NEI_12, NEI_15, NEI_16, Q62, Q37, Q42, Q63
Table 7. Field Leveling and Water Delivery Systems by Crop Group (Acres)	NEI_12, NEI_15, NEI_16, Q62, Q37, Q42, Q63
Table 8. Rice-Specific Irrigation Methods by Farm Size	NEI_14, Q97_2, Q97_1, NEI_17, Q97_3
Table 9. Rice-Specific Irrigation Methods by Farm Size (Acres)	NEI_14, Q97_2, Q97_1, NEI_17, Q97_3
Table 10. Water Source and Management for Irrigation by Farm Size	NEI_14, Q11_1, Q11_2, Q11_3_new, Q11_4_new, Q11_5_new, Q11_6_new
Table 11. Water Source and Management for Irrigation by Crop Group	NEI_12, Q11_1, Q11_2, Q11_3_new, Q11_4_new, Q11_5_new, Q11_6_new
Table 12. Ground Water Characteristics by Farm Size	NEI_14, Q13
Table 13. Water Shortage Sentiment by Farm Size	NEI_14, Q14_1, Q14_2
Table 14. Water Pump Characteristics by Farm Size	NEI_14, NEI_21, Q69, Q70, Q72
Table 15. Water Pump Fuel Source by Farm Size	NEI_14, Q69, Q76, Q77, Q78, Q79, Q80, Q81
Table 16. Pumping Time Decrease from Irrigation Method by Farm Size	NEI_14, Q105_06, Q105_03, Q105_01, Q105_02, Q105_10_new, Q105_05, Q105_04, Q105_08, Q105_07, Q105_09_new
Table 17. Pumping Time Decrease from Irrigation Method by Crop Group	NEI_12, Q105_06, Q105_03, Q105_01, Q105_02, Q105_10_new, Q105_05, Q105_04, Q105_08, Q105_07, Q105_09_new
Table 18. Water Recovery, Storage, and Number of Reservoirs by Crop Group	NEI_12, Q17, Q20
Table 19. Water Recovery, Storage, and Number of Reservoirs by Farm Size	NEI_14, Q17, Q20
Table 20. Irrigation Scheduling Methods by Crop Group	NEI_12, Q82_1, Q82_4, Q82_5, Q82_8, Q82_9, Q82_2, Q82_6, Q82_3, Q82_7

[2] See accompanying Crop Irrigation Survey: Arkansas, and NEI table workbook for full survey questions and variable descriptions.

Table Number	Survey Questions
Table 21. Irrigation Scheduling Methods by Years of Experience	NEI_19, Q82_1, Q82_4, Q82_5, Q82_8, Q82_9, Q82_2, Q82_6, Q82_3, Q82_7
Table 22. Environmental Quality and Conservation Program Participation by Farm Size	NEI_14, NEI_20, Q106_2, Q106_1, Q106_4, Q106_3
Table 23. Environmental Quality and Conservation Program Participation by Years of Farming Experience	NEI_19, NEI_20, Q106_2, Q106_1, Q106_4, Q106_3
Table 24. Tax Credit Awareness and Use by Farm Size	NEI_14, Q125, Q126, Q127_3_new, Q127_1_new, Q127_2_new, Q127_4_new
Table 25. Farming Experience and Formal Education by Crop Group	NEI_12, Q136, Q145
Table 26. Farming Experience and Formal Education by Farm Size	NEI_14, Q136, Q145
Table 27. Household Income before Taxes in 2014 by Crop Group	NEI_12, NEI_18
Table 28. Household Income Before Taxes in 2014 by Farm Size	NEI_14, NEI_18

6 References

Edwards, John F. Crop irrigation Survey: Arkansas. Social Science Research Center. Mississippi State University. October 21, 2016.