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FLOOD DAMAGE LOSSES TO AGRICULTURAL CROPS IN COLORADO

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The period from September 9-16, 2013 saw unprecedented rainfall in many parts of Colorado, and 17 counties were significantly impacted by heavy rain and flooding. Rainfall totals reached 17.15 inches in parts of Boulder County, while 2-4 inches fell in the Greeley area to the east. Because the St. Vrain, Poudre, and Big Thompson Rivers converge with the South Platte River near Greeley, the heavy rainfall to the west resulted in severe flooding in Logan, Morgan, Sedgwick, and Weld Counties that covered large areas of agricultural lands in water. The three rivers---Big Thompson, St. Vrain, and Poudre---had record or near record flows (in cubic feet per second). These rivers, combined with water flowing in the South Platte, resulted in a band of water exceeding a mile wide in many areas. This flow of water then proceeded down the South Platte into Nebraska affecting the communities of Evans, La Salle, Greeley, Goodrich, Weldona, Fort Morgan, Brush, Merino, Atwood, Sterling, Iliff, Proctor, Crook, Sedgwick, and Julesburg. Boulder, Lyons, Jamestown, Loveland, and Longmont were also impacted dramatically by flooding but had less total agricultural land at risk.

Based on on-site surveys of these areas, there were a number of acres inundated with flood waters. The water remained at a high level for 2-4 days in some areas. The flooded areas, estimated at 23,000 acres from Boulder County through Logan County, contained growing crops primarily corn, sugar beets, and alfalfa (based on an early estimate provided by the Risk Management Agency prior to the Federal Government shutdown). Some of the flooded areas already had been harvested (corn, silage, and alfalfa hay), while a large portion is pasture/range lands. Observation indicated the major damages in the pasture/range areas were to fences and debris that remained in fields that may need to be removed.

One major concern is the release of treated and untreated water from sewage treatment facilities that were inundated with the flood water. Governor Hickenlooper (KOA Radio, September 27, 2013) estimated that 20 million gallons of untreated waste were released, as were another 200 million gallons of partially treated waste. This amount translates into over 700 acre feet of waste. Colorado Department of

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Health and the Environment and U.S. Geological Survey have conducted water sample analyses and will provide assistance in the future to help assess risk for producers. CSU Extension is currently working to understand potential agronomic and specialty crop scenarios to best advise clients for management decisions.

Water which covered the corn plant over the ears has also started to show mold and likely is unusable for feed to livestock. One farmer near Miliken indicated 20 acres or so of one field had standing water (5 feet) for 5-6 days. In such cases those crops are a total loss. This farmer also lost 50 acres of sorghum forage due to the standing water over the extended time period. Crop insurance claims on such losses are yet to be determined. Forage (harvested) is quite susceptible to water damage. In particular bales of hay which were in water are likely a total loss.

With food crops, FDA advises: If the edible portion of a crop is exposed to flood waters, it is considered adulterated under Section 402(a)(4) (21 U.S.C. 342(a(4)) of the Federal Food, Drug, and Cosmetic Act and should not enter human food channels. There is no practical method of reconditioning the edible portion of a crop that will provide a reasonable assurance of human safety.

Dairy

The impact of the flood on dairies was minimal in most cases. The dairies contacted indicated they had not had significant problems as milk was picked up on schedule and cows, which in some cases had to be moved to higher positioned pens, were generally in good health. There were some minor increases in death loss and to health issues due to the wet conditions. The major problems incurred are related to transportation—the acquisition of feed and daily feeding regime. Some dairies have had to travel much greater distances to their feed sources. One dairy indicated that due to road and bridge closures, they had to travel an hour to get the feed needed daily as compared to a typical drive time of 5-10 minutes prior to the flood.

General Observations

Observations from tours of the areas between Kersey and Julesburg were quite variable in terms of severity. Some areas had flood water which remained for 12 hours or less while some areas were inundated for 4-5 days. It is these areas that pose the most concern. If the ears in the corn were covered by flood water, mold may likely become an issue. The corn impacted (standing water or plants pushed over by the force of the flowing water) tended to be closer to the Front Range than further east.

Another concern is root rot which weakens the plant making it more susceptible to wind damage. Many of these affected corn fields will take a substantial amount of time to dry out enough to facilitate harvest. Some of the affected farmers indicated a month to 6 weeks may be required. Others said a hard frost freezing the surface would also help with the harvest effort. Many farmers, at this point, do not know what the yield impacts are likely to be. Some indicated there would be no impact on yields while others were undecided.

Crop insurance claims are pending according to agents in Sterling, Fort Morgan, and Greeley. After harvest has been completed, a more accurate assessment of production losses based on the occurrence of insurance claims will verify what actual losses did take place.

Alfalfa and hay damage is somewhat more difficult to assess this early. Contaminants in addition to soaked fields are more of a concern. Sufficient sun and wind will lessen the harvest and yield impacts, but long term impacts on the plant/grass itself is yet to be determined.

Lastly, the erosion of cropland soil and debris issues in the fields were net addressed as much of the area was too wet to travel at the time of the tours.

ESTIMATED CROP LOSS

Estimated flooded acres developed by U.S. Geological Survey indicated approximately 28,525 acres of crops and 39,000 acres of pasture and rangeland (Table 1). Of the 28,525 acres of crops, 8,646 acres of corn and 18,033 acres of hay and alfalfa or 93.5 percent of the total “wet acres” affected. Western Sugar Cooperative has estimated 500 acres of sugar beets were flooded and could be a potential loss. However, these acres will be harvested last to determine if such sugar beets are acceptable for processing.

A survey of the flooded areas from Boulder County to northeast Colorado (Julesburg) was used to develop two estimates of potential impacted crop acres. Our estimate is a low of 5,500 acres to a high of 7,500 acres. The levels of production loss associated with the two levels range from $4.2 million (Table 2) to $5.5 million (Table 3). The estimated loss values are based on an equal distribution between corn (2,500 or 3,500 acres) and alfalfa/hay (2,500 or 3,500 acres) and 500 acres of sugar beets in both scenarios. The corn price used was $4.50 per bushel, alfalfa/hay price was $225 per ton and $50 per ton for sugar beets. The prices were based on current market prices observed (High Plains Journal, Volume 131, Number 40, October 7, 2013) and estimated payment per ton on sugar beets. These losses are the value of production which is expected yields times expected market prices. (Note: No estimates were made for the loss of crops incurred by specialty crop growers (vegetable, fruit, flowers, etc.) but the total acreage impacted is very small and dispersed compared to the acreage estimated for corn, alfalfa and sugar beet crop loss or damage. Estimated specialty crop losses in Boulder County are 10 acres. The primary challenges for specialty crop growers on any impacted acreage will be fostering the natural degradation of biological contamination, repairing soil erosion including leveling fields and removing physical debris of wood, cobbles, and gravel from soils prior to next season's planting.

There will be some acres deemed a total loss but the actual total losses will not be determined until the harvest season has been completed.

A third estimate of loss based on "wet acres" is provided by U.S. Geological Survey (Table 1). A total of 92,614 acres were estimated to have been flooded. Of this total, 5,279 acres are open water and 28,525 acres are crops. The remaining 58,800 acres are wetlands, grassland, and forested areas. The estimate for crop acreage flooded or "wet" is based on "cropland data obtained from USDA-National Agricultural Statistics Service. Assessment was done with 2012 crop data because 2013 data is currently being collected and processed; 2013 data will be available from NASS around February next year. (Source: Colorado Department of Agriculture Web Site, www.colorado.gov/cs/Satellite/ag). If 20 percent of these "wet acres" (crops) are damaged significantly or deemed a total loss, the estimated value of production would be approximately $3.45 million (Table 4). This loss estimate is 63 percent of the high estimated losses contained in Table 2.

In conclusion, the estimated value of the lost production is somewhere between $3.4 and $5.5 million. The flood resulted in many other losses for the farmers and ranchers. This does not include damage to fences, some stacked hay, irrigation systems, roads, bridges, homes and farm/ranch buildings, wells, and other related structures and machinery. Wet fields which may delay the harvest, debris in fields, and temporary relocation of livestock are a problem for many producers. While the moisture received in most areas was a welcome relief from dry conditions which has plagued Colorado, the record rainfall did come at a significant cost to many producers.

A special thank you to Cynthia S. Haren and Western Dairy Association, 1200 Washington Street, Thornton, CO, 80241, for the funding to prepare this report.

Table 1: U.S. Geological Survey Preliminary Flooded Area Statistic as of September 27, 2013

Area (Acres)	Percent (%)	Class_Name
10,340	11.16	Other Hay/Non-Alfalfa
8,646	9.34	Corn
7,693	8.31	Alfalfa
2,702	2.92	Fallow/Idle Cropland
1,170	1.26	Winter Wheat
679	0.73	Rye
293	0.32	Millet
119	0.13	Sugarbeets
103	0.11	Barley
81	0.09	Sorghum
79	0.08	Triticale
67	0.07	Oats
60	0.07	Safflower
52	0.06	Onions
20	0.02	Dry Beans
6	0.01	Sunflower
2	0.002	Potatoes
1	0.001	Peas
0.22	0.0002	Double Crop Winter Wheat/Corn
25,008	27.00	Woody Wetlands
17,689	19.10	Grassland Herbaceous
7,482	8.08	Herbaceous Wetlands
5,279	5.70	Open Water
2,615	2.82	Developed/Open Space
1,019	1.10	Developed/Low Intensity
844	0.91	Deciduous Forest
291	0.31	Developed/Med Intensity
176	0.19	Shrubland
55	0.06	Developed/High Intensity
34	0.04	Evergreen Forest
6	0.01	Barren
92,614	**100**	**Total Area**

Table 2: Estimated Value of Production Associated with 5,500 Acres Impacted

Corn			Corn Price	$4.50	bu
acres lost	2,500		Corn Yield	200	bu/Acre
	Loss in value of Production	$2,250,000			
Hay/Alfalfa			Alfalfa Price	$225	ton
acres lost	2,500		Alfalfa Yield	2	tons/Acre
	Loss in Value of Production	$1,125,000			
Sugar Beets			Sugar Beet Price	$50.00	ton
acres lost	500		Sugar Beet Yield	31.6	tons/Acre
	Loss in value of Production	$790,000			
TOTAL LOSS IN VALUE OF PRODUCTION		**$4,165,000**			

Table 3: Estimated Value of Production Associated with 7,500 Acres Impacted

Corn			Corn Price	$4.50	bu
acres lost	3,500		Corn Yield	200	bu/Acre
	Loss in Value of Production	$3,150,000			
Hay/Alfalfa			Alfalfa Price	$225	ton
acres lost	3,500		Alfalfa Yield	2	tons/Acre
	Loss in Value of Production	$1,575,000			
Sugar Beets			Sugar Beet Price	$50.00	ton
acres lost	500		Sugar Beet Yield	31.6	tons/Acre
	Loss in Value of Production	$790,000			
TOTAL LOSS IN VALUE OF PRODUC-TION		**$5,515,000**			

Table 4: Potential Losses based on U.S. Geological Survey Estimate of Impacted Acres

Corn				Corn Price	$4.50	bu
acres wet	8,646			Corn Yield	200	bu/Acre
percent damaged	0.2					
	Loss in Value of Production	$1,556,280.00				
Hay/Alfalfa				Alfalfa Price	$225	ton
acres wet	18,033			Alfalfa Yield	2	tons/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 1,622,970.00				
Sugar Beets				Sugar Beet Price	$50.00	ton
acres wet	119			Sugar Beet Yield	31.6	tons/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 37,604.00				
Winter Wheat				Winter Wheat Price	$7.10	bu
acres wet	1170			Winter Wheat Yield	91.4	bu/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 151,851.96				
Millet				Millet Price	$25.30	cwt
acres wet	293			Millet Yield	7.3	cwt/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 10,822.83				
Barley				Barley Price	$5.00	bu/Acre
acres wet	103			Barley Yield	95	bu/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 9,785.00				
Sorghum				Sorghum Price	$3.50	ton
acres wet	81			Sorghum Yield	60	ton/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 3,402.00				
Onion				Onion Price	$12.20	cwt
acres wet	52			Onion Yield	380	cwt/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 48,214.40				
Dry Bean				Dry Bean Price	$40.00	cwt
acres wet	20			Dry Bean Yield	25	cwt/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 4,000.00				
Sunflower				Sunflower Price	$25.70	cwt
acres wet	6			Sunflower Yield	20.3	cwt/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 626.05				
Potato				Potato Price	$11.40	cwt
acres wet	2			Potato Yield	362	cwt/Acre
percent damaged	0.2					
	Loss in Value of Production	$ 1,650.72				
TOTAL LOSS IN GROSS REVENUE FOR SCENARIO		**$3,447,206.97**				
Note that the following crops got wet as well but the acres were small and we did not have enterprise budgets created for the crops: Safflower, Oats, Triticale, Rye and peas						

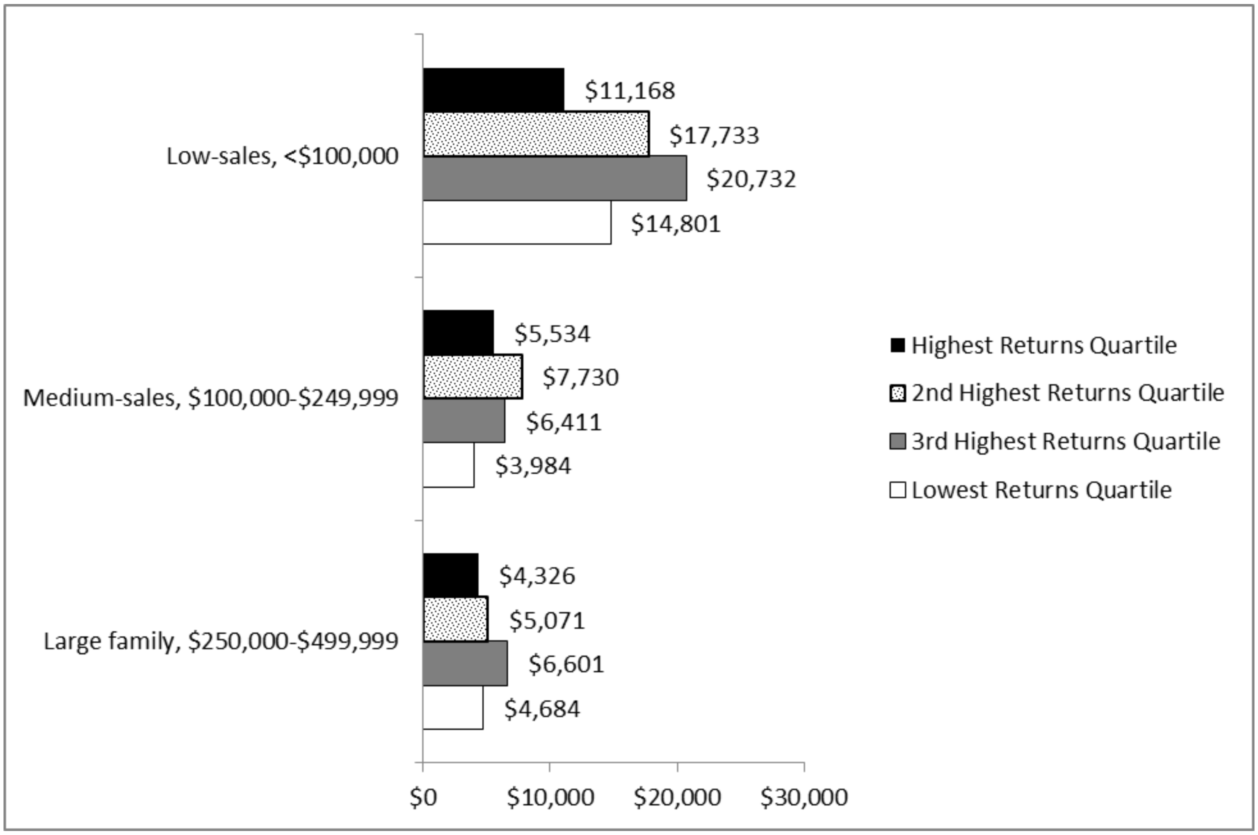

Figure 5. Social Security and Other Public Assistance, Earned by Operator Household, by Farm Sales and Quartile.

The distribution of social security and other public assistance benefits mirror the average age distribution for each of the sales classes of farms included (Figure 5) and represents all farm households that responded. Low-sales farms in the second and third highest quartiles receive markedly more in benefits since their average age are nearest the minimum age requirements for receiving social security.

The majority of primary operators for all farm sales classes have graduated from high school or attended some college (Table 3). Primary operators on large family farms in the highest quartile are more likely to complete college or attend graduate school, when compared with low-sales and medium-sales farms. The relationship between education and returns is negative for operators of medium-sales and low-sales operations.

Family Characteristics - The average number of household members, including all persons dependent on the household for financial support, whether they live in the household or not, lies within a fairly limited range from 2 to 4 over all quartiles and farm sizes (Figure 6). This was expected based on the age of the primary operators and their nearness to retirement.

Consistent with historical trends and previous research, primary operators are mostly male for all farm sizes and quartiles (Table 4). Primary operators in the lowest return quartile for low-sales farms are more likely to be female. Table 5 shows that primary operators in the highest quartile for the farm sales classes are more likely to report having no spouse compared with the lowest quartile.

Over all quartiles and the three included farm sales classes , the average age of the primary operator's spouse ranges from 46.2 to 59.4 years old (Figure 7). Every quartile for all farm sizes has spouses younger than the primary operator. Similar to the age distribution for primary operators, the highest and lowest return quartiles have the youngest average age of primary operator's spouses for all farm sizes.

Table 3. Education Level of Primary Operator, by Farm Sales and Quartile.

Education Level	Highest Return Quartile	2nd Highest Return Quartile	3rd Highest Return Quartile	Lowest Return Quartile
	Low-sales, <$100,000			
Some high school or less	7.4	7.4	8.5	14.5
Completed high school	59.2	52.0	46.9	40.3
Some college	20.7	21.0	23.3	22.3
4 year college graduate and beyond	12.6	19.6	21.2	23.0
	Medium-sales, $100,000-$249,999			
Some high school or less	12.8	7.9	11.7	13.4
Completed high school	42.9	45.0	38.1	41.3
Some college	25.4	25.4	29.3	25.1
4 year college graduate and beyond	18.9	21.7	21.0	20.2
	Large family, $250,000-$499,999			
Some high school or less	3.7	9.6	8.4	8.2
Completed high school	32.8	44.3	47.6	39.5
Some college	33.1	26.8	25.3	28.4
4 year college graduate and beyond	30.3	19.4	18.8	24.0

NOTE: Percentages may not sum to 100 percent due to rounding.

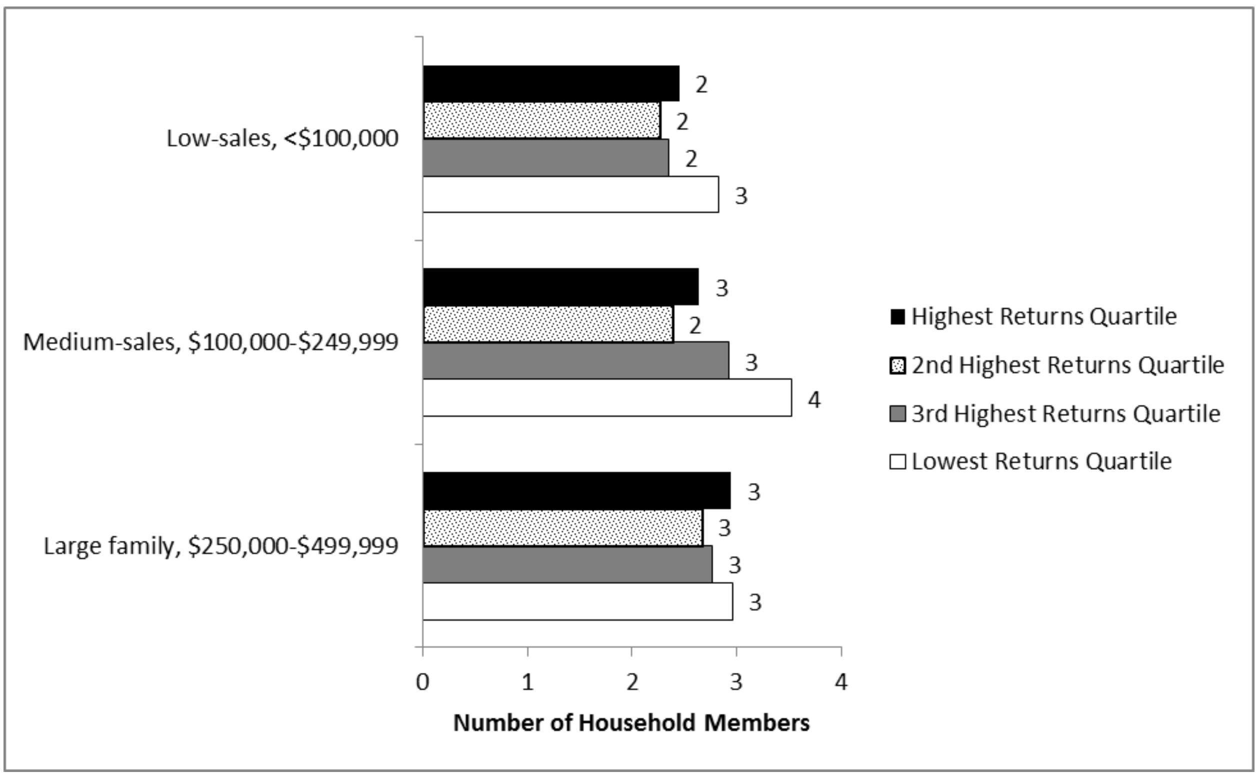

Figure 6. Average Number of Household Members, by Farm Sales and Quartile.

Table 4. Gender of Primary Operator, by Farm Sales and Quartile.

Gender	Highest Return Quartile	Lowest Return Quartile
	Low-sales, <$100,000	
Male	94.4	81.5
Female	5.6	18.5
	Medium-sales, $100,000-$249,999	
Male	95.5	97.2
Female	4.5	2.8
	Large family, $250,000-$499,999	
Male	98.4	96.7
Female	1.6	3.3

Table 5. Gender of Primary Operator's Spouse, by Farm Sales and Quartile

Gender	Highest Return Quartile	Lowest Return Quartile
	Low-sales, <$100,000	
Male	4.2	15.9
Female	72.2	71.1
No Spouse	23.6	13.0
	Medium-sales, $100,000-$249,999	
Male	1.8	2.1
Female	74.1	88.4
No Spouse	24.2	9.5
	Large family, $250,000-$499,999	
Male	0.8	2.0
Female	84.7	84.2
No Spouse	14.5	13.8

NOTE: Percentages may not sum to 100 percent due to rounding.

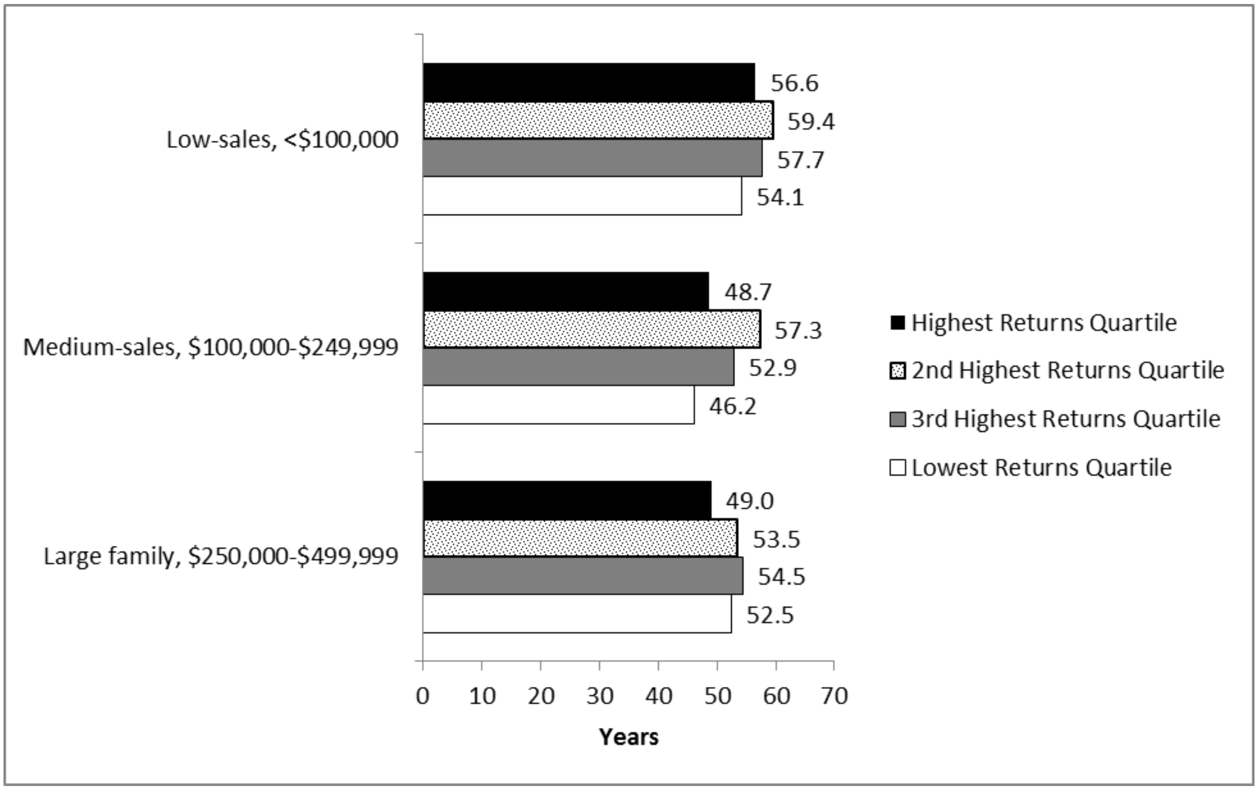

Figure 7. Average Age of Primary Operator's Spouse, by Farm Sales and Quartile.

Most of primary operators' spouses for all farm sizes have graduated from high school or attended some college (Table 6). Primary operator's spouses on large family farms in the highest returns quartile are more likely to complete college or attend graduate school, when compared with low-sales and medium-sales farms. As a spouse's education level increases, it appears that the rates of return increase on large family farms, the same was not indicated for low-sales and medium-sales farms.

The majority of primary operators' spouses work, either on or off the farm (Table 7). Almost a quarter (23.1 percent) of primary operator's spouses have a major occupation that is off farm in the highest quartile for low-sales farms, increasing to nearly half (48.5 percent) for large family farms in the highest quartile. For both low-sales and medium-sales farms, the highest return quartile had a lower percentage of spouses working off the farm compared with other quartiles. In contrast, the highest return quartile for the large family farms, showed the highest percent of spouses working off the farm.

Figure 8 shows that the average distance the primary operator's spouse drives to work ranges from 3.2 to 10.9 miles. For all farm sales categories, spouses of primary operators in the lowest return quartile drove the farthest to work when compared to other quartiles in their sales category. The distances spouses of primary operators travel from home to work may be related to their rural/urban/metro classifications cited previously. Low-sales operations in the 3rd highest and lowest quartiles drove further to work, compared to medium-sales and large family farms in the 3rd highest and lowest quartiles.

Conclusion – When performance is measured as net returns per dollar of assets (ROA), the results suggest that the smallest farms successfully hold more livestock in addition to producing grain and oilseeds than medium-sales and large family farms. Corn Belt operations account for the highest percentage of operations with the highest rates of return across all farm sizes, but small farms generate high returns in multiple regions, including Appalachia, the Northern Plains, the Pacific, and the Southeast. Low-sales, medium-sales, and large family farms also perform better in small metro areas. Distances traveled for purchase of inputs indicate that low-sales farms are most successful when limiting the distance traveled, while medium-sales and large family farms encounter a tradeoff between the

Table 6. Education Level of Primary Operator's Spouse, by Farm Sales and Quartile.

Education Level	Highest Return Quartile	2nd Highest Return Quartile	3rd Highest Return Quartile	Lowest Return Quartile
	Low-sales, <$100,000			
Some high school or less	1.7	2.7	5.0	10.1
Completed high school	46.9	38.2	40.7	37.3
Some college	11.5	19.6	20.3	17.3
4 year college graduate and beyond	16.2	19.0	18.9	22.3
No spouse	23.6	20.6	15.2	13.0
	Medium-sales, $100,000-$249,999			
Some high school or less	7.8	4.9	8.2	10.4
Completed high school	29.0	35.8	29.8	33.6
Some college	20.4	23.3	21.7	22.4
4 year college graduate and beyond	18.6	22.1	25.1	24.1
No spouse	24.2	13.9	15.2	9.5
	Large family, $250,000-$499,999			
Some high school or less	1.3	2.7	5.0	3.8
Completed high school	25.5	34.9	32.3	30.0
Some college	30.5	25.1	26.5	26.8
4 year college graduate and beyond	28.2	22.5	22.7	25.5
No spouse	14.5	14.7	13.5	13.8

NOTE: Percentages may not sum to 100 percent due to rounding.

Table 7. Major Occupation of Primary Operator's Spouse, by Farm Size and Quartile.

Occupation	Highest Return Quartile	2nd Highest Return Quartile	3rd Highest Return Quartile	Lowest Return Quartile
	Low-sales, <$100,000			
Farm or ranch work	36.9	34.4	29.8	33.1
Work other than farming or ranching	23.1	25.0	35.5	37.9
Currently not in the paid workforce	16.4	20.0	19.5	16.1
No Spouse	23.6	20.6	15.2	13.0
Total	100.0	100.0	100.0	100.0
	Medium-sales, $100,000-$249,999			
Farm or ranch work	27.5	33.3	41.5	41.3
Work other than farming or ranching	34.4	38.5	32.6	37.5
Currently not in the paid workforce	14.0	14.3	10.7	11.7
No Spouse	24.2	13.9	15.2	9.5
Total	100.0	100.0	100.0	100.0
	Large family, $250,000-$499,999			
Farm or ranch work	21.1	25.2	37.2	30.2
Work other than farming or ranching	48.5	41.2	33.8	40.7
Currently not in the paid workforce	15.8	18.8	15.5	15.3
No Spouse	14.5	14.7	13.5	13.8
Total	100.0	100.0	100.0	100.0

Note: Percentages may not sum to 100 percent due to rounding.

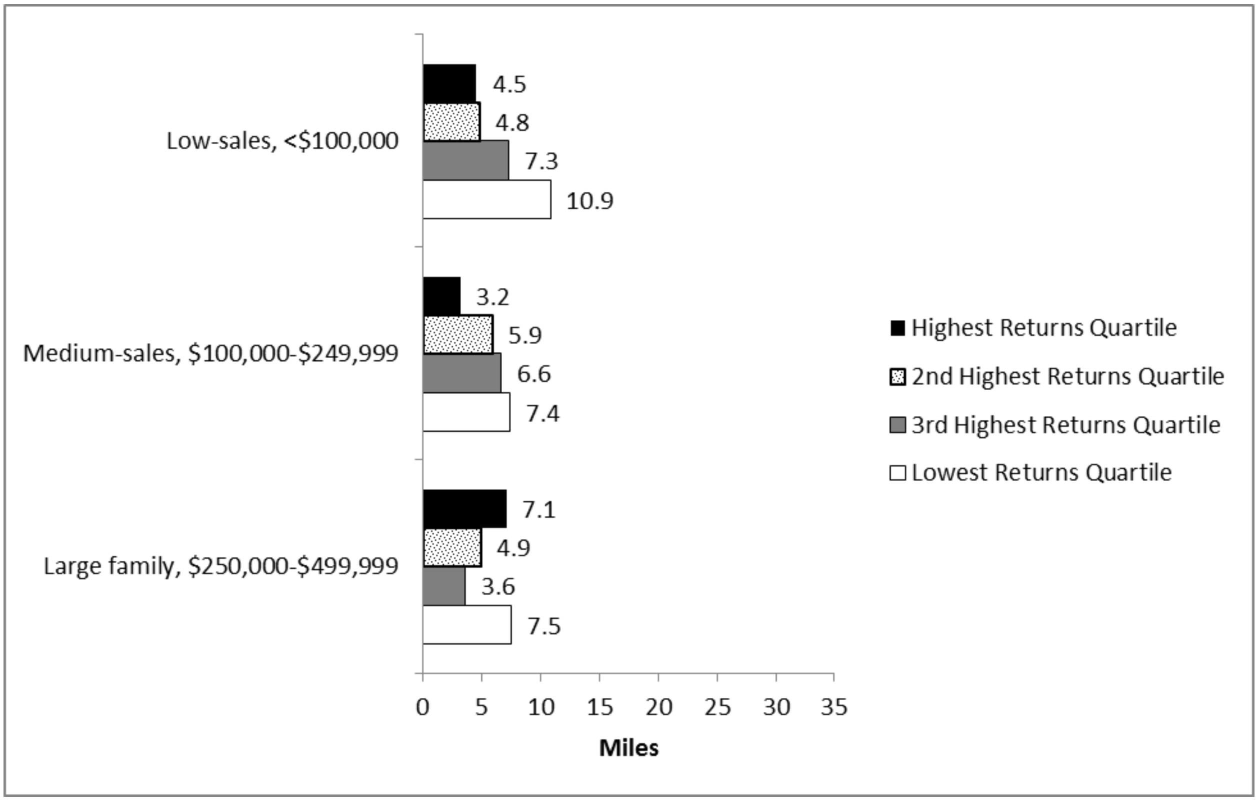

Figure 8. Primary Operator Spouse Distance from Home to Work, by Farm Sales and Quartile.

costs of distance traveled and discounts for larger purchases.

The highest and lowest return quartiles have the youngest average age of primary operators for the three farms sales classes included. It appears that the higher the education levels of primary operators, the higher the rates of return for low-sales and large family farms, while medium-sales farms do not show this same benefit to increased education. In terms of returns, the lowest returns quartiles have only a slightly higher number of household members than the other three returns quartiles. Primary operators in the lowest return quartile for low-sales farms are more likely to be female when compared to medium-sales and large family farms. Primary operators in the highest returns quartile for the farm sales classes are more likely to report having no spouse compared with the lowest quartile. While as a spouse's education level increases, it appears that the rates of return increases on large family farms, the same was not indicated for low-sales and medium-sales farms. For both low-sales and medium-sales farms, the highest return quartile had a lower percentage of spouses working off the farm compared with other quartiles. In contrast, the highest return quartile for the large family farms, showed the highest percent of spouses working off the farm. In all farm sales classes, spouses of primary operators in the lowest return quartile drove the farthest in order to reach their off farm employment.

Overall the results suggested targeting of measures to improve the performance of these small and mid-sized farms as the challenges they face are not necessarily common even to each of the sales classes included in this paper.

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