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# 2012 DROUGHT IN COLORADO: ESTIMATES OF FOREGONE REVENUES, INDIRECT AND INDUCED ECONOMIC ACTIVITY FOR THE CROP SECTOR

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Precipitation, whether realized as rain showers during the growing season or stored as snowmelt in reservoirs, is critical for crop and pasture production in Colorado. Drought is the persistent absence of precipitation, and this lack of moisture results in reduced yields, fewer harvested acres and less forage for livestock. Since October of 2010, extreme drought has plagued agricultural producers throughout much of Southern Colorado, and in May of 2012 the drought advanced to encompass the entire state (U.S. Drought Monitor Archive, 2013). Agriculture is absorbing faced with economic hardship and drought impacts statewide.

Given agriculture's prominent role as a base industry in rural regional economies, the impact of drought extends well beyond lost crop and livestock revenues. Declining revenues lead to fewer input purchases and less labor income is spent in rural towns. Main Street businesses may also suffer from a drought induced reduction of economic activity. (Bauman et al, 2013)

The primary objective of this research is to describe and quantify the broader economic impacts of the drought on agricultural productivity and allied economic activity in Colorado. The scope of the analysis takes three forms: a description of agricultural production and prices received for important Colorado crops; calculation of actual 2012 crop revenues juxtaposed against what might have been received if harvested acres and yields were consistent with historical averages; and a broader estimate of the drought's economic impact by accounting for reduced input purchases and wages spent locally.

**Overall Drought Impacts:**

Table 1 summarizes an estimate of crop revenues in 2012. The values are calculated from data reported by the US Department of Agriculture, National Agriculture Statistics Service (NASS) including estimates of planted acres, harvested acres, yields and marketing year prices.

While not an exhaustive list, the crops listed in the first column of Table 1 represent more than ninety percent of crop production in the state and includes both irrigated and non-irrigated cropping. The second column represents an estimate of revenues in which the 2012 marketing year price is multiplied by the 2012 statewide average yield and 2012 harvested acres. Corn grain production represents the greatest revenue generator ($947 million) followed by hay production ($885 million) and wheat production ($602 million). Total crop sales are approximately $2.9 billion.

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**Table 1. 2012 and Average Revenues for Selected Colorado Crops**

| | 2012 Revenues | 2000 - 2010 Average Revenue | What Might Have Been Revenues[a] | Difference Between 2012 Revenues and What Might Have Been |
|---|---|---|---|---|
| ***Crops*** | | | | |
| *Barley* | $45,663,750 | $29,513,530 | $46,967,828 | -$1,304,078 |
| *Corn Grain* | $947,026,500 | $514,752,255 | $1,201,519,061 | -$254,492,561 |
| *Corn Silage* | $166,400,000 | $62,668,182 | $183,040,000 | -$16,640,000 |
| *Dry Beans* | $32,457,600 | $26,968,564 | $30,009,411 | $2,448,189 |
| *Hay (alfalfa & other)* | $885,198,000 | $473,898,618 | $960,408,099 | -$75,210,099 |
| *Millet* | $22,848,000 | $20,393,591 | $63,542,169 | -$40,694,169 |
| *Potatoes* | $150,678,450 | $188,995,952 | $145,700,620 | $4,977,830 |
| *Sorghum* | $20,328,000 | $14,940,581 | $34,285,537 | -$13,957,537 |
| *Sunflower* | $18,313,120 | $22,091,421 | $28,005,838 | -$9,692,718 |
| *Wheat* | $602,482,930 | $301,562,112 | $606,979,514 | -$4,496,584 |
| **Total** | $2,891,396,350 | $1,655,784,805 | $3,300,458,076 | -$409,061,726 |

[1]What Might Have Been Revenues are 2012 prices multiplied by historical average yields multiplied by 2012 planted acres multiplied by the historical ratio of harvested acres to planted acres.

In spite of the drought, total revenues are significantly higher than the ten year average of 2000 through 2010 that is reported at the bottom of the third column as $1.65 billion. The difference between 2012 revenues and the average amounts are very strong commodity prices in 2012. Persistently high prices were also observed in 2011.

Higher prices mitigate some drought impacts, but farmers experiencing yield losses and/or abandoning planted acres did miss an opportunity to sell some of their crop at higher prices. The fourth column is an estimate of this "foregone" potential – values represent the 2012 marketing year price multiplied by average yields (year 2000 to 2010) multiplied by planted acres for 2012 multiplied by the historical average ratio of harvested to planted acres. More simply, if farmers had an average year in producing crops, but sold at 2012 prices, they would have received $3.3 billion, or about $409 million more than was actually received.

The $409 million of foregone revenues may also be spent on crop inputs or as labor income, both of which might have contributed to other economic activity in the local community. This indirect and induced economic activity is based on an economic concept called a "multiplier." In this context, a multiplier is the total reduction in economic activity divided by the amount of foregone revenues. In sum, the $409 million of foregone revenues (second column of Table 2) resulted in more than $726 million in foregone economic activity (last column of Table 2).

Planted acres are abandoned rather than harvested when the revenues from the crop are smaller than harvest costs. Abandoned acres are one explanation for the $409 million of foregone revenues, but not for every crop. When examining Table 3, large proportions of traditionally non-irrigated crops were not harvested: sunflowers, millet and sorghum. The exception is wheat, most of which is grown as a non-irrigated crop in Colorado. Why the difference? Note that sunflower, millet and sorghum are crops sown in the Spring and harvested in the Fall, whereas wheat is planted in the previous September/October and harvested in July. The full impact of the drought was not realized statewide until mid to late summer 2012 ***after*** wheat had been harvested. Thus wheat would not be as affected by the 2012 drought when compared to other crops.

**Table 2. Economic Activity Lost as a Result of Foregone Revenues**

| Crop | Difference Between 2012 Revenues and What Might Have Been | Foregone Indirect and Induced Economic Activity | Sum of Foregone Revenues, Indirect and Induced Economic Activity |
|---|---|---|---|
| *Barley (bu/ac)* | $1,304,078 | $988,322 | $2,292,400 |
| *Corn Grain (bu/ac)* | $254,492,561 | $192,872,377 | $447,364,938 |
| *Corn Silage (tons/ac)* | $16,640,000 | $12,610,963 | $29,250,963 |
| *Dry Beans (lbs/ac)* | -$2,448,189 | -$1,855,410 | -$4,303,598 |
| *Hay (tons/ac)* | $75,210,099 | $66,040,493 | $141,250,592 |
| *Millet (bu/ac)* | $40,694,169 | $30,840,906 | $71,535,074 |
| *Potatoes (cwt/ac)* | -$4,977,830 | -$3,801,866 | -$8,779,697 |
| *Sorghum (bu/ac)* | $13,957,537 | $10,578,004 | $24,535,541 |
| *Sunflower (lbs/ac)* | $9,692,718 | $5,483,312 | $15,176,030 |
| *Wheat (bu/ac)* | $4,496,584 | $3,407,828 | $7,904,411 |
| ***Total*** | **$409,061,726** | **$317,164,929** | **$726,226,655** |

**Table 3. Comparison of Planted vs. Harvested Acres for Selected Crops**

| | 2012 | | 2000 - 2010 Average | |
|---|---|---|---|---|
| ***Crops*** | **Planted Acres** | **Harvested Acres** | **Planted Acres** | **Harvested Acres** |
| *Barley* | 58,000 | 55,000 | 76,818 | 72,091 |
| *Corn Grain* | 1,420,000 | 1,010,000 | 1,184,545 | 995,455 |
| *Corn Silage* | N/A[a] | 160,000 | N/A[a] | 108,182 |
| *Dry Beans* | 50,000 | 45,000 | 76,636 | 68,545 |
| *Hay* | N/A[b] | 1,460,000 | N/A[b] | 1,529,091 |
| *Millet* | 210,000 | 120,000 | 261,818 | 226,818 |
| *Potatoes* | 60,500 | 59,900 | 68,173 | 67,700 |
| *Sorghum* | 245,000 | 150,000 | 251,818 | 155,455 |
| *Sunflower* | 86,000 | 70,000 | 151,000 | 132,727 |
| *Wheat* | 2,363,000 | 2,182,000 | 2,438,455 | 2,122,909 |

[a]Corn silage acres are reported as "Corn" for planting, but separated into "grain" and "silage" categories at harvest.
[b]Hay is alfalfa and other, but are only reported as harvested acres by USDA-NASS

Declining yields might also account for foregone revenues, though these could be partially offset by higher prices. Table 4 compares averages yields (irrigated and non irrigated prices. Table 4 illustrates the prices received for these crops relative to their historical averages.

**Table 4. Selected Colorado Crop Yields in 2012 and on Average (2000 – 2010)**

| ***Crops*** | **2012 Yield** | **Average Yield (2000 - 2012)** |
|---|---|---|
| *Barley (bu/ac)* | 123 | 119 |
| *Corn Grain (bu/ac)* | 133 | 143 |
| *Corn Silage (tons/ac)* | 20 | 22 |
| *Dry Beans (lbs/ac)* | 1,840 | 1,712 |
| *Hay (tons/ac)* | 2.6 | 2.7 |
| *Millet (bu/ac)* | 14 | 26 |
| *Potatoes (cwt/ac)* | 387 | 373 |
| *Sorghum (bu/ac)* | 20 | 33 |
| *Sunflower (lbs/ac)* | 788 | 1,116 |
| *Wheat (bu/ac)* | 34 | 32 |

**Table 5. Marketing Year Price Received for Selected Crops**

| | **2012 Price Received** | **Average Price Received (2010-2010)** |
|---|---|---|
| ***Crops*** | | |
| *Barley ($/bu)* | $6.75 | $3.45 |
| *Corn Grain ($/bu)* | $7.05 | $3.04 |
| *Corn Silage ($/ton)* | $52.00 | $26.41 |
| *Dry Beans ($/cwt)* | $39.20 | $24.39 |
| *Hay ($/ton)* | $235.00 | $114.95 |
| *Millet ($/bu)* | $13.60 | $3.81 |
| *Potatoes ($/cwt)* | $6.50 | $7.73 |
| *Sorghum ($/bu)* | $6.78 | $2.74 |
| *Sunflower ($/lb)* | $0.33 | $0.15 |
| *Wheat ($/bu)* | $8.05 | $4.21 |

Notable reduction in yields is observed for sunflowers, sorghum, millet and corn for grain. Tremendously improved prices can be observed for all crops except potatoes. While the high prices offset revenue losses for farmers, they represent a severe price shock for the buyers of these inputs such as cow-calf producers, feedlots and millers.

The 2012 drought is with few precedents in its intensity and geographic reach. Drought impacts include sharply reduced yields and substantial abandoned acres. Losses were mitigated by historically high prices. These prices are the direct result of short national supplies when the drought's reach extended to much of the United States. As a result, the revenues generated by Colorado crop production were well above the historical average of years 2000 through 2010. However, these revenues also represent a missed opportunity – Colorado farmers would have benefitted tremendously if production had been closer to the average. Indeed, foregone revenues total $409 million that would have generated more than $317 million of additional spending in local communities.

This analysis is but one narrative of the 2012 drought. Important impacts that are not represented are the increased costs borne by livestock producers purchasing forage and grain when prices were at historically high levels. Some of these producers chose to liquidate livestock production rather than experience continued losses. A second important narrative is how farm and ranch resiliency was eroded by the drought. The eroded resiliency is directly tied to debt and an inability to generate cash flow for making payments. The drought persists into 2013 further challenging the viability of some agricultural enterprises

For more information on research related the economic impacts of drought consider:

Bauman et al, 2013, Estimating the Economic and Social Impacts from the Drought in Southern Colorado, Journal of Contemporary Water Research & Education, Issue 151, August 2013.

Nelson, R., C. Goemans and J. Pritchett. 2013. Farmer Resiliency Under Drought Conditions. PFMR 13-02. Department of Agricultural and Resource Economics., Colorado State University. http://webdoc.agsci.colostate.edu/DARE/PFMR/PFMR%2013-02.pdf

Pritchett, J. . Goemans and R. Nelson. 2013. Adaptations to Drought: Evidence from a Producer Survey. PFMR 13-01. Department of Agricultural and Resource Economics, Colorado State University. http://webdoc.agsci.colostate.edu/DARE/PFMR/PFMR%2013-01.pdf