

# Updating Labor Efficiency and Productivity Benchmarks



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## Abstract

*Labor is a significant expense for crop farms. This paper updates labor efficiency and labor productivity benchmark values using financial data from a sample of non-irrigated crop farms in Kansas. Based on a five-year farm-level average from 2020 to 2024, the mean labor efficiency was 19%, and the mean labor productivity was \$577,739. Farms with both a below average labor efficiency*

*and above average labor productivity have an average labor efficiency of 12.6% and an average labor productivity of \$801,420.*

## INTRODUCTION

Agricultural labor productivity has been steadily increasing in the United States from 1948 to 2017, with farm output per labor hour increasing by a factor of around 17 (Wang et al., 2022). Changes in labor productivity can be driven by changes in human capital, factor intensity, and technological change (Wolla, 2017), for example, increasing the human capital per worker through training programs or physical capital per worker through new equipment purchases can increase labor productivity. Improvements in technology can also drive improvement in labor productivity, since these factors are considered complements. Mugeru, Langemeier, and Featherstone (2012) decomposed the drivers of change in productivity and found that technical efficiency and factor intensity drove an increase in Kansas labor productivity from 1993 to 2007.

Labor productivity, a measure of the value of farm production (VFP) per worker, directly influences both profit margins and labor costs. Labor efficiency, calculated by dividing labor costs by VFP, provides further insight into the labor costs of additional VFP. Combining these measures allows farm managers to assess labor management on their operation. It is important to routinely revisit and update benchmark values for labor productivity and efficiency such that when used by producers, these tools match the current conditions in which producers operate.

Labor efficiency and productivity are positively correlated with better farm financial outcomes. Early benchmarks were generated using Illinois farm records from 1944-1946, and the quintile of farms with the lowest labor expenditure were observed to have higher farm earnings (Johnston, 1951). Pairwise correlations between optimal labor efficiency, labor productivity, and individual measures of profitability and financial efficiency were found to be significant (Langemeier,

2018). Labor efficiency and labor productivity are also positively correlated with better farm financial outcomes in the aggregate (Yi and Ifft, 2019).

Langemeier (2018) provides benchmark values for labor productivity and labor efficiency. In this paper, we update these values and find similar results regarding the relationship between the labor measures and both farm profitability and efficiency. We find that benchmark values for labor efficiency have increased slightly, representing a slight decline in efficiency compared to the benchmark values introduced by Langemeier (2018), but labor productivity has increased. We also present benchmark values based on farm size as measured by VFP.

## METHODS

Benchmark values for labor efficiency and labor productivity are calculated using the definitions presented in Table 1. Labor efficiency can be considered as the total cost of labor per dollar of output. The lower the labor efficiency, the fewer resources used per dollar of output. Likewise, labor productivity can be considered as the output per worker. A producer would aim to *minimize* labor efficiency and *maximize* labor productivity.

To understand the trends in labor measures, we calculate five-year averages of demographic and financial characteristics for each farm in the sample. Following Langemeier (2018), benchmark values for 2020-2024 are calculated by sorting farms into two groups: above average (top quartile) and below average (bottom quartile). The above average group includes the farms that had both a below average labor efficiency and an above average labor productivity. The below average group consists of farms that had both an above average labor efficiency and below average labor productivity. We then sort farms into quartiles based on VFP and provide average values of labor efficiency and labor productivity for each quartile. The VFP quartiles allow us to subset farms by size, which might provide a more representative alternative benchmark value.

Correlation coefficients are calculated between select farm demographic and financial variables. These values allow us to assess statistical relationships between labor efficiency and productivity as well as farm characteristics and financial position. The farm demographic variables included were operator age, total acres, crop intensity, land tenure (percent acres owned), and VFP. Crop intensity is calculated

by dividing the harvested acres by the crop acres. Profitability measures included net farm income (NFI), the profit margin ratio, and the rate of return on assets. Financial efficiency measures included the asset turnover ratio, total expense ratio, and the operating expense ratio.

## DATA

For this analysis, we use data from the Kansas Farm Management Association (KFMA) and follow their definitions for benchmark and financial ratio calculations. Table 2 contains the included variables and descriptive statistics for each over the period used to generate benchmarks, 2020-2024. The average labor efficiency and labor productivity were 18.7% and \$577,739, respectively, and the average total acres were 1,889. Average VFP and NFI were \$902,181 and \$185,784, and the average profit margin ratio and rate of return on assets were 0.045 and 0.029. The average asset turnover ratio, total expense ratio, and operating expense ratio were 0.343, 0.817, and 0.694.

We focus on *non-irrigated crop farms*, defined as operations with greater than 80% of crop labor allocated to dryland crops. To be included in the sample, farms needed to have continuous data for the five-year period over which averages were calculated. Table 3 shows each period for which benchmark values were calculated and the number of farms included in that period. For example, a farm might be included in the period from 2005 to 2009 but excluded from the 2010 to 2014 calculation if no data were available for 2011.

KFMA uses a standard operator cost per year to compute operator labor. To manage differences in accounting for labor between business organization structures (e.g., sole proprietor versus corporation), any operator wages paid by a corporation are excluded from operator cost calculations. Unpaid family labor is calculated as the number of months worked multiplied by half the operator labor cost. The number of workers is a measure of operators, hired employees, and family members. KFMA economists report the number of workers as the fraction of the year that they work, so a half-time employee would be recorded as 0.5 workers.

Figure 1 and Figure 2 show the trends in average total labor cost and number of workers per operation for farms included in the study. Total labor cost has shown a consistent upward trend over the past 20 years, with unpaid family labor remaining steady over that same time; hired labor has increased slightly; and operator

labor has increased steadily, driving much of the rise in total cost. The number of workers has increased but has remained within a range of 0.2 workers throughout the period. Figure 3 shows the distribution of the number of workers for the sample. The median number of workers is 1, representing one full-time operator.

Figure 4 illustrates the distribution of VFP for farms in the sample. The first frame, *distribution of value of farm production*, illustrates the value in reporting labor measures by VFP quartile, as the distribution of VFP is right-skewed, with a long tail of higher VFP farms. Benchmarking against the mean would cause middle-of-the-pack farms to appear below average, as the large values pull the mean upward. Accounting for this skew by breaking the sample into quartiles when reporting benchmarks allows farm managers to make more accurate comparisons for their operation.

The second frame, *labor efficiency by VFP quartile*, illustrates how labor efficiency is distributed across quartiles. The average labor efficiency decreases as VFP increases, and the distributions are also tighter as VFP increases. Conversely, the third frame, *labor productivity by VFP quartile*, shows that as VFP increases, labor productivity also increases. We can also see that the bottom quartile has a tighter distribution than the highest quartile.

## ANALYSIS

Labor ratios were calculated as the average of farm-level five-year averages from 2005 to 2024 (Table 4). Labor efficiency remained fairly stable over this period, ranging from a low of 19% from 2020-2025 to a high of 21% from 2015-2019. Labor productivity trended upward from a low of \$300,528 in 2005-2009 to \$577,739 from 2020-2024. A dip in labor productivity, coupled with an increase in labor efficiency, is observed from 2015-2019, which is reflective of the agricultural economy during that period.

The correlation coefficients and their relative interpretation are reported in Table 5. All variables behaved as expected, with “favorable” labor measure outcomes having statistically significant correlation to favorable profitability and financial efficiency values. We find that labor efficiency and labor productivity are highly correlated, with a coefficient of -0.75. As labor productivity increases, labor efficiency decreases.

Total acres, crop intensity, and VFP are correlated with positive labor outcomes. As each of these

characteristics increases, labor efficiency decreases and labor productivity increases. As operator age and the percentage of acres owned increases, we see the opposite effect: labor efficiency values increase and labor productivity decreases. Higher expenditure on machinery, measured by crop machinery costs and investment per acre, are also found to be weakly correlated with favorable labor measure values.

Benchmark values are reported in Table 6 and Table 7. Table 6 reports the benchmarks generated from the 2020-2024 sample. Labor efficiency and productivity averages for the below average group are 27.8% and \$371,912, respectively. In the above average group, labor efficiency and labor productivity are 12.6% and \$801,420, respectively. Table 7 reports the average labor measures for farm subsets based on VFP quartile. The relationship between VFP and labor measures is, again, evident as labor efficiency decreases, and labor productivity increases with an increase in VFP.

## DISCUSSION

Compared to Langemeier’s 2018 above average benchmark values, labor efficiency has worsened (increased) by 3.5% (note that an increase to this value represents a decline in efficiency, hence we use the term “worsened”). Labor productivity, however, has increased by around \$150,000, indicating that farms are generating more dollars of output per worker. For the below average benchmark values, labor productivity has increased by approximately \$170,000. The labor efficiency benchmark improved (decreased) by 2.8%. This represents a subtle narrowing in the gap between above and below average farms in terms of labor efficiency. Table 8 compares the 2018 benchmark values to the newly calculated 2024 benchmark values.

Labor benchmarks can be used by farm managers in a variety of settings. Considering whether to add an employee or whether to invest in new technologies are both cases where understanding labor utilization is necessary. In the case of a sole proprietor wanting to add a full-time employee, the operator should compare VFP to the labor productivity benchmark. A VFP of at least \$1.6 million, or double the labor productivity benchmark, would indicate there is room to hire a full-time employee. Labor benchmarks can also be used to evaluate previous decisions—for example, how did the labor benchmarks change following an asset purchase? If they decline or remain stable, there may be changes necessary to better utilize the labor force.

Farm managers can also use these benchmarks to evaluate labor use in relation to other major costs components. If the labor efficiency ratio is high, a farm manager might look at whether machinery costs are also high. As there can be trade-offs between labor machinery costs, higher labor costs that enable lower machinery costs are not necessarily a cause for concern, but when both labor and machinery costs are high, this may indicate the presence of inefficiencies that should be addressed.

## CONCLUSION

In this paper, benchmark values for two labor measures, labor efficiency and labor productivity, are examined using a sample of non-irrigated crop farms in Kansas. Favorable labor efficiency and productivity values are found to be correlated with favorable profitability and financial efficiency ratios. Farms that are bigger, have a higher crop intensity, own a smaller percentage of their acres, and have a higher expenditure on machinery are also found to have more favorable labor efficiency and labor productivity values. The relationship between labor measures and profitability and financial efficiency underscores the importance of benchmarking labor measures for farm managers.

Benchmark values based on farms with a both below average labor efficiency and an above average labor productivity are developed. The labor efficiency benchmark value is a measure below 12.6%, and for labor productivity, the benchmark value is a measure above \$801,000. This represents an improvement

in labor productivity but a slight decline in labor efficiency compared to 2018 benchmark values. These results are consistent with past findings that changes in labor productivity are driven primarily by factor intensity and technical efficiency. Increased mechanization is reflected in increased labor productivity due to the complementary nature of labor and technology in agriculture. However, gains in technology may or may not be reflected in labor efficiency. The updated benchmarks offer farm managers a reference point for making informed decisions related to labor utilization on their operation.

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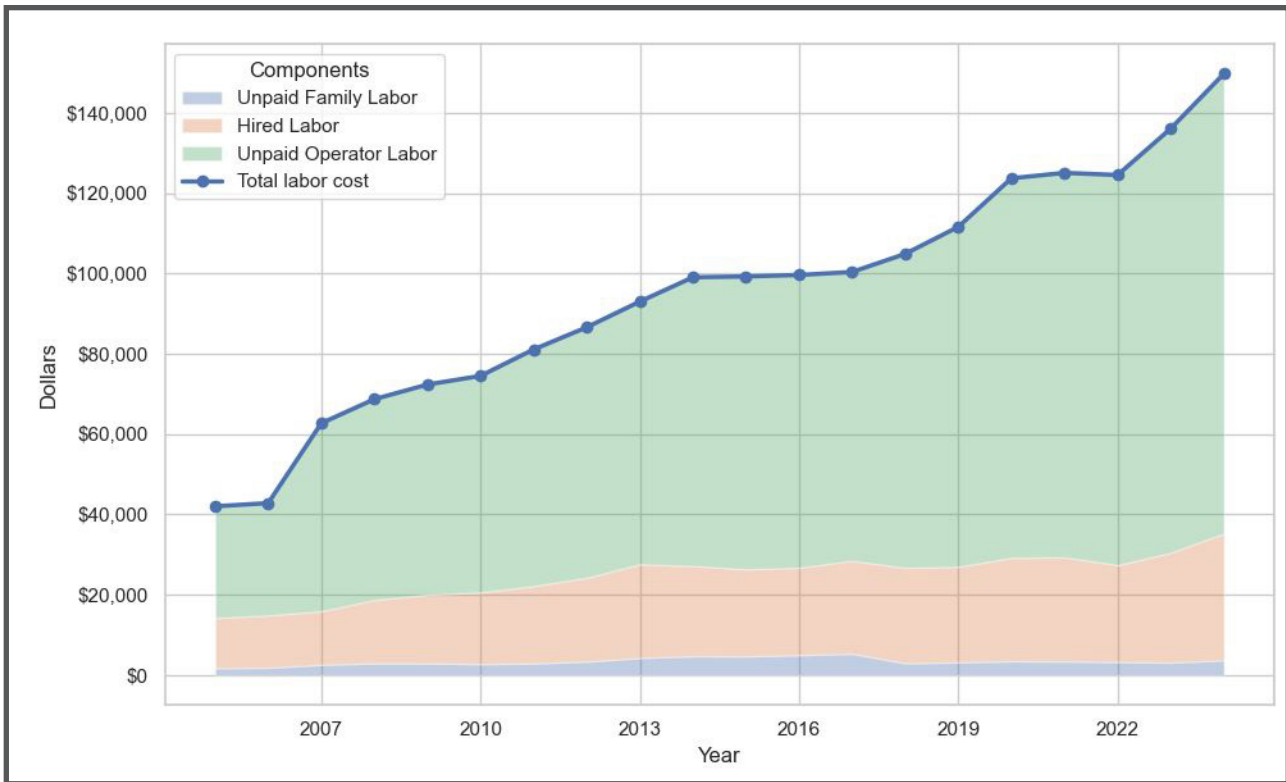


Figure 1. Average total labor cost by component

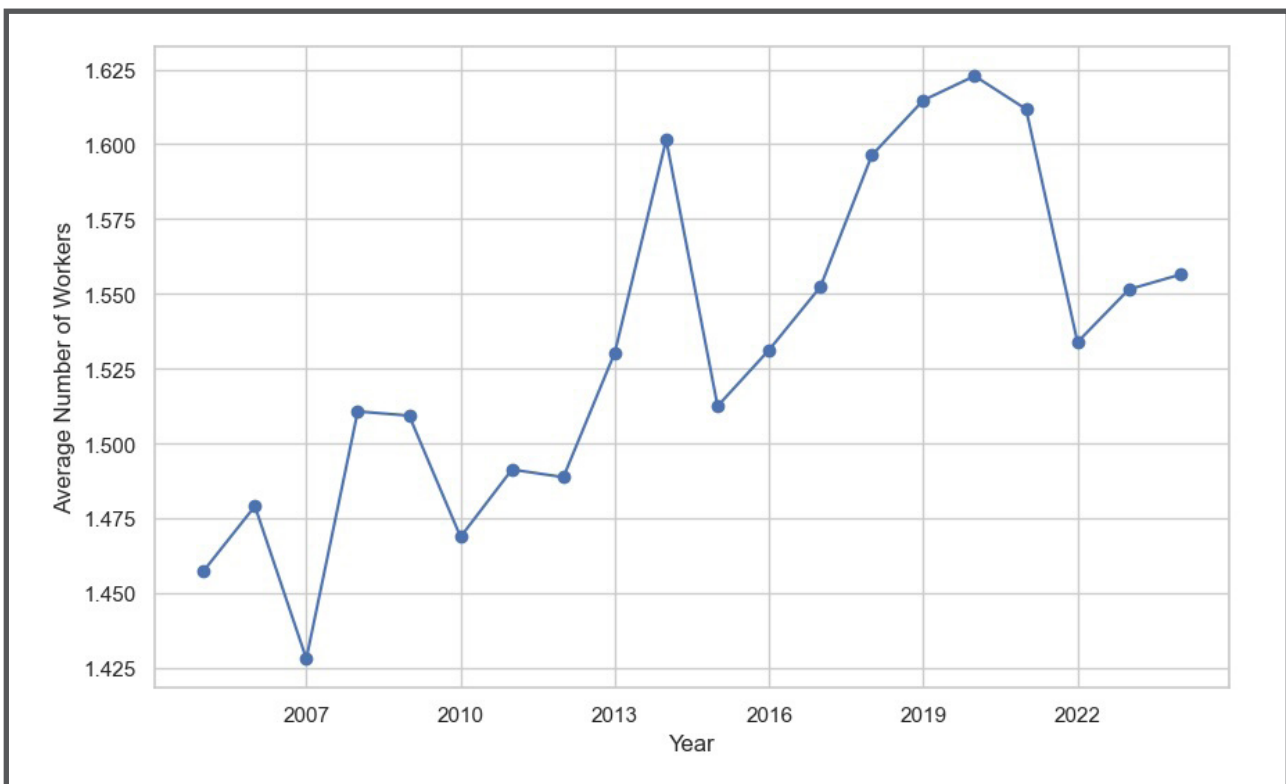


Figure 2. Average number of workers by year

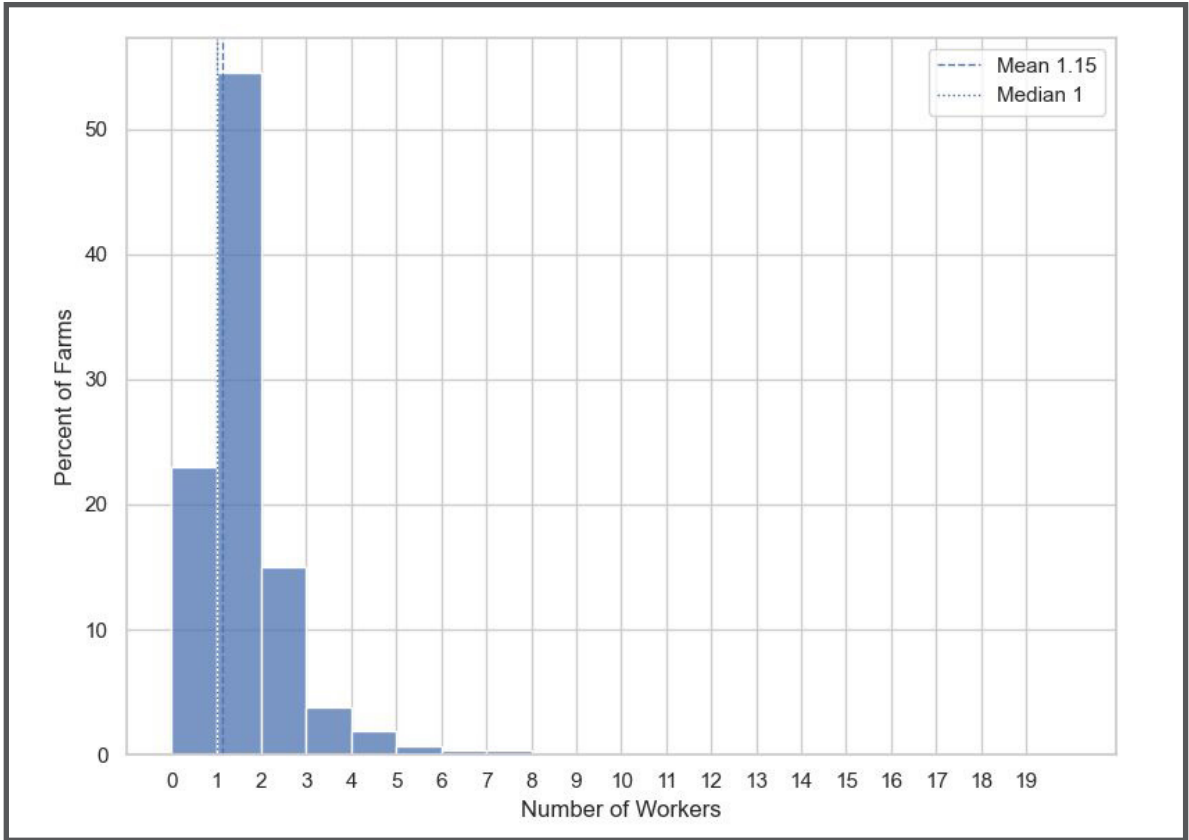


Figure 3. Distribution of number of workers

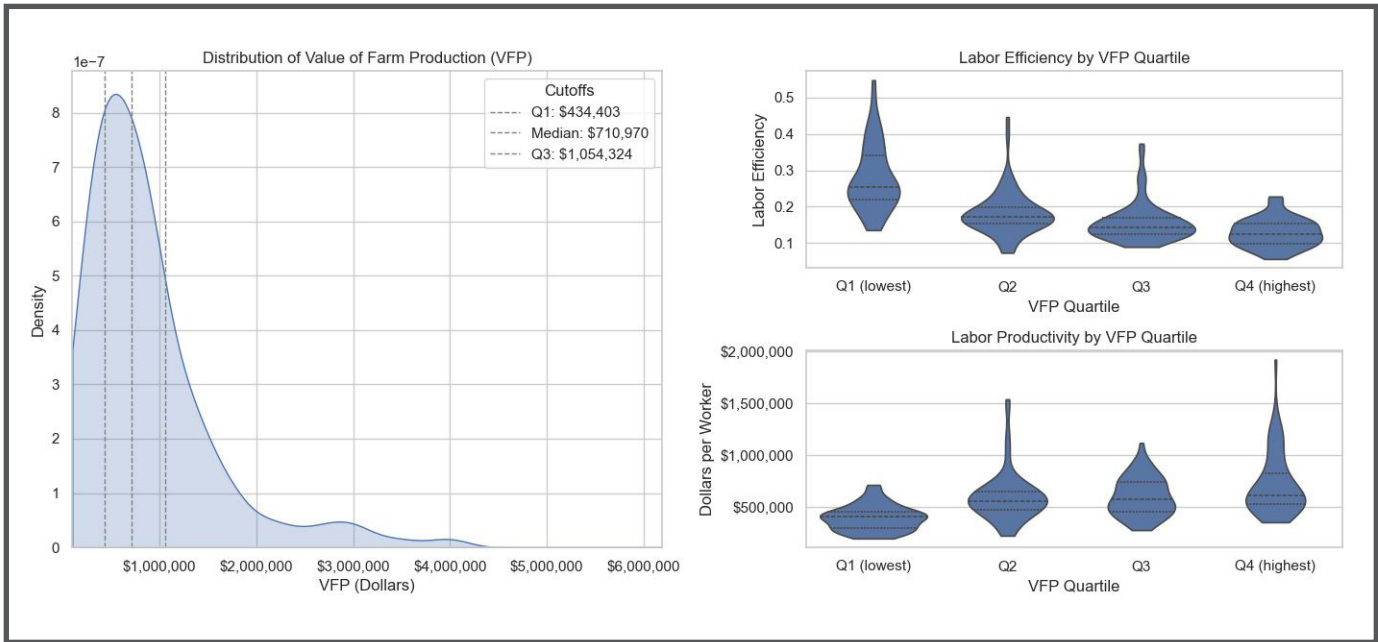


Figure 4. Distribution of VFP, distribution of labor efficiency, and labor productivity by VFP quartile

**Table 1. Labor Benchmarks Calculations**

Ratio	Calculation
Labor Efficiency	$\left( \frac{\text{Total Labor Cost}}{\text{Value of Farm Production}} \right)$
Labor Productivity	$\left( \frac{\text{Value of Farm Production}}{\text{Number of Workers}} \right)$

**Table 2. Descriptive Statistics for Included Variables**

Variable	Mean	Std Dev
Labor Efficiency	0.187	0.097
Labor Productivity	577,739	280,160

***Farm Demographics***

Operator Age	61.06	13.16
Total Acres	1889	1351
Crop Intensity	0.892	0.247
Percent Acres Owned	0.320	0.266
Value of Farm Production (VFP)	902,181	804,667

***Profitability***

Net Farm Income (NFI)	185,785	299,568
Profit Margin Ratio	0.045	0.232
Rate of Return on Assets	0.029	0.091

***Financial Efficiency***

Asset Turnover Ratio	0.343	0.259
Total Expense Ratio	0.817	0.189
Operating Expense Ratio	0.694	0.167

***Machinery Expenditure***

Crop Machinery Investment per Acre	348.41	202.42
Crop Machinery Cost per Acre	124.71	56.60

**Table 3. Sample Size by Benchmarking Period**

Year	Farms in Sample
2005–2009	599
2010–2014	504
2015–2019	355
2020–2024	271

**Table 4. Averages (5-Year) for Labor Benchmarks**

Time Period	Average Labor Efficiency (st. dev)	Average Labor Productivity (st. dev)
2005–2009	0.17 (0.15)	\$300,528 (186,320)
2010–2014	0.17 (0.11)	\$438,785 (220,993)
2015–2019	0.21 (0.14)	\$406,371 (197,829)
2020–2024	0.19 (0.14)	\$577,739 (280,160)

**Table 5. Correlation Coefficients Between Select Variables and Labor Measures**

Variable	Labor Efficiency	Labor Productivity
Labor Efficiency	-	-0.746***
Labor Productivity	-0.746***	-
<i>Farm Demographics</i>		
Operator Age	0.266***	-0.263***
Total Acres	-0.469***	0.346***
Crop Intensity	-0.322***	0.306***
Percent Acres Owned	0.213***	-0.217***
Value of Farm Production (VFP)	-0.493***	0.400***
<i>Profitability</i>		
Net Farm Income (NFI)	-0.423***	0.380***
Profit Margin Ratio	-0.698***	0.466***
Rate of Return on Assets	-0.522***	0.452***
<i>Financial Efficiency</i>		
Asset Turnover Ratio	-0.261***	0.302***
Total Expense Ratio	0.152**	-0.106*
Operating Expense Ratio	0.187***	-0.117*
<i>Machinery Expenditure</i>		
Crop Machinery Investment per Acre	-0.179***	0.141**
Crop Machinery Cost per Acre	-0.210***	0.195***

Note: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Table 6. Labor Benchmarks Based on 2020-2024**

	Below Average	Above Average
Labor Efficiency	27.8%	12.6%
Labor Productivity	\$371,912	\$801,420
Number of Farms	94	108

**Table 7. Labor Benchmarks by VFP Quartile**

VFP Quartile	VFP Range	Average Labor Efficiency	Average Labor Productivity
Q1 (Lowest)	\$0-\$434,402	27.9%	\$394,688
Q2	\$434,403-\$710,969	18.2%	\$594,436
Q3	\$710,970-\$1,054,324	15.7%	\$600,415
Q4 (Highest)	> \$1,054,324	12.9%	\$721,750

**Table 8. Historical Comparison of Labor Benchmarks**

	Below Average		Above Average	
	2018	2024	2018	2024
Labor Efficiency	30.6%	27.8%	9.10%	12.60%
Labor Productivity	\$202,808	\$371,912	\$650,116	\$801,420
Number of Farms	272	94	272	108