# Revisiting the Portfolio Diversification Impact of Farmland

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*We examine the impact of farmland within a mixed asset portfolio consisting of U.S. stocks, bonds, Treasury Bills, real estate, and gold to determine farmland's diversification benefits. Farmland returns are proxied via a U.S. Farmland Real Estate Investment Trust (F-REIT). Using both constrained and unconstrained asset allocation assumptions, we employ Markowitz Portfolio Optimization resulting in various asset allocation outcomes. We find farmland to be a suboptimal choice within a well-diversified portfolio despite possessing a low correlation with the other assets. By revisiting the portfolio impact of farmland, our results update findings in the literature which have been mixed and inactive in recent years. Additionally, our findings have meaningful implications for the average investor who is considering allocating investment into farmland.*

*Keywords: asset allocation, farmland, investment portfolio, farmland real estate investment trust*

## INTRODUCTION

Investor interest in farmland has grown in recent years. Farmland investing proponents highlight an increasing global population in conjunction with a decreasing supply of U.S. farmland acreage. Investors and fund operators emphasize farmland's consistent returns, low volatility, and low correlation with other assets. According to AcreTrader Financial LLC (2024), a farmland investing platform, a $10,000 investment in farmland in 1991 would be worth over $232,000 by 2021 while also seeing no negative annual returns along the way. Farmland investors and fund operators additionally credit farmland as an inflation hedge as well as point out its low institutional ownership, making it an attractive target for consolidation and value creation.

Given the interest in farmland investing, investment vehicles that provide access to farmland have emerged. Traditionally, an investor wanting exposure to farmland would need to buy an entire farm. While this strategy provides the most direct control it also presents the most challenges including making a large capital investment, the lack of diversification, and typically the lack of farming expertise. More recently crowdsourcing platforms and publicly traded farmland real estate investment trusts, known as F-REITs, have improved investor access to farmland. Despite the lack of direct control, both crowdsourcing and F-REITs give investors the opportunity to diversify across crop types and geographic regions as well as rely on professional farm management without the need to make a substantial capital investment. However, crowdsourcing platforms are typically available for only accredited investors, making F-REITs the only realistic option for the average investor.

Publicly traded F-REITs have been available for just over a decade in the United States. An F-REIT manages a portfolio of farmland on behalf of its shareholders and generates revenue from rental income, farm operations, and land value appreciation. Investors in F-REITs earn a capital return from both dividends and share price appreciation. Currently there are two F-REITs available to U.S. investors: Gladstone Land Corporation and Farmland Partners Incorporated. With F-REITs now possessing a trading history of over a decade it is time for investors to revisit the diversification impact of adding farmland to an investment portfolio.

This study examines whether the average investor can improve their financial performance by adding farmland to their investment portfolio via an F-REIT proxy. Following in the footsteps of prior scholars that investigate farmland's contribution to a well-diversified portfolio using portfolio optimization (Painter, 2010; Painter, 2011; Painter, 2013; Waggle & Johnson, 2008), we update findings by analyzing the risk-return characteristics and impact on portfolio performance when farmland is added to a well-diversified investment portfolio. Furthermore, we advance the analysis by applying realistic asset allocation constraints as recommend in prior studies (Eichhorn et al., 1998; Waggle & Johnson, 2008;) and improve upon past works by analyzing portfolios consisting of commonly held investment funds making our findings more generalizable to the greatest number of investors. We begin by reviewing the relevant literature, then we describe both the data and methodology used in this study, followed by the results, and finally we offer our conclusions.

## LITERATURE REVIEW

### Modern Portfolio Theory

Modern Portfolio Theory was first described by Harry Markowitz in his seminal work *Portfolio Selection* (1952). Markowitz created the framework to construct investment portfolios that optimize returns while minimizing risk. Additionally, Markowitz (1952; 1959) introduced the concept of efficient portfolios that took into consideration not only an asset's expected return and risk but its correlation with other assets in a portfolio. Markowitz (1952) considers a portfolio efficient if it provides the highest possible expected return for a given level of risk, or conversely the lowest possible level of risk for a given expected return which is often illustrated by the efficient frontier curve. Modern Portfolio Theory, also known as mean-variance portfolio optimization, is widely accepted in both academia and among finance practitioners, despite its known shortcomings.

Tobin (1958) and Treynor (1961) would expand Modern Portfolio Theory by adding the risk-free asset to the analysis and the Capital Market Line (CML) to produce the "super-efficient" portfolio. Tobin argued that a leveraged portfolio comprising of risk-free assets sitting on the CML would outperform a portfolio on the efficient frontier as CML efficient portfolios provided the highest return for a chosen level of risk or the lowest risk for a chosen level of return. Several years later, William Sharpe (1964) would introduce the Capital Asset Pricing Model, or CAPM, by asserting that all investors should hold the market portfolio regardless of leverage, in conjunction with risk-free assets. The CAPM proposed that investors should only be concerned with the portion of an asset's risk that adds to the total risk of a portfolio, known as systematic risk, rather than risk that could be diversified away. These early scholars created the foundation for optimizing risk and return within portfolio management.

### Farmland Investment Studies

Several past studies have investigated the contribution of farmland to investment portfolios. Barry (1980) examined farmland in eleven U.S. regions using the CAPM and found most farmland risk to be low at the portfolio level and capable of being diversified away. Kaplan (1985) highlights farmland's high total return and low correlation with other assets as beneficial to investment portfolios. Moss et al., (1987), Lins et al., (1992), and Ruebens and Webb (1995) each analyze efficient portfolios using farmland and other U.S assets. These scholars conclude that the addition of farmland improved overall portfolio performance. Webb and Rubens (1988) evaluate a wide range of assets, including farmland, and find farmland would account for a large portion of an optimal portfolio under many conditions.

Somewhat more recent studies have continued to examine farmland's impact on portfolios. Bigge and Langemeier (2004) discover that the low systematic risk of Kanas farmland enabled farmers to enhance their portfolio performance through investments in the stock market. Libbin et al., (2004) use New Mexico farmland to analyze the effects of various financial strategies on farmland portfolio values and find financial investments had a favorable outcome on portfolio values, however there was no indication of major diversification benefits. Waggle and Johnson (2009) use Markowitz portfolio optimization to determine the effects of including timberland, farmland, and commercial real estate in an investment portfolio. These scholars find that while timberland benefits nearly all portfolios, farmland was only beneficial for low-risk portfolios. The authors conclude by saying, "farmland does not appear to be a good choice for most portfolios" (pg. 95). Noland et al., (2011) found the farmland portfolio of the University of Illinois frequently dominated the efficient asset allocation mix. Finally, Hardin and Cheng (2002; 2005) investigate farmland's potential to improve portfolio efficiency finding mixed results that question whether farmland can enhance performance within an optimized mixed-asset portfolio framework. These findings suggest it is unclear what benefit farmland provides to a well-diversified portfolio.

Several scholars have investigated farmland's portfolio impact in countries outside the United States. Eves (2005) and Newell and Eves (2007) found that farmland in Australia and the U.S. provide portfolio diversification benefits, but it is limited when other property assets are included in the asset mix. Several scholars (Shadbolt & Gardner, 2003; Oltmans, 1995; Oltmans, 2007; Nartea & Basanta, 1998; Brown, 1999) assess farmland returns in New Zealand by delineating between land appreciation and farming operations. These authors emphasize the importance land appreciation plays on farming returns, to the point where cash flows from farming operations often determines the investment unfeasibility. Painter (2000) analyzes Canadian farmland from the perspective of a Canadian investor and found that incorporating farmland into a diverse portfolio mix enhances overall performance. Furthermore, Painter (2006) found the gains from a Canadian farmland mutual fund was the result of low levels of risk and yield that was greater than bonds, in addition to its low correlation with other financial assets. Painter and Eves (2008) assess farmland in Canada, New Zealand, Australia, and the U.S. and found that the low and negative correlation of farmland yields with stocks and bonds made it a good candidate for portfolio diversification. Painter (2010) then found that a Canadian F-REIT fared well in an efficient international investment portfolio. Finally, Painter (2011; 2013) found a Canadian F-REIT provided diversification benefits and the most financial improvement to low and medium risk portfolios.

Although many prior studies investigate farmland's potential role in a well-diversified portfolio, this research area has been inactive for several years with no new research findings. This paper builds on prior works by continuing to ask the question: Do we need farmland in our portfolios? We adopt the methodology used by Waggle and Johnson (2009) and maintain Painter's (2010; 2011; 2013) use of F-REITs to analyze farmland's portfolio impact. We contribute to the literature by bringing farmland's portfolio assessment up to date. Additionally, we go beyond past studies by applying an asset mix that is widely available to the vast majority of investors therefore making our findings much more relevant to all investors considering farmland. In the next section we describe the data and methodology of this study.

## DATA

We take the perspective of the average U.S. investor by analyzing the daily price values for U.S. stocks, U.S. bonds, U.S. Treasury bills, U.S. real estate, gold, and U.S. farmland. To proxy stocks, bonds, and real estate, we use the largest Mutual Fund or Exchange Traded Fund (ETF) by assets for each asset type. These include the Vanguard Total Stock Market Index Fund for stocks, the Vanguard Total Bond Market Index Fund for bonds, and the Vanguard Real Estate Index Fund for real estate. Daily pricing data for stocks, bonds, and real estate was obtained via Commodity Systems Inc. For T-Bills, we use the 3-month T-Bill yield provided by the St. Louis Federal Reserve. For gold, we use the daily gold futures price with data provided by Fusion Media Limited. Finally, for farmland, we use Gladstone Land Corporation as our proxy due to its longer time period as a publicly listed F-REIT compared with its competitor Farmland Partners Inc. Daily pricing data was also attained via Commodity Systems Inc. To account for the total return of each of our assets, including capital gains, dividends, or interest income, we use the adjusted closing price when necessary. The dataset spans from January 29, 2013 to January 30, 2024, which covers the full time period Gladstone Land has been available to investors and totals 2,700 observations (n = 2,700). To calculate the risk-free rate, we use the U.S. Treasury ten-year yield at the time of analysis, which equaled 4.071%. We believe this asset mix and the funds selected for their proxies to be the most realistic for the majority of investors.

## METHODOLOGY

We adopt the methodology used by prior scholars (Waggle & Johnson, 2009; Painter, 2010; 2011; 2013) to analyze farmland's portfolio impact by implementing a Markowitz mean-variance optimization to determine portfolio combinations that provide the highest expected returns for given levels of risk. Modern Portfolio Theory states efficient portfolios are preferred by all risk-averse investors given their individual risk tolerance. The Markowitz Optimization Model solves for the asset weights that maximize the expected portfolio return $r_p$, as follows:

$$r_p = \sum_{i=1}^{n} w_i \; r_i \tag{1}$$

given the following constraint:

$$\sigma_P = \sqrt{\sum_{i=1}^{n} \sum_{j=1}^{n} w_i \, w_j \rho_{ij} \sigma_i \sigma_j} = X\% \tag{2}$$

where: $n$ is the number of assets in the portfolio,
$r_i$ is the expected return of each asset in the asset mix,
$w_i$ is the portfolio weight of the $i$th asset,
$w_j$ is the portfolio weight of the $j$th asset,
$\rho_{ij}$ is the correlation coefficient of assets $i$ and $j$, and
$X$% is the target level of variability.

Further constraints include asset weights are positive values, $w_i \geq 0$, for all assets, and the sum of weights equal 1, or $\sum_{i-1}^{n} w_i = 1$.

We begin by calculating the logarithm daily returns for each asset by taking the natural log of the current period's price divided by the previous period's price. We then calculate the correlation coefficients, the average annual returns, standard deviations, and total return for the timeseries for each asset. Next, we take the same approach as Waggle and Johnson (2009) by applying portfolio weight constraints to the analysis. These constraints include minimum and maximum portfolio allocations as follows: Stocks 25 - 65%, Bonds 20 - 50%, T-Bills 0 - 20%, Real Estate 0 - 20%, Gold 0 - 20%, and Farmland 0 - 20%. A common criticism of the Markowitz model is that it can produce unrealistic allocations by over emphasizing an ex-post negative correlation or an unusually high prior return. Therefore, the use of allocation constraints supports our goal of making our findings realistic to the majority of investors. For more about the importance of allocation constraints, Eichhorn et al., (1998) discuss the advantages of constrained optimization. In sum, we analyze four distinct portfolios: 1. Unconstrained portfolio with Farmland, 2. Unconstrained portfolio without Farmland, 3. Constrained portfolio with Farmland, and 4. Constrained portfolio without Farmland.

## RESULTS

This section presents the results of the analysis. The correlation matrix and return statistics are presented in Table 1. Farmland is most correlated with U.S. real estate (0.485) and least correlated with T-Bills (-0.028). In general, farmland enjoys a low correlation with the asset mix. U.S. stocks had the highest average annualized return at 12% while T-Bills had the lowest at 1.2%. Farmland had an average annual return of 3.7% across the timeseries. Interestingly, farmland has the highest standard deviation (0.299), followed by stocks (0.176) and real estate (0.203). U.S. bonds have the lowest standard deviation (0.051). For the entire timeseries (January 29, 2013 to January 30, 2024), T-Bills had the best total return (73.430) due to historic low rates at the beginning of the timeseries and sharp increases at the end. U.S. stocks did well (2.746), almost quadrupling an initial investment. Farmland (0.508) had a greater return than gold (0.171) and bonds (0.177), however underperformed the broader real estate asset class (0.897).

**TABLE 1**
**CORRELATION MATRIX AND RETURN STATISTICS**

| | US Stocks | US Bonds | 3-mo T-Bill | US Real Estate | Gold | Farmland |
|---|---|---|---|---|---|---|
| **US Stocks** | 1 | | | | | |
| **US Bonds** | 0.095 | 1 | | | | |
| **3-mo T-Bill** | -0.002 | 0.017 | 1 | | | |
| **US Real Estate** | 0.753 | 0.260 | -0.011 | 1 | | |
| **Gold** | 0.032 | 0.348 | 0.024 | 0.122 | 1 | |
| **Farmland** | 0.417 | 0.109 | -0.028 | 0.485 | 0.074 | 1 |
| **Average Return** | 0.120 | 0.015 | 0.012 | 0.058 | 0.014 | 0.037 |
| **Standard Deviation** | 0.176 | 0.051 | 0.097 | 0.203 | 0.150 | 0.299 |
| **Total Return** | 2.746 | 0.177 | 73.430 | 0.897 | 0.171 | 0.508 |

### Unconstrained Portfolio With Farmland

Table 2 presents optimal portfolio combinations based on the portfolio manager’s desired level of risk, as measured by standard deviation, for an unconstrained portfolio with farmland. At the lower levels of risk, bonds and T-bills make up the majority of the portfolio weightings. At the higher levels of risk, real estate produces the highest allocation. Using a 10% standard deviation as our base level, the optimal allocation is 5.1% to stocks, 9.5% to bonds, 35.2% to T-bills, 8.7% to gold, 39.8% to real estate, and 1.7% to farmland.

**TABLE 2**
**OPTIMAL PORTFOLIOS WITH FARMLAND AND NO CONSTRAINTS**

| Portfolio Standard Deviation | Portfolio Expected Return | Sharpe Ratio | US Stocks | US Bonds | T-Bills | Gold | US Real Estate | Farmland |
|---|---|---|---|---|---|---|---|---|
| 0.03 | 0.019 | -0.475 | 0.045 | 0.746 | 0.209 | 0.000 | 0.000 | 0.000 |
| 0.04 | 0.019 | -0.475 | 0.045 | 0.746 | 0.209 | 0.000 | 0.000 | 0.000 |
| 0.05 | 0.022 | -0.370 | 0.049 | 0.655 | 0.144 | 0.096 | 0.040 | 0.015 |
| 0.06 | 0.024 | -0.279 | 0.056 | 0.288 | 0.405 | 0.153 | 0.080 | 0.017 |
| 0.07 | 0.022 | -0.263 | 0.048 | 0.126 | 0.633 | 0.100 | 0.077 | 0.016 |
| 0.08 | 0.031 | -0.126 | 0.050 | 0.102 | 0.495 | 0.091 | 0.246 | 0.017 |
| 0.09 | 0.035 | -0.066 | 0.052 | 0.100 | 0.411 | 0.091 | 0.330 | 0.017 |
| 0.10 | 0.038 | -0.028 | 0.051 | 0.095 | 0.352 | 0.087 | 0.398 | 0.017 |
| 0.12 | 0.044 | 0.023 | 0.050 | 0.084 | 0.253 | 0.079 | 0.518 | 0.016 |
| 0.14 | 0.049 | 0.056 | 0.047 | 0.070 | 0.170 | 0.067 | 0.630 | 0.016 |
| 0.16 | 0.053 | 0.077 | 0.043 | 0.052 | 0.100 | 0.051 | 0.738 | 0.016 |
| 0.18 | 0.058 | 0.097 | 0.043 | 0.000 | 0.099 | 0.000 | 0.858 | 0.000 |

### Unconstrained Portfolio Without Farmland

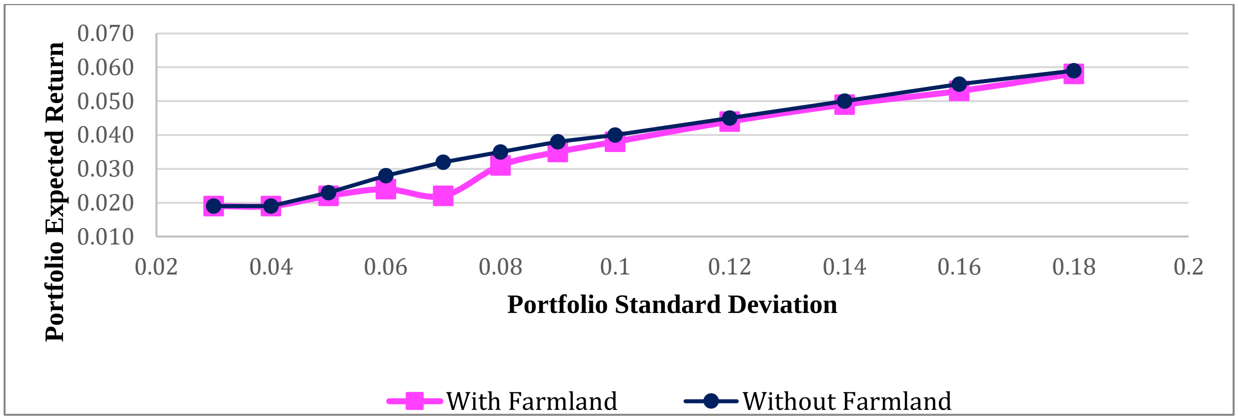
Table 3 presents optimal portfolio combinations based on the portfolio manager's desired level of risk for an unconstrained portfolio without farmland. Once again, at the lower levels of risk, bonds and T-bills make up the majority of the optimal portfolios and at the higher levels of risk, real estate dominates. For our 10% standard deviation base level, assets are allocated 7.1% to stocks, 23.9% to bonds, 18.6% to T-bills, 10.3% to gold, and 40.0% to real estate. This optimal portfolio produces a slightly higher expected return and Sharpe Ratio compared with a portfolio of equal risk when farmland is included in the asset mix.

**TABLE 3**
**OPTIMAL PORTFOLIOS WITHOUT FARMLAND AND NO CONSTRAINTS**

| Portfolio Standard Deviation | Portfolio Expected Return | Sharpe Ratio | US Stocks | US Bonds | T-Bills | Gold | US Real Estate |
|---|---|---|---|---|---|---|---|
| 0.03 | 0.019 | -0.475 | 0.045 | 0.746 | 0.209 | 0.000 | 0.000 |
| 0.04 | 0.019 | -0.475 | 0.045 | 0.746 | 0.209 | 0.000 | 0.000 |
| 0.05 | 0.023 | -0.363 | 0.045 | 0.605 | 0.209 | 0.069 | 0.072 |
| 0.06 | 0.028 | -0.214 | 0.060 | 0.487 | 0.207 | 0.095 | 0.015 |
| 0.07 | 0.032 | -0.130 | 0.066 | 0.406 | 0.206 | 0.103 | 0.219 |
| 0.08 | 0.035 | -0.073 | 0.070 | 0.337 | 0.206 | 0.106 | 0.281 |
| 0.09 | 0.038 | -0.032 | 0.072 | 0.274 | 0.206 | 0.108 | 0.341 |
| 0.10 | 0.040 | -0.003 | 0.071 | 0.239 | 0.186 | 0.103 | 0.400 |
| 0.12 | 0.045 | 0.040 | 0.069 | 0.176 | 0.147 | 0.093 | 0.515 |
| 0.14 | 0.050 | 0.068 | 0.066 | 0.121 | 0.107 | 0.080 | 0.625 |
| 0.16 | 0.055 | 0.088 | 0.061 | 0.074 | 0.068 | 0.061 | 0.735 |
| 0.18 | 0.059 | 0.101 | 0.052 | 0.034 | 0.032 | 0.036 | 0.847 |

Figure 1 summarizes our results thus far by graphing the Efficient Frontier with and without farmland for an unconstrained portfolio. The Efficient Frontier shows optimal portfolios without farmland dominate over portfolios with farmland. Next, we provide portfolio outcomes when portfolio allocations are constrained.

**FIGURE 1**
**EFFICIENT FRONTIER WITH AND WITHOUT FARMLAND WITH NO PORTFOLIO CONSTRAINTS**




**Constrained Portfolio With Farmland**

Using the portfolio constraints discussed earlier, we reconsider the optimal portfolios when farmland is included in the asset mix. Table 4 presents the optimal portfolio combinations based on the portfolio manager's desired risk level. Under these constraints, we see higher portfolio expected returns and improved Sharpe Ratios. At the benchmark 10% standard deviation risk level, assets are distributed with 46.3% to stocks, 20% to bonds, 15.1% to T-bills, 9.9% to gold, 5.1% to real estate, and 3.6% to farmland.

**TABLE 4**
**OPTIMAL PORTFOLIOS WITH FARMLAND AND ALLOCATION CONSTRAINTS**

| Portfolio Standard Deviation | Portfolio Expected Return | Sharpe Ratio | US Stocks | US Bonds | T-Bills | Gold | US Real Estate | Farmland |
|---|---|---|---|---|---|---|---|---|
| 0.06 | 0.043 | 0.030 | 0.250 | 0.449 | 0.194 | 0.108 | 0.000 | 0.000 |
| 0.07 | 0.046 | 0.073 | 0.253 | 0.363 | 0.194 | 0.108 | 0.048 | 0.035 |
| 0.08 | 0.054 | 0.166 | 0.324 | 0.284 | 0.194 | 0.111 | 0.051 | 0.036 |
| 0.09 | 0.062 | 0.238 | 0.396 | 0.238 | 0.174 | 0.106 | 0.051 | 0.036 |
| 0.10 | 0.070 | 0.291 | 0.463 | 0.200 | 0.151 | 0.099 | 0.051 | 0.036 |
| 0.11 | 0.077 | 0.333 | 0.529 | 0.200 | 0.103 | 0.081 | 0.051 | 0.036 |
| 0.12 | 0.085 | 0.366 | 0.593 | 0.200 | 0.063 | 0.059 | 0.051 | 0.035 |
| 0.13 | 0.091 | 0.390 | 0.650 | 0.200 | 0.025 | 0.035 | 0.054 | 0.036 |
| 0.14 | 0.095 | 0.385 | 0.650 | 0.200 | 0.000 | 0.000 | 0.131 | 0.019 |

Constraints: Stocks 25-65%, Bonds 20-50%, T-Bills 0-20%, Gold 0-20%, Real Estate 0-20%, Farmland 0-20%

**Constrained Portfolio Without Farmland**

Finally, Table 5 presents the optimal portfolio combinations when allocation constraints are enforced and when farmland is not included in the asset mix. Under this scenario, we once again see improved results when farmland is not included in portfolios. At the 10% standard deviation level, the optimal portfolio weights are 53.2% in stocks, 25.9% in bonds, 16% in T-bills, 3.3% in gold, and 1.5% in real estate. This portfolio produces a higher expected return and Sharpe Ratio than one with farmland, at the same level of risk.

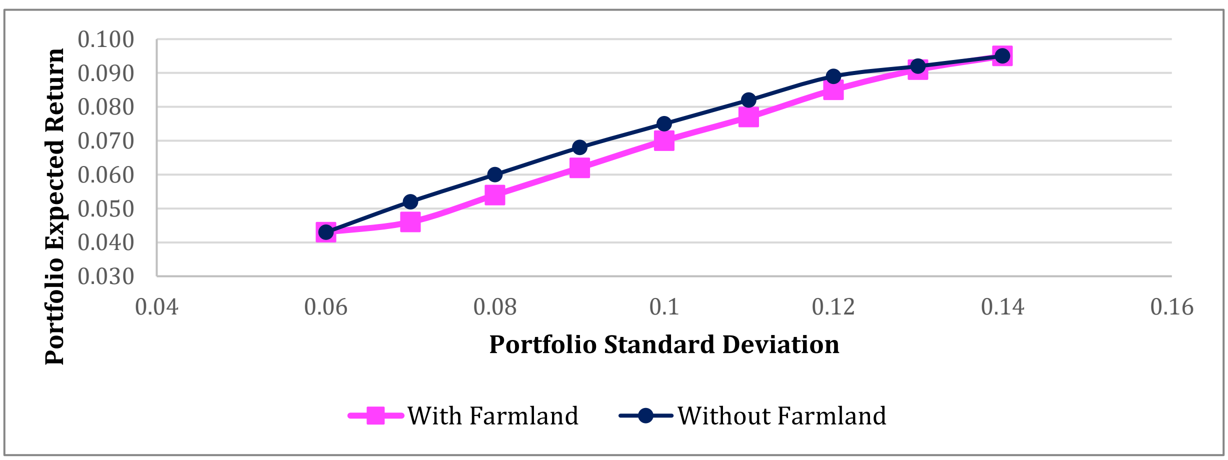
**TABLE 5**
**OPTIMAL PORTFOLIOS WITHOUT FARMLAND AND ALLOCATION CONSTRAINTS**

| Portfolio Standard Deviation | Portfolio Expected Return | Sharpe Ratio | US Stocks | US Bonds | T-Bills | Gold | US Real Estate |
|---|---|---|---|---|---|---|---|
| 0.06 | 0.043 | 0.043 | 0.251 | 0.500 | 0.200 | 0.034 | 0.015 |
| 0.07 | 0.052 | 0.165 | 0.331 | 0.431 | 0.189 | 0.034 | 0.015 |
| 0.08 | 0.060 | 0.244 | 0.401 | 0.360 | 0.190 | 0.034 | 0.015 |
| 0.09 | 0.068 | 0.301 | 0.468 | 0.308 | 0.176 | 0.034 | 0.015 |
| 0.10 | 0.075 | 0.344 | 0.532 | 0.259 | 0.160 | 0.033 | 0.015 |
| 0.11 | 0.082 | 0.377 | 0.595 | 0.215 | 0.144 | 0.033 | 0.015 |
| 0.12 | 0.089 | 0.402 | 0.650 | 0.200 | 0.097 | 0.032 | 0.021 |
| 0.13 | 0.092 | 0.394 | 0.650 | 0.200 | 0.026 | 0.040 | 0.084 |
| 0.14 | 0.095 | 0.386 | 0.650 | 0.200 | 0.004 | 0.000 | 0.146 |

Constraints: Stocks 25-65%, Bonds 20-50%, T-Bills 0-20%, Gold 0-20%, Real Estate 0-20%

Figure 2 summarizes the optimal portfolios when allocation constraints are enforced by graphing the Efficient Frontier with and without farmland. Once again, the Efficient Frontier shows optimal portfolios without farmland dominate over portfolios with farmland. Next, we offer our conclusions.

**FIGURE 2**
**EFFICIENT FRONTIER WITH AND WITHOUT FARMLAND WITH PORTFOLIO CONSTRAINTS**




## CONCLUSIONS

In this study we examine whether the average investor can improve financial performance by adding farmland to their investment portfolio. We show that for the period between January 29, 2013 to January 30, 2024, financial performance was not improved with the addition of farmland. Using a Markowitz Optimization Model, we analyze the optimal portfolios associated with various risk levels for both constrained and unconstrained solution sets. We find farmland to be an unattractive choice for investors at virtually all risk levels despite possessing a low correlation with other assets. While a case can be made for allocating a small amount to farmland due to its low correlation with other assets, this allocation would typically be suboptimal and result in a lower expected return for the same amount of risk compared with a portfolio that does not include farmland.

One possible explanation for our findings could be that our farmland proxy, the publicly traded F-REIT, Gladstone Land Corporation, did not accurately reflect the farmland asset class and its diversification benefits at the portfolio level. It may be that outright ownership of farmland or private farmland owned through crowdsourcing platforms produce different results than those in the public markets. We maintain that F-REITs are the most accessible way to invest in this asset class for the vast majority of investors, however we also acknowledge there may be a difference between publicly traded farmland and privately owned farmland. Studies in the literature have produced mixed results thus far regarding the portfolio benefits of farmland, therefore, future studies should emphasize the differences between public and private farmland as well as the differences between U.S. domestic farmland and international farmland.

Future portfolio optimization studies should consider other alternative assets and strategies in addition to farmland such as cryptocurrencies, artwork and collectibles, or quantitative investment strategies such as managed futures as examples. Like farmland, these alternative assets and strategies are becoming increasingly more common in both institutional and retail investment portfolios. For example, Bitcoin is now generally accepted as a potential component of a well-diversified portfolio by both large investors and small, however, “the source of Bitcoin’s diversification benefits are currently unclear and provide the opportunity for further research” (Lavelle, et al., 2022, p.32).

The goal of investors is to create a well-diversified portfolio consisting of many uncorrelated assets that produce enough positive expected return over time to satisfy future consumption. Our analysis indicates that adding farmland to such a portfolio is not optimal, thus it does not seem to be a favorable investment option for the average investor.

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