



Evaluating Risk in Agricultural Investments

Portfolio Diversification,
How to Avoid *Diworsification*

KEY WORDS:

Farmland diversification, volatility reduction, Sharpe ratios, risk-adjusted returns, diworsification, optimal holding number, diversification costs, Omnigence Asset Management, Veripath Farmland Partners

INTRODUCTION:

In financial markets, investors face a constant trade-off between risk and return. One of the most effective tools for managing this risk is portfolio diversification, a strategy that involves spreading investments across a variety of assets to reduce the overall risk of the portfolio. The fundamental principle behind diversification is that by holding a mix of uncorrelated or less correlated assets, an investor can reduce the portfolio's volatility while maintaining or potentially increasing expected returns.

Unlike more volatile assets, farmland typically exhibits relatively low volatility already, with annual levels for the Canadian farmland benchmark of around 3-4%. Despite this lower volatility, farmland investments can still face risks related to factors such as changing agricultural yields, climate impacts, and market conditions. Diversification works by mitigating these risks, as the negative performance of certain farmland assets may be offset by the positive performance of others. This leads to a smoothing effect on the portfolio's total return, especially when the farmland holdings are spread across distinct geographies or crop types, reducing correlation.

However, while adding more farmland assets generally lowers portfolio volatility, the benefits of diversification diminish beyond a certain point. As the number of distinct geographies increases, particularly when geographies exhibit higher cross-correlations, the incremental reduction in volatility becomes less significant. Moreover, the additional costs associated with managing and monitoring a larger number of distinct geographies—such as transaction fees, administrative burdens, and time spent monitoring each property—can begin to outweigh the benefits of diversification. This phenomenon, often referred to as "*diworsification*," occurs when the extra cost of adding more distinct geographies erodes the portfolio's overall efficiency, offering limited reductions in risk but imposing a significant drag on returns.

This paper explores the benefits of farmland portfolio diversification, with a specific focus on how adding new geographies may reduce portfolio volatility and the tipping point at which further diversification leads to diminishing returns. Through empirical analysis and simulation, we aim to quantify the extent of volatility reduction achievable through farmland diversification, assess the impact of asset correlations, and evaluate the trade-offs between holding costs and diversification to identify when diversification turns into diworsification.

FORMULAS:

To calculate the volatility of a portfolio with multiple holdings, based on the individual volatilities of the holdings, their weights in the portfolio, and their correlations, you can use the following formula:

$$\sigma_p = \sqrt{\sum_{i=1}^n \sum_{j=1}^n w_i w_j \sigma_i \sigma_j \rho_{ij}}$$

Where:

- σ_p is the portfolio volatility (standard deviation).
- w_i is the weight of asset i in the portfolio.
- σ_i is the volatility (standard deviation) of asset i .
- ρ_{ij} is the correlation between assets i and j (this is 1 when $i = j$).
- n is the number of assets in the portfolio.



Stephen Johnston
Director – Omnigence

sjohnston@omnigenceam.com



Keenan Viney
Data Scientist

kviney@omnigenceam.com



Assumptions:

1. Return on Holdings: 10% per annum.
2. Risk-Free Rate: 5% per annum.
3. Volatility of Each Holding: 3.9%.
4. Diversification Cost: 0.0075% per distinct geography.
5. Holdings are Equal-Weighted: Each distinct geography has the same weight in the portfolio.
6. Number of Distinct Geographies: Varies from 1 to 100.
7. Cross-Correlation Levels: 0.5, 0.6, and 0.7 between distinct geographies.
8. Distinct Geography: A region within which land holdings have material cross correlations and sufficient proximity such that the manager can treat them as a single holding for the purposes of diversification analysis. The result is that each geography adds to overall portfolio monitoring cost as a single block and the numbers of individual holdings within the geography does not affect incremental monitoring costs.

RESULTS:

The results of our analysis demonstrate that while farmland portfolio diversification offers significant benefits in terms of volatility reduction, as expected these benefits diminish as the number of distinct geographies increases assuming such additions are not costless from a monitoring and operations perspective. Specifically, the Sharpe ratio, which measures the risk-adjusted return, peaks at a certain point before gradually declining. This peak Sharpe ratio signifies the point where further diversification becomes less effective, often referred to as the law of diminishing returns in diversification.

Chart 1: Portfolio Volatility vs Number of Distinct Geographies (Correlation = 0.5, 0.6, 0.7)

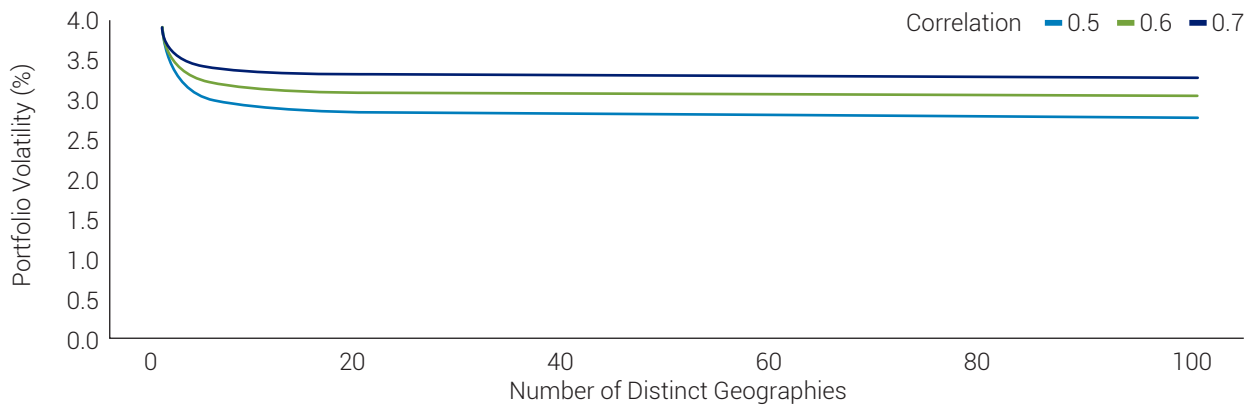
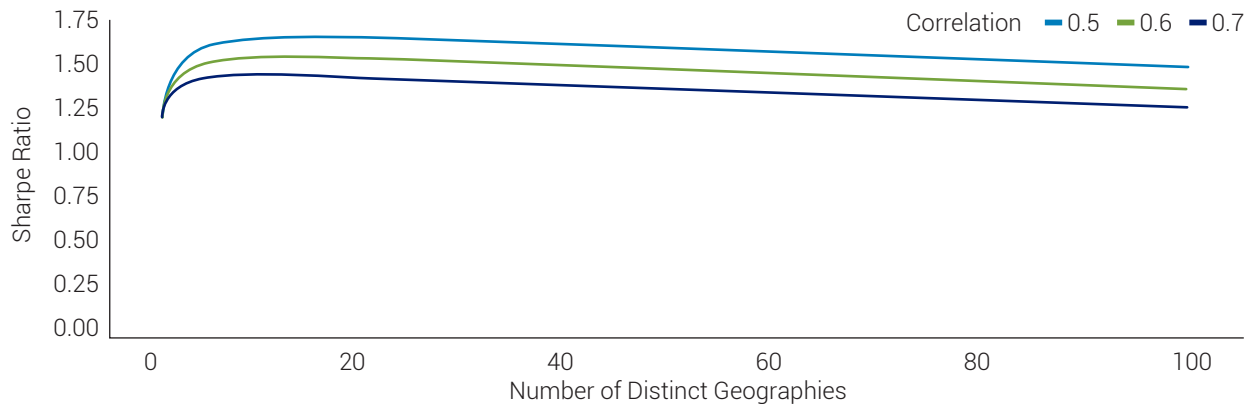


Chart 2: Sharpe Ratio vs Number of Distinct Geographies (Correlation = 0.5, 0.6, 0.7)



Portfolios with approximately 20 distinct geographies, exhibited the most significant improvements in the Sharpe ratio and reductions in volatility. As more distinct geographies were added, the incremental reduction in volatility became marginal, and the costs associated with monitoring and managing the additional holdings began to outweigh the benefits. The volatility reduction curve eventually flattened at around 30-40 holdings indicating that adding more geographies provided limited additional risk mitigation.

For example, in portfolios with a cross-correlation of 0.5, the Sharpe ratio peaked around 20 distinct geographies, where the most optimal balance of return to risk was achieved. Beyond this point, the cost of diversification (even at a low of 0.0075% per geography – 37.5 bps total portfolio cost at 50 distinct geographies) began to impact the gains in risk-adjusted return. Similarly, the greatest reduction in portfolio volatility occurred up to around 30 distinct geographies, with little additional risk reduction beyond that.

CONCLUSION:

Our analysis shows that while farmland diversification is a powerful tool for reducing risk, there is an optimal number of geographical allocations beyond which diversification may occur. At this point, the extra costs of diversification exceed the benefits. For typical portfolios with moderate correlations between geographies, 30 distinct geographies may be the ideal number for maximizing the Sharpe ratio and volatility reduction. Further diversification beyond this range may lead to diminishing returns, with little benefit in terms of risk reduction and a gradual decline in the portfolio's efficiency.

Obviously, the lower the diversification costs, the greater the number of distinct geographies a farmland portfolio can be efficiently deployed into without impacting the Sharpe ratio. It follows then that farmland investment managers must have scalable, cost-effective (on a per acre basis) tools for identifying and transacting on deal flow and then monitoring acquisitions within each geography in order to minimize diversification costs. If their portfolio monitoring is cost effective and scalable they maximise their ability to use diversification to reduce volatility and drive-up Sharpe ratios. If a manager's portfolio cannot scale in absolute acre size and number of holdings without material incremental costs, risk adjusted returns will be impacted, i.e. that manager will be subject to diversification as they grow.

APPENDIX:

Table 1: Volatility Impacts and Sharpe Ratios (based on 0.0075% portfolio diversification cost)

Number of Distinct Geographies	Volatility (0.5)	Sharpe Ratio (0.5)	Volatility (0.6)	Sharpe Ratio (0.6)	Volatility (0.7)	Sharpe Ratio (0.7)	Number of Distinct Geographies	Volatility (0.5)	Sharpe Ratio (0.5)	Volatility (0.6)	Sharpe Ratio (0.6)	Volatility (0.7)	Sharpe Ratio (0.7)
1	3.9	1.28	3.9	1.28	3.9	1.28	51	2.78	1.66	3.04	1.52	3.28	1.41
2	3.38	1.48	3.49	1.43	3.6	1.39	52	2.78	1.66	3.04	1.52	3.28	1.41
3	3.18	1.56	3.34	1.49	3.49	1.43	53	2.78	1.65	3.04	1.51	3.28	1.4
4	3.08	1.61	3.26	1.52	3.43	1.45	54	2.78	1.65	3.04	1.51	3.28	1.4
5	3.02	1.64	3.22	1.54	3.4	1.46	55	2.78	1.65	3.04	1.51	3.28	1.4
6	2.98	1.66	3.18	1.56	3.38	1.47	56	2.78	1.65	3.04	1.51	3.28	1.4
7	2.95	1.68	3.16	1.56	3.36	1.47	57	2.78	1.64	3.04	1.5	3.28	1.4
8	2.92	1.69	3.14	1.57	3.35	1.47	58	2.78	1.64	3.04	1.5	3.28	1.39
9	2.91	1.7	3.13	1.58	3.34	1.48	59	2.78	1.64	3.04	1.5	3.27	1.39
10	2.89	1.7	3.12	1.58	3.33	1.48	60	2.78	1.64	3.04	1.5	3.27	1.39
11	2.88	1.71	3.11	1.58	3.33	1.48	61	2.78	1.63	3.04	1.5	3.27	1.39
12	2.87	1.71	3.1	1.58	3.32	1.48	62	2.78	1.63	3.04	1.49	3.27	1.39
13	2.86	1.71	3.1	1.58	3.32	1.48	63	2.78	1.63	3.04	1.49	3.27	1.38
14	2.85	1.71	3.09	1.58	3.31	1.48	64	2.78	1.63	3.04	1.49	3.27	1.38
15	2.85	1.72	3.09	1.58	3.31	1.48	65	2.78	1.62	3.04	1.49	3.27	1.38
16	2.84	1.72	3.08	1.58	3.31	1.48	66	2.78	1.62	3.04	1.48	3.27	1.38
17	2.84	1.72	3.08	1.58	3.3	1.47	67	2.78	1.62	3.04	1.48	3.27	1.37
18	2.83	1.72	3.08	1.58	3.3	1.47	68	2.78	1.62	3.04	1.48	3.27	1.37
19	2.83	1.72	3.07	1.58	3.3	1.47	69	2.78	1.61	3.04	1.48	3.27	1.37
20	2.83	1.72	3.07	1.58	3.3	1.47	70	2.78	1.61	3.04	1.47	3.27	1.37
21	2.82	1.72	3.07	1.58	3.3	1.47	71	2.78	1.61	3.04	1.47	3.27	1.37
22	2.82	1.71	3.07	1.58	3.29	1.47	72	2.78	1.61	3.03	1.47	3.27	1.36
23	2.82	1.71	3.06	1.58	3.29	1.47	73	2.78	1.6	3.03	1.47	3.27	1.36
24	2.81	1.71	3.06	1.57	3.29	1.46	74	2.78	1.6	3.03	1.46	3.27	1.36
25	2.81	1.71	3.06	1.57	3.29	1.46	75	2.78	1.6	3.03	1.46	3.27	1.36
26	2.81	1.71	3.06	1.57	3.29	1.46	76	2.78	1.6	3.03	1.46	3.27	1.35
27	2.81	1.71	3.06	1.57	3.29	1.46	77	2.78	1.59	3.03	1.46	3.27	1.35
28	2.81	1.71	3.06	1.57	3.29	1.46	78	2.78	1.59	3.03	1.46	3.27	1.35
29	2.8	1.71	3.06	1.57	3.29	1.45	79	2.78	1.59	3.03	1.45	3.27	1.35
30	2.8	1.7	3.05	1.56	3.29	1.45	80	2.77	1.59	3.03	1.45	3.27	1.34
31	2.8	1.7	3.05	1.56	3.29	1.45	81	2.77	1.58	3.03	1.45	3.27	1.34
32	2.8	1.7	3.05	1.56	3.28	1.45	82	2.77	1.58	3.03	1.45	3.27	1.34
33	2.8	1.7	3.05	1.56	3.28	1.45	83	2.77	1.58	3.03	1.44	3.27	1.34
34	2.8	1.7	3.05	1.56	3.28	1.45	84	2.77	1.58	3.03	1.44	3.27	1.34
35	2.8	1.69	3.05	1.55	3.28	1.44	85	2.77	1.57	3.03	1.44	3.27	1.33
36	2.8	1.69	3.05	1.55	3.28	1.44	86	2.77	1.57	3.03	1.44	3.27	1.33
37	2.79	1.69	3.05	1.55	3.28	1.44	87	2.77	1.57	3.03	1.43	3.27	1.33
38	2.79	1.69	3.05	1.55	3.28	1.44	88	2.77	1.56	3.03	1.43	3.27	1.33
39	2.79	1.69	3.05	1.55	3.28	1.43	89	2.77	1.56	3.03	1.43	3.27	1.32
40	2.79	1.68	3.05	1.54	3.28	1.43	90	2.77	1.56	3.03	1.43	3.27	1.32
41	2.79	1.68	3.05	1.54	3.28	1.43	91	2.77	1.56	3.03	1.42	3.27	1.32
42	2.79	1.68	3.04	1.54	3.28	1.43	92	2.77	1.55	3.03	1.42	3.27	1.32
43	2.79	1.68	3.04	1.54	3.28	1.43	93	2.77	1.55	3.03	1.42	3.27	1.32
44	2.79	1.67	3.04	1.53	3.28	1.42	94	2.77	1.55	3.03	1.42	3.27	1.31
45	2.79	1.67	3.04	1.53	3.28	1.42	95	2.77	1.55	3.03	1.41	3.27	1.31
46	2.79	1.67	3.04	1.53	3.28	1.42	96	2.77	1.54	3.03	1.41	3.27	1.31
47	2.79	1.67	3.04	1.53	3.28	1.42	97	2.77	1.54	3.03	1.41	3.27	1.31
48	2.79	1.67	3.04	1.53	3.28	1.42	98	2.77	1.54	3.03	1.41	3.27	1.3
49	2.79	1.66	3.04	1.52	3.28	1.41	99	2.77	1.54	3.03	1.4	3.27	1.3
50	2.79	1.66	3.04	1.52	3.28	1.41	100	2.77	1.53	3.03	1.4	3.27	1.3



Toronto Office:
TD Canada Trust Tower, 161 Bay St.
27th Floor, P.O. Box 508
Toronto, ON, M5J 2S1

Calgary Office:
Suite 300, 4954 Richard Road SW
Calgary, AB, T3E 6L7

www.omnigenceam.com

DISCLAIMER

Our reports, including this paper, express our opinions which have been based, in part, upon generally available public information and research as well as upon inferences and deductions made through our due diligence, research and analytical process. The information contained in this paper includes information from, or data derived from, public third-party sources including industry publications, reports and research papers. Although this third-party information and data is believed to be reliable, neither Omnigence Asset Management nor its agents (collectively "Omnigence") have independently verified the accuracy, currency or completeness of any of the information and data contained in this paper which is derived from such third party sources and, therefore, there is no assurance or guarantee as to the accuracy or completeness of such included information and data. Omnigence and its agents hereby disclaim any liability whatsoever in respect of any third-party information or data, and the results derived from our utilization of that data in our analysis. While we have a good-faith belief in the accuracy of what we write, all such information is presented "as is," without warranty of any kind, whether express or implied. The use made of the information and conclusions set forth in this paper is solely at the risk of the user of this information. This paper is intended only as general information presented for the convenience of the reader and should not in any way be construed as investment or other advice whatsoever. Omnigence is not registered as an investment dealer or advisor in any jurisdiction and this report does not represent investment advice of any kind. The reader should seek the advice of relevant professionals (including a registered investment professional) before making any investment decisions. The opinions and views expressed in this paper are subject to change or modification without notice, and Omnigence does not undertake to update or supplement this or any other of its reports or papers as a result of a change in opinion stated herein or otherwise.