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Specialist investment

The strategic role of Natural Capital in institutional portfolios

Over the past decade, natural capital, defined here as institutional investment in production agriculture and forestry, has evolved from a specialist allocation to an essential component of strategic portfolio construction. The rationale for its inclusion has never been stronger. In an environment characterised by persistent inflation, elevated volatility, post-COVID supply chain rewiring, and rising geopolitical risk, institutional investors are reassessing portfolio design from first principles. Within this context, the case for natural capital is structural rather than cyclical.

This paper outlines why natural capital should be treated as a core allocation rather than a peripheral diversifier. The thesis is underpinned by durable fundamentals:

- Inelastic demand for food, timber, and ecosystem services
- A finite and, in some regions, declining stock of productive land
- The capacity to generate long-duration, inflation-linked cash flows with low correlation to public markets

Crucially, the argument is quantitative as well as thematic. Drawing on nearly 30 years of agriculture and forestry benchmark data, the analysis models the integration of natural capital into a representative institutional portfolio. Starting from an illustrative 60/40 equity-bond baseline, it evaluates the impact of agriculture and forestry on returns, volatility, and drawdowns, under governance and liquidity constraints aligned with institutional mandates.

The findings are clear: allocations of up to 20 percent materially improve portfolio efficiency - raising Sharpe ratios, strengthening inflation resilience, reducing drawdowns, and enhancing downside protection. These benefits are achievable within standard mandates and supported by robust evidence.

The analysis is anchored to the perspective of a UK pension scheme, with results expressed in GBP using annual total returns from 1995 to 2024. Natural capital is represented by three sub-sectors - annual cropland, permanent cropland, and forestry - while REITs and gold serve as public real-asset comparators within the same optimisation framework.

For institutions seeking long-term resilience, inflation protection, and structural diversification, natural capital provides a rare combination: strong secular demand, finite supply, and demonstrable portfolio impact. The implication is clear: natural capital should be elevated from a niche allocation to a strategic core holding in next-generation institutional portfolios.

Key insights for institutional investors

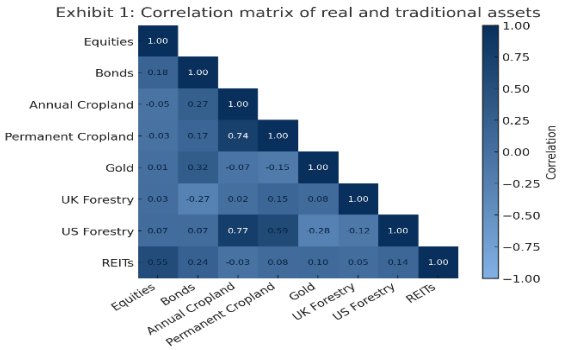
- Modest allocations to natural capital enhance institutional equity-bond portfolios, increasing Sharpe ratios by approximately thirty percent, reducing drawdowns by one third, and improving returns by six to thirteen percent across optimisation scenarios
- Agriculture and forestry allocations are complementary, exhibiting persistently low correlations with equities and fixed income and providing durable diversification across market cycles
- Revenues and land values are closely linked to inflation dynamics, offering an effective hedge against inflationary shocks
- Portfolio resilience is further reinforced by appraisal-based valuations, biological growth, and recurring cash yields, which reduce observed volatility by fifteen to twenty percent and mitigate drawdowns during periods of market stress

Understanding Natural Capital's distinct investment attributes

Diversification benefits

Agriculture and forestry demonstrate consistently low, and in some cases negative, correlations with major asset classes. This independence is structural, stemming from biological production cycles and the finite supply of land rather than financial market dynamics. Correlation analysis (Exhibit 1) confirms that natural capital assets have remained persistently uncorrelated with equities, bonds, and real estate across multiple decades and market environments. This structural independence strengthens portfolio resilience by providing both stable income and uncorrelated return streams.

Exhibit 1: Correlation matrix of real and traditional assets



Annual total return data in GBP, covering 1995-2024 (longest common history). Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations.

Superior risk-adjusted returns

Asset	Mean Return (%)	Volatility (%)	Sharpe Ratio
Annual Cropland	**11.0**	**7.7**	**1.10**
US Forestry	**7.8**	**7.0**	**0.76**
Permanent Cropland	**11.5**	**12.2**	**0.74**
UK Forestry	**11.6**	**12.6**	**0.72**
Equities	**11.8**	**18.9**	**0.49**
REITs	**9.5**	**19.6**	**0.36**
Gold	**6.5**	**14.6**	**0.27**
Bonds	**4.7**	**8.3**	**0.27**

Annual total return data in GBP, 1995-2024. Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations

Natural capital has delivered attractive absolute returns with comparatively low volatility. Over the 1995-2024 period, agriculture and forestry consistently outperformed traditional asset classes on a risk-adjusted basis:

- **Annual cropland,** driven primarily by land appreciation and contracted rental income, achieved a Sharpe ratio of 1.10, materially outperforming equities (0.49), bonds (0.27), and gold (0.27)
- **Forestry,** generating returns from a combination of biological growth, land appreciation, and timber sales, delivered Sharpe ratios of 0.71-0.76 in the UK and US, substantially ahead of equities and REITs
- **Permanent cropland,** deriving returns from the annual production and sale of crops such as almonds, wine grapes, and citrus, produced strong cash yields but more modest appreciation, as biological asset depreciation partially muted land value gains. Even so, Sharpe ratios of approximately 0.74 were achieved, comparable to forestry and well ahead of traditional asset classes

These results demonstrate the durability of natural capital's return profile, underpinned by long-term demand, biological growth cycles, and constrained land supply.

Inflation protection

Natural capital assets have long been recognised for their inflation-hedging properties, with inflation measured here by US CPI, as they generate essential commodities embedded within the CPI basket and derive value from finite land resources.

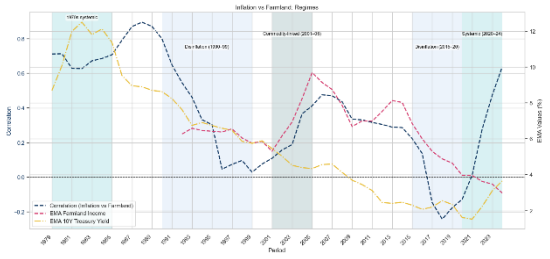
Across the 1995-2024 period, however, analysis shows only modest correlations between agriculture and forestry returns and US CPI (0.31 and 0.27, respectively). A deeper, regime-based assessment using USDA farmland data and US CPI (1970-2024) reveals more nuanced dynamics:

- **Commodity-linked inflation (2001-2005):** Agriculture acted as a pass-through asset, with returns rising alongside crop prices and global demand
- **Systemic inflation (early 1970s, 2020-2022):** Agriculture repriced as US CPI accelerated, with appraisal-based

valuations adjusting in line with inflation and broader monetary conditions

- **Disinflationary regimes (1990s, 2015-2020):** With inflation moderating, the correlation to US CPI weakened as agricultural returns remained resilient. Productivity gains and stable income were the primary drivers of total returns and land appreciation

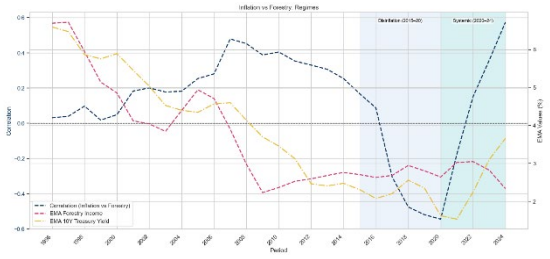
Exhibit 2: Rolling 10-Year Correlation Between Inflation and Farmland, with smoothed Income and 10Y Treasury Yield



Sources: USDA National Agricultural Statistics Service (USD); NCREIF Farmland Income Return (USD); US Bureau of Labor Statistics - CPI-U (year-over-year change); Federal Reserve Economic Data - US 10-Year Treasury Yield; Gresham House calculations.

In practice, agriculture's inflation sensitivity is conditional. It provides strong protection during inflationary shocks but exhibits weaker linkage in more stable regimes. Forestry (Exhibit 3) plays a complementary role: while its correlation with US CPI is more muted than agriculture's, it has demonstrated resilience across both systemic and disinflationary periods, most recently after 2020. When combined, farmland and forestry provide multi-channel inflation protection, enhancing resilience and improving portfolio efficiency across economic cycles.

Exhibit 3: Rolling 10-Year Correlation Between Inflation and Forestry, with smoothed Income and 10Y Treasury Yield



Sources: NCREIF Timberland Property Index (total return, USD); NCREIF Timberland Property Index (Income Return, USD); US Bureau of Labour Statistics - CPI-U (year-over-year change); Federal Reserve Economic Data - US 10-Year Treasury Yield; Gresham House calculations.

Portfolio-level benefits

For institutional investors, the appeal of natural capital lies not only in its standalone attributes but also in its portfolio impact. When integrated into an institutional allocation framework, natural capital consistently enhances efficiency. Allocations of up to 20 percent deliver immediate improvements across all major metrics:

- **Higher risk-adjusted returns**, with Sharpe-optimal allocations outperforming traditional 60/40 benchmarks
- **Lower volatility**, supported by structurally uncorrelated return streams
- **Stronger downside protection**, underpinned by appraisal-based valuations and stable biological income

Taken together, these characteristics demonstrate why natural capital should be viewed as a strategic allocation rather than a niche diversifier. It delivers persistent, quantifiable improvements in portfolio outcomes within standard institutional parameters.

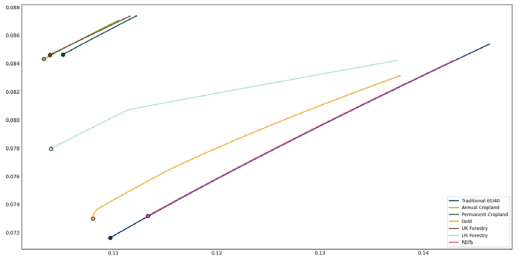
Constructing the efficient frontier

Single-sleeve diagnostic (CLA)

To illustrate the marginal contribution of each real asset - including agriculture, forestry, gold, and REITs - within an illustrative 60/40 equity-bond portfolio, each asset is first evaluated in isolation using a Critical Line Algorithm (CLA). A per-asset cap is applied in line with the illiquidity budget (0-20 percent for a single real asset; equities ≥50 percent; bonds ≥25 percent). This approach is used to highlight the incremental impact of introducing each asset.

Under these constraints, the addition of a single real asset consistently shifts the efficient frontier upward and to the left relative to the baseline 60/40 portfolio, underscoring diversification and risk-adjusted return benefits. Natural capital assets, particularly annual cropland, permanent cropland, and UK forestry, emerge as the most efficient, delivering the strongest improvements in Sharpe ratio and downside protection (see "Superior risk-adjusted returns" table). By contrast, gold and REITs contribute less, with weaker risk-adjusted returns and higher volatility.

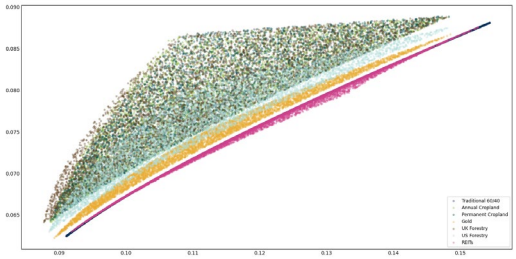
Exhibit 4: Impact of Real Asset Integration on Portfolio Efficiency - Efficient Frontiers



Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024)

To test robustness, the CLA is complemented with a Monte Carlo analysis (Exhibit 5). Sampling thousands of feasible portfolios under the same allocation constraints confirms the results: portfolios including cropland and forestry consistently cluster along the upper-left envelope of outcomes.

Exhibit 5: Impact of Real Asset Integration on Portfolio Efficiency - Monte Carlo analysis



Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024).

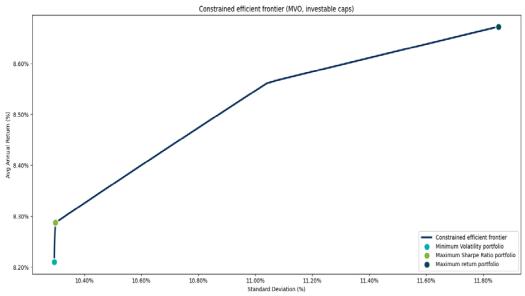
The conclusion is clear: efficiency gains from natural capital are both material and persistent. The analysis demonstrates that natural capital plays a disproportionately valuable role in optimised institutional portfolios, enhancing efficiency, resilience, and downside protection within standard allocation constraints.

Mean-variance optimisation

Having assessed each asset in isolation, the analysis then applies a full mean-variance optimisation (MVO) to identify portfolios that maximise the Sharpe ratio, minimise volatility, and maximise return under a unified set of investable constraints: real assets capped at ≤20 percent in aggregate, ≤5 percent per natural capital asset, equities at a minimum of 50 percent, and bonds at a minimum of 25 percent. In effect, the MVO determines the mix of assets that delivers the most efficient trade-off between risk and return.

These constraints are designed both to mirror institutional allocators' governance capacity and allocation limits, and to quantify the incremental contribution of natural capital within diversified portfolios. Exhibit 6 plots the resulting efficient frontier and highlights the three objective portfolios, showing that the inclusion of natural capital consistently shifts the frontier upward and to the left within the same allocation boundaries.

Exhibit 6: Constrained efficient frontier (MVO, investable caps)

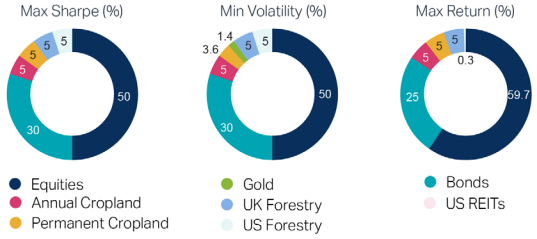


Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024)

In all three portfolio configurations - Max Sharpe, Min Volatility, and Max Return (Exhibit 7) - a consistent and notable pattern emerges:

- **Agriculture** and **forestry** are complementary, each playing a distinct role within a diversified allocation.
- **Annual cropland** and **UK forestry** reached their maximum 5 percent allocation in every case
- **Permanent cropland** achieved its full allocation in the Max Sharpe and Max Return portfolios, and 3.6 percent in the low-volatility portfolio
- By contrast, **gold** and **REITs** were generally excluded due to higher volatility and weaker contributions to efficiency

Exhibit 7: Optimal Asset Allocations under Sharpe, Volatility, and Return Objectives



Sources: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; NCREIF Annual Cropland Index; NCREIF Permanent Cropland Index; NCREIF Timberland Property Index; UK Gresham House internal benchmark. FX: Bank of England GBP/USD, applied via standard pass-through to local returns.

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When comparing relative performance across portfolios-Max Sharpe, Min Volatility, and Max Return (Exhibit 8)-material improvements in return and reductions in volatility are evident versus the 60/40 baseline. Sharpe ratios improved by 16.0-28.7 percent, underscoring the relevance of natural capital allocations within institutional portfolios.

Exhibit 8: Relative performance: benchmark vs optimised allocations

Metric	60/40 Baseline	Max Sharpe	Min Volatility	Max Return
Return	7.71%	8.29%	8.20%	8.70%
Δ vs 60/40	-	+7.5%	+6.5%	+13.0%
Volatility	12.40%	10.30%	10.30%	11.90%
Δ vs 60/40	-	−16.9%	−16.9%	−4.0%
Sharpe	0.63	0.81	0.80	0.73
Δ vs 60/40	-	+28.7%	+27.9%	+16.9%
Max Drawdown	21.18%	13.56%	13.90%	19.28%
Δ vs 60/40	-	−36%	−34%	−9%

Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024)

Drawdown resilience

Limiting large drawdowns is a central priority for institutional portfolios. Sharp losses erode capital, impair compounding, restrict rebalancing flexibility, and raise the risk of breaching governance or solvency thresholds. Portfolios that preserve downside protection are better positioned to meet liabilities, maintain stakeholder confidence, and capture opportunities during market dislocations.

Natural capital enhances resilience during crises. Between 1995 and 2024, the illustrative 60/40 baseline portfolio recorded a maximum drawdown of 21.2 percent (Exhibit 9). In contrast, the Sharpe-optimised portfolio incorporating natural capital reduced this to 13.6 percent (Exhibit 10), a 36 percent reduction. This portfolio-level resilience is underpinned by the stability of the underlying assets: agriculture and forestry have historically exhibited exceptional defensiveness, with NCREIF benchmarks showing average annual drawdowns of just 0.6 percent and volatility below 1.5 percent. This inherent stability is the reason portfolios with natural capital suffer materially smaller peak-to-trough losses during systemic stress.

Exhibit 9: Drawdown curve - 60/40 equity-bond portfolio (1995-2024)

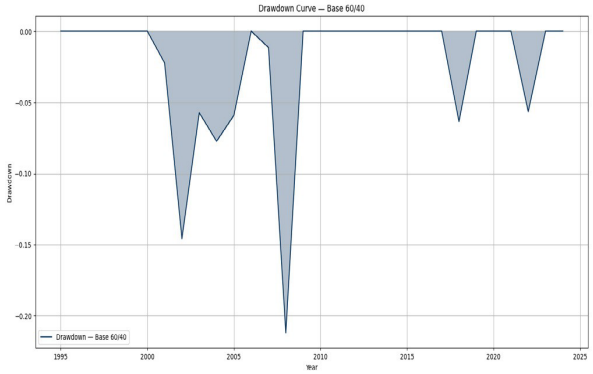
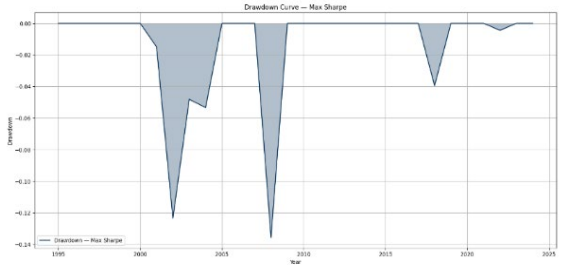


Exhibit 10: Drawdown curve - constrained MVO (Max Sharpe) portfolio (1995-2024)



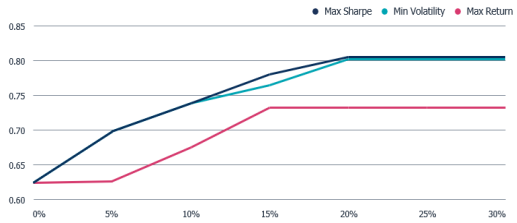
Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024).

This downside protection reinforces the efficiency gains identified in the optimisation analysis. Together, the evidence demonstrates that natural capital provides structural resilience, making it a highly effective complement to public markets.

Practical allocation considerations

Allocations to natural capital are often perceived as challenging for institutional portfolios. Investors remain cautious about illiquidity and have historically struggled to achieve meaningful scale, as assets are tightly held and less accessible than liquid equities or bonds. However, this barrier is rapidly diminishing. Specialist managers such as Gresham House, with decades of experience, have institutionalised the sector by establishing proven frameworks for governance, access, and liquidity management, thereby enabling large-scale institutional participation.

Exhibit 11: Sharpe Ratio Evolution by Real Asset Allocation Cap



Source: NCREIF; FTSE Nareit; LBMA; S&P Dow Jones Indices; Bloomberg; Bank of England; Office for National Statistics; Gresham House calculations (GBP, annual, 1995-2024)

Encouragingly, the analysis shows that even modest allocations deliver substantial benefits (Exhibit 11), with most of the performance uplift occurring early:

- Increasing exposure from 0 to 10 percent drives meaningful improvements across all optimisation strategies
- Expanding to 20 percent captures the full performance potential, maximising Sharpe ratios with only limited additional risk
- Allocations above 20 percent generate diminishing marginal gains, underscoring the practicality of commonly applied real-world allocation caps

A final note on limitations

While the analysis is robust, it is important to acknowledge certain limitations in both methodology and modelling assumptions. The use of a 60/40 equity-bond portfolio as the baseline provides a clear and widely recognised benchmark for institutional allocators. In practice, however, most institutional portfolios are more diversified, typically incorporating private equity, infrastructure, real estate, and other real assets.

The 60/40 baseline is used here to isolate and clearly demonstrate natural capital's incremental impact, given the limitations of available return data across alternative asset classes. In more complex multi-asset portfolios, the diversification and efficiency benefits of agriculture and forestry are expected to remain both meaningful and directionally consistent.

Key limitations include:

- Natural capital data is appraisal-based and reported less frequently than public market pricing
- Time series are shorter, with potential underestimation of volatility
- Mean-variance optimisation is sensitive to inputs and assumptions

Nonetheless, these constraints do not detract from the long-term strategic case. Natural capital assets are anchored in real-world fundamentals: finite land supply, persistent demand for food and timber, and the growing value placed on ecosystem services.

Conclusion: From diversifier to strategic allocation

Natural capital is no longer a peripheral or impact-led exposure. Agriculture and forestry demonstrably strengthen institutional portfolios by improving returns, lowering volatility, and enhancing drawdown resilience - without compromising liquidity or governance capacity. Allocations of up to 20 percent have historically lifted Sharpe ratios by around 30 percent, reduced drawdowns by one third, lowered volatility by 15-20 percent and increased average returns by 6-13 percent.

These advantages are structural: long-duration, inflation-linked income; persistently low correlations with public markets; and resilience during periods of economic stress. They are underpinned by fundamentals that are both global and inelastic, sustained demand for food and timber, finite land supply, and the rising value of ecosystem services.

While this paper used a 60/40 equity-bond framework as a baseline, the conclusions hold across more diversified, multi-asset institutional portfolios. The diversification and resilience benefits of agriculture and forestry are clear, durable, and front-loaded.

In an environment defined by concentration risk, inflation uncertainty, and mounting sustainability pressures, natural capital provides a rare combination of strong fundamentals, stable income, and measurable portfolio impact. The evidence supports elevating natural capital from a niche diversifier to a strategic building block of next-generation institutional portfolios.

Appendix: supporting methodology and data

This appendix sets out the quantitative approach applied in the analysis, covering the optimisation methodology, scenario testing, and supporting data treatments.

Data analysis methodology

Real assets categories

The analysis focuses on natural capital sub-assets - annual cropland, permanent cropland, and US and UK forestry - selected for their long total-return histories. For reference, REITs and gold are included as public-market real asset benchmarks, assessed under the same optimisation framework and portfolio constraints to allow direct comparison. Other real assets, such as infrastructure and private commercial real estate, are excluded to keep the scope concentrated on agriculture and forestry.

Methodology

The analysis uses a mean-variance optimization (MVO) framework to determine the set of portfolios that maximise expected return for each level of risk or minimise risk for a target return. The locus of these optimal allocations is the efficient frontier in mean-standard-deviation space.

To ensure relevance for institutional investors, the optimisation incorporated practical governance and liquidity constraints:

Constraint	Parameter	Purpose
Max allocation to real assets	20%	Reflects realistic exposure limits to illiquid private markets
Max per real asset	5%	Encourages internal diversification and deployment pacing
Min equity allocation	50%	Preserves exposure to growth assets
Min bond allocation	25%	Maintains income and liability-matching characteristics

Each optimised portfolio was benchmarked against an illustrative 60/40 equity-bond allocation to assess relative improvement in efficiency, volatility, and drawdown.

Inputs and frequency

The analysis is based on annual total returns over the longest common history available. For each asset, compounded expected returns (μ), the covariance matrix (Σ), and summary statistics - including volatility, Sharpe ratio, and correlations - are estimated. USD-denominated series are converted to GBP using standard FX pass-through to reflect a UK institutional perspective.

Step 1: Single-asset diagnostics

Each asset's standalone risk/return profile is assessed, and the full cross-asset correlation matrix is computed. Where relevant, rolling correlations to US CPI are added to characterise inflation sensitivity. This establishes transparent inputs and clarifies the structural relationships that underpin the efficient frontier.

Step 2: Marginal 'small frontier' tests

Each real asset is introduced individually into the illustrative 60/40 equity-bond portfolio. Under per-asset constraints-equities ≥ 50%, bonds ≥ 25%, and the single real asset capped at a realistic sleeve (up to 20%, with a small positive minimum if included) - the efficient frontier is traced using the Critical Line Algorithm (CLA). Monte Carlo scenario clouds of feasible weights are overlaid to illustrate robustness. These tests show how each real asset shifts the 60/40 risk/return profile before broader portfolio caps are applied.

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Step 3: Full-universe optimisation

All assets are optimised simultaneously under realistic institutional constraints using convex mean-variance optimisation (MVO). The constrained efficient frontier is plotted, with three policy-relevant portfolios highlighted: Max Sharpe, Min Volatility, and Max Return (via target-return search with feasibility back-off). For intuition, a CLA frontier under box constraints may also be shown, while the group limit on illiquids is enforced only in the MVO step.

Time period dependency

The sample spans 1995-2024, the longest common history across the indices, capturing multiple market regimes: the late-1990s expansion and dot-com cycle, the 2007-09 global financial crisis and subsequent deleveraging, the 2010s era of quantitative easing and suppressed rates, the 2020 COVID shock, and the 2021-23 inflation surge marked by the fastest tightening cycle in decades. These shifts had a material impact on equity risk premia, bond term premia, and the relative performance of alternative assets.

Currency conversion of return series

To ensure comparability across assets, all USD-denominated return series (e.g., equities, bonds, cropland, forestry, REITs) were converted into GBP terms, consistent with the perspective of a UK-based investor. The following standard formula was applied to calculate FX-adjusted returns:

$$R_t^{GBP} = (1 + R_t^{USD}) \times (FX_{t-1} / FX_t) - 1$$

Where:

- R_t^{USD} = Return of the asset in USD at time t
- FX_t = GBP/USD exchange rate at time t
- R_t^{GBP} = Return of the asset in GBP terms at time t

This approach incorporates both local asset performance and currency movements, ensuring accuracy and consistency in the multi-asset analysis.

Data sources

All return, volatility, and correlation inputs in this analysis are sourced from reputable, long-term institutional benchmarks. Specific sources include:

Asset class	Data source	Notes
Equities	S&P 500 Total Return Index (TR)	Data in USD; converted to GBP using historical FX rates
Bonds	Bloomberg US Aggregate Bond Index	Includes government and investment-grade corporates
REITs	FTSE NAREIT All Equity REITs Index	USD-denominated; includes broad real estate exposure
Gold	LBMA Gold Price Index (USD)	Spot pricing; converted to GBP
Annual Cropland	NCREIF Annual Cropland Index	Appraisal-based farmland returns in USD; converted to GBP

Asset class	Data source	Notes
Permanent Cropland	NCREIF Permanent Cropland Index	Includes permanent crops such as almonds and citrus
US Forestry	NCREIF Timberland Property Index	USD-denominated, appraisal-based returns
UK Forestry	Gresham House Internal Forestry Benchmark	Based on aggregated returns from managed portfolios
GBP/USD	Bank of England; Bloomberg Terminal	Used for currency conversion of all USD-denominated assets
US CPI	US Bureau of Labour Statistics - Consumer Price Index (CPI-U)	Used for inflation sensitivity and correlation estimates (USD returns)
USDA farmland	USDA National Agricultural Statistics Service (NASS)	Data in USD; used for inflation analysis
US Farmland	NCREIF Farmland Index - Income Return	Data in USD; used for farmland income-pattern illustrations
US Forestry (Income Return)	NCREIF Timberland Property Index - Income Return	Data in USD; used for forestry income-pattern illustrations

All datasets span 1995-2024 or the maximum available history. For internal benchmarks (e.g., UK Forestry), consistent valuation and methodological standards were applied to ensure comparability with external indices.

Note: Appraisal-based real asset indices are reported quarterly and may understate volatility. Where appropriate, adjustments were made to align frequency and granularity across all assets.