

LM05 · NATURAL RESOURCES · LOS A, B, C, D

Natural Resources

CFA Level I · 2025 Curriculum

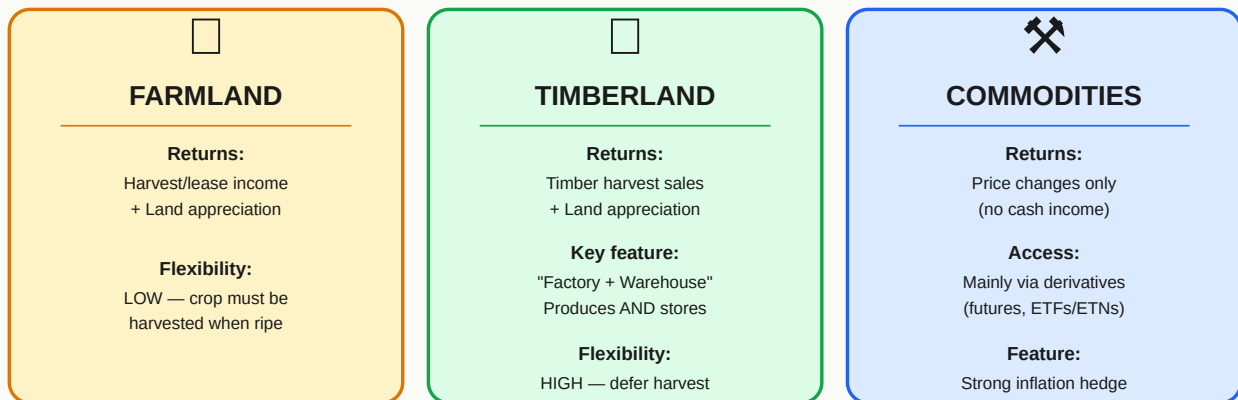
What Makes Natural Resources Unique?

Natural resources sit at the intersection of **real assets** and **commodity markets**. They include the physical building blocks of the global economy — land, agricultural products, energy, metals — and provide something unique in a portfolio: **inflation hedging** and **diversification from traditional financial assets**.

Unlike stocks and bonds whose value derives from future cash flows, natural resources are valued primarily by *supply-and-demand dynamics* for physical use.

The Main Categories of Natural Resources

NATURAL RESOURCES — MAIN INVESTMENT CATEGORIES



Raw land is a fourth category — price appreciation only, no cash flow.

Common Characteristics Across Categories

- ✓ **Physical/real assets** — backed by tangible resources, not financial cash flows
- ✓ **Inflation hedge** — food and energy are components of CPI
- ✓ **Low correlation** with stocks and bonds in normal markets
- ✓ **Supply inelasticity** — long production lead times (can't quickly mine more metal or grow more trees) drive price volatility



Illiquid land assets — value driven heavily by location

□ **Exam Tip:** Natural resources hedge inflation because food and energy are large components of CPI — when these commodities rise, that rise IS a big part of measured inflation.

LOS A · LAND-BASED NATURAL RESOURCES

Raw Land, Farmland & Timberland — Detailed Comparison

The three land-based natural resource categories have meaningfully different cash flow profiles and operational flexibility. All are illiquid, and value is heavily driven by **location**. All can generate lease income and benefit from land-price appreciation.

Side-by-Side Comparison

FEATURE	RAW LAND	FARMLAND	TIMBERLAND
Cash Flow	None until developed or sold; can generate lease income	Harvest income or lease	Periodic timber-sale income (harvest timing is flexible)
Return Drivers	Land price appreciation and/or lease income	Output sales/lease + land appreciation	Timber sales + land appreciation
Operational Flexibility	Low — mainly holding costs	Low — must harvest when crops ripen	High — can defer harvest when prices weak; trees keep growing
Typical Holders	Often institutional	More commonly held by individuals	Often institutional (e.g., via TIMOs)
ESG Appeal	Mixed — depends on future use	Crops consume carbon — aligns with climate goals	Trees consume carbon — aligns with climate goals

Why Timberland is Special — "Factory + Warehouse"

Timberland has a unique property: **the asset continues to grow while being stored.**

As a "Factory":

Trees produce timber through biological growth.

As a "Warehouse":

If timber prices are weak, the owner simply *doesn't harvest*. Trees keep growing — value continues to accumulate on the stump.

Implication: Timberland has harvest-timing *optionality*. Farmland does not share this flexibility — crops must be harvested when ripe, regardless of price.

Farmland — Crop Types

Farmland is commonly categorized into **row crops** (e.g., corn, wheat, soybeans), **permanent crops** (e.g., orchards, vineyards, tree nuts), and **energy crops**. All share the characteristic that the crop must be harvested when ready — unlike timber, the farmer does not have the flexibility to defer.

Investment Access Methods

METHOD	STRUCTURE	PROS / CONS
Direct Ownership	Buy land outright	+ Full control – Large capital, illiquid, operating expertise needed
Private Funds / LPs	Closed-end partnerships	+ Diversified, professional management – Fees, long lock-ups
REITs	Publicly-traded real estate vehicles	+ Liquid, smaller minimums – Higher correlation with equities
TIMOs (Timberland)	Timberland Investment Management Organizations — specialized managers for institutional timberland exposure	+ Specialized expertise for institutions – Typically institutional access only

□ **Exam Tip:** Key distinctions: **Raw land** — lease income and/or appreciation. **Farmland** — output income + appreciation, no harvest-timing flexibility. **Timberland** — "factory + warehouse" with harvest-timing optionality; institutions often access via TIMOs.

QUIZ 1 · LAND INVESTMENTS

Test Your Understanding: Land-Based Resources

Q1. Which natural resource is *best* described as both a "factory" and a "warehouse"?

Q2. An investor wants exposure to a natural resource that generates regular income from the sale of output AND land-price appreciation. Which is *most* suitable?

Q3. Which of the following is the *most likely* way for a large institutional investor to gain dedicated exposure to timberland?

LOS B · COMMODITIES OVERVIEW

Commodities — The Building Blocks of the Economy

Commodities are **homogeneous physical goods** traded in organized markets. They provide exposure to inflation and commodity cycles without the business-execution risk of operating companies.

Hard vs. Soft Commodities

The curriculum classifies commodities into two broad groups:

HARD COMMODITIES

Mined or Extracted

Examples: **copper, gold, oil, natural gas**, and other metals and energy products.

Produced by mining or drilling operations. Tend to be sensitive to industrial activity and macro cycles.

SOFT COMMODITIES

Grown

Examples: **grains, livestock, coffee**, and other agricultural products.

Produced through farming, with weather and seasonality as major drivers.

Broad Sector Grouping

Within these two groups, commodities are often organized into three main sectors:

- **Metals** (both industrial and precious)
- **Agricultural products** (grains, livestock, softs)
- **Energy products** (crude oil, natural gas, refined products)

Why Invest via Derivatives (Not Physical)?

Most commodity investment happens through **futures and derivatives**, not physical purchase, because of:

- **Storage costs** (warehousing, insurance)
- **Transportation costs**
- **Quality degradation** (perishability, rust)

Futures contracts, by contrast, are standardized, exchange-cleared, and abstract away physical delivery. Commodity returns come mainly from **price changes, not income** — there are no cash flows like dividends or coupons.

Four Ways to Gain Commodity Exposure

FUTURES & DERIVATIVES

ETFs / ETNs

Direct Derivative Access

The primary vehicle for commodity investment.
Requires margin management and understanding of contract specifications.

Packaged Exchange-Traded Products

Provide single-commodity or broad-index exposure through a liquid listed wrapper.

CTAS / MANAGED FUTURES

Commodity Trading Advisers

Professionally-managed futures funds that actively trade across commodity markets.

SPECIALIZED SECTOR FUNDS

Sector-Focused Vehicles

Funds targeting a specific commodity sector (e.g., energy or metals).

□ **Exam Tip:** Commodity investment happens mainly through **futures and other derivatives**, not physical possession — storage and transportation costs make direct ownership impractical for most investors.

LOS B · COMMODITY FUTURES PRICING

Commodity Futures Pricing — The Cost-of-Carry Model

The fundamental formula for the fair price of a commodity futures contract is the **cost-of-carry model**: the futures price equals the spot price grown at a net carry rate combining the risk-free rate, storage/carry costs, and convenience yield.

COST-OF-CARRY FORMULA (COMMODITY FUTURES)

$$\text{Futures} = \text{Spot} \times e^{(\text{risk-free rate} + \text{carry costs} - \text{convenience yield}) \times \text{time}}$$

Carry costs include storage and other costs of holding the physical commodity. Convenience yield is the nonmonetary benefit of holding inventory.

The Components

COMPONENT	ROLE	WHAT IT IS
Spot Price	Base	Current cash price to buy the commodity today
Risk-Free Rate	Carry cost	Cost of capital tied up to hold the physical commodity
Carry Costs	Carry cost	Costs of physically storing and holding the commodity
Convenience Yield	Offset	Nonmonetary benefit of having the physical commodity on hand (e.g., a refinery's ability to maintain operations)

Intuition

Carry Costs (Financing + Storage)

If you buy the commodity today, you pay to store it and tie up capital that could earn interest. Those costs should be reflected in a future-dated purchase price.

Convenience Yield

Sometimes having the physical commodity on hand is valuable beyond just the price — e.g., a refinery that needs crude *now* to keep operating. This benefit reduces what buyers need to pay for a future-dated contract.

□ **Exam Tip:** Know the form: $\text{Futures} = \text{Spot} \times e^{(r + \text{carry} - \text{convenience}) \times T}$. Carry costs and the risk-free rate push

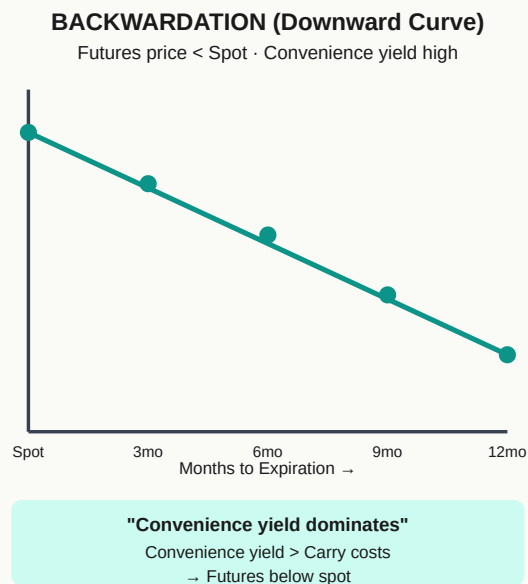
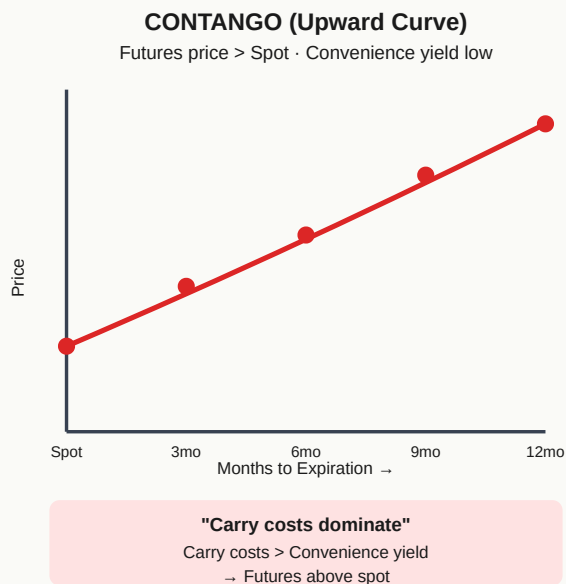
futures *above* spot; convenience yield pulls them *below*.

LOS B · FORWARD CURVE SHAPES

Contango vs. Backwardation — The Forward Curve

The shape of the commodity futures curve depends on the balance between carry costs and convenience yield.

CONTANGO VS. BACKWARDATION — TWO POSSIBLE FORWARD CURVES



When Does Each Occur?

CONTANGO

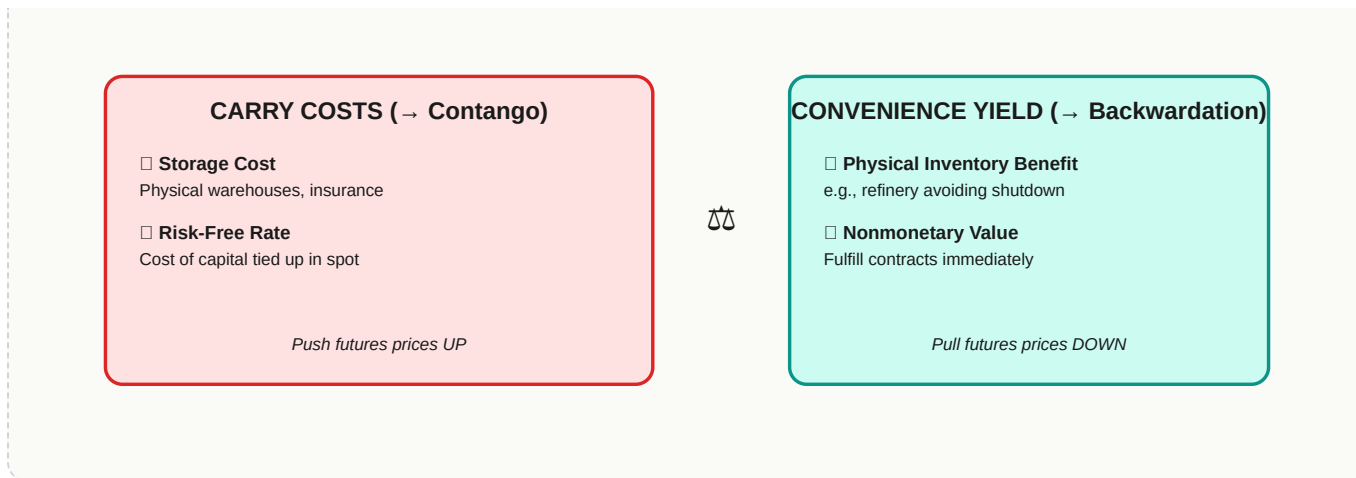
- **Low convenience yield** — little benefit from holding physical inventory
- Carry costs (storage + financing) exceed the benefits of physical possession
- Result: **futures > spot**

BACKWARDATION

- **High convenience yield** — holding physical is valuable (e.g., near-term scarcity)
- Convenience yield is large enough to offset storage and other carry costs
- Result: **futures < spot**

The Tug-of-War

CARRY COSTS VS. CONVENIENCE YIELD DETERMINE CURVE SHAPE



□ **Exam Tip:** Think of curve shape as a tug-of-war: storage + financing pull futures UP (contango); convenience yield pulls them DOWN (backwardation). Whichever side is stronger determines the shape.

QUIZ 2 · COMMODITY PRICING

Test Your Understanding: Commodities & Futures

Q4. Which of the following *most likely* causes a commodity market to be in backwardation?

INTERACTIVE TOOL

Commodity Futures Price Calculator

Adjust the sliders to explore how each input to the cost-of-carry model affects the futures price and the shape of the forward curve.

Try a Preset

Spot Price

\$75.00

Risk-Free Rate (r)

5.00%

Carry Cost (u)

2.00%

Convenience Yield (y)

1.00%

Time to Expiration

6 months

FUTURES PRICE

\$77.25

For selected expiration

MARKET STATE

CONTANGO

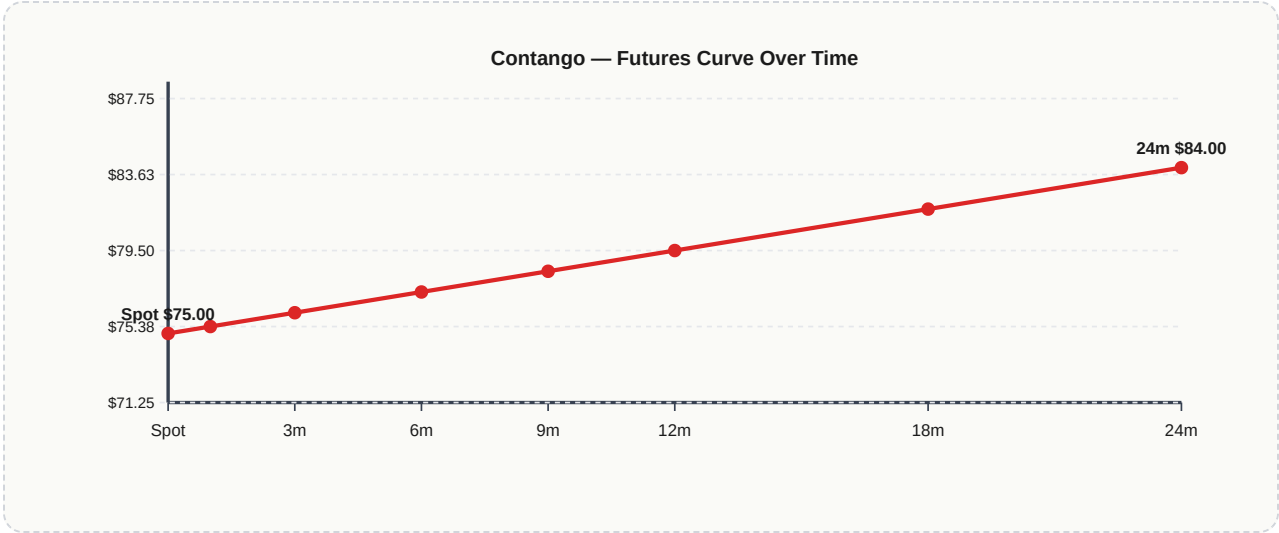
Futures > Spot (costs dominate)

ANNUALIZED BASIS

+6.00%

$(F - S) / S$ (annualized)

Forward Curve — Live Visualization



Calculation Breakdown

COMPONENT	VALUE	EFFECT ON FUTURES
Spot Price (S_0)	\$75.00	Starting point
Risk-Free Rate ($r \times T$)	+\$1.88	↑ Adds to futures
Carry Cost ($u \times T$)	+\$0.75	↑ Adds to futures
Convenience Yield ($y \times T$)	-\$0.38	↓ Subtracts from futures
Net Carry	+\$2.25	Determines curve shape
Futures Price	\$77.25	$S \times (1 + \text{net} \times T)$

□ **Exam Tip:** Try the **Nat Gas** preset to see backwardation — the curve slopes downward. Then raise convenience yield on any preset to simulate a supply crunch. The curve flips from contango to backwardation when convenience yield $> (r + u)$.

LOS C · RISK-RETURN PROFILE

Natural Resources — Risk, Return & Portfolio Role

Qualitative Risk/Return Profile

The curriculum describes the risk and return of natural resource asset classes in qualitative terms:

- **Commodities** show *higher returns and higher volatility* than global stocks and bonds.
- **Timberland and farmland** show *higher returns than global stocks and bonds*, with volatility that appears lower than global stocks and similar to global bonds.

Commodity returns come essentially from **price changes**, not cash flows. Timberland and farmland combine output-based income with land-price appreciation.

The Apparent Volatility Paradox

Timberland and farmland report relatively low volatility — but this is partly an artifact of how they are valued. Private land assets are priced based on **infrequent appraisals**, which smooth reported returns relative to the true economic volatility a continuously-traded market would reveal.

The implication: reported Sharpe ratios for these private real assets are flattered by the smoothing. Commodities, which are liquid and continuously priced, display their higher true volatility openly.

Low Correlation & Diversification

Commodities, timberland, and farmland all exhibit **low correlation with traditional stocks and bonds**, which provides diversification benefits when combined with a traditional portfolio.

Inflation Hedging

☐ Commodities as an Inflation Hedge

Commodities are a strong inflation hedge because **food and energy are major components of the CPI basket**.

When commodity prices rise sharply, that rise is a large part of measured inflation.

ESG Considerations

Timberland and farmland both have ESG appeal: trees and crops **consume carbon**, aligning these investments with climate-change goals that matter to many institutional investors.

□ **Exam Tip:** Summary: **Commodities** — higher returns and higher volatility than stocks/bonds; strong inflation hedge. **Timberland & farmland** — higher returns than stocks/bonds with volatility similar to bonds (smoothed by appraisal-based pricing). All three diversify traditional portfolios.

FINAL COMPREHENSIVE QUIZ

Final Assessment — Integrating Concepts

Q5. Which pair best describes the *uniqueness* of timberland as a natural resource investment?

Q6. An investor's portfolio is heavily weighted in stocks and bonds. To improve diversification and add an inflation hedge, the *best* addition from the natural resources universe would be:

MODULE COMPLETE

Your Scorecard

0 / 6

LM05 Key Takeaways — Exam-Ready Cheat Sheet

Natural Resources — The Big Picture

- 1 Main categories: **Raw land, Farmland, Timberland, Commodities**. All provide inflation-hedge and diversification benefits relative to stocks and bonds.
- 2 Raw land, farmland, and timberland are **illiquid**; value is heavily driven by **location**.

Land-Based Categories

- 3 **Timberland** is unique: "factory + warehouse" — trees grow while stored, giving harvest-timing optionality.
- 4 **Farmland** generates income from output but has *no* harvest-timing flexibility — crops must be harvested when ripe.
- 5 **TIMOs** (Timberland Investment Management Organizations) are the standard institutional vehicle for timberland exposure.

Commodities

- 6 **Hard commodities** (mined/extracted: copper, gold, oil, gas) vs. **soft commodities** (grown: grains, livestock, coffee).
- 7 Invested mainly via **derivatives** (futures, ETFs/ETNs, CTAs/managed futures, specialized sector funds) because of storage and transportation costs.

- 8 Returns come from **price changes**, not cash flows.

Commodity Futures Pricing

- 9 **Futures** = $\text{Spot} \times e^{(r + \text{carry} - \text{convenience}) \times T}$ — the cost-of-carry model.
- 10 **Contango**: Futures > Spot (low convenience yield — carry costs dominate).
- 11 **Backwardation**: Futures < Spot (convenience yield high enough to offset carry costs).

Portfolio Role

- 12 Commodities hedge inflation because **food and energy are components of the CPI**.
- 13 Timberland and farmland show *low reported volatility* due to appraisal-based pricing; true economic volatility is higher.

⚡ Quick Recall

Cost-of-Carry: $F = S \times e^{(r + \text{carry} - \text{convenience})T}$

Contango: Futures > Spot (convenience yield low)

Backwardation: Futures < Spot (convenience yield high)

Hard commodities: mined/extracted · **Soft commodities**: grown

Timberland: factory + warehouse (harvest-timing flexibility)

TIMOs: institutional timberland exposure