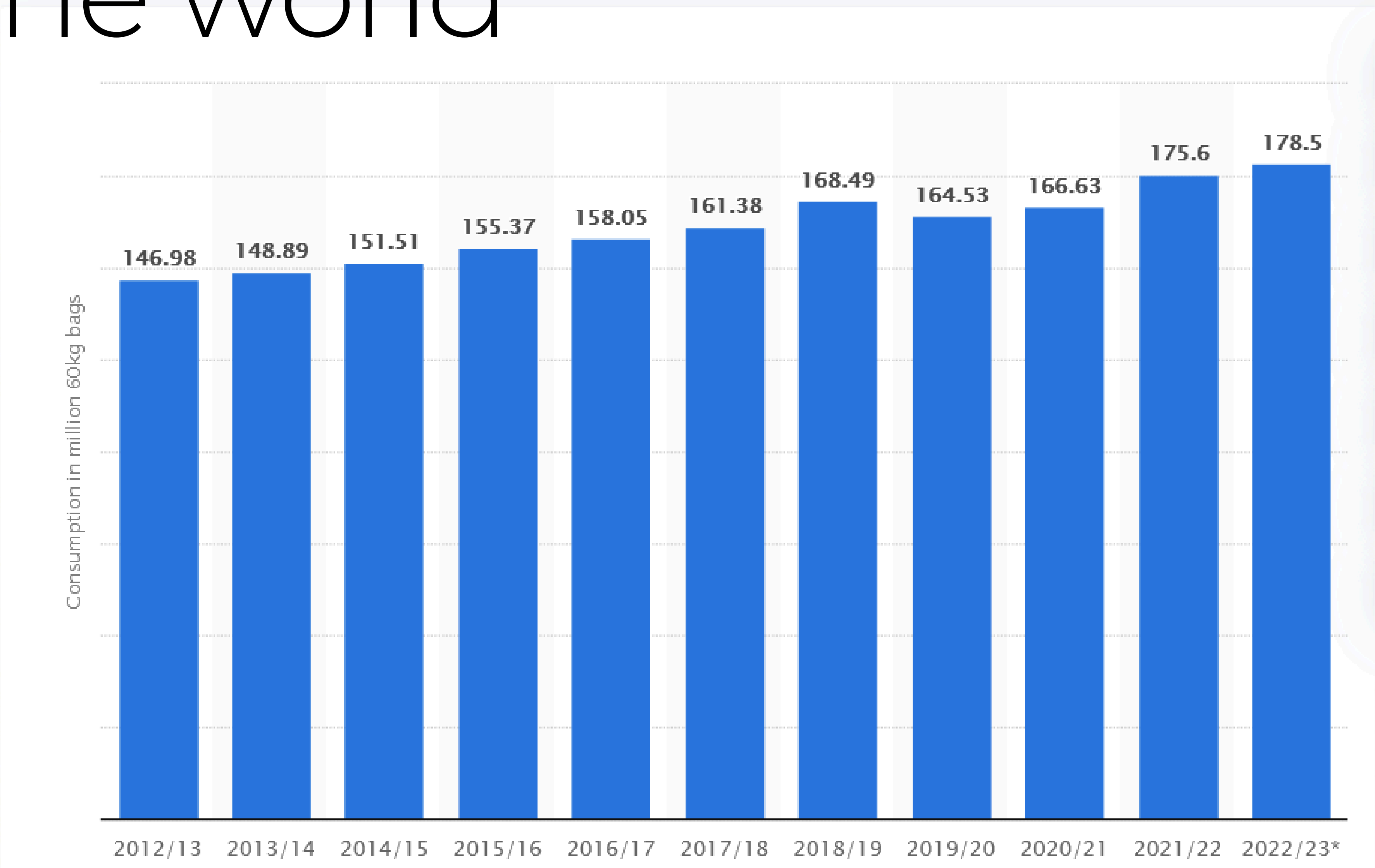
Supply Chain Simulation Model Presentation

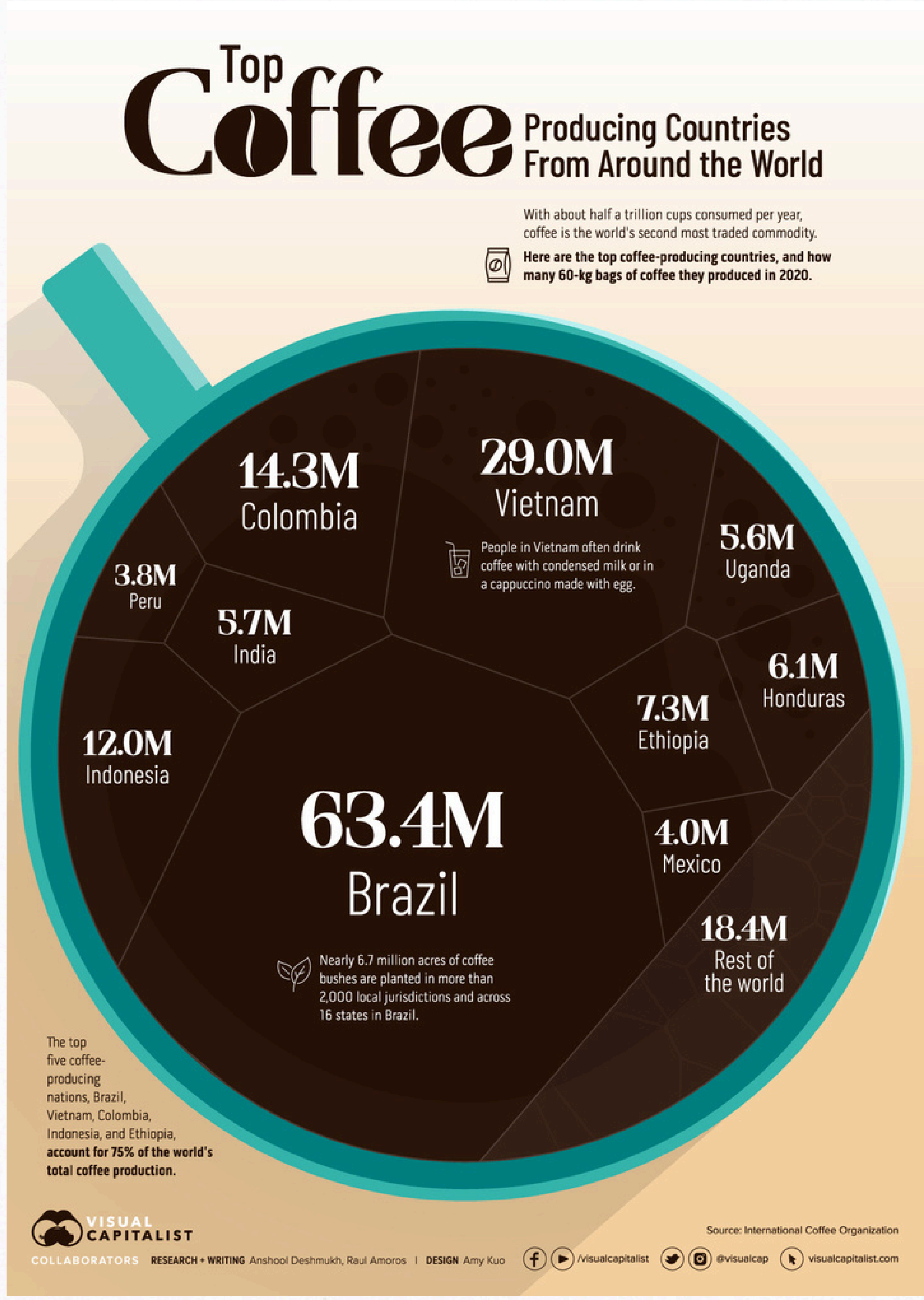
MNA1094 – Supply Chain Management
Group U

Introduction

Coffee production around the world

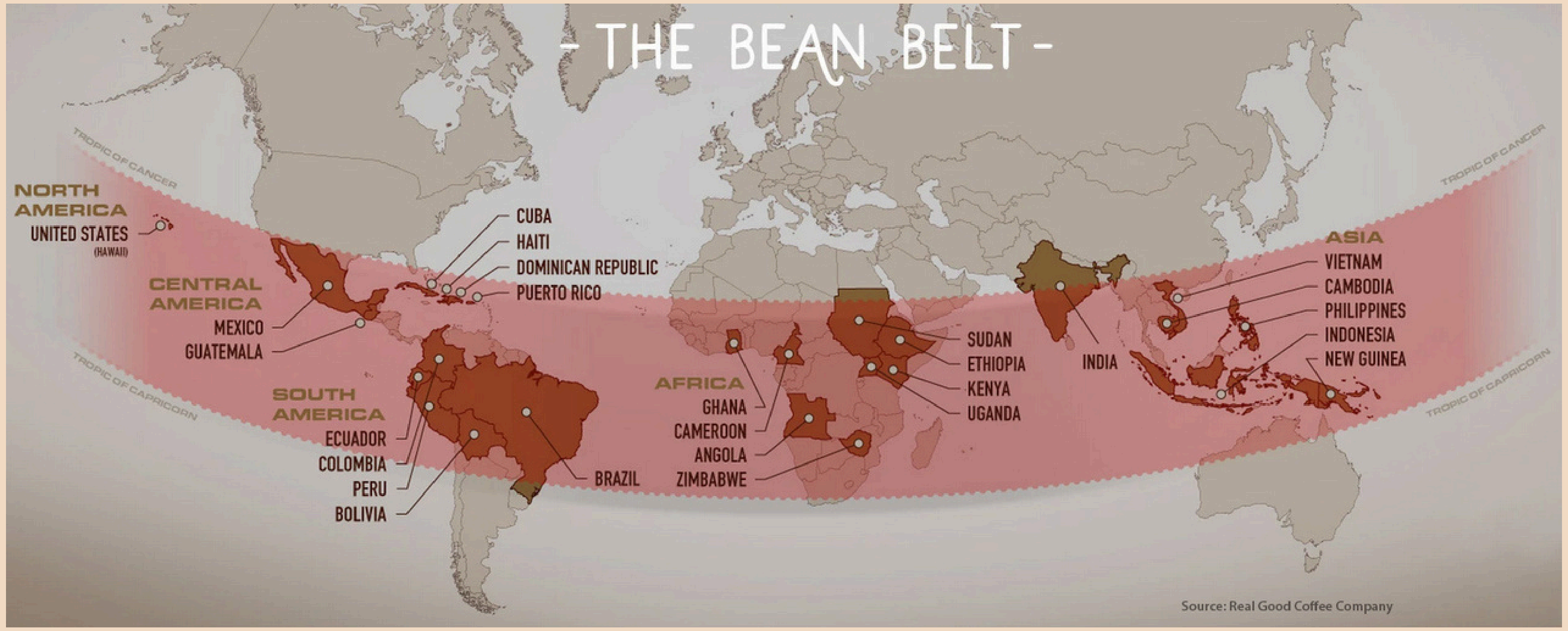


Statista. Available at: https://www.statista.com/statistics/292595/global-coffee-consumption/



Visual Capitalist. Available at https://www.visualcapitalist.com/worlds-top-coffee-producing-countries/

B



Visual Capitalist. Available at https://www.visualcapitalist.com/worlds-top-coffee-producing-countries/

Supply Chain Overview

iStock. Available at https://www.istockphoto.com/vector/stages-of-coffee-production-infographic-set-with-harvesting-hulling-and-drying-gm1471591018-502161277

Objectives of the Simulation

- Identify vulnerabilities
- Analyze weather effects
- Test resilience strategies

The Coffee Production Process

Cultivation

Growing coffee plants

Harvesting

Picking coffee cherries

Processing

Removing beans from cherries

Roasting

Enhancing flavor

Grinding & Brewing

Grinding & Brewing

Simulation Model Overview

Components

- Suppliers (Farm A and Farm B)
- Processing Facilities
- Logistics
- Distribution Channels
- Retailers

Key Metrics

- Inventory Levels
- Costs
- Unmet Demand

Test Scenarios

1. Worse Than Usual Weather
2. Better Than Usual Weather
3. Factory Strikes

Model Design

Data Inputs

- Demand Forecasts
- Inventory Levels
- Lead TImes
- Cost Structures
- Weather Data
- Safety Stock

Algorithms

- Production
- Inventory Management
- Demand Adjustment
- Cost Calculations

Assumptions

- Static Cost Structure
- Predefined Weather Multipliers
- Inventory Capacity
- Lead Time

Limitations

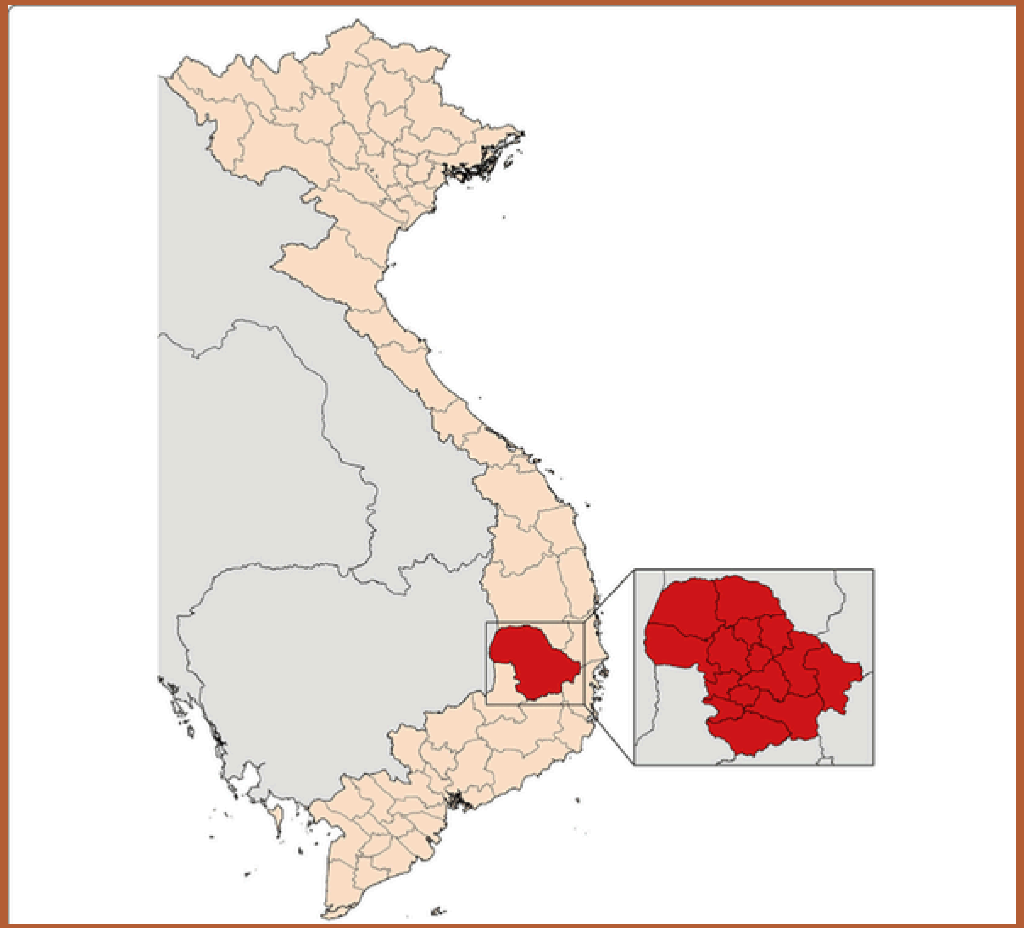
- Simplistic Weather Modelling
- Excludes real-time updates and disruptions
- Assumes Uniform Demand Patterns

Testing Scenarios

H

Rainfall index (Original)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Farm A	0.5	0.5	0.6	0.8	1	1.2	1.2	1.1	1	0.9	0.7	0.5
Farm B	0.6	0.5	0.7	0.9	1.1	1.3	1.2	1	0.9	0.8	0.6	0.5

Farms A
Buon Ma Thuot, Dak Lak Province
moderate and predictable rainfall



Farm B
Da Lat, Lam Dong Province
wetter microclimate with slightly higher rainfall.

Test 1 – Worse than Usual Weather (Extended Monsoon)

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Rainfall Patterns:

Rainfall peaks in June and July for both farms.

Farm B consistently receives more rainfall compared to Farm A throughout the year.

Rainfall Index for Farm A: Peaks at 1.2.

Rainfall Index for Farm B: Peaks at 1.3.

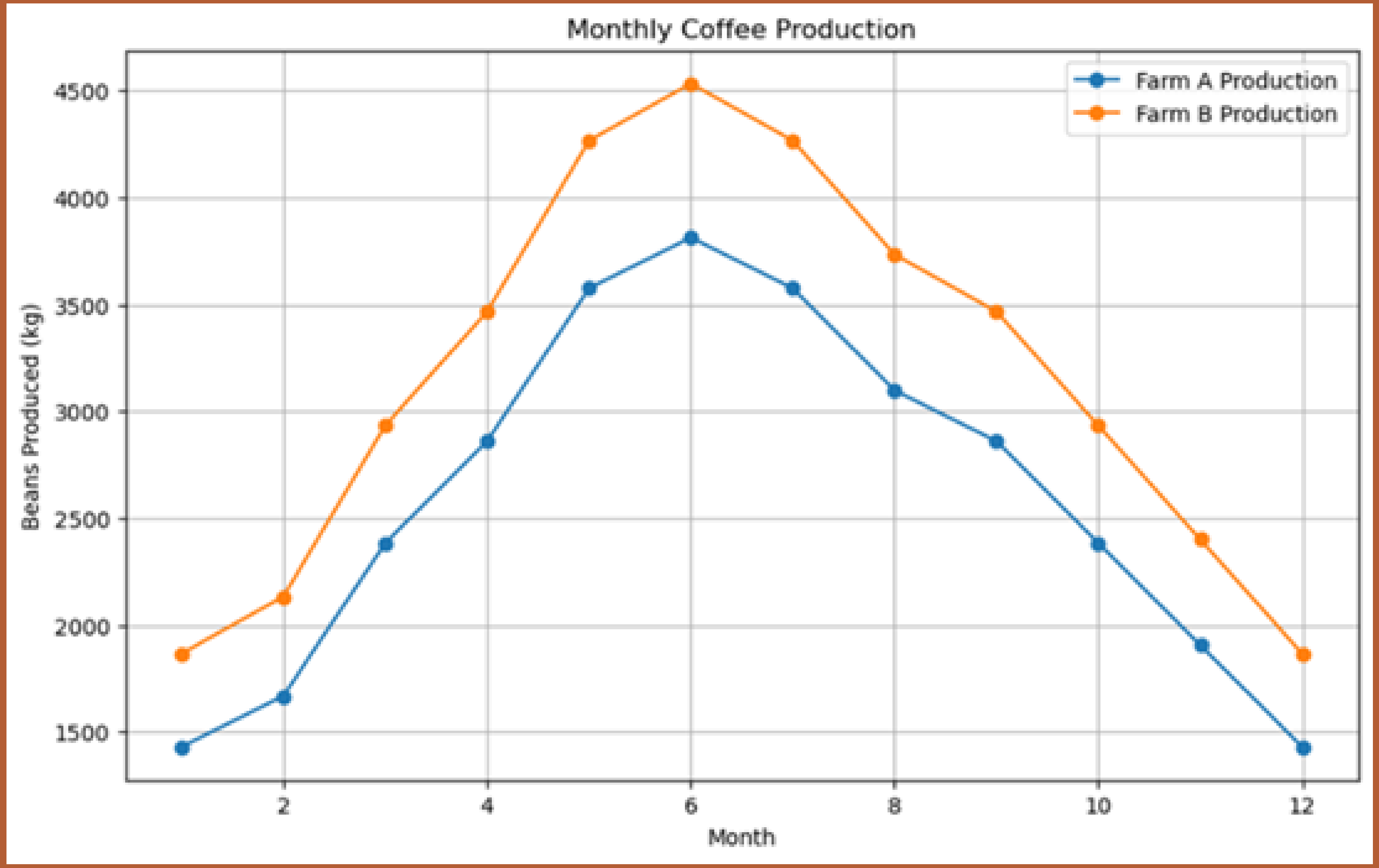
Coffee Production Trends:

Coffee production mirrors rainfall patterns.

Peak production occurs in June and July, aligning with maximum rainfall.

Production starts to decline from September to December, corresponding with reduced rainfall.

Rainfall index (Extended Monsoon)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Farm A	0.6	0.7	1	1.2	1.5	1.6	1.5	1.3	1.2	1	0.8	0.6
Farm B	0.7	0.8	1.1	1.3	1.6	1.7	1.6	1.4	1.3	1.1	0.9	0.7



Test 2 – Better than Usual Weather (Mild Monsoon)

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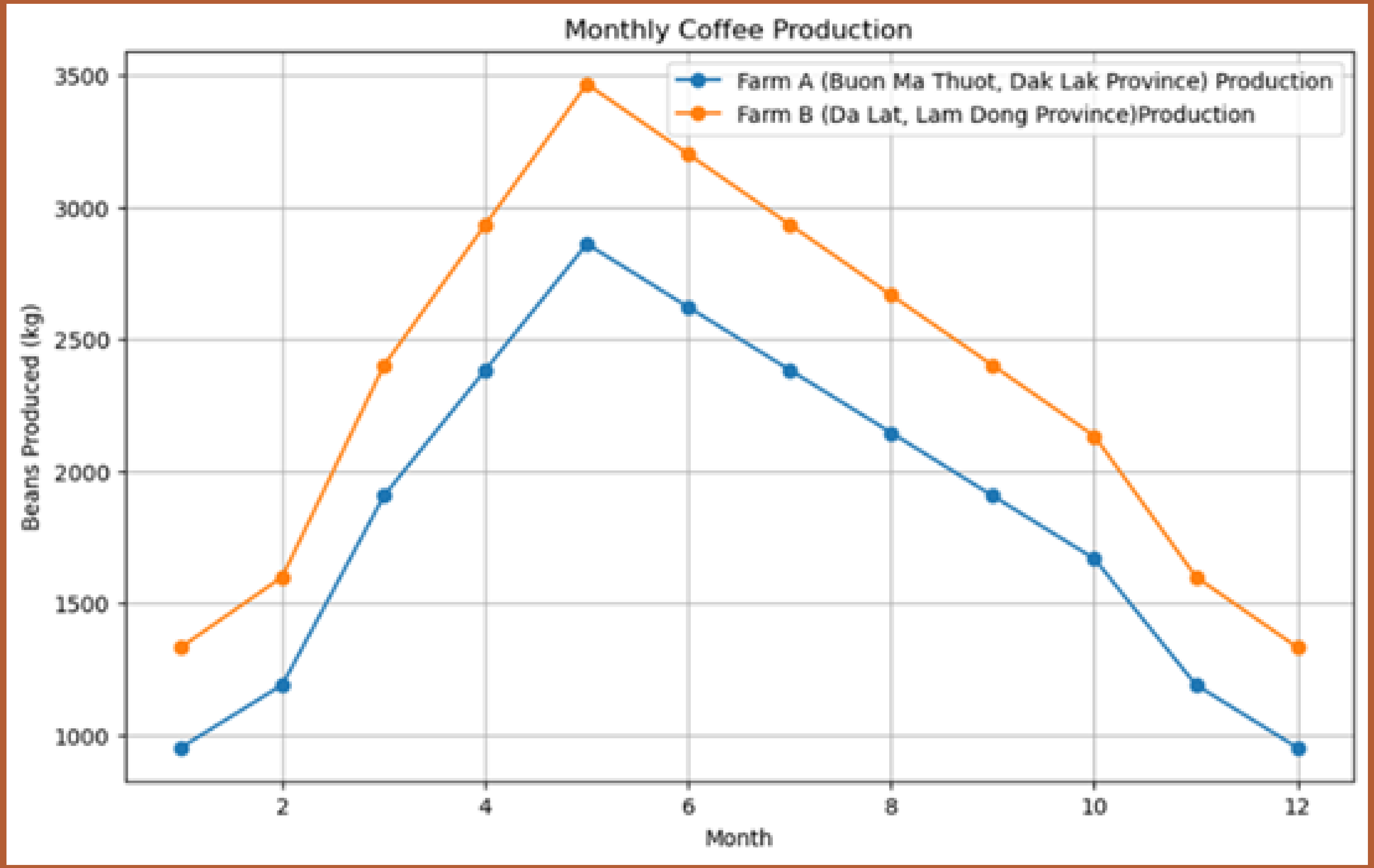
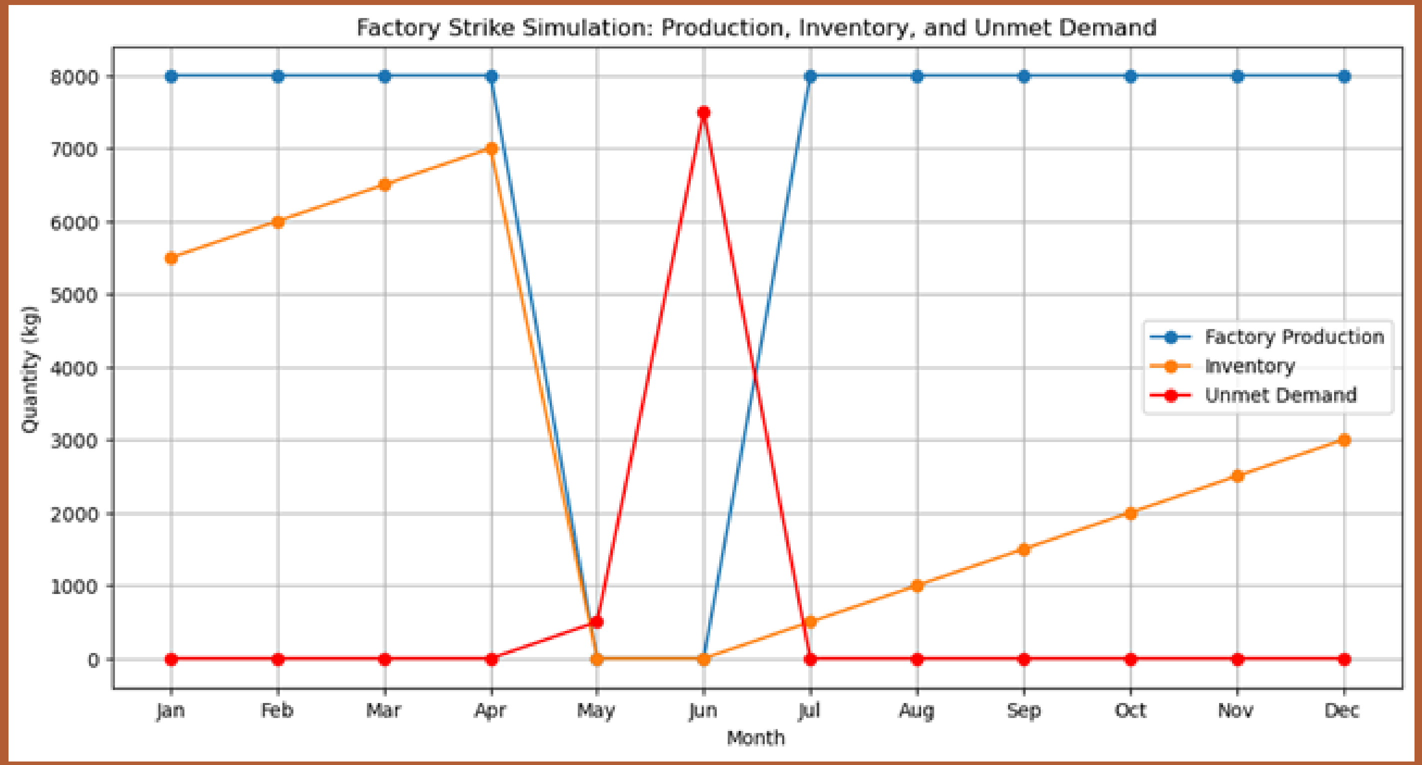
Rainfall Patterns:
Rainfall peaks earlier than in the extended monsoon scenario, with the highest levels in May and June.
Rainfall Index:
Farm A: Peaks at 1.2.
Farm B: Peaks at 1.3, slightly higher than Farm A.
Both farms exhibit similar seasonal rainfall trends.

Coffee Production Trends:
Coffee production aligns closely with rainfall, with peak yields in May and June.
Farm B again outperforms Farm A due to its higher rainfall levels.
The production gap between Farm A and Farm B narrows under mild monsoon conditions compared to the extended monsoon.

Rainfall index (Mild Monsoon)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Farm A	0.4	0.5	0.8	1	1.2	1.1	1	0.9	0.8	0.7	0.5	0.4
Farm B	0.5	0.6	0.9	1.1	1.3	1.2	1.1	1	0.9	0.8	0.6	0.5



Test 3 – Factory Strikes



Pre-strike Period:

From January to April, inventory was steadily built up to meet demand. Production and supply operated normally during this phase.

Strike Period:

Factory operations ceased in May and June. Inventories were completely depleted during these months to fulfil customer demand. Unmet demand spiked sharply, peaking in June, as production could not keep up.

Post-strike Period:

After the strike ended, production resumed but at a slower recovery rate than pre-strike levels. Inventory buildup lagged, potentially due to increased demand or tighter production margins.

PHYTON SIMULATION OVERVIEW

FOR THE SIMULATION MODEL WE USED SYPDER TO DEMONASTRATE DIFFERENT RESULTS

DEMAND FLUCTUATIONS DUE TO WEATHER

Original Weather pattern

```
# Sourcing details for farms
farm_a_details = {
    "location": "Dak Lak Province",
    "hectares": 8,
    "yield_per_hectare": 3.7,  # Tonnes per hectare annually
    "annual_production": 28600,  # kg annually
    "weather_pattern":[0.5, 0.5, 0.6, 0.8, 1.0, 1.2, 1.2, 1.1, 1.0, 0.9, 0.7, 0.5]


 # Example seasonal factors
}

farm_b_details = {
    "location": "Lam Dong Province",
    "hectares": 10,
    "yield_per_hectare": 3.2,  # Tonnes per hectare annually
    "annual_production": 32000,  # kg annually
    "weather_pattern":[0.6, 0.5, 0.7, 0.9, 1.1, 1.3, 1.2, 1.0, 0.9, 0.8, 0.6, 0.5]
```

Weather pattern in lower rain fall

Farm A Rainfall Index (Better Monsoon)

[0.4, 0.5, 0.8, 1.0, 1.2, 1.1, 1.0, 0.9, 0.8, 0.7, 0.5, 0.4]

Farm B Rainfall Index (Better Monsoon)

[0.5, 0.6, 0.9, 1.1, 1.3, 1.2, 1.1, 1.0, 0.9, 0.8, 0.6, 0.5]

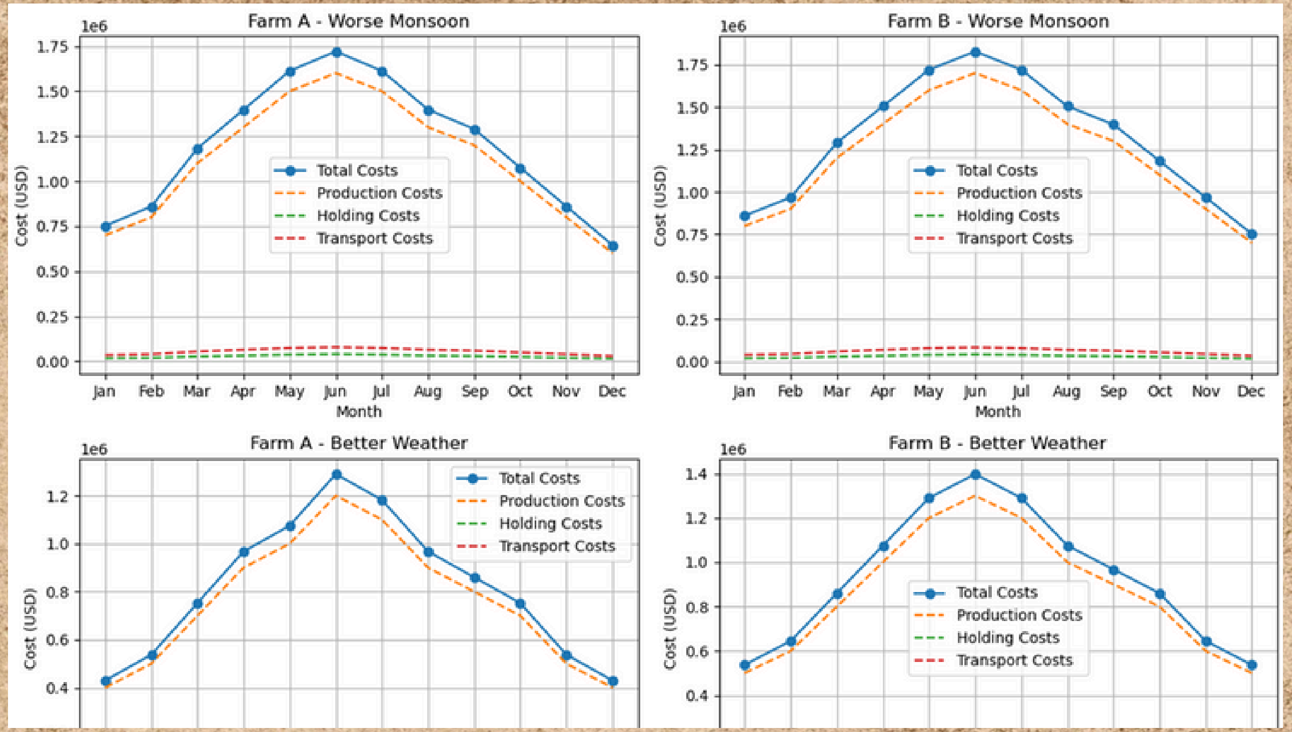
Weather pattern in heavier rain fall

Farm A Rainfall Index (Worse Monsoon)

[0.6, 0.7, 1.0, 1.2, 1.5, 1.6, 1.5, 1.3, 1.2, 1.0, 0.8, 0.6]

Farm B Rainfall Index (Worse Monsoon)

[0.7, 0.8, 1.1, 1.3, 1.6, 1.7, 1.6, 1.4, 1.3, 1.1, 0.9, 0.7]



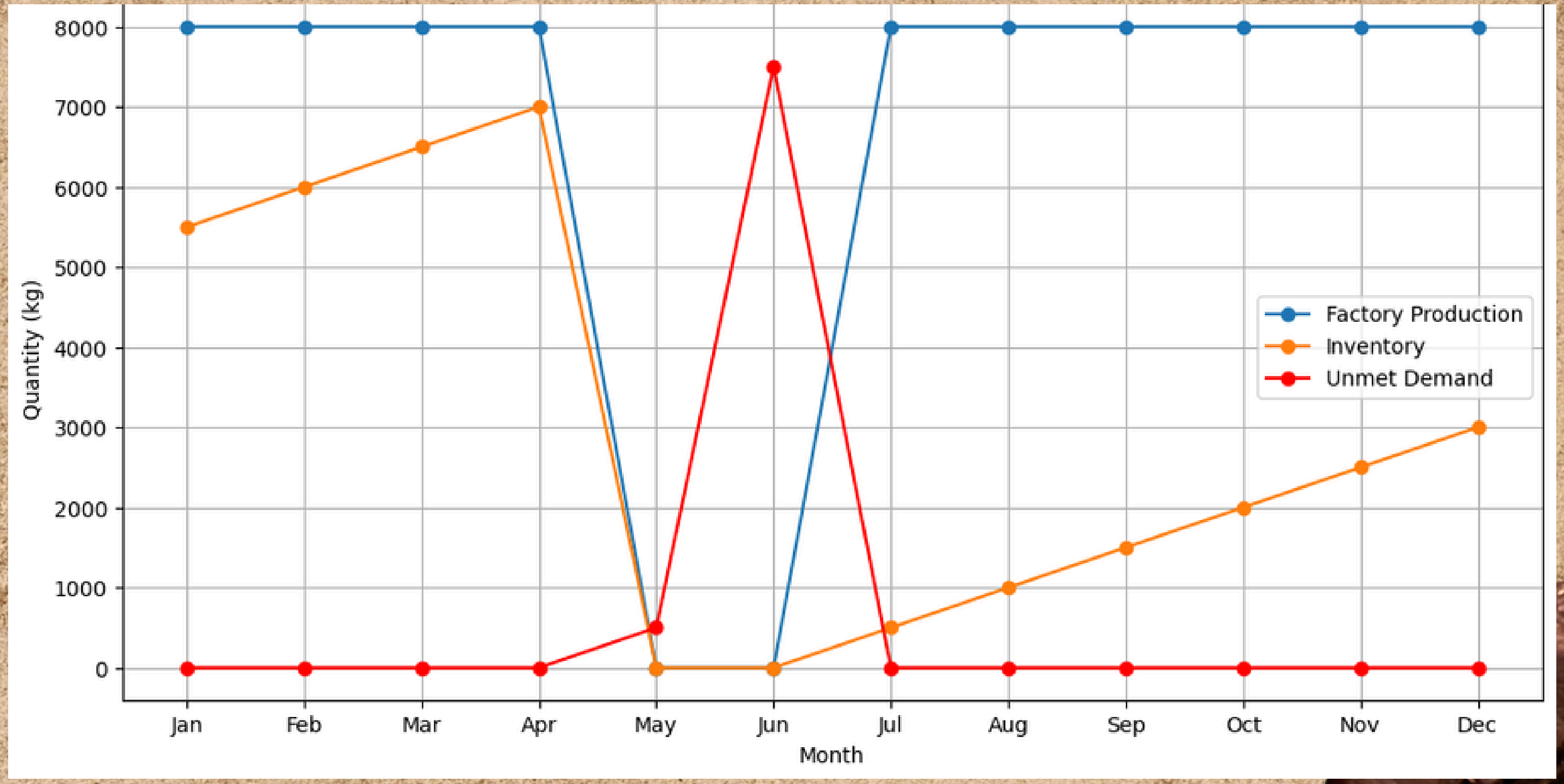
DISRUPTION ON PRODUCTION DUE TO FACTORY ATRIKE

```
# Define months
months = ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec']

# Parameters for simulation
factory_production = [8000] * 12  # Normal production (in kg per month)
factory_production[4:6] = [0, 0]  # Simulating a 2-month factory strike (May, June)

# Demand across the supply chain
demand = [7500] * 12  # Constant monthly demand

# Initial inventory levels
inventory_processing = [5000]  # Starting inventory (in kg)
processing_capacity = 8000  # Monthly processing capacity
```



USER GUIDE

- OVERVIEW: SIMULATES VIETNAM'S COFFEE SUPPLY CHAIN TO IDENTIFY WEAKNESSES AND OPTIMIZE PERFORMANCE.
- KEY METRICS: TRACKS DEMAND, INVENTORY, ORDERS, COSTS, AND UNMET DEMAND.
- INPUT PARAMETERS: ADJUST DEMAND, STARTING INVENTORY, LEAD TIMES, AND SAFETY STOCK.
- DEFINE SCENARIOS: SIMULATE DEMAND CHANGES, DISRUPTIONS, OR ENVIRONMENTAL IMPACTS.
- RUN SIMULATION: ENTER DEMAND, PRODUCTION PLANS, AND SEASONAL ADJUSTMENTS.
- INTERPRET RESULTS: ANALYZE BOTTLENECKS, STOCKOUTS, AND SUPPLY CHAIN RESPONSIVENESS.

Recommandations

- Implement predictive analytics for demand forecasting
- Strengthen inventory policies
- Develop resilience strategies for production halts
- Collaborate across the supply chain for adaptive logistics

Conclusion

Key Findings

- Importance of weather and demand fluctuations on the supply chain.
- Benefits of dynamic safety stock and shorter lead times.

Importance of simulation

- Identifies bottlenecks and tests resilience strategies.

Next steps

- Enhance the model with real-time data integration and broader disruption scenarios.

Thank You.