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Analysis of the Recent Evolution of the Global Coffee Market: Determinants of Price Increases and Perspectives on Sector Sustainability (2023–2025) – Review

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ABSTRACT

The present review examines the recent evolution of the global coffee market during the 2023–2025 period, with a particular focus on the factors that have driven the significant increase in international prices and on the effects of this dynamic on the sustainability of the sector. Based on the relevant literature and the FAO documents consulted, the analysis highlights that the rise in international quotations was closely associated with supply disruptions, mainly caused by adverse climatic conditions in major producing countries such as Brazil, Vietnam, Indonesia, and other key coffee-producing states, compounded by logistical difficulties and additional trade pressures. In this context, price volatility cannot be explained solely by the relationship between supply and demand, but must also be examined in connection with the structural vulnerabilities of the global value chain, the high exposure of coffee crops to climate-related risks, and the essential role of smallholder producers, who make a significant contribution to global production. At the same time, the analysis shows that the current challenges facing the coffee sector go beyond the strictly economic dimension, encompassing relevant issues such as traceability, supply chain transparency, increasingly stringent sustainability requirements, and the social and environmental costs associated with production. Looking ahead, the reduction of areas suitable for coffee cultivation under the impact of climate change may intensify market instability and lead to a reconfiguration of the relationships among production, trade, and consumption. In conclusion, this review supports the need for integrated interventions aimed at strengthening climate resilience, fostering innovation, enhancing traceability, and ensuring fair support for smallholder farmers, with a view to developing a more stable and sustainable coffee sector.

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Introduction

Coffee is one of the most economically and culturally significant agricultural commodities in international trade, supporting the livelihoods of approximately twenty-five million smallholder farmers across more than seventy producing countries and generating an annual market value above 460 billion United States dollars [1]. The crop is dominated by two species of commercial relevance: Coffea arabica L., which historically accounted for around 60% of world output and is preferred for its sensory quality, and Coffea canephora Pierre ex A. Froehner (commonly designated Robusta), which provides higher caffeine content and a higher tolerance to thermal stress [2,3]. Approximately seventy percent of global production originates from smallholder farms operating on plots of less than five hectares, a structural feature that creates intrinsic vulnerability to price volatility, climatic shocks and regulatory changes [4,5].

Between 2023 and 2025, the global coffee market entered an exceptional phase. According to data published in successive ICO Coffee Market Reports, the I-CIP rose from monthly averages around 170 US cents/lb in late 2023 to over 326 US cents/lb by October 2025, an aggregate increase that nearly tripled the reference commodity price within twenty-four months [6,7]. In February 2025, Arabica futures on the Intercontinental Exchange (ICE) in New York exceeded 4 US dollars per pound for the first time in their recorded history, while London Robusta futures reached three-decade highs [8]. The simultaneous occurrence of price escalation in both species is unusual: Arabica and Robusta normally exhibit decoupled behaviour because they answer to partially distinct supply-and-demand environments. The narrowing of the Arabica–Robusta differential to its lowest level since the mid-1990s represented one of the structural signals of this market phase [9].

The drivers behind this rally are multiple and interconnected. Climate-induced production shortfalls in Brazil (the largest world producer of both Arabica and Robusta) and Vietnam (the largest exporter of Robusta) reduced global supply just as demand from Asian markets and producing countries kept expanding [10,11]. Stock levels in destination markets fell to multi-year lows, generating a structural shortage. The European Union Deforestation Regulation (EUDR), adopted in 2023, imposed a new traceability burden that raised compliance costs across the value chain [12]. The United States imposed substantial tariffs on Brazilian agricultural products in 2025, briefly amplifying market dislocations before partial reversal in the same year [13]. Finally, financial speculation through futures markets played a non-negligible amplifying role [14].

In parallel, longer-term threats to coffee sector sustainability remain pressing. Several modelling studies have indicated that under medium-to-high greenhouse gas emission scenarios up to fifty percent of currently suitable Arabica cultivation areas could become marginal by mid-century, with Brazil, East Africa and parts of Central America being particularly exposed [15,16]. Smallholder farmer vulnerability to price shocks has been reported to compromise mental health and household stability in producing regions, illustrating the social externalities of commodity volatility [17]. The objective of this review is therefore to integrate scientific and institutional evidence published between 2023 and 2025 in order to (i) characterise the trajectory of the global coffee market in this period, (ii) identify the principal determinants of price escalation, and (iii) discuss the prospects for sectoral sustainability in light of climate, regulatory and socio-economic pressures.

Materials and Methods

This review was structured as a narrative synthesis of the scientific and grey literature published between January 2023 and January 2026, focused on the global coffee market. The bibliographic search combined three classes of sources. Peer-reviewed scientific publications were retrieved through Scite, Scopus and Web of Science using combinations of the keywords “coffee”, “Coffea arabica”, “Coffea canephora”, “climate change”, “price volatility”, “supply chain”, “smallholder farmer”, “agroforestry”, “certification” and “sustainability”. Institutional reports were obtained from the International Coffee Organization (ICO), the United Nations Food and Agriculture Organization (FAO), the United States Department of Agriculture (USDA) Foreign Agricultural Service, the World Bank Commodity Markets Outlook and the European Commission, with the latter providing primary documents on the EUDR. Industry market reports and trade press were used as complementary sources for the description of futures market dynamics, hedge fund positioning and policy events.

Inclusion criteria required that documents be published in English, contain quantitative or methodologically explicit qualitative analysis, and address either price formation, climate impacts, sustainability or regulatory dimensions of the coffee sector. Studies focused exclusively on consumer behaviour, sensory analysis or roasting technology were excluded unless they offered evidence on the demand side relevant to price formation. Approximately three hundred records were screened, from which fifty references were retained as primary citations on the basis of thematic relevance, recency, methodological quality and coverage of the principal producing regions (Brazil, Vietnam, Colombia, Ethiopia, Indonesia and Honduras). Following the SPASB editorial guidelines, references appear in the order of their first textual appearance.

Results and Discussion

Price Evolution: from Depressed Market to Historic Peaks

The trajectory of coffee prices over the period under review can be divided into three phases. The first, covering most of 2023, saw the I-CIP fluctuating between 160 and 200 US cents/lb, a level broadly consistent with the average of the preceding decade [6]. The second phase, from early 2024 onward, was characterised by a sustained upward pressure: prices for both Arabica and Robusta gained simultaneously, an unusual configuration that reflected concurrent supply tightness across both species [9]. The third phase, beginning in late 2024 and intensifying in the first quarter of 2025, produced a rally of historic magnitude. The I-CIP averaged 310.12 US cents/lb in January 2025 and continued to expand until reaching peaks above 330 US cents/lb in November 2025, before partially correcting to around 273 US cents/lb by March 2026 [7,18].

In real terms, the December 2024 monthly average was reported by FAO as representing a year-on-year increase of 58% for Arabica and 70% for Robusta, producing the narrowest Arabica–Robusta differential observed since the mid-1990s [6]. According to ICE futures data, Arabica peaked above 4 US dollars per pound on 5 February 2025, an all-time nominal record [8,19]. London Robusta futures reached their highest level in approximately three decades during the same period [9]. The magnitude of the rally is illustrated by the synthetic figures reported in Table 1.

It is important to interpret these nominal price levels in real terms. Since 1970, real Arabica prices have declined at an average rate of approximately 3% per year and Robusta prices at 5% per year [9], so even the 2025 highs do not necessarily represent unprecedented producer income in inflation-adjusted terms. Nevertheless, the speed of escalation generated stress along the value chain, with retail coffee prices in the United States rising approximately 40% year-on-year by September 2025 according to consumer price data, contributing to broader inflation in food categories [13,19].

A historical comparison provides further perspective on the magnitude of the recent rally. The previous nominal record for Arabica futures was set in May 1977 following the severe Brazilian frost of July 1975 (the “Geada Negra”), when monthly average prices reached approximately 277 US cents/lb [6]. The 2024–2025 episode therefore represents the first time since the late 1970s that coffee has sustained nominal price levels of comparable magnitude over an extended period, and the first time ever that Arabica futures crossed the 4 US dollars per pound threshold. Unlike the 1977 episode, which was triggered by a single discrete climatic event followed by gradual recovery, the current rally results from the cumulative interaction of multi-year supply deficits, structural demand growth, regulatory transition costs and trade-policy shocks. This compositional difference is critical for interpreting the durability of high prices: whereas a single weather shock typically allows the market to rebalance within two to three crop cycles, overlapping structural pressures may sustain elevated price levels for a longer horizon.

Table 1: Evolution of the ICO Composite Indicator Price (I-CIP) and key Futures Benchmarks During 2023–2025 (US cents/lb, Monthly Averages where Indicated)

Period	I-CIP	NY Arabica	London Robusta	Notes
2023 average	~170	~165	~120	Post-pandemic stabilization phase
Dec 2024	~299	~325	~245	+58% Arabica, +70% Robusta YoY (FAO)
Jan 2025	310.1	328.9	234.3	Arabica–Robusta arbitrage at 22-year high
Feb 2025	peak	>400	>250	Arabica >4 USD/lb on 5 Feb — historic record
Aug 2025	297.1	~340	~200	+14.6% MoM after July 2025 correction
Oct 2025	326.4	~370	~200	+30.3% YoY; 12-month rolling 312.93
Dec 2025	304.7	~310	~190	−7.8% MoM after US tariff removal

Source: compiled from references [6,7,18,34,35]. Price levels are monthly averages where indicated. NY = New York Intercontinental Exchange; YoY = year-on-year; MoM = month-on-month.

Climate Change as a Primary Supply-Side Driver

Climate change is now widely recognised as the dominant medium- and long-term pressure on coffee production. Coffea arabica has narrow climatic optima, with an average annual temperature range of 18–21 °C considered favourable for commercial production, and an annual water deficit threshold below 150 mm [20,21]. Above 23 °C, fruit ripening accelerates and bean quality deteriorates, while temperatures above 30 °C combined with insufficient rainfall trigger flower abortion and yield collapse [22,23]. Several recent modelling studies have indicated that under SSP3-7.0 and SSP5-8.5 scenarios, suitable areas for Arabica in the principal producing regions could shrink by 40–60% by mid-century, with the main losses projected for Brazil, Mexico, Central America and parts of East Africa [24-26].

Robusta, traditionally regarded as the more thermotolerant of the two species, has also been shown to respond negatively to supra-optimal temperatures and to changes in rainfall distribution. A recent study using bias-corrected regional climate models estimated that the Central Highlands of Vietnam, where the world's largest concentration of Robusta cultivation occurs, could lose on average 62% of currently suitable areas under RCP 8.5 and 27% under RCP 2.6 by 2060–2070, with increases in minimum temperature during the harvest and growing seasons and decreasing precipitation during the late growing season identified as the leading climatic signals [11]. The implication is that climate-driven losses are no longer confined to the more sensitive Arabica species.

The 2023–2025 period offered repeated empirical confirmations of climate sensitivity. In Brazil, the 2024 drought has been described by national agencies as the most severe in approximately seventy years, leaving plantation parks with what analysts have termed a permanent hydraulic deficit and reducing the area suitable for flowering [27]. The Companhia Nacional de Abastecimento (Conab) successively lowered its 2024/25 production estimates to around 54.79 million 60-kilogram bags, a 6.8% downward revision from the initial forecast [28]. Adverse weather extended into 2025: episodes of high temperature and irregular rainfall in February reduced flowering potential, leading to USDA Arabica forecasts of 40.9 million bags for 2025/26, a 6.4% decline relative to the prior season [29].

In Vietnam, the 2023/24 marketing year recorded a 20% reduction in Robusta production due to prolonged dry weather, with exports declining for two consecutive years [6]. In Indonesia, supply restrictions further amplified the global Robusta shortage, although the 2024/25 harvest brought partial normalisation [10]. Beyond these proximate climatic events, the literature now documents a generalised pattern of biennial cycle disruption, advanced flowering events, increased pest and disease pressure (notably coffee leaf rust and the coffee berry borer) and the upward displacement of suitable cultivation altitudes [30,31].

Water availability has emerged as a critical limiting factor independent of mean temperature. Field-level studies on coffee phenology under current climatic variability have demonstrated that water consumption peaks during flowering and grain ripening, with crop evapotranspiration to reference evapotranspiration ratios reaching 1.12 and 1.15 respectively, while harvest-period values can fall as low as 0.62 in years of marked rainfall deficit [30]. Precipitation and rainfall infiltration were identified as the variables most strongly correlated with vegetative growth in mid-elevation Mexican plantations, with coefficients of determination exceeding 0.70 [30]. Mattu district in southwest Ethiopia provides another empirical illustration: mean annual temperature in the area increased by 0.014 °C per year over a 32-year observation period, while annual rainfall decreased at a rate of 24.23 mm per year, producing significant negative effects on coffee yields [31]. Climate projections for the most extensively studied regions of Brazil indicate average reductions of approximately fifty percent of areas suitable for Arabica cultivation across all RCP scenarios by 2040–2080, with excessive heat and water deficit identified as the dominant restrictive factors [25].

Coffee leaf rust (Hemileia vastatrix), the historically dominant fungal pathogen of Coffea arabica, exhibits a particularly close association with climate variability. Although recent epidemics in Colombia have been partially controlled through the replanting of resistant varieties, episodes of unusual rainfall combined with cloudy periods have produced new outbreaks in 2023 and 2024 [32]. Coffee berry borer (Hypothenemus hampei) populations, sensitive to temperature and humidity thresholds, are advancing into higher elevations as climatic conditions become permissive, threatening previously protected production zones [22]. The combined effect of these phytosanitary pressures further reduces yields and compounds the climatic stresses on producers.

Production Dynamics Across Leading Origins

The geographic concentration of coffee production amplifies the systemic effect of climate disruptions. Brazil and Vietnam together contribute close to fifty percent of global output, while the top five producing countries represent more than seventy percent of supply [32]. Brazil dominates Arabica with around forty-six percent of world output, followed by Colombia (13%), Ethiopia (8.5%), Honduras (5.4%) and Peru (4.4%) [10]. For

Robusta, Vietnam contributes thirty-eight percent, followed by Brazil (27%), Indonesia (12%), Uganda (7%) and India (6%). Country-level production estimates for the period under review are summarised in Table 2.

In Brazil, the 2024 harvest closed 0.5% below 2023 at 54.79 million bags, with Arabica gaining 1.8% to 39.6 million bags but Robusta losing 5.9% to 14.6 million bags due to droughts and heat in Espirito Santo. The 2024/25 USDA estimate of 64.7 million bags incorporated the recovery of Robusta in regions favoured by rainfall, while the 2025/26 forecast of 63 million bags reflects ongoing climatic pressure on Arabica and the negative phase of the biennial cycle [29,33]. The August 2024 frost episode, which damaged early flowering of the next harvest in Cerrado Mineiro and Alta Mogiana regions, was described by local cooperatives as one of the most severe in recent memory and prompted further reductions in 2025/26 projections [27].

Colombia, by contrast, recorded a strong recovery during the period under review, with cumulative production reaching approximately 14 million bags in calendar year 2024, an increase of 23.3% over 2023 [34]. This expansion was partially attributed to favourable rainfall distribution and to renewed varietal renovation programmes. Ethiopia exported a record 7.37 million bags in coffee year 2024/25 (a 27.3% expansion), supported by an estimated harvest of 9.91 million bags [35]. Uganda similarly reached a record level of 8.26 million bags in exports, with the country announcing a national production target of 20 million bags by 2030 [35]. Indonesian Robusta output rebounded substantially in 2024/25, contributing to the partial easing of the global Robusta scarcity [10].

Honduras, Mexico and several Central American producers reported variable outcomes. Mexico's production declined sharply in 2024 due to drought, with estimates of yield reductions of approximately fifty percent in some regions [36]. In Costa Rica, by contrast, an 8.6% expansion was forecast for 2024/25. Hurricane Sara in November 2024, which delivered intense precipitation across Central America, further perturbed regional production patterns [6]. The cumulative effect of these origin-specific dynamics, combined with the structural shift towards higher Robusta production globally, contributed to the narrowing of the Arabica–Robusta price differential observed during the period.

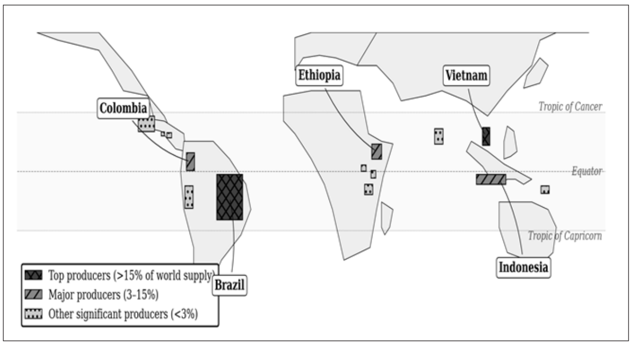

Figure 1: Geographic Distribution of Major Coffee-Producing Countries, Classified by tier of Contribution to World Supply (2024/25). The Coffee Belt Between the Tropic of Cancer and the Tropic of Capricorn is Highlighted. Source: Compiled from USDA-FAS [10] and ICO Market Reports [7,35].

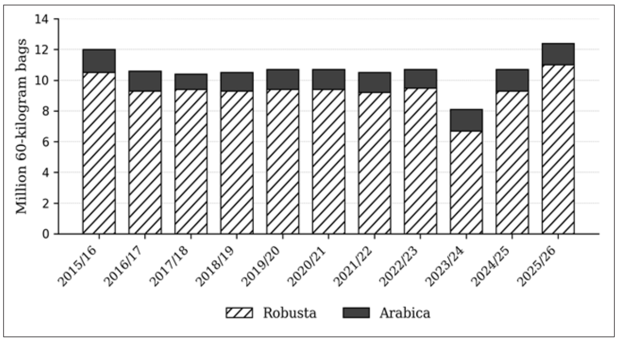

Figure 2: Evolution of Indonesia's Coffee Production by Species (Arabica vs Robusta), 2015/16–2025/26 (Million 60-kg Bags). Source: Adapted from USDA Foreign Agricultural Service, Coffee: World Markets and Trade [10].

Table 2: Coffee Production Estimates and Forecasts for the Top Five Producing Countries (Million 60-kg Bags), Coffee Marketing years 2023/24–2025/26

Country	2023/24	2024/25	2025/26 (f)	Dominant species
Brazil	66.3	64.7	63.0	Arabica + Robusta
Vietnam	27.4	29.0	31.0	Robusta
Colombia	11.4	14.8	13.8	Arabica
Indonesia	8.4	10.9	11.5	Robusta
Ethiopia	7.5	9.9	9.0	Arabica
World total	168.0	175.3	178.8	—

Source: compiled from USDA Foreign Agricultural Service [10,29] and ICO Coffee Market Reports [7,35]. (f) = forecast.

Demand Growth and Structural Consumption Shifts

On the demand side, global coffee consumption continued to grow steadily during the period under review. The USDA projected world consumption at a record 173.9 million 60-kilogram bags for 2025/26, with ending stocks expected to drop for the fifth consecutive year to approximately 20 million bags [10]. This persistent stock drawdown of nearly 17 million bags over three deficit years was a key amplifier of price reactivity to supply shocks. The 2024/25 surplus reported by certain industry sources, although marginal, did not yet provide sufficient buffer against weather volatility [9].

Geographically, the Asia-Pacific region recorded year-on-year consumption growth above seven percent in 2025, while consumption declined in Europe (−1.2%) and North America (−3.3%) according to ICO data [37]. Producing countries have become an increasingly important source of internal absorption: Brazil now consumes more than forty percent of its own production, positioning itself as the world's second-largest national consumer after the United States and structurally limiting the country's capacity to act as a swing exporter during supply shocks [9]. In the United States, sixty-six percent of adults reported daily coffee consumption in 2025, the highest rate observed in two decades according to the National Coffee Association, while specialty coffee consumption was particularly strong among the eighteen-to-twenty-four age cohort [1].

A structurally important phenomenon is the relative inelasticity of coffee demand to short- and medium-term price increases. Most consumers in mature markets have absorbed nominal retail price increases of 30–40% without significantly reducing consumption volumes, although recent industry analyses suggest that, beyond a certain price threshold, behavioural shifts towards out-of-home consumption reduction or substitution by lower-quality blends could materialise [14]. Roaster companies have responded by adjusting product mix, increasing the share of Robusta in instant coffee and ready-to-drink categories, and reformulating premium blends.

Geopolitical and Regulatory Factors

The European Union Deforestation Regulation (Regulation (EU) 2023/1115, EUDR), adopted in June 2023 and originally scheduled to apply from 30 December 2024, introduced a new layer of compliance obligations for coffee imports into the European Union. Under the EUDR, all operators placing coffee on the European market must demonstrate, through geolocation data and a Due Diligence Statement, that the product does not originate from land deforested or degraded after 31 December 2020 and that it complies with the relevant legislation of the country of production [12]. Following extensive concerns expressed by member states, third countries and operators about the readiness of the European Commission information system and the compliance burden for smallholder operators, the regulation was postponed initially to 30 December 2025, and subsequently to 30 December 2026 for large operators (with a six-month additional cushion for micro and small enterprises) by a targeted revision adopted in December 2025 [38,39].

The economic implications of the EUDR for producing countries are substantial. Compliance requires plot-level geolocation mapping, traceability across all intermediate operators and the maintenance of verifiable due diligence records for a minimum of five years. Service pricing for traceability documentation has been reported to range between 3.3 and 6.7 US dollars per hectare when delivered by local consultants and between 5 and 12 US dollars per hectare when delivered by international vendors [40]. For Ethiopia, where over ninety-five percent of coffee output is produced by approximately four million smallholders cultivating plots typically smaller than one hectare, the cumulative compliance cost is non-trivial. Annual coffee exports to the European Union were estimated at 600 million US dollars, equivalent to roughly one third of the country's total coffee exports and approximately 0.4% of national GDP [40]. The risk of EU market exclusion therefore carries macroeconomic consequences for fragile economies whose foreign-exchange reserves depend significantly on coffee.

A second regulatory shock was generated by the United States trade policy. In August 2025, a 50% tariff was imposed on imports from Brazil, with coffee included among the affected categories. Brazilian producers responded by withholding shipments, expanding domestic stocks and stalling new contractual commitments [14,41]. Although the tariff was largely reversed in November 2025 through executive orders that reinstated tariff exemptions on coffee and other agricultural products that cannot be cultivated domestically in the United States, the episode demonstrated how trade-policy uncertainty can rapidly translate into futures market volatility. Following the tariff removal, Arabica futures recorded one of the largest single-day declines of the year [13,42].

The combined effect of EUDR-related compliance pressure, postponements and United States tariff shocks generated structural uncertainty in coffee supply chains. A coalition of food and beverage companies expressed opposition to repeated EUDR postponements on the grounds that delays imposed sunk costs on operators that had already invested in compliance systems [43]. The European Commission has been tasked with conducting a simplification review of the regulation to be presented by 30 April 2026 [38].

Compliance technology has emerged as a parallel investment domain. Geolocation data acquisition, blockchain-based traceability platforms and remote-sensing-based deforestation monitoring tools have been developed by both public and private actors, with the Global Forest Watch and the European Commission Joint Research Centre providing reference satellite-based deforestation maps. Producer cooperatives have adopted digital recordkeeping systems, in some cases supported by international development funds, to consolidate plot-level data from thousands of smallholders into single Due Diligence Statements. Decentralised technologies, including blockchain-based applications and smart-contract-based payment mechanisms, have been piloted in agricultural value chains in sub-Saharan Africa and may eventually offer alternative architectures for transparency and direct producer-to-buyer transactions [40]. Nevertheless, the persistent digital divide and the limited fiscal capacity of smallholder cooperatives constrain the speed of these technological deployments.

Speculation, Financialisation and Futures Market Dynamics

Beyond physical fundamentals, financial speculation contributed to amplifying price movements during the period. Industry observers have noted that long speculative positions on the New York Arabica contract reached high levels through 2024, partially driven by parallel rallies in cocoa and other tropical soft commodities [44]. Roaster gross commercial long positions, which serve as a proxy for industrial coverage, exhibited unusual configurations during 2025: at certain points the gross long position fell to its lowest level since 2011, indicating that roasters had reduced forward coverage in anticipation of market correction, while later in the year coverage rose again ahead of contract expirations [45].

The structural backwardation observed in Arabica futures during much of 2025, with near-month contracts trading at substantial premiums over deferred ones, reflected acute supply tightness in the immediately deliverable inventory pool. Certified Arabica stocks at ICE warehouses fell to multi-year lows in the second half of 2025, while certified Robusta stocks also declined [42]. The interaction between low inventories, hedge fund positioning, currency movements affecting producer-country selling behaviour and policy events resulted in price volatility that, on certain trading days, moved by more than 15 US cents/lb in single sessions [45]. While speculative activity is not the primary cause of the underlying supply shortfall, the literature suggests that it functions as an amplifier whose magnitude depends on inventory thinness and the perception of weather risk.

Sustainability Perspectives: Smallholders, Certification and Adaptation

The economic significance of the recent rally is unequally distributed along the value chain. Approximately forty-four percent of smallholder coffee farmers globally were estimated to live below the poverty line even when world prices were rising, because farm-gate price transmission is imperfect and a substantial share of the final consumer value is captured downstream by traders, roasters and retailers [4,46]. Several decades of voluntary certification schemes (Fairtrade, Rainforest Alliance, organic and UTZ, the latter merged with Rainforest Alliance in 2018) have attempted to redress this imbalance through minimum price floors, premium payments and sustainability standards. Recent literature suggests that such schemes play a role in stabilising producer income and improving environmental practices but that their effectiveness varies by context and certifier [4,47].

Comparative analyses indicate that organic certification typically delivers stronger environmental outcomes (in terms of habitat preservation, water quality, erosion control and carbon stocks) than other schemes, while Fairtrade is associated with the most explicit economic floor for producers (currently 1.40 US dollars per pound of washed Arabica, with a higher rate for organic-certified output) [46,48]. Rainforest Alliance has incorporated climate change mitigation requirements progressively, including into its 2020 Sustainable Agriculture Standard [47]. Consumer willingness-to-pay studies in the European Union have estimated premiums of approximately 1.48 EUR per 250-gram package for Fairtrade-labelled coffee and 1.38 EUR for UTZ-labelled coffee in the Spanish market [49]. Nevertheless, certified and specialty coffees represent only nine to twelve percent of developed-market imports, leaving the majority of trade unaffected by these sustainability premiums [9].

Agroforestry has emerged as one of the principal nature-based adaptation strategies compatible with sustainable production. Coffee cultivated under shade trees (Inga spp., Erythrina spp., Albizia spp., Cordia spp. and others) benefits from buffered temperatures, improved soil moisture retention, reduced solar radiation stress and increased biodiversity, while sequestering substantial quantities of carbon. A meta-analysis of eighty-four publications between 2006 and 2022 reported a mean total carbon stock of approximately 178.9 megagrams per hectare in coffee agroforestry systems, with soil organic carbon contributing the largest fraction (105.4 Mg/ha) followed by aboveground biomass in trees (45.2 Mg/ha) [50]. In Peruvian Amazon agroforestry systems, coffee plantations with Inga sp. shade showed biomass carbon stocks of 118.2 Mg/ha versus only 31.1 Mg/ha for unshaded systems [50].

Trade-offs between productivity and ecosystem services in agroforestry remain context-dependent. Yields under fully shaded systems can be 15–30% lower than full-sun monocultures, although the differential is reduced or reversed when agroforestry is properly managed and when the longer productive life of shaded plantations and the value of co-products (timber, fruit, pollination services) are considered [50]. Producer-level studies in Indonesia, Mexico and Ethiopia indicate that farmers themselves identify shade management, soil cover and locally sourced organic fertilisation as preferred adaptation strategies [22,30].

Genetic diversity is a complementary leverage. Coffea arabica's narrow genetic base, derived from a small number of cultivated lineages with limited heterogeneity, constrains breeding flexibility, while wild relatives such as Coffea racemosa, Coffea stenophylla and the Ethiopian Coffea arabica wild populations preserve unique alleles for drought tolerance, disease resistance and lower caffeine content. Recent genomic evaluations in Mozambique have demonstrated that C. racemosa displays substantially higher heterozygosity and stress-signalling pathway robustness than cultivated C. arabica, supporting its consideration as a genetic resource for resilience breeding [3]. The economic value of Ethiopia's coffee biodiversity for global breeding programmes has been estimated at 7.6 to 8.1 billion US dollars per year, although this potential remains largely unmonetised [16]. Investment in F1 hybrid Arabica varieties combining quality, drought tolerance and disease resistance is therefore a priority for the coming decade.

Innovative financial instruments for risk transfer at producer level constitute a further pathway. Index insurance schemes that pay out automatically upon the occurrence of pre-defined extreme weather thresholds have been deployed in pilot form in several producing countries and offer a potentially scalable solution to climate-induced income volatility [4]. Direct payment models funded by tax revenue or downstream profit redistribution have been proposed as a complement to certification, given the limited income gains achieved by certification alone in lifting smallholder farmers out of poverty [46]. Research integrating community-based cost analyses with farmer-perceived adaptation needs has estimated that an additional price premium of approximately 35 US cents per pound would compensate Ethiopian smallholders for the additional costs imposed by higher temperatures, a figure consistent with existing voluntary sustainability premium ranges [4].

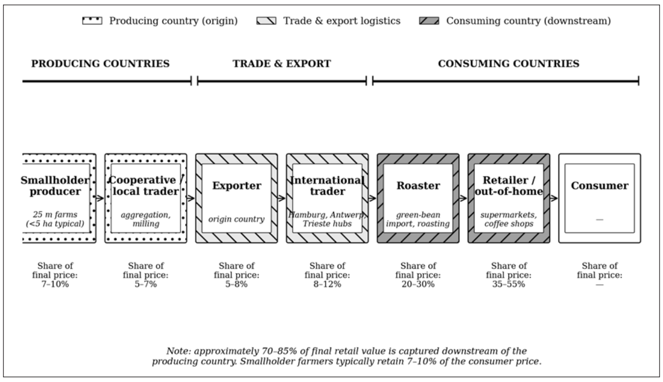

Figure 3: Schematic Representation of the Coffee Value Chain, with the Indicative Share of Final Retail Price Captured at Each Stage. Approximately 70–85% of Consumer-price Value is Captured Downstream of the Producing Country. Source: Synthesised from Fromm [46], Ruben [4] and Karatepe and Scherrer [5].

Implications for the European Market and Eastern European Consumption

Europe represents the world's largest single coffee importing region, with the European Union absorbing approximately 46.2 million 60-kilogram bags in 2024/25 according to USDA estimates [10]. Internal European consumption recorded a slight decline of 1.2% during the price escalation phase, although the contraction was distributed unevenly across markets and product categories [37]. Specialty coffee and out-of-home consumption remained relatively resilient, while retail volume sales of standard blends came under pressure as supermarket prices rose. Roaster companies adjusted product mix in response, with several major brands reducing pack sizes (a phenomenon sometimes described as "shrinkflation") and increasing the share of Robusta in supermarket private-label blends.

Eastern European markets, including Romania, exhibit consumption profiles distinct from Western Europe. Per capita consumption levels remain below Scandinavian benchmarks (Finland, with around 12 kilograms per person per year, leads the global ranking, but growth rates have been comparatively higher in recent years, supported by the development of urban specialty coffee culture, the expansion of international and domestic chain operators, and the diversification of home-brewing methods [1]. From the perspective of supply security, Eastern European roasters depend almost entirely on imports through Western European trading hubs (Hamburg, Antwerp, Trieste), making them indirect price takers in a market shaped by global supply–demand imbalances. The structural narrowing of stocks in ICE and London certified warehouses through 2025 implies that price transmission to Eastern European retail markets will continue to lag global wholesale movements by several months, with cumulative effects on consumer baskets [9].

A second dimension of European exposure concerns the EUDR. Since the regulation applies to operators placing coffee on the EU market regardless of country of origin, all European Union member states' importers and roasters must operate Due Diligence Systems and document the absence of deforestation-linked sourcing [12]. For Eastern European market actors, who often operate at smaller scale than Western European competitors, this represents a disproportionate compliance burden. Industry observations suggest that smaller roasters may rely on shared compliance services provided by trading houses or industry associations rather than building proprietary traceability systems. The eventual harmonisation of EUDR documentation with existing certification scheme records (Fairtrade, Rainforest Alliance, organic) would substantially reduce duplicate effort, an integration that is being actively explored by certifying bodies and the European Commission.

Conclusions

The 2023–2025 episode of historic price escalation in the global coffee market represents a convergence of structural and conjunctural factors. On the supply side, climate change has shifted from a long-term threat to a present-day disruptor, with the most severe Brazilian drought in seven decades, persistent dry conditions in Vietnam and increasing climatic variability across all major origins generating cumulative production shortfalls. The biennial productive cycle of Brazilian Arabica, frost events, hurricane episodes and the gradual upward displacement of cultivable altitudes contributed to repeated downward revisions of harvest forecasts.

On the demand side, sustained consumption growth in Asia-Pacific markets and in producing countries kept stocks under pressure for five consecutive years, leaving the global market structurally exposed to weather shocks. Regulatory pressure from the EUDR, although postponed twice, imposed substantial transition costs and highlighted the vulnerability of smallholder-based supply chains to compliance requirements designed without sufficient ex ante consultation of producing countries. The 2025 United States tariff episode illustrated how short-term policy shocks can rapidly amplify futures market volatility. Speculative financial flows further amplified prices in conditions of low inventories.

Sector sustainability requires coordinated action along several axes. First, investment in climate-resilient cultivars, agroforestry-based adaptation and water-efficient cultivation practices is essential to slow the contraction of suitable cultivation areas projected by climate models. Second, mechanisms for risk transfer at producer level (index insurance, long-term contracts, pre-harvest financing) must be scaled to protect smallholders from price volatility. Third, EUDR implementation should be accompanied by financial and technical support targeted at smallholder cooperatives in producing countries, ensuring that the compliance burden does not translate into market exclusion of the most vulnerable producers. Fourth, voluntary certification schemes should evolve to integrate climate adaptation criteria more explicitly and to ensure that price premiums reach farm-gate level. Fifth, the conservation of wild Coffea genetic resources, particularly in Ethiopian forests, deserves international recognition and equitable benefit-sharing arrangements. Without coordinated action across these dimensions, the coffee sector risks oscillating between repeated price spikes and structural producer impoverishment, with cumulative impacts on global food security and rural livelihoods.

Several specific recommendations emerge from this review. At the producer level, extension services should systematically promote shade-tree integration in coffee plantations, soil organic matter conservation through mulching, and the deployment of drought-tolerant clonal materials selected for the local agroclimatic context. Public investment in coffee research, currently concentrated in a small number of national programmes (Brazilian EMBRAPA, Colombian CENICAFE, Ethiopian Coffee and Tea Authority), should be expanded to cover under-researched origins in Asia and East Africa, where smallholder vulnerability is highest. At the market level, the integration of climate risk metrics into coffee futures contract specifications could increase the efficiency of price discovery and reduce the asymmetric information penalties currently borne by smallholder producers. At the regulatory level, the European Union should consider complementary measures alongside the EUDR, including direct cooperation with origin governments to fund smallholder traceability infrastructure. The forthcoming European Commission simplification review of the EUDR (April 2026) offers a timely opportunity to incorporate such complementary mechanisms.

Future research priorities identified by this review include longitudinal monitoring of farm-gate price transmission during and after the 2023–2025 rally, the quantification of EUDR compliance costs across origin contexts, the impact of agroforestry adoption on coffee quality (cup score) under varying climatic stresses, the development of digital tools for low-cost smallholder traceability, and the systematic evaluation of consumer behaviour at progressively higher retail price thresholds. The intersection of climate change, regulatory compliance and price formation in the coffee sector represents a paradigmatic case study for the broader transformation of agro-food value chains under the simultaneous pressures of climate adaptation and sustainability regulation. The 2023–2025 episode should therefore be interpreted not as an isolated commodity cycle but as a structural signal for the coming decades.

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